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FINAL REPORT
DEEPWATER PORTS MAINTENANCE DREDGING STUDY
RESULTS, INTERPRETATIONS, AND RECOMMENDATIONS
PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

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RESULTS, INTERPRETATIONS AND RECOMMENDATIONS
PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA
FOR THE FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
OFFICE OF COASTAL MANAGEMENT

EXECUTIVE SUMMARY

Chapter 81-228, Laws of Florida charges the Department of Environmental Regulation (DER) to develop a regulatory process which provides long-term permits for conducting maintenance dredging in deepwater ports. In order to accomplish this goal, reliable sediment and water chemistry data on the state's deepwater port systems are required. However, a review of the literature and pertinent permit files, as well as discussions with permitting personnel and port representatives, demonstrated that information on water and sediment quality in Florida deepwater ports was limited. Moreover, the existing data were often lacking in both precision and accuracy.

The "Florida Deepwater Ports Maintenance Dredging Study" was conducted to provide the data necessary to develop a regulatory process which establishes a system of long term maintenance dredging permits. The first year's effort was funded under Section 306 of the Coastal Zone Management Act and focused on the Ports of Jacksonville, Tampa, Manatee and Pensacola. This report presents the results of the field program and also discusses the implications of the data relative to the environmental effects of maintenance dredging.

The field program was designed to:

1. Identify those water and sediment quality parameters that were potential problems at each port so that improved permitting decisions could be made on a port-specific basis;

2. Establish procedures and quality controls which ensure reliability and subsequently provide a framework in which consistent data-gathering and updating efforts can be made;
3. Select sampling periods that provide scientific data on seasonal (i.e. wet season versus dry season) variability;
4. Select sampling locations that provide useful scientific data on port navigation systems; and
5. Develop a better understanding of the relationship between estuarine chemical conditions at each port and the potential effects of maintenance dredging and disposal conditions on estuarine biota.

Triplicate water and sediment samples were collected in the navigation systems of the four ports in the spring and fall of 1982. These samples were analyzed for the parameters determined to be most environmentally deleterious and for which the current "state-of-the-art" capabilities in commercial laboratory analysis would provide accurate results. Further it was decided to use laboratory techniques that could be readily applied for future regulatory purposes and achieve detection limits at least equivalent to those routinely achieved by the Florida DER laboratory. Nevertheless, it should be noted that due to limitations on sample size and other technical constraints, detection limits for several of the pesticide components and PCB's were above current Florida Class III water quality standards.

In the course of data interpretation several methods were utilized to determine whether observed concentrations of heavy metals such as arsenic, cadmium, copper, chromium, iron, lead, mercury, nickel, silver and zinc, in both the water column and sediments, were natural or due to anthropogenic input. In the water column, the concentrations of heavy metals were normalized to salinity which is a conservative property of estuarine waters and reflects the relative proportions of the two end members of the estuarine system (fresh water and sea water). In sediments, the ratio of a heavy metal of interest to aluminum was compared to the ~~same~~ ratio in average crustal or, in those areas in which the drainage basin is composed of carbonate materials, to average carbonate material. A ratio which is significantly above average may indicate contamination.

Occasional outliers within the data base indicate that some anthropogenic input of heavy metals is occurring within the estuarines studied. Nevertheless, for all the metals studied except mercury, concentrations observed in the water column, even for outliers, were at or below state water quality standards. (It should also be noted that the elevated concentrations of mercury observed may be an analytical artifact.)

Pesticides and phenolic compounds were below detection limits in all water samples collected during this study.

With virtually no exceptions, all observed variations in nutrients and Total Organic Carbon can be explained by natural processes. Releases from waste treatment plants were not causing a substantial impact on water quality in any of the ports studied.

In eleutriate testing, the only metals which exceeded state water quality standards were mercury and silver. This was because concentrations of these metals were at or above state standard in the ambient water used in the test.

It is significant to note, however, that large nitrogen releases were observed in all sediment samples subjected to eleutriate testing. The dispersion of these sediments, such as occurs during dredging, will lead to the release of nitrogen as ammonia.

The results of this study indicate that maintenance dredging has not resulted in chronic water quality problems in the Ports of Jacksonville, Tampa, Manatee and Pensacola. Nevertheless, it is also apparent that maintenance dredging can produce transient water quality impacts such as the release of nutrients and oxygen - demanding substances. These impacts occur primarily in the disposal area and can be predicted from studies of port sediments which include eleutriate testing as a means of simulating the dynamic processes which occur during dredging.

With respect to the development of regulations for the management of maintenance dredging in deepwater ports, the results of this study suggest the following recommendations:

1. Regulations should require, in addition to sediment analyses, an elutriate test on the sediments to be dredged. The results of this test should estimate the release of potential pollutants so that improvements in management practices can be made.
2. A reasonable monitoring program should be required during dredging operations, not so much as to evaluate compliance as to examine the adequacy of management practices. This would provide additional information on the effects of dredging which can then be used to better evaluate future operations.
3. Stringent requirements should be imposed on all tests and analyses so that data are useful for continuous re-evaluation of environmental conditions of the harbors.
4. Mixing zones should be established on a site-specific basis. The extent of the mixing zone should be based on the assimilative capacity of the receiving waters and proximity to sensitive areas.

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VOLUME I

1.0 INTRODUCTION

1.1 PROJECT OBJECTIVES

Chapter 81-228, Laws of Florida charges the Department of Environmental Regulation (DER) to develop a regulatory process which recognizes the necessity of deepwater port maintenance dredging and provides long-term permits for conducting these activities in an environmentally sound and expeditious manner. Reviews of pertinent permit files and discussions with permitting personnel, port representatives and other knowledgeable parties have indicated that efforts to implement this legislation must remedy a number of interrelated regulatory and technical impediments inherent in the existing decision making process.

Among the identified regulatory impediments are the following:

- Existing regulations do not clearly distinguish maintenance dredging, which is a continuous, but intermittent activity, from other types of "dredge and fill" activities. This situation inhibits the long-term management of maintenance dredging material.
- Existing regulations are based upon uniform statewide water quality standards that alone may not be adequate for providing clear guidance for certain maintenance dredging activities or disposal site design and operation. The inability of existing regulations to integrate smoothly environmental concerns with port-related engineering and dredging needs fosters the repeated use of water quality variances or other time-consuming regulatory relief mechanisms. Additionally, existing water quality based standards do not allow adequate consideration of contaminated harbor and channel sediments. In sum, the existing system may result in project delays and uncertain benefits to the ports and the environment.

- Existing regulations do not secure maintenance dredging permits that adequately address long-term disposal site operation and maintenance, thus encouraging stop-gap solutions to maintenance dredging problems.
- Existing regulations do not incorporate information fundamental to anticipating maintenance dredging and disposal activities. This inhibits development of long-term administrative mechanisms which consider disposal capacity, address environmental impacts, respond to changes in port operations, improve the efficiency of decision making, and take advantage of new dredging and disposal technologies.

In addition to addressing these problems, the administration of long-term permits must be able to incorporate findings of ongoing research and improvements in knowledge, as well as environmental changes at each port.

Solutions to the above administrative problems are closely related to removing several technical impediments. Among the technical problems needing to be addressed are the following:

- Insufficient information exists regarding quantities of sediments involved, locations of shoaling areas, and physical characteristics of material to be dredged at each port. Additionally, anticipated methods of dredged material containment and identification of future spoil site locations are lacking. This information is fundamental to long-range decision making, from both an operational as well as environmental viewpoint.
- The paucity of reliable sediment and water chemistry data for the navigation systems inhibits valid decisions from both a scientific and regulatory standpoint. For example, heavy metals data available from governmental and academic reports are deficient in terms of precision and accuracy. Basic deficiencies in precision are often as simple as failure to obtain replicate samples or failure to record station locations and salinity. Deficiencies in accuracy include contamination of samples either in the field or during laboratory analysis.
- Field and laboratory procedures are inadequate for obtaining timely and reliable information on maintenance dredging and disposal.

To the extent possible, solutions to the regulatory and technical impediments are being pursued through efforts of DER staff, assisted by private consultants. Data in this report represent improvements in obtaining and interpreting water quality and sediment information. Other information needs related to shoaling areas and rates, physical characteristics of sediments, and so forth, are being addressed in a separate study.

The present report, consisting of two volumes, includes results of the spring (dry) and fall (wet) season field programs conducted during 1982 in the port navigation systems of Jacksonville, Tampa, Manatee and Pensacola. These programs commenced after an assessment of approximately ten years of water and sediment quality information related to these systems was completed.

1.2 GENERAL ENVIRONMENTAL CHEMISTRY OF ESTUARIES

This section is presented to aid the reader in understanding scientific approaches used in this study and provides an overview of various fundamentals of estuarine chemistry which form the basis for data evaluation and interpretation.

Regions of the ports considered in this study (channels, berths, turning basins and disposal sites) are located in estuarine systems. In an estuary, fresh water at the head of the estuary mixes with sea water (generally approaching 36 parts per thousand salinity at the mouth) such that salinity continually increases from the head to the mouth of the estuary. The salinity at any given geographical location within the estuary will vary with time depending on tidal variations and rainfall.

For many estuaries (particularly deeper estuaries), salinity varies not only with time but also from surface to bottom, where denser, higher salinity waters settle. In such a system, stratification may result in stagnant bottom water conditions because of poor top to bottom water circulation. In these cases, oxygen depletion occurs as a result of microbially-degrading organic matter in bottom sediments which consume available oxygen. This condition, however, is less likely to occur in estuaries that are shallow and wide, allowing for good wind-driven mixing.

Unpolluted fresh water runoff from uplands contains both particulate and dissolved matter. Natural dissolved matter includes inorganic salts from rock weathering and organic compounds derived from terrestrial plant detritus. For most river systems the dissolved inorganic load exceeds the dissolved organic load (Livingstone, 1963), although, southeastern U.S. rivers often contain more dissolved organic matter (Beck et al, 1974). Such organic matter is composed predominantly of humic compounds that are not easily oxidized.

The dissolved solids concentration of river waters is generally on the order of tens of parts per million; whereas, sea water contains a thousand times more dissolved solids than fresh water. When fresh water is diluted with only a small amount of sea water, the bulk dissolved solid chemistry of the resulting solution is more similar to sea water. Consequently, at salinities greater than 0.1 parts per thousand the major ion chemistry of estuarine waters is like that of sea water.

During mixing of fresh water with sea water, the considerable change in the chemistry of these waters leads to equilibration between solid and dissolved phases. The most drastic changes observed in the physical chemistry of estuarine water are increases in pH and ionic strength that are directly related to increasing salinity. Ions such as Na^+, Mg^{++}, Cl^- and $SO_4^=$ (which represent the major portion of the dissolved solids) are not affected during mixing of fresh water and sea water and are said to behave conservatively (i.e. their concentration is directly proportional to salinity). Thus, salinity, or more appropriately its ionic constituents (i.e., sodium, magnesium, chloride, sulfate and other dissovled salts), is a conservative property of estuarine waters reflecting the relative proportions of the two end members of the estuarine system (ie. fresh water and sea water). These proportions effect the solubility of many substances. In particular, increases in pH and ionic strength lead to physical changes in particles that enhance flocculation and precipitation.

1.2.1 Metal Concentrations in Estuaries

Metals are delivered to estuaries from the land in both solid form and in solution. Most heavy metals such as arsenic (As), cadmium (Cd), copper (Cu), chromium (Cr), iron (Fe), lead (Pb), mercury (Hg), nickel (Ni), silver (Ag) and zinc (Zn) are generally transported more in dissolved rather than in particulate form. However, in terms of total mass, metals may be equally distributed between the two phases in fresh water. Upon contact with sea water, particles tend to flocculate and drop out of suspension. Southeastern estuaries act as sediment traps, since physical transport does not overcome the sedimentation process.

Metals contained in particles of land origin reflect the composition of the drainage basin from which they were derived. The composition of continental material has been found to be very consistent (Turekian and Wedepohl, 1961; Taylor, 1964), and many investigators use metal to aluminum ratios to determine whether metal concentrations in particles (either in sediments or suspended in air or water) reflect a natural crustal origin (Duce, et al, 1976). This is an extremely useful approach to environmental studies since aluminum is very abundant in the earth's crust and therefore in sediments of crustal origin (i.e. estuarine sediments). Thus aluminum concentrations are not likely to be greatly affected by man-induced (anthropogenic) inputs. However, other metals which are less abundant than aluminum can be enriched considerably as a result of anthropogenic inputs.

Metals tend to be concentrated in fine grain sediments associated with clay minerals and natural organic matter in unpolluted sediments. In natural sediments, the ratio of a particular metal to aluminum should remain relatively constant even though the grain size or mineralogy of the sediment varies. Therefore, an anthropogenic input of a metal is reflected in the metal to aluminum ratio.

Small deviations of metal to aluminum ratios from that of natural crustal material are probably not significant, reflecting only natural variability.

Natural variability in crustal ratios can be expected to differ by as much as one order of magnitude (i.e., a factor of ten). However, only when the metal to aluminum ratio of a sediment exceeds the natural variability in crustal ratios should a sediment be suspected of being polluted. Large deviations in metal to aluminum ratios greater than an order of magnitude, suggest anthropogenic inputs. Such an approach is used in the discussion of results.

This report employs another method for identifying antropogenic metal inputs. Metal concentrations (and other substances such as nutrients and TOC) in estuarine waters reflect the concentrations of the two end members (fresh water and sea water) and processes that take place in the water column (e.g. removal due to decreased solubility or release to sediments). If a metal behaves conservatively (no removal or release) its concentration will be a linear function of salinity. Even when metals are found to be nonconservative (removed or released in mixing due to natural processes), a consistent relationship to salinity is observed (Windom, et al, 1971; Waslenchuk and Windom, 1978; Boyle, et al, 1977; Eaton, 1979). It is clear that normalizing or correlating metal concentration with salinity provides an appropriate basis for evaluating anthropogenic influences on water quality. Therefore, when plotted against salinity, metal concentrations should follow a pattern. The appearance of outliers or elevated concentrations between end members (mid-estuary maxima) in such plots may indicate pollutant inputs to the estuary.

Although concentrations of heavy metals vary from one estuarine system to another, these concentrations are generally low because any excess due to local input is generally removed rapidly from the water column to the sediments. For example, arsenic concentrations in southeastern estuaries have been found to vary from about 0.1 to 1 μg/l* (Waslenchuk and Windom, 1978); copper between 0.2 and about 1.0 μg /l, nickel 0.4 to

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*parts per billion (ppb)

about 1.0 µg /l, and cadmium 0.010 to about 0.100 µg /l (Windom, *et al*, 1982 Windom, unpublished data). Similar concentrations were reported for the Amazon, Boyle, *et al*, 1982); and the Mississippi Rivers (Boyle, personal communication). Iron and manganese vary from over 100 µg/l to 1 mg/l (Beck, *et al*, 1974; Windom *et al*, 1971).

1.2.2 Organic Compounds in Estuaries

While the exact composition of organic constituents present in surface waters is poorly known, the major portion of organic matter (both in dissolved and particulate forms) in estuaries is derived from riverine inputs and *in situ* biological production. Concentrations of these naturally occurring organic compounds can be as high as several mg/l (Beck *et al*, 1974). Most natural organic compounds in rivers are refractory and therefore do not readily oxidize under natural conditions. By comparison however, most anthropogenic inputs are small.

Nevertheless, utilization of organic matter by estuarine microorganisms results in oxygen consumption (i.e. oxidation). During warm periods, natural oxygen depletion of estuarine waters may result in extremely low dissolved oxygen concentrations. The organic matter is said to exert an oxygen demand on the water column which is referred to as the biochemical oxygen demand (BOD). Although the BOD of most estuarine waters is generally less than 5 mg O_2/l and results from the presence of natural organic compounds, anthropogenic inputs of nutrients may lead to higher BOD values since such inputs stimulate increased biological production. For instance, organic matter typically released from municipal sewage treatment plants does contain readily oxidizable compounds.

Toxic organic compounds such as phenols, petroleum hydrocarbons, and chlorinated hydrocarbons (e.g., PCBs and pesticides) have low solubilities in natural waters. In general, these compounds accumulate in sediments shortly after being introduced into estuarine waters. Once in the sediments, petroleum hydrocarbons and pesticides degrade at various rates depending on their complexity. For example, highly chlorinated pesticides such as toxaphene, mirex, chlordane, DDT (and its break down products

DDE, DDA etc.) may persist for some time. PCBs are extremely stable and exhibit little degradation.

1.3 OVERVIEW OF THE APPLICATION OF ELUTRIATE TESTS IN ESTIMATING THE EFFECTS OF DREDGING AND DISPOSAL

During maintenance dredging, impacts on water quality are related to the release of materials from sediments dispersed during the operation. In estimating these impacts prior to dredging, the potential of dredged sediment to release pollutants or other degrading materials must be evaluated. Substances which may be released during maintenance dredging of estuarine sediments include toxic metals and organic compounds, biostimulatory/inhibitory substances (i.e. nutrients/turbidity) and oxygen-demanding compounds. Suspended particles themselves may exert an oxygen demand on the water column, and also reduce light penetration required by photosynthetic organisms.

The first attempt to establish a basis for evaluating the potential of a sediment to impact water quality during dredging was made during dredging operations in the Great Lakes (U.S. Army Corps of Engineers, Buffalo District, 1969). Laboratory studies suggested a relationship between the bulk chemical composition of a sediment and its biostimulatory or toxic potential. As a result of this work, the U.S. Environmental Protection Agency adopted criteria (EPA, 1975) for determining the acceptability of dredge spoil materials for disposal to the Nation's waters. The criteria consisted of discrete concentrations of those constituents observed in sediments above which, water quality degradation was predicted to occur during dredging.

Subsequent to the adoption of these criteria a number of studies of actual dredging and dredge spoil disposal operations demonstrated that changes in the quality of receiving waters bore no simple relationship to the bulk chemical composition of the sediment (Windom, 1972; May, 1974; Keely and Engler, 1974; Windom, 1974; Windom, 1975). As a result, Keely and Engler (1974) proposed the use of an elutriate test which consisted of agitating an aliquot of the sediment to be dredged in a given volume of water and measuring the amount of a substance which is released over a prescribed time period. Their rationale for the development of the elutriate test was as follows:

> "...regulatory agencies faced with the legislative requirement of establishing dredged material criteria, must strive to establish meaningful criteria based on the best possible knowledge, and avoid the tendency to set forth criteria that precede the current technical state-of-the-art. Furthermore, regulatory criteria should be based on laboratory procedures that can be performed satisfactorily in routine testing laboratories as opposed to complicated procedures that can only be conducted in sophisticated research-level laboratories. Finally, in order to be equitable, the criteria should not be prohibitively expensive."

Ultimately, this work led to the standard elutriate test (Keeley and Engler, 1974; Lee et al, 1975; Plum, 1981) to evaluate the suitability of dredged sediment for open water disposal as required in Section 404 of the Clean Water Act.

The elutriate test has met with criticism because the results are dependent on a number of conditions (e.g. filtering, pH, and DO) that may vary during the test. Although the test does not represent actual environmental conditions, it does provide a more realistic estimate of potential water quality problems than does bulk sediment analysis alone.

It is important to note that the elutriate test was not specifically designed to evaluate water quality impacts on waters receiving effluents from confined disposal areas. Nonetheless, the U.S. Army Corps of Engineers' Waterways Experiment Station is presently conducting research to evaluate predictions of contaminant levels in effluents from confinement areas using modifications of the elutriate test (Palermo, 1982).

It may be impossible to precisely predict disposal site effluent pollutant concentrations from results of elutriate tests, since duplication of environmental conditions in the laboratory is difficult. Results of Windom

(1974), however, clearly indicate that the general direction and magnitude of changes in effluent quality (with respect to the ambient water in which the sediment was disposed) can be estimated from such tests. For several study areas, high levels of nutrients, BOD, DO and low metal concentrations in effluents discharged from spoil disposal areas were predicted by analyzing the aqueous phase of sediment-water suspensions taken directly from dredge pipelines (prior to deposition in the disposal area).

Even with the inherent problems in applying the elutriate test, it is presently the most straight-forward, cost-effective means for estimating material release to and impact on receiving water during maintenance dredging. Results of elutriate tests themselves should never be used as standards for evaluating dredging operations using confined disposal. Elutriate testing can, however, serve as a basis for predicting impacts on receiving water and for developing disposal practices during actual maintenance dredging operations. During maintenance dredging, predictions can be verified by monitoring disposal area effluents. The results, in turn, can be used to modify future predictions.

1.4 SAMPLING DESIGN AND LABORATORY ANALYSIS

The purpose of the field sampling program was to address impediments related to existing water quality and sediment data at each of the four ports by: 1) identifying those water and sediment quality parameters that are potential problems at each port so that improved permitting decisions can be made on a port specific basis; 2) establishing procedures and quality controls that ensure reliability and subsequently provide a framework in which consistent data-gathering and updating efforts can be made; 3) selecting sampling periods that provide scientific data on seasonal (wet versus dry) variability; 4) selecting sampling locations that provide useful scientific data on port navigation systems; and 5) developing a better understanding of the relationship between estuarine chemical conditions at each port and the potential effects of maintenance dredging and disposal operations on estuarine biota. While this study does not directly examine biological and ecological conditions at each port, the chemical information generated from this study will provide fundamental information for future biological studies. Procedures developed in this project and outlined in this report were designed to provide field and laboratory methods that can be easily duplicated with the least probability of sample contamination. Development of the seasonal field program is discussed in more detail in Section 5, and a detailed description of these methods will be presented in separate documents currently being developed by DER.

Economics is one of the major considerations in the design of a sampling program. Early in the development of this project, it was decided that determination of "ambient" water quality conditions for the entire list of parameters regulated by the State in Class III Waters (Chapter 17-3, FAC) and presented in Table 1-1 was not economically feasible. It was apparent that even for a limited list of selected parameters, the high cost of laboratory analysis precluded sampling with sufficient density to determine "ambient" conditions in the estuaries since such systems are characterized by high spatial and temporal variability. Consequently, it was decided to limit the analysis of water and sediment samples to those parameters which were determined as most environmentally deleterious and for which the current "state-of-the-art" capabilities in commercial laboratory analysis would provide accurate results. It was also decided to sample the expected extremes - the "wet season" and the "dry season" and restrict sampling efforts to the navigation systems (e.g., the berthing areas, turning basins and channels). An attempt was made to characterize general conditions in the navigation systems and still secure information on "worst case" conditions. Samples were collected in triplicate at each sampling station in order to establish a reproducible methodology as well as provide reproducible and defendable results. Consensus on this approach as well as the environmental significance of various parameters and accuracy of laboratory analysis, was reached in discussion with representatives from DER, Savannah Laboratories and Environmental Services Inc. and the ports.

1.4.1 Program Scheduling

In estuaries, wet and dry seasons are determined by net water availability to stream flow which considers rainfall as the system input, with outflow controlled by evaporation, discharge into stream flow and percolation into deep aquifers. Sampling periods were scheduled to coincide with wet and dry conditions by using the historical net water availability to stream flow derived from historical mean pan evaporation and historical mean precipitation. This analysis is discussed in greater detail in Section 5 and supporting data are presented in Tables 2-3 and 2-4. Sampling was completed during April-May and September-October, 1982 at the four ports. The dates of sampling and observed *in situ* field conditions are presented in the Appendix of this report.

1.4.2 Parameters Selected for Analysis

Parameters included in the study program were selected for the following reasons: 1) they provided the most cost effective information on existing water and sediment quality; 2) they were the most likely potential problem pollutants in maintenance dredging and disposal operations; and 3) they provided information useful for the interpretation of other data. The selection of parameters is discussed in greater detail in Section 5.

Three types of sampling stations were established prior to the spring field program:

1. "Baseline" stations were established to provide general information on water quality and sediments in the navigation systems. It was decided to analyze samples from baseline stations for only those parameters which were determined to be the most meaningful in affecting port maintenance dredging decisions.
2. "Intensive" stations were located at anticipated polluted or worst case locations. Samples from intensive stations were analyzed for virtually all parameters noted for Class III waters in Chapter 17-3, FAC.

3. "Calibration" stations were located in high salinity waters (greater than 32 ppt) offshore from the channel entrances. Sediment was not collected at "calibration" stations. Water samples collected at these stations were analyzed for parameters identical to those for "intensive" stations. "Calibration" stations provided "clean" water used to check sampling techniques and sample handling procedures, and assist in the interpretation of data collected from other stations.

Parameters analyzed from samples collected at these stations are presented in Table 1-2.

Review of data from the spring/dry season program indicated that, with few exceptions, additional detailed water sampling in the fall/wet season field program would not be cost effective. Consequently, the major emphasis of the fall/wet season program was on sediment sampling and elutriate testing.

In refining the spring program, a number of stations were established during the fall which focused on different sets of parameters. Table 1-3 indicates those parameters analyzed from the fall/wet season stations. The development of the fall sampling program is presented in Section 5.

1.4.3 Detection Limits of Analytical Procedures

At the onset of this project, it was decided to use laboratory techniques that could be readily applied for future regulatory purposes and achieve detection limits at least equivalent to those routinely achieved by the Florida DER Laboratory. However, in this project, detection limits for several of the pesticide components and PCBs were above current Florida Class III water quality standards. Due to handling problems, water samples greater than one liter in volume were not collected for organic analysis. Thus, the size of the sample limited the detection limit for multiple component pesticides. Nevertheless, it is doubtful that even if a greater volume of sample was collected that detection limits as low as the Florida Class III standards could have been obtained for multiple component pesticides (chlordane and toxaphene) and PCBs.

In all cases, detection limits for pesticides and PCBs were as low or lower than those routinely obtained in the Florida DER Laboratory, other State environmental laboratories in the southeast, or by the EPA Regional Laboratory in Athens, Georgia.

Information on laboratory procedures and detection limits is presented in Section 5.

1.5 GENERAL BIOLOGICAL CONSIDERATIONS

Time and financial limitations precluded making detailed biological investigations at each port. Consequently, only an overview of potential biological impacts attributable to maintenance dredging and disposal operations is presented in this report. However, numerous taxonomic and ecological studies have been published for Hillsborough Bay.

Biological studies involve intensive spatio-temporal characterizations that were beyond the scope of this initial data gathering effort. The results of this study however, provide reliable information fundamental to future biological investigations.

1.5.1 Potential Biological Impacts Associated With Dredging And Disposal Operations

In order to assess potential impacts of maintenance dredging on estuarine biota, it is necessary to consider adjacent habitats and trophic structure of the affected area. For example, increased turbidity and suspended solids loads will have completely different impacts on seagrass meadows and coral reefs than on an unvegetated tidal flat. Similarly, oxidation and redeposition of metals or toxic organic compounds may encourage bioaccumulative processes in soft-bottom habitats that are dominated by deposit feeders, while no such activity may occur in a differently based trophic system. A summary of potential dredging-related impacts on several habitats encountered adjacent to Florida port navigational systems is given in Table 1-4. Additionally, potential biological impacts associated with each parameter analyzed in this report is given in Section 5.

For the Ports of Tampa and Manatee, release of nutrients, especially nitrogenous compounds, presents the greatest environmental concern. Both ports receive considerable inputs of phosphorus, and thus nitrogen is the limiting factor for biological production. Nitrogen releases (NH_3 and NO_3) are readily taken up by phytoplankton and undesirable macroalgae, and population blooms generally follow. Such events place a tremendous Biochemical Oxygen Demand (BOD) on the water column, producing fish and invertebrate kills as dissolved oxygen becomes depleted from the water. Additionally, plankton blooms, which are not uncommon in Hillsborough Bay, decrease the depth to which sunlight penetrates, creating a decrease in the compensation point.* Thus, primary productivity is limited to a shallower zone in the water column. Macroalgal species also bloom and eventually cover sessile organisms (e.g., corals, seagrasses, etc.) until they are smothered. In addition to biostimulatory effects, several nutrients (e.g., NH_3) can be acutely toxic to estuarine biota.

A general concern with dredging and disposal around urban areas is the presence of heavy metals (mercury, lead, etc.) and various organic compounds (pesticides and PCBs) in the sedimens and water column. The greatest potential impacts with heavy metals and toxic organic compounds come not necessarily from acute toxicity, but the ability of these contaminants to become incorporated into living tissue and subsequently, into estuarine food webs. As a result, reproductive fitness or behavior of the contaminated species may be altered, and a decline in population size could follow over several generations.

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* Compensation point is that point in the water column at which photosynthetic activity and respiration are equal and usually marks the lower limit of plankton populations.

Estuarine biota in the Pensacola navigation system have received chronic inputs of industrial and municipal wastes from adjacent shoreline areas. Consequently, releases of these contaminants during dredging could produce similar water column impacts discussed for the Ports of Tampa and Manatee. Thus, localized phytoplankton and algal blooms can be expected when large concentrations of nutrients are released. Additionally, TSS, turbidity, and nutrients are a potential threat to seagrass meadows located in Santa Rosa Sound, east of the lower portion of the navigation system.

Assessment of potential impacts of maintenance dredging and disposal on estuarine biota along the St. Johns River are extremely difficult to characterize due to the diversity of habitats encountered along the 24 miles of the Port of Jacksonville navigation system. The reader should consult Table 1-4 for a summary of potential impacts associated with maintenance dredging and disposal on each habitat that exists along the St. Johns River.

2.0 RESULTS

2.1 REMARKS ON DATA PRESENTATION

Results of the analyses of samples collected during the spring and fall season sampling programs are presented in summary tables and discussed on a port by port basis below. The chemical results are reported in terms of the mean and standard deviation of three replicate samples, except for cases in which one of the three replicate samples differed substantially. In this case, this replicate value was rejected. In situ results (e.g., DO, pH, turbidity etc.) represent mean values of mid-water pre-and post-sampling measurements. Results are presented in tables which include general physical water characteristics, organic and inorganic sediment and water quality characteristics, as well as the grain size of bottom sediment samples. The results of the fall/wet season elutriate tests are also presented. Existing State Class III water quality standards for predominantly marine waters as listed in Chapter 17-3 of the Florida Administrative Code have been presented with the water quality data summaries for each port. All raw data collected during the study are presented in Appendix A (Spring data) and Appendix C (Fall data) of Volume II of this report.

2.2 PORT OF PENSACOLA

2.2.1. Introduction

The spring/dry season field program was conducted in the Port of Pensacola on April 26 and April 27, 1982. Figures 2-1 and 2-2 indicate the duration of the spring/dry season field program and compare observed precipitation and net water availability to stream flow to the monthly normal conditions. These figures indicate that the spring sampling period did coincide with the observed dry season. In fact, rainfall was below normal at the time of the spring sampling.

Water samples were collected in triplicate from three stations in the Port of Pensacola during the spring/dry season field program. These locations were sampled to provide information in the vicinity of the berths (PNS-1A), conditions in the main entrance channel (PNS-2B) and offshore conditions for calibration (PNS-3C). Locations of these stations are shown in Figure 2-3 and listed in Table 2-1.

Triplicate sediment samples were collected from two stations in the Port of Pensacola during the spring/dry season field program: PNS-1A and at PNS-2B. Results of grain-size analysis and Atterberg limit testing completed on these samples are presented on Figures 2-4 and 2-5. Raw data on grain-size analysis are presented in the Appendix, Volume II, on Pages A-4 and A-8.

The fall/wet season field program for the Port of Pensacola was initiated on September 21 and completed on September 23, 1982. Figures 2-1 and 2-2 indicate the duration of the fall/wet season field program and compare monthly normal precipitation and net water availability to the observed conditions. The fall sampling program was scheduled to coincide with the observed wet season in the Port of Pensacola (i.e., during the month of highest net water availability to stream flow). Figure 2-2 indicates that the observed wet season preceded the fall sampling program by approximately one month. Rainfall was well above normal one month prior to the fall sampling period and well below normal at the time of sampling (Figure 2-1). Data for both the observed and historical precipitation and net water availability to stream flow for both spring and fall sampling periods is presented in Table 2-3 and 2-4, respectively.

Water samples were collected in triplicate from five stations in the Port of Pensacola during the fall/wet season field program. These locations were sampled to provide information in the port berthing areas (PNS 1A-WOE), approach channels (PNS 4-SF) and in the main entrance channel (PNS 2B-W(O)), PNS 5-SF and PNS 6-SF). In addition, a bulk elutriate water sample (used in testing PNS 1A-WOE sediments) was collected from Station PNS 7-X located in the main entrance channel midway between the inner harbor channel and the Navy turning basin. Locations of the fall/wet season sampling stations are shown on Figure 2-6 and presented in Table 2-2.

In the fall, sediment samples were collected in triplicate from four stations in the Port of Pensacola. Two stations (PNS 6-SF and PNS 5-SF) were located in the main entrance channel. Additionally, two stations (PNS 1A-WOE, PNS 4-SF), were located in the vicinity of the berths and port facilities to provide data on sediment quality in these potentially contaminated areas. The sediment samples collected from Station PNS 1A-WOE were used for elutriate testing. Results of grain-size analysis and Atterberg limit testing completed on these samples are presented on Figures 2-7 through 2-10. Raw data on grain-size analyses are presented in the Appendix, Volume II, on Pages C-2, C-8, C-11, and C-14.

2.2.2. Water Column

a. General Water Quality Characteristics

General physical and chemical water quality characteristics observed at the three stations in the Pensacola Bay study area sampled in the spring are presented in Table 2-5. Similar data for the six stations sampled in the fall are given in Table 2-6. During the spring sampling, there was little difference between the salinity near port facilities (PNS-1A) and the entrance channel (PNS-3C). All stations had similar high salinity reflecting the lack of appreciable local fresh water runoff. The similarity in salinity also suggests that this part of the bay is fairly well flushed. During the fall, salinity variations between the six stations were more substantial. This probably reflects both tidal effects (due to the time lapse between sampling events) and greater fresh water runoff to the estuary. In general, fall salinities were lower than those measured during the spring due to fresh water runoff.

The influence of relatively low local fresh water runoff during both sampling periods is reflected in the high transparency of the water. During the spring program, turbidity observed at Station PNS-1A exceeded the ambient offshore value (PNS-3C) by more than a factor of 4. Higher turbidity at this station

(PNS-1A) may have been due to the maneuvering of vessels in the port area (see Appendix B, Page B-2). The low Total Suspended Solids (TSS) concentrations at all three spring sampling stations are also indicative of low runoff during the spring sampling period. During the fall, turbidity was again highest in the berthing area at Station PNS 1A-WOE. In addition, all fall stations had higher turbidity than was observed at the offshore station (PNS-3C) occupied in the spring.

Nutrients and Total Organic Carbon (TOC) concentrations were low during the spring, commensurate with the relatively high salinity of the water samples. As a result Biochemical Oxygen Demand (BOD) was low as well. Dissolved Oxygen (DO) was near saturation at all stations.

Total Kjeldahl Nitrogen (TKN) and TOC concentrations were measured at only one station during the fall (PNS 7-X). During the fall, TKN was about ten times higher than in spring, while fall TOC values were similar to spring values. Except at Station PNS 1A-WOE, DO was near saturation at all stations during the fall.

b. Metals

With the exception of nickel, the concentrations of metals in the water column during the spring decrease from Stations PNS-1A to PNS-3C (Table 2-7). However, with the possible exceptions of mercury and zinc, none of the metals appear to be more than two or three standard deviations above background observed offshore at Station PNS-3C. Samples from Station PNS-1A exhibited elevated mercury and zinc levels, but only mercury at this station exceeded the State water quality standards.

The results of water sample analyses during the fall (Table 2-8) reveal concentrations of metals similar to those observed during spring. Again, only mercury concentrations at Station PNS 1A-WOE exceeded the State standard.

c. Toxic Organics

Of the pesticides analyzed, none were found to occur in water samples at levels above the analytical detection limit during either the spring or fall sampling periods (Tables 2-9 and 2-10, respectively).

Water samples collected at Station PNS-1A during the spring were the only samples found to contain any of the phenols at concentrations above detection limits. The compound detected was pentachlorophenol which, while present at concentrations above analytical detection limits, was below State standards. Samples collected at PNS 2B-W(O) during the fall were not analyzed for organics since these compounds were not detected in samples collected at PNS 1A-WOE during this sampling period.

2.2.3 Sediments

a. General Chemistry

Sediment samples were collected from one station in the Port of Pensacola during the spring (PNS-1A) and from four stations during the fall (PNS 1A-WOE, PNS 4-SF, PNS 5-SF and PNS 6-SF). Sediments collected from Bay Channel (PNS 5-SF) and adjacent to the Navy Turning Basin (PNS 6-SF) were composed predominantly of fine sand (Figures 2-9 and 2-10). Sediments collected near the port berthing area at Stations PNS 1A-WOE and PNS 4-SF were composed of silty clays (Figures 2-7 and 2-8).

Of the four ports studied, sediments from Pensacola Bay generally had the highest TOC, TKN and BOD concentrations

(Table 2-11 and 2-12) apparently reflecting a greater input of terrestrial or anthropogenic organic matter.

Oil and grease concentrations were measured in sediment samples collected during the spring sampling period at Station PNS-1A, and during the fall sampling period at Stations PNS 4-SF, PNS 5-SF and PNS 6-SF. Sediments from PNS-1A had the highest oil and grease concentrations; moreover concentrations at this station were higher than concentrations observed in any sediments collected at the other ports.

Since organic matter is generally around 50 percent carbon, an estimate of the total organic matter in sediment can be made by multiplying TOC by two. Based on such an estimate, oil and grease in Pensacola sediments accounted for only a few percent of the total organic matter (i.e. 2.8 mg oil and grease ÷ (2x94) mg TOC at PNS-1A).

Total phosphorous (only measured on spring samples) occured at around 0.1 percent in the sediments. Phosphate accounted for from one to about two thirds of the total phosphorous.

b. Metals

Metal concentrations in sediments collected from Pensacola are given in Table 2-13 (spring) and Table 2-14 (fall). Concentrations of all metals in sediments decrease with distance from the port to the Gulf along Bay Channel. Sediments collected from PNS-1A during spring and PNS 1A-WOE (fall) have the highest concentrations of metals while those collected at PNS 6-SF have the lowest metal concentrations. Sediments at the latter station, however, are composed of coarser grain material.

As discussed earlier (Section 1.2.1) metal to aluminum ratios provide a good basis to evaluate metal pollution in sediments. For natural unpolluted sediments it is well known that metals tend to be more concentrated in fine sediments rather than coarse, since the former are dominated by clay minerals which are enriched in metals. Normalizing metal concentrations to aluminum allows an evaluation of whether differences between metal concentrations are due to natural or anthropogenic processes.

The abundance of most metals in continental crustal material have been fairly well determined (Turekian and Wedepohl, 1961; Taylor, 1964). Sediments delivered to coastal areas by river systems that drain typical continental areas should have similar metal to aluminum ratios. This should be the case for Pensacola Bay, since most of the sediments here are derived from the Southern Appalachian and Piedmont provinces.

The comparison of metal to aluminum ratios for sediments collected in Pensacola Bay with the ratios for average crustal material (Table 2-15), suggest that, with the exception of cadmium and silver, all sediments, except those collected from the berthing area (PNS-1A), have ratios similar to average crustal material. Because of their coarse grain nature and low metal concentrations, ratios in sediments from PNS 6-SF are not unexpected. Metal to aluminum ratios in PNS-1A sediments, however, do indicate significant metal pollution.

c. Toxic Organics

The only organic compounds detected in sediment samples collected from the Port of Pensacola were chlordane and pentachlorophenol, observed in samples collected during the spring at Station PNS-1A (Table 2-16). Chlordane was detected in two of the replicate samples collected at Station PNS-1A and pentachlorophenol was detected in all three replicate samples. No organic compounds were detected in sediments collected during the fall (Table 2-17).

2.2.4 Elutriate Tests

Only sediments from Station PNS 1A-WOE were subjected to elutriate tests (using water from Station PNS 7-X). The results of these tests (Table 2-18) indicate releases of metals which increase metal concentrations in the elutriate water by no more than a factor of approximately two above test water. The only exception is iron which increased concentration in the ambient elutriate test water by a factor of three or more. This is probably due to metastable ferrous iron release which would probably decrease rapidly if the elutriate test period were extended (Windom, 1974).

TKN concentration in the elutriate water increased by an order of magnitude over ambient during the test. This is probably due to ammonia release. Increases in TOC concentration were less than 50 percent.

2.2.5 Summary of Results and Potential Water Quality Problems

With respect to Florida Water Quality Standards, all metal levels in the water column are low in Pensacola's major navigation systems. The only exception is mercury at the station located in the berthing area which has concentrations exceeding the standard by 0.02 to 0.05 g/l. These higher values may be a result of an analytical artifact which will be discussed in more detail in Section 3 of this report. Concentrations of most organic compounds in the water column were below analytical detection capabilities, which, in some cases, were higher than the water quality standard (see Section 1.4.3). All phenolic compounds, except for pentachlorophenol, were below detection limits and standards. All the pesticide concentrations were below detection capabilities, although these limits were as much as a factor of ten above the State standard. PCBs were not observed, but the detection limit was considerably higher than the standard.

Although it cannot be stated with certainty that the water quality in the navigation system of Pensacola Bay meets the State standards for pesticides and PCBs, it is not likely that these substances represent a particularly significant potential problem during dredging activities. This conclusion is based on the low levels of these materials observed in sediments, and in the water column.

The sediment data from Pensacola indicate that metals generally would not be expected to create a water quality problem during maintenance dredging. The only possible exceptions are cadmium and silver which appear elevated (with respect to average crustal material) in all sediments. Nevertheless, elutriate tests on sediments from PNS 1A-WOE (observed worst case sediments), indicated that substantial amounts of metals would not be released during dredging. In fact, the resulting elutriate test water still met State water quality standards.

The relatively high organic matter and nutrient concentrations of the bottom sediments, even though they are of natural origin, appear to represent the most likely source of potential water quality problems during maintenance dredging. The results of the elutriate tests, which indicate the potential of bottom sediments to release large amounts of nitrogen, support this conclusion.

2.3 PORT OF TAMPA

2.3.1 Introduction

Spring/dry season field sampling was conducted in Port of Tampa from May 10, 1982 through May 14, 1982. Figures 2-11 and 2-12 indicate the duration of the spring/dry season field program and compare observed precipitation and net water availability to stream flow to the monthly normals for this period. These figures indicate that although precipitation was above normal during the sampling period, (Figure 2-11), the program did coincide with the observed dry season as evidenced by the net water availability to stream flow during the spring sampling period (Figure 2-12). Data for both the observed and historical monthly normal rainfall and corresponding net water availability to stream flow are presented in Tables 2-3 and 2-4, respectively.

Water samples were collected in triplicate from seven stations in Port of Tampa during the spring/dry season field program. These locations were sampled to provide water and sediment quality information on conditions within Port of Tampa at East Bay (TPA-6B) and the Garrison Turning Basin (TPA-1A), conditions adjacent to two spoil disposal areas (TPA-5B and TPA-2A), in Big Bend Channel (TPA-3B), and in the Alafia Turning Basin (TPA-4B). A calibration station (TPA-7C) was located approximately five miles offshore of Mullet Key. The locations of these stations are shown on Figures 2-13, and listed in Table 2-1.

Sediment samples were collected in triplicate from all stations in Port of Tampa except the offshore water calibration station (TPA-7C). The results of grain size analysis and Atterberg limit testing completed on these samples are presented on Figures 2-14 through 2-19. Raw data on grain size analysis are presented in the Appendix on Pages A-14, A-18, A-22, A-26, A-31 and A-35.

The fall/wet season field program for the Port of Tampa was initiated on September 10 and continued from September 12 through September 17, 1982 (see Appendix D, Volume 2). Figures 2-11 and 2-12 present the duration of the fall/wet season field program and compare monthly normal precipitation and net water availability to observed conditions. These figures indicate that precipitation (Figure 2-11) was well above normal during the fall sampling period. Net water availability to stream flow (Figure 2-12) was also well above normal during the fall sampling period indicating that the fall sampling program did coincide with the end of the observed wet season. Data for both the observed and historical monthly rainfall and net water availability to stream flow are presented in Tables 2-3 and 2-4, respectively.

Water samples were collected in triplicate from eleven stations in Port of Tampa during the fall sampling program. Station locations are shown on Figure 2-20 and listed in Table 2-2. Selected locations were sampled to provide water quality information within the Port of Tampa at East Bay (TPA 6B-WOET), Garrison Channel (TPA 1A-WET(0)), and at Hookers Point (TPA 12-SFT); the Alafia River Channel (TPA 4B-WT(0) and TPA

5B-WT(0)), Big Bend Channel (TPA 10-SFT and TPA 3B-WT(0)), at Port Sutton (TPA 8-SFT), Hillsborough Channel (TPA 11-SFT and TPA 9-SFT) and adjacent to a dredge spoil disposal island (TPA 2A-WT(0)). In addition, a bulk water sample for elutriate testing was collected in Hillsborough Bay (TPA 13-XT) for elutriate testing of sediments collected from Garrison Channel and East Bay.

Triplicate sediment samples were collected from seven stations in the Port of Tampa during the fall program: three stations within the Port at East Bay, Hookers Point and Port Sutton Channel TPA 6B-WOET, TPA 12-SFT and TPA 8-SFT, respectively); two stations in Hillsborough Bay (TPA 11-SFT and TPA 9-SFT) and from one station in Big Bend Channel (TPA 10-SFT). Sediments collected from Station TPA 6B-WOET (East Bay) and TPA 1A-WET(0) (Garrison Channel) were used for elutriate testing. The results of grain size analysis and Atterberg limit testing are presented on Figures 2-21 through 2-27. Raw data on grain size analysis are presented in the Appendix on Pages C-18, C-26, C-31, C-34, C-37, C-40 and C-43.

2.3.2 Water Column

a. General Water Quality Characteristics

Tables 2-19 and 2-20 summarize the physical and chemical water quality characteristics at the sampling stations in Tampa Bay. During the spring, the observed salinity range was from 26 to 35 parts per thousand (ppt). Salinities during the fall ranged from 19.5 to 25 ppt, excluding the offshore calibration station (TPA-7C) sampled only during the spring.

The range in pH observed during both sampling periods was small (7.3 to 8.4). The pH of more organically rich estuaries (e.g., Pensacola) may vary from less than 6 to as high as 8.2. A pH of 7.4 recorded during the spring for the highest salinity station (TPA-7C) is probably incorrect due to instrument error. An initial pH value of 6.8 was recorded for TPA-7C, whereas the final recorded pH was 8.0 (all pH values presented in Tables

2-19 and 2-20 are means of mid-water pre- and post-sampling readings).

During the spring, DO concentrations of Tampa Bay waters were generally low when compared to that observed at the calibration station (TPA-7C) outside the Bay. Water column DO profiles showed a gradient of decreasing concentration from surface to bottom (see Appendix B, Volume 2). This suggests that the bottom sediments are probably a sink for DO. BOD concentrations in the water column do not appear to be high enough to account for the low DO readings.

Instrument problems, which appear to be due in part to radio wave interference in the Tampa area (Fehring, personal communication) precluded complete DO sampling at all stations during the fall. DO was collected at only 5 of the 12 Tampa stations. DO observed at these stations was similar to that observed during the spring.

Total Suspended Solids concentrations (i.e., TSS measured as total filterable residue) measured only during the spring, were variable but generally high in Tampa Bay as compared to offshore station TPA-7C. Judging from the Total Organic Carbon (i.e., TOC) values of the spring water column, the suspended solids are also rich in organic matter. For example, assuming that all the TOC at Station TPA-3B (located in Big Bend Channel) is associated with suspended solids and that the total organic matter is equal to twice the TOC (i.e. organic matter = approximately 50 percent carbon), it would appear that these solids are almost completely organic.

Turbidity measured during both sampling periods was similar, varying from around 2 to 17 NTUs. Turbidity of offshore waters at Station TPA-7C, measured about 1 NTU.

Nutrient concentrations were generally low in the areas sampled within the navigation systems in Tampa Bay and are relatively similar to levels observed in samples collected offshore at Station TPA-7C. Ammonia and nitrate concentrations appear to be highest, as suspected, at Station TPA-1A (located in the Garrison Turning Basin) when compared to observed concentrations at all other stations. Most of the phosphorous is in the form of phosphate in Tampa Bay waters, whereas offshore (TPA-7C) phosphorous is predominately in another form, possibly organic.

Only samples from station TPA 13-XT were analyzed for nutrients during the fall. Nutrient levels observed at this station were similar to those observed among stations during the spring.

b. Metals and Fluoride

Results of metal analyses for water samples collected in Port of Tampa are listed in Tables 2-21 and 2-22. During the spring, all three replicates from Garrison Channel, Station TPA-1A, were at the laboratory's detection limit for mercury, which is equivalent to the State standard of 0.1 μg/l. The concentration of metals in all the other water samples collected from the navigation system during the spring were below the State standard.

Mercury levels above State standards were observed during the fall at Stations TPA 1A-WET(O), TPA 3B-WT(O), TPA 6B-WOET, TPA 8-SFT and TPA 10-SFT. As discussed in Section 4.1, these high values are suspected to be the result of analytical artifact. Results of all other metal analyses on water samples collected in Port of Tampa in the fall were below State standards.

Concentrations of metals and fluoride at Station TPA-7C (collected in the spring) are at levels which would be expected for uncontaminated coastal waters. Because salinities at other stations within the Bay are not substantially lower than salinity observed offshore, metal concentrations at Station TPA-7C can be used as a comparison to judge the degree to which Hillsborough and Tampa Bay waters are polluted.

c. Toxic Organics

In all water samples collected in the Port of Tampa during both seasons, all pesticides and PCBs (analyzed during the spring program only) were below analytical detection limits (Tables 2-23 and 2-24). Phenol levels were below detection limits in samples from all stations except those collected at TPA 6B-WOET in the fall (Tables 2-23 and 2-24), where 2-Chlorophenol was detected in all replicates at levels above State standards (see page C-28 of Volume 2).

d. Radium 226

During the spring, results of water samples analyzed for radium 226 at Station TPA-4B exhibited concentrations below the State standard. Radium 226 was detected in only one of the three replicates (see page A-27, Volume 2).

2.3.3 Sediments

a. General Chemistry

In general, sediments sampled in the navigation system (Figures 2-14 through 2-19 and Figures 2-21 through 2-27) are poorly sorted sandy clays and silts. Finer grained sediments were found at Stations TPA-4B and TPA-5B which have the highest clay fractions.

With several exceptions, sediments are not rich in organic carbon (Table 2-25). TOC concentrations observed in spring sediment samples ranged from 0.8 percent (TPA-2A, adjacent to spoil disposal area D-2 in Hillsborough Bay) to an unnaturally high TOC value of 4.1 percent (TPA-4, in the Alafia River Turning Basin). TOC was approximately 2.0 percent at all other spring stations while fall TOC values were less than 1.5 percent at each station. Lowest values were observed in sediments collected at Stations TPA 6B-WOET and TPA 8-SFT. These TOC values appear to be considerably higher than values reported for other port areas (Savannah Labs, personal communication).

Nitrogen in all sediment samples collected from Tampa is probably organically bound since nitrate concentrations are low and TKN varies directly with TOC (Figure 3-1). The mean nitrogen to carbon ratio for Tampa Bay sediments (both seasons) is 0.13. This ratio is similar to TKN to carbon ratios in naturally occurring proteins. Thus the organic matter in the sediments is due largely to the natural decay of estuarine life and not pollution. Most of the phosphorous in sediments is associated with phosphates.

The five-day biochemical oxygen demand (BOD_5) of Tampa Bay sediments collected in the spring ranges from about 1.1 $g0_2$/Kg at Station TPA-2A to about 6.3 $g0_2$/Kg at Station TPA-4B. BOD varies directly with TOC.

Oil and grease (Table 2-25 and 2-26) was detected in a few sediment samples collected in Tampa Bay. Since organic matter is generally around 50 percent carbon, an estimate of the total organic matter in sediment can be made by multiplying TOC by two. The observed concentrations are about 10 percent of the TOC values, suggesting that oil and grease represent only about five percent of the total organic matter in sediments sampled.

b. Metals and Fluoride

The sediment sample containing the highest metal concentrations during the spring was collected from Garrison Channel at Station TPA-1A (Table 2-25). Samples collected during both seasons from other stations in close proximity to port facilities (i.e. Stations TPA-3B, TPA-4B and TPA-6B) also had high metal concentrations (Tables 2-25 and 2-26). Samples collected in Hillsborough Bay (Stations TPA-2A and TPA-5B (both adjacent to spoil disposal areas)) had the lowest concentrations.

Table 2-29 compares the metal to aluminum ratios for the Port of Tampa sediment samples to the natural crustal ratio and to ratios for carbonate rocks for each metal. Carbonate ratios are more appropriate for comparison of metal to aluminum ratios since drainage into Tampa Bay is from a carbonate terrain. Some portion of the excess metal may be associated with the phosphates but most is probably associated with organic matter. Compared to natural crustal material or carbonate rocks, cadmium appears to be enriched in all sediments, in some cases by more than two orders-of-magnitude.

Using the carbonate ratios as a basis for evaluation, sediments from Station TPA-2A appears enriched in silver. All sediments appear enriched for mercury. With the exception of those collected from Garrison Channel (TPA-1A), few sediments are enriched in any of the other metals by more than a factor of ten (see Table 2-29).

Fluoride to aluminum ratios of sediments collected in the spring varied from about four at Station TPA-5B to 17 at Station TPA-4B in the Alafia River. Both the crustal ratio and carbonate ratio are about 8 (see Table 2-29). Although there is probably some enrichment of fluoride associated with phosphates, it is not statistically significant.

c. Toxic Organics

Almost none of the sediment samples collected from the Tampa study area had detectable concentrations of either pesticides or phenolic compounds (Tables 2-30 and 2-31). One sediment replicate from Stations TPA-4B showed a trace of DDE. Sediments collected from Station TPA-6B showed traces of chlordane.

d. Radium 226

During the spring, sediment examined for Radium 226 exhibited concentrations that were below the detection limits (see page A-27, Volume 2).

2.3.4 Elutriate Tests

Elutriate tests were conducted on sediments collected from two stations within the Port of Tampa (TPA 1A-WET(O) and TPA 6B-WOET). Cadmium, chromium, nickel and silver increased to more than twice ambient in the elutriate test water (Table 2-32). Both silver and mercury concentrations exceeded State standards in the elutriate test water by a factor less than two.

Large releases of nitrogen were observed from sediment samples collected from Stations TPA 1A-WET(O) and TPA 6B-WOET. Because a similar increase in ammonia was also observed (85 and 111 times nitrogen levels in test water), most of the nitrogen released during these elutriate tests appears to be in the form of ammonia.

2.3.5 Summary of Results and Potential Water Quality Problems

Sediments collected in the navigational system were not particularly rich in organic matter and nutrients. Some metals, (cadmium, mercury and silver,) were however, enriched in sediments at stations located along the shoreline and influenced by urban run-off (Stations TPA-1A, TPA-3B, TPA-4B and TPA-6B). Other metals were slightly enriched at a number of stations judging from the fact that their ratio to aluminum was less than a factor of ten above natural values (Table 2-29).

The concentrations of all metals analyzed in the water column were at or below State water quality standards. The only exception was mercury at Station TPA-1A during the spring and five stations during the fall. As was the case in the Port of Pensacola, pesticides and phenolic compounds were below detection limits yet could be slightly above the standards. However, results of sediment analyses suggest that toxic organic pollutants do not represent a serious potential problem in relation to maintenance dredging.

Dissolved oxygen (DO) appears to be a chronic water quality problem based on the results of this study and others (Fehring, 1982, personal communication, and DER permit files). Observed concentrations rarely approach saturation. Although the Biochemical Oxygen Demand (BOD) of the water and sediments do not appear excessive, oxygen consumption (i.e. depletion) during maintenance dredging must be considered as a potential water quality problem in Tampa Bay. This is especially true given the large concentrations of nitrogenous compounds that were released during the elutriate test for TPA 1A-WET(O) and TPA 6B-WOET sediments.

Results of the elutriate tests suggest that in addition to mercury, silver may represent a potential water quality problem during maintenance dredging. Concentrations of both mercury and silver exceeded State water quality standards in the elutriate test water. Nevertheless, judging from the elutriate tests, nitrogen released from sediments during maintenance dredging potentially represents the most serious water quality problem. Consequently, increased BOD can be expected to depress DO concentrations in the water column as plankton and microalgal species respond to elevated nitrogen levels.

2.4. PORT MANATEE

2.4.1. Introduction

The spring/dry season field program for Port Manatee began and was completed on May 11, 1982. Figures 2-28 and 2-29 indicate the duration of the spring field program and compare the observed to monthly normal precipitation and net water availability to stream flow at the time of sampling. Although rainfall was above normal (Figure 2-28), the net water availability to stream flow indicates that the field program did coincide with the observed "dry season" as shown in Figure 2-29. Data for the observed and historical monthly normal precipitation and corresponding net water availability to stream flow are presented in Table 2-3 and 2-4, respectively.

Triplicate water samples were collected from two stations in Port Manatee during the spring/dry season field program. These locations were sampled to provide information in the vicinity of the berths (MAN-1A) and conditions in Port Manatee Channel (MAN-2B). The locations of these stations are shown in Figure 2-13 and presented on Table 2-1. The Port of Tampa Station TPA 7-C served as the calibration station for Port Manatee.

Triplicate sediment samples were collected from both stations in Port Manatee during the spring. The results of grain size analysis and Atterberg limit testing are presented on Figures 2-30 and 2-31. Raw data on grain size analyses are presented in the Appendix on Pages A-41 and A-45.

The fall/wet season field program for Port Manatee was conducted from September 21, 1982 through September 23, 1982. Figures 2-28 and 2-29 indicate the duration of the fall/wet season sampling period and compare observed to historical monthly precipitation and net water availability to stream flow. These figures indicate that above normal conditions occurred at the time of fall sampling and further imply that the fall sampling program did coincide with the observed wet season at Port Manatee. Data on the observed and historical precipitation and net water availability to stream flow for the fall sampling period are presented in Tables 2-3 and 2-4.

Water samples were collected in triplicate from three stations during the fall. These locations were sampled to provide information on the port berthing area (MAN 1A-WET(0)), Port Manatee Channel (MAN 2B-WOT) and adjacent to a dredge spoil disposal area (MAN 3-SFT). A bulk water sample for elutriate testing was collected from Tampa Station TPA 13-XT for elutriating MAN 1A-WET(O) sediments. The locations of the fall/wet season sampling stations for Port Manatee are depicted on Figure 2-20 and presented in Table 2-2.

Triplicate sediment samples were collected from two stations in Port Manatee during the fall sampling period. Samples were collected from the berthing area (MAN 1A-WET(0)) and adjacent to a spoil disposal area (MAN 3-SFT). Sediment collected from the berthing area was used for elutriate tests. The results of grain size analyses and Atterberg limit testing completed on these samples are presented on Figures 2-32 and 2-33. Raw data on grain size analyses are presented in the Appendix on Pages C-47 and C-53.

2.4.2. Water Column

a. General Water Quality Characteristics

The general water quality of samples collected in Port Manatee (Tables 2-19 and 2-33) is similar to that of samples collected in Port of Tampa. In the spring both Manatee stations had a salinity of 34 ppt, somewhat higher than at stations in the Tampa study area. Fall salinities were lower than spring, ranging from 28 to 30 ppt. Turbidity, DO, BOD, TOC, TSS and nutrient concentrations, however, were in the same range as those observed for the Port of Tampa samples. While pH values appear to be lower at Station MAN-2B during the spring than at the Tampa stations, there appears to be no apparent reason for this value. (An instrument malfunction or erroneous calibration is a possible explanation, since all other stations sampled in Port Manatee had pH values consistent with values determined in Tampa Bay.)

b. Metals and Fluoride

Metal concentrations in samples collected in Port Manatee during both seasons are generally low suggesting no local inputs (Tables 2-21 and 2-34). Fluoride in water samples is below State standards and appears to be at natural concentrations.

c. Toxic Organics

Pesticides and phenolic compounds were below detection in all water samples collected for Port Manatee during both seasons (Table 2-23 and 2-35).

2.4.3 Sediments

a. General Chemistry

Grain size of sediments in Port Manatee is similar to those of Tampa Bay. They are best classified as sandy silts and clays (Figures 2-30 through 2-33). The range of TOC concentrations in the Port Manatee sediments is similar to that of sediments collected from the Port of Tampa (Tables 2-25 and 2-36). BOD concentrations of Port Manatee sediments (only measured on samples collected during spring) were, however, considerably higher than those of samples collected in Port of Tampa, especially from Station MAN-2B. This high BOD concentration appears to be associated with large TKN concentrations suggesting that the most readily oxidizable organics in the sediments are nitrogen rich.

With these exceptions, the general chemistry of sediments collected in Port Manatee are similar to that of the Tampa sediments.

b. Metals

The comparison of metal to aluminum ratios of Port Manatee sediments to that of average crustal material and carbonate rocks (Table 2-37) indicates that silver, zinc, cadmium, chromium and mercury concentration in sediments collected at Station MAN-1A may be enriched. Metal to aluminum ratios exceed ratios in natural material by more than a factor of ten. In addition, cadmium, and mercury appears enriched in sediments collected at Station MAN-2B.

c. Toxic Organics

None of the toxic organic compounds analyzed were present in Port Manatee Sediments at detectable levels (Tables 2-28 and 2-39).

2.4.4 Elutriate Tests

Sediments collected from Station MAN 1A-WET(O) were subjected to elutriate testing. Results (Table 2-40) indicate that silver exceeded the State water quality standard in the elutriate. All other metals increased in the elutriate by a factor of about two or less above the elutriate test waters.

TKN concentrations increased in the elutriate by a factor of 45 greater than background values mesured in test water collected at TPA-13X (Table 2-40). This increase is clearly due to ammonia released from MAN 1A-WET(O) sediments, which increased 95 times above the elutriate test water. These values are comparable with elutriate results obtained for TKN and ammonia at TPA 1A-WET(O) and TPA 6B-WOET and further emphasize the potential problems of nitrogen release during dredging and disposal operations.

2.4.5 Summary of Results and Potential Water Quality Problems

Neither sediment nor water samples collected from Port Manatee contained detectable toxic organic compounds. Sediment samples collected in Port Manatee had no detectable levels of the organic compounds analyzed. Therefore, it can be concluded that organic pollutants are not presently a major potential water quality problem with respect to maintenance dredging activities.

Although metals in the water samples from Port Manatee were not detected at levels exceeding State water quality standards, the sediment data indicate that cadmium and silver may present potential water quality problems during maintenance dredging. Other metals appear to occur at natural levels when compared to average crustal material carbonate rocks.

Elutriate tests suggest that silver and mercury are the only potential metal problems during maintenance dredging, while nitrogen compounds released during dredging and disposal operations could produce biostimulatory effects in the water column.

2.5 PORT OF JACKSONVILLE

2.5.1 Introduction

The spring/dry season field program was conducted in the Port of Jacksonville from April 29 through May 4, 1982. Figures 2-34 and 2-35 indicate the duration of the field program and compare the observed precipitation and net water availability to stream flow to monthly normal conditions. Inspection of these figures indicates that although the observed rainfall was higher than that typically observed during the months of April and May (Fig. 2-34), net water availability to stream flow confirms that the field sampling did coincide with the observed dry season (Fig. 2-35). Data for the observed and historical precipitation and corresponding net water availability to stream flow are presented in Tables 2-3 and 2-4, respectively.

Water samples were collected in triplicate from nine stations in the Port of Jacksonville during the spring/dry season. The locations of these stations are depicted on Figures 2-36 and 2-36A, and in Table 2-1. These locations were selected to provide information in the vicinity of Jacksonville Shipyards (JAX-2A), Talleyrand Docks and Terminals (JAX-3A), Blount Island Terminal (JAX-6A) at the confluence of Trout River with the St. Johns River (JAX-5B), at the confluence of Long Branch Creek with the St. Johns River (JAX-4B), and at previously used or existing dredge spoil disposal sites near Bucks Island (JAX-8B) and adjacent to Quarantine Island (JAX-7A). An upstream calibration station (JAX-1B) was located in Godby's Lake to provide low salinity control while another calibration station (JAX-9C) was located offshore to provide a high salinity endpoint (See Figure 2-36A).

Sediment samples were collected in triplicate from seven stations in the Port of Jacksonville during spring sampling. Sediment was not collected at the offshore calibration station (JAX-9C) and due to the nature of the bottom material, only one sediment sample was collected at Station JAX-8B (see Appendix, page B-68). The results of grain size analysis and Atterberg limit testing are presented on Figures 2-37 through 2-44. Raw data on grain size analysis are presented in the Appendix on Pages, A-49, A-53, A-57, A-61, A-65, A-69, A-73 and A-77.

The fall/wet season field program for the Port of Jacksonville was conducted from September 25 through October 10, 1982. Figures 2-34 and 2-35 show the duration of the fall field program and compare the observed precipitation and net water availability to normal monthly conditions. These figures indicate that rainfall and net water availability were both above normal during the fall sampling period and suggest that the fall sampling program did coincide with the observed wet season at the Port of Jacksonville. Data on the observed and historical monthly normal precipitation and net water availability to stream flow are presented in Tables 2-3 and 2-4, respectively.

During the fall sampling program, water samples were collected in triplicate from twelve stations in the Port of Jacksonville. These locations were sampled to provide additional information on water quality in the St. Johns River at Commodore Point (JAX 10-SFJ), Talleyrand Docks and Terminals and the Terminal Channel (JAX 15-WEJ, JAX 3A-FWE(0) and JAX 17-S), at the confluence of the St. Johns River with Long Branch Creek (JAX 16-S and JAX 4B-WJT(0)), at the confluence of the St. Johns River with the Trout River and Dunn Creek (JAX 5B-WJ(0) and JAX 11-SFJ, respectively), near Blount Island Terminal (JAX 7A-WOJ and JAX 13-SFJ), in Blount Island Channel (JAX 12-SFJ) and near existing or previously used dredge spoil disposal sites at Quarantine Island (JAX 6A-WJ(0), and near Bucks Island (JAX 8B-WJ(0)). In addition, a bulk water sample for elutriate testing was collected in the St. Johns River at its confluence with Drummond Creek (JAX 14-X). The locations of the fall/wet season sampling stations are shown on Figure 2-45 and presented in Table 2-2.

Triplicate sediment samples were collected from eight stations in the Port of Jacksonville to more accurately depict sediment quality near Blount Island (JAX 13-SFJ and JAX 12-SFJ), near the confluence of the St. Johns River with Dunn Creek and Long Branch Creek (JAX 11-SFJ and JAX 16-S) and in the Terminal Channel (JAX 3A-FWE(0), JAX 15-WEJ, JAX 17-S and JAX 10-SFJ). Sediments collected from Stations JAX 3A-FWE(0) and JAX 15 WEJ, both located in the Terminal Channel, were used for elutriate testing. The results of grain size analysis and Atterberg limit testing are presented on Figures 2-45 through 2-52. Raw data on grain size analysis are presented in the Appendix on Pages C-56, C-66, C-70, C-73, C-77, C-81 and C-83.

2.5.2 Water Column

a. General Water Quality Characteristics

Of all the ports studied, only Jacksonville is directly influenced by a major river discharge and therefore, a large range in salinity is observed. During both seasons the observed salinity ranged from around five parts per thousand at upstream stations, to around 30 parts per thousand at the most seaward station (Tables 2-41 and 2-42). Throughout this salinity range, pH values varied from about 7.3 to 7.4 at the least saline stations to values of 7.6 to 8.2 at the higher salinity stations. This is a typical range in pH for southeastern estuaries.

Dissolved oxygen varied between 5.2 and 7.4 mg/l during the spring and between 4.9 and 7.9 mg/l during the fall. The highest DO values however, are generally found at either end of the estuary; 7.4 mg/l at Station JAX-1B and 6.9 mg/l at Station JAX-9C. This spring pattern of higher DO values at endpoints of the estuary is not reflected in BOD values which were found to be rather uniform throughout the stations sampled in the spring. DO values observed at estuarine endpoints during the fall program were 7.3 mg/l at Station JAX 10-SFJ near Commodore Point and 6.2 mg/l at Station JAX 8-WJ(0) near Bucks Island.

Turbidity was generally uniform throughout the estuary during the spring. Observed values ranged from about 10 to 17 NTUs, compared to an value of 3.2 NTUs at offshore Station JAX-9C. Turbidity measurements during the fall were lower than the spring with fall values ranging from about 4 to 10 NTU's. The observed turbidity at Station JAX 3A-WEJF(O), however, was 28 NTU's. Total Suspended Solids (measured only during the spring) ranged from 26 to 85 mg/l. Turbidity in the Port of Jacksonville was the highest of any port studied.

TOC concentrations measured during the spring decreased with increasing salinity and appear to represent conservative mixing of river-derived organic water with sea water. To a first approximation, TKN and total phosphorous follows a similar trend. Nutrient concentrations in waters of the Port of Jacksonville are higher than those of the other ports, reflecting the importance of riverine inputs.

b. Metals

Mercury concentrations were observed above detection limits (and slightly above state water quality standards) at two stations during the spring (JAX-1B and JAX-2A) and at six stations during the fall (Table 2-44). At all other stations, concentrations were 0.1 μg/l. During the spring, cadmium, iron, copper, nickel, zinc and lead concentrations generally decrease with increasing salinity, suggesting river transported metals are conservatively diluted with sea water. This trend is not as apparent in data collected during the fall. While results from the spring indicate no apparent local anthropogenic inputs, the fall results are ambiguous. Nonetheless, with the exception of mercury none of the metals exceed State standards.

c. Toxic Organics

None of the samples collected during either season contained detectable levels of pesticides or phenolic compounds (Table 2-45 and 2-46).

2.5.3 Sediments

Sediment samples collected in the Jacksonville study area varied considerably in texture (Figures 2-37 through 2-44 and 2-46 through 2-52). Many samples were composed of fairly uniform fine sands while others were sandy clays or silts. Some samples, however, were poorly sorted and contained materials from coarse sands to clays.

a. General Chemistry

With the exception of sediments at Stations JAX-3A (located in the vicinity of Talleyrand Docks and Terminals) and JAX-4B (located near the confluence of Long Branch Creek with the St. Johns River), sediments collected during the spring in the Port of Jacksonville were low in organic matter (Table 2-42). With the exception of sediments at Station JAX 10-SFJ and JAX 13-SFJ, samples collected during the fall had high TOC concentrations (Table 2-48). Generally oil and grease accounted for only about five percent of the TOC of the sediments.

In the sediments having the highest concentration of organic matter (i.e. one percent) the TKN:TOC ratio is around 0.20 ± 0.04. This ratio varied considerably in the sediments containing smaller amounts of TOC.

Sediments containing highest levels of TOC also had the highest concentrations of phosphorous.

b. Metals

Metal concentrations in sediments collected from the Port of Jacksonville are presented in Tables 2-49 and 2-50. With the exception of cadmium and mercury, which are enriched in most sediment samples collected, none of the metals appear to be considerably enriched with respect to the average crustal or carbonate materials (Table 2-51). That is, the metal to aluminum ratios of the sediment samples were not over a factor of ten above the natural ratios. Exceptions were Station JAX-2A near the Jacksonville Shipyards, where the sediment samples exhibit chromium, iron and silver to aluminum ratios which exceed natural ratios by more than one order of magnitude. Also, the iron to aluminum ratio for spring Station JAX-5B sediments and the silver to aluminum ratio for Stations JAX-2A, JAX-3A, JAX-6A, JAX-7A and JAX 13-SFJ sediments were an order-of-magnitude above both the crustal and carbonate ratios.

c. Toxic Organics

Sediments collected from stations in Jacksonville during the spring contained organic compounds at detectable levels (Table 2-52). Chlordane was detected in one replicate sample collected from both stations JAX-2A and JAX-5B. Toxaphene, DDE, 2-chlorophenol and PCBs were detected in one replicate sample collected at Station JAX-3A, located near the Buckman Street STP discharge pipe at Talleyrand Terminals. Pesticides or phenolic compounds were not detected in the remaining spring samples. Furthermore, neither of these compounds were detected in samples collected during the fall.

2.5.4 Elutriate Tests

Elutriate tests were performed on samples collected from Stations JAX 3A-FWE(O) and JAX 15-WEJ. Sediments from these stations contained some of the highest concentrations of metals and organic matter.

Elutriate test results are presented in Table 2-54. These results represent the expected changes in ambient water concentrations (JAX 14-X Table 2-44 and 2-46) which result from agitating ambient water (from Station JAX 14-X) with sediments (from Stations JAX 3A-FWE(0) or JAX 15-WEJ). With the exception of iron, chromium, and possibly silver, increases in metal concentrations in the test water were less than a factor of two above ambient levels. Except for mercury, none of the metal concentrations in the test water exceeded State standards.

TOC concentrations showed only a small increase (25 percent or less) in the test water. TKN concentration in test water increased by a factor of 4 above ambient using JAX 3-FWE(0) sediments and by a factor of 21 using sediments from JAX 15-WEJ, even though the TKN concentrations were greater in the sediment sample from JAX 3-FWE(0).

2.5.5 Summary of Results and Potential Water Quality Problems

Of the metals examined in ambient water, only mercury exceeded the State water quality standard. However, it appears that the reported values for mercury may have be due to an analytical artifact (see Section 4.1). As in the other ports, all organics were below detection limits in water samples. Pesticides and PCBs did not exceed State standards (although restrictions in analytical detection limits precluded making any definitive conclusions). However, it appears that these substances are not an obvious problem in the Port of Jacksonville, judging from low levels observed in sediments.

Based on the results of sediment analyses, cadmium, mercury and silver could create water quality problems during maintenance dredging. However, results of the elutriate testing suggest that these metals may not be released in quantities sufficient to exceed State standards. In the case of mercury, the standard was exceeded in the initial test water.

Nitrogen release (probably in the form of ammonia) represents the greatest potential water quality problem related to maintenance dredging in Jacksonville Harbor.

3.0 COMPARISON OF RESULTS FROM ALL PORTS

3.1 INTRODUCTION

Review of the data collected during the field program indicates that while there are some basic similarities between the Ports of Jacksonville, Tampa, Manatee and Pensacola, there are also some considerable differences. However, it is important to note that most of these differences in water column and sediment chemistry can be explained by natural processes.

3.2 WATER COLUMN

Results of TOC analyses of the spring water samples from all ports are plotted against salinity in Figure 3-1. In southeastern estuaries a linear relationship between TOC and salinity is commonly observed (Waslenchuk and Windom 1978), implying that TOC in fresh water conservatively mixes with sea water. In general, results of TKN and nitrate analyses of all the samples collected during this season show similar relationships with salinity (Figures 3-2, 3-3). While sufficient data were not available to make similar comparisons for the fall, with respect to fresh water inputs in all the ports studied, this implies that the TOC, TKN and nitrate loading is similar and probably due to natural inputs (i.e. river runoff). No local input of organic matter or nitrogen to waters within the ports is suggested by these data.

Variability of ammonia concentrations with salinity (Figure 3-4) for the spring reflects the peculiar bio-geochemical regimes of the various ports. Likewise, results of phosphate and total phosphorous from all the ports (Figures 3-5, 3-6) show variations with salinity that reflect higher phosphate levels in the Ports of Tampa and Manatee.

For metal concentration variations within the water column, only copper and lead show a consistent pattern. Concentrations of both metals correlate significantly ($p<0.01$) with salinity during both the spring (Figures 3-7, 3-8) and the fall (Figures 3-9 and 3-10). This implies that loading of these metals is similar in all ports and that these metals behave conservatively in the water column. The zero salinity concentrations (intercept of regression curves of data in Figure 3-7 and 3-8) for copper and lead for the spring would be approximately 1.3 and 2.0 μg/l, respectively. Values for the fall would be approximately the same. Therefore, observed levels probably represent background values. Exceptions are two outliers for copper encountered at 26 and 34 ppt during the spring (Figure 3-7), one outlier for lead at about 28 ppt (Figure 3-8) during the spring, and another outlier detected at approximately 31 ppt during the fall. Concentrations observed at these stations may reflect local inputs.

Comparison of nickel concentrations with salinity for the spring (Figure 3-11) suggests two possible trends; one for Jacksonville and another for the remaining data. This would indicate that nickel loading of Jacksonville estuarine waters is less than that for the other ports. When compared to salinity, results for cadmium (Figures 3-12 and 3-13) indicates similar trends and suggests that cadmium loading for Jacksonville is also less than that for other ports.

Chromium showed no trend with relation to salinity during the spring sampling period (chromium was not analyzed in the water column during the fall) indicating either real variability (local inputs) or inaccuracy in the data (Figure 3-14). Iron (Figure 3-15) and zinc (Figure 3-16) concentrations show a general negative correlation with salinity during the spring but not as significantly as the relationship between copper and lead to salinity. Since total suspended solids show a negative relation to salinity, the correlation of metals with salinity may be related to their association with particulate phases. Zinc results for the fall show a general trend with salinity similar to copper and lead (Figure 3-17). The zero salinity, intercept is about 5 μg/l.

Results of the mercury analyses were near detection limits for spring samples (Figure 3-18). During the fall, results of many analyses are considerably higher and above State standards (Figure 3-19).

Results of silver analyses for all ports for the fall sampling suggests that higher concentrations are generally observed at higher salinites (Figure 3-20). There is no obvious natural explanation for this relationship.

Pesticides and phenolic compounds were absent from all water samples collected during this study. This is not surprising since these are surface active compounds that are generally more associated with sediments. It must be pointed out, however, that analytical techniques employed in this study were not sensitive enough to detect concentrations near the State water quality standards (see Section 4.1).

While most of the data on concentrations of metals can be explained by natural processes, occasional outliers from natural trends may be the result of anthropogenic inputs. Nonetheless, for all the metals except mercury, concentrations observed even for outliers are below State water quality standards. The observation of mercury levels above State standards needs further verification, particularly during the fall sampling, since it is likely that these high mercury concentrations may be an analytical artifact. This possibility is discussed further in Section 4.1.

With virtually no exceptions, all observed variations in nutrients and TOC can be explained by natural processes. Clearly, releases from waste treatment plants are not substantial in any of the ports in terms of water quality impacts.

3.3 SEDIMENTS

An analysis of the sediment data from all the ports studied reveals highly significant relationships ($p < 0.001$) between TKN and TOC and the five-day BOD and TOC (Figure 3-1). Obviously, this implies that TOC controls BOD in all sediments, but more importantly, the data suggest that the nature of this control is similar for sediments collected from all four ports. Likewise the nitrogen component of TOC (i.e. the nitrogen content of the organic matter) is similar in all sediments.

The mean BOD:TOC ratio can be calculated using the regression line in Figure 3-1. This value, considering all sediments collected during the study, is 0.18. Since carbon accounts for about 50 percent of the organic matter, it can be concluded that the ratio of the amount of oxygen readily consumed to total organic matter is about 0.10. BOD:TOC ratio for organic matter in typical sewage varies between 0.25 and 0.95 (Camp, 1968), suggesting that organic matter in sediments is not particularly rich in sewage and is probably more refractory natural organic material. In sediments, this conclusion is further supported by the mean N:C ratio determined from the slope of the regression curve in Figure 3-1. The value of 0.14 is very close to that of natural marine organic matter, 0.17 (Russell-Hunter, 1970).

In general, as shown above, the metal concentrations in most of the sediment samples were similar to that of the material likely to be transported by natural runoff into the ports (i.e. either average crustal material or carbonate crustal material). When compared to aluminum, metal concentrations at Pensacola did not exceed natural levels (i.e. average crustal ratios) by more than a factor of ten, except at Station PNS-1A. In Jacksonville and Tampa/Manatee, metal concentrations were found to exceed natural or expected values by less than a factor of ten in most cases when compared to average crustal material or, more appropriately, carbonate rocks. Such a comparison (i.e. Pensacola Bay sediments to average crustal material and Jacksonville and Tampa/Manatee sediments to average carbonate rocks) appears to be a reasonable basis for evaluating metal pollution levels in sediments. When the metal:aluminum ratio in sediments significantly exceeds (i.e. by more than a factor of ten) the corresponding value of the reference material, there is good reason to suspect anthropogenic inputs. A factor of ten has been used in this study to account for natural variability.*

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*Average crustal and carbonate ratios are based on the results of analyses of many samples of these natural materials. Average ratios obviously have standard deviations associated with them due to natural variability. From review of the actual data used in the calculation of mix ratios, a factor of ten is used to allow for this variability.

Figures 3-21 to 3-40 clearly indicate that metals tend to be concentrated in finer sediments. Normalizing metal concentrations to aluminum takes into consideration the inhomogeneity of sediment-metal distribution and probably provides the best basis for sediment quality evaluation (Section 1.2.1). It is obvious that this approach breaks down for coarser sediments since a very small addition of metal may drastically affect metal to aluminum ratios, and consequently some judgement must be used.

3.4 ELUTRIATE TESTS

With the exception of mercury and silver, none of the metals examined in the elutriate tests from any port exceeded State water quality standards. Additionally, in most cases, none of the metal concentrations in the elutriate increased by more than a factor of two above ambient. Mercury and silver exceeded State standards in elutriate tests because concentrations of these metals were at or above State standard in the ambient water used as part of these elutriate tests.

The small releases of metals from the sediments, indicated by the elutriate tests, is not surprising in light of the low concentrations of metals detected in the sediments. From these analyses, metal concentrations in sediments were found to approximate natural levels. Clearly, large metal releases are not expected since chemical equilibrium of the system leads to metal association with the sediment. At least a portion of the released metal will accumulate back in the sediment in a relatively short time.

The observation of large nitrogen releases from all sediments tested is also not surprising since this has been observed in previous work (Windom, 1974; Windom 1975) and is due to the release of ammonia. Ammonia-nitrogen is formed in sediments primarily as a result of the presence of nitrogen reducing bacteria. Some ammonia may escape from sediments by direct diffusion through the sediment/water interface, but most is trapped by oxidizing conditions at this interface. Clearly, dispersion of the sediment, such as occurs during dredging, will lead to the release of this labile nitrogen species.

3.5 COMPARISON WITH HISTORICAL DATA

It is difficult to compare historical data with those resulting from this study since the former lack important documentation (for example, quality control and station location) that this study has provided. Consequently, data produced in the past cannot be used for comparison in the present study for one or more of the following reasons:

1. Lack of ancillary data necessary for interpretation such as geographic location of station, salinity (in the case of water samples), grain size, TOC, and aluminum, in the case of sediments.
2. No information on sampling and/or analytical procedures (precautions to avoid contamination, detection limits, and so forth).
3. No replicate analyses.

The data produced as a result of the present study include all of the above information and conditions. This data set will therefore, be comparable with future work when the above criteria of data aquisition are imposed.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 ESTIMATING EFFECTS OF MAINTENANCE DREDGING ON WATER QUALITY

From the overall results of this study it must be concluded that maintenance dredging has not resulted in chronic water quality impairment in any of the ports (the only possible exception is mercury which will be considered below). It is more likely that maintenance dredging will produce transient water quality impacts. It is also likely that these impacts can be predicted from studies of port sediments rather than by detailed investigations of water quality. There are three important reasons for this. The first is that sediments are static; they stay in place relative to the much more dynamic water column and, clearly, areas with high pollutant loading are reflected in the distribution of polluted sediments. Secondly, most pollutants, both inorganic and organic, tend to accumulate in sediments. Finally, since it is the sediments that must be handled during the dredging, they are ultimately the cause of water quality impairment.

As a first approach to evaluating potential water quality impacts of dredging a given port sediment, some estimate of the anthropogenic component of given pollutants in the sediment must be made. In the case of heavy metals, normalizing concentrations of the given metal to aluminum provides a basis for this evaluation (see Section 3.3).

Results of this study have also provided a basis for evaluating the anthropogenic component of organic matter in sediments (Figure 4-10), since it has been observed that there are natural relationships between TOC, BOD and TKN. Sediments having concentrations of these materials that do not follow this trend are suspected of being contaminated by anthropogenic inputs.

Although the elutriate test does not consider all the conditions of an actual dredging operation, it at least provides a basis for predicting the probable water quality impact (see Section 1.2.3). This is certainly true in the prediction of nitrogen releases (see Section 3.4). Results of elutriate tests conducted during this study indicate that nitrogen releases do not bear a straightforward relation to the nitrogen content of the sediments. Currently, dynamic procedures which attempt to mimic dredging processes, such as elutriate tests, (when used in conjunction with bulk chemical data) provide the best available tool for evaluating the amount of nutrients released during dredging.

Accurate analysis of parameters in the sediments and the water column is of utmost importance in estimating effects of dredging on water quality. Close attention must, therefore, be paid to analytical procedures. For example, most standard EPA methods have detection limits for metals that are more commensurate with polluted waters rather than for natural conditions. In order to understand natural conditions, analytical methods should have detection limits at least as low as State standards, and preferably approaching natural levels.

During this study some difficulties were experienced which illustrate this problem. Although techniques for measuring ambient mercury concentrations typically use small amounts of oxidizing reagents (Olafson, 1982), the EPA method applied in the fall analyses required the use of 15 ml. of permanganate. This high level of permanganate can convert chloride to free chlorine which, in turn, will cause an elevated mercury reading. Even though care was taken to remove this free chlorine prior to the analysis, its removal may not have been complete. The results of the mercury analyses from this study may therefore be erroneously high. This conclusion is supported by the fact that greater levels were determined on fall samples than spring, after the technique (Table 5-2, notes) had been altered to more adequately analyze high concentrations (EPA's standard methods were developed to examine organomercury compounds by adding larger quantities of oxidizing agents). This conclusion is also supported by results for the Jacksonville area which show mercury concentrations were generally above 0.1 μg/l. However, results from Windom and Taylor (1979) for samples collected monthly over a year in this area show concentrations that average about 0.04 μg/l.

In the case of the organic compounds analyzed during this program, EPA techniques were also used. As is discussed in greater detail in Section 5, detection limits of these methods, were above the State standard. Nevertheless, in all cases, the detection limits for these compounds were as low or lower than those routinely obtained in the Florida DER Laboratory, other State environmental laboratories in the southeast, or by the EPA Regional Laboratory in Athens, Georgia. This brings into question the validity of State standards for organic compounds.

4.2 SUMMARY OF POTENTIAL WATER QUALITY PROBLEMS RELATED TO MAINTENANCE DREDGING

None of the sediments from any of the ports had unnaturally high concentrations of oxygen demanding materials or nutrients. Oxygen depletion and nutrient release, however, are always potential problems resulting from dredging in subtropical estuaries where periods of low oxygen occur due to natural depletion. For this reason oxygen depletion and nutrient release should be addressed in the development of rules and best management practices for maintenance dredging. For example, when receiving waters are sensitive to low oxygen concentrations it might be preferable to dredge during periods when oxygen demands of dredged sediments will not exert as much impact (e.g. during the winter). Nutrient releases will probably be best managed by estimating release rates from a contained area (based on dredging rates and elutriate test results) and controlling discharge rates in relation to the assimilative capacity (flushing rates, and so forth) of receiving waters.

No obvious problems have been identified in this study that might result in significant increases in metals or organic pollutants in the water column as a result of maintenance dredging. There is always the chance of this, however, since these pollutants may accumulate in sediments in the future. Also, it can not be assumed that the most heavily polluted sediments were sampled during this study, although every attempt was made to sample worst case sediments. As with nutrients, potential problems with metals and organic pollutants as a result of dredging can be estimated by a combination of sediment analyses and elutriate testing. Best management practices can then be developed taking into account local assimilative capacities.

4.3 RECOMMENDATIONS FOR MAINTENANCE DREDGING AND DISPOSAL

4.3.1 Dredging Operations

The major effects of maintenance dredging on water quality will be in the disposal area. In the case of hydraulic pipeline dredging, the greatest effects will be on the waters receiving effluent from the disposal area. Where clam shell or bucket dredges are used, the greatest impacts will be in the vicinity of the hopper or receiving barge. Therefore, environmental impacts are dependent on the type of dredge used.

In areas where sensitive habitats are located adjacent to the channel to be dredged, pipeline dredging will insure that local water quality impact will be minimized. Hopper dredges properly operated to control overflow, may be appropriate for heavily polluted areas where the only other alternative is to dispose of material in confinement areas which discharge into environmentally sensitive habitats or areas with poor assimilative capacities.

Generally, attempts to regulate water quality at the dredge site are probably not cost effective or environmentally beneficial. First, channel areas are essentially written-off environmentally in return for navigational benefits. Secondly, water quality impacts at the cutter head or bucket are often localized. For example, recent studies of a large bucket dredging operation in the Thames River estuary near New London, Connecticut found increases in dissolved phosphate, ammonia, silica, manganese and copper from two to nine times above ambient at the dredge site. Particulates increased a hundredfold. Within about 180 meters down-flow, the dissolved components returned to ambient levels and particulate values returned to ambient levels at about 700 meters (recent studies by the University of Delaware, in review).

For any dredging operation, estimates of water quality impacts at the dredging site are possible. Such estimates should be based on bulk chemistry data, elutriate testing, estimates of dredging efficiencies and mean local current flow regimes.

4.3.2 Disposal

Discussion and recommendations on disposal site management are contained in Section 4.4.2 - Environmental Protection. Recommended disposal site practices are currently being developed by DER and are not available at this time.

4.4 GENERAL RECOMMENDATIONS ON DEVELOPING REGULATIONS

4.4.1 Practical Standards

Historically, water quality standards have been used as the basis for many environmental regulations. For many parameters, such as metals, pesticides, and other organic compounds, they are impractical and/or unrealistic for several reasons:

1. Standards for metals, organic compounds, etc., are usually based on toxicity tests (e.g., LD_{50}'s) carried out on specific, stressed organisms. Test conditions seldom approach those of the environments being evaluated. Furthermore, organisms used in the tests generally bear little similarity to those of the environments to which the standards are applied.

2. The effects of a given metal or organic compound often depends on its form in the environment rather than its total concentration. This is rarely taken into consideration in establishing standards. Since the speciation of metals or organic compounds may vary considerably from one ecosystem to another, it is unlikely that a given standard can be generally applied to a variety of environments.

3. State-of-the-art in the analysis of metals and many organic compounds at natural or near-natural levels in ecosystems has only recently reached a level of acceptable reliability. In large part, this is due to the realization of the importance of collection and handling of samples to minimize contamination. Contamination of samples is always a possibility even when extreme care is taken. In fact, many bioassay studies are probably in error

> since experimental systems are generally contaminated at levels higher than prescribed. As a result of this situation, it is unlikely that much of the data on the quality of natural waters are reliable.

Given the inherent problems in a water quality standard, we can conclude from the above that if water quality criteria (particularly for metals and hydrocarbons) are used, they should be as site specific as possible. Section 4.4.2 outlines a system which accommodates water quality standards and is based on port specific conditions (sediments and hydrography). Also, given the present state of knowledge on the effects of increased levels of various pollutants in a specific environment, any water quality standard adopted will of necessity be arbitrary.

Discussions with DER regarding the development of regulations for long-term maintenance dredging permits have raised a number of questions for which answers must be found. Among the most important recurring questions are:

1. What is a practical and realistic set of standards on which to base the regulations?
2. How can we make the regulations operationally feasible and responsive to workable dredging and disposal practices.
3. How do we establish regulations that adequately assess potential environmental impacts of proposed dredging operations?
4. What kind of flexibility should be built in so that the regulations take into account future changes in environmental (and other) conditions?

It has become clear that there are no simple answers to these questions but through our discussions, general agreement on workable answers appears to be evolving. The consensus described below may be considered tentative recommendations for regulations as well as a basis for future program development.

Tentative recommendations for developing criteria and procedures for making regulatory decisions on maintenance dredging and disposal are as follows:

1. While water quality standards appear at present to be the only socially, politically, and legally acceptable basis for regulation, it has become increasingly apparent that the quality of sediment to be dredged should also be considered in a straightforward and consistent manner. Estuarine sediments are a sink for both anthropogenic and natural contaminants originating from upland areas, and their release and subsequent oxidation could be potentially deleterious to estuarine biota.
2. Criteria incorporating sediment-related information should be port specific and flexible. For example, suspended sediment issues related to dredging pose a greater problem for ports where ambient suspended sediment levels are low.
3. Criteria should be based on the best predictive procedure for assessing environmental effects. Such a procedure should be capable of being updated and improved based on results of monitoring programs and other environmental studies.

4.4.2 Environmental Protection

Standards alone do not protect the environment, but simply allow the permitter to evaluate whether physico-chemical conditions deviate from some presumably acceptable condition. Certainly standards based on the above criteria can provide the setting for such an evaluation, but no standard can predict the environmental impact of maintenance dredging.

If regulations are to serve a useful purpose, they must include requirements or procedures that help predict impacts. Only in this way can conditions imposed by the permit attempt to minimize adverse impacts to the environment.

Nowhere is there a more urgent need for careful water quality management than at the spoil disposal site. Since potentially deleterious sediments will be removed from the navigation channels, it is imperative that return waters from the discharge wiers be treated such that the receiving waters are not degraded. Thus, reasonable standards should be established according to "background" water quality conditions outside appropriate mixing zones.

The concept of mixing zones has been established to provide an acceptable area within which water quality degradation is allowed. The size of the mixing zone should take into account the major factor characterizing assimilative capacity outside of the disposal area: the proximity of sensitive environments, the mixing regime of the receiving water, and the characteristics of the effluent. Although difficult, it is possible to estimate the assimilative capacity of receiving waters by identifying these factors. Once the assimilative capacity is estimated, a mixing zone can be established. This should be followed up by monitoring during the discharge of dredge spoil effluents to evaluate the efficiencies of management practices.

In addition to employing mixing zones and dredging practices reflecting conditions at each port, data should be gathered and updated to improve practical environmental safeguards. Correlations between heavy metal concentrations and sediment grain size interpreted in light of metal to aluminum ratios (see Section 1.2.1) appear to be useful for determining potential hazards associated with handling sediments from a particular channel or cut. If a strong correlation is found between a contaminant and sediment type, then specific dredging equipment can be used (hopper barges with no overflow, hydraulic dredging, etc.). A similar set of criteria should be used at the spoil disposal site to isolate hazardous sediment types and employ variable retention rates.

Metal to aluminum ratios can be employed to signal problem areas along various segments of the navigation channel. If these ratios are considerably greater (i.e. greater than one order of magnitude) than those for natural crustal abundances, then dredging and spoil disposal techniques should be developed to deal with these potentially deleterious sediments.

It should be noted, however, that the above deals only with physical and chemical processes occurring within the navigation systems, essentially neglecting direct biological impacts created by maintenance dredging operations. After a reliable data base becomes established for sediment and water quality conditions, the ultimate impacts of maintenance dredging on estuarine resources can be more fully addressed.

Considering the above, recommendations regarding environmental protection aspects of the regulations are:

1. Regulations should require, in addition to sediment analyses, an elutriate test on the sediments to be dredged. The results of this test should estimate the release of potential pollutants so that improvements in management practices can be made.
2. A reasonable monitoring program should be required during dredging operations, not so much as to evaluate compliance as to examine the adequacy of management practices. This would provide additional information on the effects of dredging operations which can then be used to better evaluate future operations.
3. Stringent requirements should be imposed on all tests and analyses so that data are useful for continuous re-evaluation of environmental conditions of the harbors. Because of the present state-of-the-art and continual improvement of many analyses, (as discussed above) this is extremely important.
4. Mixing zones should be established on a site-specific basis. The extent of the mixing zone should be based on the assimilative capacity of the receiving waters and proximity to sensitive areas.

4.4.3 Operational Feasibility

Real-time monitoring is often imposed on dredging activities. Justification is that if results of the monitoring indicate that water quality degradation is occurring, the dredging operation can be ceased. Operationally, however, this is not feasible since the turn-around time for reliable laboratory analysis is often too long. This type of monitoring program also has punitive implications which make the dredger less enthusiastic about participation in a monitoring program. If practical long-range dredging permits are issued, they should be as free as possible from unreasonable interruption during actual operation. The results of the monitoring program should be of reliable accuracy and be used to either tighten or loosen constraints (i.e., management practices), on subsequent operations. Monitoring should not be used to disrupt on-going operations unless obvious contravention of imposed conditions of the permit occur.

The administration of long-term permits must provide a place for carefully developed monitoring programs and be able to make management adjustments during the permit term.

The required high quality performance of tests and analyses involved for regulation will be difficult to achieve. Understanding the effects of dredging and disposal in estuarine areas will depend on the development of field and laboratory manuals and the application of improved quality assurance programs to evaluate the laboratories conducting the tests and analyses.

4.4.4 Flexibility of the Regulations

It is likely that conditions in the channels and harbors will change with time. Demands on the harbors may increase, population densities change, adjacent industrial growth may occur and environmental conditions will change in response. Water quality may improve due to increased pollution abatement or it may decline due to increased industrialization and urbanization. Management must be flexible enough to take into account these changes and still be meaningful in terms of environmental protection. It is easy to visualize that requirements imposed on a dredger today may be either too severe or too lax ten years from now.

To minimize this possibility, management programs should be flexible. The requirements to analyze ambient conditions and monitor changes during dredging provide for continual data growth. They also provide a secure and necessary place in the long-term regulatory process for improving the understanding of impacts associated with maintenance dredging operations. Management Program objectives can be successfully achieved by developing a mechanism to integrate updated information into the regulatory process. This would suggest, at least as a first step, the following recommendations.

1. A study group established for each port to develop a monitoring program and periodically review the results of elutriate tests and monitoring analyses, and translate these results into an updated

estimate of environmental conditions and needed regulatory responses regarding maintenance dredging.

2. A mandatory review and updating of standards should be established as a part of the separate regulatory process for deepwater ports.

5.0 FIELD AND LABORATORY METHODOLOGY

This section identifies sampling stations at the Ports of Jacksonville, Tampa, Manatee and Pensacola, outlines sample collection methodologies and presents information on parameters selected for analyses and laboratory procedures utilized in the analyses of the field samples collected during the spring/dry and fall/wet season field programs.

5.1 INTRODUCTION

The initial task in developing the field sampling program was to assess existing data on the ports of Jacksonville, Pensacola, Tampa and Manatee. In order to use the most reliable information, these data were carefully screened in several ways. This preliminary screening is discussed in greater detail in the 3 May, 1982 report on the assessment of existing information entitled, "Data Summary for Dredging and Spoil Disposal Study for Deepwater Ports - Phase 1, Subtask II B".

Early in the development of this project, it was decided that determination of "ambient" water quality conditions for the entire list of Class III parameters regulated by the state (Chapter 17-3 FAC), was not economically feasible. Therefore, the analysis of water and sediment samples was limited to only those parameters which were considered environmental hazards at each port and for which the current state-of-the-art in commerical laboratory analysis would provide accurate results. Even for selected parameters, the high cost of laboratory analysis precluded sampling with sufficient density to determine "ambient" conditions in estuarine systems which are characterized by high spatial and temporal variability. For this reason, it was decided to sample the expected extremes - the "wet season" (fall) and the "dry season" (spring) as well as sample the "worst case" conditions in each port (e.g. the berthing areas, turning basins and channels). Consensus on such an approach was reached after discussions with representatives from DER, Savannah Laboratories, and Environmental Services Inc., and the ports.

5.2 SPRING/DRY SEASON FIELD PROGRAM

Based upon the existing information, water quality parameters listed in Chapter 17-3 of the Florida Administrative Code (FAC), and consensus of scientific and technical personnel, the parameters to be investigated at each port during the spring field program were determined (see Table 1-2). Because of physical/environmental differences between individual ports, there are some differences in the parameters selected for analysis at each port. For example, as part of the spring program, it was decided to analyze the samples from a station adjacent to phosphate loading docks in Tampa Bay for radium. Samples collected in Tampa Bay were also analyzed for fluoride.

To reasonably "characterize" sediment and water quality conditions in the navigation systems during the spring, three types of sample stations were established:

1. Intensive Stations

   These stations were located at anticipated "worst case" locations. Samples from intensive stations were analyzed for virtually all of the parameters listed for Class III Waters in Chapter 17-3, FAC. The results of these analyses aided in identifying potential problem conditions which may be anticipated elsewhere in the port.

2. Baseline Stations

   Samples collected from baseline stations were analyzed for those parameters which were determined to be of greatest importance in influencing permitting decisions at each of the ports.

3. Calibration Stations

   Water samples only (analyzed for parameters identical to those for Intensive stations) were collected at Calibration stations. These stations were located in high salinity (i.e., greater than 32 ppt) waters offshore of the channel entrance of each port. Information collected from these stations were used to check sampling technique and sample handling procedures as well as assist in the interpretation of data collected from the other stations.

Water and sediment samples were collected in triplicate during the spring in order to establish a reproducible methodology and provide defendable results. The alternative, to increase the sampling density by varying the sampling points in either time or space, would not provide the needed reliability of results.

5.2.1 Spring Sample Station Locations

The spring/dry season sample station locations for the Ports of Jacksonville, Tampa, Manatee and Pensacola are discussed for each port below and also in Section 2. Sampling locations were dependent on local bathymetry, observed point and non-point discharges, local traffic conditions, and, observed salinity for "Calibration" stations.

The spring/dry season station locations were chosen using the following criteria:

1. Existence of historical water quality, sediment quality, or biological data in the vicinity of the sample station.
2. Anticipated "worst-case" water quality and sediment conditions.
3. Previous and/or existing disposal site locations.
4. Offshore stations to aid in data interpretation.

Port of Pensacola

Figure 2-3 presents the spring/dry season sample station locations for the Port of Pensacola. These locations were sampled to provide information on conditions in the vicinity of the berths (PNS-1A), conditions in the main entrance channel (PNS-2B) and offshore conditions (PNS-3C) for calibration.

Port Tampa

Figure 2-13 presents spring/dry season sample station locations for Port Tampa. The six stations shown were sampled to provide information on conditions within the Port of Tampa at East Bay (TPA-6B) and in the Garrison Turning Basin (TPA-1A), conditions adjacent to two spoil disposal areas (TPA-5B and TPA-2A), conditions in the Big Bend Channel (TPA-3B), and conditions in the Alafia Turning Basin (TPA-4B). A calibration station (TPA-7C) was located approximately five miles offshore of Mullet Key.

Port Manatee

Also shown on Figure 2-13 are the locations of stations sampled in Port Manatee during the spring/dry season field program. Two stations were sampled to provide information on conditions in the vicinity of the berths (MAN-1A), as well as conditions between the main entrance channel and the spoil disposal area (MAN-2B). The offshore station for Port Tampa (TPA-7C) provided calibration for the Port Manatee samples.

Port of Jacksonville

Figures 2-35 and 2-36 present the location of spring/dry season sample stations in the Port of Jacksonville. An upstream station (JAX-1B) was located near Godby's Lake to provide low salinity control. Another station (JAX-9C) was located offshore to provide a high salinity endpoint. Because high levels of contamination were expected, additional stations were located and sampled near Jacksonville Shipyards (JAX-2B), Talleyrand Docks and Terminals (JAX-3A), Blount Island Terminals (JAX-6A), near the confluence of the Trout River with the St. Johns River (JAX-5B) and near the confluence of Long Branch Creek with the St. Johns River (JAX-4B). The two remaining stations were located near previously used or existing dredge spoil disposal sites on the St. Johns River near Bucks Island (JAX-8B), and near Quarantine Island (JAX-7A).

5.3. FALL/WET SEASON FIELD PROGRAM

The initial task in developing the fall/wet season field program was to assess and interpret the results of the analyses of samples collected from each port during the spring/dry season field program. These results and interpretations are discussed in detail in the draft IID (e) report of October 25, 1982 entitled, "Deepwater Ports Maintenance Dredging Study, Spring/Dry Season Field Program: Results, Interpretations and Recommendations, Ports of Jacksonville, Tampa, Manatee and Pensacola".

Results of the analyses of the spring samples suggested that, with some exceptions, additional intensive water sampling would not be cost effective. Although detailed analyses on water samples collected during the fall program would provide for a better understanding of ambient water quality conditions, little additional information would be provided to evaluate potential water quality problems that may accompany maintenance dredging operations. Nevertheless it was decided that additional analyses of water samples would be useful to:

1. check procedures and provide additional reliable data
2. provide data on concentrations of organic compounds during fall run off conditions
3. provide information on water quality to be used in conjunction with elutriate tests.

At the onset of planning the spring/dry season sample analyses, it was recommended that elutriate tests be conducted and form a major part of the fall/wet season sampling program. The results of the spring program indicated that contaminated sediments appear to be localized. Consequently, the elutriate tests were confined to sediments collected from these contaminated areas and available funds used to gain more information on the distribution of contaminated sediments. On this premise, the fall/wet season sampling program was developed.

Parameters selected for analysis during the fall/wet season field program (Table 1-3) were determined after a port specific assessment of the results of the spring program. These results (discussed in detail in Section 2) are briefly described on a port by port basis below:

Port of Pensacola

The spring results of anayses of water samples collected from the berthing areas (PNS-1A) in the Port of Pensacola indicated elevated levels of mercury and zinc. Water samples collected from this area were the only samples to contain phenols (pentachlorophenol) at concentrations above the analytical detection limits during the spring.

The results of analyses of sediments collected from the berthing area in the Port of Pensacola indicate that of all the ports studied, sediments from this area had the highest oil and grease concentrations. When compared to the metal to aluminum ratios for average crustal material, the spring results indicated elevated mercury levels in sediments collected from Station PNS-2B (Bay Channel) and elevated silver, zinc, mercury, lead and cadmium levels in sediments collected from the berthing areas (PNS-1A).

The only organic compounds detected in sediments from the Port of Pensacola were chlordane and dichlorophenol, both detected in samples collected from Station PNS-1A.

These results (presented in Table 5-1) are based solely on the results of collected spring samples and consider localized conditions. Table 5-1 also identifies dissolved oxygen and nutrients as continual problems for the Port of Pensacola in relation to maintenance dredging. Oxygen depletion and nutrient release are potential problems resulting from dredging in subtropical estuaries. The relatively high organic matter and nutrient concentrations of bottom sediments collected during the spring from the Port of Pensacola appear a likely source of potential water quality problems.

Port of Tampa

Water samples collected in the Port of Tampa during the spring, indicate that at Station TPA-1A (located in Ybor Channel) only mercury and pentachlorophenol were at concentrations equal to at the analytical detection limit. State water quality standards were not exceeded for organics or metals in the remaining samples collected in Port of Tampa.

Sediment samples collected in Port of Tampa during the spring indicated high metal concentrations in samples collected from stations in close proximity to port facilities (i.e. Stations TPA-1A (Garrison Channel), TPA-3B (Big Bend Channel), TPA-4B (Alafia River Channel) and TPA-6B (East Bay)). When compared to natural levels (using the metal to aluminum ratios for carbonate rock), the metals enriched in the Port of Tampa sediments are cadmium, lead, mercury, silver, zinc, copper and nickel. Of the organic compounds analyzed, chlordane, 2-chlorophenol and pentachlorophenol were detected in sediments collected from Station TPA-1A (Ybor Channel). One of the three replicate samples collected at Station TPA-4B (Alafia River Channel) had detectable DDE, and one sample from Station TPA-6B (East Bay) had detectable amounts of chlordane.

These results of the spring program for the Port of Tampa are presented in Table 5-1. Dissolved oxygen and nutrients appear to be a chronic water quality problem and represent a likely source of potential water quality problems during maintenance dredging in the Port of Tampa.

Port Manatee

Water samples collected from Port Manatee during the spring sampling program indicated metal concentrations at near natural levels. State water quality standards were not exceeded in water samples from either station in Port Manatee during the spring program. All pesticides and phenols analyzed during the spring were below detection in all water samples.

Although none of the sediment samples collected in Port Manatee during the spring contained any of the organics at detectable levels, the comparison of the metal to aluminum ratios of Port Manatee sediments to that of average crustal material or carbonate rocks indicates that cadmium, mercury and silver are enriched. These results along with the potential problems associated with dissolved oxygen and nutrients are presented in Table 5-1.

Port of Jacksonville

Water samples collected in the Port of Jacksonville during the spring indicated that of all the metals analyzed, only mercury was above the State standard and only at Stations JAX-1B and JAX-2A (Godby's Lake and Jacksonville Shipyards, respectively). None of the water samples collected from any station contained pesticides or phenolic compounds at detectable levels.

With respect to the metal to aluminum ratios of average crustal material, the results of the analysis of spring sediment samples from the Port of Jacksonville indicated elevated concentrations of cadmium, copper, lead, silver, mercury and zinc. These results along with the potential problems associated with dissolved oxygen and nutrients during maintenance dredging are identified in Table 5-1.

Table 5-1 identifies on a port by port basis, those parameters which, based on the spring results, represent potential water quality problems during maintenance dredging and also identifies the parameters selected for analysis during the fall/wet season field program. These parameters were determined to be of greatest importance in influencing permitting decisions. Limiting the analyses to those parameters associated with potential water quality problems during maintenance dredging, and those necessary for data interpretation (e.g. aluminum, grain size, "in-situ" salinity etc.) provided the opportunity to establish additional stations to satisfy the objectives of the fall field program (i.e., elutriate testing, determining the extent of contaminated sediments, providing additional reliable data where necessary and determining organic concentrations during wet season conditions). However, even for the selected list of parameters (Table 1-3), the high cost of laboratory analysis precluded sampling with sufficient density to determine ambient conditions during the fall in each port.

Fall water and sediment samples were collected in triplicate in order to establish reproducible methodology and provide defendable results.

5.3.1 Fall Sample Station Locations

The fall/wet season sample station locations for the Ports of Jacksonville, Tampa, Manatee and Pensacola are discussed for each port below and in Section 2. Fall sampling locations were dependent on local bathymetry, observed point and non-point discharges, local traffic conditions and, spring sample station locations.

Sampling locations for the fall/wet season were selected using the following criteria:

1. Sampling "worst case" sediments for elutriate tests.
2. Determining the spatial distribution of contaminated sediments identified by the spring/dry field program results.
3. providing information on water quality used in conjunction with the elutriate test.
4. providing additional reliable data where necessary and identifying potential problem areas in terms of concentrations of organic compounds during wet season conditions.

Port of Pensacola

Figure 2-6 presents the location of the fall/wet season sampling stations for the Port of Pensacola. Station PNS 1A-WOE was located near the berthing areas in Inner Harbor Channel. Sediments collected from this station were used for elutriate testing. Water samples collected from this station were analyzed for metals (Hg, Ag and Zn) and organics (pesticides and phenols).

Spring Station PNS-2B, located in Bay Channel, was re-established as Station PNS 2B-W(O) for fall sampling. Water samples collected during the fall at this location were analyzed for metals (Ag, Hg, and Zn).

Because elevated mercury levels were observed in Bay Channel sediments during the spring, three additional fall stations were sampled to determine the spatial extent of contaminated sediments observed in the spring and provide reliable information on the water quality between previously sampled spring stations. These stations were located in Bay Channel at Santa Rosa Island (PNS 6-SF), the Naval turning basin (PNS 5-SF) and near the port approach channels (PNS 4-SF) as shown on Figure 2-6.

Elutriate test water was collected from Station PNS-7X located in Bay Channel midway between the port approach channels and the Naval turning basin. Samples collected from this station also provided water quality information between two locations sampled during the spring program.

Port of Tampa

Figure 2-20 presents the locations of the fall/wet season sampling stations for the Port of Tampa. The spring results for sediments collected from stations in close proximity to port facilities indicated that cadmium, lead, mercury, silver, zinc and nickel were above natural levels (see Sections 2 thru 4). Phenols were also detected in sediment replicates collected from stations located in Garrison Channel, East Bay and the Alafia River Channel during the spring. As a result, stations were re-established in Garrison Channel (TPA 1A-WET(O)) and East Bay (TPA 6B-WOET). Sediments collected from both stations were used for elutriate testing. Water samples collected from these stations and stations in the Alafia River Channel (TPA 4B-WT(O)) and Big Bend Channel (TPA 3B-WT(O)) were analyzed for metals (Ag, Hg and Zn), and fluorides. In addition, water samples collected in East Bay were analyzed for phenols and pesticides (see Table 1-3).

Sediments collected from Stations TPA 12-SFT and TPA 8-SFT (located at Hooker Point and Port Sutton Channel, respectively) were sampled to determine the spatial extent of contaminated sediments identified by the spring results. Water samples collected from these stations were analyzed for metals (Ag, Cd, Hg, Pb and Cu) and fluoride to provide additional water quality data at locations not sampled during the spring.

Samples were collected from stations in Hillsborough Channel (TPA 11-SFT, and TPA 9-SFT) and Big Bend Channel (TPA 10-SFT), to provide additional water and sediment quality information. Water samples collected during the fall from stations located adjacent to spoil disposal areas (TPA 2A-WT(O)) and TPA 5B-WT(O)) were analyzed for fluorides and metals (Ag, Hg and Zn).

Elutriate test water was collected as Station TPA 13-XT located in Hillsborough Channel South of Gadsden Point.

Port Manatee

Figure 2-20 (insert B) presents the fall/wet season sample locations for Port Manatee. Sediment samples collected in the port berthing area (MAN 1A-WET(O)) were used for elutriate testing. Water samples collected from this station were analyzed for fluorides and metals (Ag, Hg and Zn).

During the spring, elevated metal concentrations were observed at Station MAN 2B located adjacent to a spoil disposal area; During the fall water samples collected from this area (Station MAN 2B-WOT) were analyzed for metals (Ag, Hg and Zn) and fluorides. Additionally, these samples were analyzed for organics (pesticides and phenols in Table 1-3) to provide information on concentrations of these parameters during wet season conditions.

Station MAN 3-SFT was located in Port Manatee Channel adjacent to Tampa Bay Channel (Cut B). This station was sampled to determine the spatial extent of contaminated sediments observed in the spring and also provide additional water quality information at locations not sampled in Port Manatee Channel during the spring.

Water collected from Tampa Station TPA 12-XT was used for elutriate testing of Port Manatee sediments.

Port of Jacksonville

The fall/wet season sample station locations for the Port of Jacksonville are presented in Figure 2-45. Sediment samples collected during the fall in the Terminal Channel at Station JAX 15-WEJ and in the vicinity of an outfall which discharges into the Terminal Channel (JAX 3A-FWE(O)) were subjected to elutriate testing. Water samples collected at these stations during the fall were analyzed for metals (Ag, Cd, Hg, Pb, Zn and Cu as shown in table 1-3).

Sediment samples were collected from five stations along the St. Johns River at Commodore Point (JAX 10-SFJ), near the Sea Land Terminal in the Terminal Channel (JAX 17-S) at Blount Island (JAX 13-SFJ) and in Blount Island Channel (JAX 12-SFJ). These samples provided information on the extent of contaminated sediment observed during the spring. Water samples collected at the fall locations were analyzed for metals (Ag, Hg, Cd, Pb, and Cu) and provided additional water quality information for areas not sampled during the spring.

Water samples were collected in the St. Johns River at Long Branch Cut (JAX 4B-WJT(O)), Trout River (JAX 5B-WJ(O)), near Dunn Creek and Quarantine Island (JAX 11-FJ and JAX 6A-WJ(O)), at Dames Point (JAX 7A-WOJ) and near Bucks Island (JAX 8B-WJ(O)). These samples were analyzed for metals (Ag, Hg, Zn, Cd, Pb and fluorides at long Branch Cut) to provide additional water quality information during wet season conditions. Water samples collected from the St. Johns River at Dame Point (JAX 7A-WOJ) were subjected to analyses for pesticides and phenols (Table 1-3) to provide information on organic concentrations during wet season conditions.

Elutriate test water was collected from Station JAX 14-X located in the St. Johns River at Drummond Creek.

5.4 FIELD PROGRAM SCHEDULING

The spring sampling program was begun in the Port of Pensacola on April 26, 1982, continuing through sampling in the Port of Jacksonville on April 29, 1982, Port Manatee on May 10, 1982 and was completed on May 14, 1982 at the Port of Tampa. This time period was selected to coincide with the historical "dry" season determined for each of the four ports (see Figure 2-4).

The fall sampling program began in the Port of Tampa on September 10, 1982 continuing through sampling in Port Manatee on September 11, 1982 with completion of sampling in Tampa Bay (Port Tampa) on September 17, 1982. Fall sampling was completed in the Port of Pensacola from September 21 through September 23, 1982. Sampling was initiated in Jacksonville Harbor on September 25, 1982 and completed in October 2, 1982. As shown on Figure 2-4, the fall sampling program was scheduled to coincide with the historical "wet" season observed at each of the four ports.

Histograms of the observed and historical mean precipitation and mean net water availability to stream flow are discussed and presented for each port in Section 2 (see Sigures 2-3 and 2-4). The historical mean precipitation histograms were derived from the monthly normal precipitation data published by the U.S. Department of Commerce for the Jacksonville, Tampa, St. Petersburg and Pensacola areas (1941 - 1970).

The historical net water availability for stream flow was derived from the historical precipitation data and historical pan evaporation data (1973-1977) for areas near Pensacola (Milton Experiment Station), Jacksonville (Lake City Experiment Station) and Tampa (Lake Alfred Experiment Station). The historical mean pan evaporation was converted to lake evaporation and subtracted from the historical mean precipitation to determine the net water availability to stream flow, which considers rainfall as the system input with outflow controlled by evaporation, discharge into streamflow and percolation into deep aquifers. For the data presented in these histograms, percolation into deep aquifers has been considered constant.

Any variation in this flow would effect the quantity of available water but would not effect the distribution as presented by the histograms.

Stream discharge data was not used to determine the wet and dry seasons in the various ports because of the complicating effects of tidal influence and upstream control structures.

5.5 PARAMETER SECTION

As discussed in the introduction, it was determined that, with the given resources, it would not be possible to conduct laboratory analysis for all of the parameters listed for Class III Waters in Chapter 17-3, FAC (Table 1-1). For this reason, it was decided to limit the analysis of water and sediment samples to those parameters determined as most environmentally hazardous in ports and for which the current state of the art in commercial laboratory analysis would provide accurate results.

The parameters selected for analysis during the field program are presented in Tables 1-2 and 1-3. A detailed explanation of the rationale used in the selection of each parameter is presented below:

Aluminum content, grain size, specific gravity and Atterberg Limits

Grain size, aluminum concentration and specific gravity analyses were performed on each replicate sediment sample. Results from these tests are used to interpret data on the absolute concentration of sediment contaminants.

Generally, an inverse relationship between grain size and heavy metal concentration is observed for estuarine and aquatic sediments. Essentially metals tend to be more concentrated in fine rather than in coarse grained sediments. By correlating grain size and metal concentration it becomes possible to determine if the sediment is enriched in a particular metal. This is a useful tool for identifying a potential contaminated sediment, but it fails to account for the intrinsic heterogeneity of estuarine sediments (i.e., grain size) and provides little information on the source (i.e., natural vs. anthropogenic) of the observed metal concentrations. Once a contaminated sediment is identified, metal concentrations are normalized to aluminum. This not only factors out heterogeneities in grain size but also allows for evaluation of whether an observed metal concentration is at a natural level (referenced to crustal or carbonate rock ratios) or elevated (enriched) due to anthropogenic inputs.

Specific gravity measurements and Atterberg limit test results are employed primarily to determine the suitability of a particular sediment as construction material around disposal sites.

Ammonia, TKN, and Nitrate

Nitrogen compounds such as ammonia, nitrite, nitrate, and organic nitrogen (TKN) limit productivity of phytoplankton in southeastern estuaries. Nitrates typically comprise the highest concentrations of nitrogen compounds in estuarine waters while ammoniacal nitrogen is considerably less abundant. However, sediment-bound ammonia is potentially the most critical problem during dredging operations since ammonia can stimulate planktonic growth (or epiphytic algae) and yet, be toxic to estuarine organisms. (Estuarine phytoplankton begin to "bloom" as ammonium concentrations approach 0.1 mg/l, while EPA and DER have established an unionized ammonia concentration of 0.02 mg/l as being toxic).

Total Phosphorus, Phosphate, and TOC

Phosphorus, phosphate, and total organic carbon (TOC), like nitrogenous compounds, are essential nutrients. Although these nutrients are released during dredging, no adverse impacts to exposed estuarine biota are anticipated since nitrogen is generally the limiting nutrient to algal growth in most southeastern estuaries. Consequently, they are less critical than nitrogen release during dredging operations.

Metals: Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Silver and Zinc.

Heavy metals enter the estuarine environment from both natural weathering processes and anthropogenic sources. As fresh and brackish waters meet at the head of an estuary, various physico-chemical processes cause riverborne particulate matter to flocculate out of suspension. Thus, estuarine sediments act as a sink for heavy metals and other contaminants, reflecting the chemical composition of the drainage basin which they border.

A commonly expressed concern with sediment bound metals is not necessarily acute toxicity to estuarine biota, but chronic effects that can occur if metals become incorporated into the estuarine food web via bioconcentration and bioaccumulation processes.

Toxic Organics: Pesticides (Aldrin, Toxaphene, DDT, Chlordane, and Mirex)

Each of the pesticides examined in this study is an organochlorine compound that is somewhat refractory in the estuarine environment (the pesticides above are listed in order of decreasing toxicity to humans). Thus, if pesticide contamination is a problem at any of the ports samples, the presence of these organic compounds would indicate the extent of the problem.

Chlorinated hydrocarbons have low solubilities in natural waters, and therefore will generally accumulate in sediments after they are introduced into estuarine waters. Spring water samples showed extremely low concentration of pesticides, confirming the belief that sediments probably act as a sink for these compounds.

Biochemical Oxygen Demand

Biochemical Oxygen Demand (BOD) measures the concentration of oxidizable organic matter and the oxygen demand of that organic material (OM) in water and sediment samples. However, because complete oxidation of organic matter does not occur, BOD estimates only the total OM in the sample, and Total Organic Carbon (TOC) provides a more accurate approximation of organic matter concentration. Thus, BOD predicts the amount of oxygen in mg/l required to oxidize the organic matter present in a particular sample.

Toxic Organics: PCBs and Phenols

Polychlorinated biphenyls (PCB) and phenols comprise a group of toxic synethic organic compound that have been chronically discharged into the aquatic environment.

Like chlorinated pesticides, PCBs are highly resistant to microbial degradation and can be assimilated into aquatic food webs. PCBs have low solubilities and tend to accumulate in estuarine sediments. Phenolic compounds are more labile and are therefore more acutely toxic than chlorinated hydrocarbons.

Total Suspended Solids (Measured as Total Filterable Residue)

TSS measures the total concentration of particulate matter in the water column; expressed as mg/l. Although numerous studies have attempted to make TSS and turbidity synonymous, they are not.

Suspended solids are always a problem associated with dredging and disposal operations since they reduce sunlight penetration reaching photosynthetic organisms through the water column. These particulates have been shown to adsorb metals and other potential contaminants.

Radium 226

Radium 226 was examined only at sediments from Station TPA-4 where radium has been associated with phosphate processing activities. Radium 226, a member of the Uranium 238 series, is one of the easiest isotopes to analyze. It occurs naturally in phosphate rich terrain.

Fluoride

Fluoride is a potential contaminant at those ports handling large quantities of phosphate materials. Therefore, Fluoride analyses were performed only at Tampa, Manatee and Station JAX 4 at Jacksonville.

Iron

Iron is seldom a contaminant in the estuarine environment, but it can be an efficient scavenger (especially ferrous iron, FE II) of heavy metals in the water column. Thus, the presence of ferrous iron in dredged sediments may scavenge and bind toxic metals during dredging/disposal operations and minimize the potential impacts associated with heavy metals.

Oil and Grease

Because of their insolubility, higher molecular weight hydrocarbons are generally encountered in sediments rather than the water column of an estuary.

5.5.1 Parameters Excluded From Analysis

It was decided that the Class III water quality parameters listed below could be excluded without greatly impacting the results of the program, certainly not in a way commensurate with the additional costs.

Generally, because the rational for exclusion is often similar for several parameters, the following paragraphs discuss parameter exclusion by groups:

Chlorides, Bromates, Bromine, Chlorine and Fluorine

The halogens are abundant in estuarine waters and it is not likely that any are released in amounts that greatly affect total concentrations. These substances are extremely soluble and are therefore not likely to be associated with sediments in a way so as to be released during dredging operations.

Chromium (VI) and Beryllium

There is no indication that concentrations of these metals should be expected to be high in any of the ports (i.e. there are no specific sources of these metals in the ports). If levels are high, they are likely the result of non specific, multicomponent inputs and would be reflected in the concentrations of the other metals that are included in the study. In addition, analysis of beryllium in estuarine waters is difficult and not likely to be accomplished in most commercial laboratories with any degree of accuracy. Total chromium analysis should indicate any potential problems related to Cr (VI).

Oil and Grease (Water Column), Detergents

These substances are surface active and are therefore not uniformly distributed in the water column. Thus, it is almost impossible to obtain a representative sample. Their concentrations are also quite variable in ports since rates of inputs vary considerably in relation to port activity. They are also biodegradable. The sampling program adopted for this study would provide little useful information on these substances.

Radium 228 and Gross Alpha Particle Activity

There are no identifiable sources of radioactive material in any of the ports with the possible exception of Tampa. Because of the expense of these analyses it was felt unwarranted to include these parameters for all stations in all ports.

Alkalinity

The alkalinity of estuarine waters is naturally high. Substantial alkalinity variations due to other than natural processes is unlikely.

Bacteriological Quality and Biological Integrity

These are rather general water quality criteria that cover a broad range of parameters. Any meaningful investigation of these parameters would be prohibitively expensive for this study.

Cyanide

No known problem concerning cyanides exists in any of the harbors. No potential problems are anticipated regarding this substance and therefore inclusion was not considered to be cost effective.

Pesticides and Herbicides

The expense of determining all of the pesticides listed in Table 1-1 would be excessive and certainly not cost effective. The pesticides chosen for inclusion in the study are generally more persistent than those excluded. For example malathion degrades rapidly in aqueous media with a half life measured in hours to days, whereas DDT, Mirex and toxaphene and their residues may persist for months or more.

Selenium

There are no indications of problems related to this metal. Its analysis in natural waters is difficult and certainly not "state-of-the-art" for commercial laboratories. The environmental chemistry of selenium is similar to that of antimony and arsenic which are included in the study. If the concentrations of these parameters were excessive in any of the ports, additional analyses for selenium would have been warranted.

Transparency

This parameter varies considerably in time and space - due to physical, chemical and biological processes. Inclusion of this parameter in the study would provide little useful additional information regarding potential environmental problems related to port maintenance.

Phthalate Esters

Analyses of these substances is not "state-of-the-art" for commercial laboratories and are expensive if done correctly. There was no evidence to suggest that they were an important problem in any of the ports.

5.6 FIELD SAMPLING PROCEDURES

Sampling procedures and methodology are outlined below for use as a general guide for properly collecting in-situ data and collecting and handling water and sediment samples. These procedures were utilized in field work related to this study.

5.6.1 Occupying The Station

Several factors must be considered when occupying a station. These factors and the methods used to occupy a station are as follows:

1. The proposed station locations should be plotted on nautical charts before leaving berth. When approaching the station it is

important to make note of several observations which include the following:

a. the location of channel markers
b. direction and velocity of current
c. frequency of ship traffic
d. point pollution sources
e. channel width

2. To locate the proposed sampling station relative to the dredged channel, the boat is positioned so that a transect can be run perpendicular to the channel and plotted using the recording fathometer. The station number, date, compass heading, engine rpm and start and end points of each transect are recorded directly on the fathometer record (Figure 5-1). After plotting the channel boundaries, a marker buoy is deployed at the desired station location and another transect is completed across (perpendicular to) the channel, marking the sampling buoy location on the fathometer records. The locations of sampling stations positioned in channels will be determined primarily by ship traffic.

3. Depending on current velocity and direction, the bow anchor is dropped so that when anchor is set, the boat will be near the station marker buoy and within the dredged channel. Wind direction and velocity will determine if a stern anchor is necessary to maintain the position within the channel.

4. Using magnetic bearings of local land marks (radio towers, water tanks, and so forth), locate and mark the station on the appropriate nautical chart.

5. Verify water depth using both the recording fathometer and lead line.

6. Record time, date, depth of water, meteorological conditions, water conditions and general observations (distance from outfalls, point pollution sources, and so forth) on the appropriate data sheets (Figure 5-2).

5.6.2 Water Column Sampling

Water samples can be collected with either discrete samplers (e.g., Kemmerer bottle) or a pump (e.g., peristaltic or magnetic), providing the equipment and accessories are constructed of a non-contaminating material (e.g., Teflon or silicon). Discrete samples however, can be easily contaminated when the open bottle passes through surface water which contains metals and low molecular weight organic compounds. In some cases, contamination may be minimized by avoiding visible surface slicks or by selecting a sampler with a large surface to volume ratio (EPA-COE, 1981).

Sampler contamination problems can be overcome by using a pumping device for water collection. The important factor in minimizing contamination during sampling using a pump system is to flush the system thoroughly prior to sample collection. For this project, a peristaltic pump was used for water column sample collection.

Peristaltic Pumping System

Preparation for mid-depth water sampling using the peristaltic pump is as follows:

1. Swing the davit to the outboard position and secure.
2. Locate the peristaltic pump near the davit and connect the electrical leads to a 12V power source (automobile or marine battery).
3. Attach a plastic coated 10 kilogram weight to a 3/8-inch polypropylene line and secure the line in the snatch block on the davit. Secure the free end of the line and hang the weighted end overboard and lower into the water. The line should be calibrated to insure accuracy in sampling depth.
4. Insert the pump head in the peristaltic pump housing.
5. Remove the pump head cover using a screw driver and lay (wrap) the silicon tubing around the pump head rollers so that two feet of tubing (the effluent end) extend from the pump head. Replace the cover. (The pump head should be lubricated on a regular basis by removing the pump head cover and spraying the rollers using a spray silicon lubricant. When the pump head is lubricated, the silicon tubing should be shifted so that a different area of tubing is over the rollers.)
6. Insert the effluent end of the silicon tube into a four-inch cube of wood with a one-half inch hole drilled through for the line and another one-half inch hole drilled perpendicular to and slightly offset from the line hole. This block should be placed on the line approximately one foot above the plastic covered weight. Secure the tube using tie wraps. The intake end should extend two to three inches from the wooden block.
7. Lower the plastic coated weight to mid-water depth. If the current is greater than 1½ knots, the silicon tubing must be

secured with duct tape to the polypropylene line at three to five foot intervals. If a strong current is encountered, deflection of the weighted line scope must be considered in order to assure mid-water sampling.

8. Start the pump by pushing the switch to the forward position. If the pump is functioning properly it should prime and begin pumping water in about thirty seconds. Flush the pumping system for a minimum of two minutes before taking the first sample. Be sure to keep fingers and objects away from the effluent tube opening.
9. Flush sample container twice.
10. Collect sample.
11. When sampling is completed, shut the pump off and allow excess water to drain from the system. Secure a whirl pac over the effluent tube, being careful not to touch the end of the tube.
12. Retrieve the weighted line so that the weight is hanging just below the water's surface and cleat the line.
13. Secure a whirl pac over the influent end of the silicon tube after all residual water has drained from the tube.
14. Swing the plastic coated weight into the boat and release the line from the cleat. The line can then be removed from the snatch block on the davit.
15. Secure the pump (pump head attached) and tubing.
16. Release davit lock, swing inboard and secure.

Salinity/pH Measurement

Salinity is measured using a temperature compensated refractometer and pH is measured using a temperature compensated pH meter. Both the refractometer and the pH meter must be calibrated before use. The refractometer is calibrated by pouring distilled water onto the reading plate. The instrument should show zero salinity on the indicator scale. If the value is not zero the instrument should be adjusted. The pH meter is calibrated using buffer solutions of known pH. The temperature of the buffer solution should be measured using a standard thermometer and recorded. Both salinity and pH are measured before and after water column sampling. Sample is collected for measurement in a rinsed cup, after completing steps 1 through 9 listed above.

Metals

Flush six half-liter polyethylene bottles twice and then fill each bottle with water from the pump effluent. It is important to keep fingers and objects away from the end of the pump effluent tube and away from the mouth of the bottle. The effluent tube should not be allowed to touch or fall inside of the sample bottle. Should a sample bottle become contaminated, wash the bottle using a solution of 5 ml nitric acid (HNO_3) and 10 ml of deionized water. Flush the bottle several times and then collect another sample. Once a sample is collected, add 0.5 ml of Utrex ultrapure nitric acid to each sample bottle. If an automatic pipet is used, caution should be taken to avoid drawing acid into the pipet housing as sample contamination will result. Clearly mark each sample bottle with a permanent marker. Samples do not need to be stored on ice.

Sample contamination is probably the greatest problem associated with collecting metal samples. Contamination can occur at the time samples are collected if metal devices are used during handling and containment. In addition, glass containers adsorb metals which can then be released to the original uncontaminated sample. Cadmium adsorbs to glass at concentrations that are elecated ten times higher than non-glass containers. Therefore, in view of these considerations, most metal samples should be placed in plastic containers. Unfortunately, atmospheric mercury readily diffuses through plastic, and mercury samples must be placed in glass bottles.

BOD/TSS

Flush three two-liter polyethylene bottles twice and then fill each bottle with water from the pump effluent. Clearly mark each bottle using a permanent marker and store on ice.

Ammonia (NH_4)

Flush three 250 ml polyethylene bottles twice and then fill with water from the pump effluent. After sample collection, fix each sample using 0.5 ml concentrated sulfuric acid (H_2SO_4). Caution should be exercised when using the automatic pipet to avoid sample contamination. Clearly mark each bottle with a permanent marker and store on ice.

Precautions should be taken in handling, shipping and storage of nitrogen compounds due to their instability. Ammonia is easily volatilized and thus, ammonia concentrations can inadvertantly be reduced after being collected. (Nitrates are unstable in the presence of oxygen and readily volatilize.)

Fluorides, BOD and TSS

Fluoride samples are collected in two-liter polyethylene bottles along with BOD and TSS during the spring sampling program. During the fall sampling period, smaller containers (three four ounce polyethylene bottles) were used for fluoride samples only. Sample collection for fluorides should follow the same methodology as previously mentioned for the spring program. Samples for fluoride do not require acid fixation or iced storage (BOD and TSS are stored on ice).

After sample collection for these parameters, secure the peristaltic pump as previously discussed.

Pesticides

Particular caution must be exercised during the collection of organic samples (pesticides and phenols) since there are a number of contaminant sources on the boat. To collect sample for organic analysis, affix a one-liter glass jar to the all metal hand-held water and sewer sampling device. Thrust the device into the water so that the sample container is five to six feet beneath the surface. Open the container and when approximately one-half full, retrieve the jar, agitate and empty. Again, thrust five to six feet below water surface, allow the sample jar to fill and retrieve. Repeat the sequence so that three samples are collected. Examine each bottle cap to insure an aluminum foil or teflon liner is present. If no foil is present, place a piece of aluminum foil over the mouth of the jar and then secure the lid. In order to avoid contamination of the sample, insure that the foil has not been touched and has not been in contact with any object where the foil contacts the water sample. Clearly label each bottle by placing a piece of duct tape on the outside of each jar and marking with a permanent marker or wax pencil. Store each bottle on ice.

Phenols

Affix a one-liter glass jar to the all metal hand-held sampling device. Thrust the device to a depth of five to six feet and allow the jar to partially fill. Retrieve, agitate and empty the jar. Again, thrust the device to a depth of five to six feet and allow the jar to fill with sample. Repeat the sequence so that three sample jars are filled. Add 1 ml of concentrated sulfuric acid (H_2SO_4) to each bottle, using a glass pipet to measure the acid. Be sure each jar cap has an aluminum foil or teflon liner. If the foil liner is missing place aluminum foil over the jar top and then secure the cap. Be sure not to touch the foil where it is in contact with the sample water or sample contamination may result. Clearly mark each jar and place on ice.

5.6.3 Sediment Sampling

Estuarine sediments act as a sink for most upland-derived pollutants. Thus, it is the sediments, rather than the overlying water column, that generally reflect the distribution of contaminants within a particular estuary. By performing chemical analyses on bulk sediment, information is generated on the total concentration of the chemical constituents in a sediment sample. Bulk analysis alone however, cannot predict potential water quality impacts that may result from a dredging event, but they are used as an aid for making an inventory of the pollution climate at each port.

One of the biggest potential problems with collecting sediment samples for chemical analysis is sample contamination. The most likely source of contamination comes from allowing the sediment sample to come into contact with collecting equipment (e.g., ponar, plastic or metallic utensils), the boat chassis, or by inadvertently touching a sample. Additionally, handling and storage techniques can also have an effect on the final laboratory results.

Sampling techniques used to collect sediment samples during the field program are as follows:

Deploy Bottom Sampler

Attach one-half inch non-stretch (Dacron) line to the ponar dredge. Place the line through the snatch block on the davit. Secure the line to a nearby cleat. With assistance, carefully cock the ponar and lift it overboard. Lock the davit in the outboard position. Remove the line from the cleat and begin lowering the ponar to the bottom. Once on the bottom, tie a knot in the line to assist in judging ponar contact with the bottom during succeeding bottom grabs at the station being sampled, then trip the release mechanism to collect the sample.

Sample Collection

Retrieve the ponar. When the dredge is well above the gunnel of the boat, unlock the davit and carefully swing the ponar inboard. Care should be taken to keep hands and feet safely situated so that if the ponar accidentally falls no injuries will result. Once inboard, lower the ponar into a rectangular plastic pan. The pan should have low sides and should be larger than the ponar so that the device can be easily opened. The ponar must remain low in the pan so that when the jaws of the dredge are opened the sample will slip out of the dredge and into the pan without mixing.

TS, TOC, Metals, Grain Size, Specific Gravity, BOD, Ra

Using non-metallic utensils, remove the oxidized layer from one-half of the surface of the sample in the plastic pan. (The oxidized layer may only be about one-sixteenth inch thick.) Fill a one quart plastic jar with sediment from the pan. To avoid collecting sediments that were in contact with any part of the ponar dredge, care should be taken not to scrape the pan. Clearly mark each sample bottle with a permanent marker and store the samples on ice.

PCB, Pesticides, Oil and Grease, Phenols

Using metallic utensils, remove the oxidized layer from the remaining half of the sample remaining in the plastic pan. Fill a one quart glass jar with sediment from the pan. Care should be taken not to scrape the pan to avoid collecting sediments that were in contact with the ponar dredge. Attach duct tape to the outside of the jar and clearly mark each sample bottle using a permanent marker. Store the sample bottle on ice.

Replication

Repeat the procedures outlined in Sections 5.6.2 and 5.6.3 twice more to obtain triplicate samples.

Sedimentation Rates and Atterberg Limits

A Lexan coring device is used to collect samples for Atterberg Limit tests and sedimentation tests. This corer cannot be used when the bottom sediment is firm sand or sand with rock fragments. Prepare the device for sampling as follows: secure the Lexan corer to the line. Place the line through the snatch block of the davit and cleat the free end. Swing the davit to the outboard position and secure. With assistance from crew members lift the Lexan corer overboard. Set the trigger device and grasp the tripping messenger. Slowly lower the corer to the bottom and tie a knot in the line to aid in judging bottom depth for successive samples at the station. If the bottom sediment is fine grained, soft or loose, the core barrel will slide through the material under its own weight. When the material is firm, the core may have to free fall for the last two to three feet of water depth in order to penetrate the bottom sediment and fill the core barrel. Retrieve the core sampler. Retrieval should cease when the top of the coring device is at the water's surface. A crew member must then reach overboard, place a hand over the bottom of the core barrel and lift the core device inboard. The sample can then be extruded into a plastic pan. Visually inspect the recovered sample noting amount recovered and soil type, then homogenize the sample, and place into a plastic one quart jar and seal. Clearly mark the sample jar with a permanent marker. Store samples away from heat or direct sunlight.

5.6.4 Sample Inventory

Before leaving a sample station an inventory should be completed to insure that all necessary samples have been collected. A sample inventory checklist similar to those presented on Figures 5-3 and 5-4 can be used.

5.6.5 "In-Situ" Data Collection

One important aspect of water column analysis involves completing in situ measurements each time water or sediment samples are collected. Information regarding salinity, conductivity, pH, temperature, and dissolved oxygen values encountered during each sampling episode is paramount for making valid interpretations for metals, nutrients, and organic materials. Procedures for completing in situ field measurement are as follows:

Salinity, Conductivity and Temperature

Determine and record salinity, conductivity and temperature at the beginning and at the end of mid-water column sampling (Figure 5-2). "In-situ" measurement of these parameters is easily accomplished using an SCT meter such as the Yellow Springs Instrument, Inc., Model 33 with a 50-foot probe cable (or other comparable device), explicitly following the manufacturers operation procedures. Before data collection begins, the instrument should be "warmed up" for 15 minutes and calibrated before each use. Calibration is completed by: 1) adjusting the mechanical zero screw (under the meter scale on the face of the instrument) so that the indicator needle is on zero. With the instrument turned off, 2) turn the mode control dial to "red line" and adjust the indicator needle so that it lies over the red-line indicator on the meter face, 3) plug the probe jack into the side of the instrument, 4) lower the probe to mid-water depth, 5) set the mode control dial to temperature and allow time for the probe temperature to come to equilibrium with that of the water before taking a reading; 6) switch the mode control dial to salinity and record the salinity indicated in parts per thousand; 7) depress the cell test button and see if the new reading is the same or within two percent of the salinity value recorded (Step 6); 8) switch the mode control to the x100 on the conductivity scale. If the reading is below 50 on the 0-500 range switch to the x10 scale. If the reading is still below 50, switch to the x1 scale. Read the meter scale and multiply the reading by the appropriate x scale number and record the result as hos/cm. The result is not temperature compensated (consult the instruction manual for reading error due to temperature). When operating on the x100x10 scales, depress the cell test button. The meter reading should fall less than two percent; if greater, the probe should be cleaned and the conductivity re-measured. The cell test button does not function on the x1 scale.

Once all readings are taken and recorded, the S-C-T mode control dial should be turned to the off position. The probe should be rinsed with distilled water and the cable rewound on the cable holder. The instrument and probe should be stowed so that they are well cushioned and will not absorb shock when the boat is underway. The instrument and probe should not be left exposed to the suns rays for more than a few minutes before use.

pH Determination

In the field, pH was measured using an analytical pocket pH meter, Model 107. Mid-depth water samples can be taken in a styrofoam drinking cup or plastic bucket from the peristaltic pump effluent. Before using the instrument it must be calibrated as follows: 1) connect the probe unit to the meter housing (the probe does not need to be disconnected during the field program); 2) measure the temperature of the buffer solution to be used in calibrating the meter; 3) set the meter by turning the temperature dial to the measured temperature; 4) turn the selector switch to pH; 5) immerse the probe in the buffer solution and adjust the buffer knob so that the needle indicates the pH value of the buffer (solution should be free from contaminants); 6) turn the selector dial to the "check" position and record the readings. If the buffer knob is inadvertently moved during testing simply reset the buffer knob to the value noted in the check mode; and 7) remove and rinse probe with distilled water and stow.

Dissolved Oxygen

Dissolved oxygen was determined using a Yellow Springs Instrument, Inc., Model 51A dissolved oxygen meter (comparable equipment can be substituted). Dissolved oxygen values are determined for surface, mid-depth and bottom waters. Note: only mid-depth D.O. was determined during the spring field program except at Port of Tampa and Port Manatee where surface, mid-depth and bottom D.O. values were determined as shown in Appendix B by lowering the probe to the desired depth and recording the reading indicated. The instrument should be prepared for use as follows:

1. Connect the two probe jacks to the instrument.
2. With the instrument turned off, check the mechanical zero of the meter. If the pointer is not over the zero adjust the pointer with the screw on the front of the meter. Recheck when the position of the instrument has changed.
3. Switch to "CALIB O_2" position and adjust the indicator to Altitude 400 on the small scale in the upper right of the large scale on the face of the meter. If 400 cannot be attained, replace the batteries. If a different model meter is used the procedure will differ. Consult the operation manual for the model meter being used.
4. Place a paper towel or cloth around the D.O. probe and wet with fresh water. Leave the meter on and let the probe remain wrapped and out of the sun for 15-20 minutes.
5. Switch the indicator knob to "full scale" and adjust to the full scale value if necessary.
6. Switch the indicator knob to "Temp" and adjust the large dial (using "Fresh Water Scale") to temperature.
7. Turn the indicator switch to "Read" and check D.O. The value indicated should be close to the saturated air D.O. reading given in the table on the back of the meter for the specified

temperature. If the determined value is very different from the value given in the table repeat the calibration sequence. If the meter is turned off, the above sequence must be repeated.

8. Lower the D.O. probe to the desired depth of water and allow it to equilibrate for one to two minutes.
9. Turn the indicator switch to "Temp" and adjust the large dial, using the "Sea Water Scale", to the appropriate temperature.
10. Turn the indicator knob to "Read" and record the D.O. value given.
11. When D.O. readings are completed the meter should be turned off and the probe should be rinsed with distilled water and stowed so that the probe membrane remains moist. The instrument and probe should be stowed out of direct sunlight.

Occasionally an air bubble will form under the probe membrane. When this occurs the membrane must be removed. A small O-ring holds the membrane in place. Holding the probe so that the membrane end is up, fill the central cavity with KCL solution using a pipet. The KCL crystals and membranes are contained in the YSI 5034 service kit which should be on board. Proper technique for membrane replacement is shown diagrammatically as part of the service kit.

Water Temperature

Surface and bottom water temperatures were determined using the S-C-T meter and the D.O. meter previously described. Mid-depth water temperature was also determined with a standard thermometer by collecting mid-depth water, with the peristaltic pump. The thermometer was allowed to remain in the water sample for approximately one minute before it was read.

5.7 LABORATORY ANALYSIS

5.7.1 Laboratory Sample Handling Procedures

Samples were brought into the laboratory, unpacked, checked for proper identification, labeling and custody forms, and logged into a Sample Registry Book. Unstable samples were immediately refrigerated and prepared for analyses.

The following parameters were processed on the day the samples were received: BOD, nitrate, phosphate, total phosphorus, suspended solids and ammonia.

The following parameters were processed within one week of the day the samples were received: TOC, TKN, pesticides, phenols, mercury and PCBs.

The following parameters were processed upon completion of the analyses for the parameters listed above: metals.

The Chief Chemist and/or the Laboratory Director prepared all job assignments, made daily checks to see that all samples were properly logged in and processed within the above holding times (Federal Register 44: No. 244, December 18, 1979), and supervised QC/QA assignments.

5.7.2 Quality Control Program

For each new procedure, a standard curve with a minimum of five to seven points was prepared. This curve was used to determine the lower and upper limits of concentration under optimum conditions of analysis. Percentage relative standard deviations are determined from five or more values near the lower detection limit and at mid-range.

With each batch of samples, the following measures were taken: (a) a reagent blank was run; (b) a standard was run near the mid-point of the standard curve; (c) at least one sample was spiked with a standard; (d) duplicate analyses were made on at least one sample for precision data; (e) when more than 10 samples were run, 10 percent of all samples were run in duplicate. If after the results were calculated, it was determined that the samples had a wide range of values or values near the detection limit, additional spiked samples were run.

5.7.3 Procedures

The laboratory procedures used in the analysis of water and sediment samples collected as part of the spring/dry season field program are presented in Tables 5-2 and 5-3 on the following pages.

The standard elvtinate test was run in accordance with the procedures outlined in, "Procedures For Handling and Chemical Analysis of Sediment and Water Samples" (EPA/COE Technical Committee on Criteria for Dredged and Fill Material - Published by U.S. Army Engineer Waterway Experiment Station, Vicksburg, Mississippi). Wet sediment samples were stored at 40°C prior to extraction and were processed within one week. Sediments were extracted for thirty minutes with four parts (VOL/VOL) site water. The mixture was allowed to settle for one hour prior to .045 filtration and analysis.

5.7.4 Detection Limits Of Analytical Procedures

Detection limits for the nutrients (ammonia, TKN, nitrate, phosphate and total phosphorus) were 0.01 ppm for water samples and 1 ppm in sediment samples. This level of detection was obtained by using an expanded range-10 cm. path length spectrophotometer for the colormetric methods and a specific ion electrode for the ammonia and TKN determinations. Interferences in the sediment extracts prohibit a lower detection limit for these analyses.

The limiting factor for detection limits for metals in water samples is the signal to noise ratio, which is effected by sample collection techniques, purity of acids and other reagents, and the sample matrix. In general, the detection limits for each of the elements analyzed by atomic absorption spectroscopy is two times the standard deviation of the results from a high purity reagent blank sample. The blank concentrations were minimized by using ultra pure reagents (i.e., redistilled nitric acid). Contamination of field samples was minimized by prewashing all collection bottles and other glassware with dilute acid and using an isolated "clean" area for sample preparation and extractions.

In saline samples the detection limits for metals required by Florida Class III water standards can only be obtained by procedures which will reduce the salt matrix interference. For this reason the APBC-DDDC and MIBK extraction procedure was used for determining cadmium, chromium, copper, iron, lead, nickel, silver and zinc. Applying this procedure to an acidified-nonfiltered sample gives results which represent the weak acid-leachable metals. The gaseous hydride technique was used for analysis of antimony and arsenic, and mercury was analyzed by the cold-vapor technique. By using these ultrasensitive techniques, detection limits were in all cases below the Florida criteria for Class III waters.

As was the case with metals, detection limits for the phenolic compounds were below Florida Class III water standards. The low detection limits were achieved by concentrating the sample to as high a degree as possible (limited by interferences) and using a highly sensitive electron capture detector (gas chromatography).

Detection limits for several of the pesticide components and PCBs were above current Florida Class III water standards. At the onset of this project the laboratory was instructed to use techniques which could be readily applied in the future for regulatory purposes and to achieve detection limits at least equivalent to the Florida DER Laboratory. It was decided that it was not practical to take field samples greater than one liter for each organic analysis. Thus, the size of the sample limited the detection limit. It is doubtful that even if larger samples were extracted that detection limits as low as the Florida Class III standards could have been obtained for multiple component pesticides (chlordane and toxaphene) and PCBs.

In order to reduce background interference, high purity solvents were used on all extractions, thus increasing the sensitivity of the method.

In all cases the detection limits for pesticides and PCBs were as low or lower than those routinely obtained in the Florida DER Laboratory, other state environmental laboratories in the southeast, or by the EPA Regional Laboratory in Athens, Georgia. To obtain lower detection limits, research techniques would have to be employed with specially prepared high purity solvents. Sample clean up procedures would have to be used to remove interfering components (i.e., sulfur in sediment) and the extract would have to be concentrated several thousand fold prior to injection. Recovery rates would have to be evaluated to determine how much of the various components were lost in clean up procedures. These procedures would increase the cost of analyses several fold and would provide questionable results. Thus, they would not be practical or cost effective from a regulatory standpoint.

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TABLES

TABLE 1-1

WATER QUALITY PARAMETERS
CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE

Surface Waters General Criteria

- Arsenic
- BOD
- Chlorides
- Chromium hexavalent
  - total
- Copper
- Detergents
- Fluorides
- Lead
- Nutrients - total Nitrogen
  - total Phosphorus
- Oils and Grease
- pH
- Phenolic Compounds
- Radioactive Substances (RA 226 and RA 228)
- Specific Conductance
- Turbidity
- Zinc
- Dissolved Oxygen

Class III Waters

- Alkalinity
- Aluminum
- Ammonia (un-ionized)
- Antimony
- Bacteriological Quality
- Beryllium
- Biological Integrity
- Bromine and Bromates
- Cadmium
- Chlorine (total residual)
- Copper
- Cyanide
- Dissolved Gases
- Dissolved Oxygen
- Fluorides
- Iron
- Lead
- Mercury
- Nickel
- Nutrients

- Pesticides and Herbicides
  - Aldrin and Dieldrin
  - Chlordane
  - DDT
  - Demeton
  - Endosulfan
  - Endrin
  - Guthion
  - Heptachlor
  - Lindane
  - Malathion
  - Methoxychlor
  - Mirex
  - Parathion
  - Toxaphene

- pH
- Phosphorus (elemental)
- Phthalate Esters
- Polychorinated Biphenyls
- Selenium
- Silver
- Transparency
- Zinc

TABLE 1-2

LABORATORY ANALYSIS
SPRING/DRY SEASON

Parameter	Water	Sediment
Aldrin	A, B, C	A, B
Aluminum	-	A, B
Ammonia	A, B, C	-
Antimony	A, C	A
Arsenic	A, C	A
Biological Oxygen Demand	A, B, C	A, B
Cadmium	A, B, C	A, B
Chlordane	A, B, C	A, B
Total Chromium	A, C	A
Copper	A, B, C	A, B
DDT	A, B, C	A, B
Fluoride*	A, B, C	A, B
Iron	A, B, C	A, B
Total Kjeldahl Nitrogen	A, B, C	A, B
Lead	A, B, C	A, B
Mercury	A, B, C	A, B
Mirex	A, B, C	A, B
Nickel	A, B, C	A, B
Nitrate	A, B, C	A, B
Oil and Grease	-	A
Total Organic Carbon	A, B, C	A, B
PCB's	A, C	A
Phenols	A, C	A
Phosphate	A, B, C	A, B
Total Phosphorus	A, B, C	A, B
Radium 226**	B	B
Silver	A, C	A
Total Suspended Solids	A, B, C	A, B
Toxaphene	A, B, C	A, B
Zinc	A, B, C	A, B
Grain Size	-	A, B
Specific Gravity	-	A, B
Atterberg Limits	-	A, B

Key: A - Intensive Stations
B - Baseline Stations
C - Calibration Stations

Notes:* All stations in Port Tampa and Port Manatee and Port Jacksonville Station JAX-4B only.

** Port of Tampa Station TPA-4B only

TABLE 1-3

LABORATORY ANALYSIS
FALL/WET SEASON

Parameter	Water	Sediment
Aldrin	0	S
Aluminum	X	E, S
Ammonia - N*	X	E
Cadmium	F, J, X	E, S
Chlordane	0	S
Copper	F, X	E, S
DDT	0	S
Fluoride*	T, X	-
Iron	X	E
Lead	F, J, X	E, S
Mirex	0	S
Mercury	F, W, X	E, S
Nickel	X	E, S
Nitrate - N*	X	E
Oil and Grease	-	S
Phenols	0	S
Phosphate - P*	X	E
Silver	F, W, X	E, S
Total Chromium	X	E, S
Total Kjeldahl Nitrogen	X	E, S
Total Organic Carbon*	X	E, S
Toxaphene	0	S
Zinc	W, X	E, S
Grain Size	-	E, S
Specific Gravity	-	E, S
Atterberg Limits	-	E, S

Key:
E - All Ports
S - All Ports
F - All Ports
J - Port of Jacksonville only
O - All Ports
T - Port of Tampa and Port Manatee only
W - All Ports
X - All Ports

* For Stations in Port Manatee and Port Tampa only.

TABLE 1-4

SUMMARY OF POTENTIAL BIOLOGICAL IMPACTS IN ESTUARIES ASSOCIATED WITH DREDGING

Habitat	Impact at Dredge Site	Impact at Disposal Site
Water Column	The direct impacts of dredging may include increased turbidity, Total Suspended Solids (TSS), and the release of nutrients. These impacts are most likely to have an adverse effect on plankton organisms. Turbidity and TSS reduce light penetration that is essential for photosynthetic phytoplankters which are important primary producers in plankton-based food webs. Turbidity problems at a hydraulic dredge site are generally not as great as turbidity associated with return waters at the disposal site, since deeper channels are generally biologically depauperate. However, turbidity generated by dredging methods that do not offer as much control over the dispersal of fine material (e.g. hopper dredges) present the greatest concern in most dredging operations. Nutrients can stimulate biological production, which in turn creates greater BOD and lower dissolved oxygen concentraions in the water column. They can be acutely toxic (e.g., NH_3) to the biota. Solubilization of toxic substances released at the dredge head is also a problem that could lead to bioconcentration by estuarine biota.	Impacts adjacent to disposal sites are qualitatively the same as for the dredge site, but for certain impacts, especially those associated with nutrients, turbidity and TSS, problems may be far greater than at the dredge site. Solubilization of toxic compounds is also a concern in disposal site discharge waters since these compounds may be taken up by estuarine biota.
Estuarine Benthic Communities	Increased turbidity and TSS loads can clog breathing and feeding (e.g., filter feeders) mechanisms, or directly smother live bottom areas. Resuspended contaminants can be oxidized and microbially-activated (e.g., via bio-alkylantion processes) so that they can be passed into estuarine	Impacts are the same as for dredge site, athough disposal site littoral areas are generally shallower and productive than deep navigation channels. Thus, these be much greater and could affect more species and individuals.

TABLE 1-4 (Cont'd)

Habitat	Impact at Dredge Site	Impact at Disposal Site
Coral Reefs	Decreased light penetration due to increased turbidity and TSS will reduce photosynthesis carried out by symbiotic zooxanthellae, eventually killing corals. Dredge spoils can clog feeding and breathing mechanisms of the corals, and calcification rates may also be depressed by interference with these processes. Nutrients released from the dredging operation can stimulate microalgal growth which can also kill corals. Consequently, food, shelter, and habitat function of these reef systems will be reduced or even eliminated.	The effects of disposal can have the same qualitative impacts as those discussed for dredging. Dredge spoils can clog feeding and breathing mechanisms of the corals, and calcification rates may also be depressed by interference with these processes. Nutrients released from the dredging operation can also kill corals. Consequently, food, shelter, and habitat function of these reef systems will be reduced or even eliminated. Side casting is extremely deleterious to coral reef communities due to blanketing and smothering of biota.
Barrier Islands	Channel maintenance dredging through or around barrier islands can alter hydrodynamic regimes and reduce shoreline stability.	Improper spoiling on barrier island beaches (i.e., renourishment) can eliminate productive bottom areas, outcrop habitats, and shoreline vegetation which export nutrient-rich detrital material to adjacent estuary areas.
Worm Reefs	Suspended and settable materials clog feeding and respiratory mechanisms. Nutrients released to these fragile communities can stimulate growth of encrusting algal species which cover worm reefs and destroy colonies.	Direct disposal on reefs eliminates food, shelter, and habitat for biota by smothering actions. Side casting products increased suspended and setteable solids that clog feeding and breathing mechanisms. Nutrients stimulate undesireable macroalgal growth over reef habitat.

TABLE 1-4 (Cont'd)

Habitat	Impact at Dredge Site	Impact at Disposal Site
	food webs via the bioaccumulation process. Additionally, bottom areas can be disrupted in such a way to cause difficulties for larvae settling in the area.	Diked disposal areas situated in estuarine waters will eliminate productive benthic habitat, disrupt trophic relationships, and reduce overall pollutant-assimilation capacity of bottom areas (i.e.., by eliminating microflora).
Seagrass Meadows	Chronic impacts of dredging are associated with increased turbidity and TSS can reduce light penetration that is crucial to seagrass survival. Additionally, dredging fine materials can blanket grassbeds; fine grain sediment relocation and deposition in grassbed habitat can inhibit rhizomes from rooting in such dredged material. Nutrient releases can produce localized plankton blooms which reduce light penetration; nutrients also stimulate seagrass epiphyte and macroalgal (encrusting algae) growth which in turn reduces sunlight reaching grassblades.	Qualitative impacts are essentially the same as at dredging site, but since disposal site discharge waters generally enter shallower areas, the potential for each of these problems is considerably greater if grassbeds are adjacent to spoil site. Side casting operations are particularly deleterios to seagrasses. Diked disposal areas constructed in grassbeds will eliminate productive submerged wetlands and destroy food, shelter, and habitat required by estuarine biota that depend on these nursery areas to complete their life cycles.
Tidal Flats, Marshes and Non-Tidal Wetlands	Direct impacts of dredging include elimination of these productive tidal habitats which provide food and shelter for estuarine biota; bottom areas also sequester pollutants (microbially-mediated) and transform nutrients into a biologically useable form.	Diked disposal areas located in tidal flats will have similar impacts on those noted for dredging operations. Diking and burial will eliminate these valuable habitats.

TABLE 2-1

SPRING/DRY SEASON
SAMPLE STATION LOCATION

Location - Port Tampa

Station	Latitude	Longitude
TPA 1A	27° 56' 28" N	82° 26' 40" W
TPA 2A	27° 52' 49" N	82° 26' 30" W
TPA 3B	27° 48' 10" N	82° 24' 50" W
TPA 4B	27° 51' 21" N	82° 23' 30" W
TPA 5B	27° 55' 40" N	82° 26' 08" W
TPA 6B	27° 55' 20" N	82° 25' 29" W
TPA 7C	27° 39' 13" N	82° 49' 01" W

Location - Port Manatee

MAN 1A	27° 38' 01" N	82° 33' 39" W
MAN 2B	27° 38' 16" N	82° 34' 12" W

Location - Port Jacksonville

JAX 1B	30° 17' 40" N	81° 40' 49" W
JAX 2A	30° 18' 59" N	81° 37' 44" W
JAX 3A	30° 20' 57" N	81° 37' 15" W
JAX 4B	30° 22' 16" N	81° 37' 48" W
JAX 5B	30° 23' 16" N	81° 37' 35" W
JAX 6A	30° 24' 04" N	81° 34' 52" W
JAX 7A	30° 23' 10" N	81° 33' 16" W
JAX 8B	30° 23' 37" N	81° 28' 44" W
JAX 9C	30° 25' 50" N	81° 21' 40" W

Location - Port Pensacola

PNS 1A	30° 24' 00" N	87° 12' 13" W
PNS 2B	30° 21' 15" N	87° 14' 00" W
PNS 3C	30° 18' 41" N	87° 18' 12" W

TABLE 2-2

FALL/WET SEASON
SAMPLE STATION LOCATIONS

Location - Port Tampa

Station	Latitude	Longitude
TPA 1A-WET(O)	27° 56' 26" N	82° 26' 42" W
TPA 2A-WT(O)	27° 52' 49" N	82° 26' 20" W
TPA 3B-WT(O)	27° 48' 08" N	82° 24' 47" W
TPA 4B-WT(O)	27° 51' 21" N	82° 23' 32" W
TPA 5B-WT(O)	27° 50' 44" N	82° 26' 05" W
TPA 6B- WOET	27° 55' 14" N	82° 25' 34" W
TPA 8-SFT	27° 54' 27" N	82° 25' 12" W
TPA 9-SFT	27° 50' 42" N	82° 26' 41" W
TPA 10-SFT	27° 48' 33" N	82° 26' 12" W
TPA 11-SFT	27° 47' 07" N	82° 31' 05" W
TPA 12-SFT	27° 55' 08" N	82° 26' 34" W
TPA 13-XT	27° 48' 00" N	82° 28' 31" W

Location - Port Manatee

MAN 1A-WET(O)	27° 38' 01" N	82° 33' 39" W
MAN 2B-WOT	27° 38' 16" N	82° 34' 09" W
MAN 3-SFT	27° 39' 08" N	82° 35' 26" W

Location - Port Jacksonville

JAX 3A-FWE(O)	30° 21' 04" N	81° 37' 14" W
JAX 4B-WJT(O)	30° 22' 15" N	81° 37' 49" W
JAX 5B-WJ(O)	30° 23' 23" N	81° 37' 34" W
JAX 6A-WJ(O)	30° 24' 03" N	81° 34' 50" W
JAX 7A-WOJ	30° 23' 10" N	81° 33' 16" W
JAX 8B-WJ(O)	30° 23' 35" N	81° 28' 35" W
JAX 10-SFJ	30° 19' 00" N	81° 38' 24" W
JAX 11-SFJ	30° 24' 24" N	81° 35' 01" W
JAX 12-SFJ	30° 24' 14" N	81° 32' 53" W
JAX 13-SFJ	30° 23' 20" N	81° 31' 50" W
JAX 14-X	30° 24' 11" N	81° 36' 37" W
JAX 15-WEJ	30° 20' 18" N	81° 37' 21" W
JAX 16-S	30° 21' 52" N	81° 37' 19" W
JAX 17-S	30° 21' 06" N	81° 37' 08" W

TABLE 2-2 (Cont'd)

FALL/WET SEASON
SAMPLE STATION LOCATIONS

Port Pensacola

Station	Latitude	Longitude
PNS 1A-WOE	30° 24' 02" N	87° 12' 33" W
PNS 2B-W(O)	30° 21' 17" N	87° 14' 00" W
PNS 4-SF	30° 23' 11" N	87° 12' 29" W
PNS 5-SF	30° 20' 30" N	87° 14' 26" W
PNS 6-SF	30° 20' 02" N	87° 16' 59" W
PNS 7-X	30° 22' 11" N	87° 13' 14" W

TABLE 2-3

OBSERVED PRECIPITATION AND NET WATER AVAILABILITY TO STREAM FLOW JANUARY - OCTOBER 1982

Location	Month	Precipitation (Inches)	Net Water Availability To Stream Flow (Inches)
Tampa[1]	January	1.86	0
	February	2.09	0
	March	2.99	0
	April	1.87	0
	May	5.90	0
	June	8.34	2.83
	July	10.49	4.99
	August	7.20	1.76
	September	10.76	5.96
	October	2.17	0
Jacksonville[2]	January	3.00	0
	February	1.67	0
	March	4.26	0.02
	April	3.60	0
	May	3.55	0
	June	8.06	2.30
	July	3.80	0
	August	6.93	1.74
	September	9.32	5.01
	October	3.37	0
Pensacola[3]	January	2.84	0.78
	February	8.87	6.11
	March	5.58	2.12
	April	1.90	0
	May	2.05	0
	June	4.00	0
	July	6.99	1.82
	August	9.87	5.20
	September	1.32	0
	October	2.51	0

TABLE 2-3 (Cont'd)

Location	Month	Precipitation (Inches)	Net Water Availability To Stream Flow (Inches)
St. Petersburg[4]	January	2.44	0
	February	1.49	0
	March	6.81	1.96
	April	3.81	0
	May	5.03	0
	June	7.66	2.15
	July	2.40	0
	August	7.45	2.01
	September	9.88	5.08
	October	4.16	0.02

Notes:

1. From NOAA Local Climatological Data, Monthly Summaries, January through October 1982 for Tampa, Florida.
2. From NOAA Local Climatological Data, Monthly Summaries, January through October 1982 for Jacksonville, Florida.
3. From NOAA Local Climatological Data, Monthly Summaries, January through October 1982 for Pensacola, Florida.
4. From NOAA Climatological Data, Florida, January through October 1982 for St. Petersburg, Florida.

TABLE 2-4

HISTORICAL MEAN PRECIPITATION, LAKE EVAPORATION AND NET WATER AVAILABILITY TO STREAM FLOW

Area	Month	Mean Precipitation (Inches)	Mean Lake Evaporation (Inches)	Net Water Availability to Stream Flow (Inches)
Pensacola	January	4.37	2.06[C]	2.31
	February	4.69	2.76	1.93
	March	6.31	3.46	2.85
	April	4.99	4.81	0.18
	May	4.25	5.34	0
	June	6.30	5.53	0.77
	July	7.33	5.17	2.16
	August	6.67	4.67	2.00
	September	8.15	3.77	4.38
	October	3.13	3.53	0
	November	3.37	2.26	1.11
	December	4.66	1.83[C]	2.83
Jacksonville	January	2.78	2.26[A]	0.52
	February	3.58	3.21[C]	0.37
	March	3.56	4.24	-
	April	3.07	5.38	-
	May	3.22	5.72	-
	June	6.27	5.76	0.51
	July	7.35	5.88	1.47
	August	7.89	5.19[C]	2.70
	September	7.83	4.31	3.52
	October	4.54	3.60	0.94
	November	1.79	2.73	-
	December	2.59	2.16[B]	0.43
Tampa/ St. Petersburg	January	2.33/2.57[D]	2.50	0/0.07[D]
	February	2.86/2.90	3.20	0/0
	March	3.89/4.01	4.85	0/0
	April	2.10/2.67	5.74	0/0
	May	2.41/2.45	6.11	0/0
	June	6.49/6.39	5.51	0.98/0.88
	July	8.43/9.10	5.50	2.93/3.60
	August	8.00/9.14	5.44	2.56/3.70
	September	6.35/7.68	4.80	1.55/2.88
	October	2.54/3.42	4.14	0/0
	November	1.79/1.94	3.14[C]	0/0
	December	2.19/2.33	2.15[C]	0.04/0.18

Notes:
A) Represents a two-year mean
B) Represents a three-year mean
C) Represents a four-year mean
D) Precipitation and net water availability data presented using Tampa/St. Petersburg format.

TABLE 2-4 (Cont'd)

Remarks: 1) Mean precipitation from Climatography of the United States No. 81 (Florida), Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1941 - 1970.

2) Unless otherwise noted, values shown for lake evaporation represent a five-year mean. (see Section 5 for details).

TABLE 2-5

PENSACOLA
GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS
SPRING / DRY SEASON

STATION / PARAMETER	PNS-1A		PNS-2B		PNS-3C		Standard**
Temperature (°C)	23		21		21		NA
Salinity (PPT)	32		33		33		NA
pH	8.1		7.8		8.2		≥6.0 ≤8.5
Dissolved Oxygen (mg/l)	6.6		6.7		6.7		4
Dissolved Oxygen (% Saturation)	92		91		91		NA
Turbidity (NTU)	4.8		1.1		1.0		NA
Conductivity (μmhos)	32000		36000		39000		NA
Ammonia[1] (mg/l)	<0.01	-	<0.01	-	<0.01	-	NA
Nitrate (mg/l)	0.02	0.01	0.02	0	0.03	0	NA
Total Kjeldahl Nitrogen (mg/l)	0.03	0.01	0.04	0.01	0.03	0.01	NA
Phosphate - P (mg/l)	0.01*	-	0.04	0.01	0.02	0.01	NA
Total Phosphorus (mg/l)	0.02	0.01	0.06	0.01	0.11	0.01	NA
Total Organic Carbon (mg/l)	2.90	0.06	2.90	0.55	2.90	0.10	NA
Biological Oxygen Demand (mg O_2/l)	0.80	0.20	1.10	0.21	1.70	0.20	NA
Total Suspended Solids (mg/l)	8.4	1.3	7.5	0.9	6.0	0.9	NA

NOTES:

NA REFERS TO STANDARD NOT AVAILABLE.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-6

PENSACOLA

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

FALL / WET SEASON

STATION / PARAMETER	PNS 1A WOE		PNS 2B W(O)		PNS 4 SF		PNS 5 SF		PNS 6 SF		PNS 7 X		STANDARD
TEMPERATURE (°C)	28		28		26		25		25		26		NA
SALINITY (PPT)	30		29.5		29		21		24.8		28		NA
PH	7.9		7.8		7.9		7.9		8.0		7.8		≥ 6.0 ≤ 8.5
DISSOLVED OXYGEN (mg/l)	4.3		7.0		6.9		7.2		7.2		6.6		4
DISSOLVED OXYGEN (% saturation)	64.6		105.0		98.0		97.7		99.8		94.7		NA
TURBIDITY (NTU)	3.3		1.7		3.1		2.6		2.0		2.4		NA
CONDUCTIVITY (μmhos)	38020		39250		37600		33000		34200		35000		NA
TOTAL KJELDAHL NITROGEN (mg/l)	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.35	0.07	NA
TOTAL ORGANIC CARBON (mg/l)	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	3.2	0.3	NA

NOTES:

FOR PARAMETERS LISTED BELOW CONDUCTIVITY, THE LEFT COLUMN CONTAINS THE MEAN AND THE RIGHT COLUMN CONTAINS THE STANDARD DEVIATION OF REPLICATE SAMPLES FOR EACH STATION.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NA REFERS TO STANDARD NOT AVAILABLE.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-7

PENSACOLA

INORGANIC WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETER µg/liter \ STATION	PNS-1A		PNS-2B		PNS-3C		Standard**
	MEAN	σ	MEAN	σ	MEAN	σ	
Antimony	<0.1	-	NC	NC	< 0.1	-	200
Arsenic	1.0*	-	NC	NC	1.1	0.06	50
Cadmium	0.13	0.03	0.06	0.01	<0.01	-	5.0
Chromium	0.26	0.09	NC	NC	0.15	0.02	50
Copper	0.46	0.03	0.80	0.07	0.60	0.08	15
Iron	6.9	0.7	1.2	0.1	1.8	0.1	300
Lead	0.43*	-	0.25	0.04	0.20*	-	50
Mercury	0.12	0.01	<0.1	-	<0.1	-	0.1
Nickel	0.39	0.08	0.52	0.04	0.76	0.15	100
Silver	<0.01	-	NC	NC	<0.01	-	0.05
Zinc	3.5	0.6	0.4	0.1	0.2	0.1	1000
Flouride (mg/l)	NC	NC	NC	NC	NC	NC	5.0 (mg/l)

Notes: * Mean determined using 2 replicate values.
** Water quality standards for selected parameters in predominantly marine waters, Chapter 17-3, Florida Administrative Code for Class III waters.

Remarks: NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-8

PENSACOLA

INORGANIC WATER QUALITY

FALL / WET SEASON

STATION PARAMETER µg/liter	PNS 1A WOE		PNS 2B W(O)		PNS 4 SF		PNS 5 SF		PNS 6 SF		PNS 7 X		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	2.0	0.2	1500
CADMIUM	NC	NC	NC	NC	0.03	0.01	0.43	0.04	0.10	0.01	0.03	0	5.0
CHROMIUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.90	0.05	50
COPPER	NC	NC	NC	NC	0.64	0.07	1.0	0.1	1.00	0.2	0.41	0.03	15
FLUORIDE[1]	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5.0[1]
IRON	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	6.4	1.7	300
LEAD	NC	NC	NC	NC	0.28	0.04	0.47	0.08	0.28	0.04	0.23	0.03	50
MERCURY	0.15	0.01	<0.1	-	<0.10	-	<0.10	-	<0.10	-	<0.10	-	0.1
NICKEL	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.71	0.03	100
SILVER	0.03	0	0.02	0.01	<0.01	-	0.03	0.01	0.02	0.01	<0.01	-	0.05
ZINC	1.3	0.2	1.3*	-	NC	NC	NC	NC	NC	NC	2.9	0.1	1000

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

[1] FLORIDE UNITS ARE MG/L.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-9

PENSACOLA

ORGANIC WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETER µg/Liter \ STATION	PNS- 1A MEAN	PNS- 1A σ	PNS- 2B MEAN	PNS- 2B σ	PNS- 3C MEAN	PNS- 3C σ	Standard*
Pesticides							
Mirex	<0.03	-	<0.03	-	<0.03	-	0.001
Toxaphene	<0.25	-	<0.25	-	<0.25	-	0.005
DDT	<0.01	-	<0.01	-	<0.01	-	0.001
Aldrin	<0.005	-	<0.005	-	<0.005	-	0.003
Chlordane	<0.2	-	<0.2	-	<0.2	-	0.004
PCB's	<0.25	-	NC	NC	<0.25	-	0.001
Phenols							
2 - Chlorophenol	<0.1	-	NC	NC	<0.1	-	1.0
Phenol	<1.0	-	NC	NC	<1.0	-	1.0
2,4 - Dichlorophenol	<0.05	-	NC	NC	<0.05	-	1.0
2,4,6 - Trichlorophenol	<0.07	-	NC	NC	<0.07	-	1.0
4 - Chloro-m-cresol	<1.0	-	NC	NC	<1.0	-	1.0
2,4 - Dinitrophenol	<0.7	-	NC	NC	<0.7	-	1.0
Pentachlorophenol	0.05	0.01	NC	NC	<0.04	-	1.0

Notes:

* Water quality standards for selected parameters in predominantly marine waters, Chapter 17-3, Florida Administrative Code for Class III waters.

Remarks: NC refers to analysis not completed due to station designation (See table 1.2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-10

PENSACOLA

ORGANIC WATER QUALITY

FALL / WET SEASON

PARAMETER μg/liter \ STATION	PNS 1A WOE		PNS 2B W(O)		STANDARD
PESTICIDES	MEAN	σ	MEAN	σ	
MIREX	<0.02	-	NA	NA	0.001
TOXAPHENE	<0.2	-	NA	NA	0.005
DDT	<0.01	-	NA	NA	0.001
ALDRIN	<0.003	-	NA	NA	0.003
CHLORDANE	<0.2	-	NA	NA	0.004
OTHER CHLORINATED	NC	NC	NC	NC	NS
PHENOLS	MEAN	σ	MEAN	σ	
2-CHLOROPHENOL	<1.0	-	NA	NA	1.0
PHENOL	<5.0	-	NA	NA	1.0
2,4-DICHLOROPHENOL	<0.05	-	NA	NA	1.0
2,4,6-TRICHLOPHENOL	<0.05	-	NA	NA	1.0
4-CHLORO-M-CRESOL	<2.0	-	NA	NA	1.0
2,4-DINITROPHENOL	<20	-	NA	NA	1.0
PENTACHLOROPHENOL	<0.05	-	NA	NA	1.0

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NA INDICATES ADDITIONAL ORGANIC ANALYSIS NOT COMPLETED DUE TO RESULT OF ANALYSIS FOR STATION PNS 1A-WOE.

NS INDICATES STANDARD NOT AVAILABLE.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-11

PENSACOLA

GENERAL PHYSICAL AND CHEMICAL SEDIMENT QUALITY CHARACTERISTICS

SPRING / DRY SEASON

STATION / PARAMETERS	PNS-1A		PNS-2B	
	MEAN	σ	MEAN	σ
Biological Oxygen Demand (mg 02/kg)	16000	3200	16000	2100
Nitrate-N (mg/kg)	1.9	0.1	1.8	0.7
Phosphate (mg/kg)	970	150	360	31
Specific Gravity	2.76	0.04	3.0	0.09
Total Kjeldahl Nitrogen (mg/kg)	11000	1200	12000	2100
Total Organic Carbon (mg/kg)	94000	11000	77000	7600
Total Phosphorus (mg/kg)	1400	360	1300	260
Total Solids (%)	27.8	2.8	37.4	1.4

Notes :

Specific gravity as shown is dimensionless

TABLE 2-12

PENSACOLA

GENERAL PHYSICAL AND CHEMICAL SEDIMENT CHARACTERISTICS

FALL /WET SEASON

STATION / PARAMETER ppm (dry basis)	PNS 1A WOE		PNS 4 SF		PNS 5 SF		PNS 6 SF	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
SPECIFIC GRAVITY^1	2.76	0.02	2.57	0.05	2.67	0.02	2.69	0.03
TOTAL KJELDAHL NITROGEN	4700	450	1900	750	500	90	300*	-
TOTAL ORGANIC CARBON	38000	4000	14000	4600	2800	350	440*	-
AMMONIA -N	NC	NC	NC	NC	NC	NC	NC	NC
PHOSPHATE -P	NC	NC	NC	NC	NC	NC	NC	NC
NITRATE -N	NC	NC	NC	NC	NC	NC	NC	NC
OIL and GREASE	NC	NC	920	260	190	55	115	27

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.
- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-13

PENSACOLA

INORGANIC SEDIMENT QUALITY

SPRING / DRY SEASON

STATION / PARAMETER	PNS-1A		PNS-2B	
	MEAN	σ	MEAN	σ
Aluminum	9,700	250	59,000	3100
Antimony	<0.5	-	NC	NC
Arsenic	12.3	1.5	NC	NC
Cadmium	0.27	0.03	0.16	0.03
Chromium	63	3	NC	NC
Copper	17	3	10	1
Fluoride	NC	NC	NC	NC
Iron	38,000	4000	2300	1200
Lead	35	2	19	4
Mercury	0.47*	-	0.78	0.14
Nickel	20	1	14	2
Silver	0.23	0.06	NC	NC
Zinc	95	2	57	4

NOTES:

* Mean determined using 2 replicate values.

REMARKS:

NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentrations were below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-14

PENSACOLA
INORGANIC SEDIMENT QUALITY
FALL / WET SEASON

STATION / PARAMETER ppm (dry basis)	PNS 1A WOE		PNS 4 SF		PNS 5 SF		PNS 6 SF	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
ALUMINUM	43000	5100	47000	5000	6800	1300	2000	400
CADMIUM	0.52	0.14	0.40	0.04	0.21	0.03	0.17	0.03
CHROMIUM	82	8	57	13	22	3	5.1	1.0
COPPER	14	2	9.1	1.1	1.6	0.4	<1.1	-
IRON	23000	1500	NC	NC	NC	NC	NC	NC
LEAD	40	4	32	2	9	2	15	2
MERCURY	0.52*	-	0.15	0.04	0.18	0.04	0.04*	-
NICKEL	17	2	12	2	6.8	0.9	3.1	0.2
SILVER	0.26	0.04	0.11	0.03	<0.11*	-	<0.10*	-
ZINC	45	9	58	7	10	2	7.2*	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-15

METAL:ALUMINUM RATIOS IN SEDIMENTS PORT OF PENSACOLA

Station	Cd $(\times 10^{-6})$	Cr $(\times 10^{-4})$	Cu $(\times 10^{-4})$	Fe $(\times 10^{0})$	Pb $(\times 10^{-4})$	Hg $(\times 10^{-6})$	Ni $(\times 10^{-5})$	Ag $(\times 10^{-6})$	Zn $(\times 10^{-4})$
PNS-1A	27.8	64.9	17.5	3.9	36.1	48.5[1]	206.2	23.7	97.9
PNS 1A-WOE	12.1	19.1	3.3	0.53	9.3	12.1[1]	39.5	6.0	10.5
PNS-2B	2.7	NC	1.7	0.04	3.2	13.2	23.7	NC	9.7
PNS 4-SF	8.5	12.1	1.9	NC	6.8	3.2	25.5	2.3	12.3
PNS 5-SF	30.9	32.4	2.4	NC	13.2	26.5	100.0	16.2[1]	14.7
PNS 6-SF	85.0	25.5	5.5	NC	75.0	20.0[1]	155.0	50.0[1]	36.0[1]
Crustal* Ratio	2.0	10	7.0	0.7	1.5	1.0	90	0.1	8.0

NOTES:

NC Indicates ratio not determined due to station designation (see Tables 1-2 and 1-3)

[1] Ratio determined using the mean of two replicate metal values.

* From Taylor (1964)

TABLE 2-16

PENSACOLA
ORGANIC SEDIMENT QUALITY
SPRING / DRY SEASON

STATION PARAMETER µg/liter	PNS-1A MEAN	PNS-1A σ	PNS-2B MEAN	PNS-2B σ	PNS-3C MEAN	PNS-3C σ
Pesticides						
Mirex	<0.001	-	<0.001	-	NC	NC
Toxaphene	<0.02	-	<0.02	-	NC	NC
DDT	<0.001	-	<0.001	-	NC	NC
Aldrin	<0.001	-	<0.001	-	NC	NC
Chlordane	<0.007	-	<0.006	-	NC	NC
Oil and Grease	2800*	-	NC	NC	NC	NC
PCB's	<0.002	-	NC	NC	NC	NC
Phenols						
2 - Chlorophenol	<0.01	-	<0.01	-	NC	NC
Phenol	<0.02	-	<0.2	-	NC	NC
2,4-Dichlorophenol	<0.1	-	<0.1	-	NC	NC
2,4,6-Trichlorophenol	<0.01	-	<0.01	-	NC	NC
4-Chloro-m-cresol	<0.2	-	<0.2	-	NC	NC
2,4-Dinitro phenol	<0.3	-	<0.3	-	NC	NC
Penta chlorophenol	0.007	0.002	<0.005	-	NC	NC

Notes:

* Mean determined using 2 replicate values

Remarks:

NC refers to analysis not completed due to station designation (See table 1.1).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-17

PENSACOLA

ORGANIC SEDIMENT QUALITY

FALL / WELL SEASON

STATION / PARAMETER ppm (dry basis)	PNS 1A WOE		PNS 4 SF		PNS 5 SF		PNS 6 SF	
PESTICIDES	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
MIREX	NC	NC	<0.001	-	<0.001	-	<0.001	-
TOXAPHENE	NC	NC	<0.015	-	<0.015	-	<0.015	-
ALDRIN	NC	NC	<0.001	-	<0.001	-	<0.001	-
CHLORDANE	NC	NC	<0.005	-	<0.005	-	<0.005	-
DDT	NC	NC	<0.001	-	<0.001	-	<0.001	-
OTHER CHLORINATED	NC	NC	NC	NC	NC	NC	NC	NC
PHENOLS	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
2-CHLOROPHENOL	NC	NC	<0.05	-	<0.05	-	<0.05	-
PHENOL	NC	NC	<1.0	-	<1.0	-	<1.0	-
2,4-DICHOROPHENOL	NC	NC	<1.0	-	<1.0	-	<1.0	-
2,4,6-TRICHLOROPHENOL	NC	NC	<0.01	-	<0.01	-	<0.01	-
4-CHLORO-M-CRESOL	NC	NC	<0.1	-	<0.1	-	<0.1	-
2,4-DINITROPHENOL	NC	NC	<0.07	-	<0.07	-	<0.07	-
PENTACHLOROPHENOL	NC	NC	<0.01	-	<0.01	-	<0.01	-

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-18

PENSACOLA

ELUTRIATE RESULTS

PARAMETER µg/l[1] / STATION	PNS 7		PNS 1A WOE		STANDARD
	MEAN	σ	MEAN	σ	
ALUMINUM	2.0	0.2	3.7	0.6	1500
CADMIUM	0.03	0	0.03	0.01	5.0
CHROMIUM	0.90	0.05	2.6	0.1	50
COPPER	0.41	0.03	0.60	0.03	15
IRON	6.4	1.7	19	2	300
LEAD	0.23	0.03	0.39	0.03	50
MERCURY	< 0.10	-	0.18	0.02	0.1
NICKEL	0.71	0.03	1.8	0.12	100
SILVER	< 0.01*	-	0.02	0.01	0.05
ZINC	2.9	0.1	3.8	0.3	1000
FLUORIDE	NC	NC	NC	NC	5.0
TOTAL KJELDAHL NITROGEN	0.35	0.07	4.7	1.1	NS
TOTAL ORGANIC CARBON	3.2	0.3	4.5	0.9	NS
AMMONIA - N	NC	NC	NC	NC	NS
NITRATE - N	NC	NC	NC	NC	NS
PHOSPHATE - P	NC	NC	NC	NC	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		STANDARD

NOTES:

* MEAN DETERMINED USING 2 REPLICATE VALUES

NS REFERS TO STANDARDS NOT AVAILABLE

NC REFERS TO ANALYSIS NOT COMPUTED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

[1] UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L .

REMARKS:

STANDARD REFERS TO WATER QULAITY STANDARDS FOR PREDOMINANTLY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TABLE 2-19

TAMPA / MANATEE

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETER \ STATION	TPA-1A		TPA-2A		TPA-3B		TPA-4B		TPA-5B		TPA-6B		TPA-7C		MAN 1A		MAN-2B		STANDARD**
Temperature (°C)	25		23		24		25		24		25		24		26		25		NA
Salinity (ppt)	26		28		28		28		27		27		35		34		34		NA
pH	8.2		8.1		8.0		7.9		8.2		8.1		7.4		7.9		6.6		≥6.0 ≤8.5
Dissolved Oxygen (mg/l)	3.2		4.6*		4.2		2.2		5.2		3.6		5.5		4.6		5.4		4
Dissolved Oxygen (% Saturation)	45		63		58		31		72		51		79		68		79		NA
Turbidity (NTU)	8.5		15.0		17.3		9.0		12.5		4.5		1.3		8.1		7.5		NA
Conductivity (umhos)	36800		36300*		37000		36900		35000		37100		44000		43000		42000		NA
Ammonia ¹ (mg/l)	0.10	0.01	<0.01	-	0.01*	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.01*	-	<0.01	-	NA
Nitrate (mg/l)	0.07	0.02	0.08	0.01	0.06	0.01	0.06	0.01	0.06	0.01	0.04	0.01	0.04	0.01	0.04	0.01	0.03	0	NA
Total Kjeldahl Nitrogen (mg/l)	0.4	0.1	0.2	0.1	0.3	0.1	0.09	0.02	0.2	0	0.3*	-	0.07	0.03	0.1*	-	0.1*	-	NA
Phosphate (mg/l)	0.57	0.01	0.59	0.03	0.51	0.01	0.58	0.04	0.57	0.01	0.51	0.01	0.09	0.01	0.21	0.02	0.23	0.02	NA
Total Phosphorus (mg/l)	0.59	0.06	0.69	0.01	0.56	0.01	0.63	0.02	0.60	0.02	0.59	0.03	0.31	0.03	0.28	0.02	0.28	0.02	NA
Total Organic Carbon (mg/l)	8.5	0.7	7.9	0.2	9.4	0.4	6.7	1.0	8.7	0.2	5.6*	-	4.6	0.9	5.1	0.3	5.0	0.2	NA
Biological Oxygen Demand (mg O_2/l)	1.9	0	2.4	0.5	2.6	0.1	1.8	0.1	2.6	0.3	2.7*	-	1.3	0.4	2.0	0.2	3.0	0.7	NA
Total Suspended Solids (mg/l)	45*	-	93	4	21	3	16	0.6	85	5	38	4	8.5	1.4	19	2	23*	-	NA

NOTES: *Mean of surface and bottom values.
**Water quality standards for selected parameters in predominately marine waters, Chapter 17-3, Florida Administrative Code for Class III waters.

REMARKS: NA refers to water quality standards not available.
¹For parameters listed below "conductivity", the left column contains the mean and the right column contains the standard deviation of replicate samples for each station.
For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-20

TAMPA

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

FALL / WET SEASON

PARAMETER \ STATION	TPA 1A WET(O)		TPA 2A WT(O)		TPA 3B WT(O)		TPA 4B WT(O)		TPA 5B WT(O)		TPA 6B WOET		TPA 8 SFT		TPA 9 SFT		TPA 10 SFT		TPA 11 SFT		TPA 12 SFT		TPA 13 XT		STANDARD
TEMPERATURE (°C)	28.5		30.0		28.5		29		30.5		28.5		27.8		28.5		29		31.5	29*	26		29		NS
SALINITY (ppt)	24.5		19.5		22.5		23		21		21.5		22.5		22		22		22	24.5	24.5		25		NS
pH	7.5		7.9		7.9		7.3		8.4		7.7		7.8		8.0		7.8		7.9	8.2	7.7		8.1		≥6.0 ≤8.5
DISSOLVED OXYGEN (mg/l)	3.0		8.5^{s}		NA		4.5^{s}		11.0^{s}		9.0^{s}		4.3		9.2^{s}		6.4		5.8	9.0	4.0		NA		4
DISSOLVED OXYGEN (% SATURATION)	44.1		NA		NA		NA		NA		NA		61.7		NA		93.6		88.9	133.3	56.2		NA		NS
TURBIDITY (NTU)	2.1		4.3		3.5		8.6		5.2		3.0		5.8		7.0		2.7**		NA	2.8	3.0		4.5		NS
CONDUCTIVITY (μmhos)	34000		34300		34250		34400		30300		33800		17000		34500		38600		27850	32400	34400		35300		NS
TOTAL KJELDAHL NITROGEN (mg/l)	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	3.1	0.5	NS
AMMONIA-N	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.10	0.02	NS
PHOSPHATE-P	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.59	0.10	NS
NITRATE-N	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.07	0.02	NS
TOTAL ORGANIC CARBON	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5.2	0.3	NS

NOTES: FOR DATA PRESENTED BELOW CONDUCTIVITY, THE LEFT COLUMN CONTAINS THE MEAN AND THE RIGHT COLUMN CONTAINS THE STANDARD DEVIATION OF REPLICATE SAMPLES FOR EACH STATION.

NC REFERS TO DATA NOT CALCULATED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NS INDICATES STANDARD NOT AVAILABLE.

* VALUES SHOWN IN UPPER RIGHT WERE COLLECTED 9/12/82; VALUES SHOWN IN LOWER LEFT WERE COLLECTED 9/10/82.

** INITIAL VALUE ONLY.

s REPRESENTS DATA COLLECTED AT WATER SURFACE.

REMARKS: STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-21

TAMPA / MANATEE
INORGANIC WATER QUALITY CHARACTERISTICS
SPRING / DRY SEASON

PARAMETER µg/Liter \ STATION	TPA-1A		TPA-2A		TPA-3B		TPA-4B		TPA-5B		TPA-6B		TPA-7C		MAN-1A		MAN-2B		*STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
Radium 226 **	NC	NC	NC	NC	NC	NC	< 2	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5 pci/l
Antimony	< 0.1	-	< 0.1*	-	NC	NC	NC	NC	NC	NC	NC	NC	< 0.1	-	< 0.1	-	NC	NC	200
Arsenic	2.5	0.2	1.8	0.2	NC	NC	NC	NC	NC	NC	NC	NC	1.3	0.1	1.8	0.1	NC	NC	50
Cadmium	0.07	0.01	0.09	0.01	0.12	0.01	0.07	0.02	0.07	0.06	0.4*	-	0.04	0.01	0.04	-	0.04	0.01	5.0
Chromium	1.9	0.3	1.3	0.7	NC	NC	NC	NC	NC	NC	NC	NC	0.55	0.15	0.53	0.10	NC	NC	50
Copper	1.4	0.2	0.5	0	0.53	0.03	0.6	0.1	0.47	0	0.59	0.14	0.44	0.07	0.49	0.12	1.1	0.1	15
Iron	3.5	0.7	7.8	0.4	10.0	1.7	3.5*	-	4.2	1.6	1.8*	-	1.8*	-	4.9*	-	3.0	0.6	300
Lead	0.76	0.06	0.77	0.10	2.0	0.2	0.6	0.1	0.72	0.04	0.39	0.05	0.28	0.05	0.25	0.05	0.27	0.07	50
Mercury	0.1	0	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	0.1
Nickel	1.1	0.1	1.1	0.1	0.95	0.24	1.5	0.1	1.2	0.3	0.87	0.16	0.32	0.07	0.41	0.03	0.46	0.06	100
Silver	< 0.01	-	< 0.01	-	NC	NC	NC	NC	NC	NC	NC	NC	<0.01	-	<0.01	-	NC	NC	0.05
Zinc	1.6	0.2	0.8*	-	1.2	0.2	0.8	0.3	0.7	0.2	0.6	0.1	1.0	0.4	0.6*	-	0.8	0.1	1000
Fluoride (pCi/l)	1.1	0.1	1.2	0.1	1.1	0.1	1.1	0	1.1	0.1	1.1	0.1	1.0	0.1	0.9	0	1.0	0	5.0(mg/l)

NOTES:

* mean determined from 2 replicate values
** Station TPA-4B only

REMARKS:

1) Water quality standards for selected parameters in predominantly marine waters, Chapter 17-3, Florida Administrative Code for Class III waters.

NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentrations were below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-22

TAMPA

INORGANIC SEDIMENT QUALITY

FALL / WET SEASON

PARAMETER ppm (dry basis) \ STATION	TPA 1A WET(O)		TPA 6B WOET		TPA 8 SFT		TPA 9 SFT		TPA 10 SFT		TPA 11 SFT		TPA 12 SFT	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
ALUMINUM	13000	3600	20000	2000	26000*	-	27000	2500	18000	5500	19000	4500	29000	2300
CADMIUM	2.0*	-	1.6	0.3	0.93*	-	1.4	0.4	0.89	0.28	1.0	0.3	1.5	0.3
CHROMIUM	83	23	85	12	115	31	91	29	61	7	60	9	110	10
COPPER	122	18	14	5	26	11	21	3	12*	-	8.0*	-	42	5
IRON	14000	3000	11000	1200	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
LEAD	177	47	49	7	29	8	26	4	9*	-	18	4	52	27
MERCURY	0.34	0.04	0.56	0.12	0.25	0.05	0.26	0.04	0.22	0.03	0.12	0.03	0.23*	-
NICKEL	21*	-	18	3	19	4	33	14	18	5	9.5	2.4	14	4
SILVER	0.96	0.23	0.9	0.2	0.88*	-	0.62	0.22	0.32	0.10	0.37	0.09	1.3	0.3
ZINC	385	109	120	6	160	35	147	38	79	15	115*	-	180	12

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-23

TAMPA / MANATEE

ORGANIC WATER QUALITY

SPRING / DRY SEASON

PARAMETER µg/Liter / STATION	TPA-1A		TPA-2A		TPA-3B		TPA-4B		TPA-5B		TPA-6B		TPA-7C		MAN-1A		MAN-2B		STANDARD*
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
Pesticides																			
Mirex	<0.03	-	<0.03	-	<0.03	-	<0.03	-	<0.03	-	<0.03	-	<0.03	-	<0.03	-	<0.03	-	0.001
Toxaphene	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	0.005
DDT	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.001
Aldrin	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	0.003
Chlordane	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	0.004
Other Chlorinated (DDE)																			
PCB's	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	0.001
Phenols																			
2 - Chlorophenol	<0.1	-	<0.1	-	NC	NC	NC	NC	NC	NC	NC	NC	<0.1	-	<0.1	-	NC	NC	1.0
Phenol	<1.0	-	<1.0	-	NC	NC	NC	NC	NC	NC	NC	NC	<1.0	-	<1.0	-	NC	NC	1.0
2,4 - Dichlorophenol	<0.05	-	<0.05	-	NC	NC	NC	NC	NC	NC	NC	NC	<0.05	-	<0.05	-	NC	NC	1.0
2,4,6 - Trichlorophenol	<0.07	-	<0.07	-	NC	NC	NC	NC	NC	NC	NC	NC	<0.07	-	<0.07	-	NC	NC	1.0
4 - Chloro-m-cresol	<1.0	-	<1.0	-	NC	NC	NC	NC	NC	NC	NC	NC	<1.0	-	<1.0	-	NC	NC	1.0
2,4 - Dinitrophenol	<0.7	-	<0.7	-	NC	NC	NC	NC	NC	NC	NC	NC	<0.7	-	<0.7	-	NC	NC	1.0
Pentachlorophenol	<0.04	-	<0.04	-	NC	NC	NC	NC	NC	NC	NC	NC	<0.04	-	<0.04	-	NC*	NC	1.0

NOTES:

* Water quality standards for selected parameters in predominantly marine waters, Chapter 17-3, Florida Administrative Code for Class III waters.

REMARKS:

NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-24

TAMPA

ORGANIC WATER QUALITY

FALL / WET SEASON

STATION / PARAMETER µg/liter	TPA 1A WET(O)		TPA 2A WT(O)		TPA 3B WT(O)		TPA 4B WT(O)		TPA 5B WT(O)		TPA 6B WOET		STANDARD
PESTICIDES	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
MIREX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.02	-	0.001
TOXAPHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	-	0.005
DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.01	-	0.001
ALDRIN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.003	-	0.003
CHLORDANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	-	0.004
OTHER CHLORINATED	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NS
PHENOLS	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
2-CHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.3	0.8	1.0
PHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<5.0	-	1.0
2,4-DICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	-	1.0
2,4,6-TRICHOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	-	1.0
4-CHLORO-M-CRESOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.0	-	1.0
2,4-DINITROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<20	-	1.0
PENTACHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	-	1.0

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NA INDICATES ADDITIONAL ORGANIC ANALYSIS NOT COMPLETED DUE TO RESULTS OF ANALYSIS FOR STATION TPA 6B-WOET.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-25

TAMPA / MANATEE

GENERAL PHYSICAL AND CHEMICAL SEDIMENT QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETER \ STATION	TPA-1A		TPA-2A		TPA-3B		TPA-4B		TPA-5B		TPA-6B		TPA-7C		MAN-1A		MAN-2B	
	mean	σ		σ	mean	σ	mean	σ	mean	σ	mean	σ	mean	σ	mean	σ	mean	σ
Biological Oxygen Demand (mg O_2/kg)	3600	310	1100	290	3300	610	6300	57	2600	120	2600	310	NC	NC	6400	1100	11400	2900
Nitrate - N (mg/kg)	1.8	0.1	0.72	0.09	0.93	0.21	0.33	0.06	1.02	0.14	1.01	0.08	NC	NC	0.90	0.08	0.57	0.57
Phosphate (mg/kg)	2900	450	3800*	-	4100	640	7400	810	2700	310	3500	710	NC	NC	3100	550	2900	610
Specific Gravity	2.78	0.05	2.47	0.03	2.66	0.03	2.41	0.04	2.71	0.07	2.84	0.03	NC	NC	2.72	0.02	2.76	0.03
TKN (mg/kg)	3200	400	790*	-	3400	320	5400	200	1300	260	2200	400	NC	NC	2000*	-	7200	210
Total Organic Carbon (mg/kg)	23000	2600	7700	1700	19000*	-	41000	3600	20000	1000	24000	5600	NC	NC	28000	5700	31000	11000
Total Phosphorus (mg/kg)	3100	300	4300	360	4500	570	8100	1100	3200	120	3300*	-	NC	NC	4600	600	5000*	-
Total Solids (%)	24.5	1.9	43.6	6.2	28.3	4.3	17.4	1.2	30.5	0.7	27.0	4.9	NC	NC	24.0	2.3	25.1	4.4

NOTES: * Mean determined from 2 replicate values.

REMARKS: NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-26

TAMPA
GENERAL PHYSICAL AND CHEMICAL SEDIMENT CHARACTERISTICS

FALL / WET SEASON

STATION / PARAMETER ppm (dry basis)	TPA 1A WET (O)		TPA 6B WOET		TPA 8 SFT		TPA 9 SFT		TPA 10 SFT		TPA 11 SFT		TPA 12 SFT	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
SPECIFIC GRAVITY ¹	2.64	0.09	2.88	0.06	2.67	0.01	2.54	0.02	2.49	0.03	2.58	0.01	2.55	0.07
TOTAL KJELDAHL NITROGEN	1200	490	1000	100	1000	160	1300	400	1000	150	2200	1100	2100	150
TOTAL ORGANIC CARBON	13000*	-	7700	400	6400	1500	9500	1400	8900	570	8000	1900	12000	1000
AMMONIA -N	710*	-	225*	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
PHOSPHATE - P	1100	58	2200	150	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NITRATE - N	1.4	0.2	1.1	0.1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
OIL AND GREASE	NC	NC	NC	NC	144	84	420	150	315*	-	690	180	330*	-

NOTES:

- * MEAN DETERMINED USING TWO REPLICATE VALUES.
- \- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

¹ SPECIFIC GRAVITY AS SHOWN IS DIMENSIONLESS.

TABLE 2-27

TAMPA / MANATEE

INORGANIC SEDIMENT QUALITY CHARACTERISTICS

SPRING / DRY SEASON

STATION / PARAMETER ppm (dry basis)	TPA-1A		TPA-2A		TPA-3B		TPA-4B		TPA-5B		TPA-6B		TPA-7C		MAN-1A		MAN-2B	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
Aluminum	2200	150	1300	300	2200	150	3600	500	3600	290	3500	210	NC	NC	1800	210	1900	310
Antimony	<0.5	-	<0.5	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	<0.5	-	NC	NC
Arsenic	9.3	2.2	<0.1	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	4.6	-	NC	NC
Cadmium	2.2	0.2	0.96	0.21	1.4	0.25	3.6	0.40	0.60	0.11	1.5	0.3	NC	NC	0.64	0.10	0.65	0.35
Chromium	100	10	54.5*	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	57	4	NC	NC
Copper	130	6	4.0	1.0	6.6	1.1	22.0*	-	5.3	1.7	14	3	NC	NC	10	1	10*	-
Fluoride	14	3	8.1	1.1	23	5	62	3	13	1	20	4	NC	NC	22	3	17	2
Iron	19000	1500	7500	610	14000	1500	22000	2000	24000	1000	12000*	-	NC	NC	14000	1000	14000	3600
Lead	130	10	7.5	1.6	15	4	40	6	14	4	45*	-	NC	NC	10	1	10	2
Mercury	1.2	0.4	0.20	0.05	0.55	0.05	1.2	0.2	0.69	0.13	0.42	0.08	NC	NC	0.29	0.08	0.31*	-
Nickel	47	8	9.3	2.7	14*	-	26*	-	16*	-	11	3	NC	NC	12	1	17	6
Silver	0.92	0.07	0.21	0.04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.20	0.04	NC	NC
Zinc	320	25	29*	-	52	6	160	5	31	3	180*	-	NC	NC	77	9	32	9
Radium (pCi/g)	NC	NC	NC	NC	NC	NC	<0.05	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-2).

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

TABLE 2-28

TAMPA

INORGANIC WATER QUALITY

FALL / WET SEASON

STATION / PARAMETER µg/liter	TPA 1A WET(O)		TPA 2A WT(O)		TPA 3B WT(O)		TPA 4B WT(O)		TPA 5B WT(O)		TPA 6B WOET		TPA 8 SFT		TPA 9 SFT		TPA 10 SFT		TPA 11 SFT		TPA 12 SFT		TPA 13 XT		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	2.5*	-	1500
CADMIUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.65	0.06	0.57	0.09	0.55	0.18	0.05	0.01	0.02	0.01	0.02	0.01	5.0
CHROMIUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.0	0.1	50
COPPER	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.36	0.05	0.44	0.02	0.44	0.11	0.95	0.22	0.73	0.09	0.77	0.05	15
FLUORIDE[1]	1.0	0	1.0	0.1	1.1	0.1	1.0	0	1.2	0.1	1.0	0	0.98	0.03	1.0	0.1	1.0	0	1.0	0	1.0	0	1.0	0	5.0[1]
IRON	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	7.9	0.6	300
LEAD	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	2.4	0.4	1.1	0.2	2.0	0.25	0.29	0.02	0.30	0.07	0.36	0.07	50
MERCURY	0.19	0.05	<0.10	-	0.13	0.04	<0.1	-	<0.1	-	0.13	0.04	0.39	0.03	<0.10	-	0.17	0.04	<0.1	-	<0.10	-	<0.1	-	0.1
NICKEL	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.0	0.2	100
SILVER	0.04	0.01	0.02	0.01	0.01*	-	0.01	0	0.01*	-	0.03	0.01	0.02*	-	<0.02	-	0.03	0.01	0.01*	-	0.04	0.01	0.03	0.01	0.05
ZINC	3.4	1.0	2.2	0.2	1.5	0.1	<1.1	-	1.4	0.3	1.8	0.2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	3.9	0.3	1000

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

[1] FLUORIDE UNITES ARE MG/L.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-29

METAL:ALUMINUM RATIOS IN SEDIMENTS
PORT TAMPA

Station	Cd $(\times 10^{-3})$	Cr $(\times 10^{-1})$	Cu $(\times 10^{-3})$	Fe $(\times 10^{0})$	Pb $(\times 10^{-3})$	Hg $(\times 10^{-4})$	Ni $(\times 10^{-3})$	Ag $(\times 10^{-4})$	Zn $(\times 10^{-3})$	F $(\times 10^{-3})$
TPA-1A	1.0	0.45	59.1	8.6	59.1	5.5	21.4	4.2	145.5	6.4
TPA-1A-WET(O)	0.15	0.06	9.4	1.1	13.6	0.26	1.6[1]	0.74	29.6	NC
TPA-2A	0.7	0.4[1]	3.1	5.8	5.8	1.5	7.2	1.6	22.3[1]	6.2
TPA-3B	0.6	NC	3.0	6.4	6.8	2.5	6.4	NC	23.6	10.5
TPA-4B	1.0	NC	6.1[1]	6.1	11.1	3.3	7.2	NC	44.4	17.2
TPA-5B	0.17	NC	1.5	6.7	3.9	1.9	4.4[1]	NC	8.6	3.6
TPA-6B	0.4	NC	4.0	3.4	12.9	1.2	3.1	NC	51.4	5.7
TPA 6B-WOET	0.08	0.04	0.7	0.55	2.5	0.28	0.09	0.45	6.0	NC
TPA 8-SFT[2]	0.04[1]	0.04	1.0	NC	1.1	0.10	0.73	0.34[1]	6.2	NC
TPA 9-SFT	0.05	0.03	0.8	NC	1.0	0.10	1.2	0.23	5.4	NC
TPA 10-SFT	0.05	0.03	0.7[1]	NC	0.5[1]	0.12	1.0	0.18	4.4	NC
TPA 11-SFT	0.05	0.03	0.4[1]	NC	0.95	0.06	0.50	0.19	1.4[1]	NC
TPA 12-SFT	0.05	0.04	1.4	NC	1.8	0.08[1]	0.48	0.45	6.2	NC
Crustal* Ratio	0.002	0.01	0.7	0.7	0.15	0.01	0.9	0.001	0.8	7.6
Carbonate** Rocks	0.009	0.03	1.0	0.9	2.1	0.1	4.8	0.05	48	7.8

NOTES:

NC Indicates ratio not determined due to station designation (see Tables 1-2 and 1-3)
1 Ratio determined using the mean of two replicate metal values
2 Ratios determined using the mean of two aluminum values
* From Taylor (1964)
** From Turekian and Wedepohl (1961)

TABLE 2-30

TAMPA / MANATEE
ORGANIC SEDIMENT QUALITY

SPRING / DRY SEASON

STATION PARAMETER ppm (dry basis)	TPA-1A		TPA-2A		TPA-3B		TPA-4B		TPA-5B		TPA-6B		TPA-7C		MAN-1A		MAN-2B	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
Pesticides																		
Mirex	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-	<0.001	-
Toxaphene	<0.02	-	<0.02	-	<0.02	-	<0.02	-	<0.02	-	<0.02	-	NC	NC	<0.02	-	<0.02	-
DDT	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-	<0.001	-
Aldrin	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-	<0.001	-
Chlordane	<0.006	-	<0.006	-	<0.006	-	<0.006	-	<0.006	-	1,2 <0.006	-	NC	NC	<0.006	-	<0.006	-
Other Chlorinated (DDE)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1 0.001	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PCB's	<0.002	-	<0.002	-	<0.002	-	<0.002	-	<0.002	-	<0.002	-	NC	NC	<0.002	-	<0.002	-
Oil and Grease	2000*	-	835*	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	820	120	NC	NC
Phenols																		
Phenol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	NC	NC	<0.2	-	<1.2	-
2 - Chlorophenol	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	NC	NC	<0.01	-	<0.01	-
2,4 - Dichlorophenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	NC	NC	<0.1	-	<0.1	-
2,4,6 - Trichlorophenol	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	NC	NC	<0.01	-	<0.01	-
4 - Chloro-m-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	NC	NC	<0.2	-	<0.2	-
2,4 - Dinitrophenol	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	NC	NC	<0.3	-	<0.3	-
Pentachlorophenol	<0.007	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	NC	NC	<0.005	-	<0.005	-

NOTES:

1) Observed in one replicate only, other replicate values below deflection limit.
2) Possible trace (TR) observed in one replicate only.
* Mean determined using 2 replicate values.

REMARKS:

NC refers to analysis not completed due to station designation (See table 1.2).
For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

NA Indicates no analysis completed

TABLE 2-31

TAMPA

ORGANIC SEDIMENT QUALITY

FALL / WET SEASON

STATION / PARAMETERS ppm (dry basis)	TPA 1A WET(O)		TPA 6B WOET		TPA 8 SFT		TPA 9 SFT		TPA 10 SFT		TPA 11 SFT		TPA 12 SFT	
PESTICIDES	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
MIREX	NC	NC	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
TOXAPHENE	NC	NC	NC	NC	<0.015	-	<0.015	-	<0.015	-	<0.015	-	<0.015	-
ALDRIN	NC	NC	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
CHLORDANE	NC	NC	NC	NC	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-
DDT	NC	NC	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
OTHER CHLORINATED	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
PHENOLS	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
2-CHLOROPHENOL	NC	NC	NC	NC	< 0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-
PHENOL	NC	NC	NC	NC	< 1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-
2,4-DICHLOROPHENOL	NC	NC	NC	NC	< 1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-
2,4,6-TRICHLOROPHENOL	NC	NC	NC	NC	< 0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-
4-CHLORO-M-CRESOL	NC	NC	NC	NC	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-
2,4-DINITROPHENOL	NC	NC	NC	NC	<0.07	-	<0.07	-	<0.07	-	<0.07	-	<0.07	-
PENTACHLOROPHENOL	NC	NC	NC	NC	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-32

TAMPA

ELUTRIATE RESULTS

PARAMETER / STATION μg/l[1]	TPA 13 XT MEAN	σ	TPA 1A WET (O) MEAN	σ	TPA 6B WOET MEAN	σ	STANDARD
ALUMINUM	2.5*	-	3.1	0.2	2.7	0.4	1500
CADMIUM	0.02	0.01	0.06	0.01	0.06	0.01	5.0
CHROMIUM	1.0	0.1	2.3	0.2	4.1	0.9	50
COPPER	0.77	0.05	0.27	0.06	0.28	0.07	15
IRON	7.9	0.6	15	2.0	13	2.0	300
LEAD	0.36	0.07	0.38	0.05	0.35	0.05	50
MERCURY	<0.1	-	0.22	0.02	0.21	0.03	0.1
NICKEL	1.0	0.2	5.0	0.4	3.9	0.6	100
SILVER	0.03	0.01	0.09	0.02	0.07	0.01	0.05
ZINC	3.9	0.3	3.8	0.4	4.7	0.5	1000
FLUORIDE	1.0	0	1.2	0.1	1.2	0.1	5.0
TOTAL KJELDAHL NITROGEN	3.1	0.5	15	2	16	4	NS
TOTAL ORGANIC CARBON	5.2	0.3	7.2	0.7	12	0.6	NS
AMMONIA-N	0.10	0.02	8.5	0.7	11.1	1.5	NS
NITRATE-N	0.07	0.02	0.16	0.03	0.11	0.02	NS
PHOSPHATE-P	0.59	0.10	1.03	0.15	1.1	0.2	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		POST-ELUTRIATE TEST RESULTS		STANDARD

NOTES:

NS REFERS TO STANDARDS NOT AVAILABLE

[1] UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L

NOTES:

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT

* MEAN DETERMINED USING 2 REPLICATE VALUES

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINANTLY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TABLE 2-32

TAMPA

ELUTRIATE RESULTS

PARAMETER µg/l[1] \ STATION	TPA 13 XT		TPA 1A WET (O)		TPA 6B WOET		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	2.5*	-	3.1	0.2	2.7	0.4	1500
CADMIUM	0.02	0.01	0.06	0.01	0.06	0.01	5.0
CHROMIUM	1.0	0.1	2.3	0.2	4.1	0.9	50
COPPER	0.77	0.05	0.27	0.06	0.28	0.07	15
IRON	7.9	0.6	15	2.0	13	2.0	300
LEAD	0.36	0.07	0.38	0.05	0.35	0.05	50
MERCURY	<0.1	-	0.22	0.02	0.21	0.03	0.1
NICKEL	1.0	0.2	5.0	0.4	3.9	0.6	100
SILVER	0.03	0.01	0.09	0.02	0.07	0.01	0.05
ZINC	3.9	0.3	3.8	0.4	4.7	0.5	1000
FLUORIDE	1.0	0	1.2	0.1	1.2	0.1	5.0
TOTAL KJELDAHL NITROGEN	3.1	0.5	15	2	16	4	NS
TOTAL ORGANIC CARBON	5.2	0.3	7.2	0.7	12	0.6	NS
AMMONIA-N	0.10	0.02	8.5	0.7	11.1	1.5	NS
NITRATE-N	0.07	0.02	0.16	0.03	0.11	0.02	NS
PHOSPHATE-P	0.59	0.10	1.03	0.15	1.1	0.2	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		POST-ELUTRIATE TEST RESULTS		STANDARD

NOTES:

NS REFERS TO STANDARDS NOT AVAILABLE

[1] UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT

* MEAN DETERMINED USING 2 REPLICATE VALUES

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINANTLY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TABLE 2-33

MANATEE

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

FALL / WET SEASON

STATION PARAMETER	MAN 1A WET (O)	MAN 2B WOT	MAN 3 SFT	STANDARD
TEMPERATURE (°C)*	28	29	28	NA
SALINITY (PPT)	28.5	30	27	NA
DISSOLVED OXYGEN (mg/l)	6.5	3.5	NA	4
DISSOLVED OXYGEN (% SATURATION)	95.6	53.4	NA	NA
TURBIDITY (NTU)	2.9	2.1	4.4	NA
CONDUCTIVITY (µmhos)	35700	37600	36100	NA
pH	7.8	7.6	7.9	≥ 6.0 ≤ 8.5

NOTES:

NA REFERS TO DATA NOT AVAILABLE

* VALUES DETERMINED WITH THE D.O. METER.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-34

MANATEE
INORGANIC WATER QUALITY
FALL / WET SEASON

PARAMETER µg/liter \ STATION	MAN 1A WET(O)		MAN 2B WOT		MAN 3 SFT		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	NC	NC	NC	NC	NC	NC	1500
CADMIUM	NC	NC	NC	NC	0.06	0.01	5.0
CHROMIUM	NC	NC	NC	NC	NC	NC	50
COPPER	NC	NC	NC	NC	0.43	0.05	15
FLUORIDE[1]	0.98	0.03	1.0	0	1.0	0.2	5.0[1]
IRON	NC	NC	NC	NC	NC	NC	300
LEAD	NC	NC	NC	NC	0.27	0.03	50
MERCURY	< 0.10	-	< 0.1	-	< 0.10	-	0.1
NICKEL	NC	NC	NC	NC	NC	NC	100
SILVER	0.02	0	0.01*	-	0.02	0.01	0.05
ZINC	< 1.1	-	< 1.0	-	NC	NC	1000

NOTES:

- * MEAN DETERMINED USING TWO REPLICATE VALUES.
- \- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.
- NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).
- 1 FLORIDE UNITS IN MG/L.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE III WATERS.

TABLE 2-35

MANATEE
ORGANIC WATER QUALITY
FALL / WET SEASON

STATION PARAMETER μg/liter	MAN 1A WET(O)		MAN 2B WOT		STANDARD
PESTICIDES	MEAN	σ	MEAN	σ	
MIREX	NA	NA	< 0.02	-	0.001
TOXAPHENE	NA	NA	< 0.2	-	0.005
DDT	NA	NA	< 0.01	-	0.001
ALDRIN	NA	NA	< 0.003	-	0.003
CHLORDANE	NA	NA	< 0.2	-	0.004
OTHER CHLORINATED	NC	NC	NC	NC	NS
PHENOLS	MEAN	σ	MEAN	σ	
2-CHLOROPHENOL	NA	NA	< 1.0	-	1.0
PHENOL	NA	NA	< 5.0	-	1.0
2,4-DICHLOROPHENOL	NA	NA	< 0.05	-	1.0
2,4,6-TRICHLOPHENOL	NA	NA	< 0.05	-	1.0
4-CHLORO-M-CRESOL	NA	NA	< 2.0	-	1.0
2,4-DINITROPHENOL	NA	NA	<20	-	1.0
PENTACHLOROPHENOL	NA	NA	< 0.05	-	1.0

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NS INDICATES STANDARD NOT AVAILABLE.

NA INDICATES ADDITIONAL ORGANIC ANALYSIS NOT COMPLETED DUE TO RESULTS FOR TPA 6B-WOET.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-36

MANATEE

GENERAL PHYSICAL AND CHEMICAL SEDIMENT CHARACTERISTICS

FALL / WET SEASON

STATION PARAMETER ppm (dry basis)	MAN 1A WET (O)		MAN 3 SFT	
	MEAN	σ	MEAN	σ
SPECIFIC GRAVITY [1]	2.76	0.03	2.70	0.03
TOTAL KJELDAHL NITROGEN	2300	750	330	82
TOTAL ORGANIC CARBON	16000	4900	1300	430
AMMONIA - N	470	78	NC	NC
PHOSPHATE - P	1400	210	NC	NC
NITRATE - N	1.2	0.4	NC	NC
OIL and GREASE	NC	NC	330	75

NOTES:

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

[1] SPECIFIC GRAVITY AS SHOWN IS DIMENSIONLESS.

TABLE 2-37

METAL:ALUMINUM RATIOS IN SEDIMENTS
PORT MANATEE

Station	Cd $(\times10^{-3})$	Cr $(\times10^{-1})$	Cu $(\times10^{-3})$	Fe $(\times10^{0})$	Pb $(\times10^{-3})$	Hg $(\times10^{-4})$	Ni $(\times10^{-3})$	Ag $(\times10^{-4})$	Zn $(\times10^{-3})$	F $(\times10^{-3})$
MAN-1A	0.36	0.32	5.6	7.8	5.6	1.6	6.7	1.1	42.8	12.2
MAN 1A-WET(O)	0.05	0.02	1.4	0.6	0.9	0.17	1.1	0.2[1]	1.2	NC
MAN-2B	0.34	NC	5.3	7.4	5.3	1.6[1]	8.9	NC	16.8	8.9
MAN 3-SFT	0.10	0.06[1]	0.1	NC	1.8[1]	0.7	1.3[1]	0.9	2.1[1]	NC
Crustal* Ratio	0.002	0.01	0.7	0.7	0.15	0.01	0.9	0.001	0.8	7.6
Carbonate** Rocks	0.009	0.03	1.0	0.9	2.1	0.1	4.8	0.05	48	7.8

NOTES:

NC Indicates ratio not determined due to station designation (see Tables 1-2 and 1-3)

1 Ratio determined using the mean of two replicate metal values.

* From Taylor (1964)

** From Turekian and Wedepohl (1961)

MANATEE

INORGANIC SEDIMENT QUALITY

FALL / WET SEASON

STATION / PARAMETER ppm (dry basis)	MAN 1A WET (O)		MAN 3 SFT	
	MEAN	σ	MEAN	σ
ALUMINUM	15000	3800	2100	500
CADMIUM	0.78	0.03	0.22	0.05
CHROMIUM	32	9	13*	-
COPPER	21	5	2.0*	-
IRON	8700	2400	NC	NC
LEAD	13	4	3.8*	-
MERCURY	0.25	0.09	0.14	0.03
NICKEL	16	5	2.7*	-
SILVER	0.31*	-	0.19	0.04
ZINC	18	11	4.5*	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-39

MANATEE
ORGANIC SEDIMENT QUALITY
FALL / WET SEASON

STATION PARAMETER ppm (dry bases)	MAN 1A WET(O)		MAN 3 SFT	
PESTICIDES	MEAN	σ	MEAN	σ
MIREX	NC	NC	<0.001	-
TOXAPHENE	NC	NC	<0.015	-
ALDRIN	NC	NC	<0.001	-
CHLORDANE	NC	NC	<0.005	-
DDT	NC	NC	<0.001	-
OTHER CHLORINATED	NC	NC	NC	NC
PHENOLS	MEAN	σ	MEAN	σ
2-CHLOROPHENOL	NC	NC	<0.05	-
PHENOL	NC	NC	<1.0	-
2,4-DICHLOROPHENOL	NC	NC	<1.0	-
2,4,6-TRICHLOROPHENOL	NC	NC	<0.01	-
4-CHLORO-M-CRESOL	NC	NC	<0.1	-
2,4-DINITROPHENOL	NC	NC	<0.07	-
PENTACHLOROPHENOL	NC	NC	<0.01	-

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-40

MANATEE
ELUTRIATE RESULTS

PARAMETER $\mu g/l^1$ / STATION	TPA 13 XT MEAN	TPA 13 XT σ	MAN 1A WET(O) MEAN	MAN 1A WET(O) σ	STANDARD
ALUMINUM	2.5*	-	4.1	0.7	1500
CADMIUM	0.02	0.01	0.04	0.01	5.0
CHROMIUM	1.0	0.1	2.2	0.6	50
COPPER	0.77	0.05	0.80	0.05	15
IRON	7.9	0.6	11.1	1.9	300
LEAD	0.36	0.07	0.52	0.11	50
MERCURY	< 0.1	-	<0.10 *	-	0.1
NICKEL	1.0	0.2	2.1	0.2	100
SILVER	0.03	0.01	0.09	0.02	0.05
ZINC	3.9	0.3	2.1	0.2	1000
FLUORIDE	1.0	0	1.1	0.06	5.0
TOTAL KJELDAHL NITROGEN	3.1	0.5	14	2.5	NS
TOTAL ORGANIC CARBON	5.2	0.3	8.6	0.3	NS
AMMONIA -N	0.10	0.02	9.5	0.6	NS
NITRATE -N	0.07	0.02	0.12	0.02	NS
PHOSPHATE -P	0.59	0.10	3.3*	-	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		STANDARD

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT

* MEAN DETERMINED USING 2 REPLICATE VALUES

NS REFERS TO STANDARD NOT AVAILABLE

1 UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINANTLY MARINE WATERS. CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TA 2-41

JACKSONVILLE

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETER \ STATION	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B		JAX-9C		STANDARD[1]
Temperature (°C)	22		21		22		24		21		23		23		22		20		NA
Salinity (PPT)	5		5		15		20		18		17		17		18		30		NA
pH	7.3		7.6		7.3		7.5		8.0		7.8		8.2		7.7		8.0		≥6.0 ≤8.5
Dissolved Oxygen (mg/l)	7.4		6.0		5.2		5.6		5.4		5.5		5.2		5.4		6.9		4
Dissolved Oxygen (% Saturation)	87		69		71		74		68		70		67		68		90		NA
Turbidity (NTU)	11.5		11.0		9.1		11.5		11.0		17.0		11.5		9.5		3.2		NA
Conductivity (µmhos)	6000		8500		19000		26000		22000		24000		24000		23500		37000		NA
Ammonia[2] (mg/l)	<0.01	-	0.02	0.01	<0.01	-	0.03	0.01	0.05	0.01	<0.01	-	<0.01	-	0.05	0.01	0.02	0.01	NA
Nitrate (mg/l)	0.15	0.02	0.14	0.03	0.10	0.02	0.10	0.01	0.15	0.03	0.15	0.02	0.09	0.01	0.09	0.31	0.04	0.01	NA
Total Kjeldahl Nitrogen (mg/l)	0.80	0.20	0.80	0.10	0.60	0.20	0.50	0.10	0.60	0	0.30	0.10	0.60	0.10	0.40	0.10	0.04	0.01	NA
Phosphate - P (mg/l)	0.10	0.01	0.09	0.01	0.08	0.01	0.10	0.01	0.11	0	0.09	0.01	0.09	0.01	0.06	0.01	0.01	0	NA
Total Phosphorus (mg/l)	0.16	0.02	0.24	0.02	0.18	0.05	0.15	0.01	0.25	0.01	0.18	0.02	0.31	0.03	0.12	0.01	0.03	0.01	NA
Total Organic Carbon (mg/l)	12.8	0.29	11.0	0.23	10.3	0.70	8.70	0.20	9.70	0.10	8.90	0.50	9.10	0.26	8.90	0.63	2.80	0.10	NA
Biological Oxygen Demand (mgO_2/l)	3.10	0.40	2.70	0.2	2.50	0.50	2.10	0.20	1.80	0.30	2.50	0.30	2.00	0.2	3.10*	-	2.3	0.32	NA
Total Suspended Solids (mg/l)	26*	1	26	5	65	6	65	8	62	3	55	3	56	6	41	-	52	2	NA

NOTES:

1) Water quality standards for selected parameters in predominantly marine waters, Chapter 17-3, Florida Administrative Code for Class III waters
2) For Ammonia through Total Suspended Solids Parameters, the left column contains the mean and the right column contains the standard deviation for replicate samples.
* Mean determined using 2 replicate values.

REMARKS:

NA refers to water quality standard not available.

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. *For these cases, a dash (-) is presented to indicate where data was not determined.*

TABLE 2-42

JACKSONVILLE

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

FALL / WET SEASON

PARAMETER \ STATION	JAX 3A FWE (O)		JAX 4B WJT(O)		JAX 5B WJ(O)		JAX 6A WJ(O)		JAX 7A WOJ		JAX 8B WJ(O)		JAX 10 SFJ		JAX 11 FJ		JAX 12 SFJ		JAX 13 SFJ		JAX 14 X		JAX 15 WEJ		JAX 16 S		STANDARD
TEMPERATURE (°C)	24.9		24.5		24.5		25		25		25		24		24.9		25		24.5		25		24		24.9*		NS
SALINITY (ppt)	8.0		4.5		14.5		7.3		14		31.2		5.0		5.0		12.5		15.5		11.0		9.5		10.4**		NS
pH	7.4		7.5		7.7		7.4		7.7		7.6		7.5		7.4		7.4		7.7		7.4		7.6		NA		≥ 6.0 ≤ 8.5
DISSOLVED OXYGEN (mg/l)	4.9		7.6		7.9		5.2		6.9		6.2		7.3		5.1		5.6		7.7		NA		5.8		6.3		4
DISSOLVED OXYGEN (% SATURATION)	61.8		92.9		102.3		65.3		90.7		89.0		88.8		63.2		72.4		100.3		NA		72.3		80.1		NS
TURBIDITY (NTU)	28		9.5		6.1		4.5		7.3		7.2		8.5		7.3		9.7		4.1		NA		NA		NA		NS
CONDUCTIVITY (μmhos)	13800		7500		21400		12200		20100		38600		10000		9100		17650		24000		NA		15500		16400		NS
TOTAL KJELDAHL NITROGEN (mg/l)	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.49	0.08	NC	NC	NC	NC	NS
TOTAL ORGANIC CARBON (mg/l)	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	12	1	NC	NC	NC	NC	NS

NOTES: FOR PARAMETERS BELOW CONDUCTIVITY, THE LEFT COLUMN CONTAINS THE MEAN AND THE RIGHT COLUMN CONTAINS THE STANDARD DEVIATION OF REPLICATE SAMPLES FOR EACH STATION.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NA REFERS TO DATA NOT AVAILABLE.

NS INDICATES NO STANDARD AVAILABLE.

REMARKS: STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

* VALUE DETERMINED WITH THE D.O. METER PROBE AT WATER SURFACE.

** VALUE DETERMINED WITH THE SCT METER AT WATER SURFACE.

TABLE 2-43

JACKSONVILLE

INORGANIC WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

STATION PARAMETER µg/liter	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B		JAX-9C		Standard[1]
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
Antimony	NC	NC	<0.1	-	<0.1	-	NC	NC	NC	NC	<0.1	-	<0.1	-	NC	NC	<0.1	-	200
Arsenic	NC	NC	1.8	0.2	1.7	0.2	NC	NC	NC	NC	2.0	0.2	1.7	0.1	NC	NC	1.0	0.1	50
Cadmium	0.03	0.01	0.05	0.01	0.03	0.01	0.02	0.01	0.06	0	0.04	0.01	0.03*	-	0.02	0.01	0.02*	-	5.0
Chromium	NC	NC	0.87	0.16	1.3*	-	NC	NC	NC	NC	1.6	0.3	0.81*	-	NC	NC	0.11	-	50
Copper	1.1	0.1	0.98	0.11	0.95	0.05	0.85	0.05	1.0	0.1	1.2	0.1	1.2	0.1	0.97	0.01	0.69	0.06	15
Iron	18	2	17	3	21	1.7	17	2	6.9	0.7	9.5	1.8	7.4	0.2	2.9	0.8	1.7	0.1	300
Lead	1.9	0.2	1.8	0.2	1.2	0.1	1.1	0.1	0.97	0.02	1.5	0.2	0.92	0.06	0.61	0.06	0.21	0.03	50
Mercury	0.11	0.02	0.12	0.02	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	0.1
Nickel	0.53	0.03	0.65	0.08	0.66	0.07	0.56	0.06	0.47	0.12	0.42	0.08	0.32	0.04	0.2	0.1	0.21	0.03	100
Silver	NC	NC	<0.01	-	<0.01	-	NC	NC	NC	NC	0.02	0.01	0.02	0	NC	NC	0.01*	-	0.5
Zinc	1.5	0.1	1.2	0.3	1.2	0.2	0.7	0.1	0.6	0.1	0.6	0	0.7	0.1	0.5	0.1	0.6	0.2	1000
Fluoride	NC	NC	NC	NC	NC	NC	0.6	0.1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5000

Notes: 1) Water quality standards for selected parameters in predominantely marine waters, Chapter 17-3, Florida Administrative Code for Class III Waters

* Mean determined using 2 replicate values

Remarks: NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-44

JACKSONVILLE

INORGANIC WATER QUALITY

FALL / WET SEASON

STATION / PARAMETER µg/liter	JAX 3A FWE (O)		JAX 4B WJT(O)		JAX 5B WJ(O)		JAX 6A WJ (O)		JAX 7A WOJ		JAX 8B WJ (O)		JAX 10 SFJ		JAX 11 FJ		JAX 12 SFJ		JAX 13 SFJ		JAX 14 X		JAX 15 WEJ		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	3.4	0.4	NC	NC	1500
CADMIUM	0.09	0.01	0.02	0.01	0.08	0.02	0.44	0.05	0.09*	-	0.60	0.19	0.09	0.02	0.06	0.02	0.08*	-	0.02	0	0.05	0.01	0.05	0.01	5.0'
CHROMIUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.49	0.04	NC	NC	50
COPPER	1.4	0.2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.5	0.3	1.1	0.1	1.1	0.1	1.0	0.1	0.77	0.05	NC	NC	15
FLUORIDE [a]	NC	NC	0.44	0.04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5.0'
IRON	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	19	2	NC	NC	300
LEAD	2.0	0.2	0.36	0.03	1.2	0.3	6.9	0.7	1.8	0.4	4.3	0.9	1.9	0.4	1.4	0.3	1.3	0.2	1.0	0.2	0.91	0.04	NC	NC	50
MERCURY	<0.11	-	<0.1	-	0.26	0.06	0.30	0.05	<0.10	-	<0.1	-	<0.10	-	0.17	0.03	0.16	0.04	0.16	0.06	<0.1	-	0.12	0.03	0.1
NICKEL	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.28	0.04	NC	NC	100
SILVER	<0.01	-	<0.01	-	0.02	0	0.02	0.01	0.02	0.01	<0.01*	-	0.02	0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.05
ZINC	4.7	0.5	<1.0	-	<1.1	-	29	6	<1.1	-	1.5	0.2	NC	NC	NC	NC	NC	NC	NC	NC	2.5	0.2	2.6	0.3	1000

NOTES:

- * MEAN DETERMINED USING TWO REPLICATE VALUES.
- \- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.
- NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).
- [a] FLUORIDE UNITS ARE MG/L.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-45

JACKSONVILLE

ORGANIC WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETER ug/liter \ STATION	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B		JAX-9C		Standard[1]
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
Pesticides																			
Mirex	<0.03	-	<0.03	-	<0.03	-	<0.03	-	<0.03	-	0.03	-	<0.03	-	<0.03	-	<0.03	-	0.001
Toxaphene	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	0.25	-	<0.25	-	<0.25	-	<0.25	-	0.005
DDT	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.001
Aldrin	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	0.005	-	<0.005	-	<0.005	-	<0.005	-	0.003
Chlordane	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.02	-	<0.02	-	<0.2	-	<0.2	-	0.004
PCB's	NC	NC	<0.25	-	<0.25	-	NC	NC	NC	NC	<0.25	-	<0.25	-	NC	NC	<0.25	-	0.001
Phenols																			
2 - Chlorophenol	NC	NC	<0.1	-	<0.1	-	NC	NC	NC	NC	<0.1	-	<0.1	-	NC	NC	<0.1	-	1.0
Phenol	NC	NC	<1.0	-	<1.0	-	NC	NC	NC	NC	<1.0	-	<1.0	-	NC	NC	<1.0	-	1.0
2,4 - Dichlorophenol	NC	NC	<0.05	-	<0.05	-	NC	NC	NC	NC	<0.05	-	<0.05	-	NC	NC	<0.05	-	1.0
2,4,6 - Trichlorophenol	NC	NC	<0.07	-	<0.07	-	NC	NC	NC	NC	<0.07	-	<0.07	-	NC	NC	<0.07	-	1.0
4 - Chloro-m-cresol	NC	NC	<1.0	-	<1.0	-	NC	NC	NC	NC	<1.0	-	<1.0	-	NC	NC	<1.0	-	1.0
2,4 - Dinitrophenol	NC	NC	<0.7	-	<0.7	-	NC	NC	NC	NC	<0.7	-	<0.7	-	NC	NC	<0.7	-	1.0
Pentachlorophenol	NC	NC	<0.04	-	0.04	-	NC	NC	NC	NC	<0.04	-	<0.04	-	NC	NC	<0.04	-	1.0

NOTES:

Water Quality Standards For Selected Marine Parameters in Predominately Marine Waters. Chapter 17-3, Florida Administrative Code For Class 111 Waters.
*Mean and deviation determined using 2 replicate values.

REMARKS:

NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-46

JACKSONVILLE

ORGANIC WATER QUALITY

FALL / WET SEASON

STATION PARAMETER µg/liter	JAX 3A FWE (O)		JAX 4B WJT(O)		JAX 5B WJ(O)		JAX 6A WJ(O)		JAX 7A WOJ		JAX 8B WJ(O)		STANDARD
PESTICIDES	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
MIREX	NA	NA	NA	NA	NA	NA	NA	NA	< 0.02	-	NA	NA	0.001
TOXAPHENE	NA	NA	NA	NA	NA	NA	NA	NA	< 0.2	-	NA	NA	0.005
DDT	NA	NA	NA	NA	NA	NA	NA	NA	< 0.01	-	NA	NA	0.001
ALDRIN	NA	NA	NA	NA	NA	NA	NA	NA	< 0.003	-	NA	NA	0.003
CHLORDANE	NA	NA	NA	NA	NA	NA	NA	NA	< 0.2	-	NA	NA	0.004
OTHER CHLORINATED	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NS
PHENOLS	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
2-CHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 1.0	-	NA	NA	1.0
PHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 5.0	-	NA	NA	1.0
2,4-DICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 0.05	-	NA	NA	1.0
2,4,6-TRICHOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 0.05	-	NA	NA	1.0
4-CHLORO-M-CRESOL	NA	NA	NA	NA	NA	NA	NA	NA	< 2.0	-	NA	NA	1.0
2,4-DINITROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 20	-	NA	NA	1.0
PENTACHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 0.09	-	NA	NA	1.0

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NA INDICATES ADDITIONAL ORGANIC ANALYSIS NOT COMPLETED DUE TO RESULTS FOR JAX 7A WOJ

NS INDICATES NO STANDARD AVAILABLE.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-47

JACKSONVILLE

GENERAL PHYSICAL AND CHEMICAL SEDIMENT QUALITY CHARACTERISTICS

SPRING / DRY SEASON

STATION / PARAMETER	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6B		JAX-7A		JAX-8B		JAX-9C	
	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ
Biological Oxygen Demand (mg O_2/kg)	350	53	440	90	4100	1300	7000	600	160	15	200	60	380	70	160*	-	NC	NC
Nitrate - N (mg/kg)	5.2	1.2	0.61	0.04	0.62	0.05	1.0	0.2	0.32	0.05	1.3	0.1	0.92	0.09	0.66	0.09	NC	NC
Phosphate (mg/kg)	31	5	37	8	600	180	900	100	15	6	56	14	120	10	110	17	NC	NC
Specific Gravity	2.60	0.07	2.69	0.01	2.46	0.04	2.43	0.05	2.48	0.02	2.67	0.02	3.05	0.13	2.70	0.08	NC	NC
Total Kjeldahl Nitrogen (mg/kg)	240	70	320*	-	3200*	-	9100	1900	650	250	89*	-	350	90	130	55	NC	NC
Total Organic Carbon (mg/kg)	4800	700	3700	800	11000	3300	43000	1200	1100	270	960	230	1100	57	820	91	NC	NC
Total Phosphorus (mg/kg)	130	29	150	46	1600	330	2200	210	87*	-	240*	-	670	21	160	20	NC	NC
Total Solids (%)	73.8	1.2	75.9	1.1	26.9	3.8	19.2	2.3	76.8	1.5	76.2	1.8	76.1	3.2	77.0	2.0	NC	NC

NOTES: * Mean determined from 2 replicate values.

REMARKS: NC refers to analysis not completed due to station designation (See table 1-2)

For those cases where the mean was determined from 2 replicate values or where concentrations were below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

The results presented for Station Jax-8B were determined from 3 splits of 1 sample

TABLE 2-48

JACKSONVILLE

GENERAL PHYSICAL AND CHEMICAL SEDIMENT CHARACTERISTICS

FALL / WET SEASON

STATION / PARAMETER ppm (dry basis)	JAX 3A FWE(0)		JAX 10 SFJ		JAX 17 S		JAX 12 SFJ		JAX 13 SFJ		JAX 15 WEJ		JAX 16 S	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
SPECIFIC GRAVITY [1]	2.92	0.05	2.55	0.06	2.38	0.04	2.40	0.01	2.53	0.05	2.38	0.17	2.30	0.01
TOTAL KJELDAHL NITROGEN	4000	760	105*	-	4100	500	2700	950	190	47	2800	440	4900	660
TOTAL ORGANIC CARBON	20000	1200	790	310	24000	3600	19000	2100	173	21	13000	2600	25000	580
AMMONIA -N	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
PHOSPHATE -P	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NITRATE - N	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
OIL AND GREASE	NC	NC	90	49	510*	-	610*	-	46	10	NC	NC	1800	570

NOTES:

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3)

[1] SPECIFIC GRAVITY AS SHOWN IS DIMENSIONLESS.

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

TABLE 2-49

JACKSONVILLE

INORGANIC SEDIMENT QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETERS ppm (dry basis) / STATION	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B		JAX-9C	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
Aluminum	72	18	89*	-	2500	350	3000	400	41*	-	74*	-	320*	-	140*	-	NC	NC
Antimony	NC	NC	<0.5	-	<0.5	-	NC	NC	NC	NC	<0.5	-	<0.5	-	NC	NC	NC	NC
Arsenic	NC	NC	<1.0	-	6.6	2.0	NC	NC	NC	NC	<1.0	-	<0.5	-	NC	NC	NC	NC
Cadmium	0.05	0.03	0.05	0.02	0.33*	-	0.47	0.11	0.03*	-	0.09*	-	0.09*	-	0.06	0.02	NC	NC
Chromium	NC	NC	6.3	2.1	40*	-	NC	NC	NC	NC	0.71*	-	3.6*	-	NC	NC	NC	NC
Copper	1.1	0.2	2.3*	-	25	3	24	5	<1.0	-	<1.5	-	<1.1	-	<1.1	-	NC	NC
Fluoride	NC	NC	NC	NC	NC	NC	<0.5	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Iron	650	190	1000*	-	20,000	3000	26,000	3000	495*	-	670*	-	2000*	-	1000	70	NC	NC
Lead	2.4	0.2	11*	-	25	9	45	13	0.66	0.14	0.78	0.12	2.2*	-	0.87*	-	NC	NC
Mercury	0.13	0.03	0.22	0.04	0.59	0.25	1.1	0.4	0.15	0.02	0.12	0.03	0.15*	-	0.19	0.02	NC	NC
Nickel	<1.0	-	<1.0	-	8.6*	-	16	4	<1.1	-	<1.1	-	<1.0	-	<1.0	-	NC	NC
Silver	NC	NC	0.03	0.01	0.25	0.01	NC	NC	NC	NC	0.06*	-	0.04*	-	NC	NC	NC	NC
Zinc	6.9	1.3	11*	-	140	27	150	36	5.4	1.7	3.9*	-	8.8*	-	2.9	0.2	NC	NC

NOTES:

* Mean determined using 2 replicate values.

REMARKS:

NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

The results presented for Station Jax 8B were determined from 3 splits of 1 sample.

TABLE 2-50

JACKSONVILLE

INORGANIC SEDIMENT QUALITY

FALL / WET SEASON

STATION / PARAMETER PPM (dry basis)	JAX 3A FWE (O)		JAX 10 SFJ		JAX 17 S		JAX 12 SFJ		JAX 13 SFJ		JAX 15 WEJ		JAX 16 S	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
ALUMINUM	25000	2600	9700	260	32000	3100	23000	2500	800	160	20000	3000	26000	5200
CADMIUM	1.0	0.3	0.12	0.03	1.1*	-	0.32	0.13	0.12	0.03	0.40*	-	0.70*	-
CHROMIUM	27	4	6.7	0.5	63	16	39*	-	3.1	0.7	120*	-	132*	-
COPPER	33	5	3.9	2.1	21	6	9.0*	-	1.4*	-	20	4	19	3
IRON	27000	5000	NC	NC	NC	NC	NC	NC	NC	NC	12000	2100	NC	NC
LEAD	64	15	6.9	2.0	45	23	20*	-	9.7*	-	45*	-	53*	-
MERCURY	0.36	0.03	0.16	0.04	0.34	0.09	0.28	0.02	0.11	0.05	0.39	0.11	0.43	0.04
NICKEL	20	4	5.3*	-	25	3	7.5	1.0	21*	-	18	4	34*	-
SILVER	0.9	0.2	0.1*	-	0.70	0.16	0.23*	-	0.62	0.17	0.93	0.21	0.30*	-
ZINC	10	1	11	3	19	8	40*	-	3.4*	-	125*	-	265*	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-51

METAL:ALUMINUM RATIOS IN SEDIMENTS
PORT OF JACKSONVILLE

Station	Cd $(\times 10^{-4})$	Cr $(\times 10^{-2})$	Cu $(\times 10^{-2})$	Fe $(\times 10^{0})$	Pb $(\times 10^{-2})$	Hg $(\times 10^{-3})$	Ni $(\times 10^{-3})$	Ag $(\times 10^{-4})$	Zn $(\times 10^{-3})$
JAX-1B[2]	6.9	NC	1.5	9.0[1]	3.3[1]	1.8	<13.9	NC	95.8[1]
JAX-2A	5.6[1]	7.1[1]	2.6	11.2	12.4	2.5	<11.2[1]	3.4	123.6
JAX-3A	1.3	1.6	1.0	8.0	1.0	0.2	3.4	1.0	56.0
JAX 3A-WEJ(O)	0.4	0.1	0.1	1.1	0.3	0.01	0.8	0.4	0.4
JAX-4B[2]	1.6[1]	NC	0.8	8.7[1]	1.5	0.4	5.3	NC	50.0
JAX-5B[2]	7.3	NC[1]	<2.4	12.1[1]	1.6	3.7	<2.7	NC[1]	131.7[1]
JAX-6A[2]	12.2[1]	1.0[1]	<2.0[1]	9.1[1]	1.1[1]	1.6[1]	<14.9	8.1[1]	52.7[1]
JAX-7A[2]	2.8	1.1	0.3	6.3	0.7[1]	0.5	<3.1	1.3	27.5
JAX-8B	4.3	NC	<0.8	7.1	0.6	1.4	<7.1[1]	NC[1]	20.7
JAX 10-SFJ	0.1	0.07[1]	0.04[1]	NC	0.07[1]	0.02	0.55	0.1[1]	1.1[1]
JAX 12-SFJ	0.1	0.17	0.04[1]	NC	0.09[1]	0.01	0.33[1]	0.1[1]	1.8[1]
JAX 13-SFJ	1.5[2]	0.39[1]	0.18	NC	1.21[1]	0.14	26.3	7.8	4.3[1]
JAX 15-WEJ	0.2[1]	0.60[2]	0.10	0.6	0.23[1]	0.02	0.9[1]	0.5[1]	6.3[1]
JAX 16-S	0.3[1]	0.51	0.07	NC	0.20	0.02	1.3	0.1	10.2
JAX 17-S	0.3	0.2	0.07	NC	0.14	0.01	0.8	0.2	0.6
Crustal* Ratio	0.02	0.1	0.07	0.7	0.015	0.001	0.9	0.001	0.08
Carbonate** Rocks	0.09	0.3	10	0.9	21	0.01	4.8	0.05	48

NOTES:

NC Indicates ratio not determined due to station designation (see Tables 1-2 and 1-3)
1 Ratio determined using the mean of two replicate metal values
2 Ratios determined using the mean of two aluminum values
* From Taylor (1964)
** From Turekian and Wedepohl (1961)

TABLE 2-52

JACKSONVILLE

ORGANIC SEDIMENT QUALITY

SPRING / DRY SEASON

PARAMETER ppm (dry basis) / STATION	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B	
	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ
Pesticides																
Mirex	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
Toxaphene	<0.02	-	<0.02	-	<0.02[2]	-	<0.02	-	<0.02	-	<0.02	-	<0.02	-	<0.02	-
DDT	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
Aldrin	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
Chlordane	<0.006	-	<0.006[1,2]	-	<0.006	-	<0.007	-	<0.006	-	<0.006	-	<0.006	-	<0.006	-
Other Chlorinated (DDE)	-	-	-	-	<0.001[1]	-	-	-	-	-	-	-	-	-	-	-
PCB's	<.002	-	<0.002	-	<0.002[3]	-	<0.002	-	<0.002	-	<0.002	-	<0.002	-	<0.002	-
Oil and Grease	NC	NC	520	40	1600	440	NC	NC	NC	NC	160*	-	160	20	NC	NC
Phenols																
Phenol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-
2-Chlorophenol	<0.01	-	<0.01	-	<0.02[1]	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-
2,4-Dichlorophenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-
2,4,6-Trichlorophenol	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-
4-Chloro-m-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-
2,4-Dinitrophenol	<0.3	-	<0.3	-	<0.3	-	<0.1	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-
Pentachlorophenol	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-

NOTES: 1) Observed in one replicate only.
2) Possible trace (TR) observed in one replicate only.
3) PCB type 1254.
* Mean determined using 2 replicate values.

REMARKS: NC refers to analysis not completed due to sation designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentrations where below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-53

JACKSONVILLE

ORGANIC SEDIMENT QUALITY

FALL / WET SEASON

PARAMETERS ppm (dry basis) / STATION	JAX 3A FWE (O)		JAX 10 SFJ		JAX 17 S		JAX 12 SFJ		JAX 13 SFJ		JAX 15 WEJ		JAX 16 S	
PESTICIDES	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
MIREX	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-
TOXAPHENE	NC	NC	<0.015	-	<0.015	-	<0.015	-	<0.015	-	NC	NC	<0.015	-
ALDRIN	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-
CHLORDANE	NC	NC	<0.005	-	<0.005	-	<0.005	-	<0.005	-	NC	NC	<0.005	-
DDT	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-
OTHER CHLORINATED	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
PHENOLS	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
2-CHLOROPHENOL	NC	NC	<0.05	-	<0.05	-	<0.05	-	<0.05	-	NC	NC	<0.05	-
PHENOL	NC	NC	<1.0	-	<1.0	-	<1.0	-	<1.0	-	NC	NC	<1.0	-
2,4-DICHLOROPHENOL	NC	NC	<1.0	-	<1.0	-	<1.0	-	<1.0	-	NC	NC	<1.0	-
2,4,6-TRICHLOROPHENOL	NC	NC	<0.01	-	<0.01	-	<0.01	-	<0.01	-	NC	NC	<0.01	-
4-CHLORO-M-CRESOL	NC	NC	<0.1	-	<0.1	-	<0.1	-	<0.1	-	NC	NC	<0.1	-
2,4-DINITROPHENOL	NC	NC	<0.07	-	<0.07	-	<0.07	-	<0.07	-	NC	NC	<0.07	-
PENTACHLOROPHENOL	NC	NC	<0.01	-	<0.01	-	<0.01	-	<0.01	-	NC	NC	<0.01	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABEL 1-3).

TABLE 2-54

JACKSONVILLE
ELUTRIATE RESULTS

PARAMETER μg/l¹ / STATION	JAX 14 X MEAN	σ	JAX 3A FWE (O) MEAN	σ	JAX 15 WEJ MEAN	σ	STANDARD
ALUMINUM	3.4	0.4	4.5	0.6	6.3	0.8	1500
CADMIUM	0.05	0.01	0.07	0.01	0.04	0.01	5.0
CHROMIUM	0.49	0.04	4.1	0.3	8.6*	-	50
COPPER	0.77	0.05	1.4	0.3	1.4	0.4	15
IRON	19	2	91	7	64	18	300
LEAD	0.91	0.04	1.6	0.1	0.47	0.06	50
MERCURY	0.1	-	0.13	0.01	0.19	0.02	0.1
NICKEL	0.28	0.04	0.26	0.08	0.21	0.03	100
SILVER	0.01	-	0.04	0.01	0.04	0.01	0.05
ZINC	2.5	0.2	3.9	0.7	3.4	0.5	1000
FLUORIDE	NC	NC	NC	NC	NC	NC	5.0
TOTAL KJELDAHL NITROGEN	0.49	0.08	2.0	0.1	10.4	1.4	NS
TOTAL ORGANIC CARBON	12	1	15	4	14	1	NS
AMMONIA -N	NC	NC	NC	NC	NC	NC	NS
NITRATE -N	NC	NC	NC	NC	NC	NC	NS
PHOSPHATE -P	NC	NC	NC	NC	NC	NC	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		POST-ELUTRIATE TEST RESULTS		STANDAR

NOTES:

- \- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT
- * MEAN DETERMINED USING 2 REPLICATE VALUES
- NS REFERS TO STANDARD NOT AVAILABLE
- NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3)
- 1 UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L

REMARKS:

STANDARD REFERS TO WATER QULAITY STANDARDS FOR PREDOMINANTLY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TABLE 5-1

PARAMETERS REPRESENTING POTENTIAL WATER QUALITY PROBLEMS DURING MAINTENANCE DREDGING ACTIVITIES

Port	Dissolved Oxygen	Nutrients	Metals	Organic Compound
Pensacola	+	+	Ag* Hg* Zn*	Phenols
Tampa	+	+	Cd Hg Ag Cu* Ni* Pb* Zn*	Phenols*
Manatee	+	+	Cd Cr Hg	
Jacksonville	+	+	Cd Hg Ag Pb* Zn* Cu	

\+ Represent continual problem in relation to maintenance dredging.

* Localized problem (only observed to be high at one or two stations).

TABLE 5-2

LABORATORY PROCEDURES FOR SEDIMENT SAMPLES

Parameter	Analytical Method*		Special Procedures
Aluminum	EPA 202-1	AA-flame	Note 1
Antimony	EPA 204-2	AA-hydride	Note 2
Arsenic	EPA 206-2	AA-hydride	Note 2
BOD	EPA 405.1	5 Day - 20°C	Note 3
Cadmium	EPA 213-2	AA-furnace	Note 1
Total Chromium	EPA 218-3	AA-furnace	Note 1
Copper	EPA 220-2	AA-flame	Note 1
Fluoride	EPA 340.2	Potentiometric	Water extraction
Iron	EPA 236-1	AA-flame	Note 1
Lead	EPA 239-2	AA-furnace	Note 1
Mercury	EPA 245-5	Cold vapor	Note 4
Nickel	EPA 249-2	AA-furnace	Note 1
TKN	EPA 351.3	Digestion - potentiometric	Note 5
Oil and Grease	EPA 413.1	Gravimetric	Note 6
Mirex	EPA 608**	GC - EC	Note 7
Toxaphene	EPA 608**	GC - EC	Note 7
DDT	EPA 608**	GC - EC	Note 7
Aldrin	EPA 608**	GC - EC	Note 7
Chlordane	EPA 608**	GC - EC	Note 7
PCB	EPA 608**	GC - EC	Note 7
Phenols	EPA 604**	GC - EC and FID	Note 8
Phosphate	EPA 365.2	Ascorbic Acid	Note 9
Nitrate	EPA 353.3	Cadmium reduction	Note 10
Radium 226	EPA -		
Silver	EPA 272-2	AA-furnace	
Total Phosphorus	EPA 365.2	Persulfate digestion - Ascorbate	Note 11
Total Solids	EPA 160.2	Gravimetric - 105°C	
TOC	EPA 415.1		Note 12
Zinc	EPA 289-1	AA-flame	
Grain size	ASTM-19-D422		Including hydrometer
Specific gravity	ASTM-19-D854		
Atterberg Limits	ASTM-19-D423 and D424		
Sedimentation Rate-			

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* EPA - Methods of Chemical analysis of Water and Waste (EPA-600/4-79-020).

**EPA Gas Chromatographic Methods - Federal Register 44, No. 233, December 3, 1979.

TABLE 5-2 (Cont'd)

Notes:

1. 1 g of sediment was weighted out into a teflon capped digestion vial. 5 ml of conc. HNO_3 was added and the vials were allowed to sit for two hours. Beakers were then capped and digested on low heat for 48 hours. Caps were removed and nitric acid was then taken off (to near dryness) and five additional ml of HNO_3 and 1 ml of perchloric acid were added. The vials were heated until the white perchloric acid fumes subsided. If necessary, additional increments of HNO_3 and perchloric acid were added to complete digestion. The sediment was then brought up with 1 ml conc. HNO_3 and 9 ml of redistilled demineralized water and analyzed by atomic absorption.
2. The digest from note 1 was analyzed by the AA-hydride technique.
3. Wet sediment samples were weighed into BOD bottles and diluted to 300 ml.
4. Samples were digested with sulfuric and nitric acid and potassium permanganate in an autoclave prior to cold vapor analyses.
5. Wet sample was digested in a Kjeldahl flask, distilled and ammonia was determined by potentiometric method.
6. Gravimetric - extraction with Fluorocarbon-113.
7. Samples were extracted by techniques in "Interim Methods for Sampling and Analysis of Priority Pollutants in Sediments and Fish Samples". US EPA - October 1980. Extracts were cleaned up by florisil column chromatography prior to GC-EC analyses.
8. Sample was extracted with methylene chloride (pH 2) and analyzed by GC-FID and GC-EC (chlorinated phenols).
9. Water extractable phosphates.
10. Water extractable nitrates.
11. Sample was digested with persulfate and digest was analyzed by ascorbic acid technique.
12. Sediment was analyzed by ampule technique - OI instrument.

TABLE 5-3

LABORATORY PROCEDURES FOR WATER SAMPLES

Parameter	Analytical Method*		Special Procedures
Ammonia	EPA 350.3	Potentiometric	
Antimony	EPA 204-2	AA-hydride	
Arsenic	EPA 206-3	AA-hydride	
BOD	EPA 405.1	5 Day - 20°C	
Cadmium	EPA 213-2	AA-furnace	Note 1
Total Chromium	EPA 218-3	AA-furnace	Note 2
Copper	EPA 220-2	AA-furnace	
Fluoride	EPA 340.2	Potentiometric	
Iron	EPA 236-1	AA-flame	Note 1
Lead	EPA 239-2	AA-furnace	
Mercury	EPA 245-1	Cold vapor	
Nickel	EPA 249-2	AA-furnace	Note 1
TKN	EPA 351.4	Digestion - potentiometric	
Mirex	EPA 608**	GC - EC	Note 3
Toxaphene	EPA 608**	GC - EC	Note 3
DDT	EPA 608**	GC - EC	Note 3
Aldrin	EPA 608**	GC - EC	Note 3
Chlordane	EPA 608**	GC - EC	Note 3
PCB	EPA 608**	GC - EC	Note 3
Phenols	EPA 604**	GC - EC and FID	Note 4
Phosphate	EPA 365.2	Ascorbic Acid	10 cm light path
Nitrate	EPA 353.3	Cadmium reduction	10 cm light path
Radium 226	EPA		
Silver	EPA 272-2	AA-furnace	
Total Phosphorus	EPA 365.2	Persulfate digestion - Ascorbate	10 cm light path
TSS	EPA 160.2	Gravimetric - 105°C	
TOC	EPA 415.1		Note 5
Zinc	EPA 289-1	AA-flame	Note 1

---

* EPA - Methods of Chemical analysis of Water and Waste (EPA-600/4-79-020).

**EPA Gas Chromatographic Methods - Federal Register 44, No. 233, December 3, 1979.

TABLE 5-3 (Cont'd)

Notes:

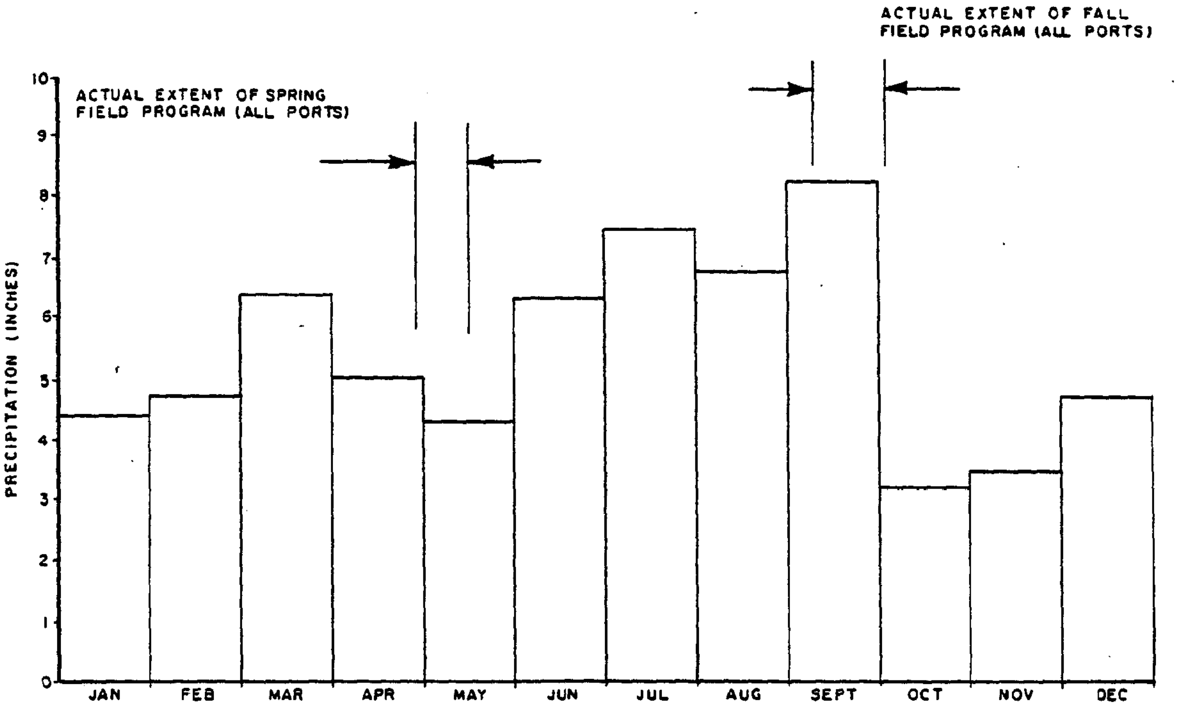
1. APDC - DDDC chelation (pH 5.0) - MIBK extraction method was utilized on 200 ml sample. (Kinrade and Van Loon, Analytical Chemistry 46 (No. 13): 1894.)

2. Sample (100 ml) was oxidized by EPA 218-3 method, followed by APDC - DDDC chelation (pH 2.4) and MIBK extraction.

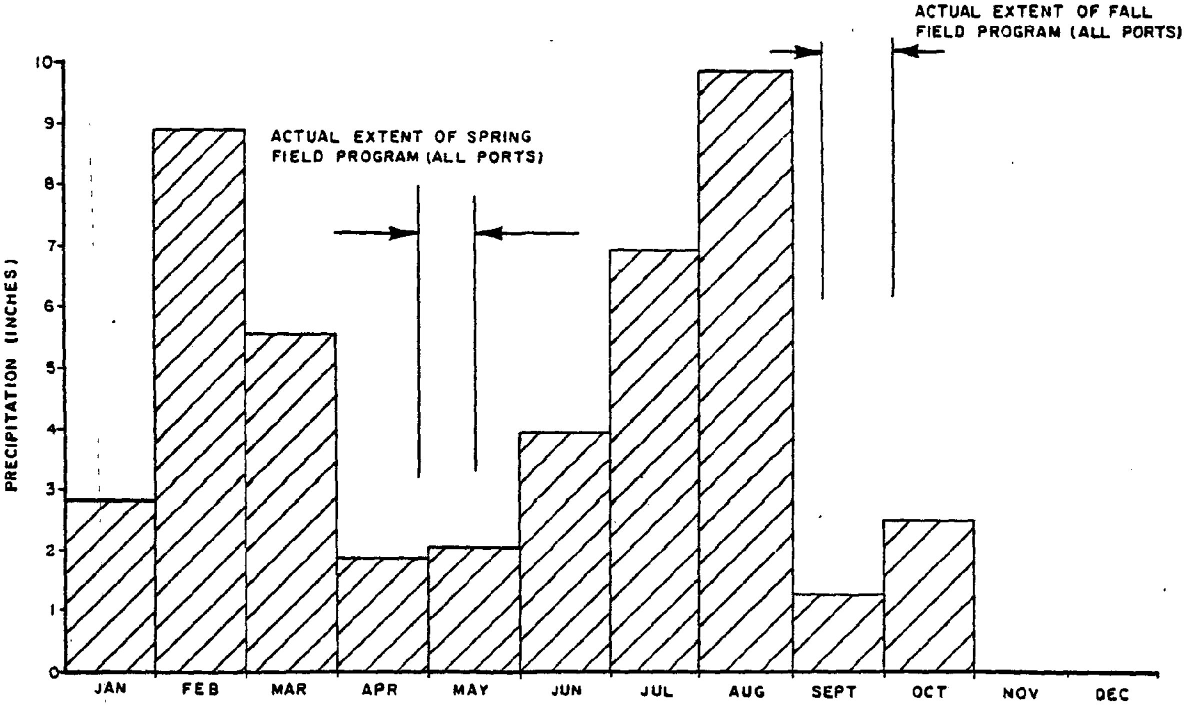
3. Sample (750 ml) was extracted with methylene chloride. Florisil cleanup was required for some samples.

4. Acidified sample (750 ml) was extracted with methylene chloride. Extract was analyzed by GC - FID. 2-Propanol extracts of chlorinated phenols were analyzed by EC detector for increased sensitivity.

5. Samples (5 ml) were analyzed by ampule technique (OI instrument, OI Corp., College Station, Texas). Organic carbon was oxidized to CO_2 by persulfate and CO_2 was measured by IR.



NORMAL MONTHLY PRECIPITATION 1941 - 1970, PENSACOLA



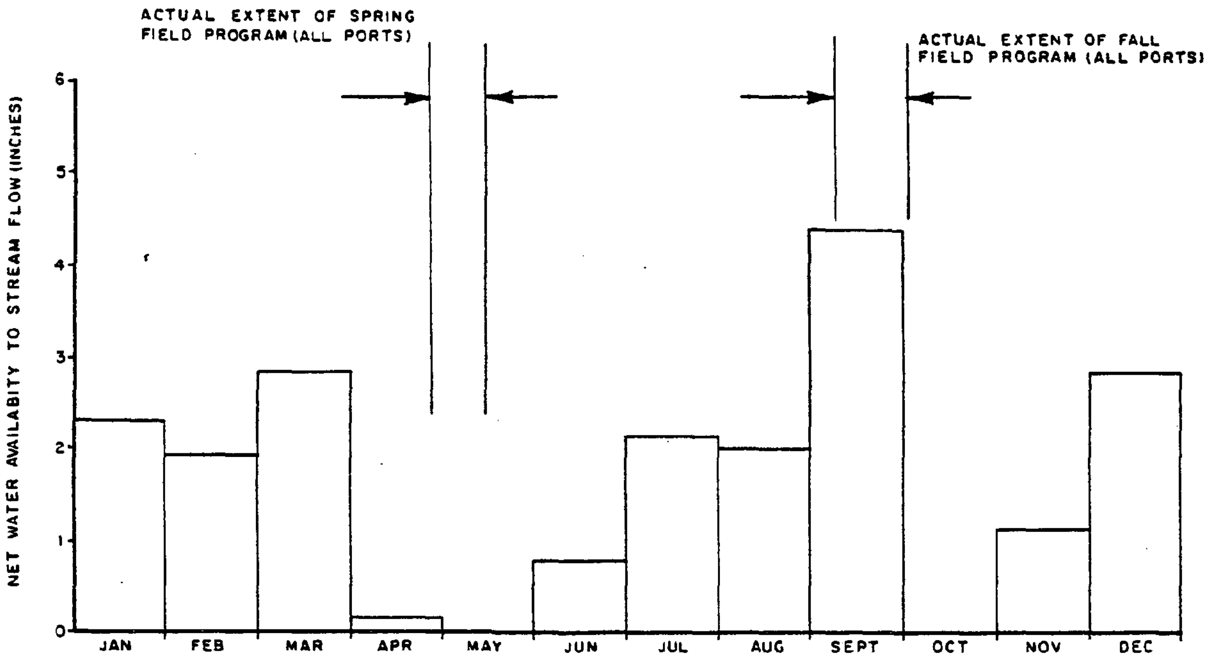
OBSERVED MONTHLY PRECIPITATION, PENSACOLA, JANUARY - OCTOBER 1982

NORMAL MONTHLY AND OBSERVED PRECIPITATION, PORT OF PENSACOLA

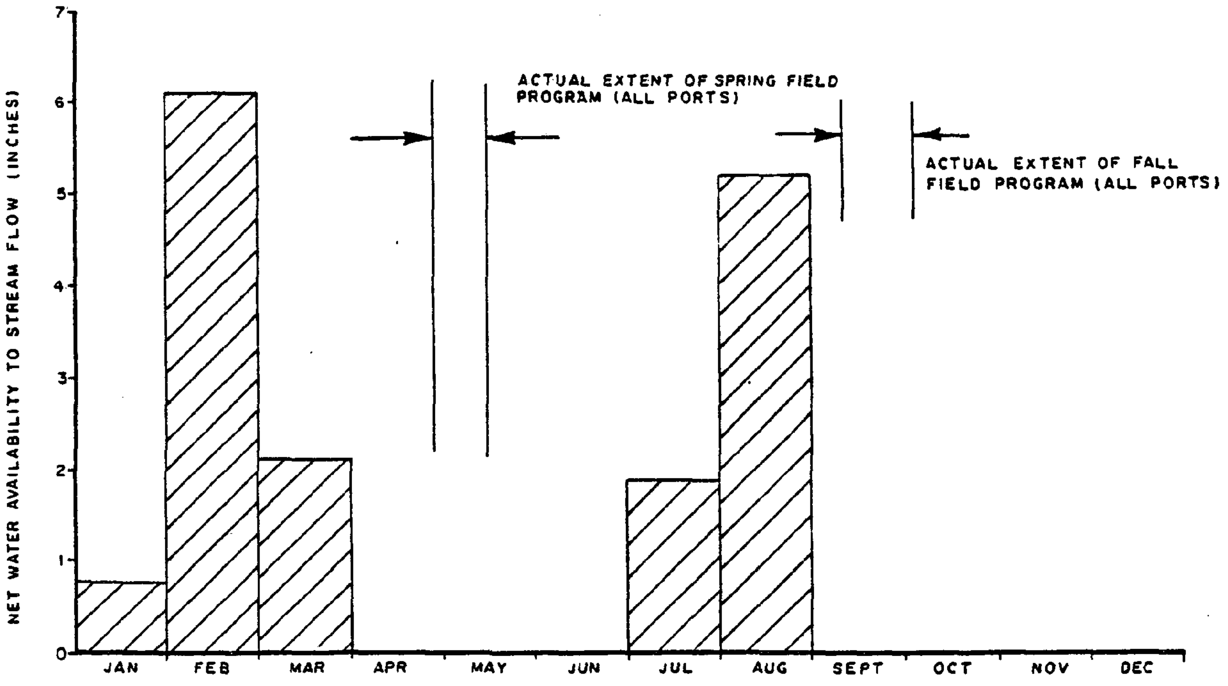
PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 2-1



MONTHLY NORMAL NET WATER AVAILABILITY TO STREAM FLOW USING 1941-1970
MONTHLY NORMAL PRECIPITATION
PENSACOLA



OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, PENSACOLA, USING JANUARY
OCTOBER 1982 OBSERVED MONTHLY PRECIPITATION

MONTHLY NORMAL AND OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, PORT OF PENSACOLA

PROJECT : DER DEEPWATER PORTS
LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 2-2

BY ___ DATE 8-82 REVISIONS
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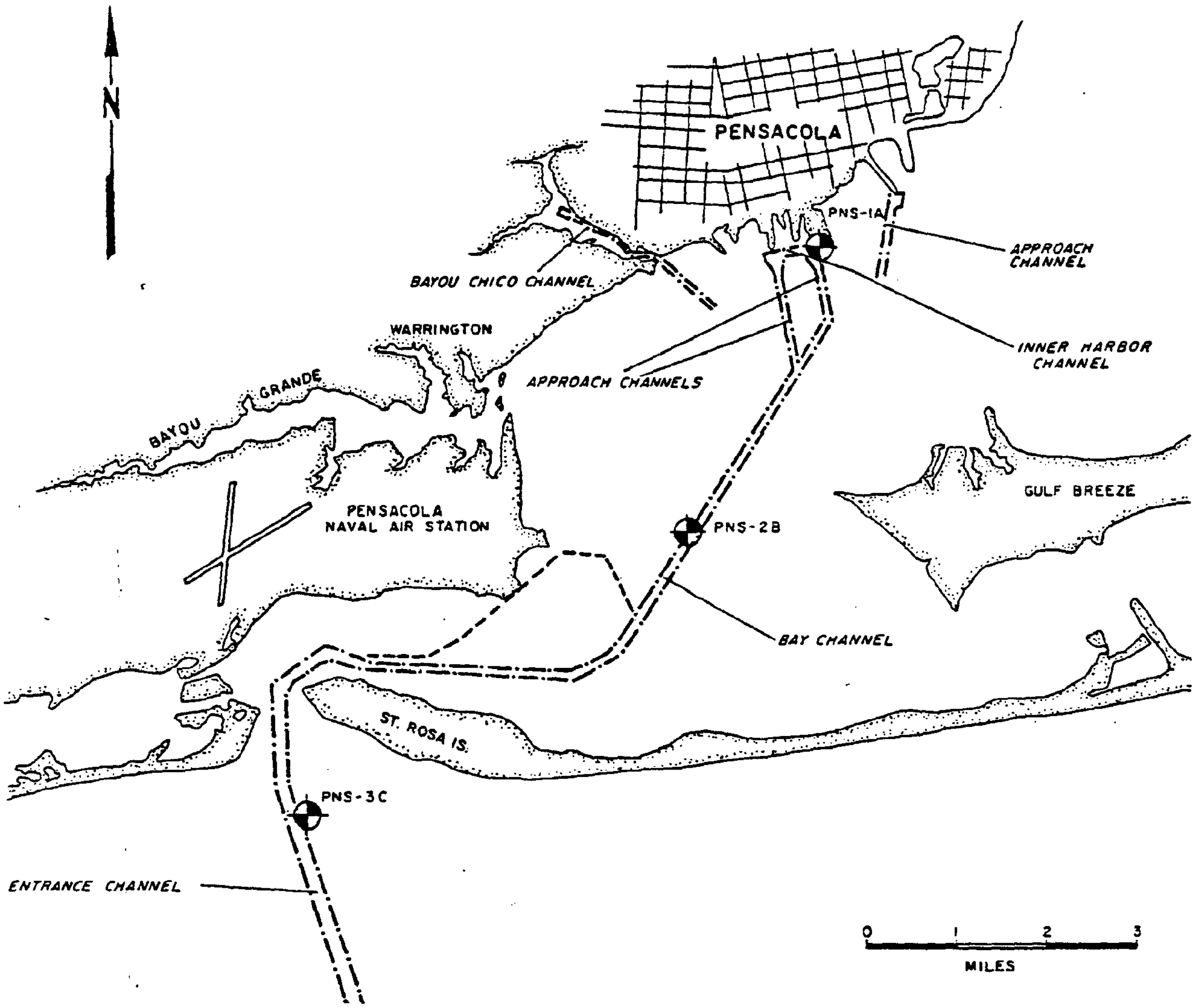
1273900426(8/82)



REFERENCE:

CORPS OF ENGINEERS DWG. No. 14 PENSACOLA HARBOR, FLA.
DATED: 9-30-79

SPRING / DRY SEASON
SAMPLE STATION LOCATIONS
PENSACOLA HARBOR

PROJECT: DER - DEEP WATER PORTS
LOCATION: JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE
FIGURE 2-3

CHECKED BY ________ DATE ________
APPROVED ________ DATE ________

1273900426 (5-82)

757.2 (REV. 4-62)

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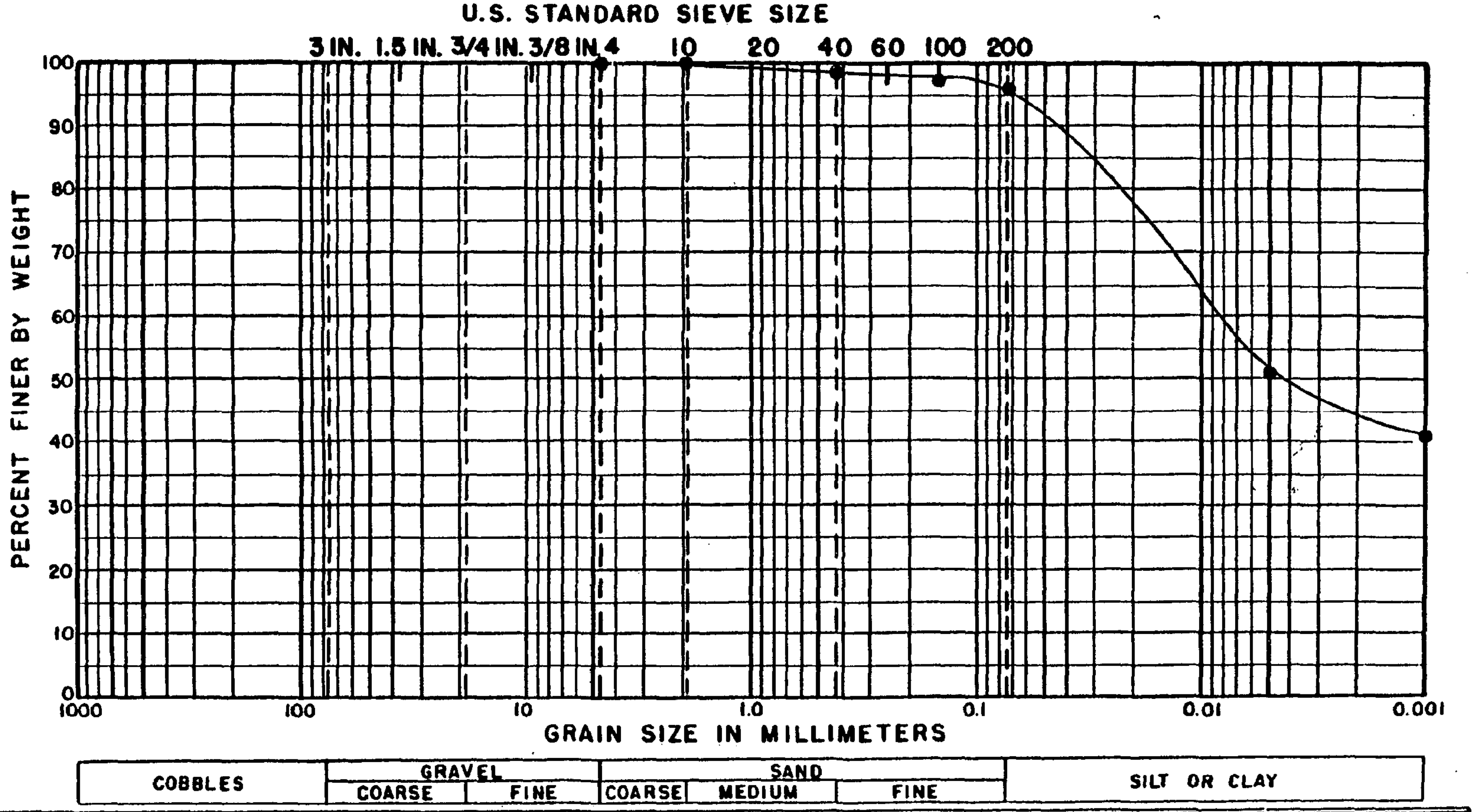

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS-1A		OH	ORGANIC SILTY CLAY	239.0	63.5	48.4	15	INNER HARBOR CHANNEL

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM 3 REPLICATE SAMPLES

GRADATION CURVE

PENSACOLA PNS-1A

DAMES & MOORE

FIGURE 2-4

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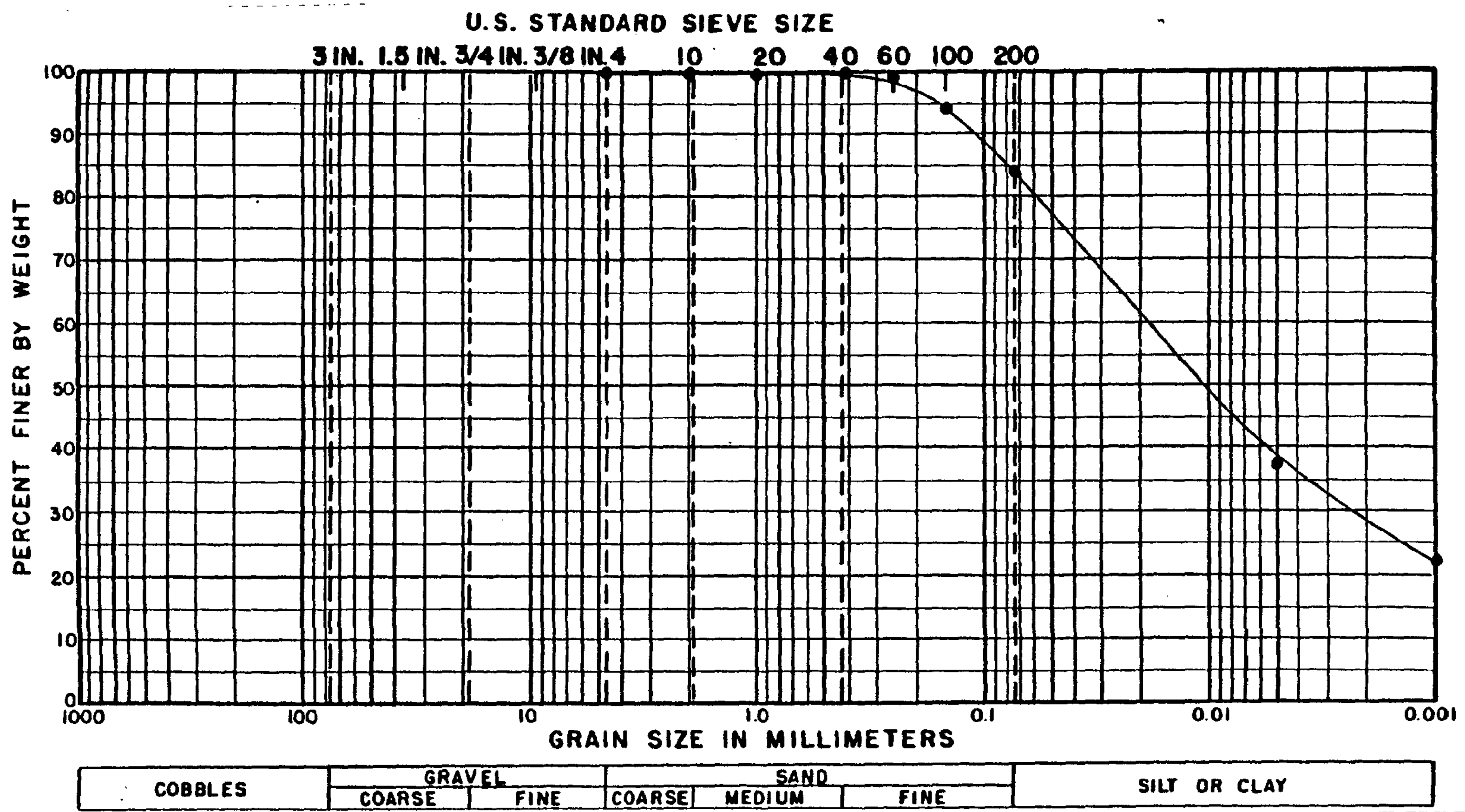


STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS-2B		OH	ORGANIC SILTY CLAY	151.5	62.2	38.7	23.5	BAY CHANNEL

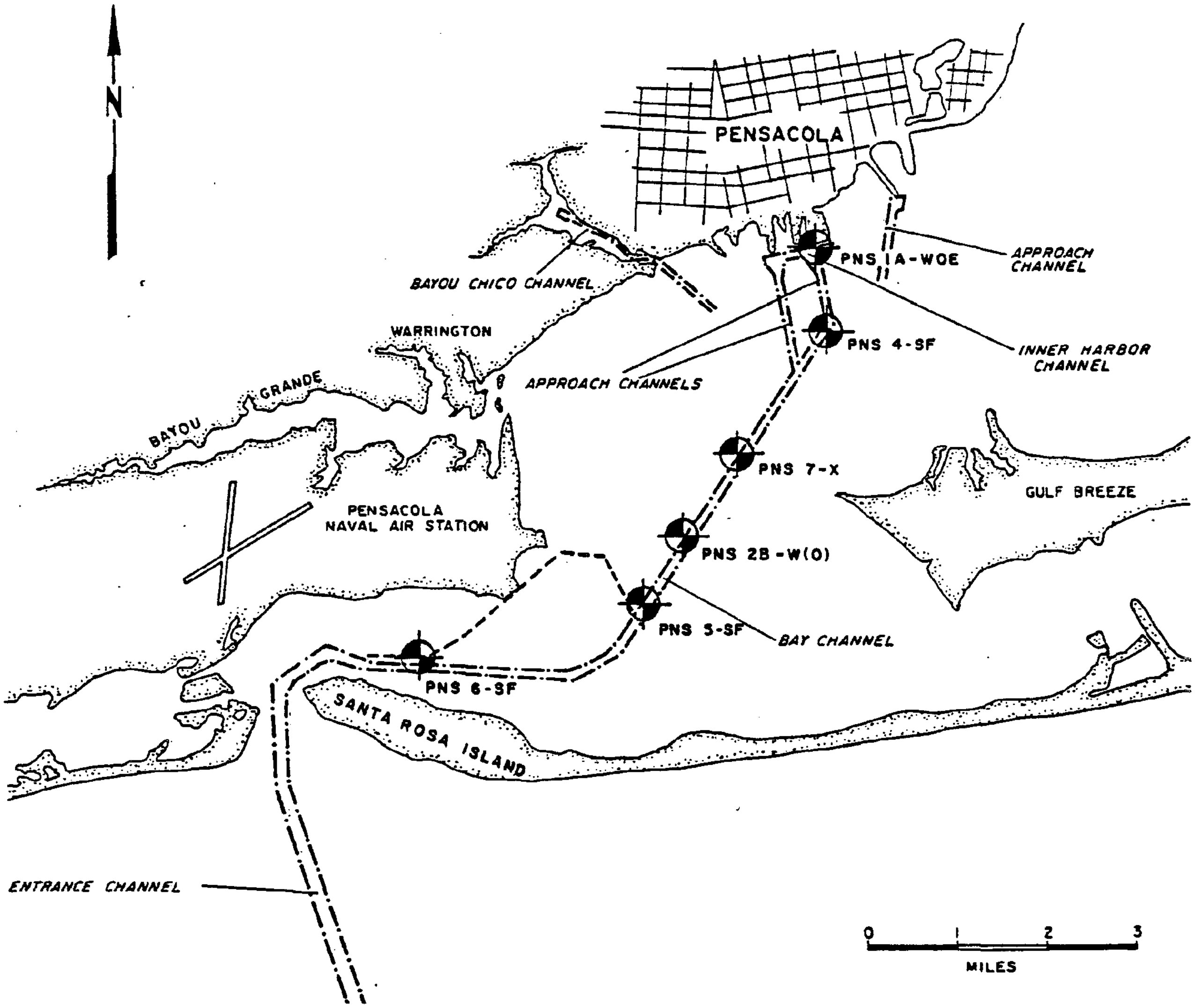
NOTE: ATTERBERG LIMITS VALUES DETERMINED FROM 3 REPLICATE SAMPLES.

GRADATION CURVE

PENSACOLA PNS-2B

DAMES & MOORE

FIGURE 2-5



REFERENCE :

CORPS OF ENGINEERS DWG. No. 14 PENSACOLA HARBOR, FLA.
DATED : 9-30-79

NOTES:

1. FOR STATION DESIGNATION DESCRIPTIONS PLEASE SEE TEXT.
2. LOCATIONS AS SHOWN ARE APPROXIMATE, PLEASE SEE TEXT FOR DETAILED LOCATIONS

FALL / WET SEASON SAMPLE STATION LOCATIONS PENSACOLA HARBOR

BY ______ DATE ______ REVISIONS
CHECKED BY ______ DATE ______
APPROVED ______ DATE ______

1273900426(5-82)

PROJECT: DER-DEEP WATER PORTS
LOCATION: JACKSONVILLE-PENSACOLA-TAMPA-MANATEE

DAMES & MOORE
FIGURE 2-6

737.2 (REV. 4-62)

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PLATE OF

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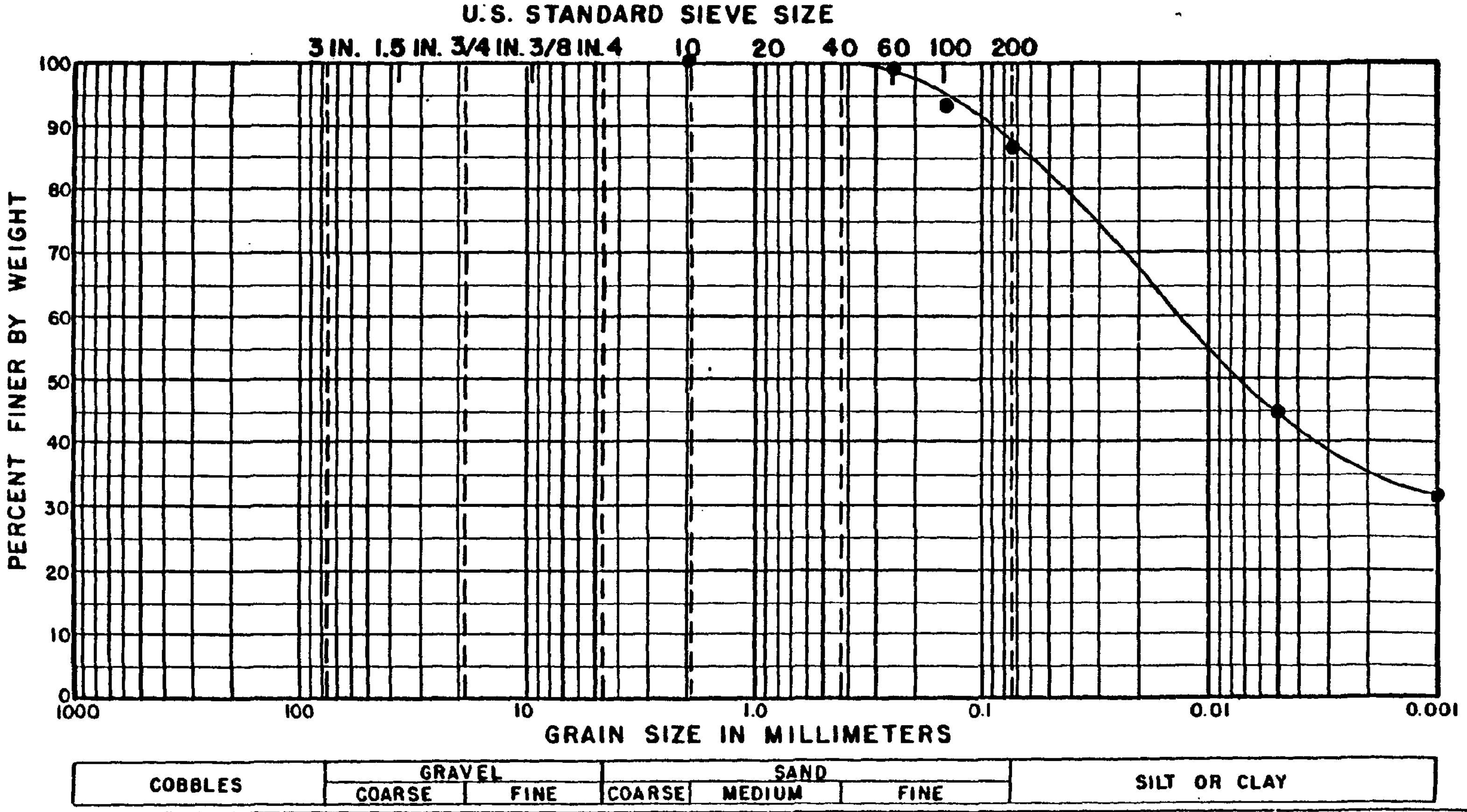

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS IA - WOE	—	OH	ORGANIC SILTY CLAY	—	—	—	—	INNER HARBOR CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

PENSACOLA PNS IA-WOE
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-7

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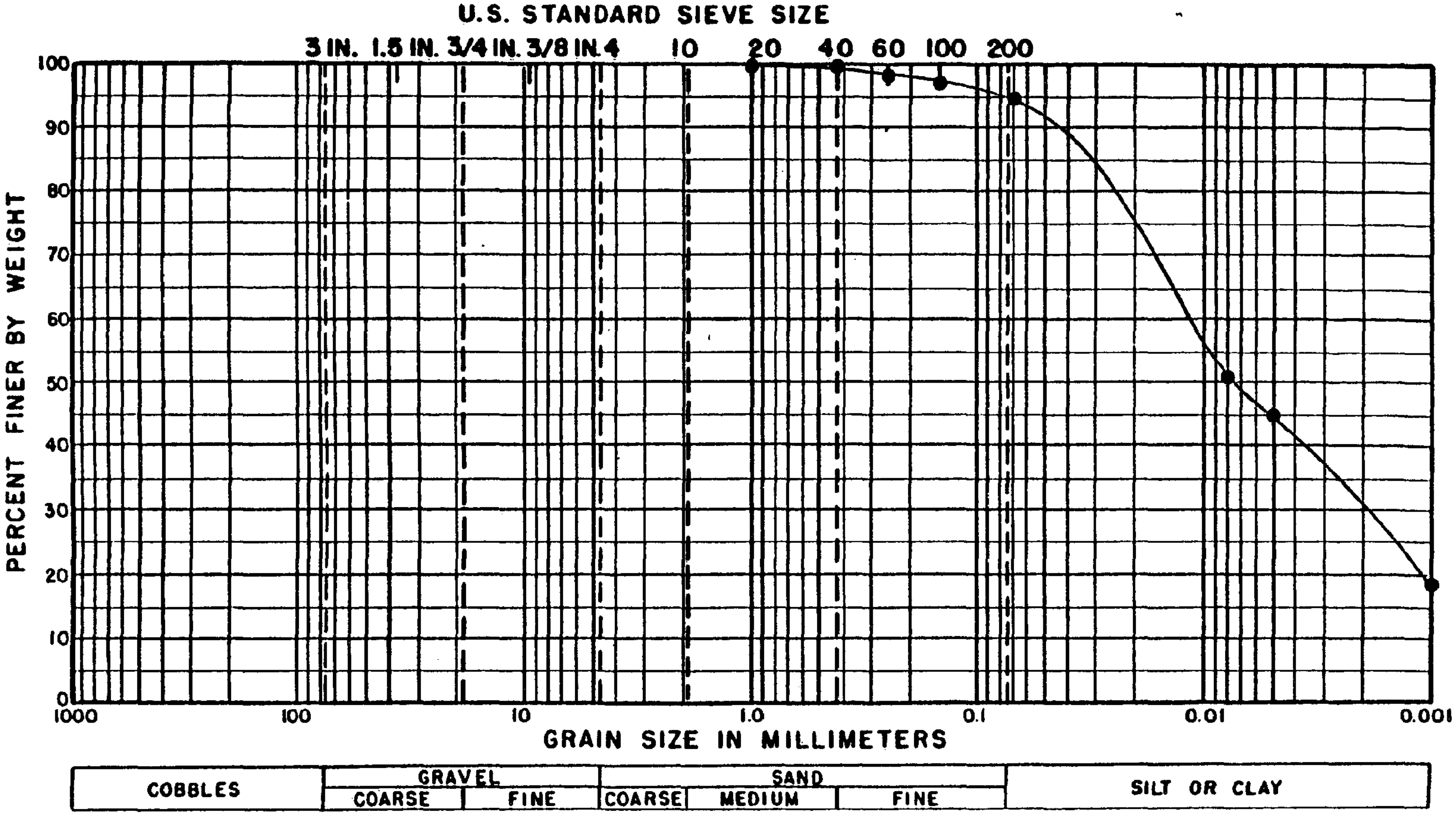

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS-4-SF	—	OH	ORGANIC SILTY CLAY	224.2	70.8	47.3	23.5	BAY CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

PENSACOLA PNS 4-SF
FALL/ WET SEASON

DAMES & MOORE

FIGURE 2-8

757 2 (REV 4-82)

757.2 (REV. 4-82)

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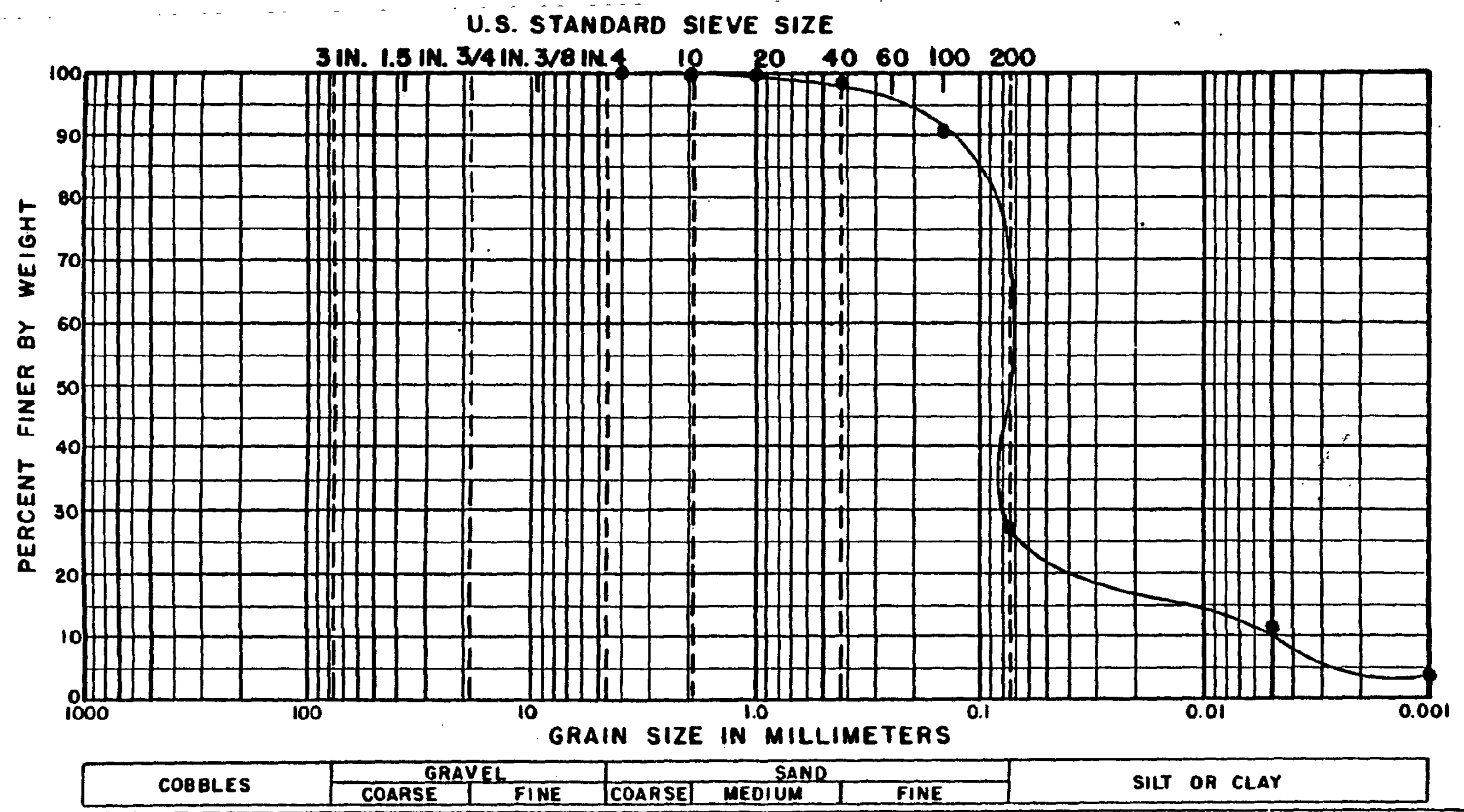

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS 5-SF	—	SM/OL	ORGANIC SILTY FINE SAND	65.0	31.8	23.5	8.3	BAY CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES

GRADATION CURVE

PENSACOLA PNS 5 - SF
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-9

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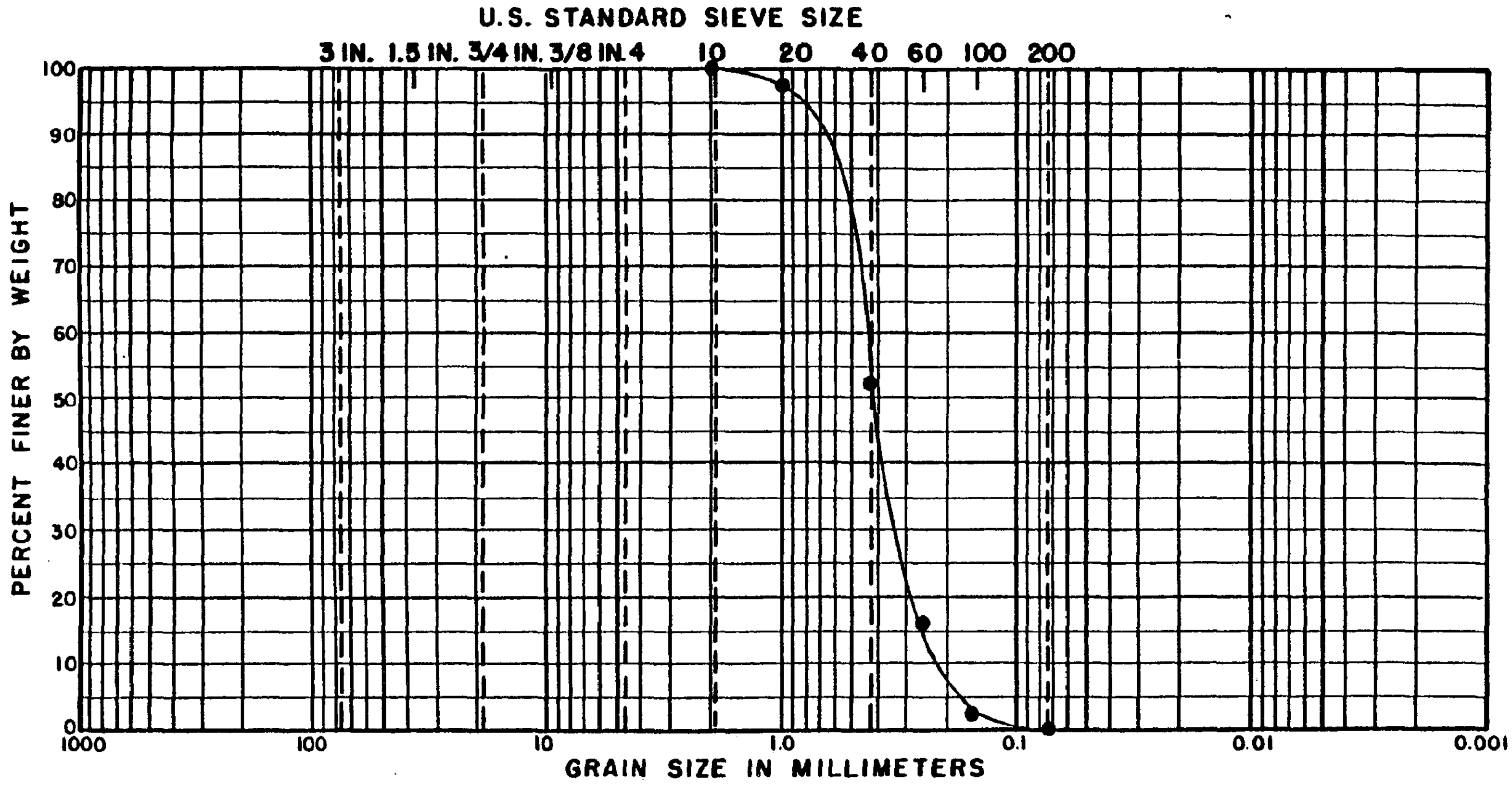


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

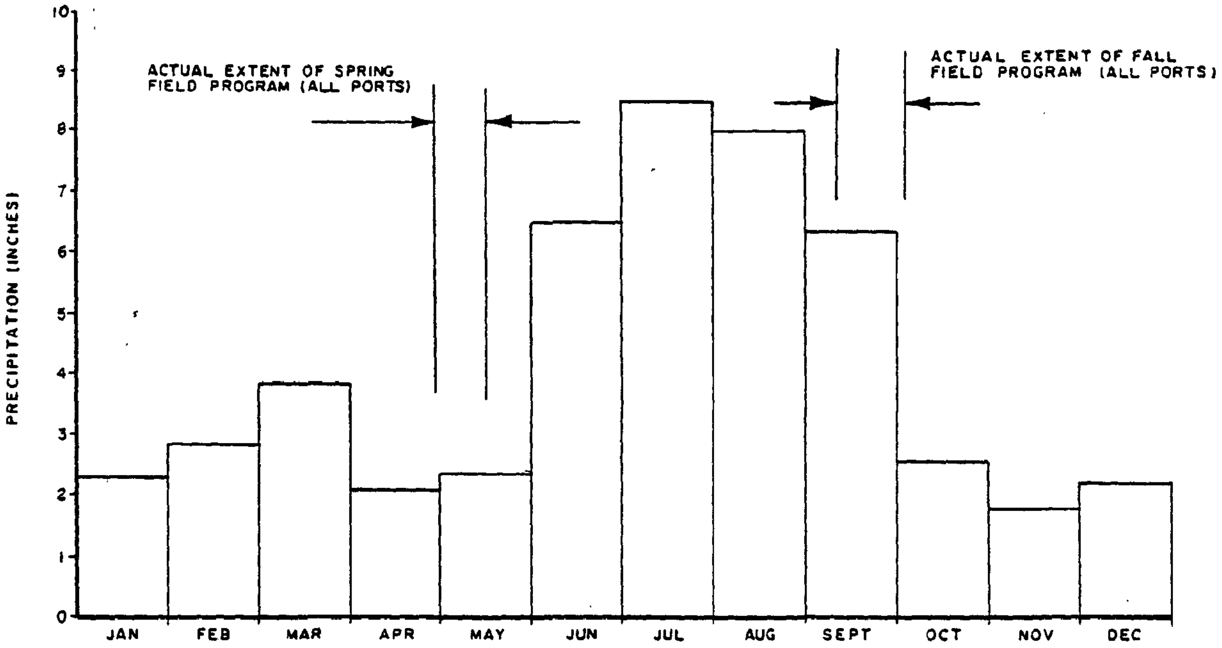
STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS 6-SF	—	SP	MEDIUM TO FINE SAND	—	—	—	—	BAY CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

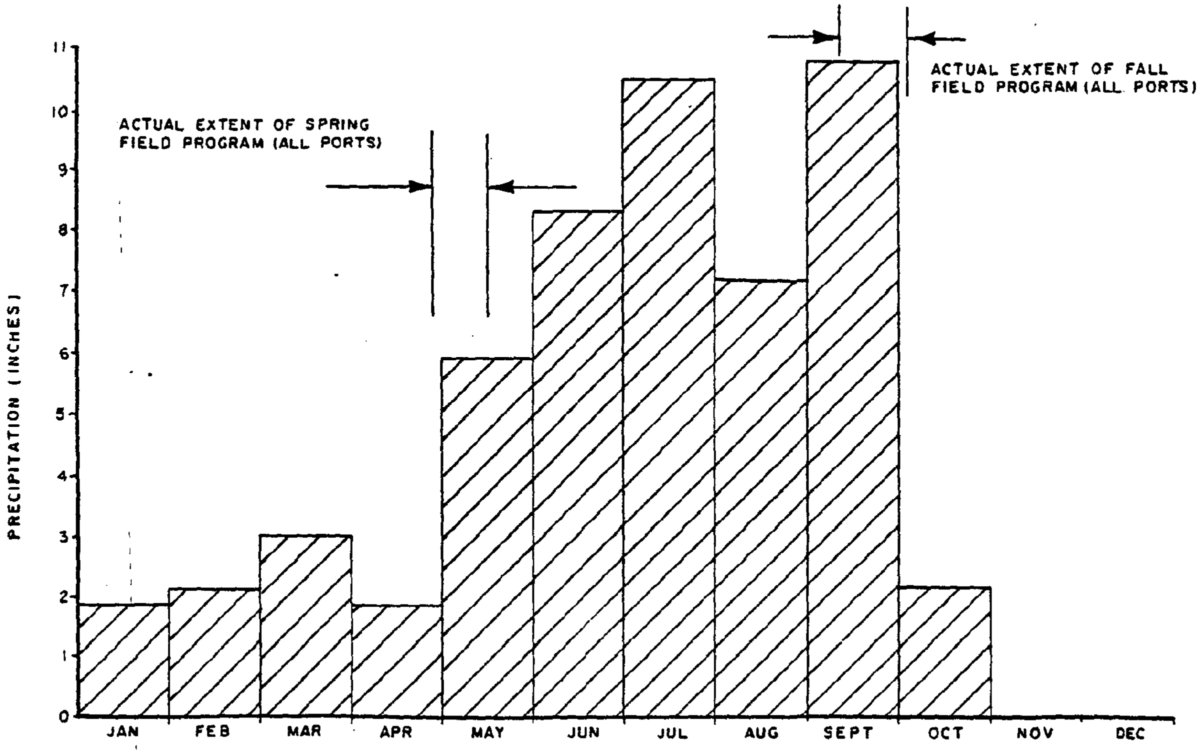
GRADATION CURVE

PENSACOLA PNS 6-SF
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-10



NORMAL MONTHLY PRECIPITATION 1941-1970, TAMPA



OBSERVED MONTHLY PRECIPITATION , TAMPA , JANUARY-OCTOBER 1982

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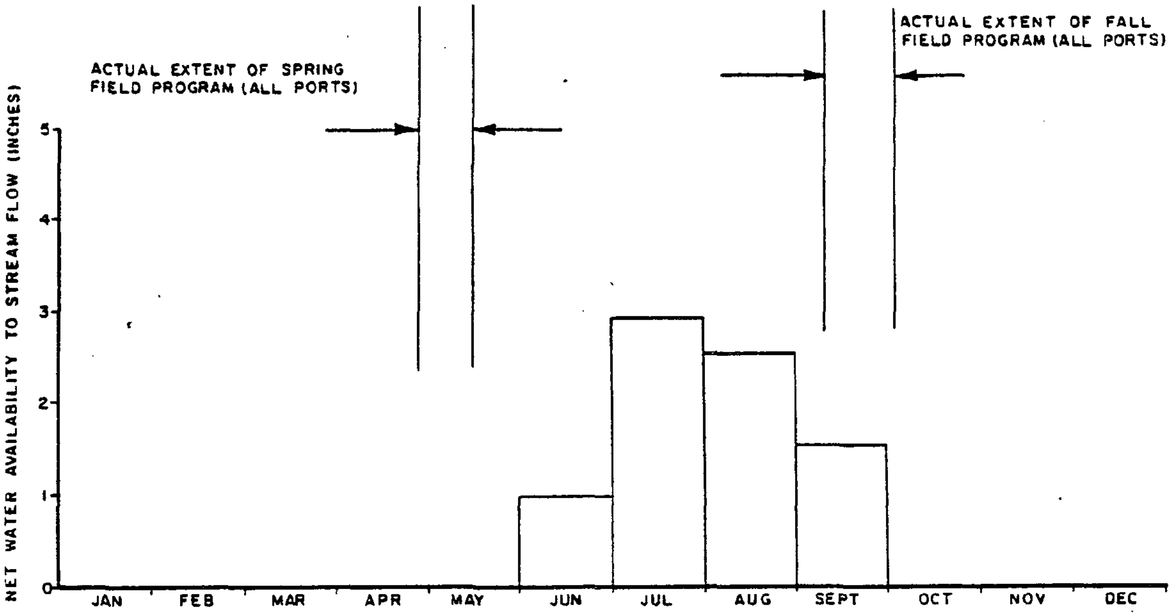
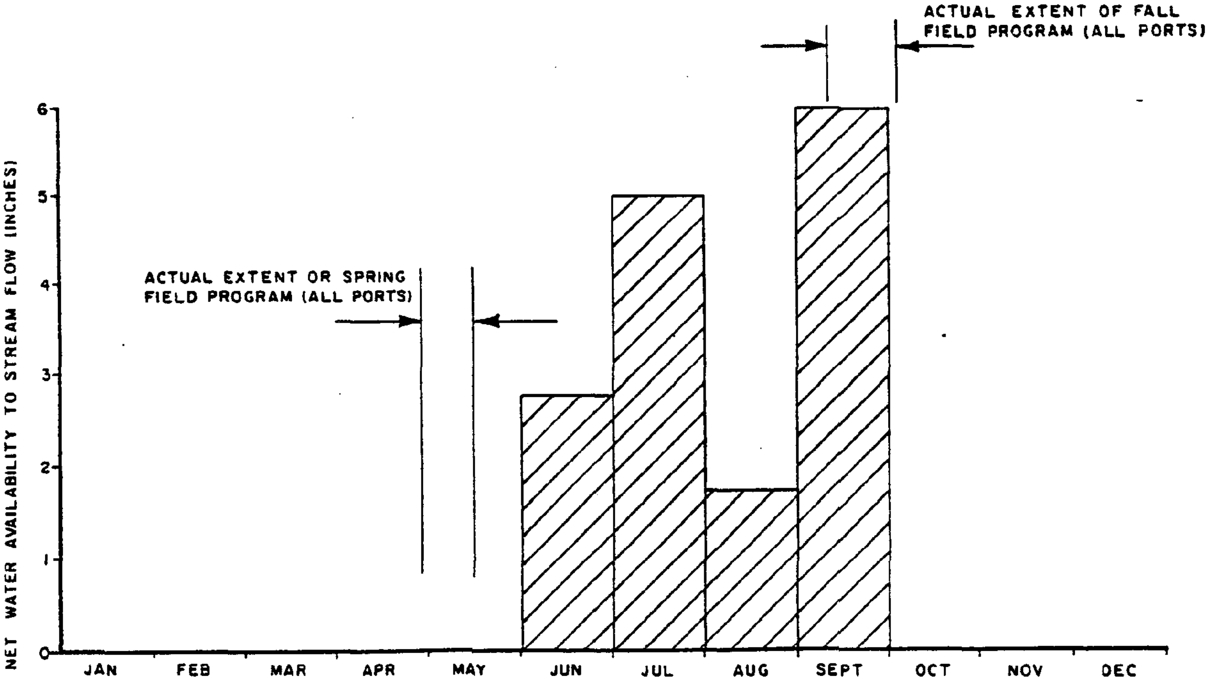
NORMAL MONTHLY AND OBSERVED
PRECIPITATION , TAMPA HARBOR

PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 2-11



MONTHLY NORMAL NET WATER AVAILABILITY TO STREAM FLOW USING 1941-1970 MONTHLY NORMAL PRECIPITATION
TAMPA



OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, TAMPA, USING JANUARY-OCTOBER 1982 OBSERVED MONTHLY PRECIPITATION

MONTHLY NORMAL AND OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, TAMPA HARBOR

PROJECT : DER DEEPWATER
LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 2-12

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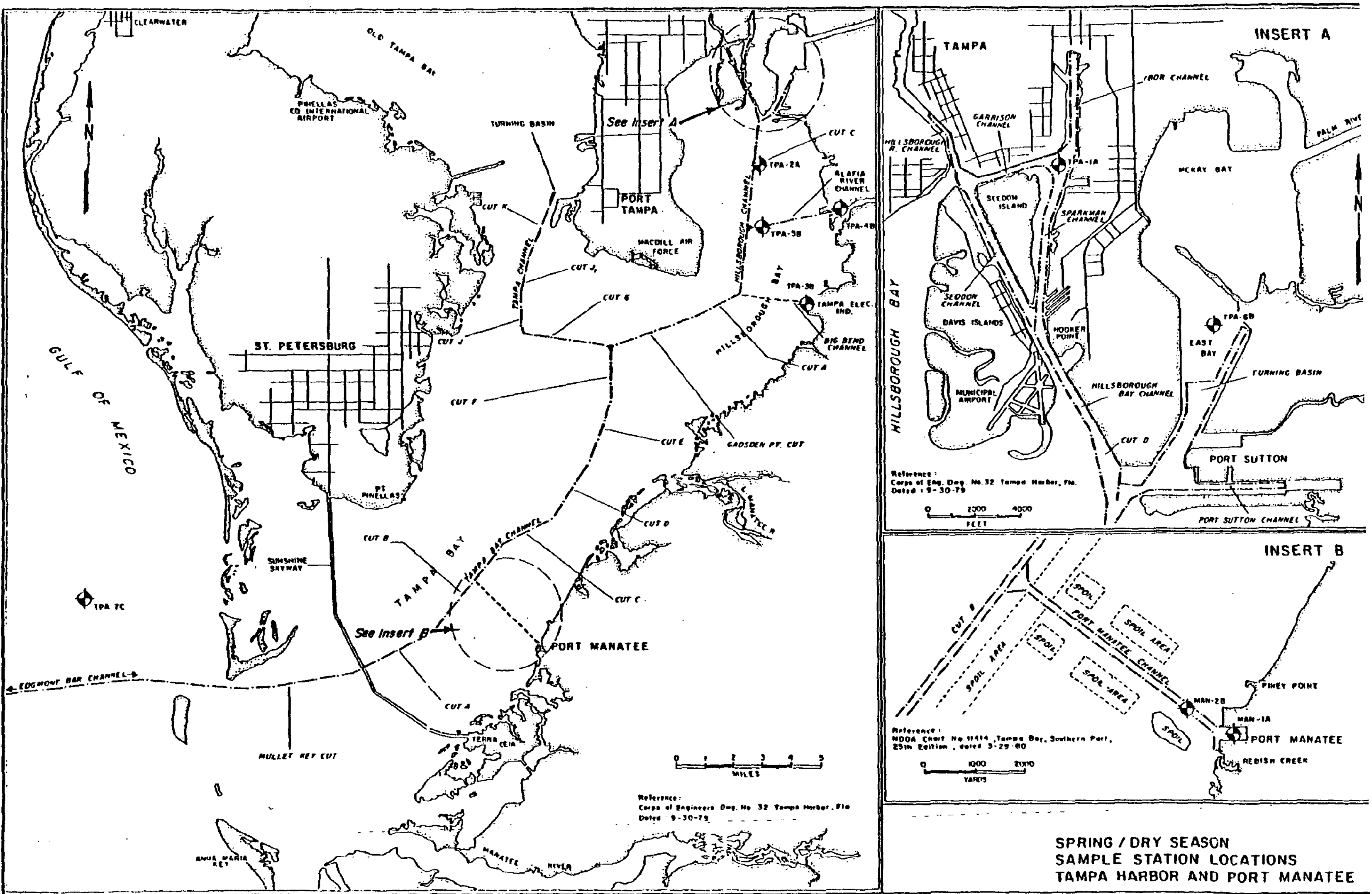

Reference:
Corps of Engineers Dwg. No 32 Tampa Harbor, Fla
Dated 9-30-79

Reference:
Corps of Eng. Dwg. No.32 Tampa Harbor, Fla.
Dated : 9-30-79

Reference:
NOAA Chart No 11414, Tampa Bay, Southern Part,
25th Edition, dated 3-29-80

SPRING / DRY SEASON
SAMPLE STATION LOCATIONS
TAMPA HARBOR AND PORT MANATEE

PROJECT DER-DEEP WATER PORTS
LOCATION JACKSONVILLE-PENSACOLA-TAMPA-MANATEE

DAMES & MOORE
FIGURE 2-13

1273900426 (4-82)

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757.2 (REV. 4-63)

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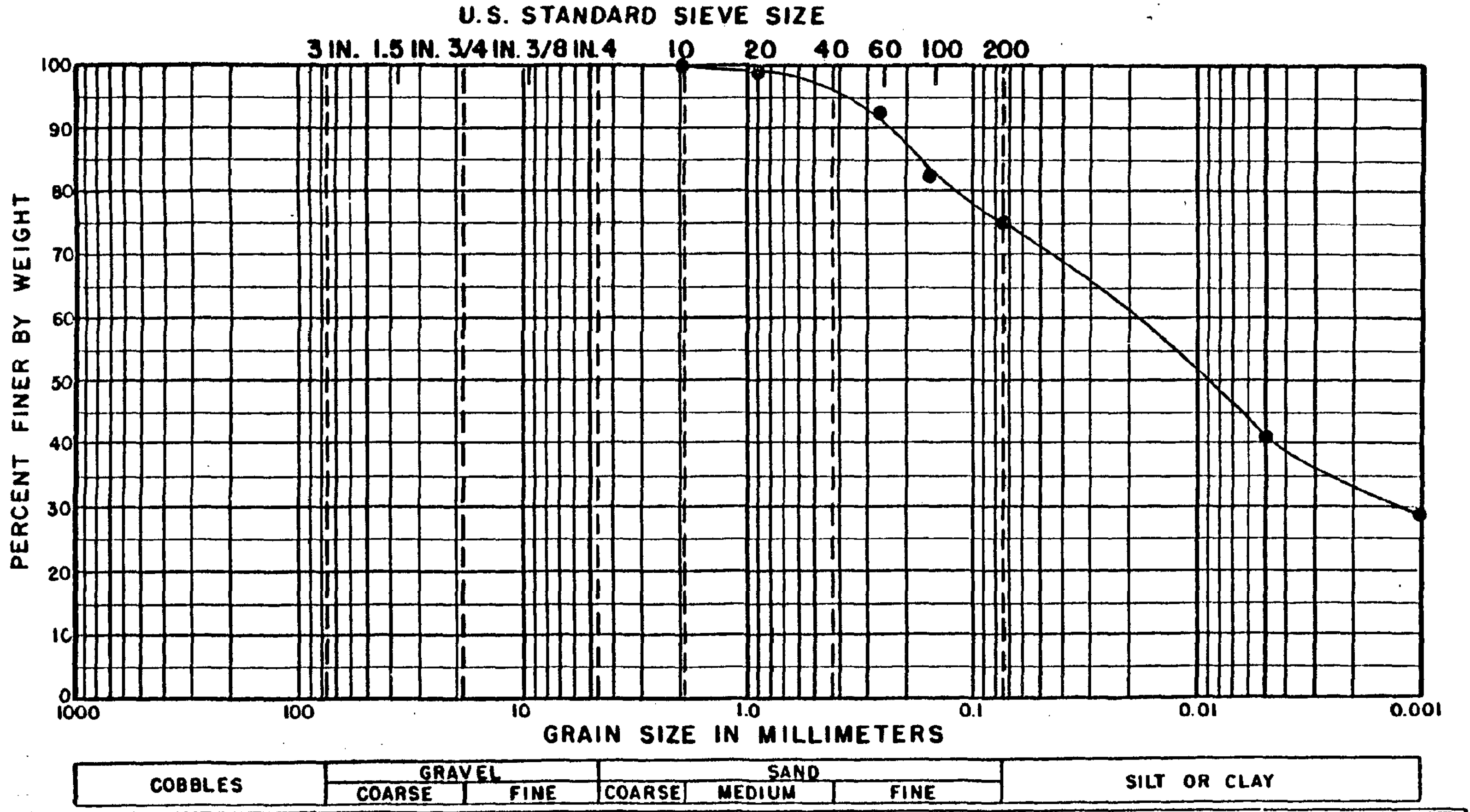

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA - 1A		OH	ORGANIC SILTY CLAY	175.8	57.5	34.5	23.0	YBOR CHANNEL

NOTE : ATTERBERG LIMIT VALUES : DETERMINED FROM 1 SAMPLE

GRADATION CURVE

TAMPA TPA-1A

DAMES & MOORE

FIGURE 2-14

757.2 (REV. 4-62)

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PLATE OF

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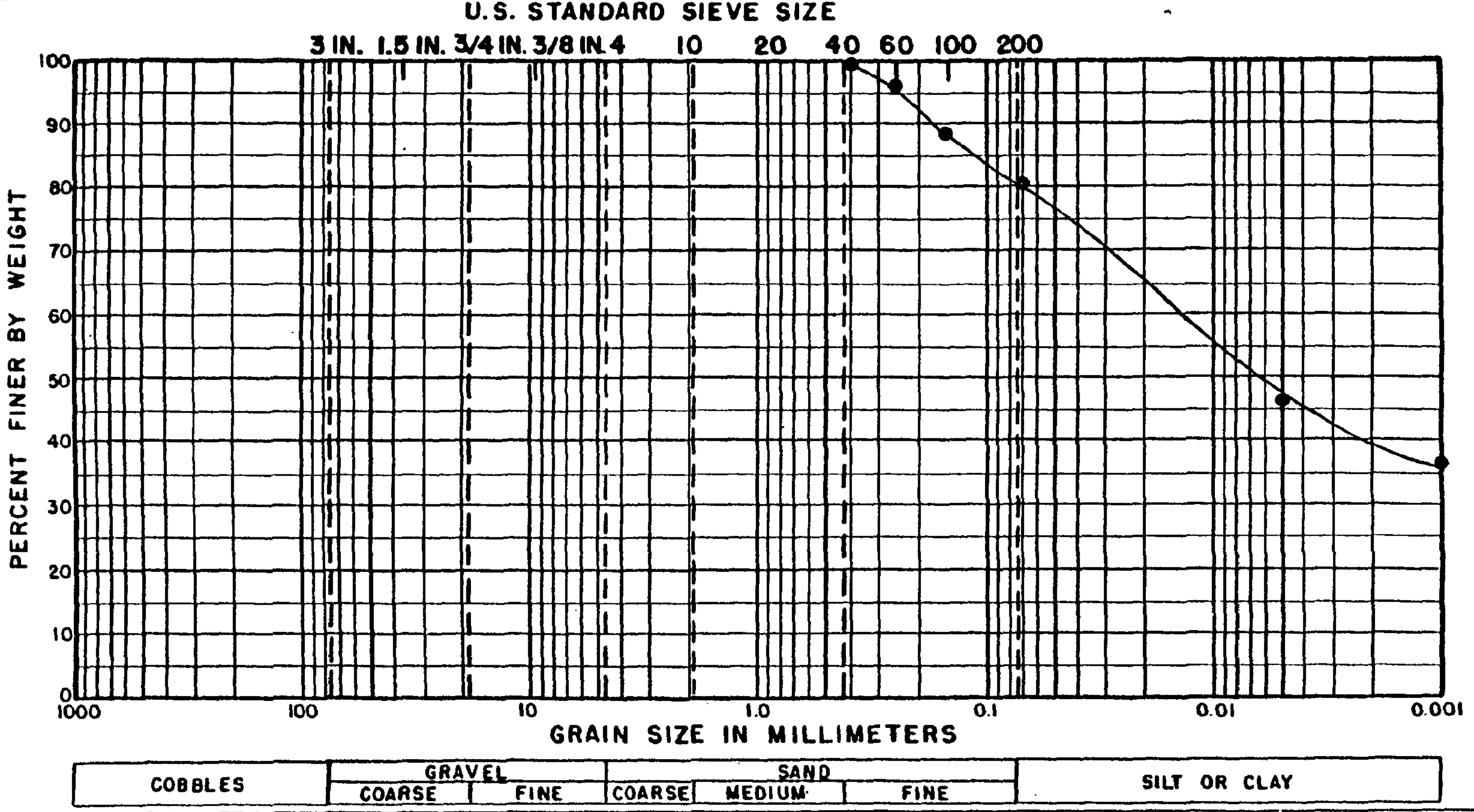

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA - 2A		CH	SILTY CLAY	124.2	60.7	23.1	37.6	HILLSBOROUGH CHANNEL (CUT C)

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM 2 REPLICATE SAMPLES

GRADATION CURVE

TAMPA TPA-2A

DAMES & MOORE

FIGURE 2-15

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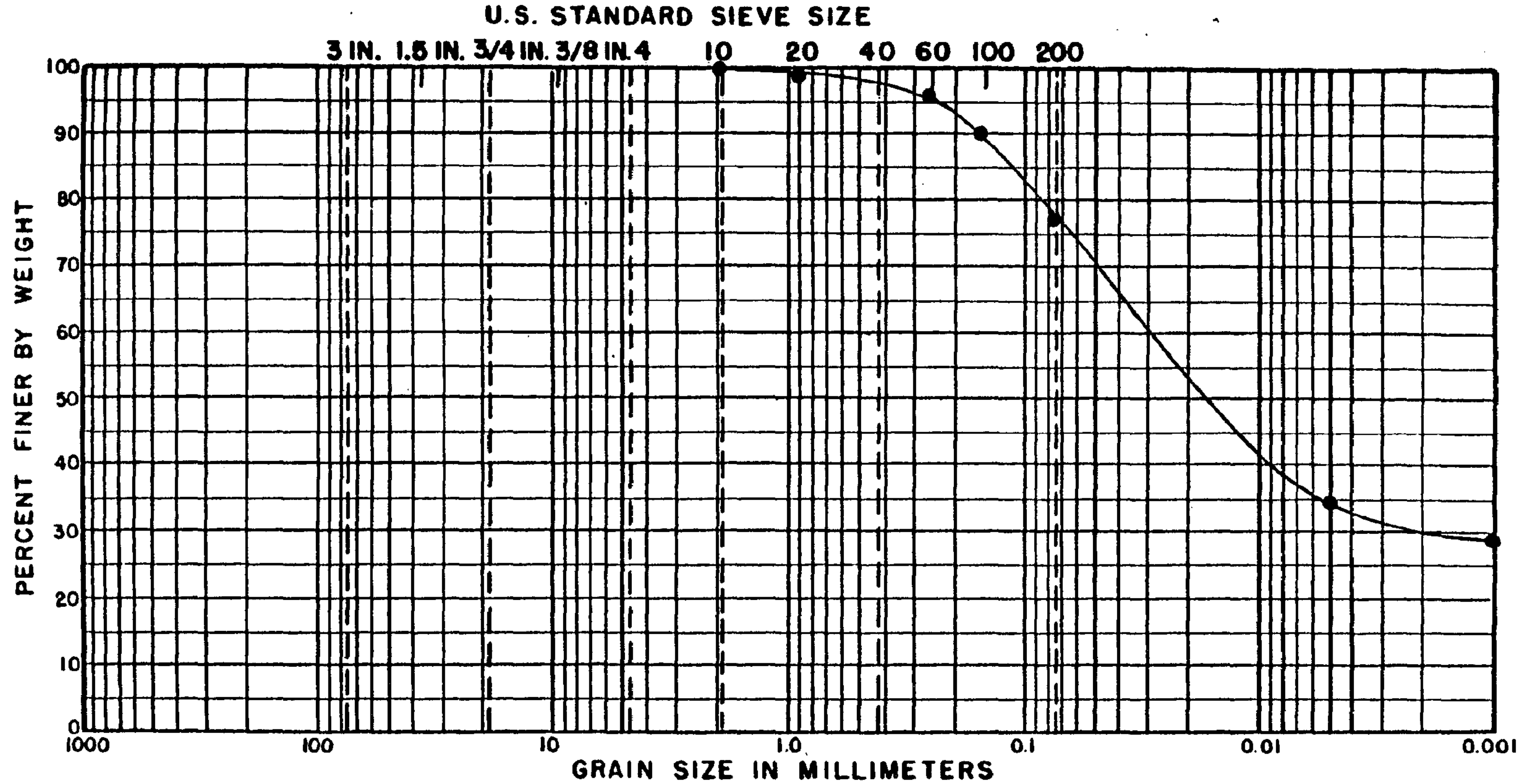
757.2 (REV. 4-68)

1273900426 (9/82)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA-3B		CH	SILTY CLAY	108.0	68.0	30.1	37.9	BIG BEND CHANNEL

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM I SAMPLE

GRADATION CURVE

TAMPA TPA-3B

DAMES & MOORE

FIGURE 2-16

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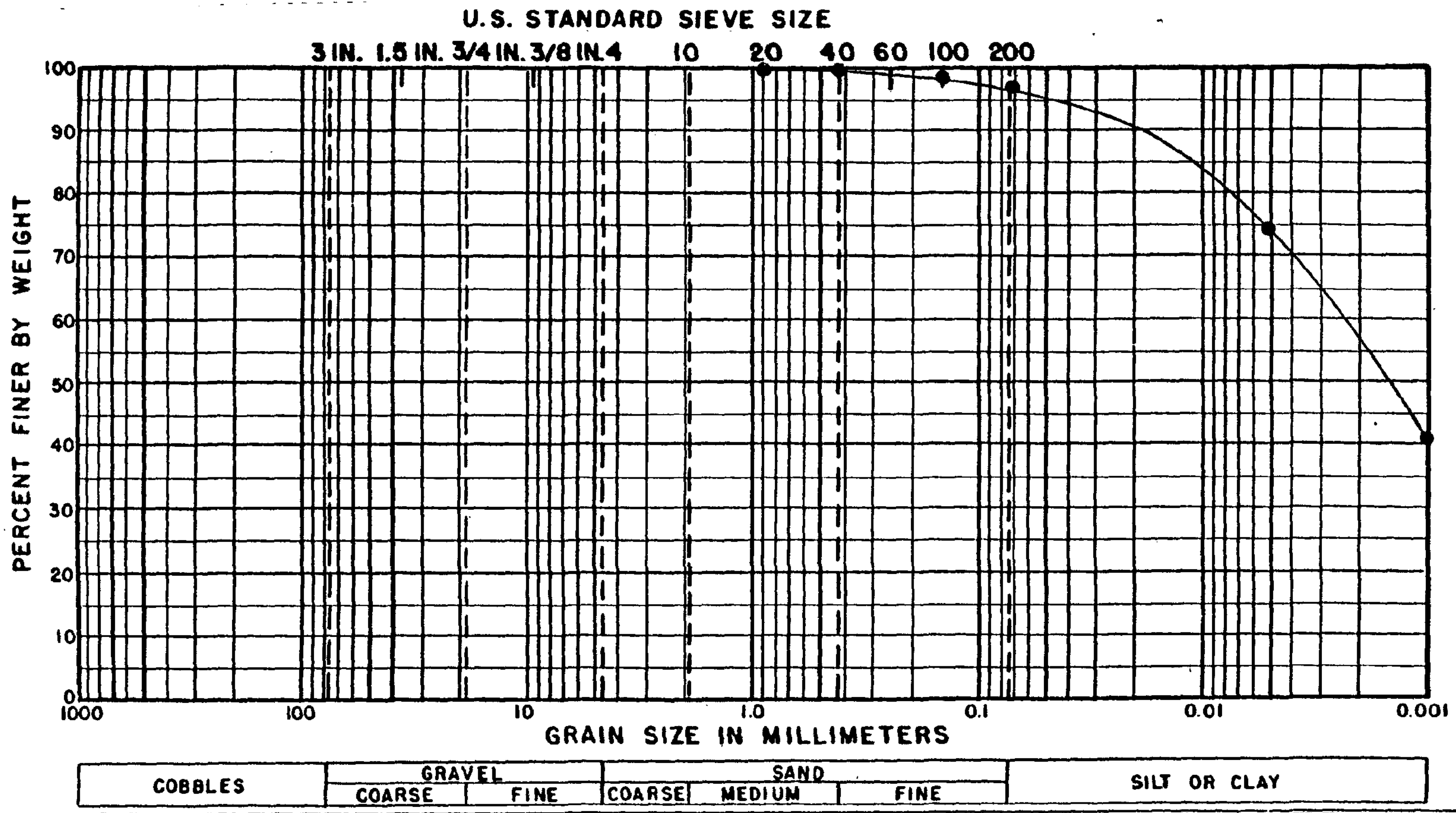
757.2 (REV. 4-82)

1273900426(9/82)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA-4B		OH	ORGANIC SILTY CLAY	122.4	72.0	50.7	21.3	ALAFIA RIVER CHANNEL

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM 1 SAMPLE.

GRADATION CURVE

TAMPA TPA-4B

DAMES & MOORE

FIGURE 2-17

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757.2 (REV. 4-62)

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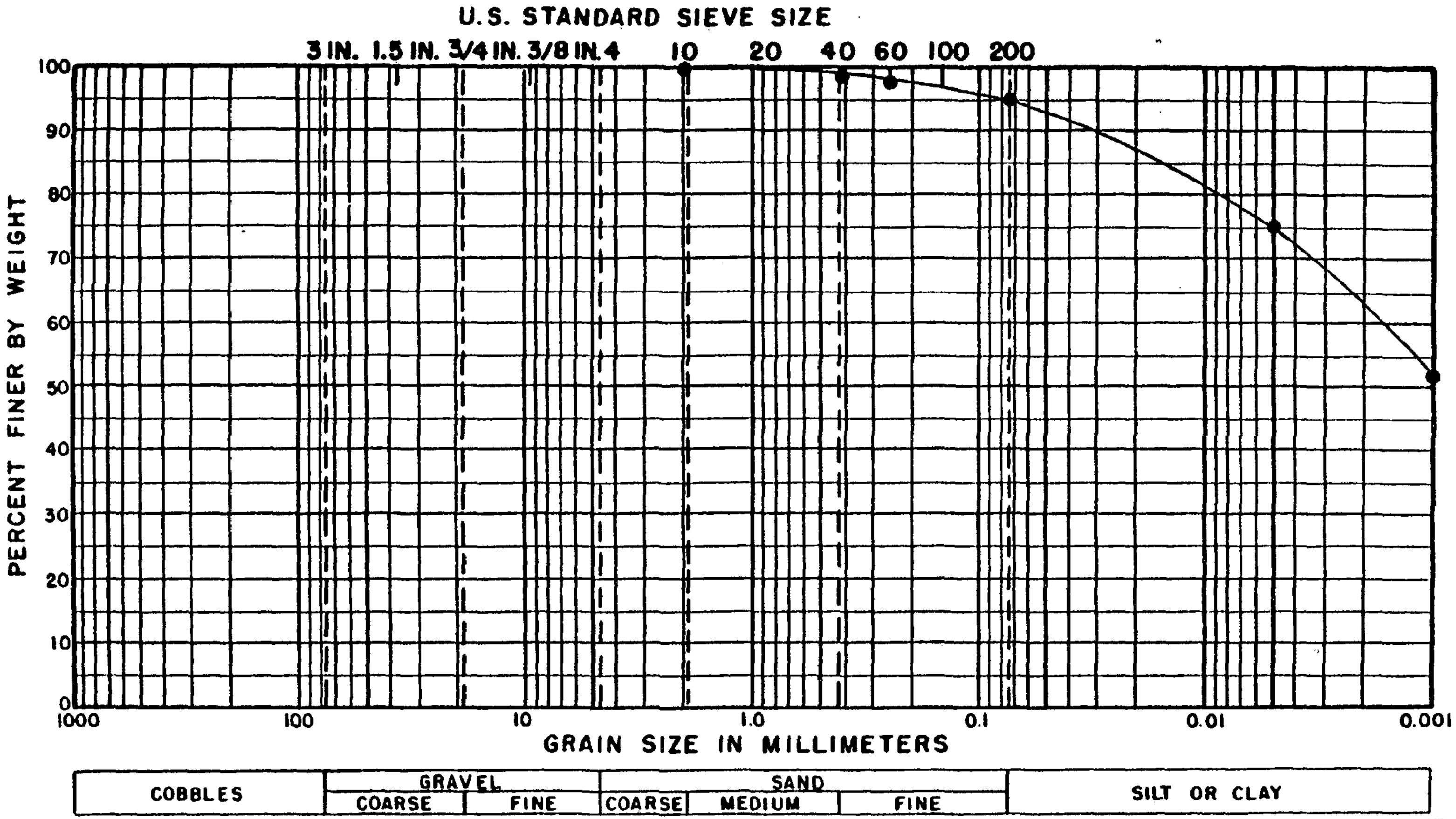

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA-5B		CH	SILTY CLAY	152.7	84.5	28.7	55.8	ALAFIA RIVER CHANNEL

NOTE: ATTERBERG LIMIT VALUES DETERMINED FROM 1 SAMPLE.

GRADATION CURVE

TAMPA TPA-5B

DAMES & MOORE
FIGURE 2-18

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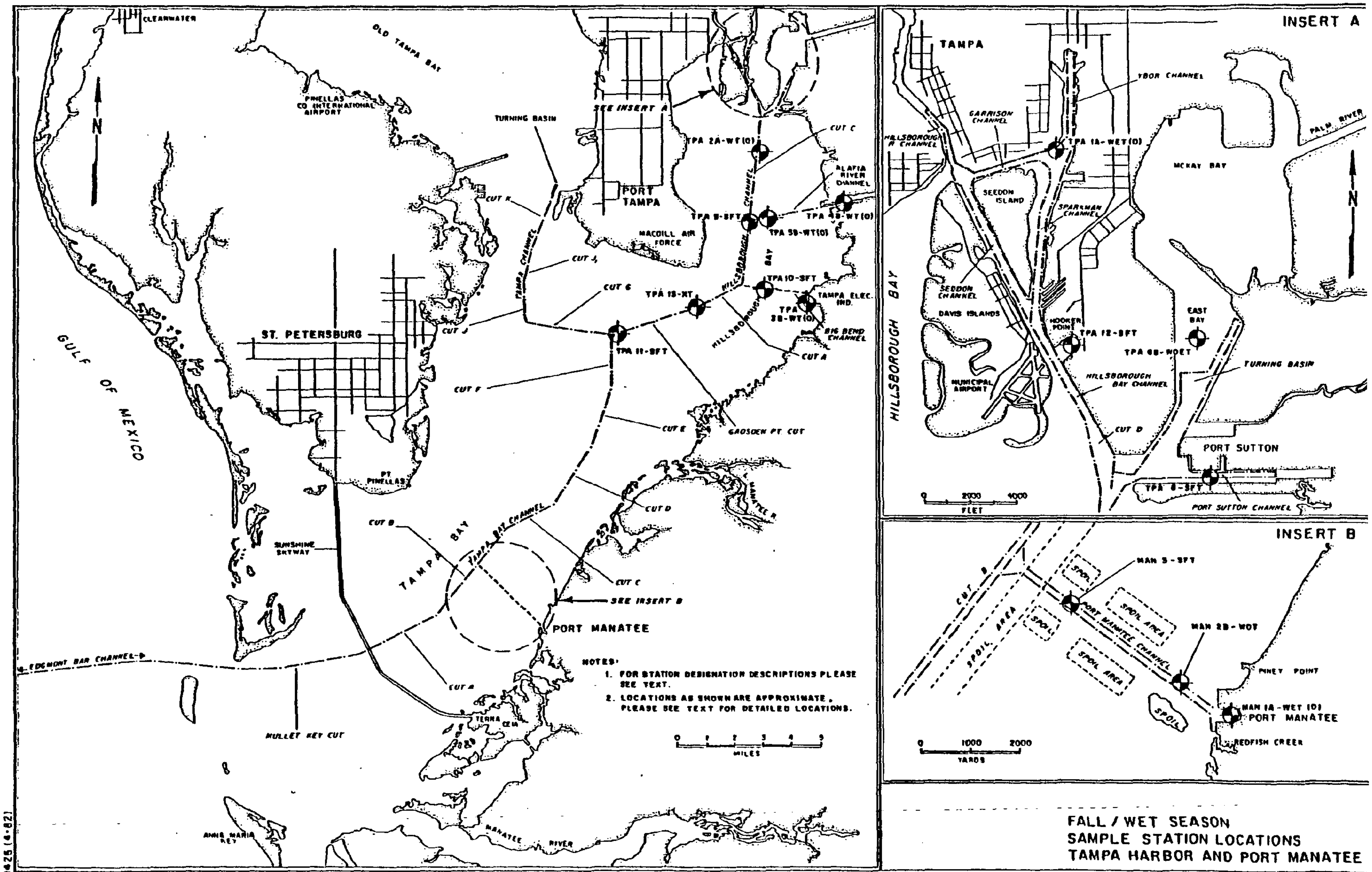

NOTES:
1. FOR STATION DESIGNATION DESCRIPTIONS PLEASE SEE TEXT.
2. LOCATIONS AS SHOWN ARE APPROXIMATE, PLEASE SEE TEXT FOR DETAILED LOCATIONS.

FALL / WET SEASON
SAMPLE STATION LOCATIONS
TAMPA HARBOR AND PORT MANATEE

1273900425 (4-82)

PROJECT DER-DEEP WATER PORTS
LOCATION JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE
FIGURE 2-20

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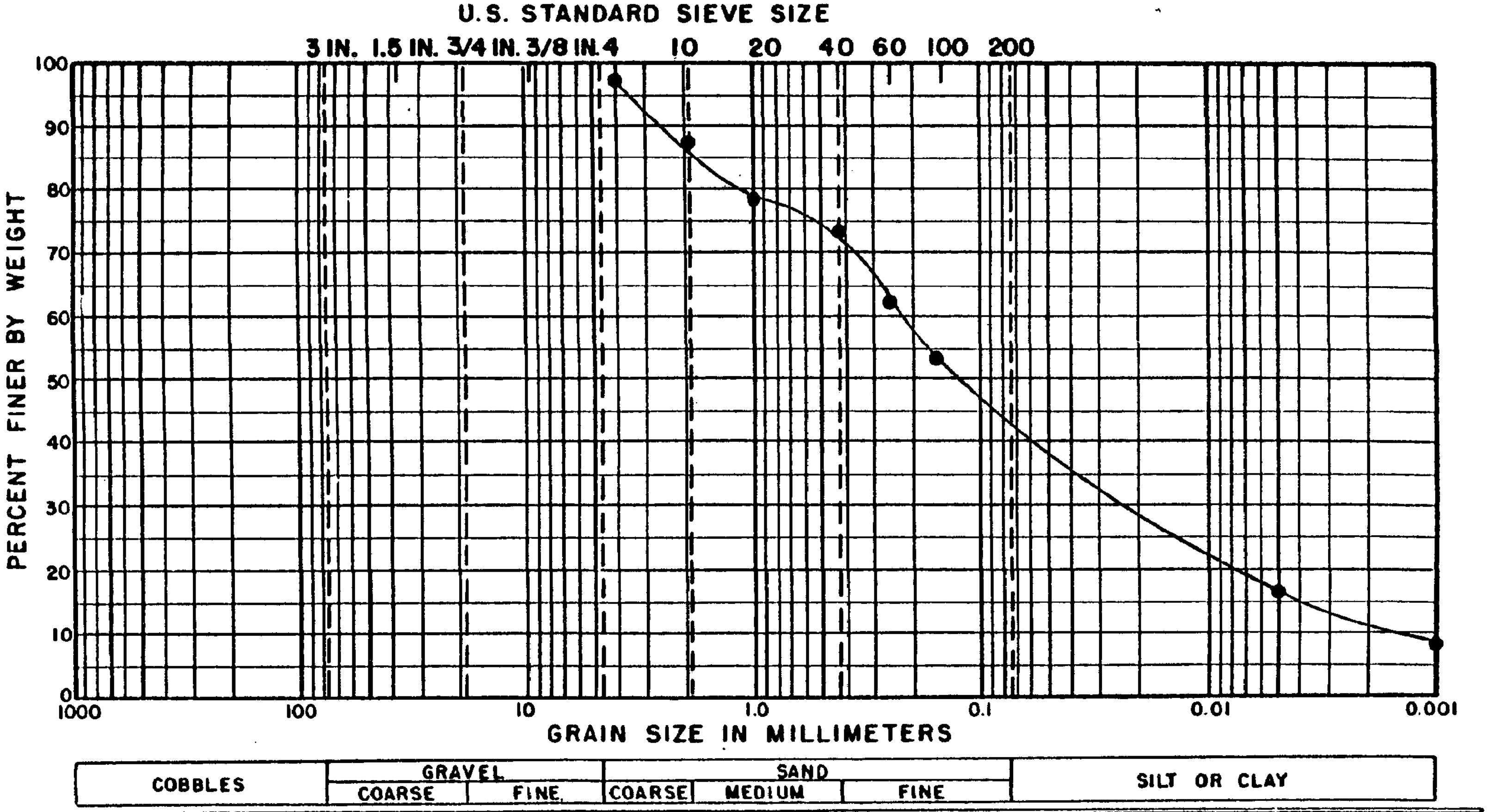
757.2 (REV. 4-62)

1273900426(1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 1A-WET(O)	—	SM/OL	MEDIUM TO FINE ORGANIC SANDY SILT	—	—	—	—	YBOR CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 1A-WET (O)
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-21

757.2 (REV. 4-62)

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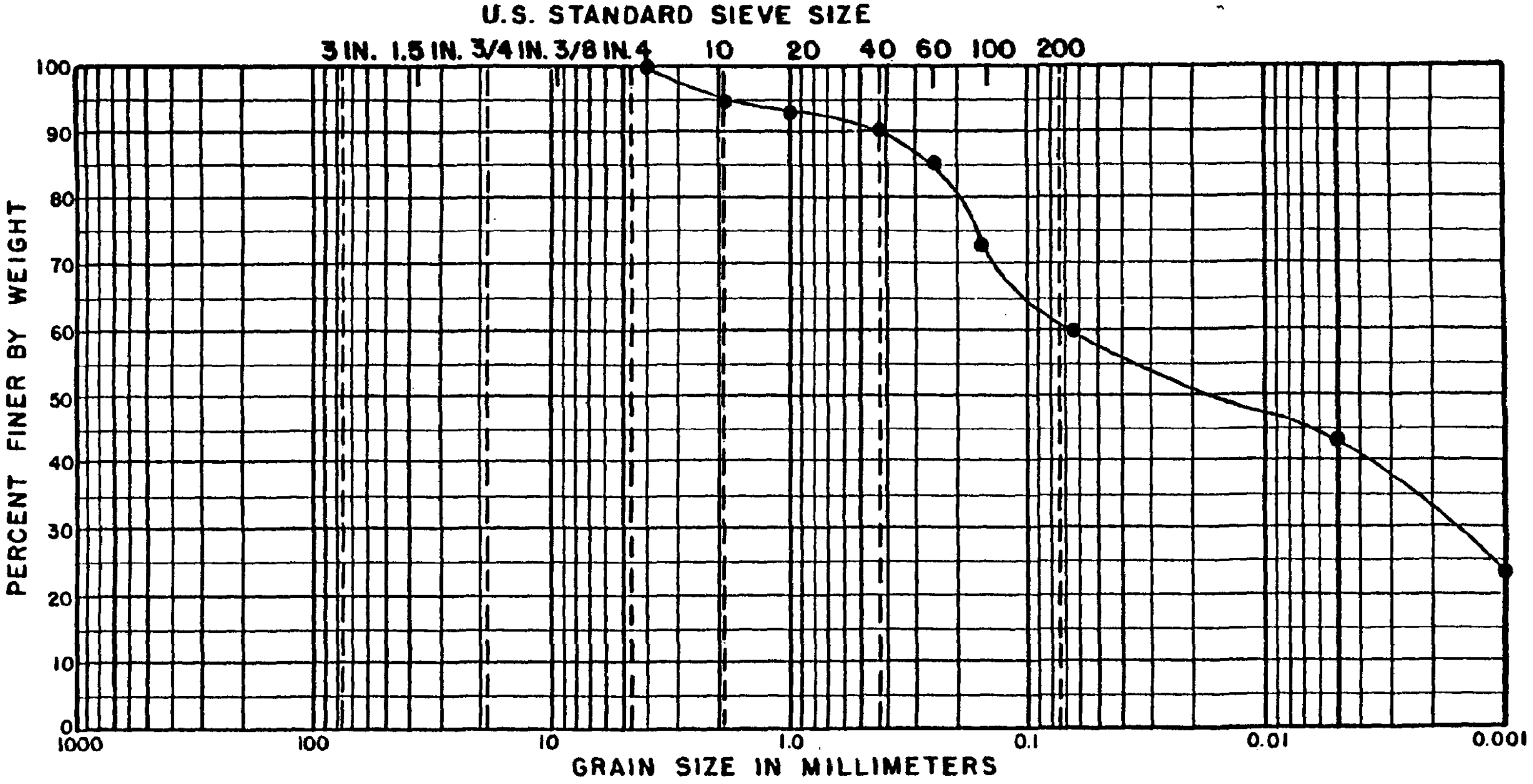

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 6A-WOET	—	SM/SC	FINE SANDY CLAY	—	—	—	—	EAST BAY

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMP TPA 6A-WOET

FALL / WET SEASON

DAMES & MOORE

FIGURE 2-22

757.2 (REV. 4-62)

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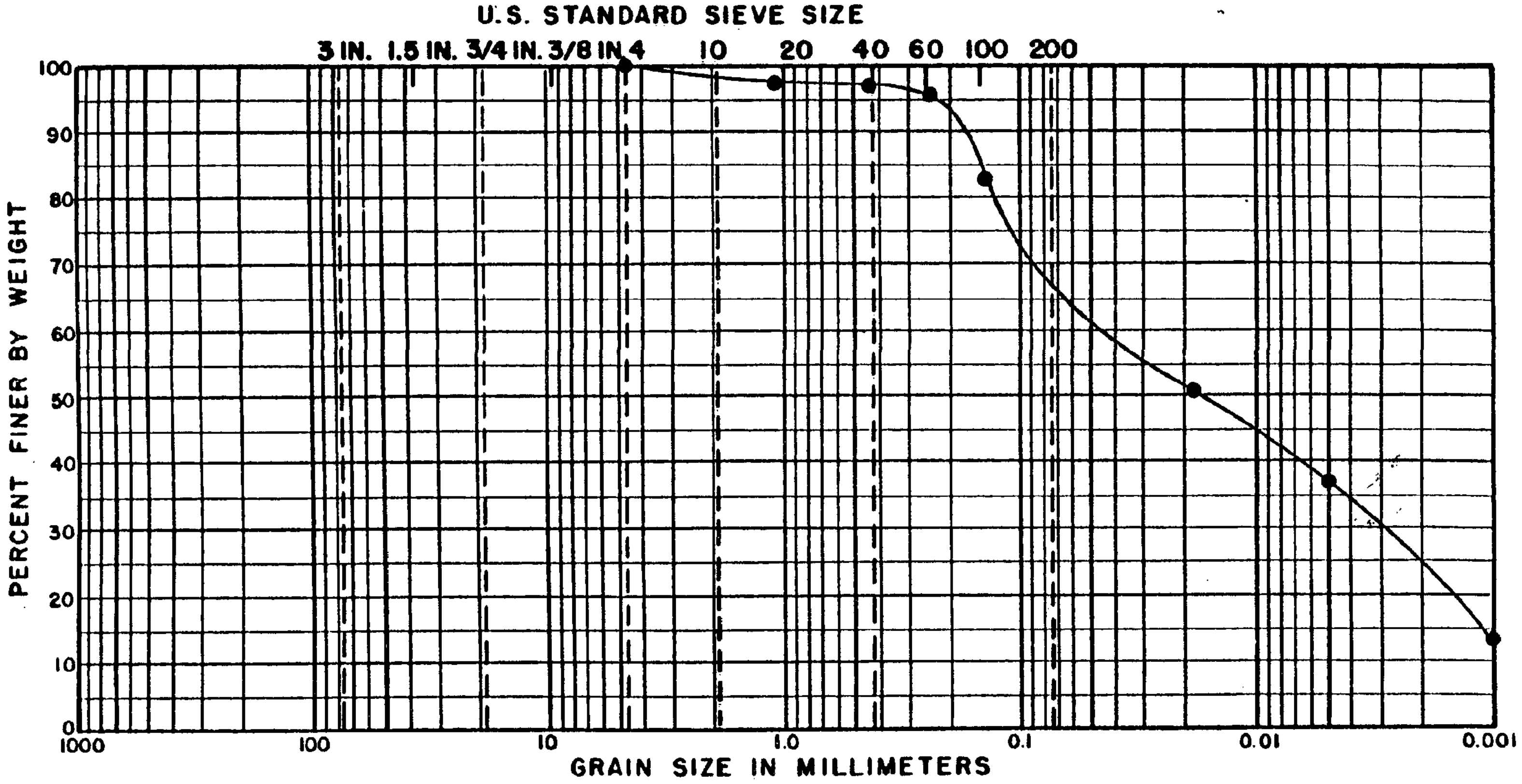


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 8 - SFT	—	CL	SILTY CLAY WITH SOME LIMESTONE FRAGMENTS	85.7	41.8	16.3	25.5	PORT SUTTON CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 8-SFT

FALL / WET SEASON

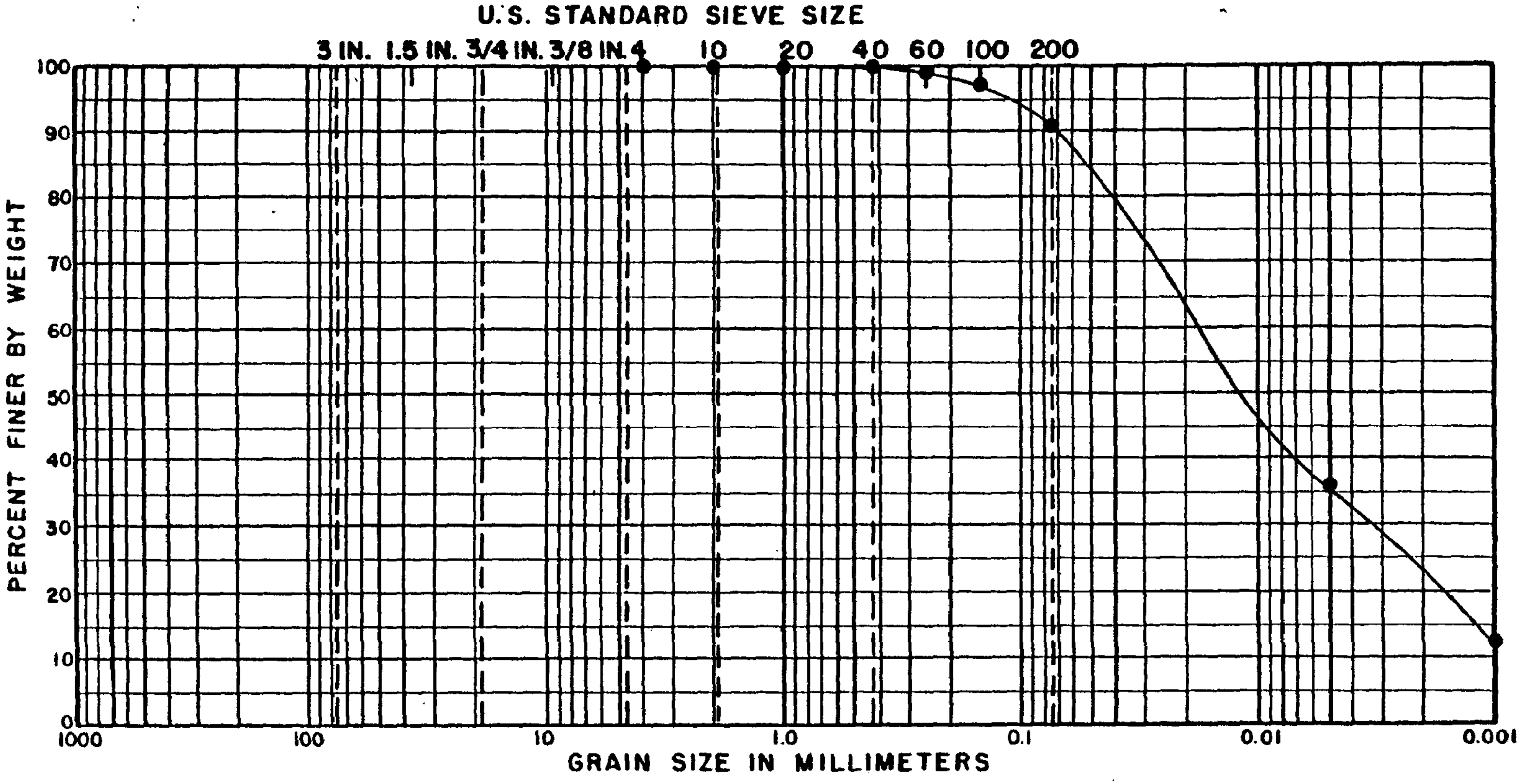
DAMES & MOORE

FIGURE 2-23

BY ______ DATE 1/83
CHECKED BY ______ DATE ______

REVISIONS
BY ______ DATE ______
BY ______ DATE ______
PLATE ______ OF ______

1273900426(1/83)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 9-SFT	—	OH	ORGANIC SILTY CLAY	215.9	58.3	36.0	22.3	HILLSBOROUGH BAY CHANNEL CUT C

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 9-SFT
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-24

757.2 (REV. 4-62)

FILE
BY Lay DATE 1/83
CHECKED BY DATE

REVISIONS
BY DATE
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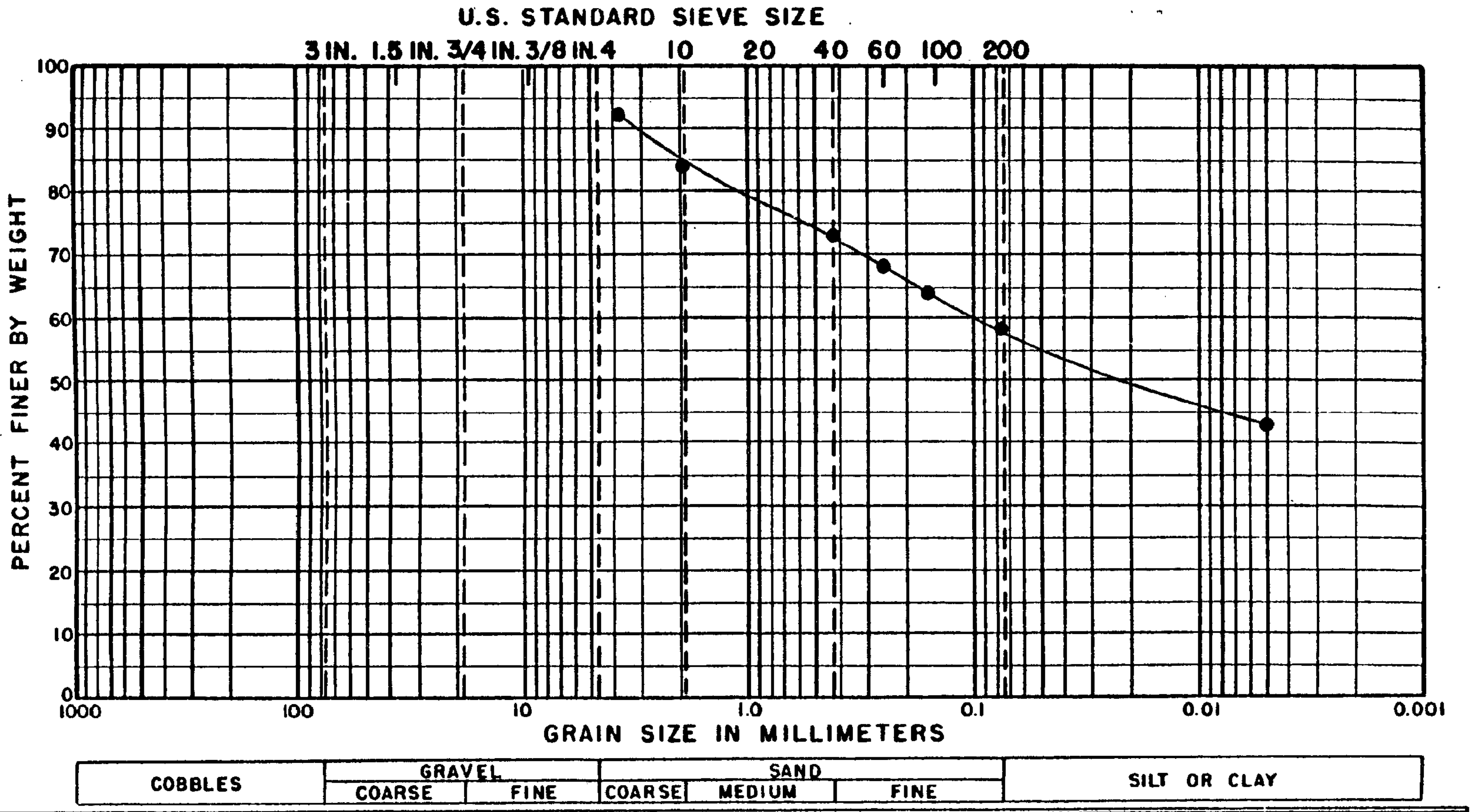
PLATE OF

757.2 (REV. 4-62)

1273900426 (1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 10-SFT	—	OH	ORGANIC SILTY CLAY WITH SOME MEDIUM TO FINE CLAY	177.8	69.8	47.3	22.5	BIG BEND CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 10-SFT
FALL / WET SEASON

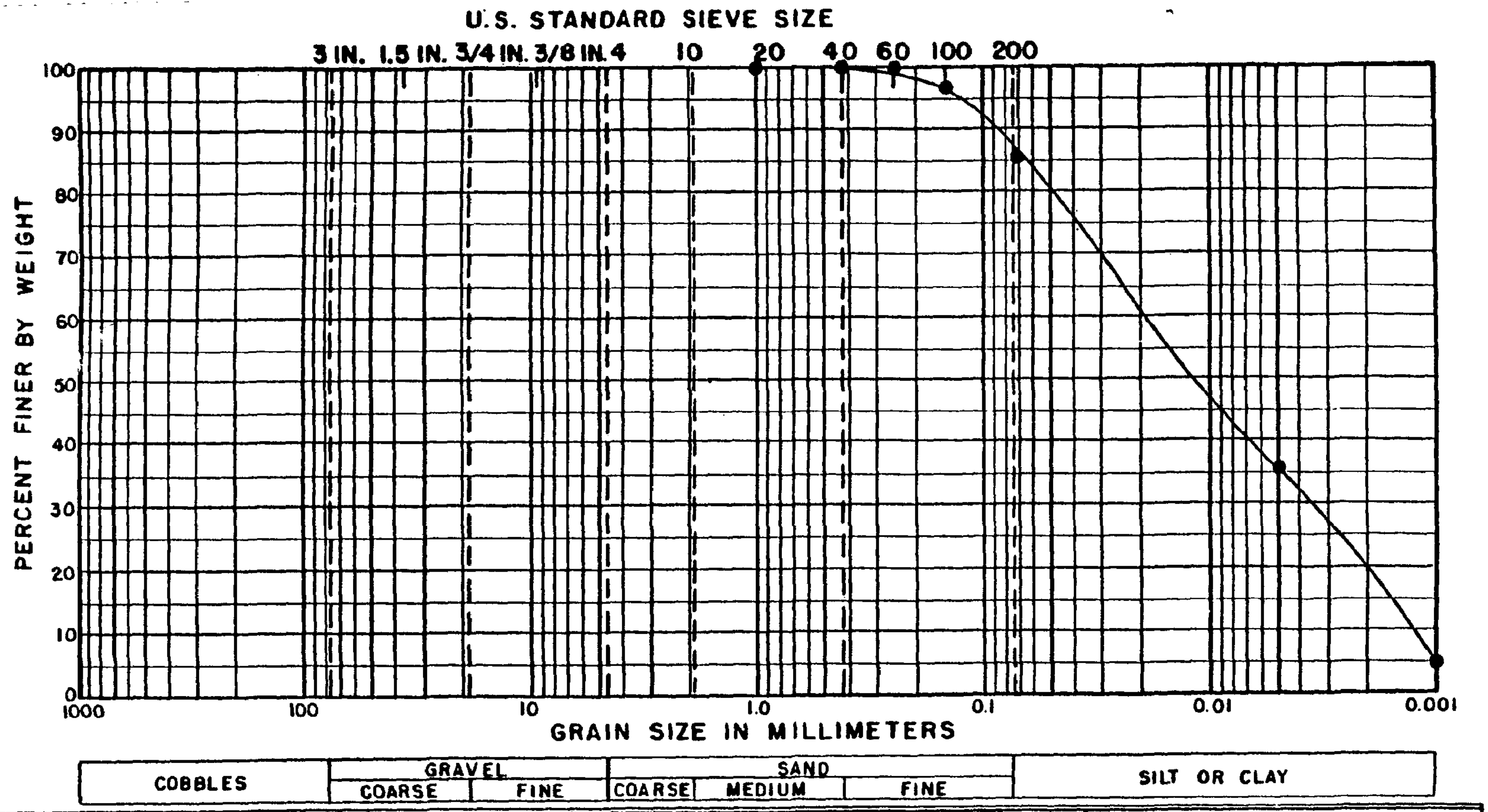
DAMES & MOORE

FIGURE 2-25

BY ____ DATE ____
CHECKED BY ____ DATE ____

REVISIONS
BY ____ DATE ____
BY ____ DATE ____
PLATE ____ OF ____

12739004 26 (1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 11-SFT	—	CH/OH	ORGANIC SILTY CLAY	149.2	65.9	31.0	34.9	GADSDEN POINT CUT

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 11-SFT
FALL / WET SEASON
DAMES & MOORE
FIGURE 2-26

757.2 (REV. 4-62)

TABLE 2-27

TAMPA / MANATEE

INORGANIC SEDIMENT QUALITY CHARACTERISTICS

SPRING / DRY SEASON

STATION / PARAMETER ppm (dry basis)	TPA-1A		TPA-2A		TPA-3B		TPA-4B		TPA-5B		TPA-6B		TPA-7C		MAN-1A		MAN-2B	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
Aluminum	2200	150	1300	300	2200	150	3600	500	3600	290	3500	210	NC	NC	1800	210	1900	310
Antimony	<0.5	-	<0.5	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	<0.5	-	NC	NC
Arsenic	9.3	2.2	<0.1	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	4.6	-	NC	NC
Cadmium	2.2	0.2	0.96	0.21	1.4	0.25	3.6	0.40	0.60	0.11	1.5	0.3	NC	NC	0.64	0.10	0.65	0.35
Chromium	100	10	54.5*	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	57	4	NC	NC
Copper	130	6	4.0	1.0	6.6	1.1	22.0*	-	5.3	1.7	14	3	NC	NC	10	1	10*	-
Fluoride	14	3	8.1	1.1	23	5	62	3	13	1	20	4	NC	NC	22	3	17	2
Iron	19000	1500	7500	610	14000	1500	22000	2000	24000	1000	12000*	-	NC	NC	14000	1000	14000	3600
Lead	130	10	7.5	1.6	15	4	40	6	14	4	45*	-	NC	NC	10	1	10	2
Mercury	1.2	0.4	0.20	0.05	0.55	0.05	1.2	0.2	0.69	0.13	0.42	0.08	NC	NC	0.29	0.06	0.31*	-
Nickel	47	8	9.3	2.7	14*	-	26*	-	16*	-	11	3	NC	NC	12	1	17	6
Silver	0.92	0.07	0.21	0.04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.20	0.04	NC	NC
Zinc	320	25	29*	-	52	6	160	6	31	3	180*	-	NC	NC	77	9	32	9
Radium (pCi/g)	NC	NC	NC	NC	NC	NC	<0.05	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-2).

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

TABLE 2-28

TAMPA

INORGANIC WATER QUALITY

FALL / WET SEASON

STATION / PARAMETER µg/liter	TPA 1A WET(O)		TPA 2A WT(O)		TPA 3B WT(O)		TPA 4B WT(O)		TPA 5B WT(O)		TPA 6B WOET		TPA 8 SFT		TPA 9 SFT		TPA 10 SFT		TPA 11 SFT		TPA 12 SFT		TPA 13 XT		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	2.5*	-	1500
CADMIUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.65	0.06	0.57	0.09	0.55	0.18	0.05	0.01	0.02	0.01	0.02	0.01	5.0
CHROMIUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.0	0.1	50
COPPER	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.36	0.05	0.44	0.02	0.44	0.11	0.95	0.22	0.73	0.09	0.77	0.05	15
FLUORIDE[1]	1.0	0	1.0	0.1	1.1	0.1	1.0	0	1.2	0.1	1.0	0	0.98	0.03	1.0	0.1	1.0	0	1.0	0	1.0	0	1.0	0	5.0[1]
IRON	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	7.9	0.6	300
LEAD	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	2.4	0.4	1.1	0.2	2.0	0.25	0.29	0.02	0.30	0.07	0.36	0.07	50
MERCURY	0.19	0.05	<0.10	-	0.13	0.04	<0.1	-	< 0.1	-	0.13	0.04	0.39	0.03	<0.10	-	0.17	0.04	<0.1	-	<0.10	-	<0.1	-	0.1
NICKEL	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.0	0.2	100
SILVER	0.04	0.01	0.02	0.01	0.01*	-	0.01	0	0.01*	-	0.03	0.01	0.02*	-	<0.02	-	0.03	0.01	0.01*	-	0.04	0.01	0.03	0.01	0.05
ZINC	3.4	1.0	2.2	0.2	1.5	0.1	<1.1	-	1.4	0.3	1.8	0.2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	3.9	0.3	1000

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

[1] FLUORIDE UNITES ARE MG/L.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-29

METAL:ALUMINUM RATIOS IN SEDIMENTS
PORT TAMPA

Station	Cd $(\times 10^{-3})$	Cr $(\times 10^{-1})$	Cu $(\times 10^{-3})$	Fe $(\times 10^{0})$	Pb $(\times 10^{-3})$	Hg $(\times 10^{-4})$	Ni $(\times 10^{-3})$	Ag $(\times 10^{-4})$	Zn $(\times 10^{-3})$	F $(\times 10^{-3})$
TPA-1A	1.0	0.45	59.1	8.6	59.1	5.5	21.4	4.2	145.5	6.4
TPA-1A-WET(O)	0.15	0.06	9.4	1.1	13.6	0.26	1.6[1]	0.74	29.6	NC
TPA-2A	0.7	0.4[1]	3.1	5.8	5.8	1.5	7.2	1.6	22.3[1]	6.2
TPA-3B	0.6	NC	3.0	6.4	6.8	2.5	6.4	NC	23.6	10.5
TPA-4B	1.0	NC	6.1[1]	6.1	11.1	3.3	7.2	NC	44.4	17.2
TPA-5B	0.17	NC	1.5	6.7	3.9	1.9	4.4[1]	NC	8.6	3.6
TPA-6B	0.4	NC	4.0	3.4	12.9	1.2	3.1	NC	51.4	5.7
TPA 6B-WOET	0.08	0.04	0.7	0.55	2.5	0.28	0.09	0.45	6.0	NC
TPA 8-SFT[2]	0.04[1]	0.04	1.0	NC	1.1	0.10	0.73	0.34[1]	6.2	NC
TPA 9-SFT	0.05	0.03	0.8	NC	1.0	0.10	1.2	0.23	5.4	NC
TPA 10-SFT	0.05	0.03	0.7[1]	NC	0.5[1]	0.12	1.0	0.18	4.4	NC
TPA 11-SFT	0.05	0.03	0.4[1]	NC	0.95	0.06	0.50	0.19	1.4[1]	NC
TPA 12-SFT	0.05	0.04	1.4	NC	1.8	0.08[1]	0.48	0.45	6.2	NC
Crustal* Ratio	0.002	0.01	0.7	0.7	0.15	0.01	0.9	0.001	0.8	7.6
Carbonate** Rocks	0.009	0.03	1.0	0.9	2.1	0.1	4.8	0.05	48	7.8

NOTES:

NC Indicates ratio not determined due to station designation (see Tables 1-2 and 1-3)
1 Ratio determined using the mean of two replicate metal values
2 Ratios determined using the mean of two aluminum values
* From Taylor (1964)
** From Turekian and Wedepohl (1961)

TABLE 2-30

TAMPA / MANATEE
ORGANIC SEDIMENT QUALITY

SPRING / DRY SEASON

STATION / PARAMETER ppm (dry basis)	TPA-1A		TPA-2A		TPA-3B		TPA-4B		TPA-5B		TPA-6B		TPA-7C		MAN-1A		MAN-2B	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
Pesticides																		
Mirex	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-	<0.001	-
Toxaphene	<0.02	-	<0.02	-	<0.02	-	<0.02	-	<0.02	-	<0.02	-	NC	NC	<0.02	-	<0.02	-
DDT	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-	<0.001	-
Aldrin	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-	<0.001	-
Chlordane	<0.006	-	<0.006	-	<0.006	-	<0.006	-	<0.006	-	[1,2] <0.006	-	NC	NC	<0.006	-	<0.006	-
Other Chlorinated (DDE)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	[1] 0.001	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PCB's	<0.002	-	<0.002	-	<0.002	-	<0.002	-	<0.002	-	<0.002	-	NC	NC	<0.002	-	<0.002	-
Oil and Grease	2000*	-	835*	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	820	120	NC	NC
Phenols																		
Phenol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	NC	NC	<0.2	-	<0.2	-
2 - chlorophenol	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	NC	NC	<0.01	-	<0.01	-
2,4 - Dichlorophenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	NC	NC	<0.1	-	<0.1	-
2,4,6 - Trichlorophenol	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	NC	NC	<0.01	-	<0.01	-
4 - Chloro-m-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	NC	NC	<0.2	-	<0.2	-
2,4 - Dinitrophenol	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	NC	NC	<0.3	-	<0.3	-
Pentachlorophenol	<0.007	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	NC	NC	<0.005	-	<0.005	-

NOTES:

1) Observed in one replicate only, other replicate values below deflection limit.
2) Possible trace (TR) observed in one replicate only.
* Mean determined using 2 replicate values.

REMARKS:

NC refers to analysis not completed due to station designation (See table 1.2).
For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

NA indicates no analysis completed

TABLE 2-31

TAMPA

ORGANIC SEDIMENT QUALITY

FALL / WET SEASON

STATION / PARAMETERS ppm (dry basis)	TPA 1A WET(O)		TPA 6B WOET		TPA 8 SFT		TPA 9 SFT		TPA 10 SFT		TPA 11 SFT		TPA 12 SFT	
PESTICIDES	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
MIREX	NC	NC	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
TOXAPHENE	NC	NC	NC	NC	<0.015	-	<0.015	-	<0.015	-	<0.015	-	<0.015	-
ALDRIN	NC	NC	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
CHLORDANE	NC	NC	NC	NC	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-
DDT	NC	NC	NC	NC	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
OTHER CHLORINATED	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
PHENOLS	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
2-CHLOROPHENOL	NC	NC	NC	NC	< 0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-
PHENOL	NC	NC	NC	NC	< 1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-
2,4-DICHLOROPHENOL	NC	NC	NC	NC	< 1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-
2,4,6-TRICHLOROPHENOL	NC	NC	NC	NC	< 0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-
4-CHLORO-M-CRESOL	NC	NC	NC	NC	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-
2,4-DINITROPHENOL	NC	NC	NC	NC	<0.07	-	<0.07	-	<0.07	-	<0.07	-	<0.07	-
PENTACHLOROPHENOL	NC	NC	NC	NC	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-32

TAMPA

ELUTRIATE RESULTS

STATION / PARAMETER μg/l[1]	TPA 13 XT		TPA 1A WET (O)		TPA 6B WOET		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	2.5*	-	3.1	0.2	2.7	0.4	1500
CADMIUM	0.02	0.01	0.06	0.01	0.06	0.01	5.0
CHROMIUM	1.0	0.1	2.3	0.2	4.1	0.9	50
COPPER	0.77	0.05	0.27	0.06	0.28	0.07	15
IRON	7.9	0.6	15	2.0	13	2.0	300
LEAD	0.36	0.07	0.38	0.05	0.35	0.05	50
MERCURY	<0.1	-	0.22	0.02	0.21	0.03	0.1
NICKEL	1.0	0.2	5.0	0.4	3.9	0.6	100
SILVER	0.03	0.01	0.09	0.02	0.07	0.01	0.05
ZINC	3.9	0.3	3.8	0.4	4.7	0.5	1000
FLUORIDE	1.0	0	1.2	0.1	1.2	0.1	5.0
TOTAL KJELDAHL NITROGEN	3.1	0.5	15	2	16	4	NS
TOTAL ORGANIC CARBON	5.2	0.3	7.2	0.7	12	0.6	NS
AMMONIA-N	0.10	0.02	8.5	0.7	11.1	1.5	NS
NITRATE-N	0.07	0.02	0.16	0.03	0.11	0.02	NS
PHOSPHATE-P	0.59	0.10	1.03	0.15	1.1	0.2	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		POST-ELUTRIATE TEST RESULTS		STANDARD

NOTES:

NS REFERS TO STANDARDS NOT AVAILABLE

[1] UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT

* MEAN DETERMINED USING 2 REPLICATE VALUES

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINANTLY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TABLE 2-32

TAMPA

ELUTRIATE RESULTS

STATION / PARAMETER $\mu g/l^1$	TPA 13 XT		TPA 1A WET (O)		TPA 6B WOET		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	2.5*	-	3.1	0.2	2.7	0.4	1500
CADMIUM	0.02	0.01	0.06	0.01	0.06	0.01	5.0
CHROMIUM	1.0	0.1	2.3	0.2	4.1	0.9	50
COPPER	0.77	0.05	0.27	0.06	0.28	0.07	15
IRON	7.9	0.6	15	2.0	13	2.0	300
LEAD	0.36	0.07	0.38	0.05	0.35	0.05	50
MERCURY	<0.1	-	0.22	0.02	0.21	0.03	0.1
NICKEL	1.0	0.2	5.0	0.4	3.9	0.6	100
SILVER	0.03	0.01	0.09	0.02	0.07	0.01	0.05
ZINC	3.9	0.3	3.8	0.4	4.7	0.5	1000
FLUORIDE	1.0	0	1.2	0.1	1.2	0.1	5.0
TOTAL KJELDAHL NITROGEN	3.1	0.5	15	2	16	4	NS
TOTAL ORGANIC CARBON	5.2	0.3	7.2	0.7	12	0.6	NS
AMMONIA-N	0.10	0.02	8.5	0.7	11.1	1.5	NS
NITRATE-N	0.07	0.02	0.16	0.03	0.11	0.02	NS
PHOSPHATE-P	0.59	0.10	1.03	0.15	1.1	0.2	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		POST-ELUTRIATE TEST RESULTS		STANDARD

NOTES:

NS REFERS TO STANDARDS NOT AVAILABLE

1 UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT

* MEAN DETERMINED USING 2 REPLICATE VALUES

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINANTLY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TABLE 2-33

MANATEE

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

FALL / WET SEASON

STATION PARAMETER	MAN 1A WET (O)	MAN 2B WOT	MAN 3 SFT	STANDARD
TEMPERATURE (°C)*	28	29	28	NA
SALINITY (PPT)	28.5	30	27	NA
DISSOLVED OXYGEN (mg/l)	6.5	3.5	NA	4
DISSOLVED OXYGEN (% SATURATION)	95.6	53.4	NA	NA
TURBIDITY (NTU)	2.9	2.1	4.4	NA
CONDUCTIVITY (μmhos)	35700	37600	36100	NA
pH	7.8	7.6	7.9	≥ 6.0 ≤ 8.5

NOTES:

NA REFERS TO DATA NOT AVAILABLE

* VALUES DETERMINED WITH THE D.O. METER.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-34

MANATEE
INORGANIC WATER QUALITY
FALL / WET SEASON

PARAMETER µg/liter / STATION	MAN 1A WET(O)		MAN 2B WOT		MAN 3 SFT		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	NC	NC	NC	NC	NC	NC	1500
CADMIUM	NC	NC	NC	NC	0.06	0.01	5.0
CHROMIUM	NC	NC	NC	NC	NC	NC	50
COPPER	NC	NC	NC	NC	0.43	0.05	15
FLUORIDE[1]	0.98	0.03	1.0	0	1.0	0.2	5.0[1]
IRON	NC	NC	NC	NC	NC	NC	300
LEAD	NC	NC	NC	NC	0.27	0.03	50
MERCURY	< 0.10	-	< 0.1	-	< 0.10	-	0.1
NICKEL	NC	NC	NC	NC	NC	NC	100
SILVER	0.02	0	0.01*	-	0.02	0.01	0.05
ZINC	< 1.1	-	< 1.0	-	NC	NC	1000

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

[1] FLORIDE UNITS IN MG/L.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS. CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE III WATERS.

TABLE 2-35

MANATEE

ORGANIC WATER QUALITY

FALL / WET SEASON

STATION PARAMETER µg/liter	MAN 1A WET(O)		MAN 2B WOT		STANDARD
PESTICIDES	MEAN	σ	MEAN	σ	
MIREX	NA	NA	< 0.02	-	0.001
TOXAPHENE	NA	NA	< 0.2	-	0.005
DDT	NA	NA	< 0.01	-	0.001
ALDRIN	NA	NA	< 0.003	-	0.003
CHLORDANE	NA	NA	< 0.2	-	0.004
OTHER CHLORINATED	NC	NC	NC	NC	NS
PHENOLS	MEAN	σ	MEAN	σ	
2-CHLOROPHENOL	NA	NA	< 1.0	-	1.0
PHENOL	NA	NA	< 5.0	-	1.0
2,4-DICHLOROPHENOL	NA	NA	< 0.05	-	1.0
2,4,6-TRICHLOPHENOL	NA	NA	< 0.05	-	1.0
4-CHLORO-M-CRESOL	NA	NA	< 2.0	-	1.0
2,4-DINITROPHENOL	NA	NA	<20	-	1.0
PENTACHLOROPHENOL	NA	NA	< 0.05	-	1.0

NOTES:

-	INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.
NC	REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).
NS	INDICATES STANDARD NOT AVAILABLE.
NA	INDICATES ADDITIONAL ORGANIC ANALYSIS NOT COMPLETED DUE TO RESULTS FOR TPA 6B-WOET.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS IN PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-36

MANATEE

GENERAL PHYSICAL AND CHEMICAL SEDIMENT CHARACTERISTICS

FALL / WET SEASON

STATION / PARAMETER ppm (dry basis)	MAN 1A WET (O)		MAN 3 SFT	
	MEAN	σ	MEAN	σ
SPECIFIC GRAVITY [1]	2.76	0.03	2.70	0.03
TOTAL KJELDAHL NITROGEN	2300	750	330	82
TOTAL ORGANIC CARBON	16000	4900	1300	430
AMMONIA - N	470	78	NC	NC
PHOSPHATE - P	1400	210	NC	NC
NITRATE - N	1.2	0.4	NC	NC
OIL and GREASE	NC	NC	330	75

NOTES:

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

1 SPECIFIC GRAVITY AS SHOWN IS DIMENSIONLESS.

TABLE 2-37

METAL:ALUMINUM RATIOS IN SEDIMENTS
PORT MANATEE

Station	Cd ($\times 10^{-3}$)	Cr ($\times 10^{-1}$)	Cu ($\times 10^{-3}$)	Fe ($\times 10^{0}$)	Pb ($\times 10^{-3}$)	Hg ($\times 10^{-4}$)	Ni ($\times 10^{-3}$)	Ag ($\times 10^{-4}$)	Zn ($\times 10^{-3}$)	F ($\times 10^{-3}$)
MAN-1A	0.36	0.32	5.6	7.8	5.6	1.6	6.7	1.1	42.8	12.2
MAN 1A-WET(O)	0.05	0.02	1.4	0.6	0.9	0.17	1.1	0.2[1]	1.2	NC
MAN-2B	0.34	NC	5.3	7.4	5.3	1.6[1]	8.9	NC	16.8	8.9
MAN 3-SFT	0.10	0.06[1]	0.1	NC	1.8[1]	0.7	1.3[1]	0.9	2.1[1]	NC
Crustal* Ratio	0.002	0.01	0.7	0.7	0.15	0.01	0.9	0.001	0.8	7.6
Carbonate** Rocks	0.009	0.03	1.0	0.9	2.1	0.1	4.8	0.05	48	7.8

NOTES:

NC Indicates ratio not determined due to station designation (see Tables 1-2 and 1-3)

[1] Ratio determined using the mean of two replicate metal values.

* From Taylor (1964)

** From Turekian and Wedepohl (1961)

TABLE 2-38

MANATEE

INORGANIC SEDIMENT QUALITY

FALL / WET SEASON

STATION PARAMETER ppm(dry basis)	MAN 1A WET (O)		MAN 3 SFT	
	MEAN	σ	MEAN	σ
ALUMINUM	15000	3800	2100	500
CADMIUM	0.78	0.03	0.22	0.05
CHROMIUM	32	9	13*	-
COPPER	21	5	2.0*	-
IRON	8700	2400	NC	NC
LEAD	13	4	3.8*	-
MERCURY	0.25	0.09	0.14	0.03
NICKEL	16	5	2.7*	-
SILVER	0.31*	-	0.19	0.04
ZINC	18	11	4.5*	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-39

MANATEE
ORGANIC SEDIMENT QUALITY
FALL / WET SEASON

STATION PARAMETER ppm (dry bases)	MAN 1A WET(O)		MAN 3 SFT	
PESTICIDES	MEAN	σ	MEAN	σ
MIREX	NC	NC	<0.001	-
TOXAPHENE	NC	NC	<0.015	-
ALDRIN	NC	NC	<0.001	-
CHLORDANE	NC	NC	<0.005	-
DDT	NC	NC	<0.001	-
OTHER CHLORINATED	NC	NC	NC	NC
PHENOLS	MEAN	σ	MEAN	σ
2-CHLOROPHENOL	NC	NC	<0.05	-
PHENOL	NC	NC	<1.0	-
2,4-DICHLOROPHENOL	NC	NC	<1.0	-
2,4,6-TRICHLOROPHENOL	NC	NC	<0.01	-
4-CHLORO-M-CRESOL	NC	NC	<0.1	-
2,4-DINITROPHENOL	NC	NC	<0.07	-
PENTACHLOROPHENOL	NC	NC	<0.01	-

NOTES:

- \- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.
- NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-40

MANATEE

ELUTRIATE RESULTS

STATION / PARAMETER $\mu g/l^1$	TPA 13 XT		MAN IA WET(O)		STANDARD
	MEAN	σ	MEAN	σ	
ALUMINUM	2.5*	-	4.1	0.7	1500
CADMIUM	0.02	0.01	0.04	0.01	5.0
CHROMIUM	1.0	0.1	2.2	0.6	50
COPPER	0.77	0.05	0.80	0.05	15
IRON	7.9	0.6	11.1	1.9	300
LEAD	0.36	0.07	0.52	0.11	50
MERCURY	< 0.1	-	<0.10 *	-	0.1
NICKEL	1.0	0.2	2.1	0.2	100
SILVER	0.03	0.01	0.09	0.02	0.05
ZINC	3.9	0.3	2.1	0.2	1000
FLUORIDE	1.0	0	1.1	0.06	5.0
TOTAL KJELDAHL NITROGEN	3.1	0.5	14	2.5	NS
TOTAL ORGANIC CARBON	5.2	0.3	8.6	0.3	NS
AMMONIA -N	0.10	0.02	9.5	0.6	NS
NITRATE - N	0.07	0.02	0.12	0.02	NS
PHOSPHATE - P	0.59	0.10	3.3*	-	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		STANDARD

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT

* MEAN DETERMINED USING 2 REPLICATE VALUES

NS REFERS TO STANDARD NOT AVAILABLE

1 UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINANTLY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TA. 2-41

JACKSONVILLE

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

STATION / PARAMETER	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B		JAX-9C		STANDARD[1]
Temperature (°C)	22		21		22		24		21		23		23		22		20		NA
Salinity (PPT)	5		5		15		20		18		17		17		18		30		NA
pH	7.3		7.6		7.3		7.5		8.0		7.8		8.2		7.7		8.0		≥6.0 ≤8.5
Dissolved Oxygen (mg/l)	7.4		6.0		5.2		5.6		5.4		5.5		5.2		5.4		6.9		4
Dissolved Oxygen (% Saturation)	87		69		71		74		68		70		67		68		90		NA
Turbidity (NTU)	11.5		11.0		9.1		11.5		11.0		17.0		11.5		9.5		3.2		NA
Conductivity (μmhos)	6000		8500		19000		26000		22000		24000		24000		23500		37000		NA
Ammonia[2] (mg/l)	<0.01	-	0.02	0.01	<0.01	-	0.03	0.01	0.05	0.01	<0.01	-	<0.01	-	0.05	0.01	0.02	0.01	NA
Nitrate (mg/l)	0.15	0.02	0.14	0.03	0.10	0.02	0.10	0.01	0.15	0.03	0.15	0.02	0.09	0.01	0.09	0.31	0.04	0.01	NA
Total Kjeldahl Nitrogen (mg/l)	0.80	0.20	0.80	0.10	0.60	0.20	0.50	0.10	0.60	0	0.30	0.10	0.60	0.10	0.40	0.10	0.04	0.01	NA
Phosphate - P (mg/l)	0.10	0.01	0.09	0.01	0.08	0.01	0.10	0.01	0.11	0	0.09	0.01	0.09	0.01	0.06	0.01	0.01	0	NA
Total Phosphorus (mg/l)	0.16	0.02	0.24	0.02	0.18	0.05	0.15	0.01	0.25	0.01	0.18	0.02	0.31	0.03	0.12	0.01	0.03	0.01	NA
Total Organic Carbon (mg/l)	12.8	0.29	11.0	0.23	10.3	0.70	8.70	0.20	9.70	0.10	8.90	0.50	9.10	0.26	8.90	0.63	2.80	0.10	NA
Biological Oxygen Demand (mgO_2/l)	3.10	0.40	2.70	0.2	2.50	0.50	2.10	0.20	1.80	0.30	2.50	0.30	2.00	0.2	3.10*	-	2.3	0.32	NA
Total Suspended Solids (mg/l)	26*	1	26	5	65	6	65	8	62	3	55	3	56	6	41	-	52	2	NA

NOTES:

1) Water quality standards for selected parameters in predominantly marine waters, Chapter 17-3, Florida Administrative Code for Class III waters
2) For Ammonia through Total Suspended Solids Parameters, the left column contains the mean and the right column contains the standard deviation for replicate samples.

* Mean determined using 2 replicate values.

REMARKS:

NA refers to water quality standard not available.

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-42

JACKSONVILLE

GENERAL PHYSICAL AND CHEMICAL WATER QUALITY CHARACTERISTICS

FALL / WET SEASON

PARAMETER \ STATION	JAX 3A FWE (O)	JAX 4B WJT(O)	JAX 5B WJ(O)	JAX 6A WJ(O)	JAX 7A WOJ	JAX 8B WJ(O)	JAX 10 SFJ	JAX 11 FJ	JAX 12 SFJ	JAX 13 SFJ	JAX 14 X	JAX 15 WEJ	JAX 16 S	STANDARD
TEMPERATURE (°C)	24.9	24.5	24.5	25	25	25	24	24.9	25	24.5	25	24	24.9*	NS
SALINITY (ppt)	8.0	4.5	14.5	7.3	14	31.2	5.0	5.0	12.5	15.5	11.0	9.5	10.4**	NS
pH	7.4	7.5	7.7	7.4	7.7	7.6	7.5	7.4	7.4	7.7	7.4	7.6	NA	≥ 6.0 ≤ 8.5
DISSOLVED OXYGEN (mg/l)	4.9	7.6	7.9	5.2	6.9	6.2	7.3	5.1	5.6	7.7	NA	5.8	6.3	4
DISSOLVED OXYGEN (% SATURATION)	61.8	92.9	102.3	65.3	90.7	89.0	88.8	63.2	72.4	100.3	NA	72.3	80.1	NS
TURBIDITY (NTU)	28	9.5	6.1	4.5	7.3	7.2	8.5	7.3	9.7	4.1	NA	NA	NA	NS
CONDUCTIVITY (μmhos)	13800	7500	21400	12200	20100	38600	10000	9100	17650	24000	NA	15500	16400	NS
TOTAL KJELDAHL NITROGEN (mg/l)	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	0.49 0.08	NC NC	NC NC	NS
TOTAL ORGANIC CARBON (mg/l)	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	NC NC	12 1	NC NC	NC NC	NS

NOTES: FOR PARAMETERS BELOW CONDUCTIVITY, THE LEFT COLUMN CONTAINS THE MEAN AND THE RIGHT COLUMN CONTAINS THE STANDARD DEVIATION OF REPLICATE SAMPLES FOR EACH STATION.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NA REFERS TO DATA NOT AVAILABLE.

NS INDICATES NO STANDARD AVAILABLE.

REMARKS: STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

* VALUE DETERMINED WITH THE D.O. METER PROBE AT WATER SURFACE.

** VALUE DETERMINED WITH THE SCT METER AT WATER SURFACE.

TABLE 2-43

JACKSONVILLE

INORGANIC WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETER µg/liter \ STATION	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B		JAX-9C		Standard[1]
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
Antimony	NC	NC	<0.1	-	<0.1	-	NC	NC	NC	NC	<0.1	-	<0.1	-	NC	NC	<0.1	-	200
Arsenic	NC	NC	1.8	0.2	1.7	0.2	NC	NC	NC	NC	2.0	0.2	1.7	0.1	NC	NC	1.0	0.1	50
Cadmium	0.03	0.01	0.05	0.01	0.03	0.01	0.02	0.01	0.06	0	0.04	0.01	0.03*	-	0.02	0.01	0.02*	-	5.0
Chromium	NC	NC	0.87	0.16	1.3*	-	NC	NC	NC	NC	1.6	0.3	0.81*	-	NC	NC	0.11	-	50
Copper	1.1	0.1	0.98	0.11	0.95	0.05	0.85	0.05	1.0	0.1	1.2	0.1	1.2	0.1	0.97	0.01	0.69	0.06	15
Iron	18	2	17	3	21	12	17	2	6.9	0.7	9.5	1.8	7.4	0.2	2.9	0.8	1.7	0.1	300
Lead	1.9	0.2	1.8	0.2	1.2	0.1	1.1	0.1	0.97	0.02	1.5	0.2	0.92	0.06	0.61	0.05	0.21	0.03	50
Mercury	0.11	0.02	0.12	0.02	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	0.1
Nickel	0.53	0.03	0.65	0.08	0.66	0.07	0.56	0.06	0.47	0.12	0.42	0.08	0.32	0.04	0.2	0.1	0.21	0.03	100
Silver	NC	NC	<0.01	-	<0.01	-	NC	NC	NC	NC	0.02	0.01	0.02	0	NC	NC	0.01	-	0.5
Zinc	1.5	0.1	1.2	0.3	1.2	0.2	0.7	0.1	0.6	0.1	0.6	0	0.7	0.1	0.5	0.1	0.6	0.2	1000
Fluoride	NC	NC	NC	NC	NC	NC	0.6	0.1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5000

Notes: 1) Water quality standards for selected parameters in predominantely marine waters, Chapter 17-3, Florida Administrative Code for Class III Waters

* Mean determined using 2 replicate values

Remarks: NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-44

JACKSONVILLE

INORGANIC WATER QUALITY

FALL / WET SEASON

PARAMETER µg/liter \ STATION	JAX 3A FWE (O)		JAX 4B WJT(O)		JAX 5B WJ(O)		JAX 6A WJ (O)		JAX 7A WOJ		JAX 8B WJ (O)		JAX 10 SFJ		JAX 11 FJ		JAX 12 SFJ		JAX 13 SFJ		JAX 14 X		JAX 15 WEJ		STANDARD
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
ALUMINUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	3.4	0.4	NC	NC	1500
CADMIUM	0.09	0.01	0.02	0.01	0.08	0.02	0.44	0.05	0.09*	-	0.60	0.19	0.09	0.02	0.06	0.02	0.08*	-	0.02	0	0.05	0.01	0.05	0.01	5.0'
CHROMIUM	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.49	0.04	NC	NC	50
COPPER	1.4	0.2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.5	0.3	1.1	0.1	1.1	0.1	1.0	0.1	0.77	0.05	NC	NC	15
FLUORIDE [1]	NC	NC	0.44	0.04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	5.0[1]
IRON	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	19	2	NC	NC	300
LEAD	2.0	0.2	0.36	0.03	1.2	0.3	6.9	0.7	1.8	0.4	4.3	0.9	1.9	0.4	1.4	0.3	1.3	0.2	1.0	0.2	0.91	0.04	NC	NC	50
MERCURY	<0.1	-	<0.1	-	0.26	0.06	0.30	0.05	<0.10	-	<0.1	-	<0.10	-	0.17	0.03	0.16	0.04	0.16	0.06	<0.1	-	0.12	0.03	0.1
NICKEL	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.28	0.04	NC	NC	100
SILVER	<0.01	-	<0.01	-	0.02	0	0.02	0.01	0.02	0.01	<0.01*	-	0.02	0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.05
ZINC	4.7	0.5	<1.0	-	<1.1	-	29	6	<1.1	-	1.5	0.2	NC	NC	NC	NC	NC	NC	NC	NC	2.5	0.2	2.6	0.3	1000

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

[1] FLUORIDE UNITS ARE MG/L.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-45

JACKSONVILLE

ORGANIC WATER QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETER ug/liter \ STATION	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B		JAX-9C		Standard[1]
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
Pesticides																			
Mirex	<0.03	-	<0.03	-	<0.03	-	<0.03	-	<0.03	-	0.03	-	<0.03	-	<0.03	-	<0.03	-	0.001
Toxaphene	<0.25	-	<0.25	-	<0.25	-	<0.25	-	<0.25	-	0.25	-	<0.25	-	<0.25	-	<0.25	-	0.005
DDT	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.001
Aldrin	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	0.005	-	<0.005	-	<0.005	-	<0.005	-	0.003
Chlordane	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.02	-	<0.02	-	<0.2	-	<0.2	-	0.004
PCB's	NC	NC	<0.25	-	<0.25	-	NC	NC	NC	NC	<0.25	-	<0.25	-	NC	NC	<0.25	-	0.001
Phenols																			
2 - Chlorophenol	NC	NC	<0.1	-	<0.1	-	NC	NC	NC	NC	<0.1	-	<0.1	-	NC	NC	<0.1	-	1.0
Phenol	NC	NC	<1.0	-	<1.0	-	NC	NC	NC	NC	<1.0	-	<1.0	-	NC	NC	<1.0	-	1.0
2,4 - Dichlorophenol	NC	NC	<0.05	-	<0.05	-	NC	NC	NC	NC	<0.05	-	<0.05	-	NC	NC	<0.05	-	1.0
2,4,6 - Trichlorophenol	NC	NC	<0.07	-	<0.07	-	NC	NC	NC	NC	<0.07	-	<0.07	-	NC	NC	<0.07	-	1.0
4 - Chloro-m-cresol	NC	NC	<1.0	-	<1.0	-	NC	NC	NC	NC	<1.0	-	<1.0	-	NC	NC	<1.0	-	1.0
2,4 - Dinitrophenol	NC	NC	<0.7	-	<0.7	-	NC	NC	NC	NC	<0.7	-	<0.7	-	NC	NC	<0.7	-	1.0
Pentachlorophenol	NC	NC	<0.04	-	0.04	-	NC	NC	NC	NC	<0.04	-	<0.04	-	NC	NC	<0.04	-	1.0

NOTES:

Water Quality Standards For Selected Marine Parameters in Predominately Marine Waters. Chapter 17-3, Florida Administrative Code For Class III Waters.
*Mean and deviation determined using 2 replicate values.

REMARKS:

NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-46

JACKSONVILLE

ORGANIC WATER QUALITY

FALL / WET SEASON

PARAMETER µg/liter / STATION	JAX 3A FWE (O)		JAX 4B WJT(O)		JAX 5B WJ(O)		JAX 6A WJ(O)		JAX 7A WOJ		JAX 8B WJ(O)		STANDARD
PESTICIDES	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
MIREX	NA	NA	NA	NA	NA	NA	NA	NA	< 0.02	-	NA	NA	0.001
TOXAPHENE	NA	NA	NA	NA	NA	NA	NA	NA	< 0.2	-	NA	NA	0.005
DDT	NA	NA	NA	NA	NA	NA	NA	NA	< 0.01	-	NA	NA	0.001
ALDRIN	NA	NA	NA	NA	NA	NA	NA	NA	< 0.003	-	NA	NA	0.003
CHLORDANE	NA	NA	NA	NA	NA	NA	NA	NA	< 0.2	-	NA	NA	0.004
OTHER CHLORINATED	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NS
PHENOLS	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	
2-CHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 1.0	-	NA	NA	1.0
PHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 5.0	-	NA	NA	1.0
2,4-DICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 0.05	-	NA	NA	1.0
2,4,6-TRICHOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 0.05	-	NA	NA	1.0
4-CHLORO-M-CRESOL	NA	NA	NA	NA	NA	NA	NA	NA	< 2.0	-	NA	NA	1.0
2,4-DINITROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 20	-	NA	NA	1.0
PENTACHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	< 0.09	-	NA	NA	1.0

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

NA INDICATES ADDITIONAL ORGANIC ANALYSIS NOT COMPLETED DUE TO RESULTS FOR JAX 7A WOJ

NS INDICATES NO STANDARD AVAILABLE.

REMARKS:

STANDARD REFERS TO WATER QUALITY STANDARDS FOR PREDOMINATELY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS.

TABLE 2-47

JACKSONVILLE

GENERAL PHYSICAL AND CHEMICAL SEDIMENT QUALITY CHARACTERISTICS

SPRING / DRY SEASON

STATION / PARAMETER	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6B		JAX-7A		JAX-8B		JAX-9C	
	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ
Biological Oxygen Demand (mg O_2/kg)	350	53	440	90	4100	1300	7000	600	160	15	200	60	380	70	160*	-	NC	NC
Nitrate - N (mg/kg)	5.2	1.2	0.61	0.04	0.62	0.05	1.0	0.2	0.32	0.05	1.3	0.1	0.92	0.09	0.66	0.09	NC	NC
Phosphate (mg/kg)	31	5	37	8	600	180	900	100	15	6	56	14	120	10	110	17	NC	NC
Specific Gravity	2.60	0.07	2.69	0.01	2.46	0.04	2.43	0.05	2.48	0.02	2.67	0.02	3.05	0.13	2.70	0.08	NC	NC
Total Kjeldahl Nitrogen (mg/kg)	240	70	320*	-	3200*	-	9100	1900	650	250	89*	-	350	90	130	55	NC	NC
Total Organic Carbon (mg/kg)	4800	700	3700	800	11000	3300	43000	1200	1100	270	960	230	1100	57	820	91	NC	NC
Total Phosphorus (mg/kg)	130	29	150	46	1600	330	2200	210	87*	-	240*	-	670	21	160	20	NC	NC
Total Solids (%)	73.8	1.2	75.9	1.1	26.9	3.8	19.2	2.3	76.8	1.5	76.2	1.8	76.1	3.2	77.0	2.0	NC	NC

NOTES: * Mean determined from 2 replicate values.

REMARKS: NC refers to analysis not completed due to station designation (See table 1-2)

For those cases where the mean was determined from 2 replicate values or where concentrations were below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

The results presented for Station Jax-8B were determined from 3 splits of 1 sample

TABLE 2-48

JACKSONVILLE

GENERAL PHYSICAL AND CHEMICAL SEDIMENT CHARACTERISTICS

FALL / WET SEASON

STATION / PARAMETER ppm (dry basis)	JAX 3A FWE(O)		JAX 10 SFJ		JAX 17 S		JAX 12 SFJ		JAX 13 SFJ		JAX 15 WEJ		JAX 16 S	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
SPECIFIC GRAVITY [1]	2.92	0.05	2.55	0.06	2.38	0.04	2.40	0.01	2.53	0.05	2.38	0.17	2.30	0.01
TOTAL KJELDAHL NITROGEN	4000	760	105*	-	4100	500	2700	950	190	47	2800	440	4900	660
TOTAL ORGANIC CARBON	20000	1200	790	310	24000	3600	19000	2100	173	21	13000	2600	25000	580
AMMONIA -N	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
PHOSPHATE - P	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NITRATE - N	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
OIL AND GREASE	NC	NC	90	49	510*	-	610*	-	46	10	NC	NC	1800	570

NOTES:

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3)

[1] SPECIFIC GRAVITY AS SHOWN IS DIMENSIONLESS.

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

TABLE 2-49

JACKSONVILLE

INORGANIC SEDIMENT QUALITY CHARACTERISTICS

SPRING / DRY SEASON

PARAMETERS ppm (dry basis) / STATION	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B		JAX-9C	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
Aluminum	72	18	89*	-	2500	350	3000	400	41*	-	74*	-	320*	-	140*	-	NC	NC
Antimony	NC	NC	< 0.5	-	< 0.5	-	NC	NC	NC	NC	< 0.5	-	<0.5	-	NC	NC	NC	NC
Arsenic	NC	NC	< 1.0	-	6.6	2.0	NC	NC	NC	NC	< 1.0	-	<0.5	-	NC	NC	NC	NC
Cadmium	0.05	0.03	0.05	0.02	*0.33	-	0.47	0.11	*0.03	-	*0.09	-	*0.09	-	0.06	0.02	NC	NC
Chromium	NC	NC	6.3	2.1	*40	-	NC	NC	NC	NC	*0.71	-	3.6*	-	NC	NC	NC	NC
Copper	1.1	0.2	2.3*	-	25	3	24	5	<1.0	-	<1.5	-	<1.1	-	<1.1	-	NC	NC
Fluoride	NC	NC	NC	NC	NC	NC	<0.5	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Iron	650	190	*1000	-	20,000	3000	26,000	3000	*495	-	670*	-	*2000	-	1000	70	NC	NC
Lead	2.4	0.2	*11	-	25	9	45	13	0.66	0.14	0.78	0.12	2.2*	-	0.87*	-	NC	NC
Mercury	0.13	0.03	0.22	0.04	0.59	0.25	1.1	0.4	0.15	0.02	0.12	0.03	*0.15	-	0.19	0.02	NC	NC
Nickel	<1.0	-	<1.0	-	8.6*	-	16	4	<1.1	-	<1.1	-	<1.0	-	<1.0	-	NC	NC
Silver	NC	NC	0.03	0.01	0.25	0.01	NC	NC	NC	NC	*0.06	-	*0.04	-	NC	NC	NC	NC
Zinc	6.9	1.3	*11	-	140	27	150	36	5.4	1.7	3.9*	-	8.8*	--	2.9	0.2	NC	NC

NOTES:

* Mean determined using 2 replicate values.

REMARKS:

NC refers to analysis not completed due to station designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentration was below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

The results presented for Station Jax 8B were determined from 3 splits of 1 sample.

TABLE 2-50

JACKSONVILLE

INORGANIC SEDIMENT QUALITY

FALL / WET SEASON

STATION / PARAMETER PPM (dry basis)	JAX 3A FWE (O)		JAX 10 SFJ		JAX 17 S		JAX 12 SFJ		JAX 13 SFJ		JAX 15 WEJ		JAX 16 S	
	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
ALUMINUM	25000	2600	9700	260	32000	3100	23000	2500	800	160	20000	3000	26000	5200
CADMIUM	1.0	0.3	0.12	0.03	1.1*	-	0.32	0.13	0.12	0.03	0.40*	-	0.70*	-
CHROMIUM	27	4	6.7	0.5	63	16	39*	-	3.1	0.7	120*	-	132*	-
COPPER	33	5	3.9	2.1	21	6	9.0*	-	1.4*	-	20	4	19	3
IRON	27000	5000	NC	NC	NC	NC	NC	NC	NC	NC	12000	2100	NC	NC
LEAD	64	15	6.9	2.0	45	23	20*	-	9.7*	-	45*	-	53*	-
MERCURY	0.36	0.03	0.16	0.04	0.34	0.09	0.28	0.02	0.11	0.05	0.39	0.11	0.43	0.04
NICKEL	20	4	5.3*	-	25	3	7.5	1.0	21*	-	18	4	34*	-
SILVER	0.9	0.2	0.1*	-	0.70	0.16	0.23*	-	0.62	0.17	0.93	0.21	0.30*	-
ZINC	10	1	11	3	19	8	40*	-	3.4*	-	125*	-	265*	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE 1-3).

TABLE 2-51

METAL:ALUMINUM RATIOS IN SEDIMENTS
PORT OF JACKSONVILLE

Station	Cd (x10^{-4})	Cr (x10^{-2})	Cu (x10^{-2})	Fe (x10^{0})	Pb (x10^{-2})	Hg (x10^{-3})	Ni (x10^{-3})	Ag (x10^{-4})	Zn (x10^{-3})
JAX-1B$_2$	6.9	NC	1.5	9.0$_1$	3.3$_1$	1.8	<13.9	NC	95.8$_1$
JAX-2A^2	5.6$_1$	7.1$_1$	2.6	11.2^1	12.4^1	2.5	<11.2$_1$	3.4	123.6^1
JAX-3A	1.3^1	1.6^1	1.0	8.0	1.0	0.2	3.4^1	1.0	56.0
JAX 3A-WEJ(O)	0.4	0.1	0.1	1.1	0.3	0.01	0.8	0.4	0.4
JAX-4B$_2$	1.6$_1$	NC	0.8	8.7$_1$	1.5	0.4	5.3	NC	50.0
JAX-5B$^2_2$	7.3^1	NC$_1$	<2.4	12.1$^1_1$	1.6	3.7	<2.7	NC$_1$	131.7$_1$
JAX-6A$^2_2$	12.2$_1$	1.0$^1_1$	<2.0$_1$	9.1$^1_1$	1.1$_1$	1.6$_1$	<14.9	8.1$^1_1$	52.7$^1_1$
JAX-7A$^2_2$	2.8^1	1.1^1	0.3^1	6.3^1	0.7$^1_1$	0.5^1	<3.1	1.3^1	27.5^1
JAX-8B^2	4.3	NC	<0.8	7.1	0.6^1	1.4	<7.1$_1$	NC$_1$	20.7
JAX 10-SFJ	0.1	0.07$_1$	0.04$_1$	NC	0.07$_1$	0.02	0.55^1	0.1$^1_1$	1.1$_1$
JAX 12-SFJ	0.1	0.17^1	0.04$^1_1$	NC	0.09$^1_1$	0.01	0.33$_1$	0.1$^1_1$	1.8$^1_1$
JAX 13-SFJ	1.5$_2$	0.39$_1$	0.18^1	NC	1.21$^1_1$	0.14	26.3^1	7.8^1	4.3$^1_1$
JAX 15-WEJ	0.2$^2_1$	0.60$^1_2$	0.10	0.6	0.23$^1_1$	0.02	0.9$_1$	0.5$_1$	6.3$^1_1$
JAX 16-S	0.3$^1_1$	0.51^2	0.07	NC	0.20^1	0.02	1.3^1	0.1^1	10.2^1
JAX 17-S	0.3^1	0.2	0.07	NC	0.14	0.01	0.8	0.2	0.6
Crustal* Ratio	0.02	0.1	0.07	0.7	0.015	0.001	0.9	0.001	0.08
Carbonate** Rocks	0.09	0.3	10	0.9	21	0.01	4.8	0.05	48

NOTES:

NC Indicates ratio not determined due to station designation (see Tables 1-2 and 1-3)
1 Ratio determined using the mean of two replicate metal values
2 Ratios determined using the mean of two aluminum values
* From Taylor (1964)
** From Turekian and Wedepohl (1961)

TABLE 2-52

JACKSONVILLE

ORGANIC SEDIMENT QUALITY

SPRING / DRY SEASON

PARAMETER ppm (dry basis) / STATION	JAX-1B		JAX-2A		JAX-3A		JAX-4B		JAX-5B		JAX-6A		JAX-7A		JAX-8B	
	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ
Pesticides																
Mirex	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
Toxaphene	<0.02	-	<0.02	-	<0.02[2]	-	<0.02	-	<0.02	-	<0.02	-	<0.02	-	<0.02	-
DDT	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
Aldrin	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
Chlordane	<0.006	-	<0.006[1,2]	-	<0.006	-	<0.007	-	<0.006[1]	-	<0.006	-	<0.006	-	<0.006	--
Other Chlorinated (DDE)	-	-	-	-	<0.001[1]	-	-	-	-	-	-	-	-	-	-	-
PCB's	<.002	-	<0.002	-	<0.002[3]	-	<0.002	-	<0.002	-	<0.002	-	<0.002	-	<0.002	-
Oil and Grease	NC	NC	520	40	1600	440	NC	NC	NC	NC	160*	-	160	20	NC	NC
Phenols																
Phenol	< 0.2	-	< 0.2	-	< 0.2	-	<0.2	-	<0.2	-	< 0.2	-	<0.2	-	<0.2	-
2-Chlorophenol	< 0.01	-	< 0.01	-	< 0.02[1]	-	<0.01	-	<0.01	-	<0.01	-	< 0.01	-	<0.01	-
2,4-Dichlorophenol	< 0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	< 0.1	-	<0.1	-
2,4,6-Trichlorophenol	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-
4-Chloro-m-cresol	<0.2	-	<0.2	-	< 0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-
2,4-Dinitrophenol	<0.3	-	<0.3	-	<0.3	-	<0.1	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-
Pentachlorophenol	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-	<0.005	-

NOTES: 1) Observed in one replicate only.
2) Possible trace (TR) observed in one replicate only.
3) PCB type 1254.
* Mean determined using 2 replicate values.

REMARKS: NC refers to analysis not completed due to sation designation (See table 1-2).

For those cases where the mean was determined from 2 replicate values or where concentrations where below the analytical detection limit for one or more of the replicates, the standard deviation was not determined. For these cases, a dash (-) is presented to indicate where data was not determined.

TABLE 2-53

JACKSONVILLE

ORGANIC SEDIMENT QUALITY

FALL / WET SEASON

PARAMETERS ppm (dry basis) / STATION	JAX 3A FWE (0)		JAX 10 SFJ		JAX 17 S		JAX 12 SFJ		JAX 13 SFJ		JAX 15 WEJ		JAX 16 S	
PESTICIDES	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
MIREX	NC	NC	<0.001	-	< 0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-
TOXAPHENE	NC	NC	<0.015	-	< 0.015	-	<0.015	-	<0.015	-	NC	NC	<0.015	-
ALDRIN	NC	NC	<0.001	-	< 0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-
CHLORDANE	NC	NC	<0.005	-	< 0.005	-	<0.005	-	<0.005	-	NC	NC	<0.005	-
DDT	NC	NC	<0.001	-	< 0.001	-	<0.001	-	<0.001	-	NC	NC	<0.001	-
OTHER CHLORINATED	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
PHENOLS	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ	MEAN	σ
2-CHLOROPHENOL	NC	NC	<0.05	-	<0.05	-	<0.05	-	<0.05	-	NC	NC	<0.05	-
PHENOL	NC	NC	<1.0	-	<1.0	-	<1.0	-	<1.0	-	NC	NC	<1.0	-
2,4-DICHLOROPHENOL	NC	NC	<1.0	-	<1.0	-	<1.0	-	<1.0	-	NC	NC	<1.0	-
2,4,6-TRICHLOROPHENOL	NC	NC	<0.01	-	<0.01	-	<0.01	-	<0.01	-	NC	NC	<0.01	-
4-CHLORO-M-CRESOL	NC	NC	<0.1	-	<0.1	-	<0.1	-	<0.1	-	NC	NC	<0.1	-
2,4-DINITROPHENOL	NC	NC	<0.07	-	<0.07	-	<0.07	-	<0.07	-	NC	NC	<0.07	-
PENTACHLOROPHENOL	NC	NC	<0.01	-	<0.01	-	<0.01	-	<0.01	-	NC	NC	<0.01	-

NOTES:

* MEAN DETERMINED USING TWO REPLICATE VALUES.

\- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT.

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABEL 1-3).

TABLE 2-54

JACKSONVILLE
ELUTRIATE RESULTS

STATION / PARAMETER $\mu g/l^1$	JAX 14 X MEAN	σ	JAX 3A FWE (O) MEAN	σ	JAX 15 WEJ MEAN	σ	STANDARD
ALUMINUM	3.4	0.4	4.5	0.6	6.3	0.8	1500
CADMIUM	0.05	0.01	0.07	0.01	0.04	0.01	5.0
CHROMIUM	0.49	0.04	4.1	0.3	8.6*	-	50
COPPER	0.77	0.05	1.4	0.3	1.4	0.4	15
IRON	19	2	91	7	64	18	300
LEAD	0.91	0.04	1.6	0.1	0.47	0.06	50
MERCURY	0.1	-	0.13	0.01	0.19	0.02	0.1
NICKEL	0.28	0.04	0.26	0.08	0.21	0.03	100
SILVER	0.01	-	0.04	0.01	0.04	0.01	0.05
ZINC	2.5	0.2	3.9	0.7	3.4	0.5	1000
FLUORIDE	NC	NC	NC	NC	NC	NC	5.0
TOTAL KJELDAHL NITROGEN	0.49	0.08	2.0	0.1	10.4	1.4	NS
TOTAL ORGANIC CARBON	12	1	15	4	14	1	NS
AMMONIA -N	NC	NC	NC	NC	NC	NC	NS
NITRATE -N	NC	NC	NC	NC	NC	NC	NS
PHOSPHATE -P	NC	NC	NC	NC	NC	NC	NS
	AMBIENT CONDITIONS		POST-ELUTRIATE TEST RESULTS		POST-ELUTRIATE TEST RESULTS		STANDARI

NOTES:

- INDICATES WHERE THE STANDARD DEVIATION WAS NOT DETERMINED FOR CASES WHERE EITHER THE MEAN WAS DETERMINED USING TWO REPLICATE VALUES OR OR WHERE ONE OR MORE REPLICATE VALUES WERE BELOW THE ANALYTICAL DETECTION LIMIT

* MEAN DETERMINED USING 2 REPLICATE VALUES

NS REFERS TO STANDARD NOT AVAILABLE

NC REFERS TO ANALYSIS NOT COMPLETED DUE TO STATION DESIGNATION (SEE TABLE I-3)

1 UNITS FOR PARAMETERS LISTED BELOW ZINC ARE MG/L

REMARKS:

STANDARD REFERS TO WATER QULAITY STANDARDS FOR PREDOMINANTLY MARINE WATERS, CHAPTER 17-3 FLORIDA ADMINISTRATIVE CODE FOR CLASS III WATERS

TABLE 5-1

PARAMETERS REPRESENTING POTENTIAL WATER QUALITY PROBLEMS DURING MAINTENANCE DREDGING ACTIVITIES

Port	Dissolved Oxygen	Nutrients	Metals	Organic Compound
Pensacola	+	+	Ag* Hg* Zn*	Phenols
Tampa	+	+	Cd Hg Ag Cu* Ni* Pb* Zn*	Phenols*
Manatee	+	+	Cd Cr Hg	
Jacksonville	+	+	Cd Hg Ag Pb* Zn* Cu	

+ Represent continual problem in relation to maintenance dredging.

* Localized problem (only observed to be high at one or two stations).

TABLE 5-2

LABORATORY PROCEDURES FOR SEDIMENT SAMPLES

Parameter	Analytical Method*		Special Procedures
Aluminum	EPA 202-1	AA-flame	Note 1
Antimony	EPA 204-2	AA-hydride	Note 2
Arsenic	EPA 206-2	AA-hydride	Note 2
BOD	EPA 405.1	5 Day - 20°C	Note 3
Cadmium	EPA 213-2	AA-furnace	Note 1
Total Chromium	EPA 218-3	AA-furnace	Note 1
Copper	EPA 220-2	AA-flame	Note 1
Fluoride	EPA 340.2	Potentiometric	Water extraction
Iron	EPA 236-1	AA-flame	Note 1
Lead	EPA 239-2	AA-furnace	Note 1
Mercury	EPA 245-5	Cold vapor	Note 4
Nickel	EPA 249-2	AA-furnace	Note 1
TKN	EPA 351.3	Digestion - potentiometric	Note 5
Oil and Grease	EPA 413.1	Gravimetric	Note 6
Mirex	EPA 608**	GC - EC	Note 7
Toxaphene	EPA 608**	GC - EC	Note 7
DDT	EPA 608**	GC - EC	Note 7
Aldrin	EPA 608**	GC - EC	Note 7
Chlordane	EPA 608**	GC - EC	Note 7
PCB	EPA 608**	GC - EC	Note 7
Phenols	EPA 604**	GC - EC and FID	Note 8
Phosphate	EPA 365.2	Ascorbic Acid	Note 9
Nitrate	EPA 353.3	Cadmium reduction	Note 10
Radium 226	EPA -		
Silver	EPA 272-2	AA-furnace	
Total Phosphorus	EPA 365.2	Persulfate digestion - Ascorbate	Note 11
Total Solids	EPA 160.2	Gravimetric - 105°C	
TOC	EPA 415.1		Note 12
Zinc	EPA 289-1	AA-flame	
Grain size	ASTM-19-D422		Including hydrometer
Specific gravity	ASTM-19-D854		
Atterberg Limits	ASTM-19-D423 and D424		
Sedimentation Rate-			

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* EPA - Methods of Chemical analysis of Water and Waste (EPA-600/4-79-020).

**EPA Gas Chromatographic Methods - Federal Register 44, No. 233, December 3, 1979.

TABLE 5-2 (Cont'd)

Notes:

1. 1 g of sediment was weighted out into a teflon capped digestion vial. 5 ml of conc. HNO_3 was added and the vials were allowed to sit for two hours. Beakers were then capped and digested on low heat for 48 hours. Caps were removed and nitric acid was then taken off (to near dryness) and five additional ml of HNO_3 and 1 ml of perchloric acid were added. The vials were heated until the white perchloric acid fumes subsided. If necessary, additional increments of HNO_3 and perchloric acid were added to complete digestion. The sediment was then brought up with 1 ml conc. HNO_3 and 9 ml of redistilled demineralized water and analyzed by atomic absorption.

2. The digest from note 1 was analyzed by the AA-hydride technique.

3. Wet sediment samples were weighed into BOD bottles and diluted to 300 ml.

4. Samples were digested with sulfuric and nitric acid and potassium permanganate in an autoclave prior to cold vapor analyses.

5. Wet sample was digested in a Kjeldahl flask, distilled and ammonia was determined by potentiometric method.

6. Gravimetric - extraction with Fluorocarbon-113.

7. Samples were extracted by techniques in "Interim Methods for Sampling and Analysis of Priority Pollutants in Sediments and Fish Samples". US EPA - October 1980. Extracts were cleaned up by florisil column chromatography prior to GC-EC analyses.

8. Sample was extracted with methylene chloride (pH 2) and analyzed by GC-FID and GC-EC (chlorinated phenols).

9. Water extractable phosphates.

10. Water extractable nitrates.

11. Sample was digested with persulfate and digest was analyzed by ascorbic acid technique.

12. Sediment was analyzed by ampule technique - OI instrument.

TABLE 5-3

LABORATORY PROCEDURES FOR WATER SAMPLES

Parameter	Analytical Method*		Special Procedures
Ammonia	EPA 350.3	Potentiometric	
Antimony	EPA 204-2	AA-hydride	
Arsenic	EPA 206-3	AA-hydride	
BOD	EPA 405.1	5 Day - 20°C	
Cadmium	EPA 213-2	AA-furnace	Note 1
Total Chromium	EPA 218-3	AA-furnace	Note 2
Copper	EPA 220-2	AA-furnace	
Fluoride	EPA 340.2	Potentiometric	
Iron	EPA 236-1	AA-flame	Note 1
Lead	EPA 239-2	AA-furnace	
Mercury	EPA 245-1	Cold vapor	
Nickel	EPA 249-2	AA-furnace	Note 1
TKN	EPA 351.4	Digestion - potentiometric	
Mirex	EPA 608**	GC - EC	Note 3
Toxaphene	EPA 608**	GC - EC	Note 3
DDT	EPA 608**	GC - EC	Note 3
Aldrin	EPA 608**	GC - EC	Note 3
Chlordane	EPA 608**	GC - EC	Note 3
PCB	EPA 608**	GC - EC	Note 3
Phenols	EPA 604**	GC - EC and FID	Note 4
Phosphate	EPA 365.2	Ascorbic Acid	10 cm light path
Nitrate	EPA 353.3	Cadmium reduction	10 cm light path
Radium 226	EPA		
Silver	EPA 272-2	AA-furnace	
Total Phosphorus	EPA 365.2	Persulfate digestion - Ascorbate	10 cm light path
TSS	EPA 160.2	Gravimetric - 105°C	
TOC	EPA 415.1		Note 5
Zinc	EPA 289-1	AA-flame	Note 1

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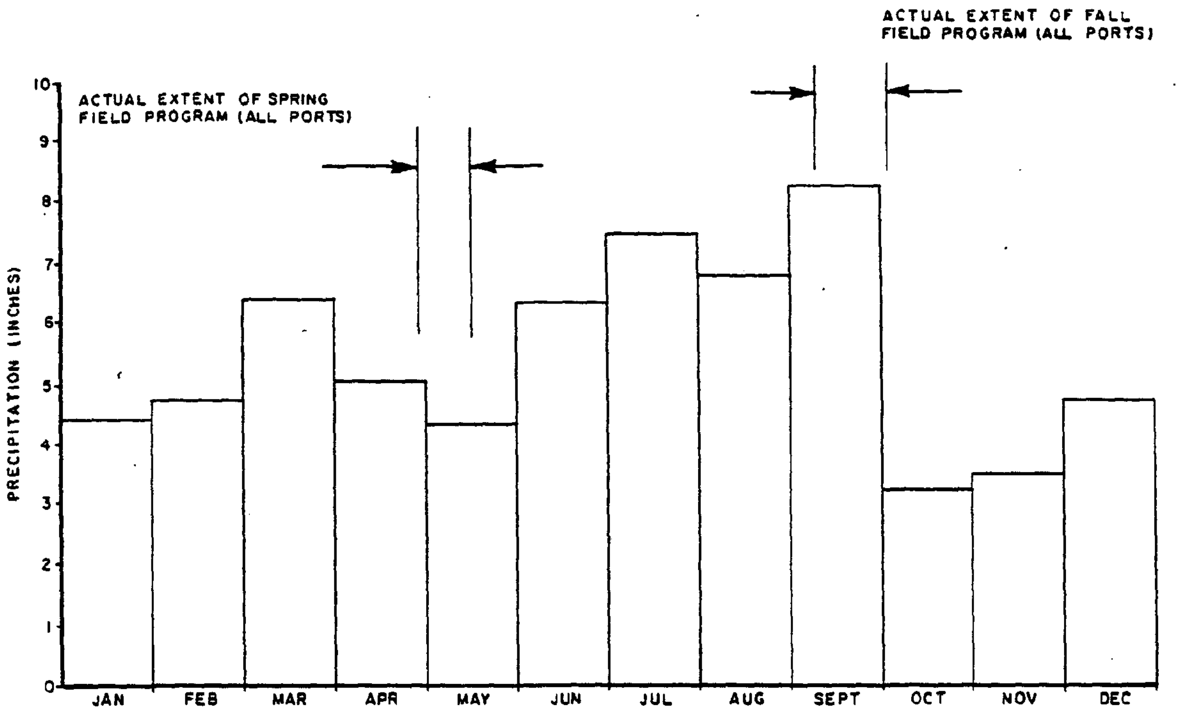
* EPA - Methods of Chemical analysis of Water and Waste (EPA-600/4-79-020).

**EPA Gas Chromatographic Methods - Federal Register 44, No. 233, December 3, 1979.

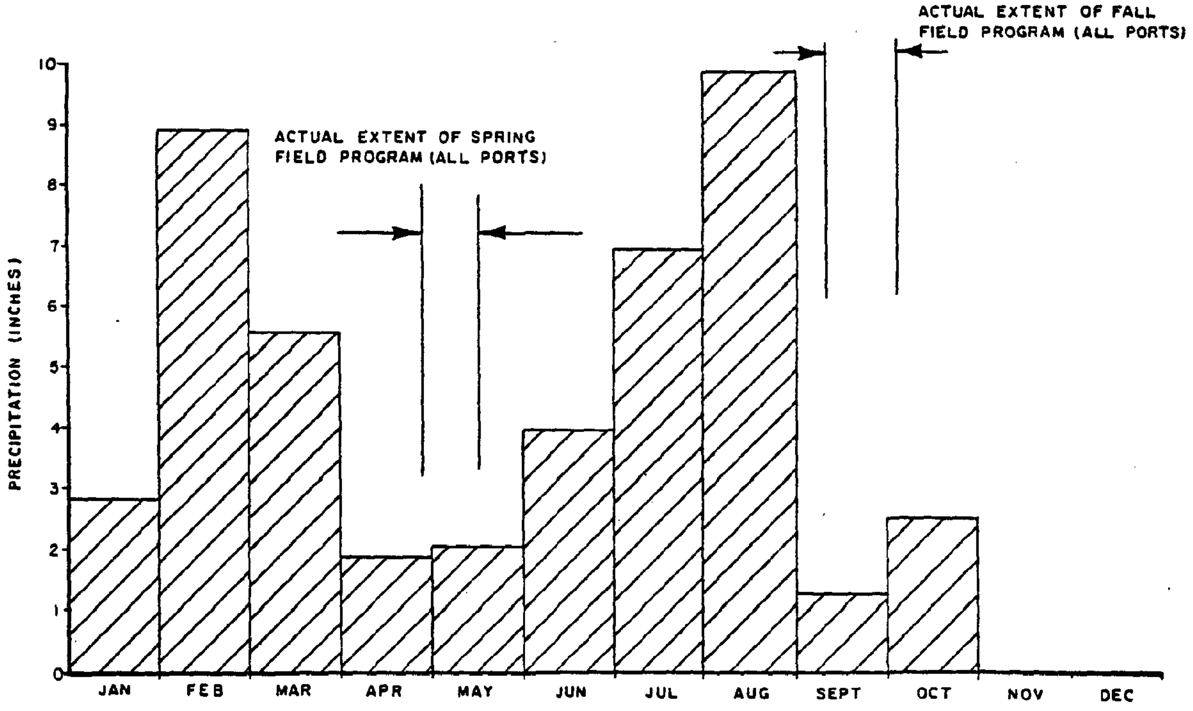
TABLE 5-3 (Cont'd)

Notes:

1. APDC - DDDC chelation (pH 5.0) - MIBK extraction method was utilized on 200 ml sample. (Kinrade and Van Loon, Analytical Chemistry 46 (No. 13): 1894.)
2. Sample (100 ml) was oxidized by EPA 218-3 method, followed by APDC - DDDC chelation (pH 2.4) and MIBK extraction.
3. Sample (750 ml) was extracted with methylene chloride. Florisil cleanup was required for some samples.
4. Acidified sample (750 ml) was extracted with methylene chloride. Extract was analyzed by GC - FID. 2-Propanol extracts of chlorinated phenols were analyzed by EC detector for increased sensitivity.
5. Samples (5 ml) were analyzed by ampule technique (OI instrument, OI Corp., College Station, Texas). Organic carbon was oxidized to CO_2 by persulfate and CO_2 was measured by IR.



NORMAL MONTHLY PRECIPITATION 1941 - 1970,
PENSACOLA



OBSERVED MONTHLY PRECIPITATION, PENSACOLA, JANUARY - OCTOBER 1982

NORMAL MONTHLY AND OBSERVED PRECIPITATION, PORT OF PENSACOLA

PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 2-1

REVISIONS
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APPROVED BY
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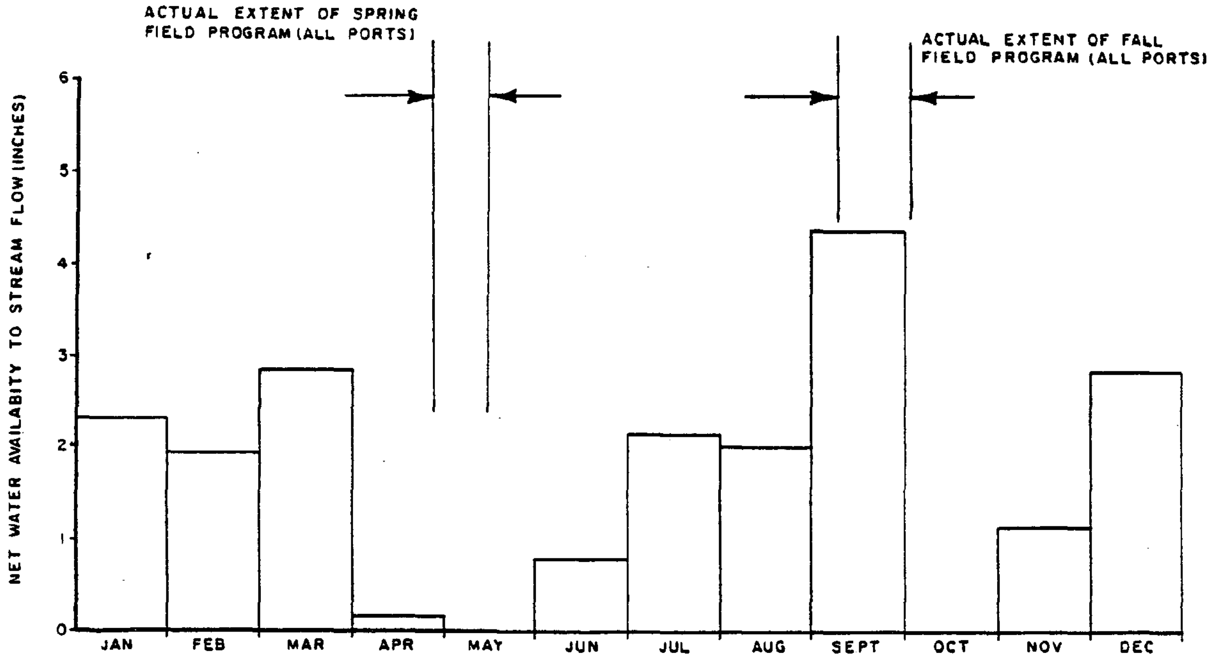
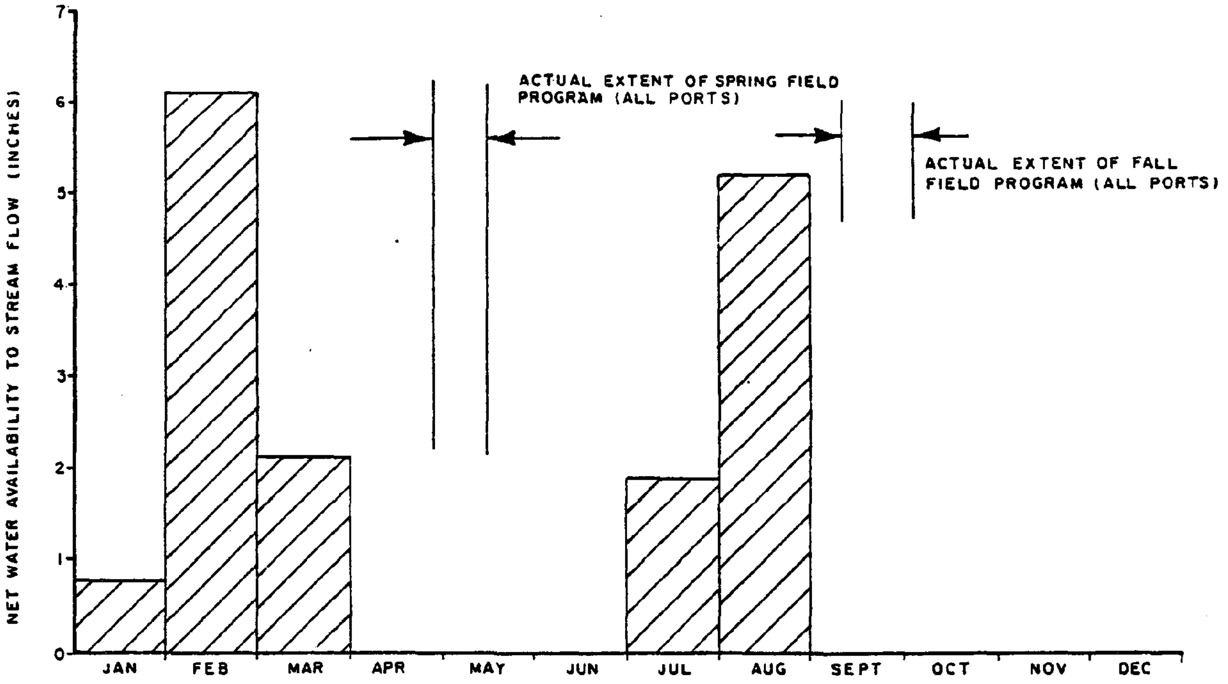


MONTHLY NORMAL NET WATER AVAILABILITY TO STREAM FLOW USING 1941-1970
MONTHLY NORMAL PRECIPITATION
PENSACOLA

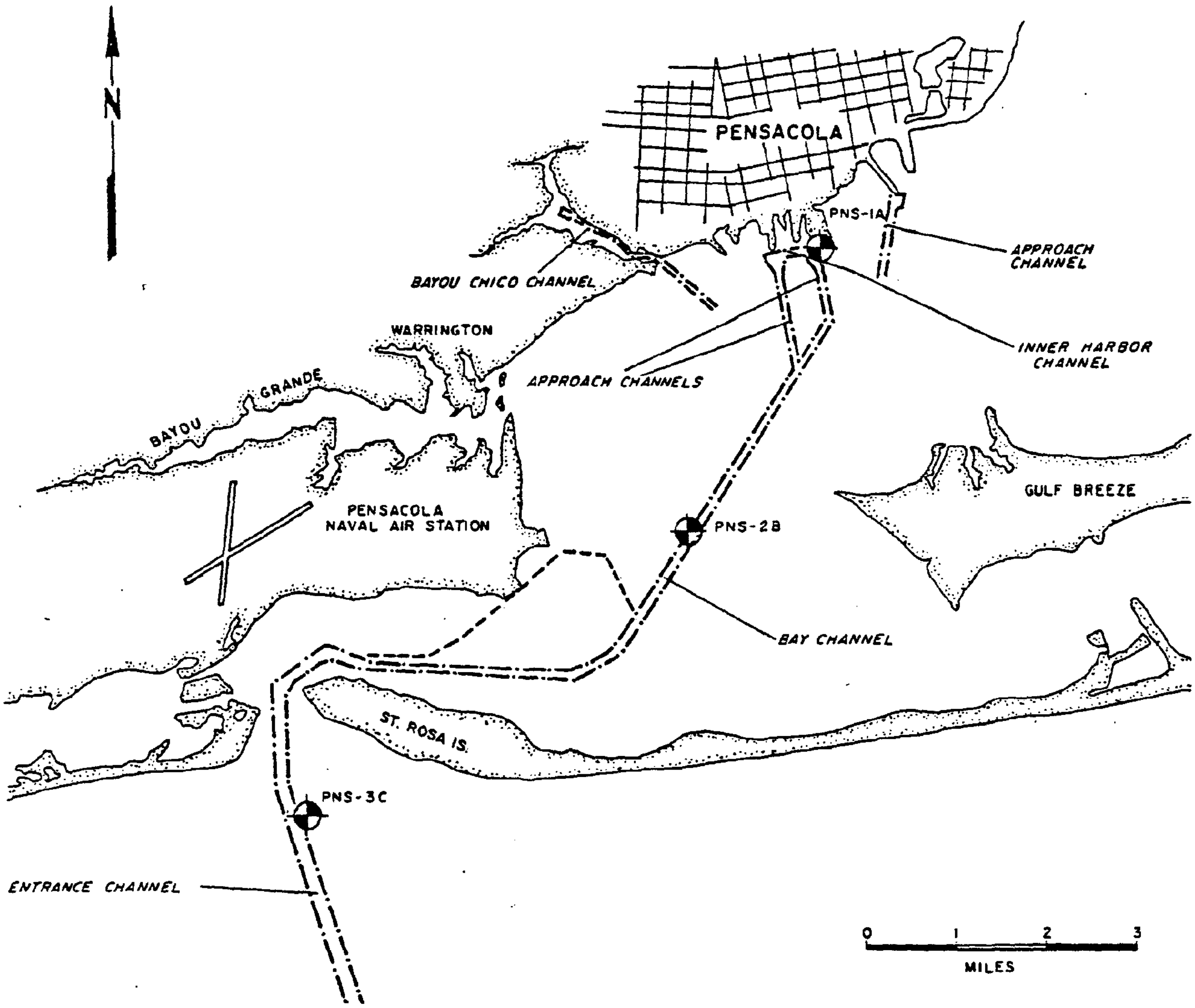


OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, PENSACOLA, USING JANUARY
OCTOBER 1982 OBSERVED MONTHLY PRECIPITATION

MONTHLY NORMAL AND OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, PORT OF PENSACOLA

PROJECT : DER DEEPWATER PORTS
LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 2-2



REFERENCE:

CORPS OF ENGINEERS DWG. No. 14 PENSACOLA HARBOR, FLA.
DATED: 9-30-79

SPRING / DRY SEASON SAMPLE STATION LOCATIONS PENSACOLA HARBOR

PROJECT: DER - DEEP WATER PORTS
LOCATION: JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE
FIGURE 2-3

CHECKED BY ________ DATE ________
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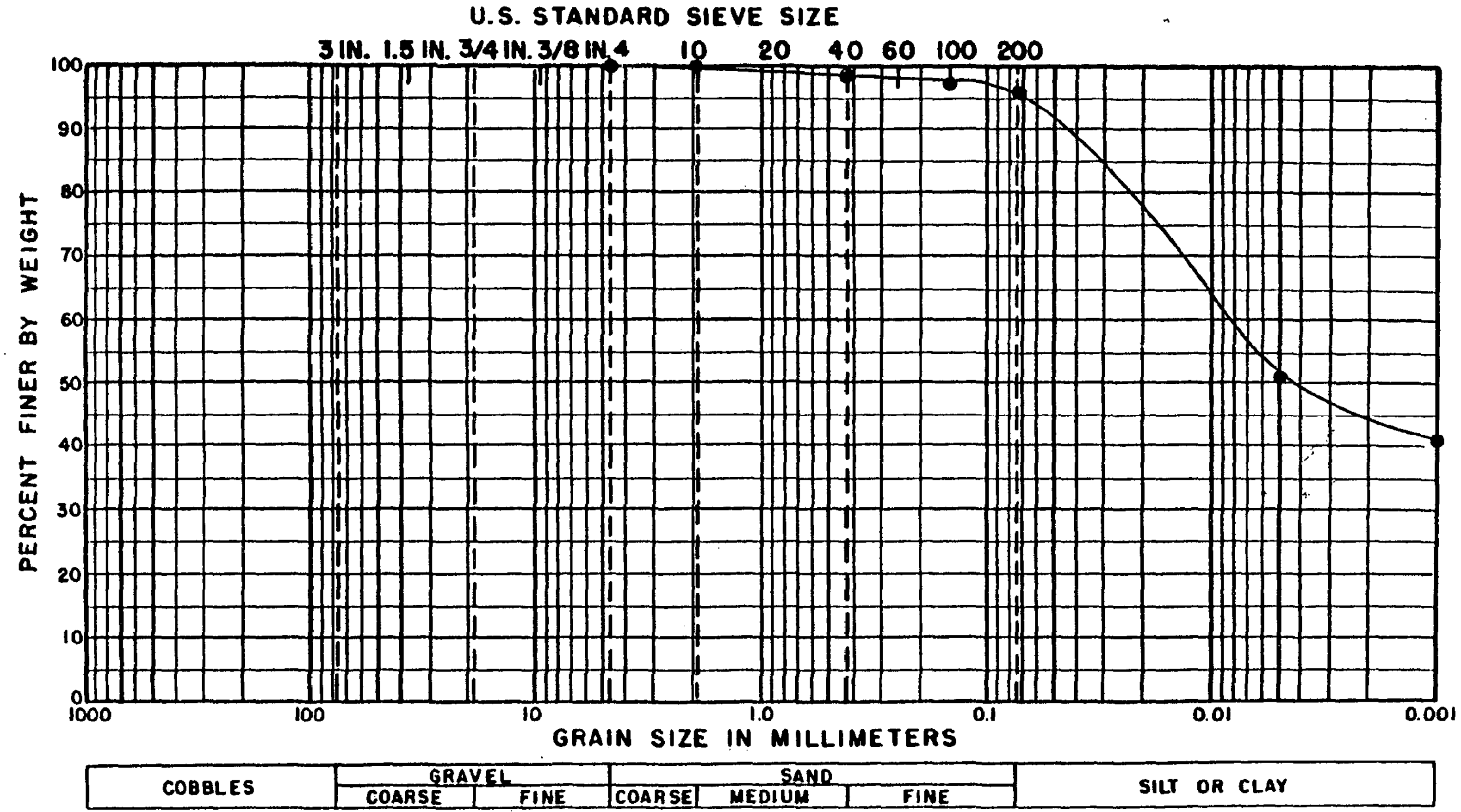
757.2 (REV. 4-62)

12739004 26 (9/82)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS-1A		OH	ORGANIC SILTY CLAY	239.0	63.5	48.4	15	INNER HARBOR CHANNEL

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM 3 REPLICATE SAMPLES

GRADATION CURVE

PENSACOLA PNS - 1A

DAMES & MOORE

FIGURE 2-4

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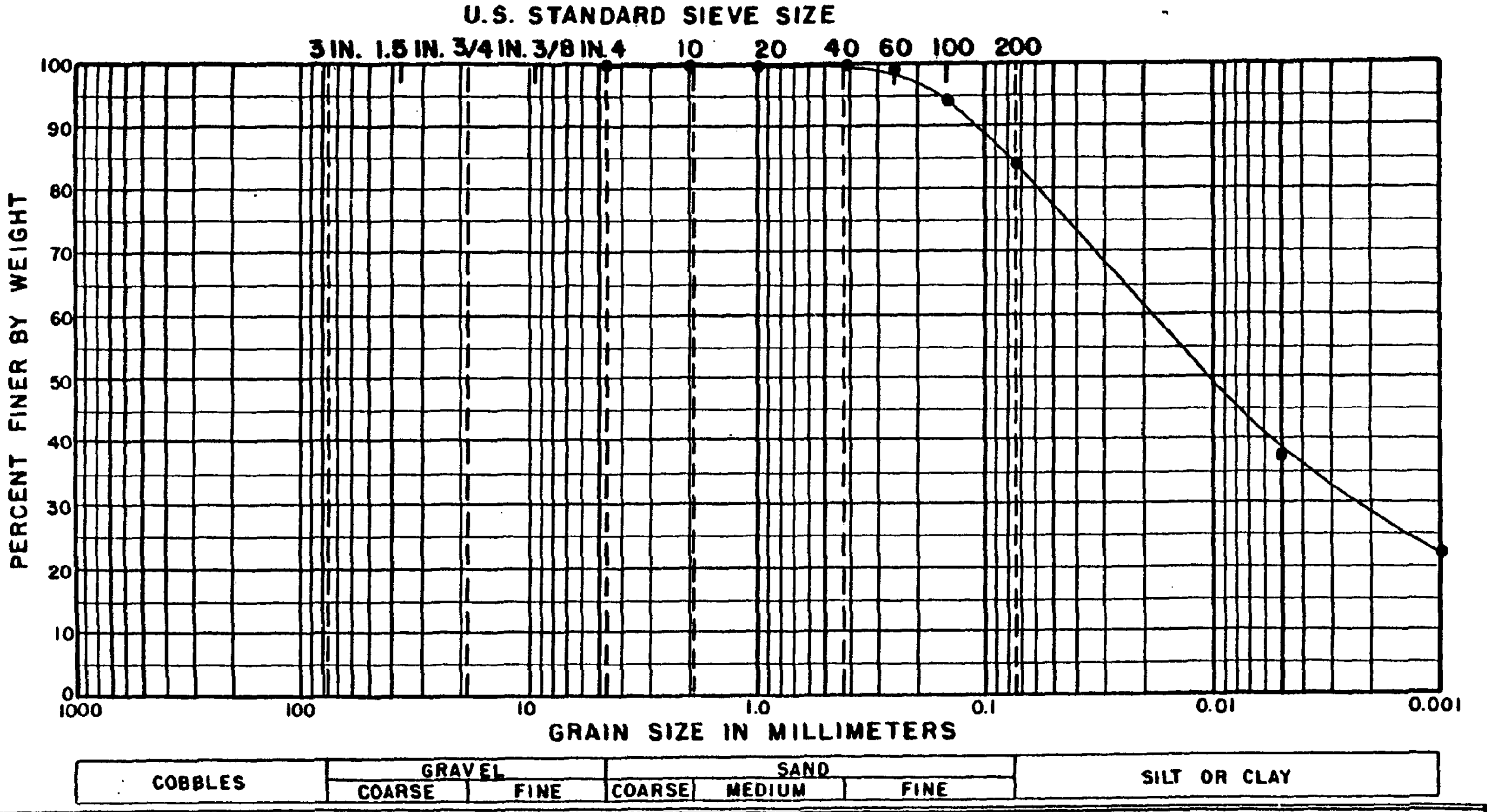


STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS-2B		OH	ORGANIC SILTY CLAY	151.5	62.2	38.7	23.5	BAY CHANNEL

NOTE: ATTERBERG LIMITS VALUES DETERMINED FROM 3 REPLICATE SAMPLES.

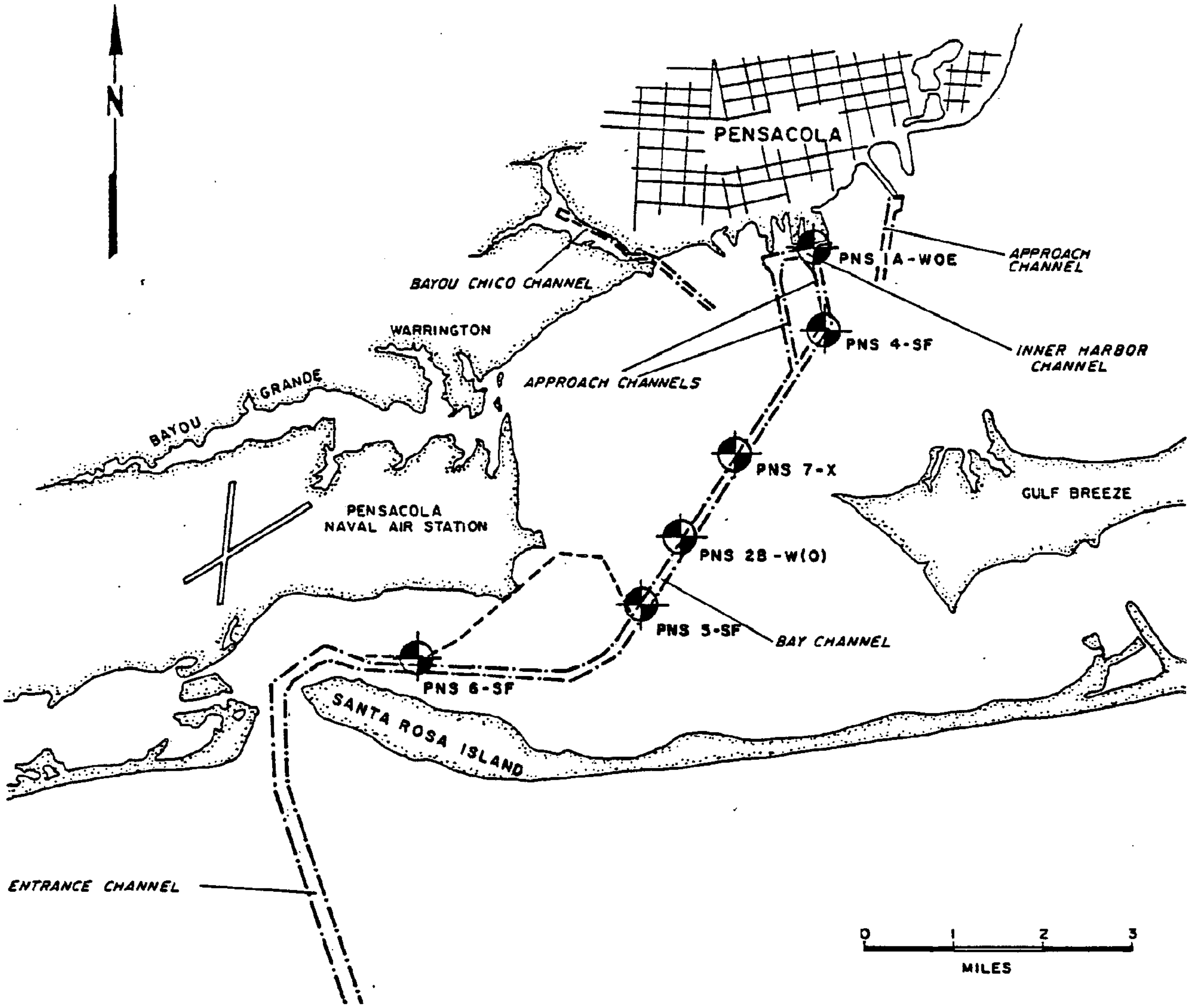
GRADATION CURVE

PENSACOLA PNS-2B

DAMES & MOORE

FIGURE 2-5

757.2 (REV. 4-62)



REFERENCE:

CORPS OF ENGINEERS DWG. No. 14 PENSACOLA HARBOR, FLA.
DATED: 9-30-79

NOTES:

1. FOR STATION DESIGNATION DESCRIPTIONS PLEASE SEE TEXT.
2. LOCATIONS AS SHOWN ARE APPROXIMATE, PLEASE SEE TEXT FOR DETAILED LOCATIONS

FALL / WET SEASON SAMPLE STATION LOCATIONS PENSACOLA HARBOR

PROJECT: DER - DEEP WATER PORTS
LOCATION: JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE
FIGURE 2-6

BY ___ DATE ___
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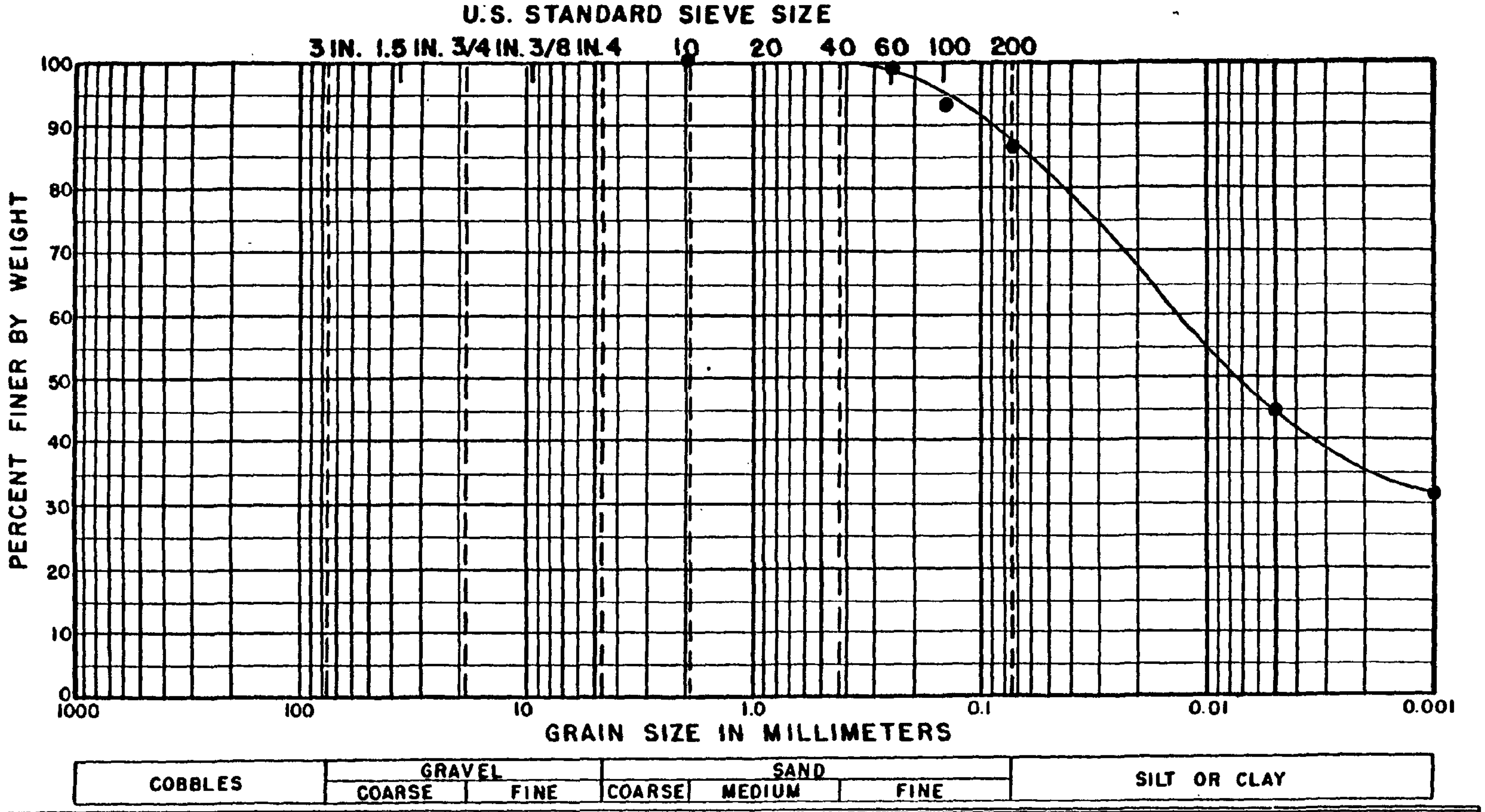
737.2 (REV. 4-62)

1273900426(1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS IA - WOE	—	OH	ORGANIC SILTY CLAY	—	—	—	—	INNER HARBOR CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

PENSACOLA PNS IA-WOE
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-7

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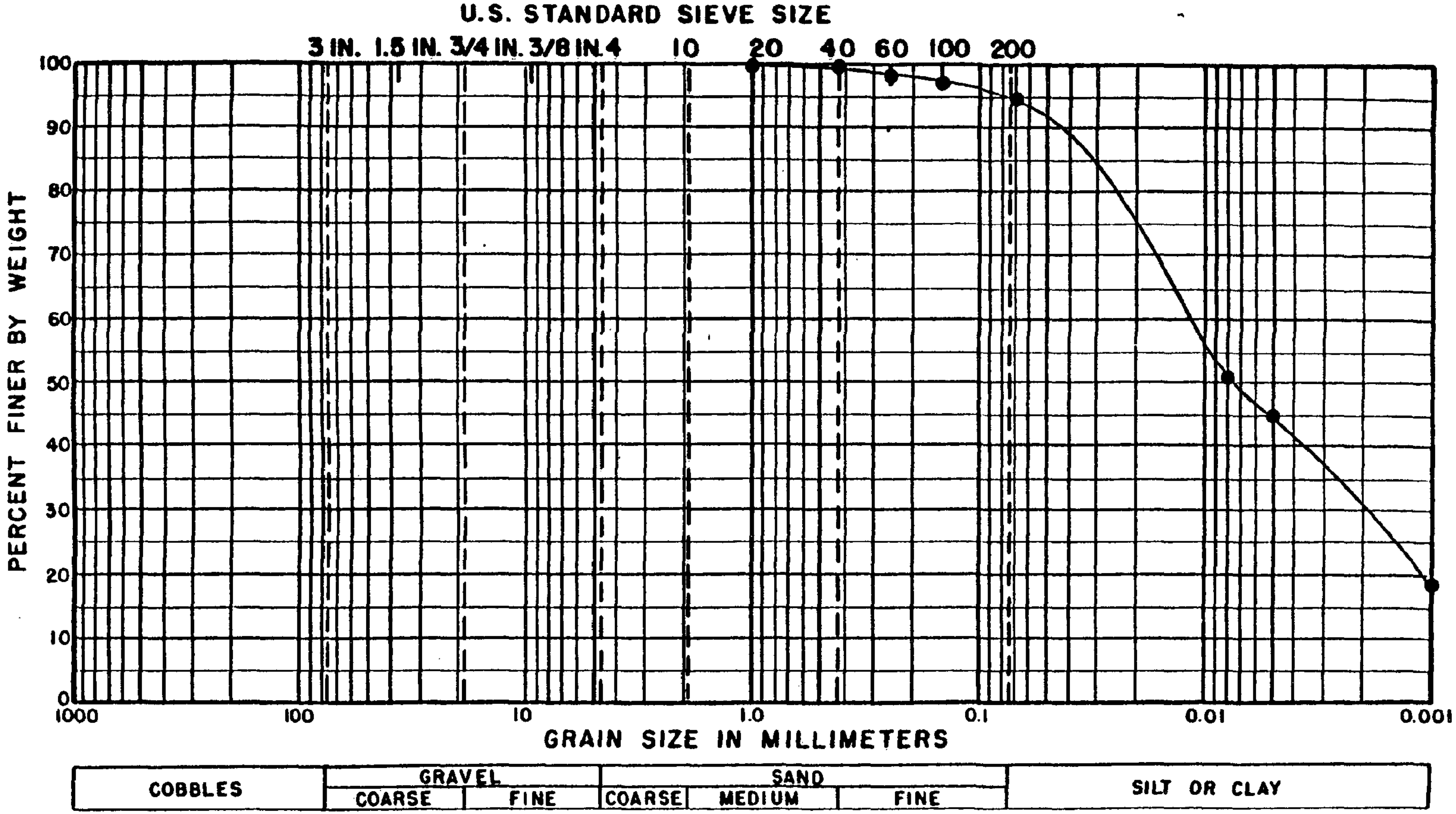

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS-4-SF	—	OH	ORGANIC SILTY CLAY	224.2	70.8	47.3	23.5	BAY CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

PENSACOLA PNS 4-SF
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-8

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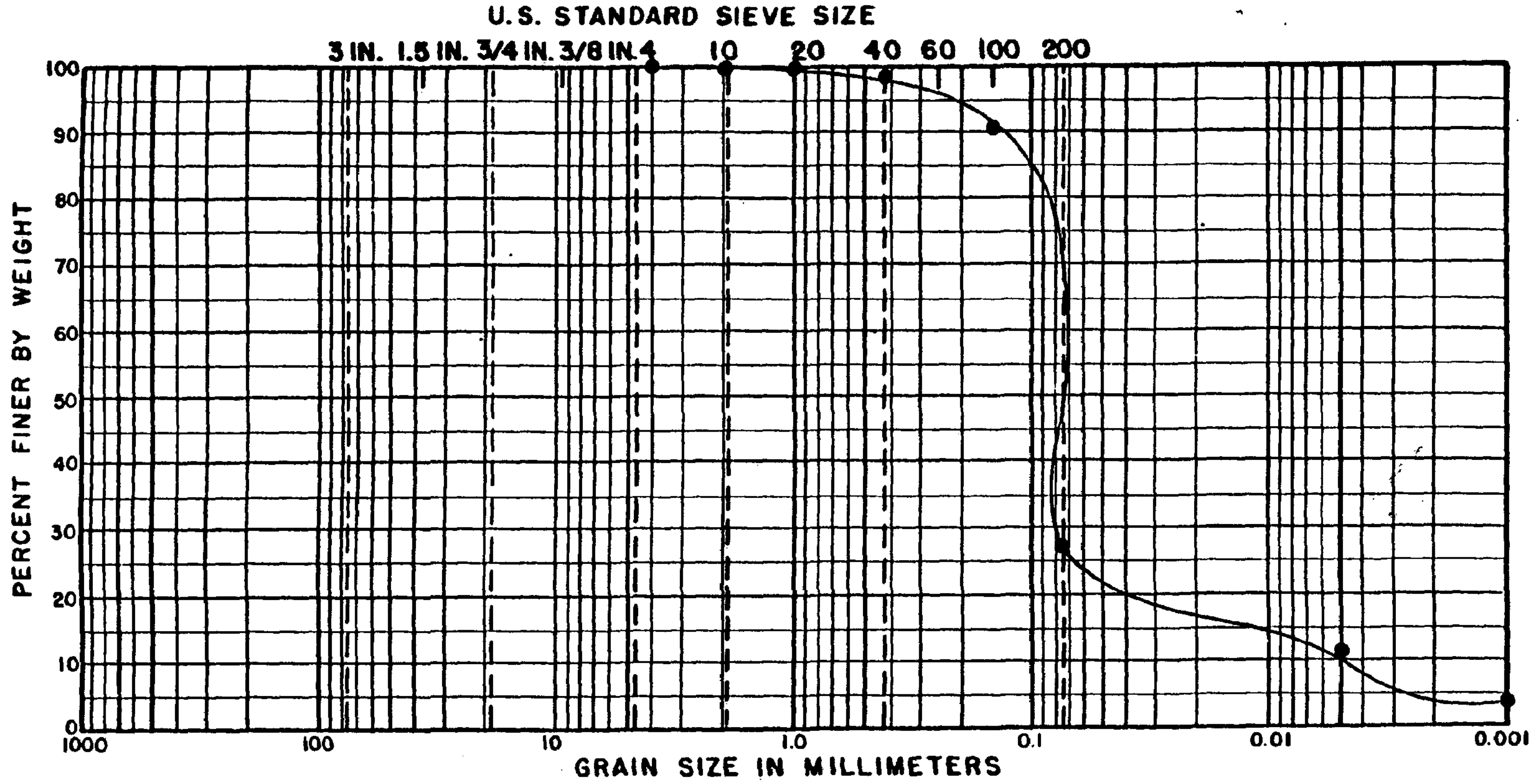

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS 5-SF	—	SM/OL	ORGANIC SILTY FINE SAND	65.0	31.8	23.5	8.3	BAY CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES

GRADATION CURVE

PENSACOLA PNS 5 - SF
FALL / WET SEASON

DAMES & MOORE

FIGURE 2-9

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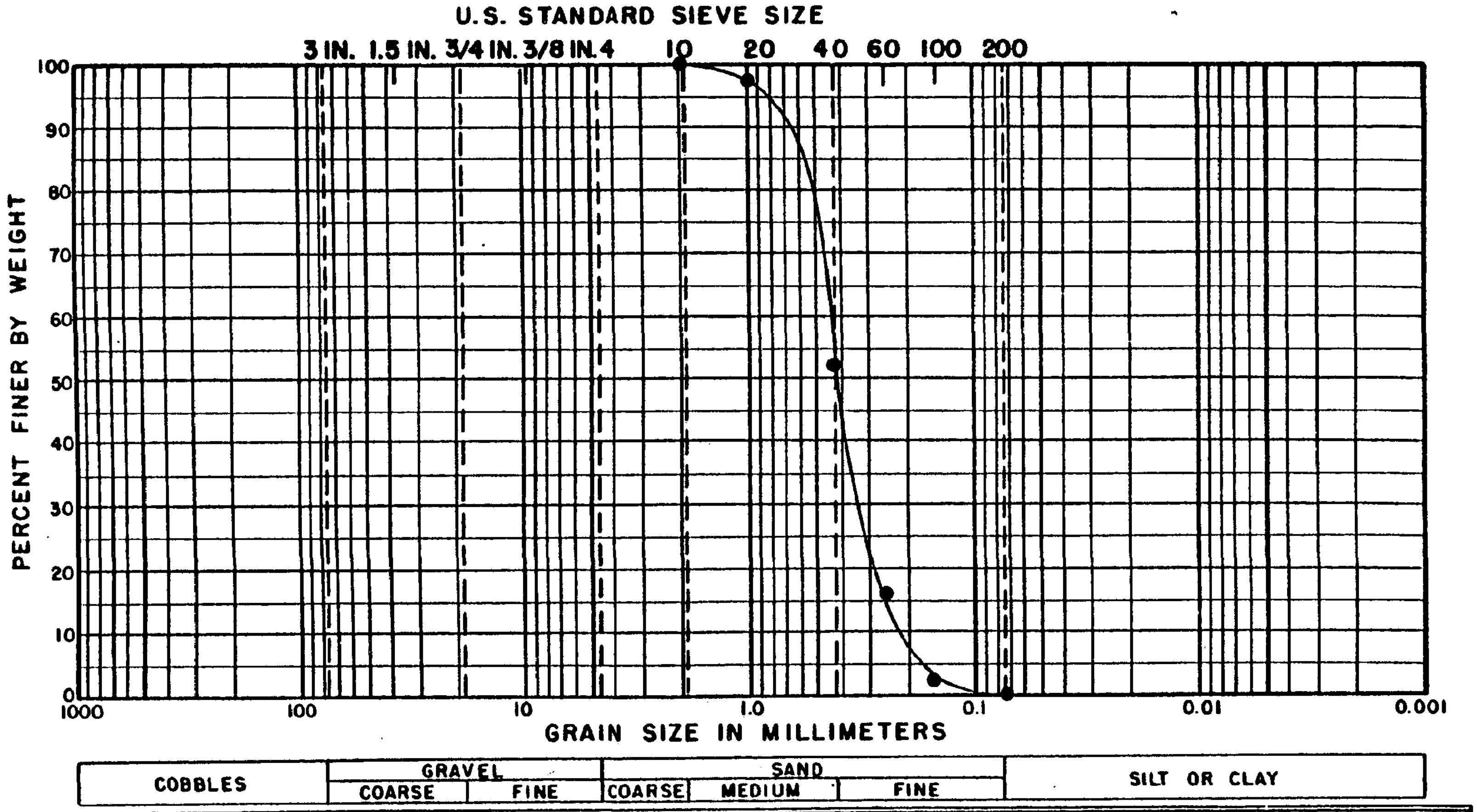


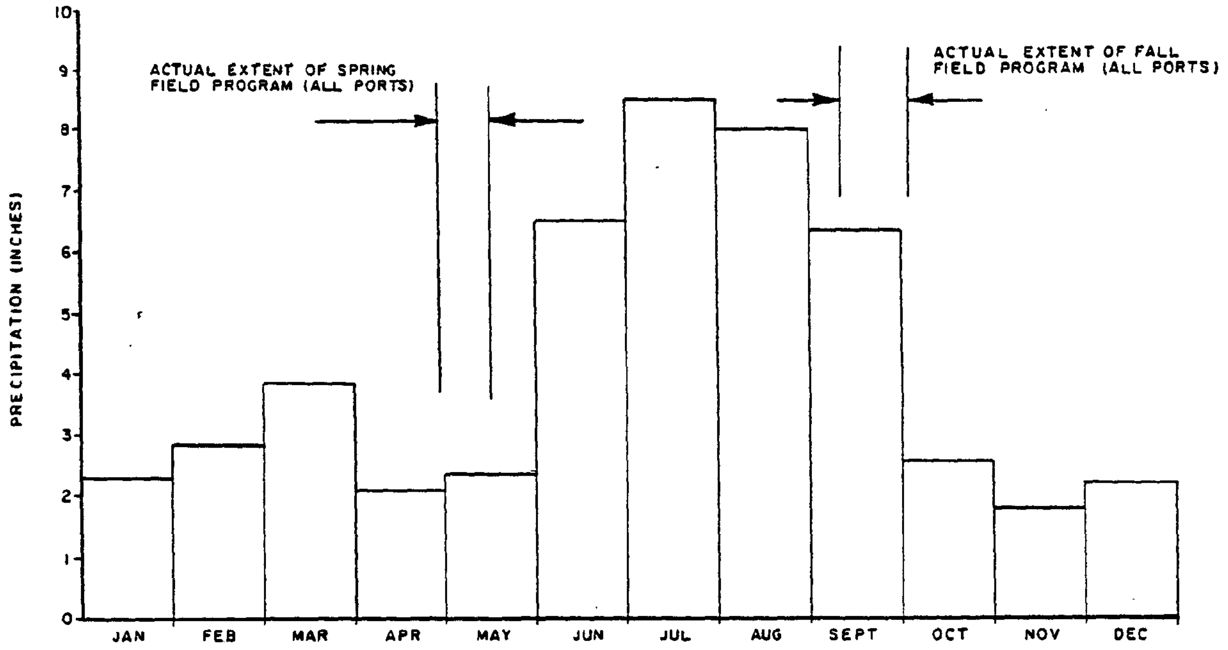
STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
PNS 6-SF	—	SP	MEDIUM TO FINE SAND	—	—	—	—	BAY CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

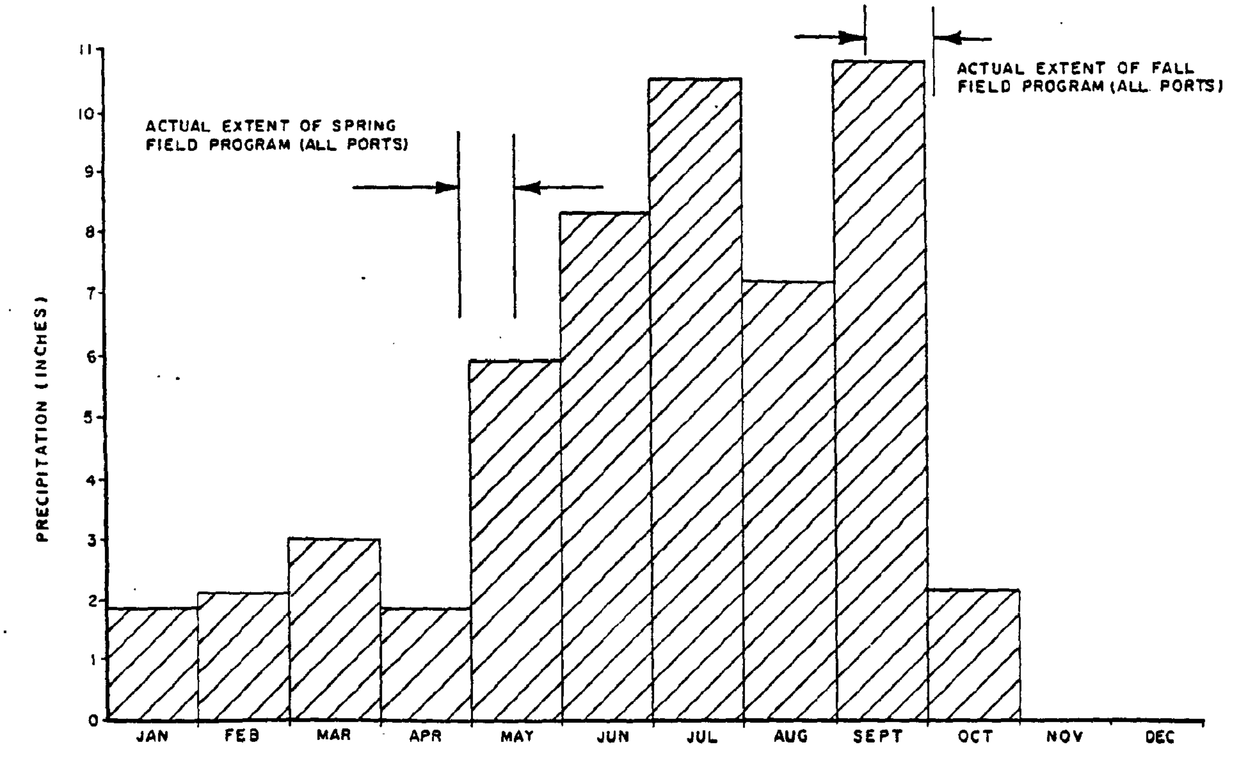
GRADATION CURVE

PENSACOLA PNS 6-SF
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-10



NORMAL MONTHLY PRECIPITATION 1941-1970, TAMPA



OBSERVED MONTHLY PRECIPITATION, TAMPA, JANUARY-OCTOBER 1982

NORMAL MONTHLY AND OBSERVED PRECIPITATION, TAMPA HARBOR

PROJECT: DER DEEPWATER PORTS	DAMES & MOORE
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA	FIGURE 2-11

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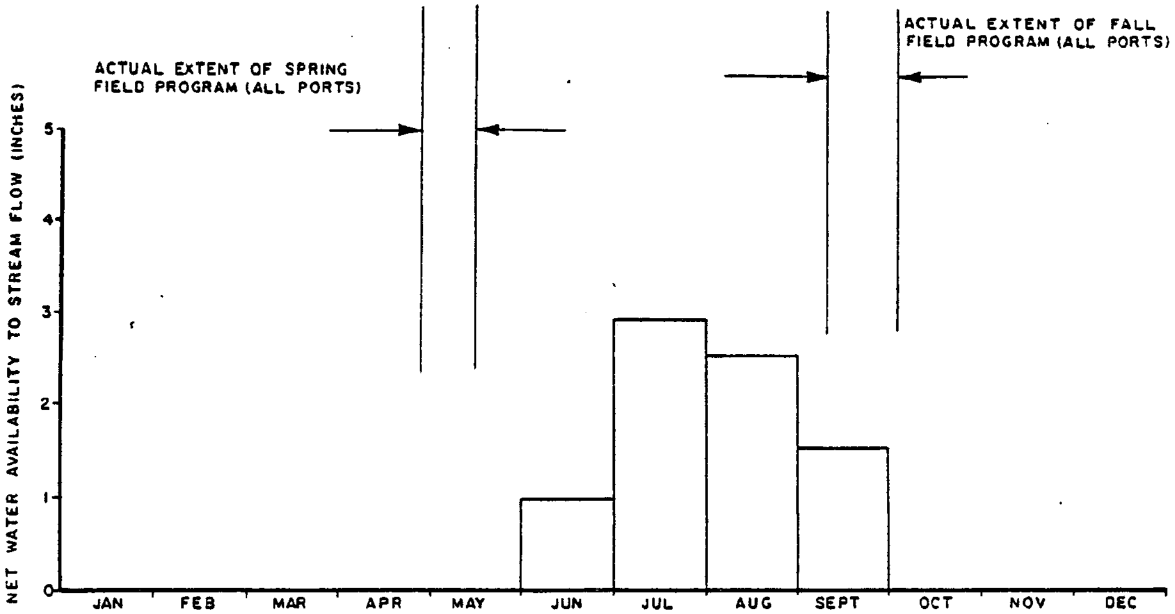
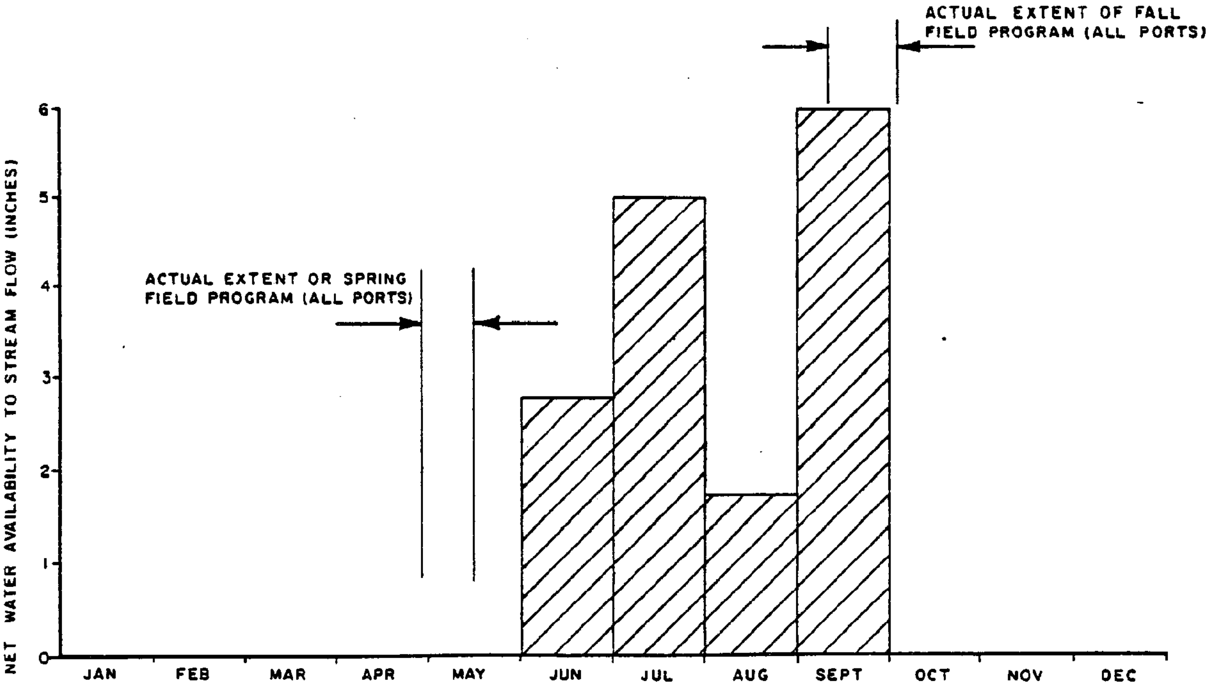


MONTHLY NORMAL NET WATER AVAILABILITY TO STREAM FLOW USING 1941-1970
MONTHLY NORMAL PRECIPITATION
TAMPA



OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, TAMPA, USING JANUARY-OCTOBER
1982 OBSERVED MONTHLY PRECIPITATION

MONTHLY NORMAL AND OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, TAMPA HARBOR

PROJECT : DER DEEPWATER LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA	**DAMES & MOORE** FIGURE 2-12

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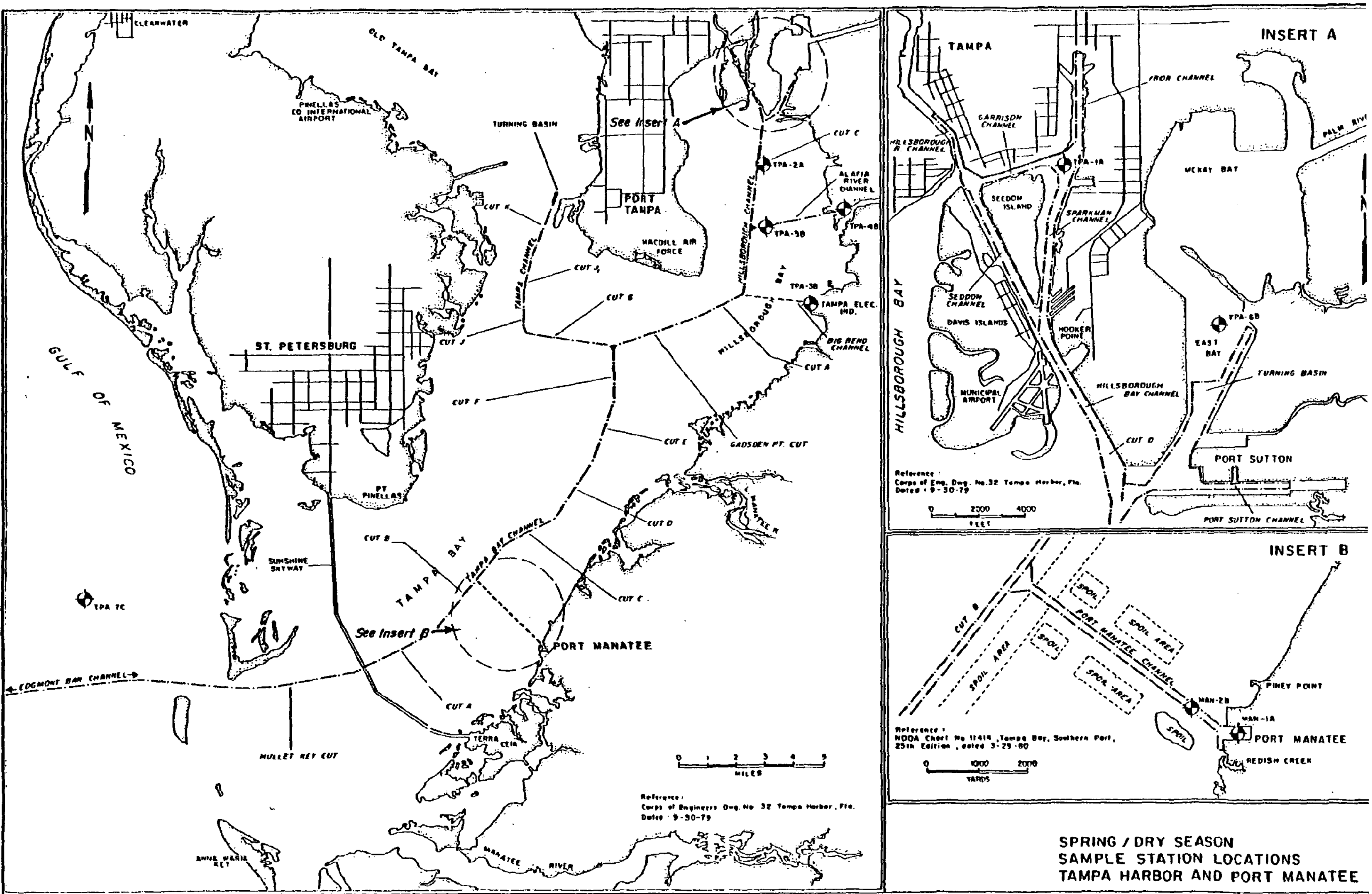

Reference:
Corps of Engineers Dwg. No. 32 Tampa Harbor, Fla.
Dated 9-30-79

Reference:
Corps of Eng. Dwg. No. 32 Tampa Harbor, Fla.
Dated: 9-30-79

Reference:
NOAA Chart No 11414, Tampa Bay, Southern Part,
25th Edition, dated 3-29-80

SPRING / DRY SEASON
SAMPLE STATION LOCATIONS
TAMPA HARBOR AND PORT MANATEE

PROJECT DER DEEP WATER PORTS
LOCATION JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE
FIGURE 2-13

1273900426 (4-82)

757.2 (REV. 4-63)

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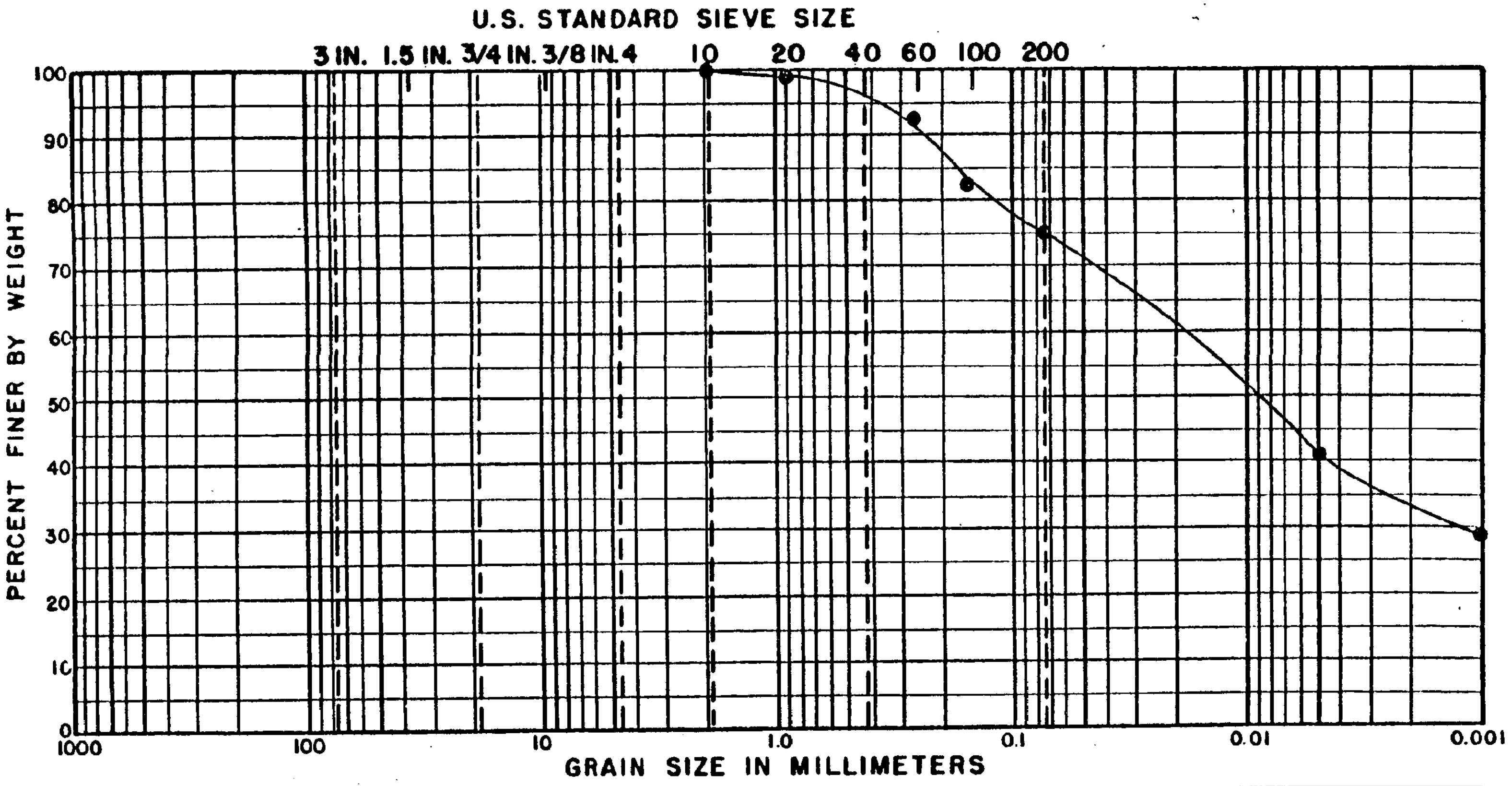

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA - 1A		OH	ORGANIC SILTY CLAY	175.8	57.5	34.5	23.0	YBOR CHANNEL

NOTE : ATTERBERG LIMIT VALUES : DETERMINED FROM 1 SAMPLE

GRADATION CURVE

TAMPA TPA-1A

DAMES & MOORE

FIGURE 2-14

757.2 (REV. 4-62)

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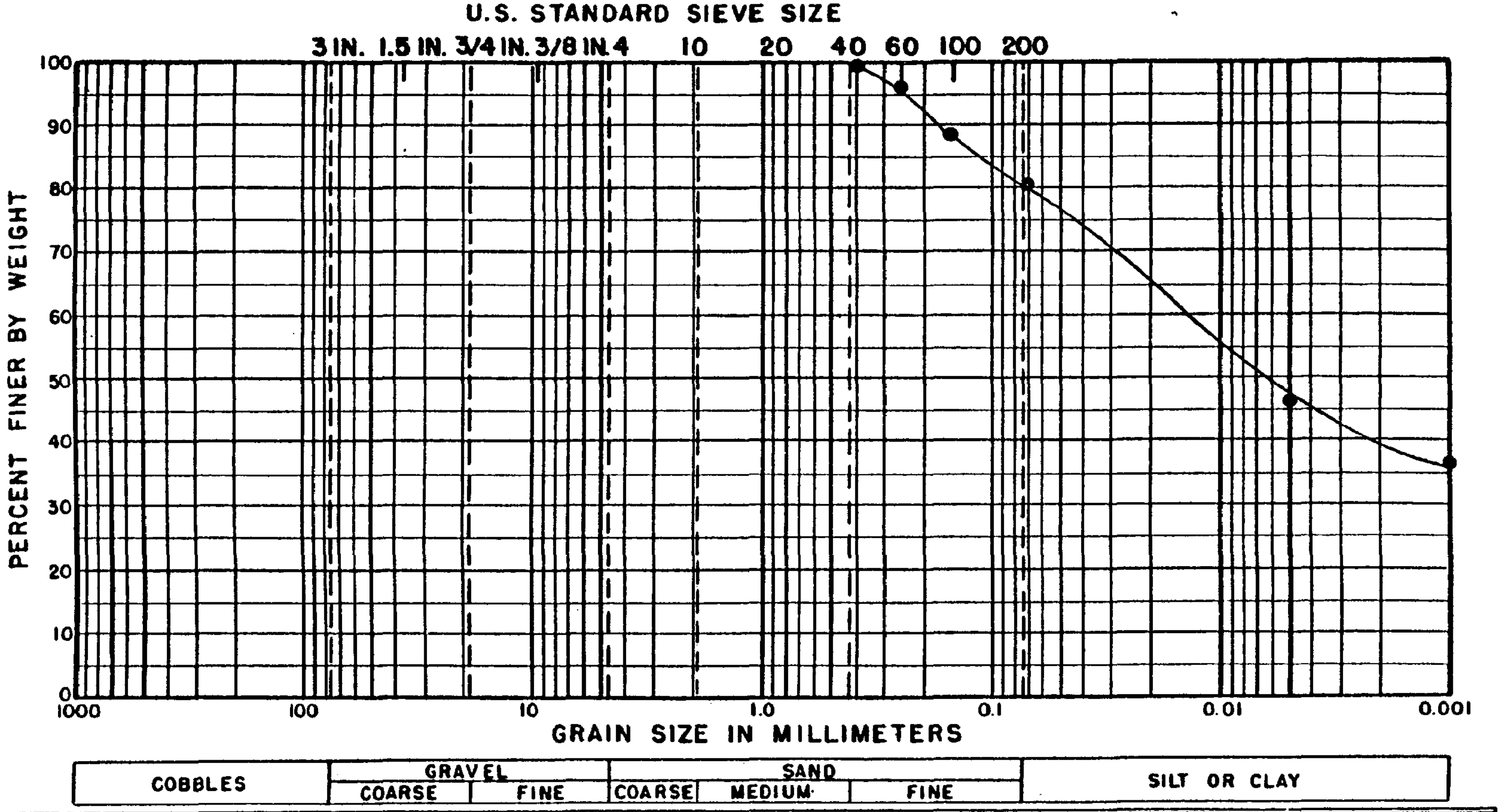

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA - 2A		CH	SILTY CLAY	124.2	60.7	23.1	37.6	HILLSBOROUGH CHANNEL (CUT C)

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM 2 REPLICATE SAMPLES

GRADATION CURVE

TAMPA TPA-2A

DAMES & MOORE
FIGURE 2-15

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757.2 (REV. 4-62)

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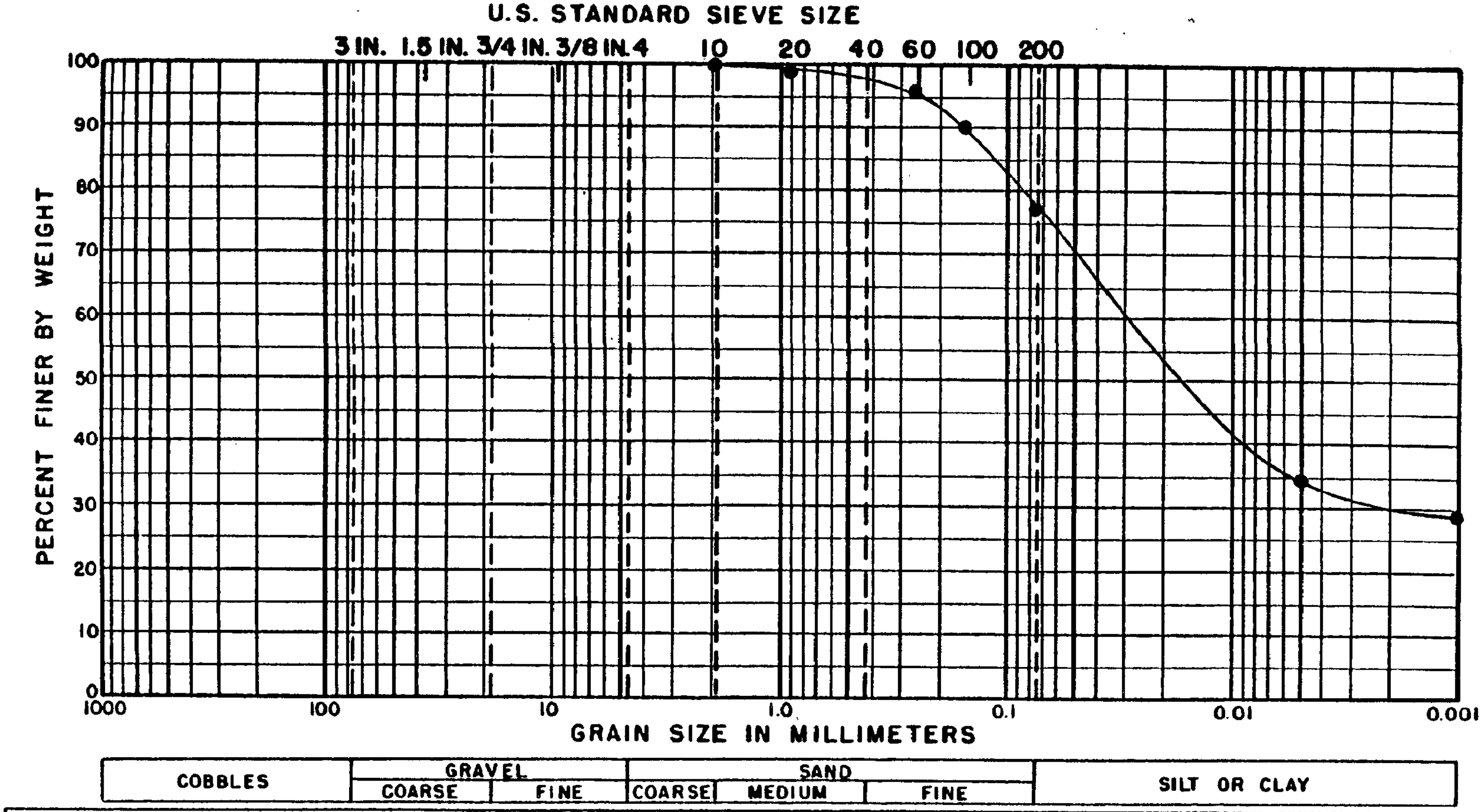

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA-3B		CH	SILTY CLAY	108.0	68.0	30.1	37.9	BIG BEND CHANNEL

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM 1 SAMPLE

GRADATION CURVE

TAMPA TPA-3B

DAMES & MOORE

FIGURE 2-16

757.2 (REV. 4-62)

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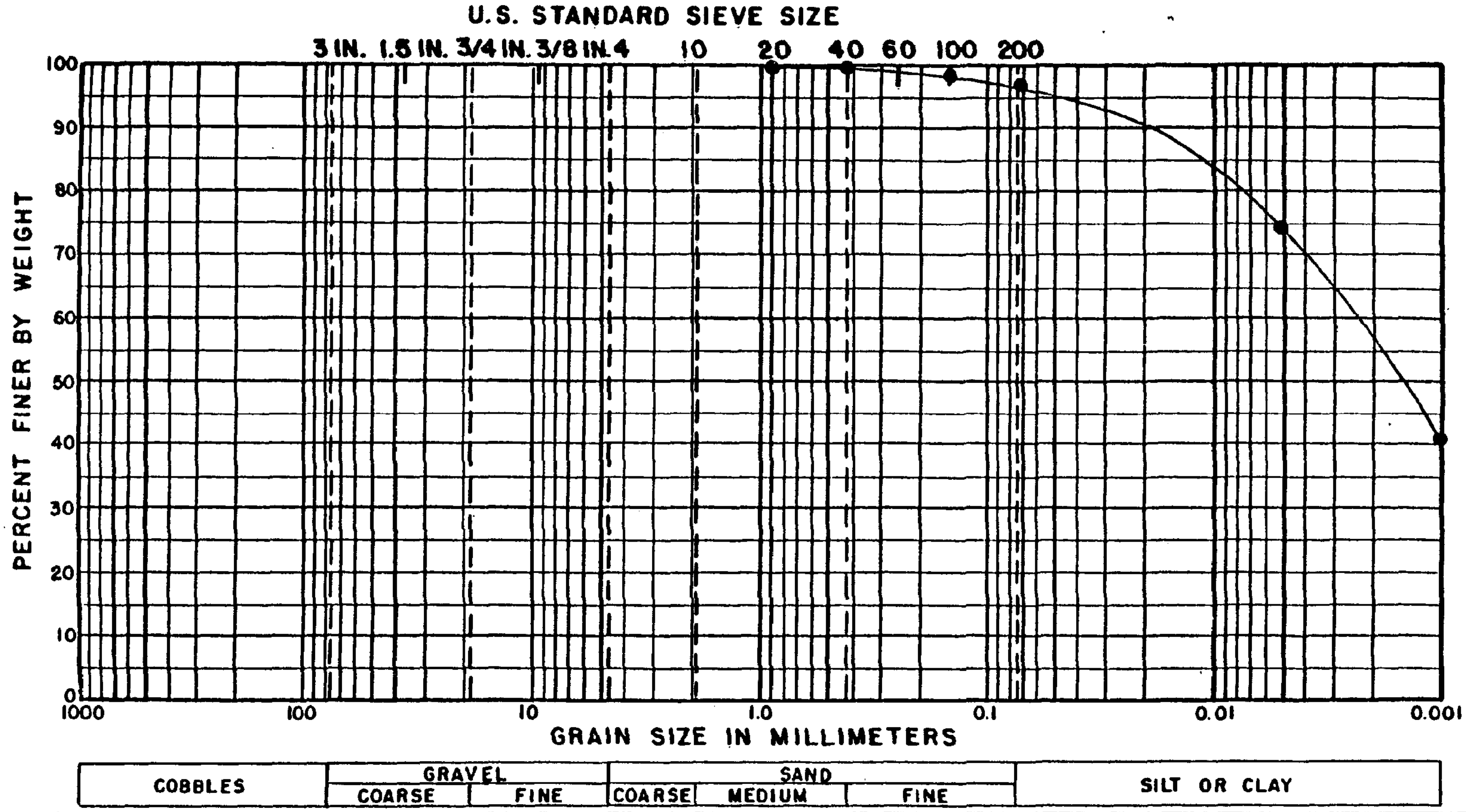

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA-4B		OH	ORGANIC SILTY CLAY	122.4	72.0	50.7	21.3	ALAFIA RIVER CHANNEL

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM 1 SAMPLE.

GRADATION CURVE

TAMPA TPA-4B

DAMES & MOORE

FIGURE 2-17

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757.2 (REV. 4-62)

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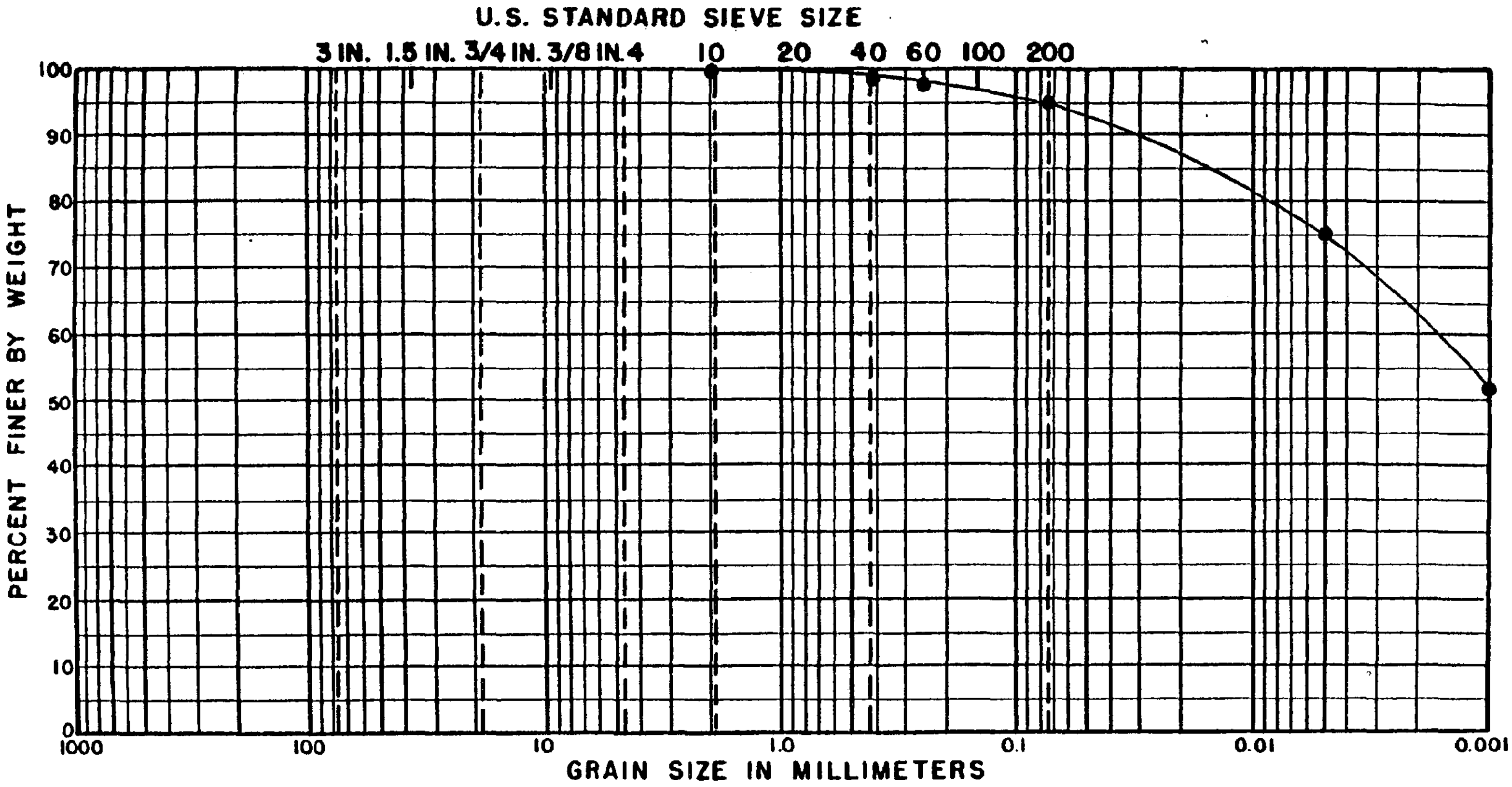


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA-5B		CH	SILTY CLAY	152.7	84.5	28.7	55.8	ALAFIA RIVER CHANNEL

NOTE: ATTERBERG LIMIT VALUES DETERMINED FROM 1 SAMPLE.

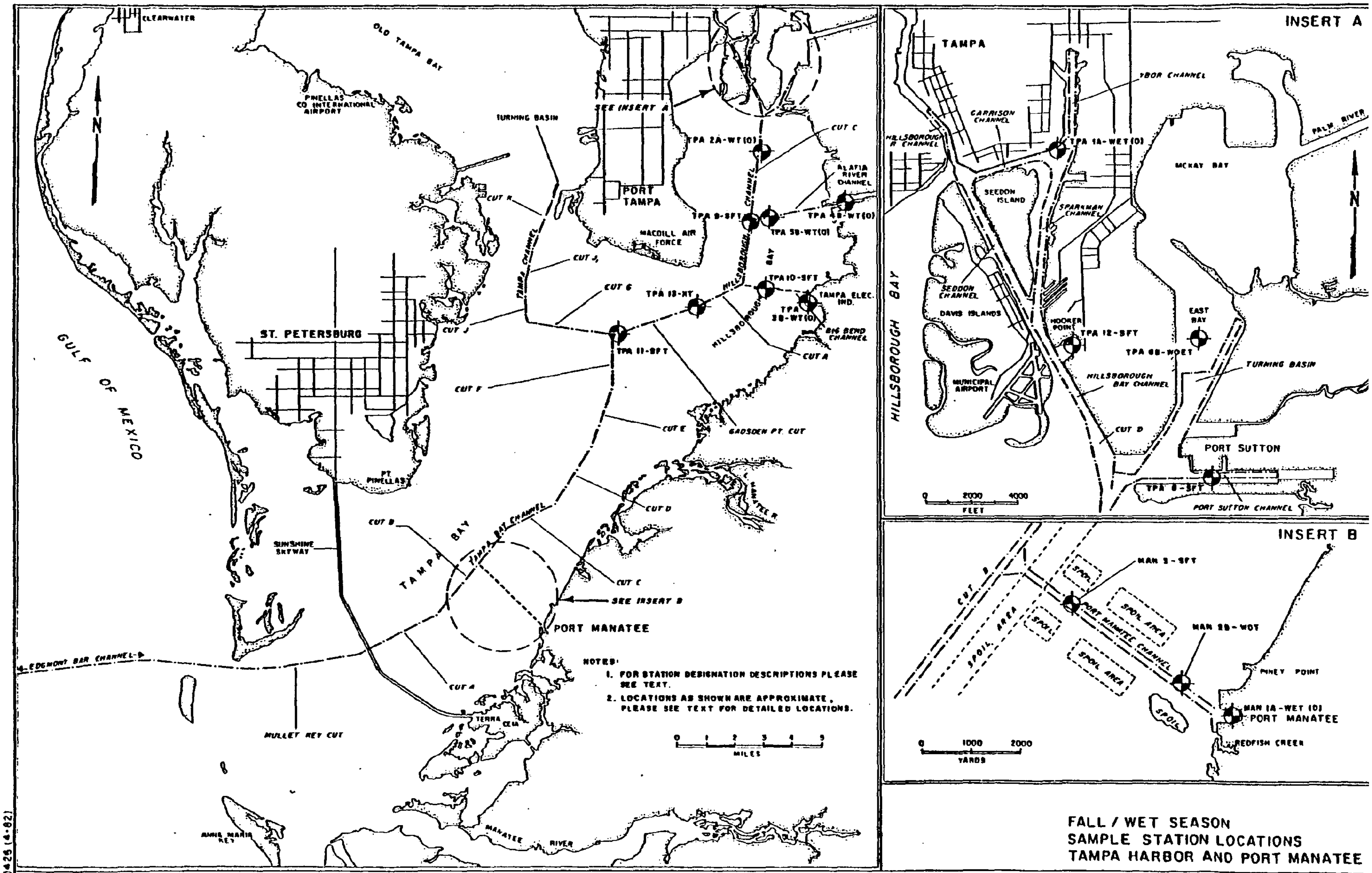
GRADATION CURVE

TAMPA TPA-5B

DAMES & MOORE

FIGURE 2-18

REVISIONS BY ________ DATE ________



NOTES:

1. FOR STATION DESIGNATION DESCRIPTIONS PLEASE SEE TEXT.
2. LOCATIONS AS SHOWN ARE APPROXIMATE, PLEASE SEE TEXT FOR DETAILED LOCATIONS.

FALL / WET SEASON
SAMPLE STATION LOCATIONS
TAMPA HARBOR AND PORT MANATEE

PROJECT DER- DEEP WATER PORTS
LOCATION JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE
FIGURE 2-20

1273900426 (4-82)

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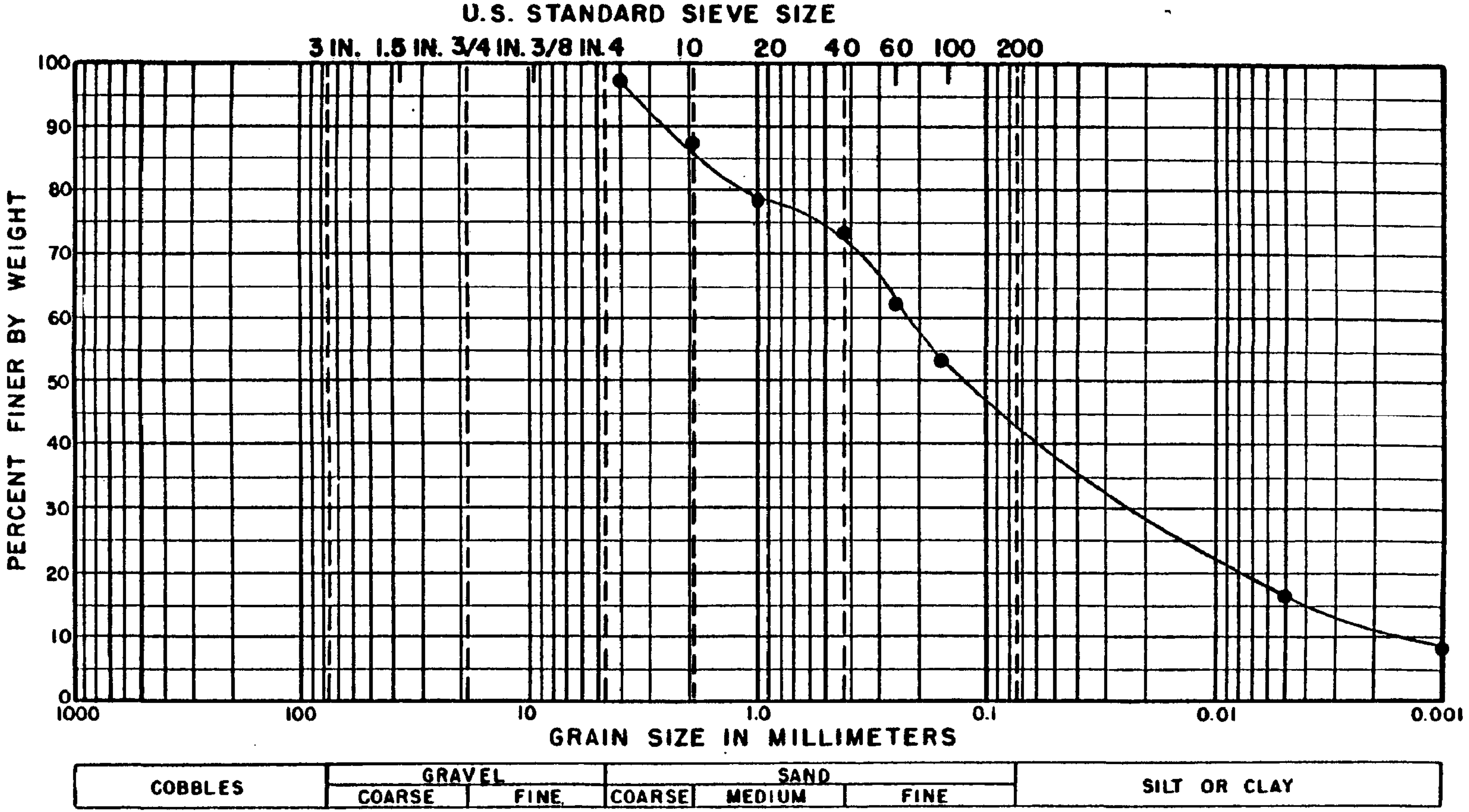
12739004 26(1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 1A-WET(O)	—	SM/OL	MEDIUM TO FINE ORGANIC SANDY SILT	—	—	—	—	YBOR CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 1A-WET (O)
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-21

757.2 (REV. 4-62)

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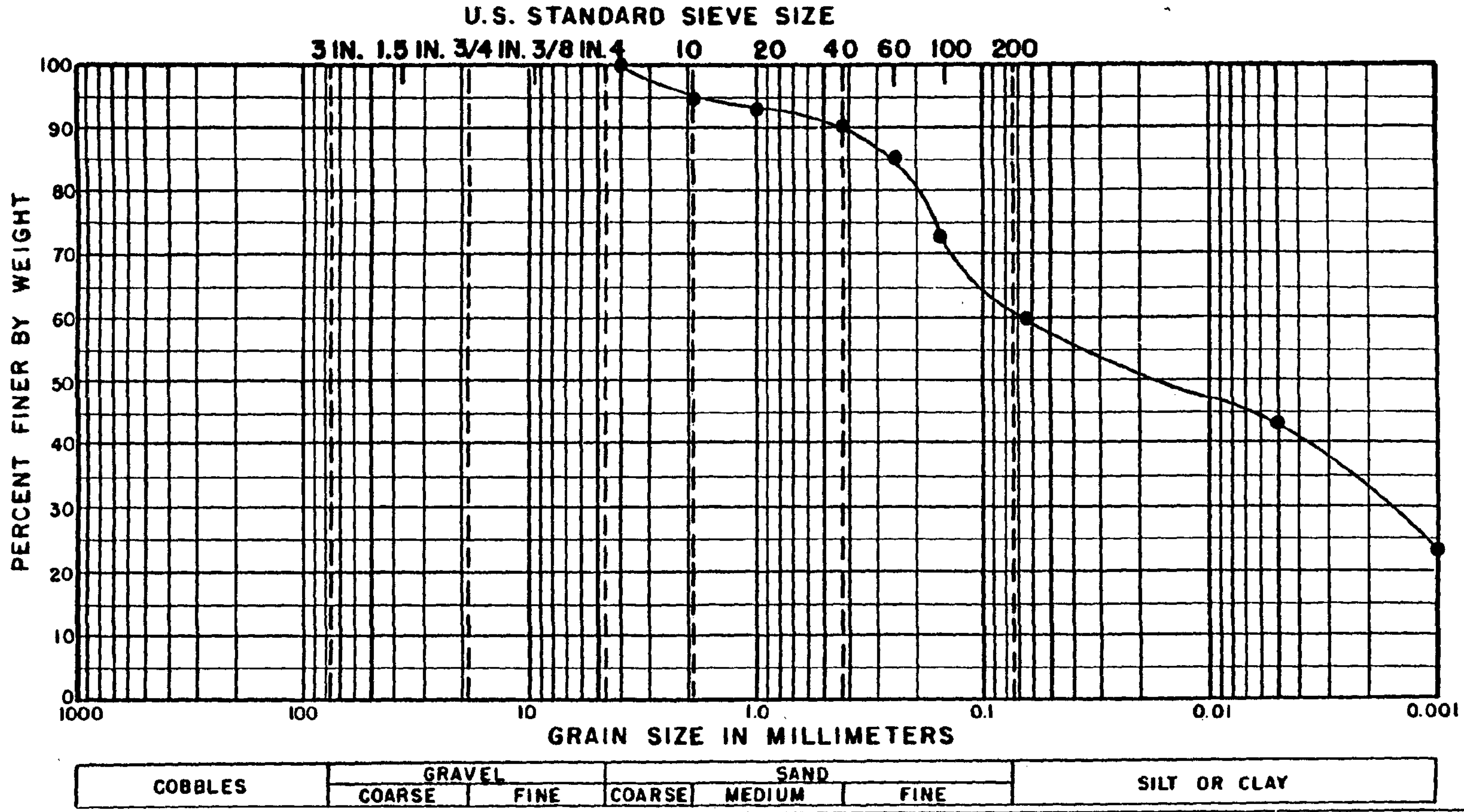
757.2 (REV. 4-62)

12739004 26(1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 6A-WOET	—	SM/SC	FINE SANDY CLAY	—	—	—	—	EAST BAY

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMP TPA 6A-WOET
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-22

FILE

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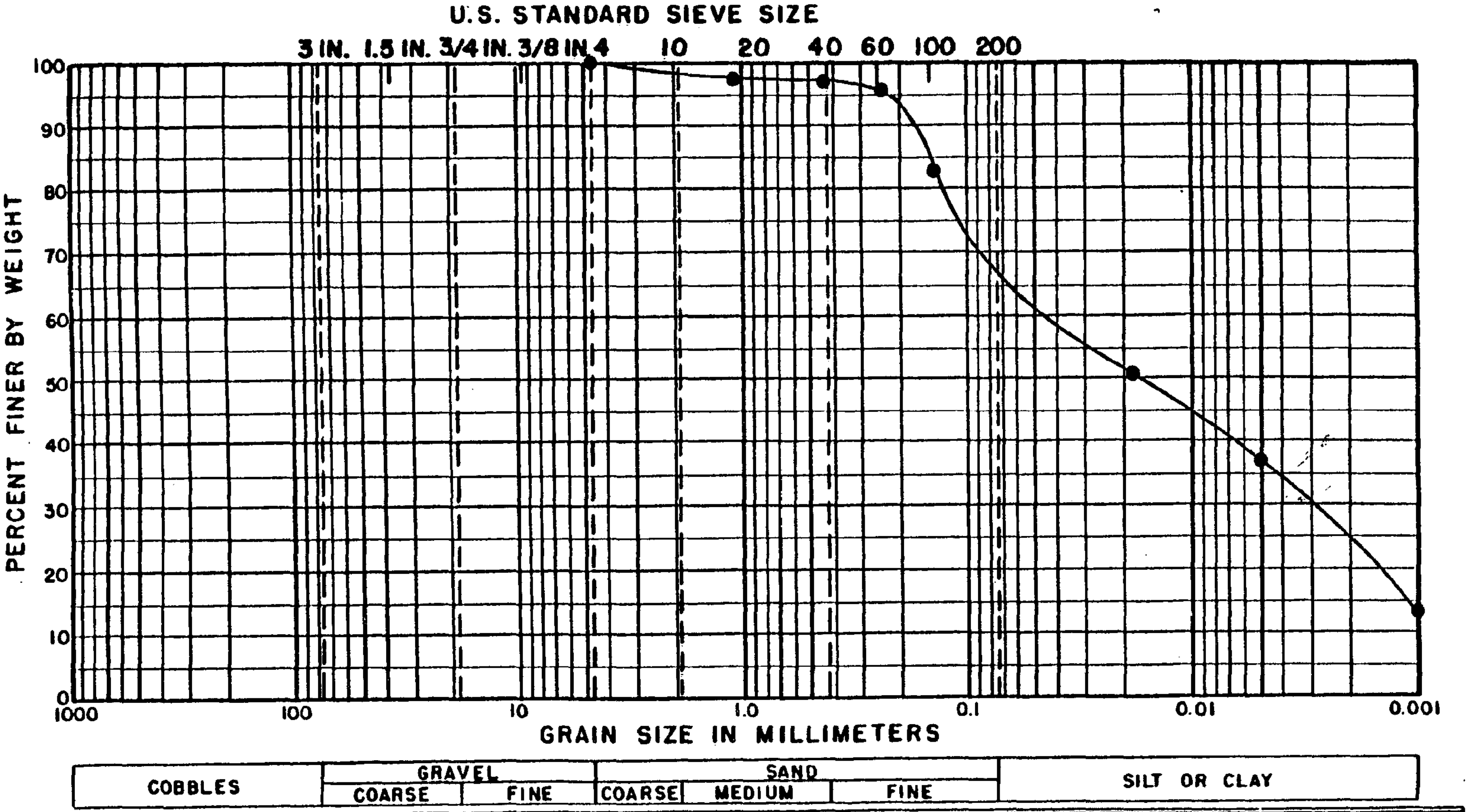
1273900426(1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 8 - SFT	—	CL	SILTY CLAY WITH SOME LIMESTONE FRAGMENTS	85.7	41.8	16.3	25.5	PORT SUTTON CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 8-SFT

FALL / WET SEASON

DAMES & MOORE

FIGURE 2-23

737.2 (REV. 4-62)

757.2 (REV. 4-62)

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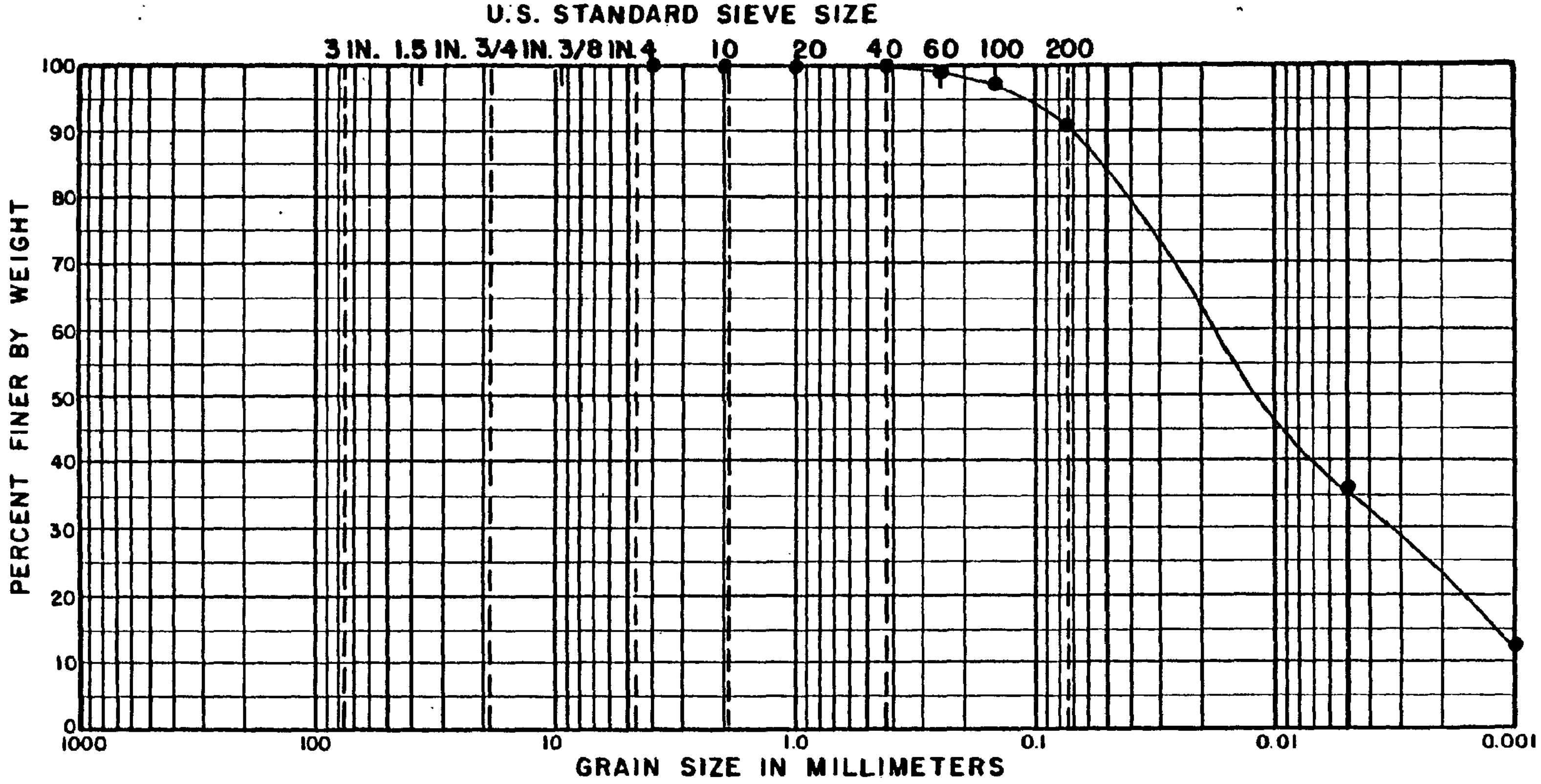

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 9-SFT	—	OH	ORGANIC SILTY CLAY	215.9	58.3	36.0	22.3	HILLSBOROUGH BAY CHANNEL CUT C

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 9-SFT
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-24

757.2 (REV. 4-62)

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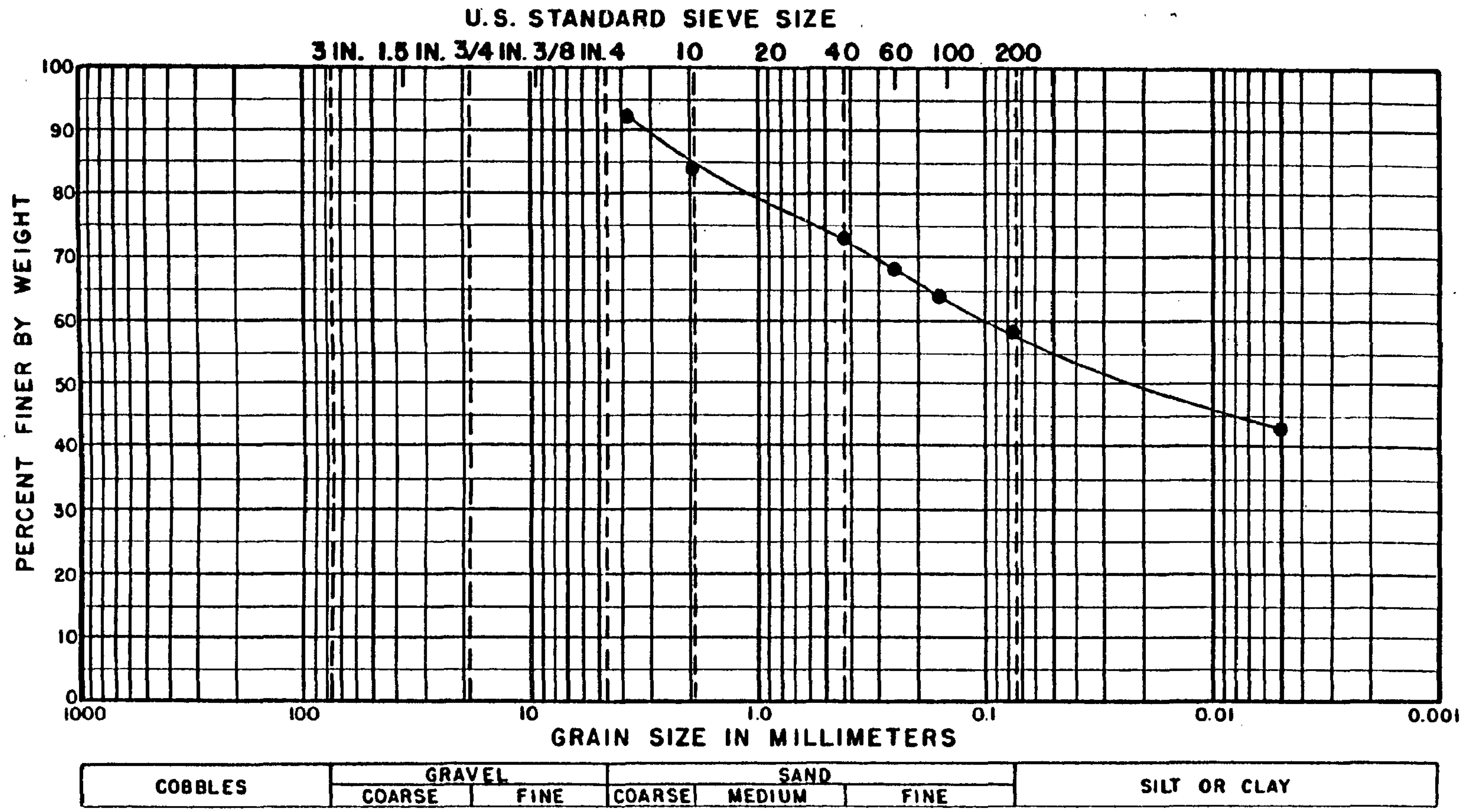

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 10-SFT	—	OH	ORGANIC SILTY CLAY WITH SOME MEDIUM TO FINE CLAY	177.8	69.8	47.3	22.5	BIG BEND CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 10-SFT
FALL / WET SEASON

DAMES & MOORE

FIGURE 2-25

757.2 (REV. 4-62)

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BY ______ DATE ______
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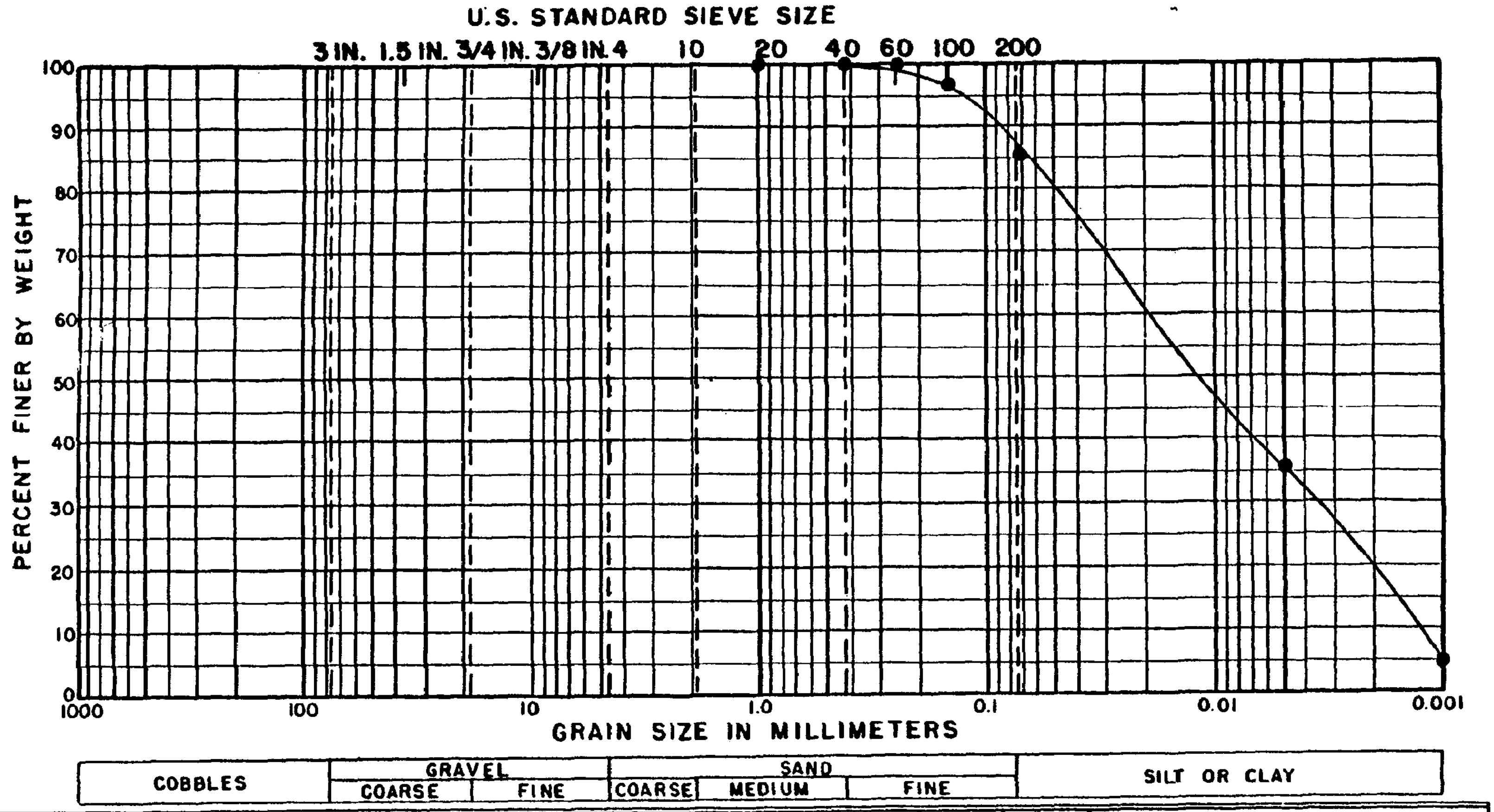

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 11-SFT	—	CH/OH	ORGANIC SILTY CLAY	149.2	65.9	31.0	34.9	GADSDEN POINT CUT

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

TAMPA TPA 11-SFT
FALL / WET SEASON
DAMES & MOORE
FIGURE 2-26

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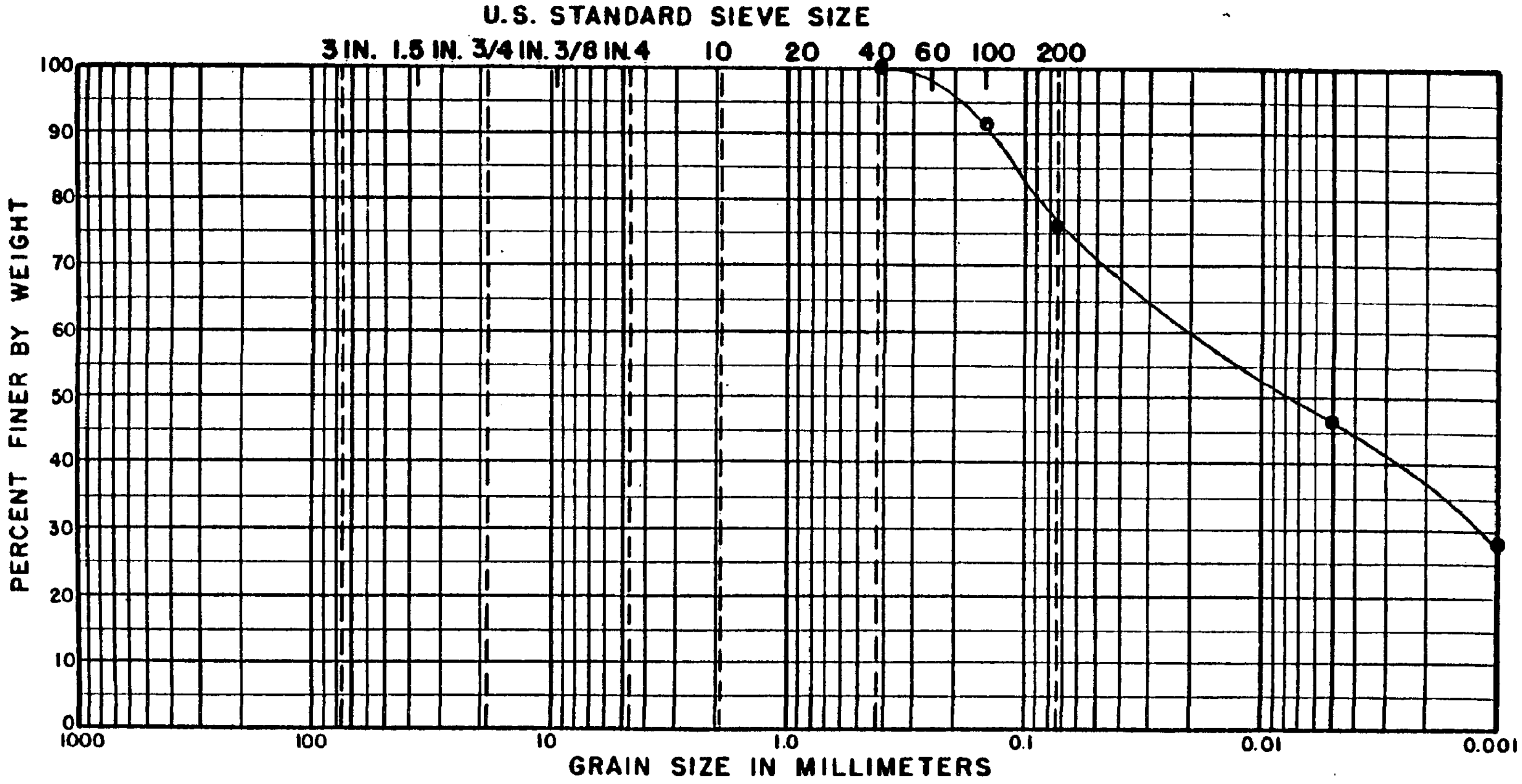
797.2 (REV. 4-62)

1273900426(1/83)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

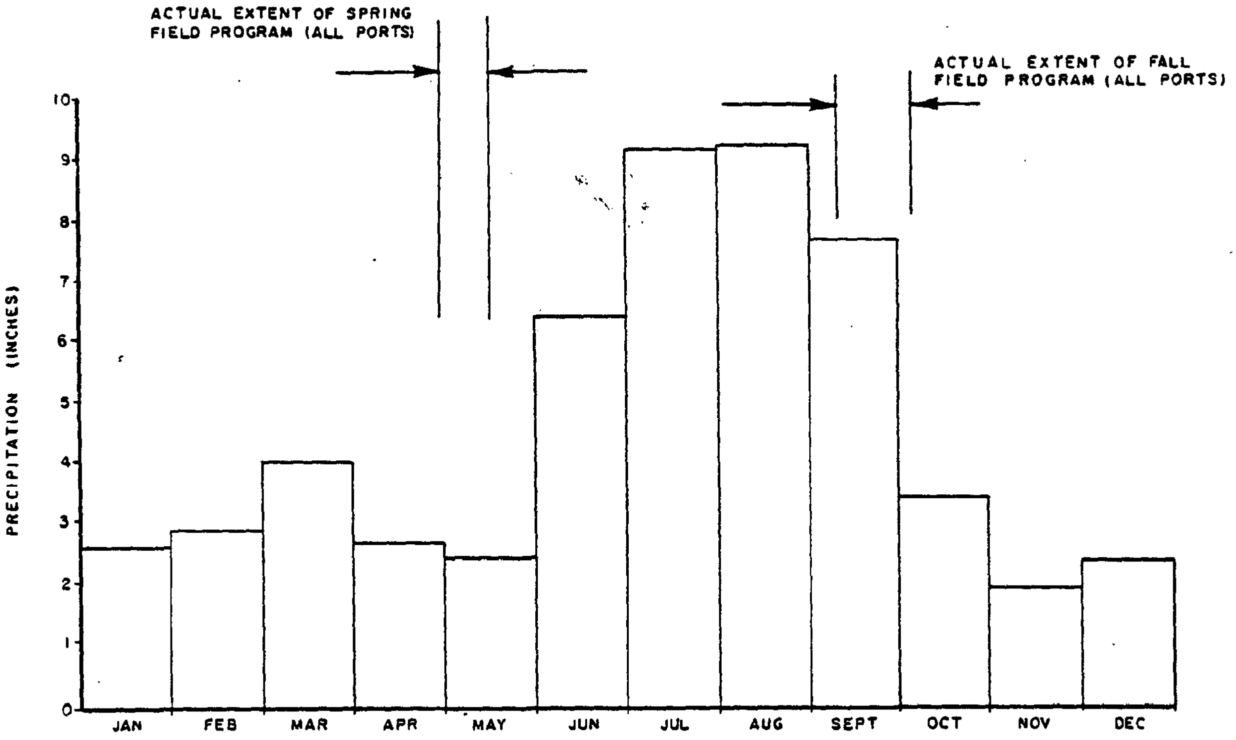
STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
TPA 12-SFT	——	CL/ML	CLAYEY SILT WITH SOME FINE SAND	156.1	32.7	24.7	8.0	HILLSBOROUGH BAY CHANNEL CUT D

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

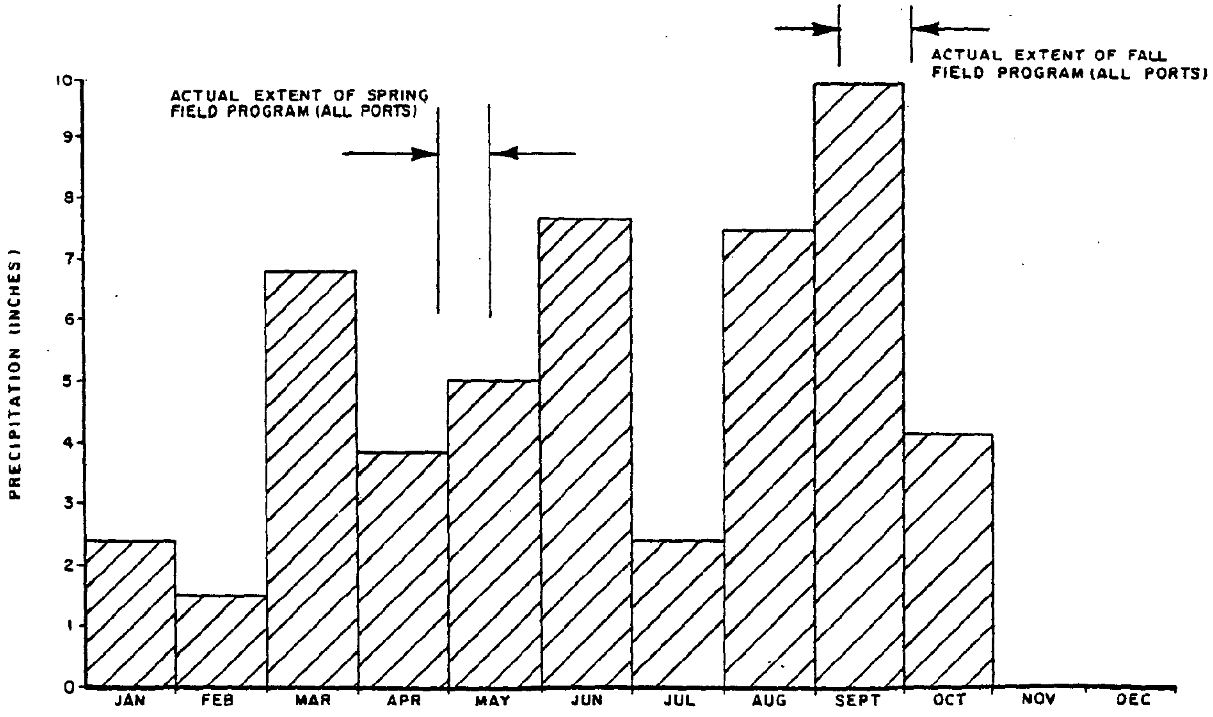
GRADATION CURVE

TAMPA TPA 12 - SFT
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-27



NORMAL MONTHLY PRECIPITATION 1941-1970
ST. PETERSBURG



OBSERVED MONTHLY PRECIPITATION, ST. PETERSBURG, JANUARY-OCTOBER, 1982

NORMAL MONTHLY AND OBSERVED PRECIPITATION PORT MANATEE

REVISIONS BY ______ DATE ______

1273900426(8/82)

PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

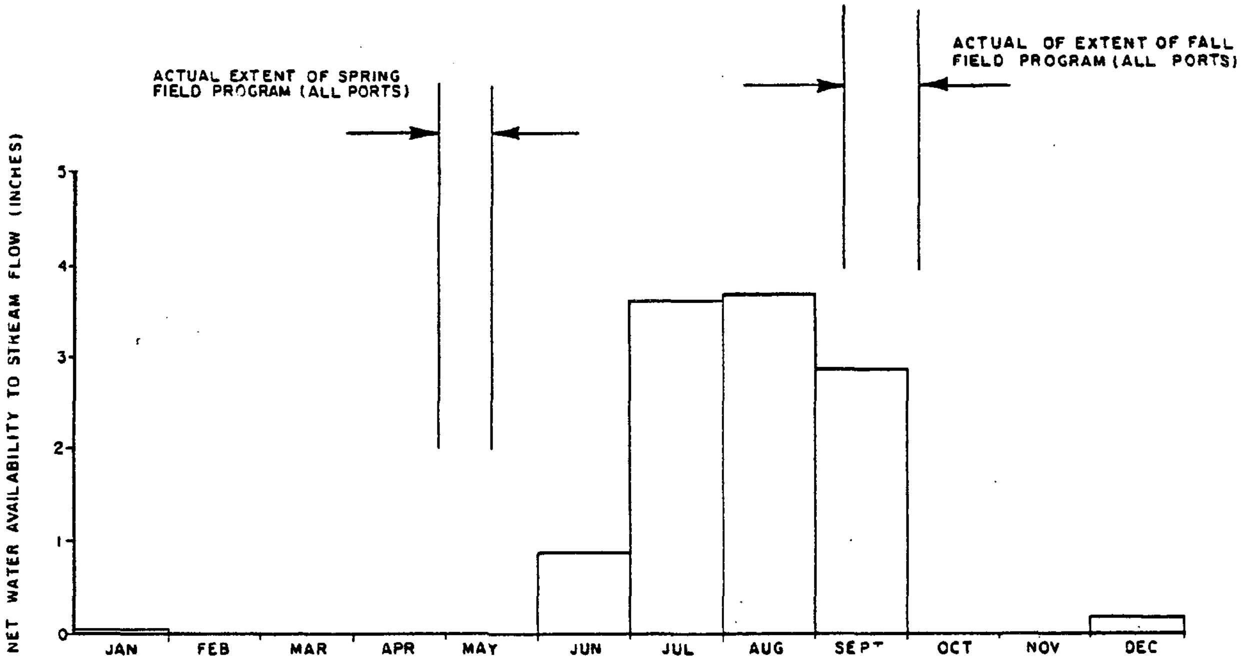
DAMES & MOORE

FIGURE 2-28

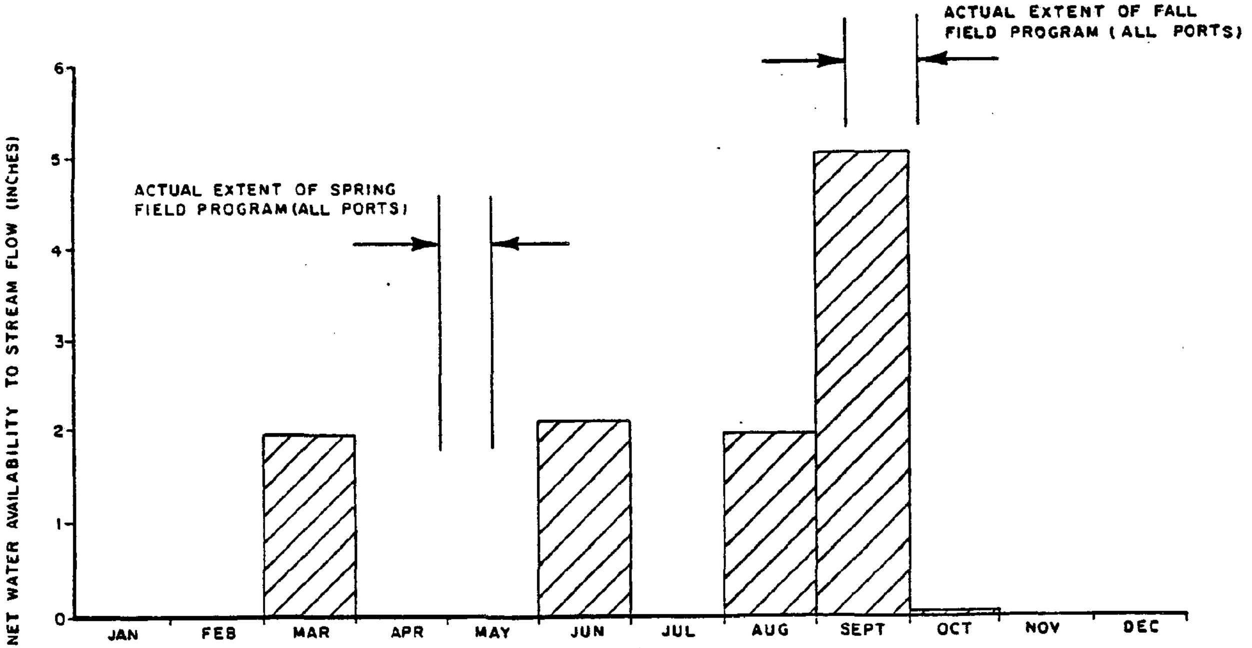
BY ______ DATE ______ CHECKED BY ______ DATE ______ APPROVED BY ______ DATE ______

REVISIONS BY ______ DATE ______

1273900426 (8/82)



MONTHLY NORMAL NET WATER AVAILABILITY TO STREAM FLOW USING 1941-1970 MONTHLY NORMAL PRECIPITATION ST. PETERSBURG



OBSERVED
NET WATER AVAILABILITY TO STREAM FLOW, ST. PETERSBURG, USING JANUARY-OCTOBER 1982 OBSERVED MONTHLY PRECIPITATION

MONTHLY NORMAL AND OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, PORT MANATEE

PROJECT: DER DEEPWATER
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 2-29

BY ________ DATE 9/82
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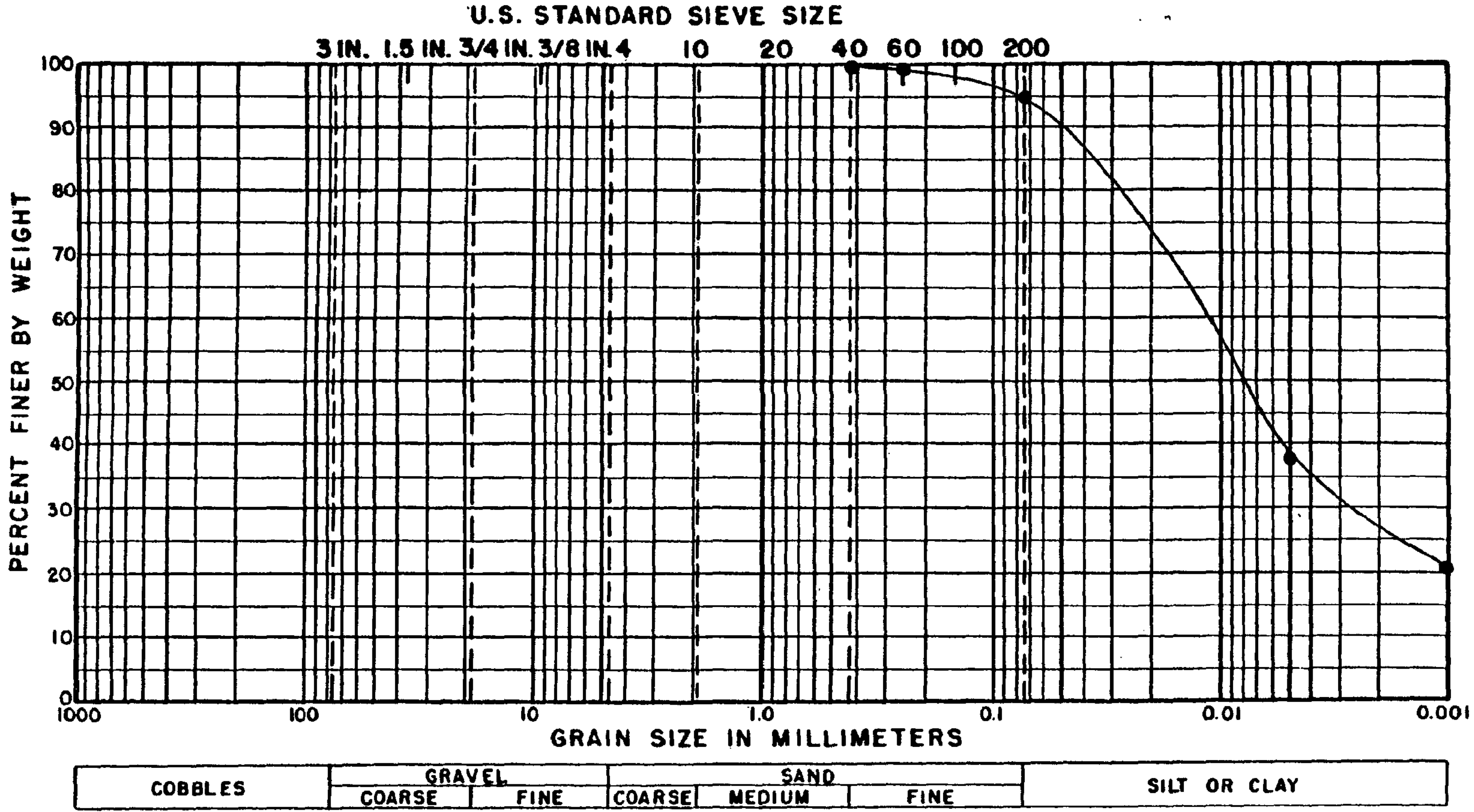
757.2 (REV. 4-62)

1273900426 (9/82)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
MAN.-IA		CH/OH	ORGANIC SILTY CLAY	91.0	62.7	32.1	30.6	PORT MANATEE CHANNEL

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM I SAMPLE

GRADATION CURVE

MANATEE MAN -IA

DAMES & MOORE

FIGURE 2-30

FILE
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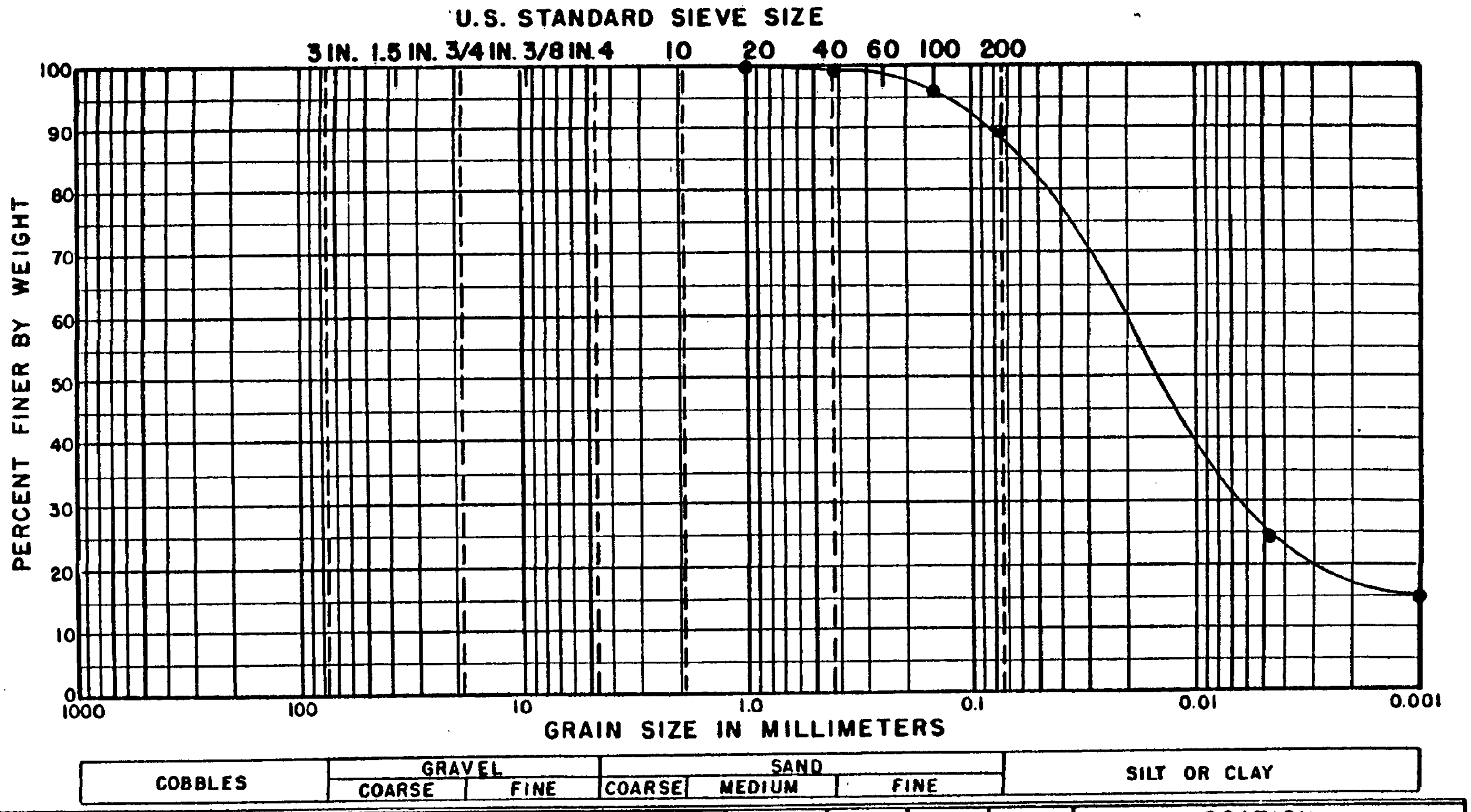
757.2 (REV. 4-82)

12739004 26 (9/82)



STA.	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
MAN.-2B		OH	ORGANIC SILTY CLAY	175.4	71.1	43.0	28.1	PORT MANATEE CHANNEL

NOTE : ATTERBERG LIMIT VALUES DETERMINED FROM 1 SAMPLE

GRADATION CURVE

MANATEE MAN-2B

DAMES & MOORE

FIGURE 2-31

737.2 (REV. 4-62)

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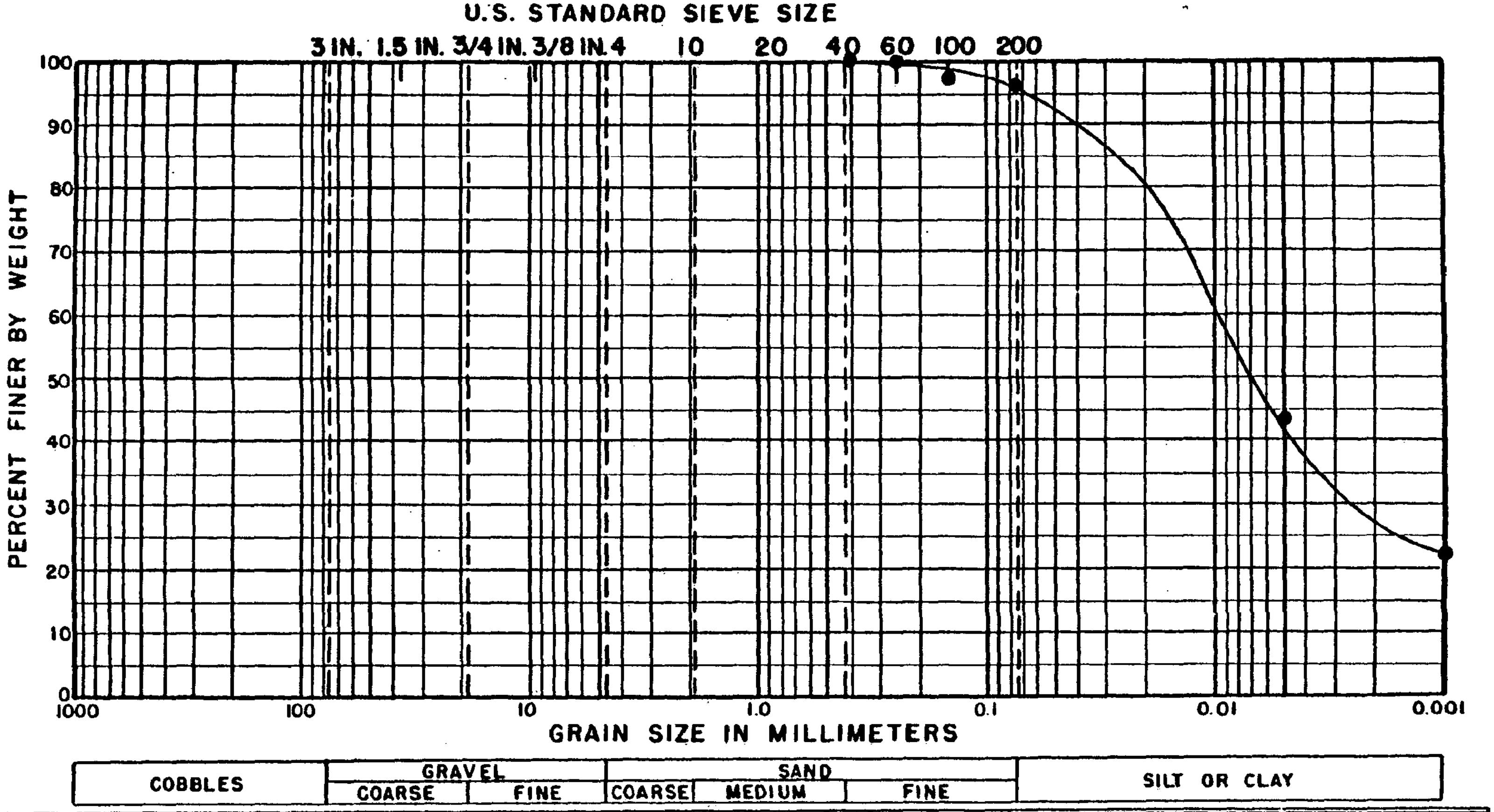

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
MAN IA-WET(O)	—	OL/OH	ORGANIC SILTY CLAY	—	—	—	—	PORT MANATEE CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

MANATEE MAN IA-WET (O)
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-32

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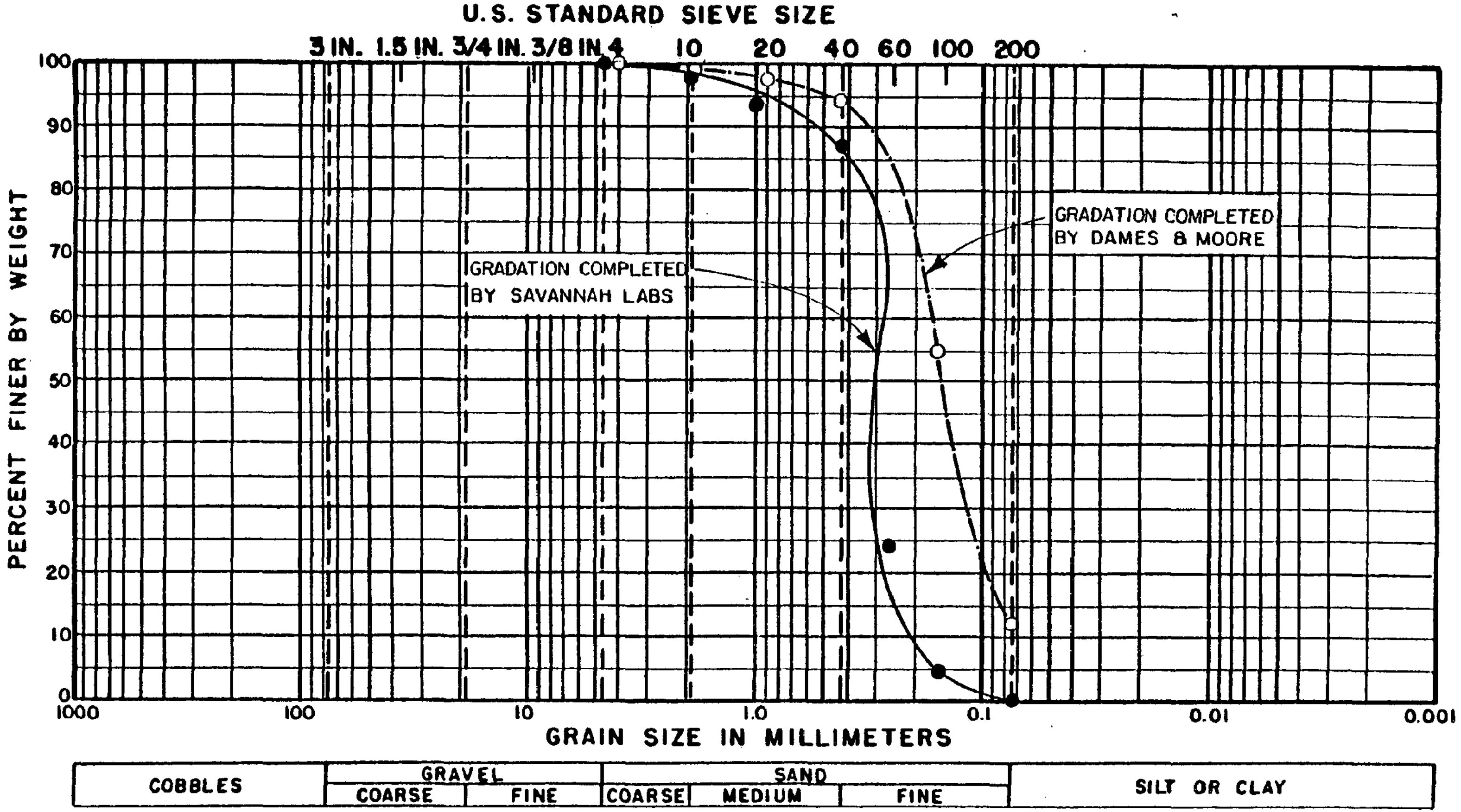
737.2 (REV. 4-62)

1273900426 (1/83)



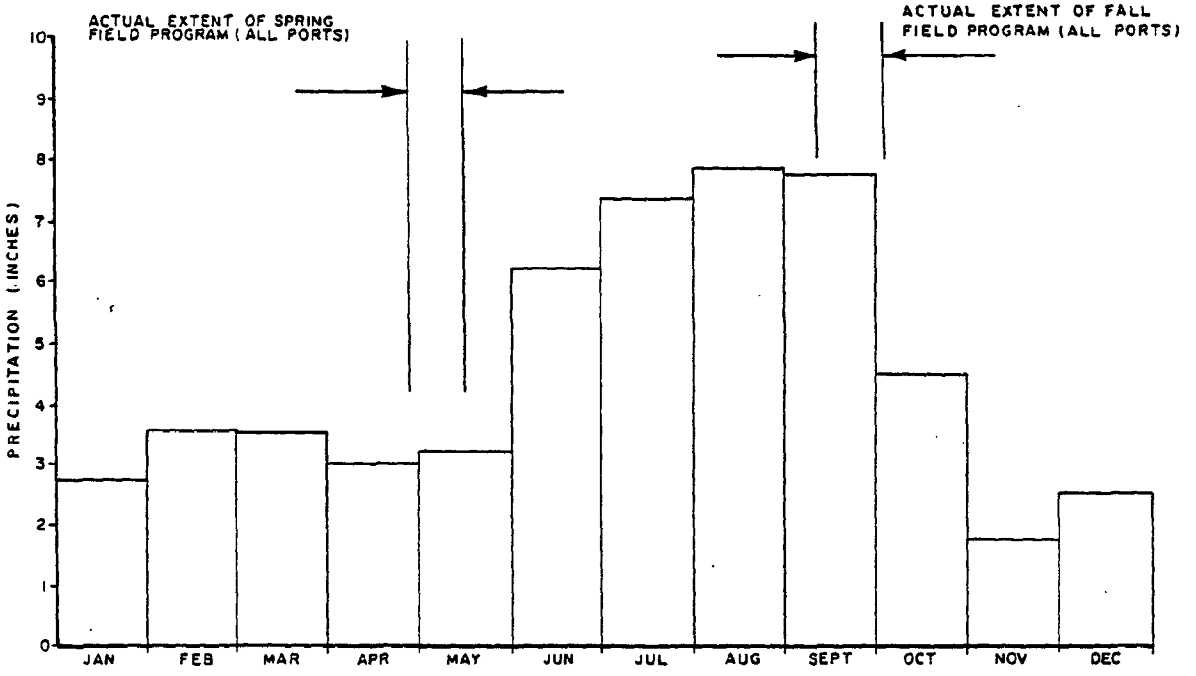
STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
MAN-3SFT	—	SP	FINE SAND TRACE SILT	38.7	—	—	—	PORT MANATEE CHANNEL

NOTE : NATURAL WATER CONTENT DETERMINED BY DAMES & MOORE

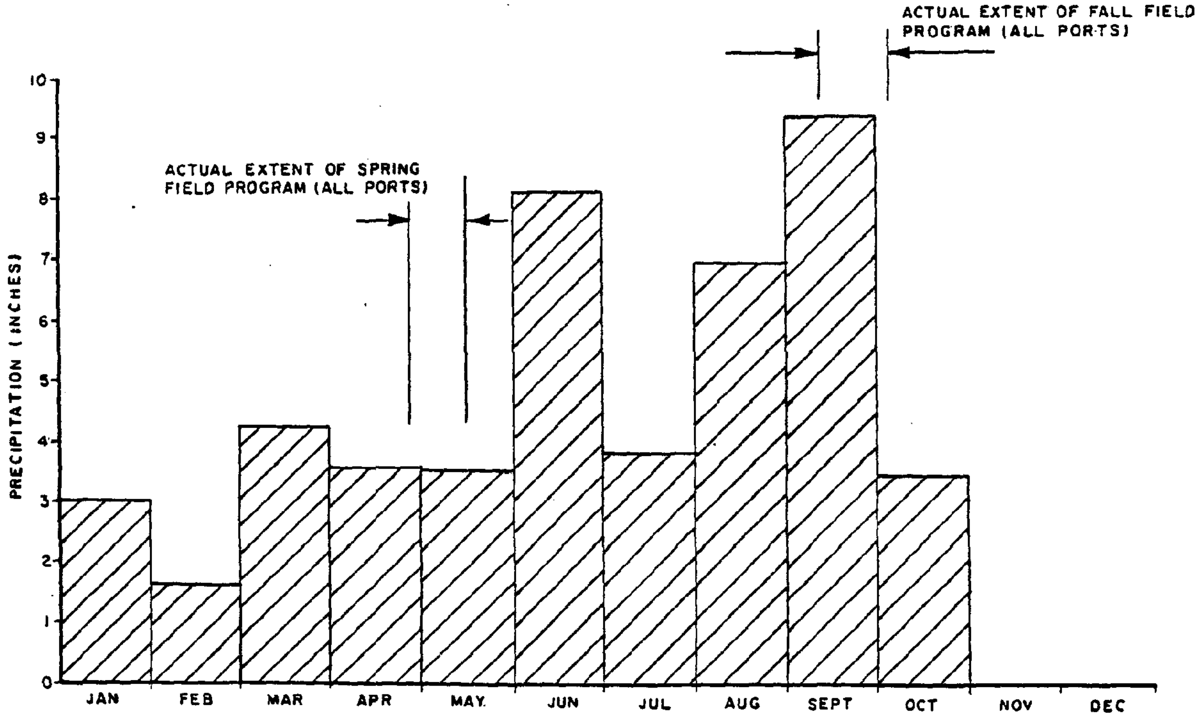
GRADATION CURVE

MANATEE MAN 3-SFT
FALL/WET SEASON

DAMES & MOORE
FIGURE 2-33



NORMAL MONTHLY PRECIPITATION 1941 — 1970, JACKSONVILLE



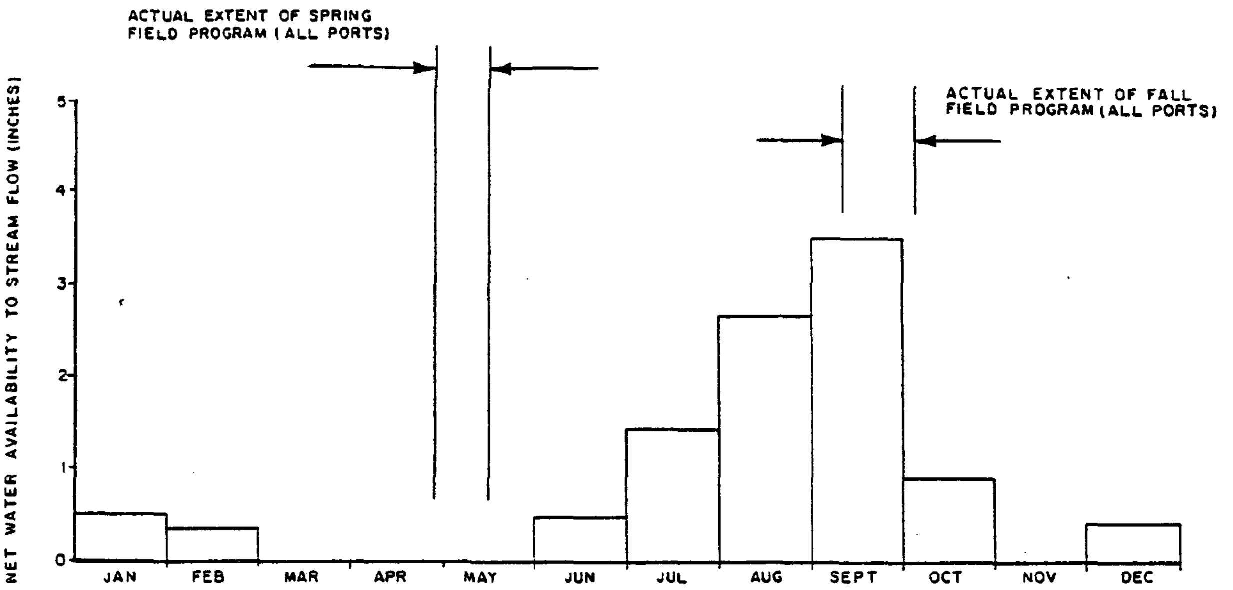
OBSERVED MONTHLY PRECIPITATION, JACKSONVILLE, JANUARY-OCTOBER 1982

REVISIONS BY ______ DATE ______ APPROVED BY ______ DATE ______

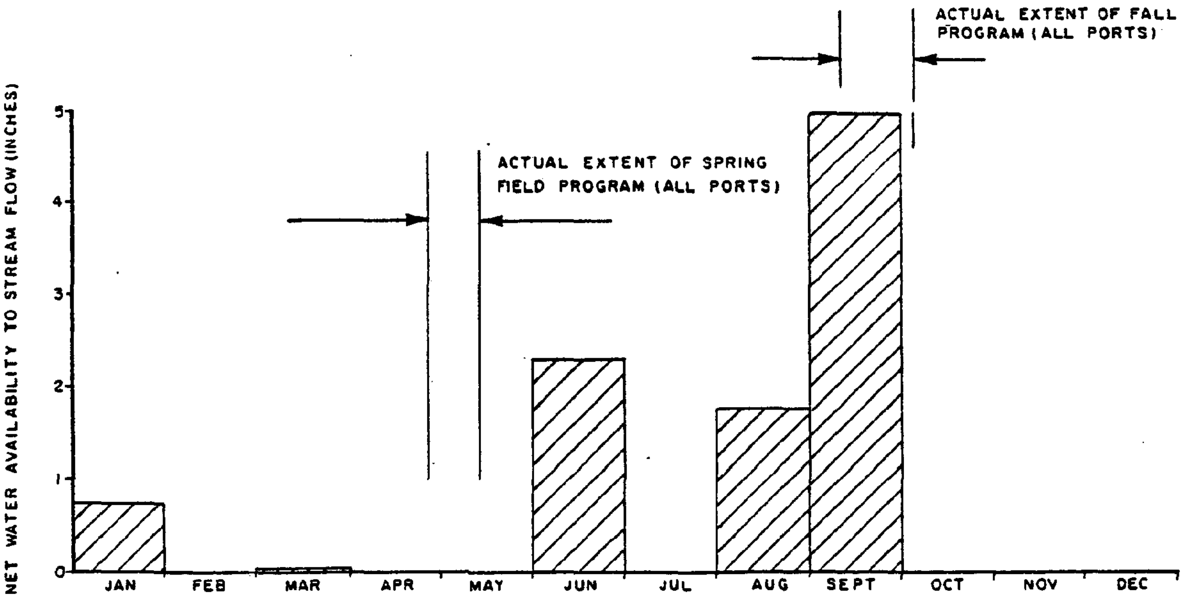
12739004261(8/82)

NORMAL MONTHLY AND OBSERVED PRECIPITATION, JACKSONVILLE HARBOR

PROJECT : DER DEEPWATER PORTS LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA	**DAMES & MOORE** FIGURE 2-34



MONTHLY NORMAL NET WATER AVAILABILITY TO STREAM FLOW USING 1941-1970
MONTHLY NORMAL PRECIPITATION
JACKSONVILLE



OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, JACKSONVILLE, USING JANUARY TO OCTOBER 1982 OBSERVED MONTHLY PRECIPITATION

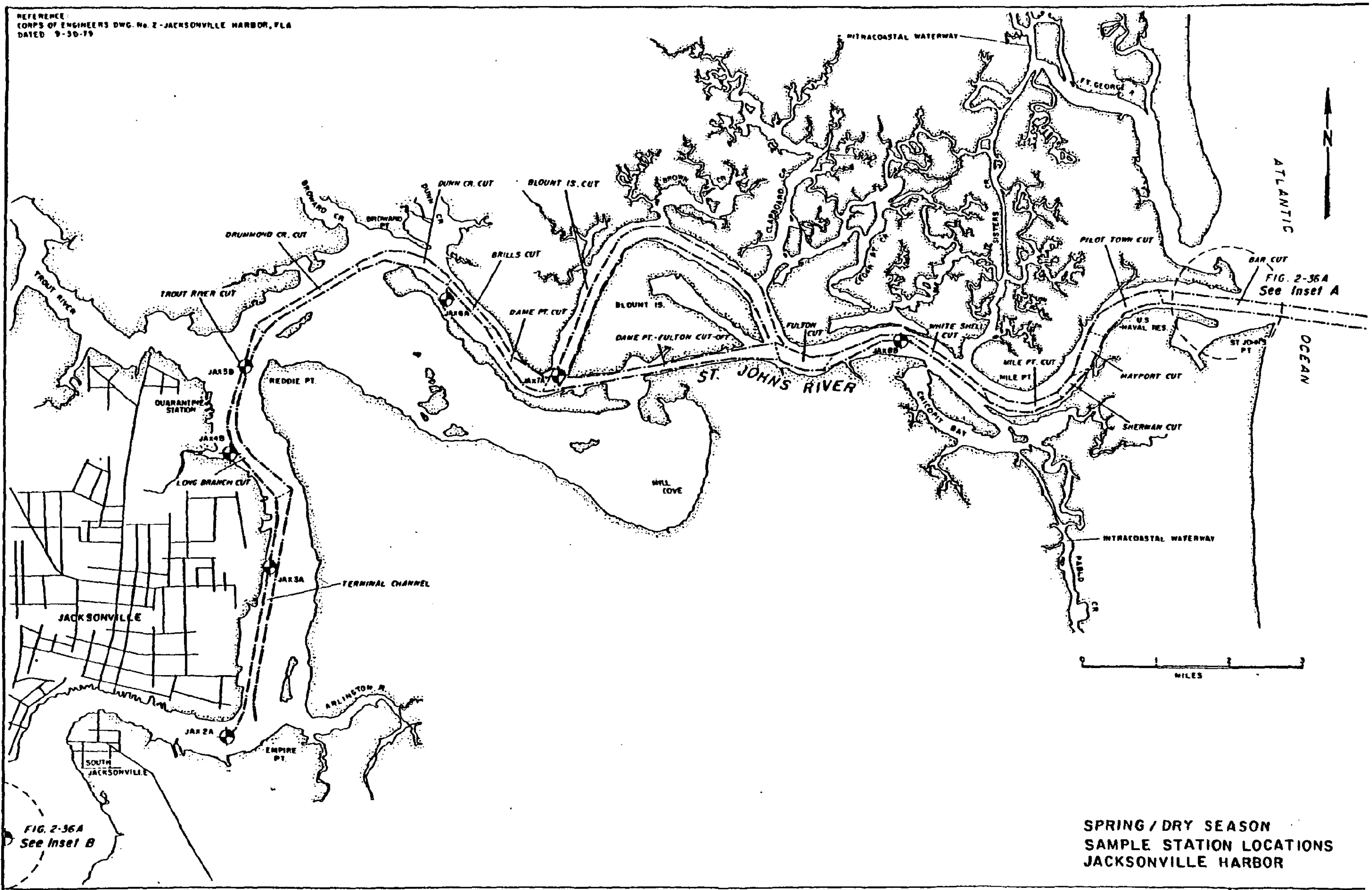
BY ____ DATE 8-82 CHECKED BY ____ DATE ____ APPROVED BY ____ DATE ____
REVISIONS ____ DATE ____

1273900426 (8/82)

MONTHLY NORMAL AND OBSERVED NET WATER AVAILABILITY TO STREAM FLOW, JACKSONVILLE HARBOR

PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 2-35



SPRING / DRY SEASON
SAMPLE STATION LOCATIONS
JACKSONVILLE HARBOR

PROJECT: DER - DEEP WATER PORTS
LOCATION: JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE

FIGURE 2-36

12739004261(4-82)

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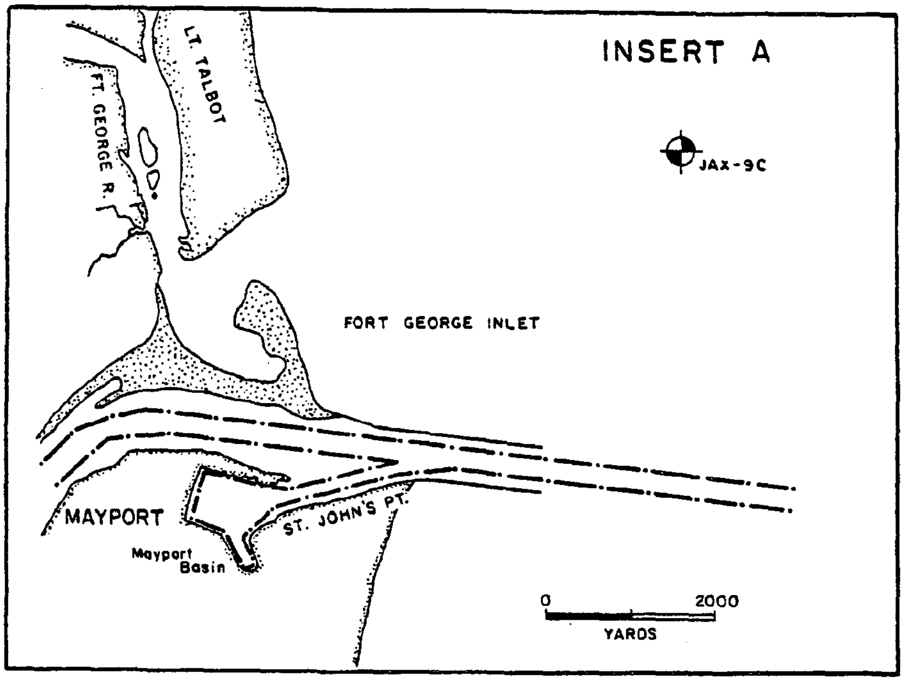
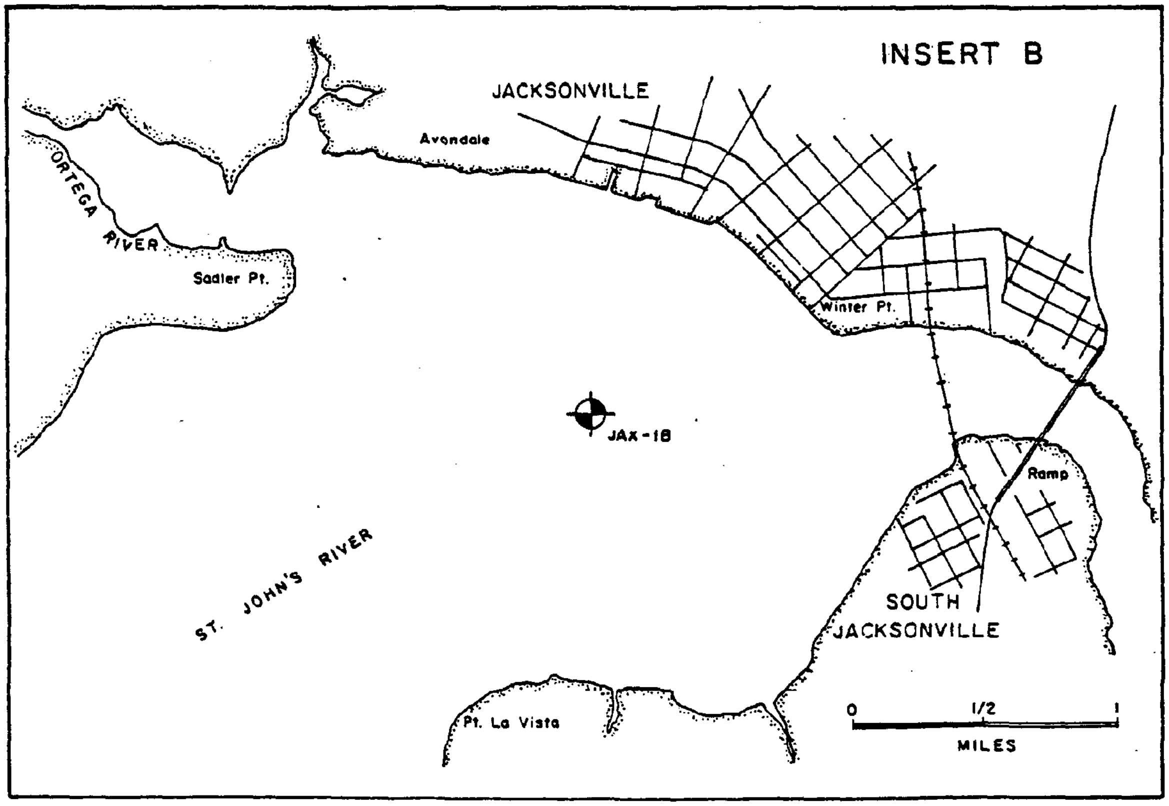


Reference:
NOAA Chart No. 11488, Scale 1:80,000
Amelia Island to St. Augustine
14th Ed. Dec. 29/79.



Reference:
NOAA Chart No. 11491, Scale 1:20,000
St. Johns River
18th Ed. April 11/81

SPRING / DRY SEASON
SAMPLE STATION LOCATIONS
JACKSONVILLE HARBOR (INSERTS

PROJECT: DER-DEEP WATER PORTS
LOCATION: JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE

FIGURE 2-36A

12739004 26(8-82)

797.2 (REV. 4-62)

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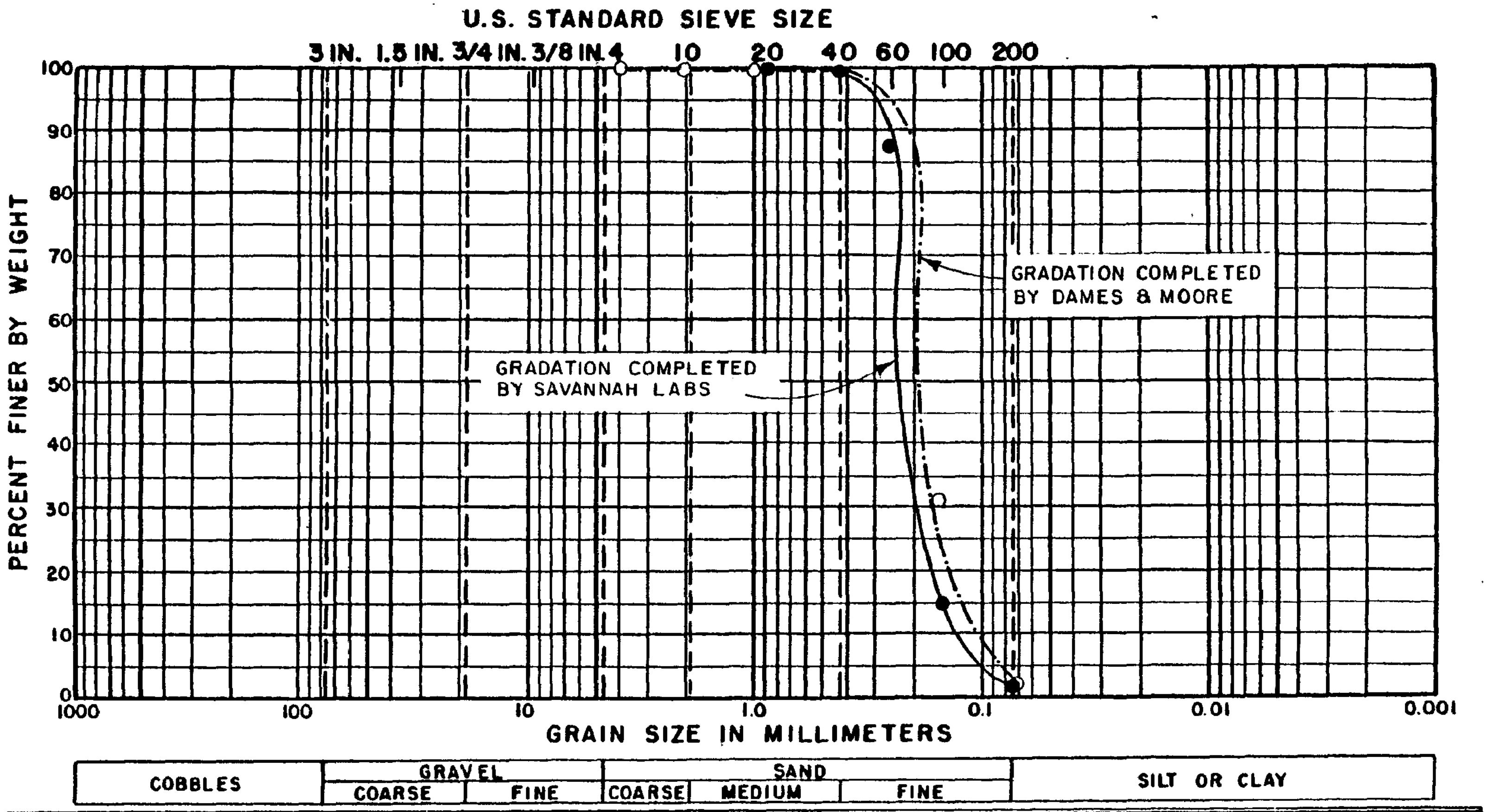

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX-1B		SP	FINE SAND	—	—	—	—	ST. JOHNS RIVER (GODBY'S LAKE)

NOTE: NATURAL WATER CONTENT DETERMINED BY DAMES & MOORE

GRADATION CURVE

JACKSONVILLE JAX.-1B

DAMES & MOORE

FIGURE 2-37

757.2 (REV. 4-62)

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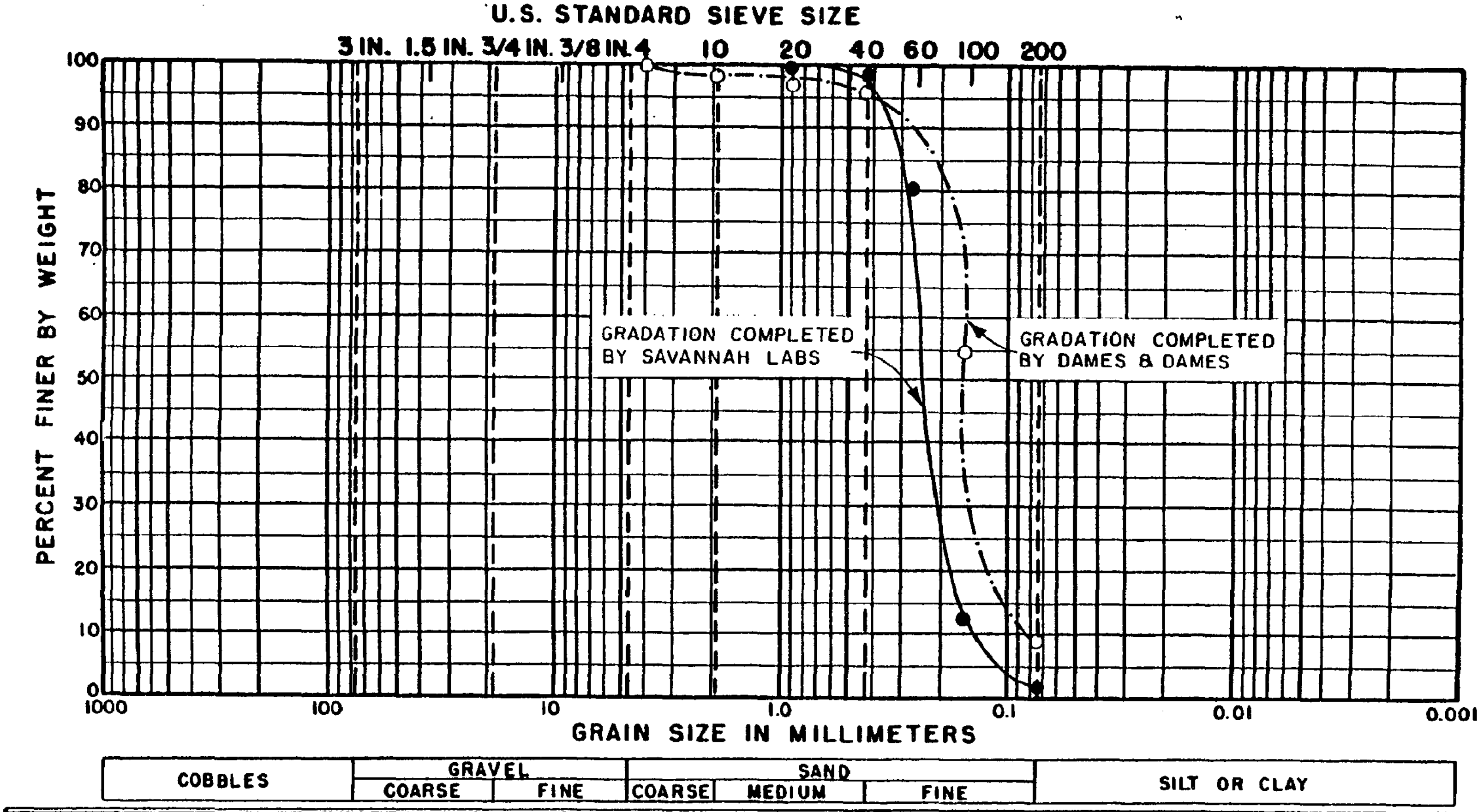

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX.-2A		SP	FINE SAND	—	—	—	—	TERMINAL CHANNEL

NOTE : NATURAL WATER CONTENT DETERMINED BY DAMES & MOORE

GRADATION CURVE

JACKSONVILLE JAX -2A

DAMES & MOORE

FIGURE 2-38

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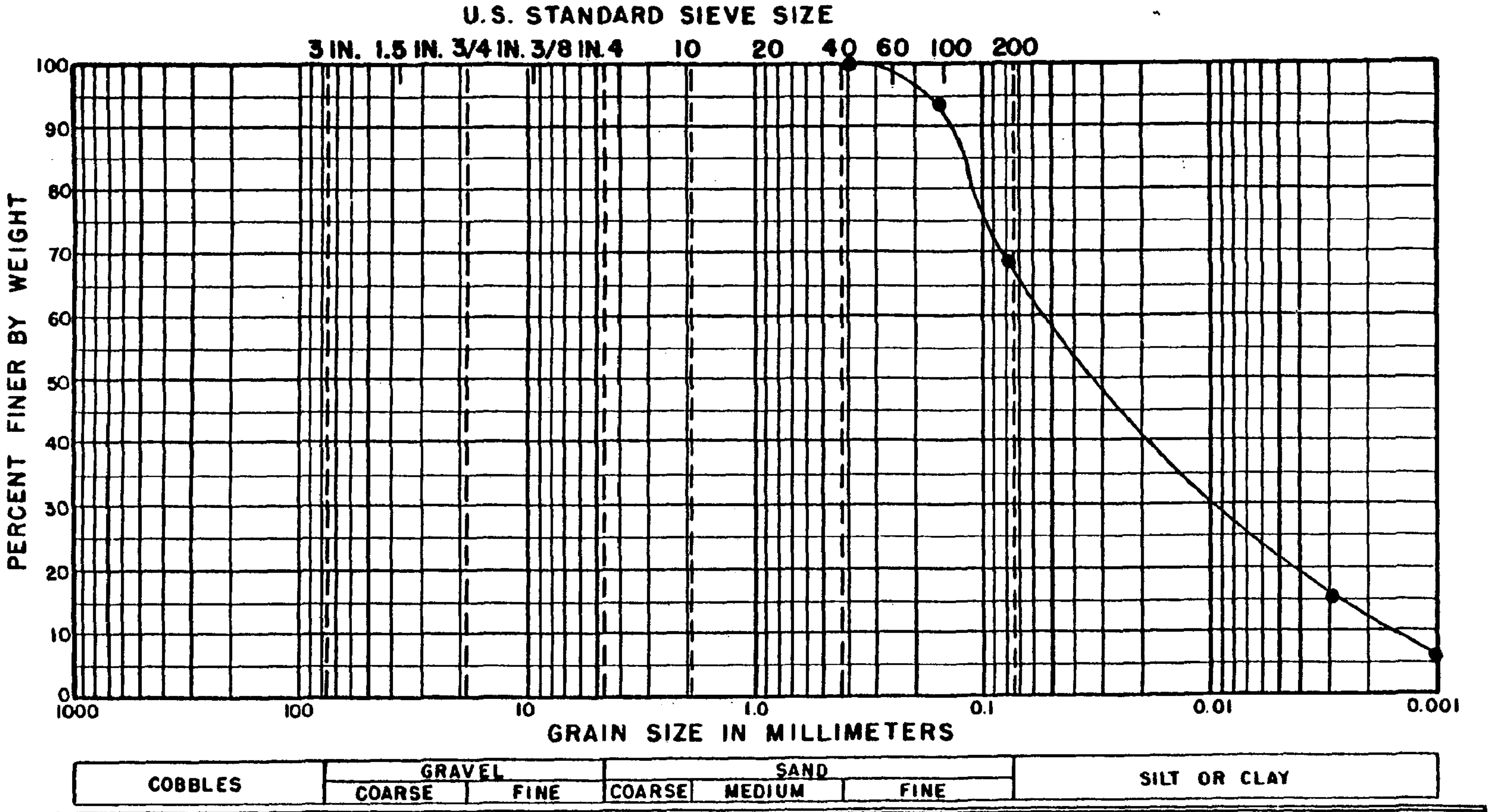
757.2 (REV. 4-82)

12739004 26 (9/82)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX. - 3A		CH/OH	ORGANIC SILTY CLAY	125.2	54.8	30.5	24.3	TERMINAL CHANNEL

NOTE : ATTERBERG LIMIT VALUE DETERMINED FROM 1 SAMPLE

GRADATION CURVE

JACKSONVILLE JAX. - 3A

DAMES & MOORE

FIGURE 2-39

757.2 (REV. 4-62)

FILE

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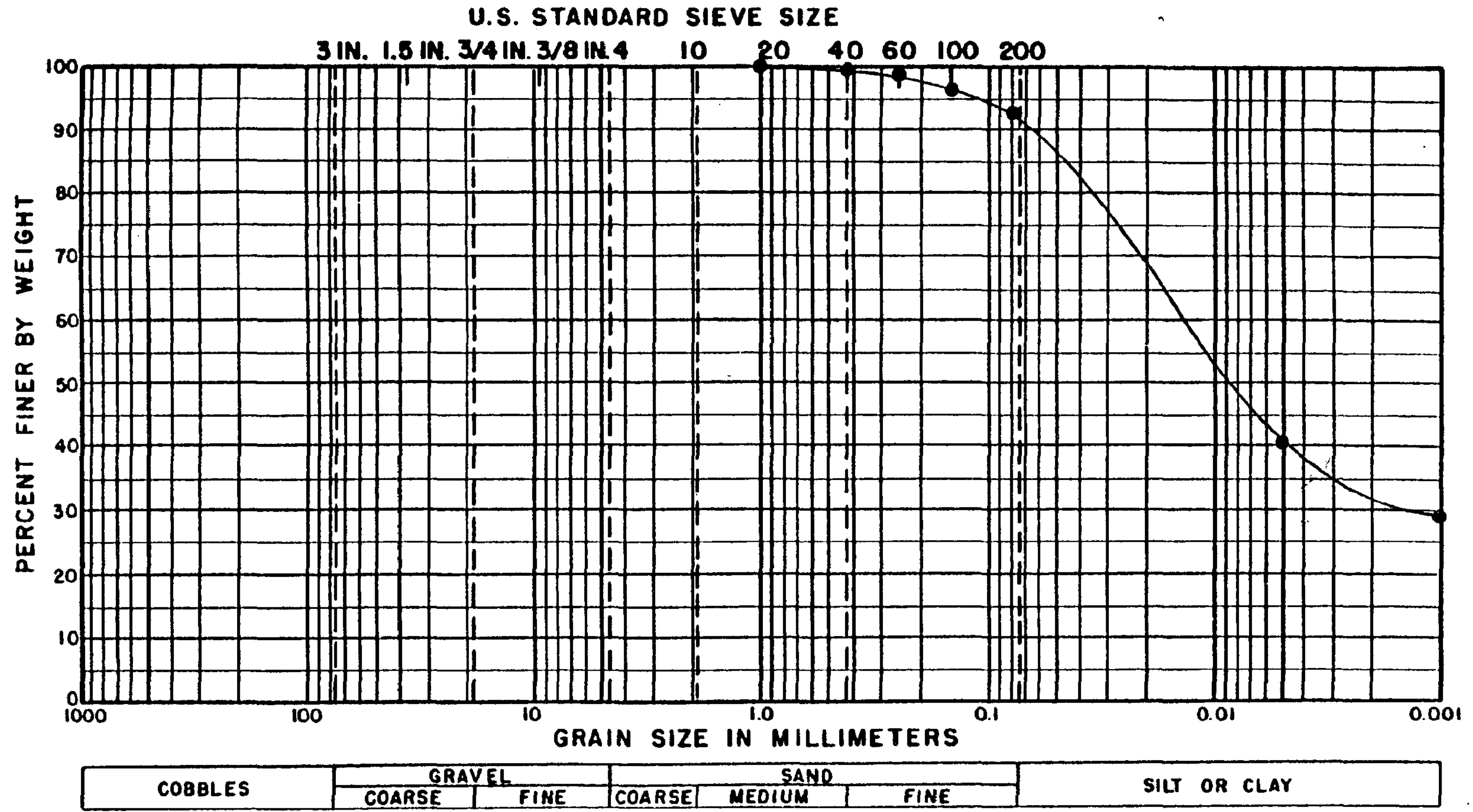

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX.-4B		OH	ORGANIC SILTY CLAY	148.2	84.5	41.6	42.9	LONG BRANCH CUT

NOTE : ATTERBERG LIMIT DETERMINED FROM 1 SAMPLE

GRADATION CURVE

JACKSONVILLE JAX -4B

DAMES & MOORE

FIGURE 2-40

FILE
BY DATE 7/83
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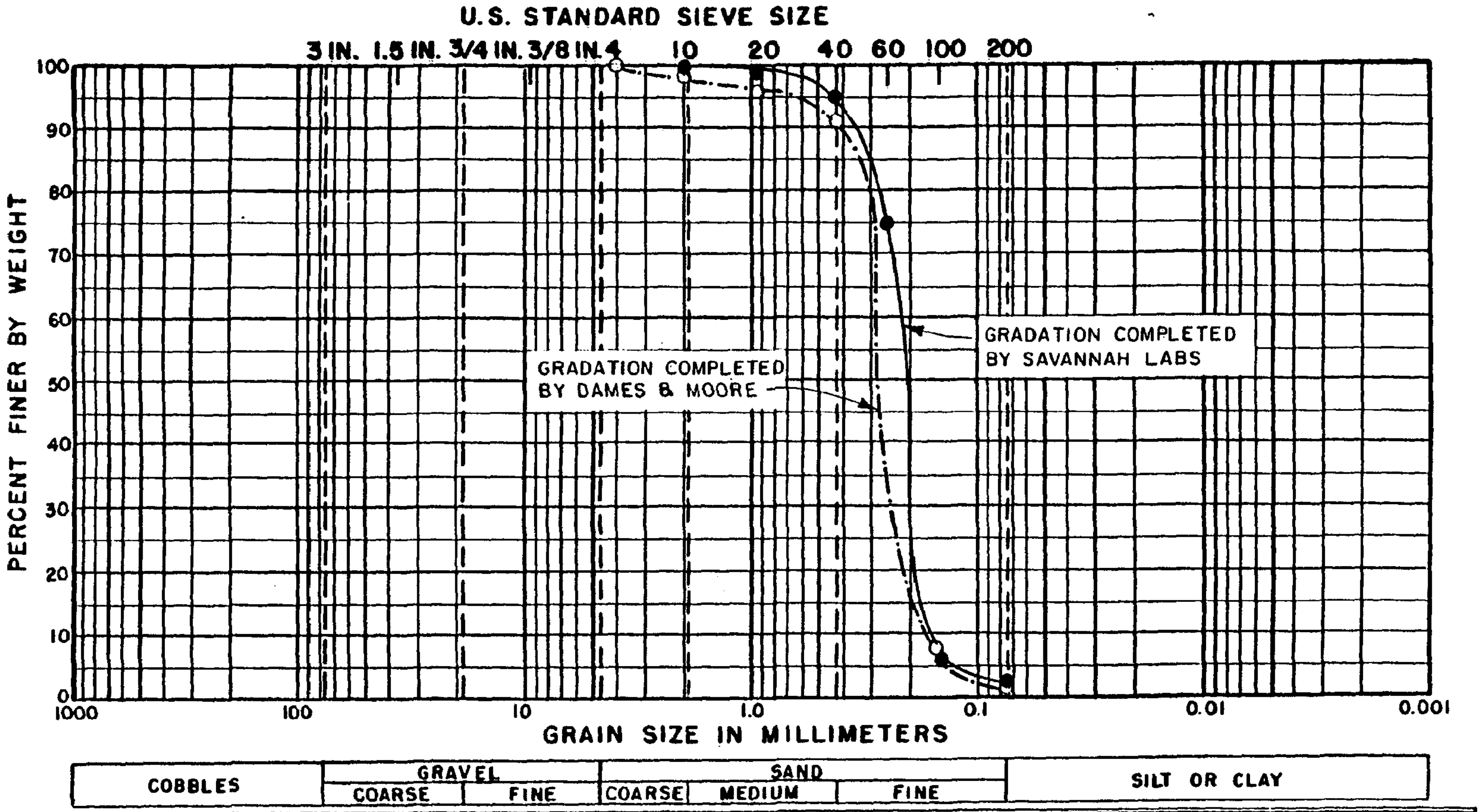
BY DATE
PLATE OF

1273900426 (9/82)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX.-5B		SP	FINE SAND	—	—	—	—	TROUT RIVER CUT

NOTE: NATURAL WATER CONTENT DETERMINED BY DAMES & MOORE

GRADATION CURVE

JACKSONVILLE JAX - 5B

DAMES & MOORE

FIGURE 2-41

757.2 (REV. 4-62)

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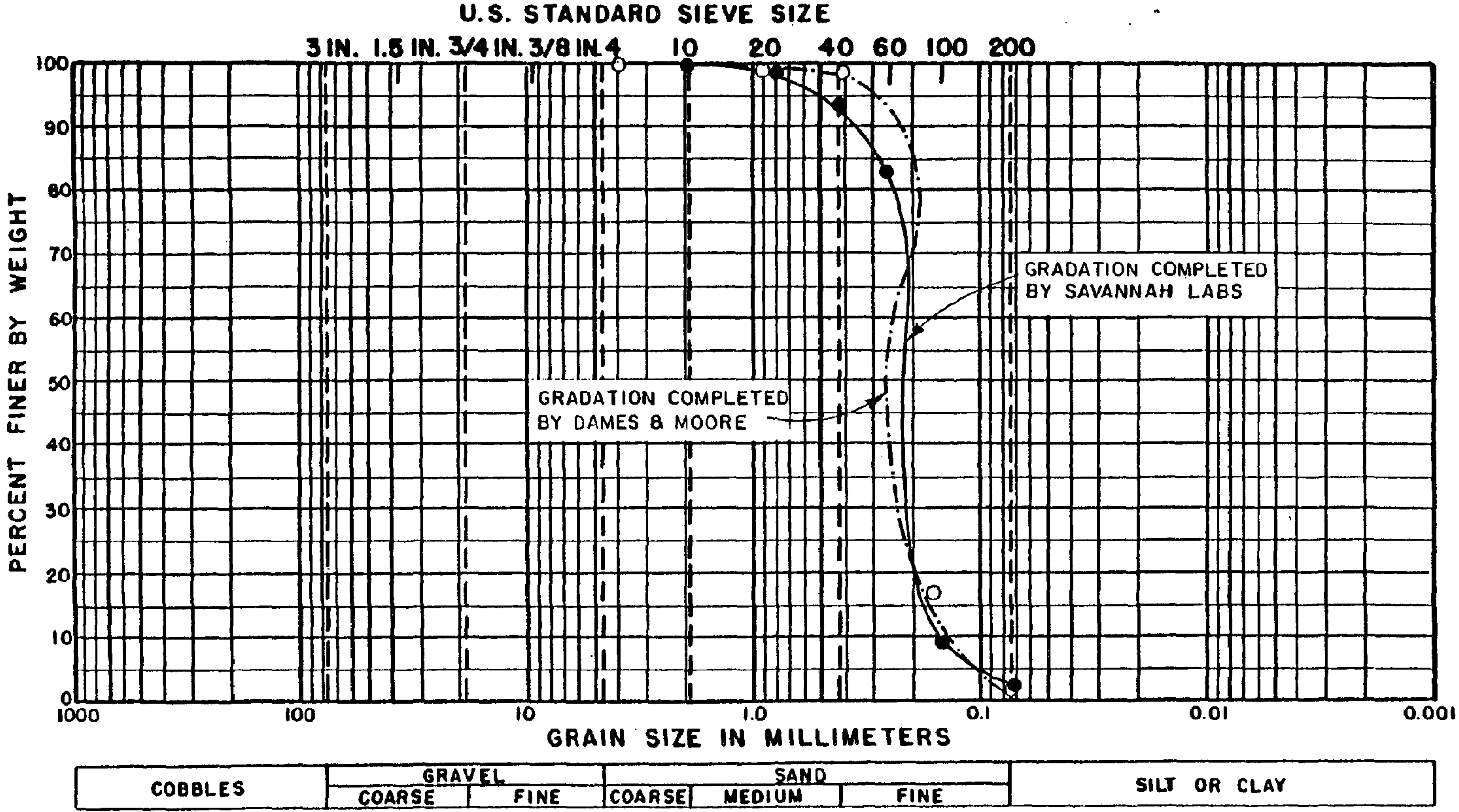
BY DATE
PLATE OF

757.2 (REV. 4-62)

1273900426 (9/82)



STATION	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	LOCATION
JAX.-6A		SP	FINE SAND	—	—	—	—	BRILLS CUT

NOTE : NATURAL WATER CONTENT DETERMINED BY DAMES & MOORE

GRADATION CURVE

JACKSONVILLE JAX-6A

DAMES & MOORE
FIGURE 2-42

BY DATE 8/82
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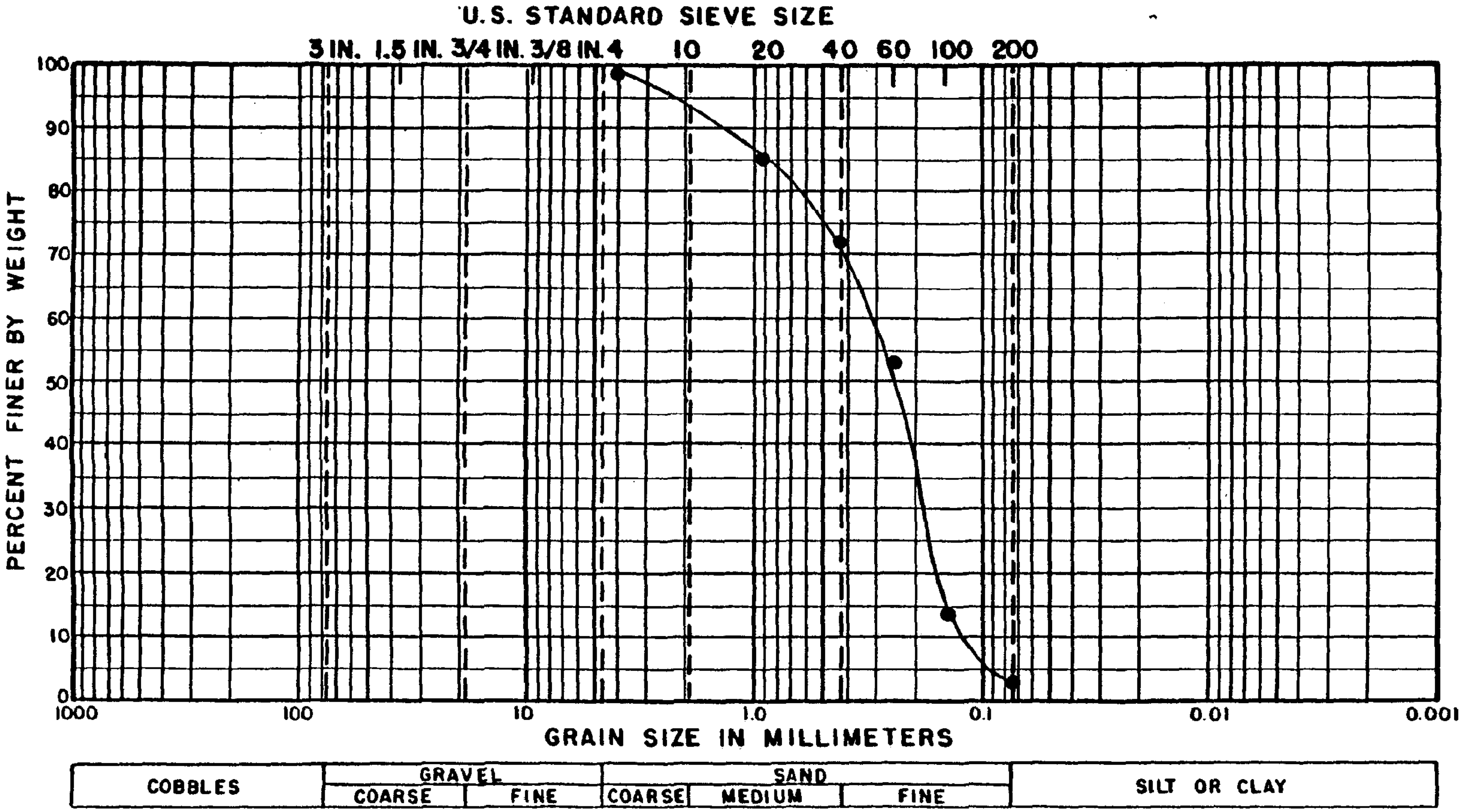
BY DATE
PLATE OF

757.2 (REV. 4-62)

1273900426 (9/82)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX.-7A		SP	FINE TO MEDIUM SAND	—	—	—	—	DAME POINT - FULTON CUT OFF

NOTE : GRAIN SIZE ANALYSIS COMPLETED FOR 1 SAMPLE

GRADATION CURVE

JACKSONVILLE JAX-7A

DAMES & MOORE

FIGURE 2-43

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BY *[illegible]* DATE *9-R*
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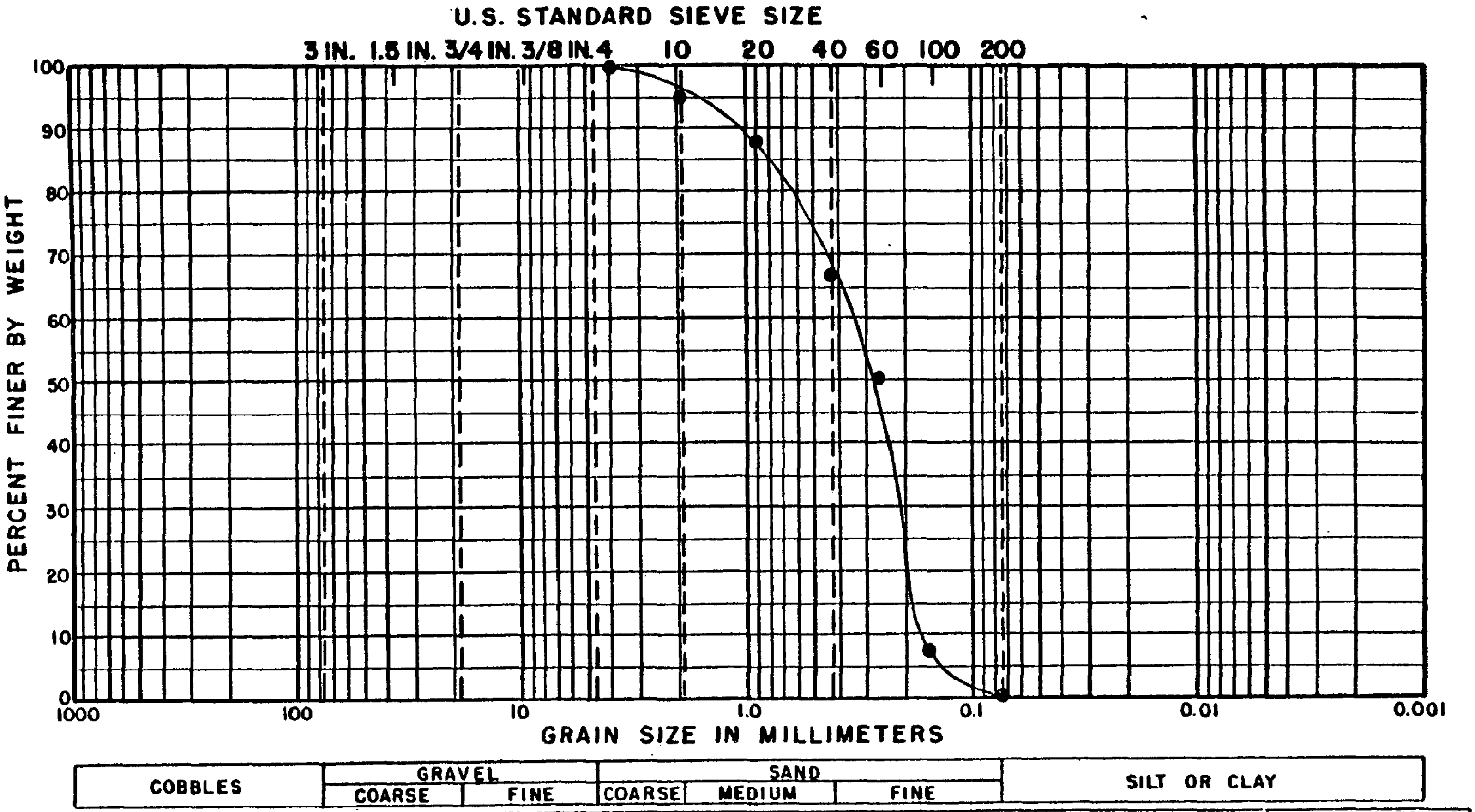
PLATE OF

757.2 (REV. 4-62)

12739004 26(9/82)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX-8B		SP	FINE TO MEDIUM SAND	—	—	—	—	WHITE SHELLS CUT

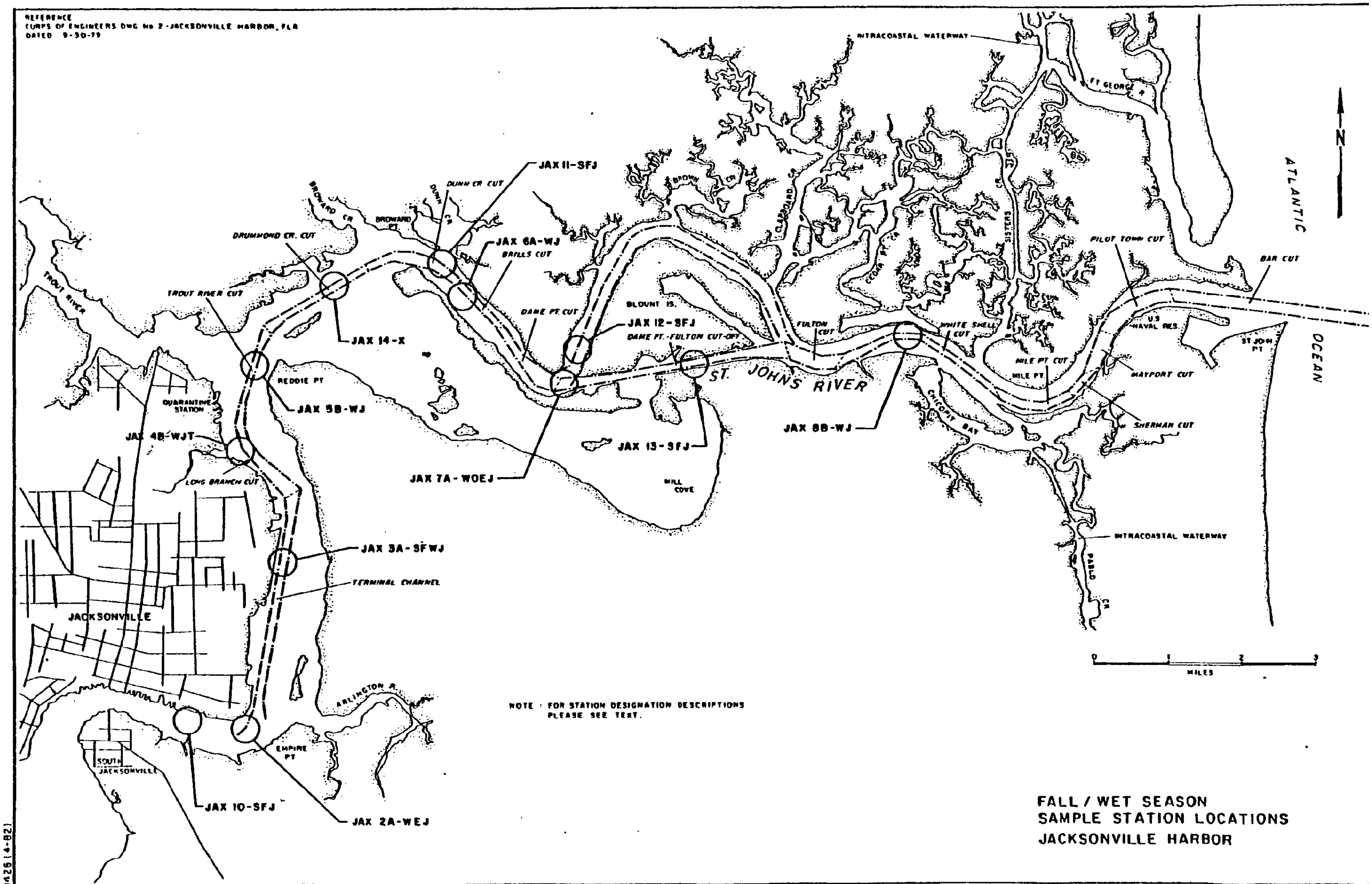
NOTE :GRAIN SIZE ANALYSIS COMPLETED FOR I SAMPLE

GRADATION CURVE

JACKSONVILLE JAX.-8B

DAMES & MOORI
FIGURE 2-44

REFERENCE
CORPS OF ENGINEERS DWG No 2-JACKSONVILLE HARBOR, FLA
DATED 9-30-79



NOTE : FOR STATION DESIGNATION DESCRIPTIONS PLEASE SEE TEXT.

FALL / WET SEASON
SAMPLE STATION LOCATIONS
JACKSONVILLE HARBOR

PROJECT DER - DEEP WATER PORTS
LOCATION : JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE
FIGURE 2-45

2739004261(4-82)

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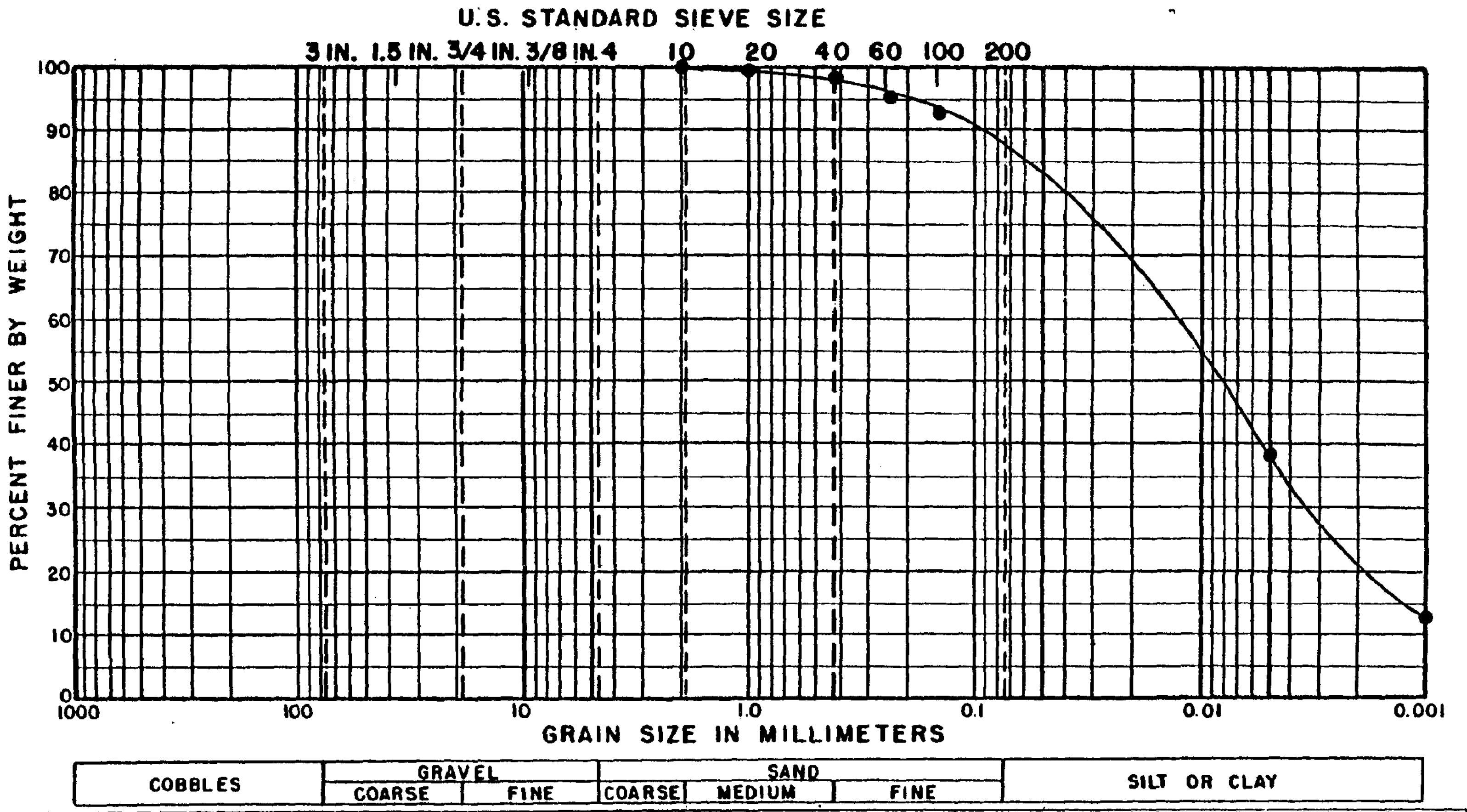
757.2 (REV. 4-82)

1273900426 (1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX 3A-WEJF(O)	—	MH/ML	FINE SANDY SILT	204.4	50.6	34.6	16.0	TERMINAL CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

JACKSONVILLE JAX 3A-FWE(O
FALL/WET SEASON

DAMES & MOORE
FIGURE 2-46

1273900426(1/83)

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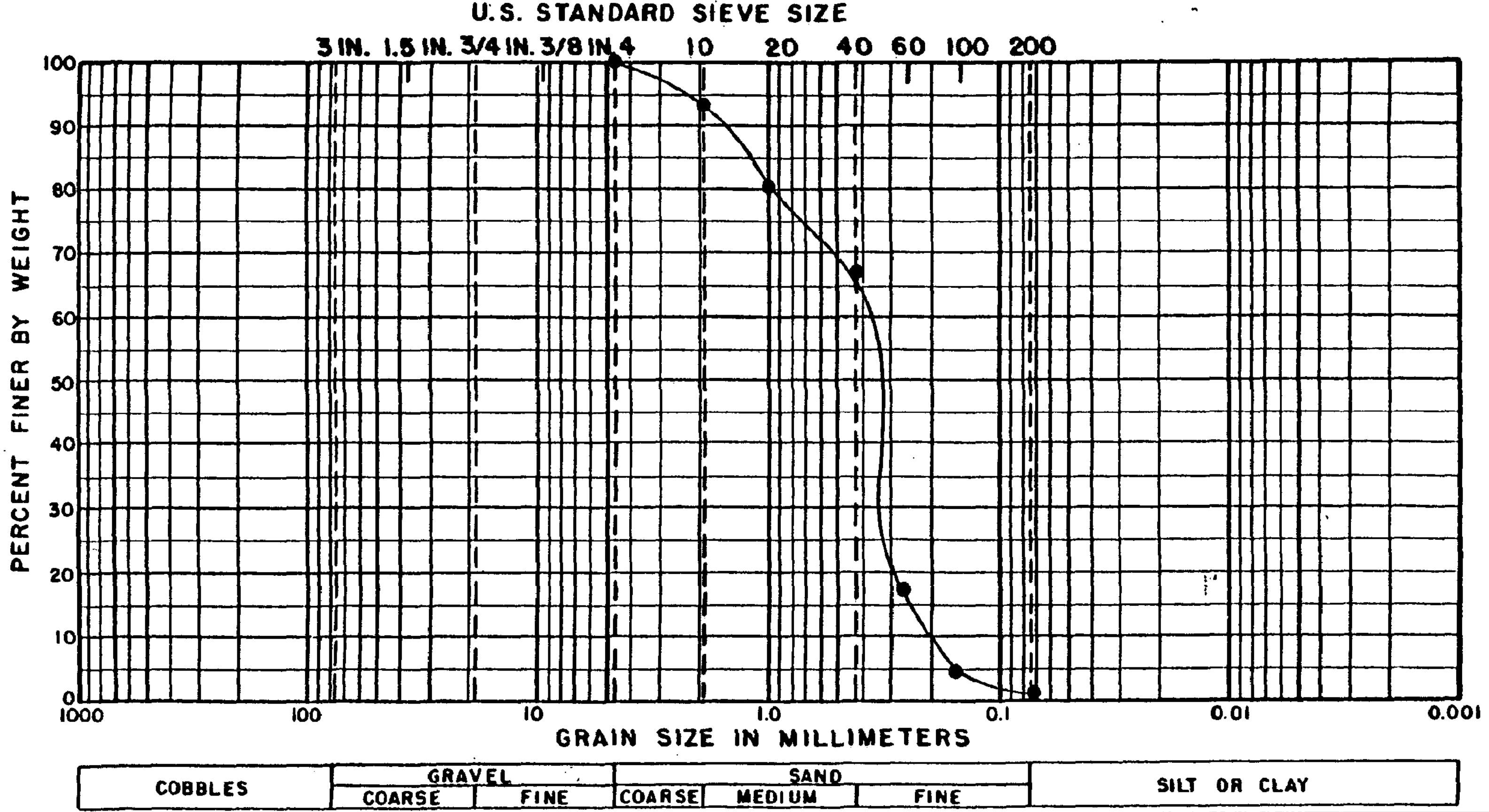

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX-10-SFJ	—	SP	MEDIUM TO FINE SAND	—	—	—	—	ST. JOHN'S RIVER (COMMODORE PT.)

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

JACKSONVILLE JAX 10-SFJ

FALL / WET SEASON

DAMES & MOORE

FIGURE 2-47

757.2 (REV. 4-62)

757.2 (REV. 4-62)

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BY DATE 1/83

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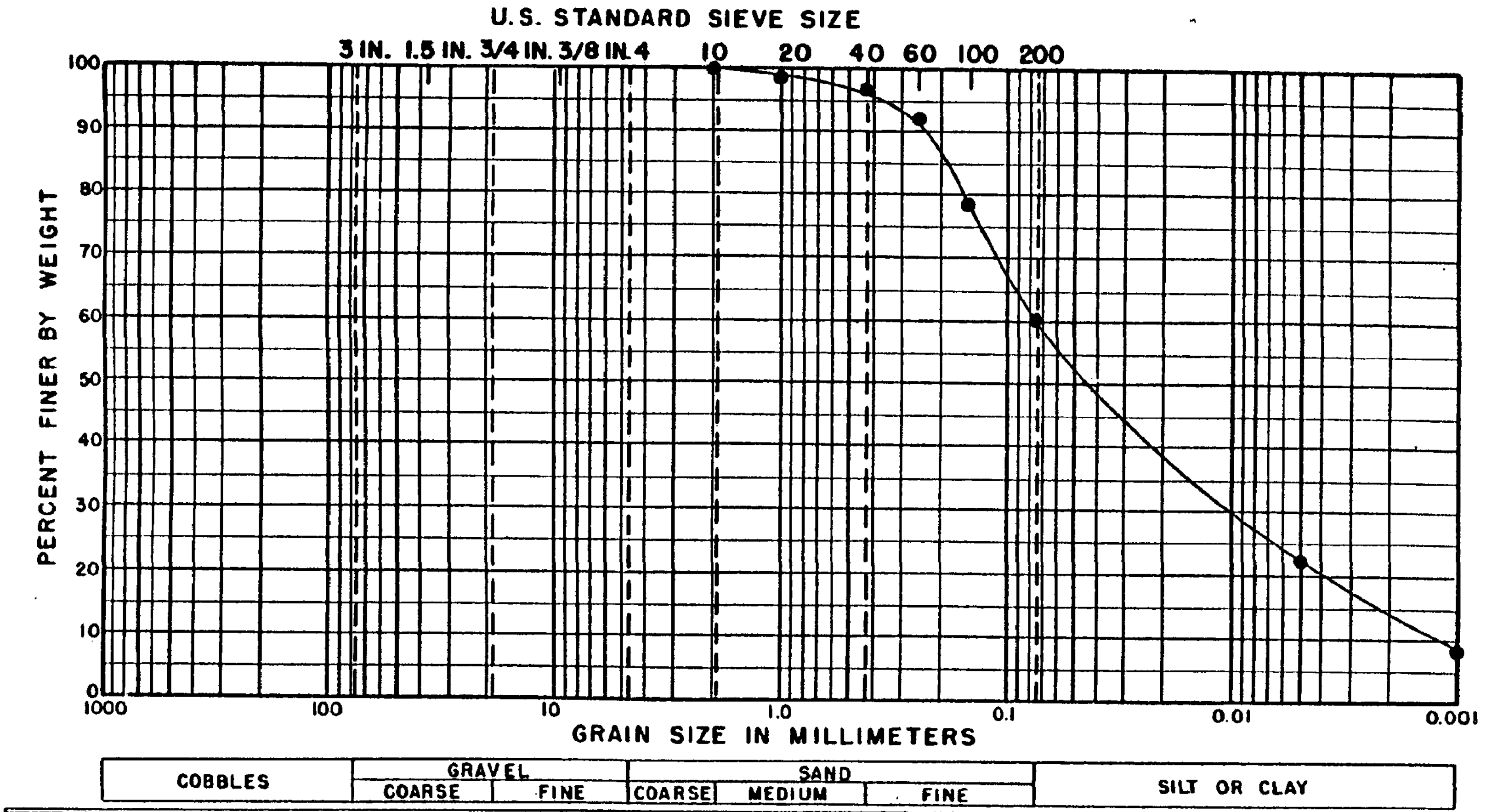
PLATE OF

1273900426(1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX-12-SFJ	—	OH	ORGANIC SILTY CLAY	139.1	54.0	34.7	19.3	BLOUNT ISLAND CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

JACKSONVILLE JAX 12-SFJ

FALL / WET SEASON

DAMES & MOORE

FIGURE 2-48

BY DATE 1/82
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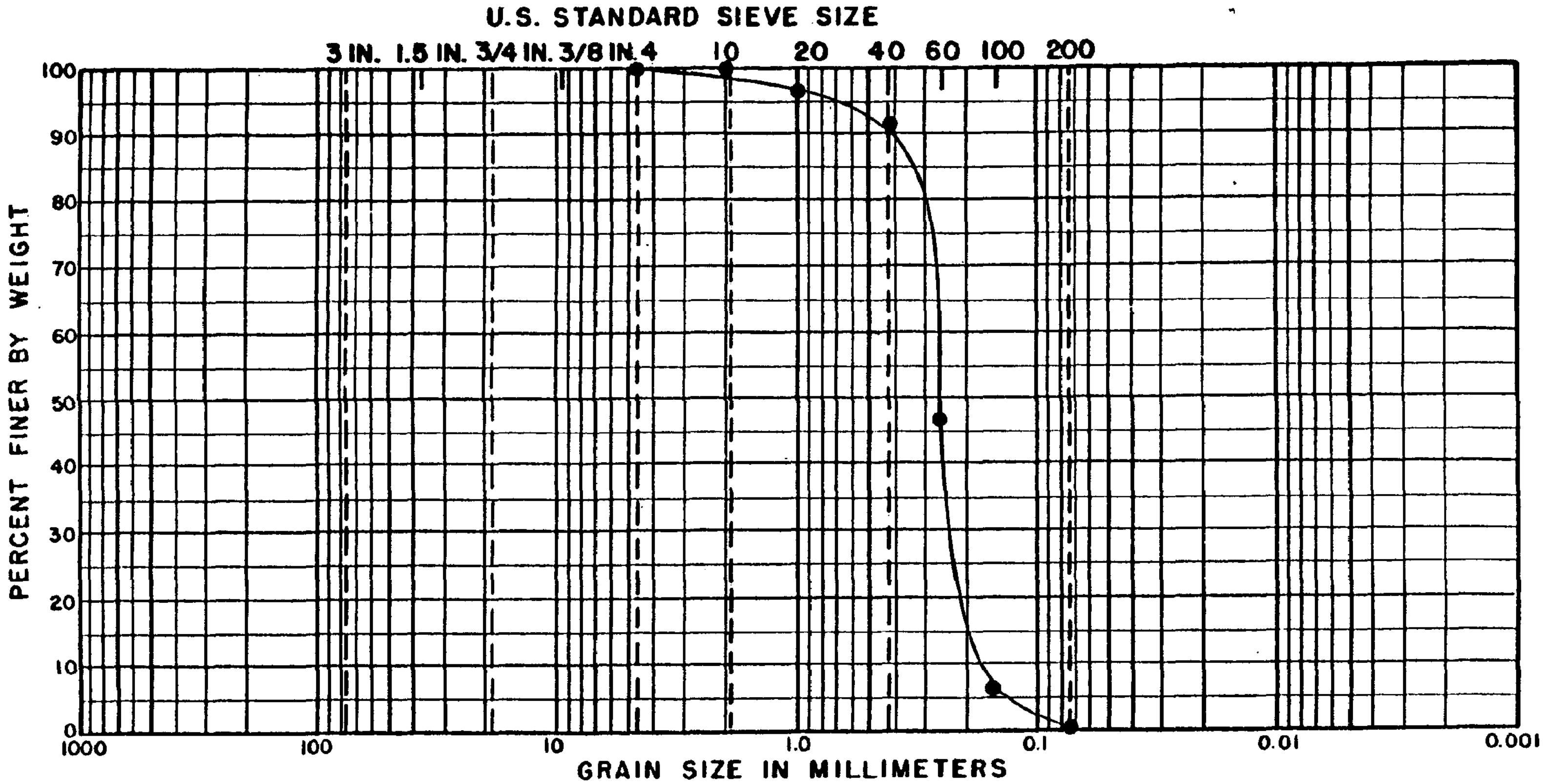
REVISIONS
BY DATE
BY DATE
PLATE OF

1273900426(1/83)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX 13-SFJ	—	SP	FINE SAND	—	—	—	—	DAME POINT - FULTON CUT OFF

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

JACKSONVILLE JAX 13-SFJ
FALL / WET SEASON

DAMES & MOORE
FIGURE 2-49

757.2 (REV. 4-62)

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BY DATE 1/83

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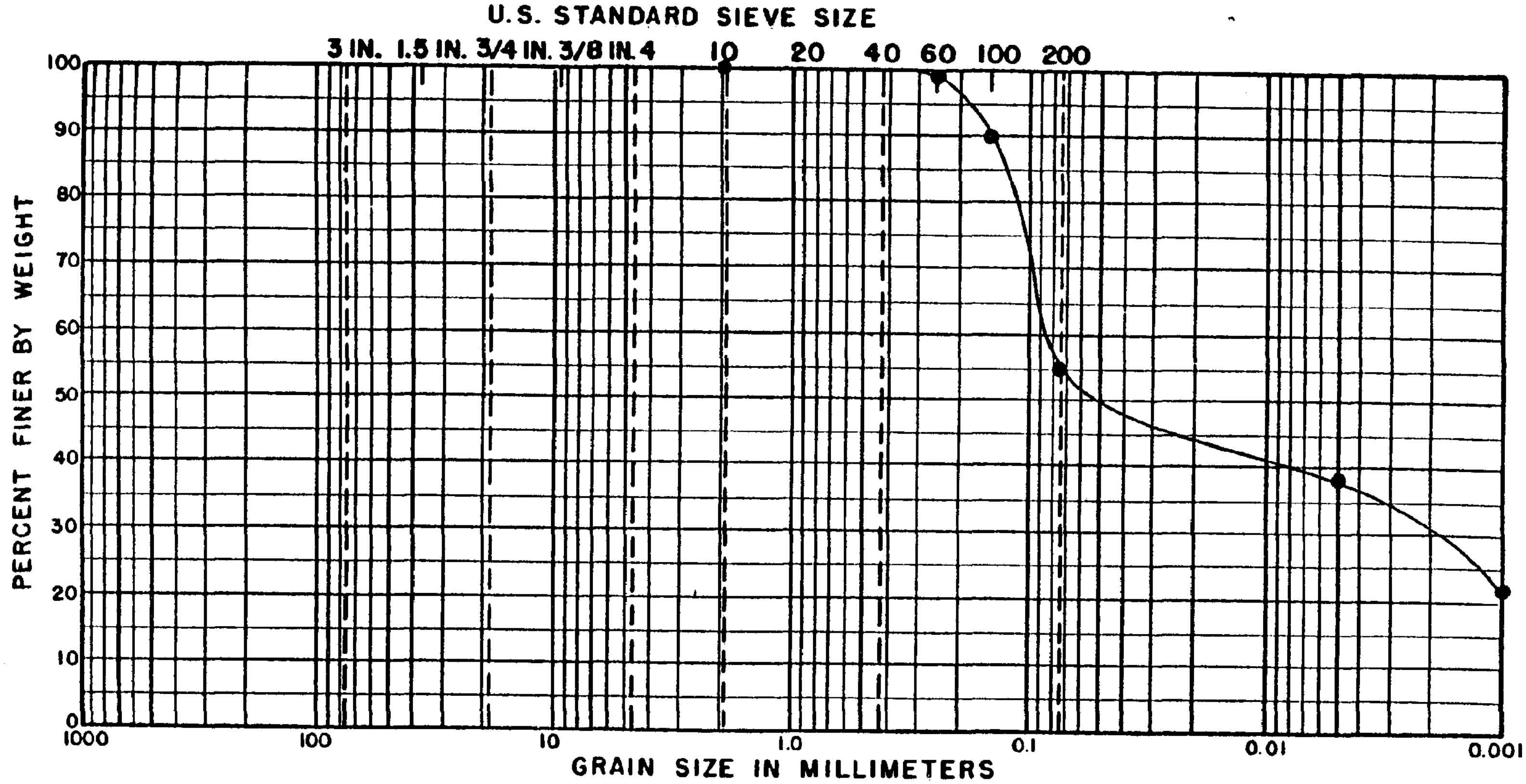
BY DATE

BY DATE

PLATE OF

1273900426 (1/83)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX 15-WEJ	—	ML	SILT WITH SOME FINE SAND	82.2	33.0	24.8	8.2	TERMINAL CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

JACKSONVILLE JAX 15-WE

FALL/WET SEASON

DAMES & MOORE

FIGURE 2-50

757.2 (REV. 4-62)

FILE

BY DATE 1/83

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REVISIONS

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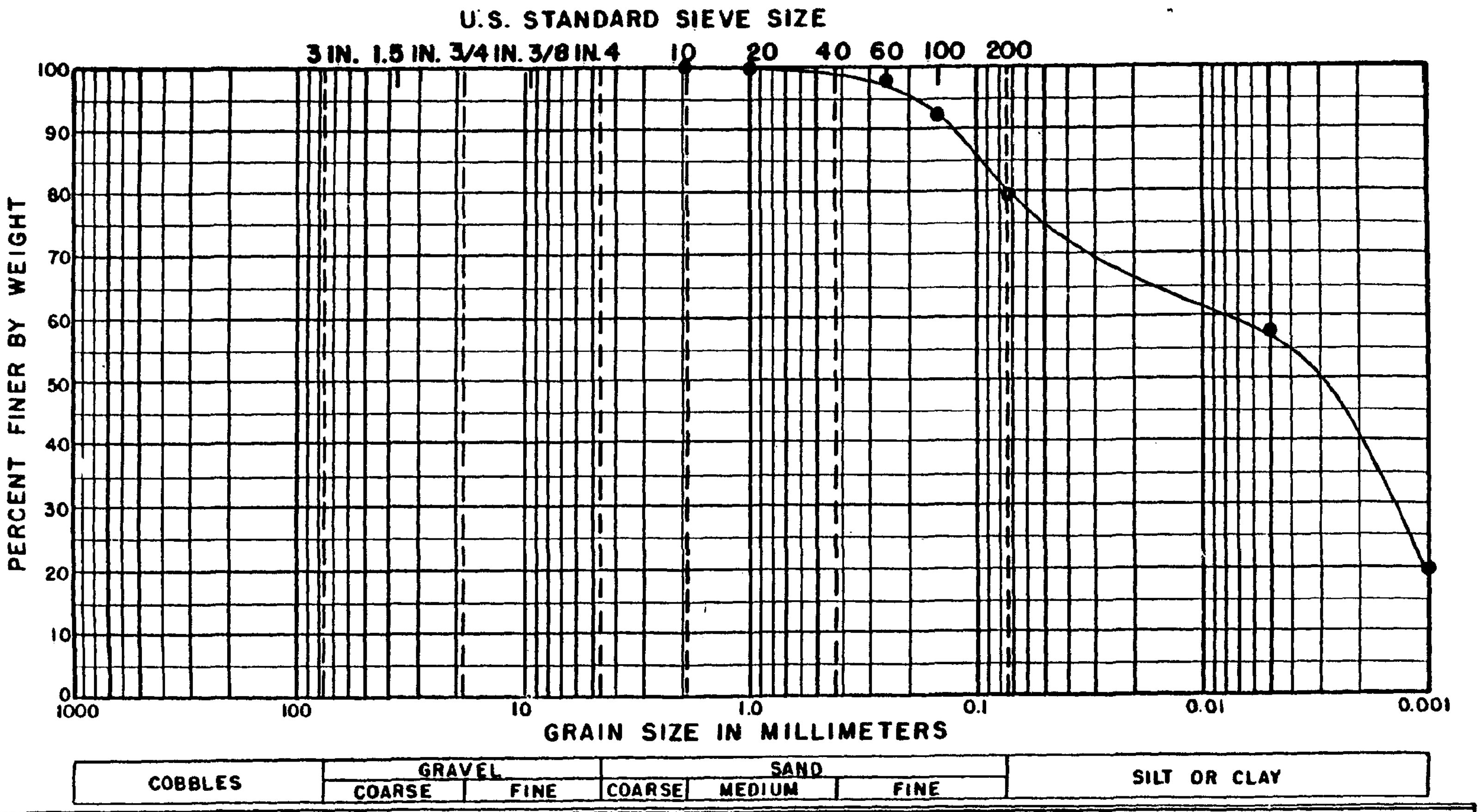
BY DATE

PLATE OF

757.2 (REV. 4-82)

1273900426 (1/83)



STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX-16-S	—	ML	FINE SANDY SILT	120.6	37.5	27.7	9.8	LONG BRANCH CUT

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES.

GRADATION CURVE

JACKSONVILLE JAX 16-S

FALL / WET SEASON

DAMES & MOORE

FIGURE 2-51

FILE
BY ____ DATE ____
CHECKED BY ____ DATE ____

REVISIONS
BY ____ DATE ____
BY ____ DATE ____
PLATE ____ OF ____

757.2 (REV. 4-62)

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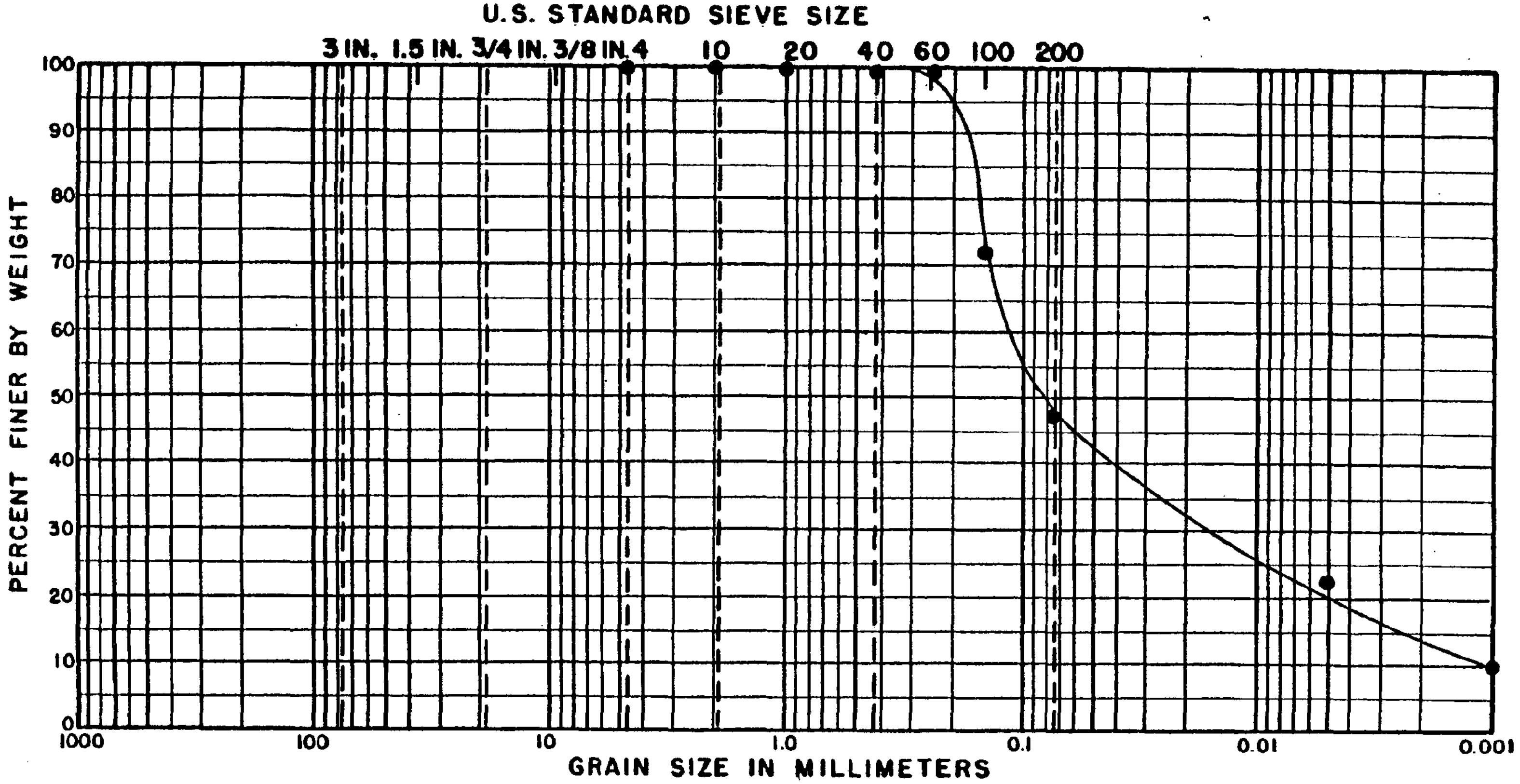


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

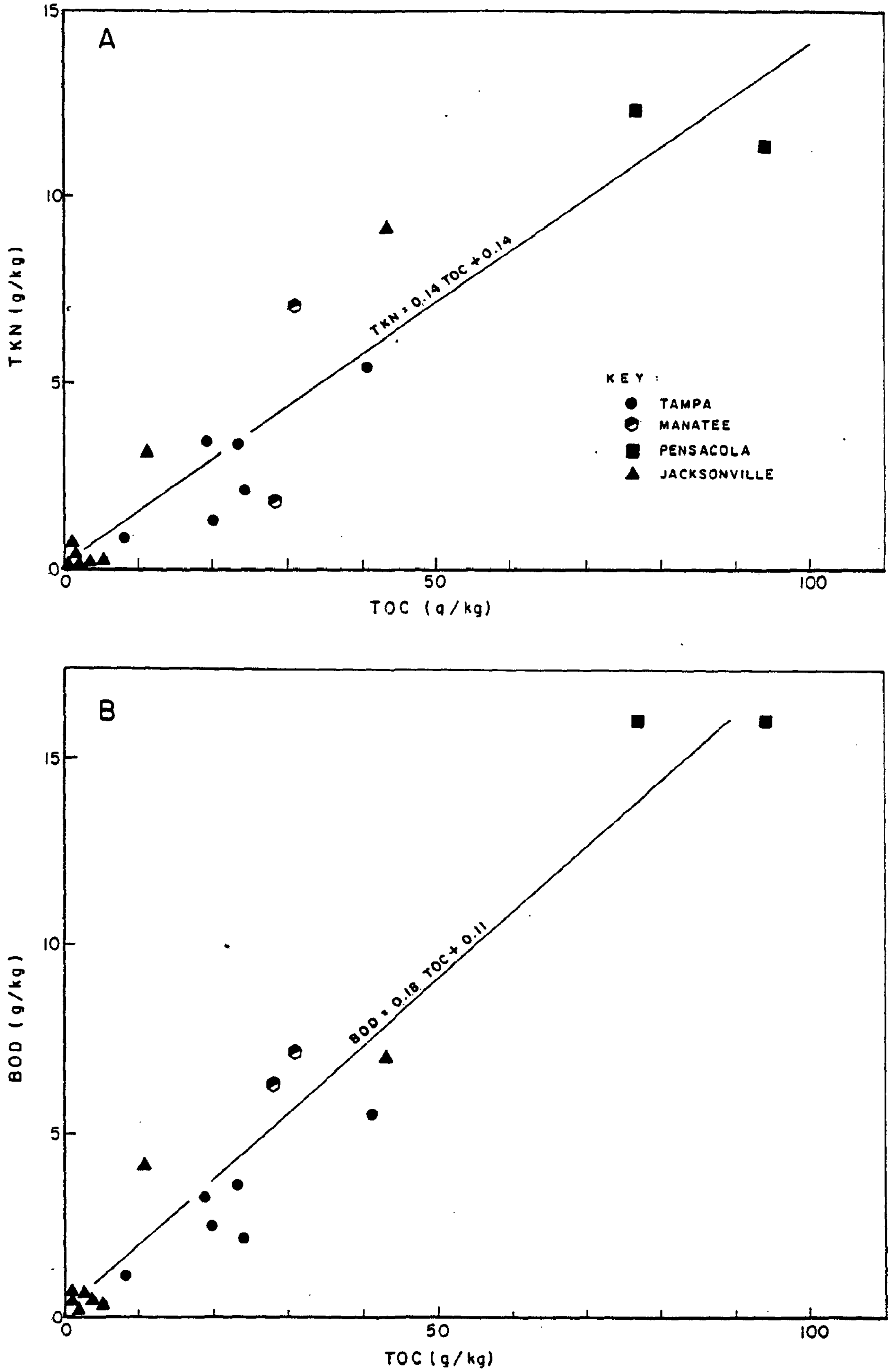
STATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	LOCATION
JAX 17-S		ML	SLIGHTLY CLAYEY SANDY SILT	—	—	—	—	TERMINAL CHANNEL

NOTE : GRAIN SIZE ANALYSIS COMPLETED BY SAVANNAH LABORATORIES

GRADATION CURVE

JACKSONVILLE JAX 17-S
FALL/WET SEASON

DAMES & MOORE
FIGURE 2-52



TKN AND BOD VERSUS TOC

SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE, AND PENSACOLA	DAMES & MOORE FIGURE 3-1

REVISIONS

DATE

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REVISIONS BY ___ DATE ___

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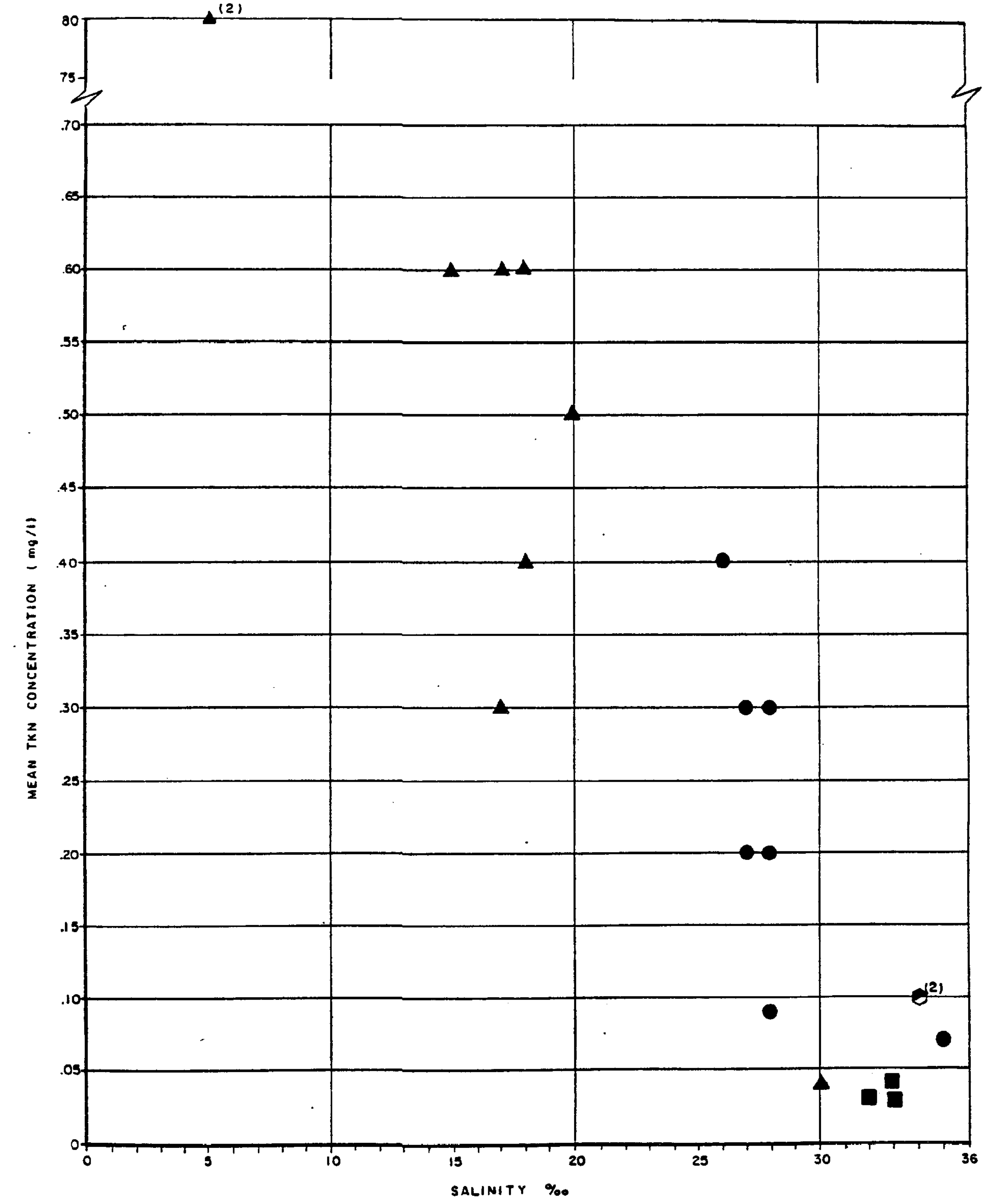


KEY:

(2) INDICATES NUMBER OF DATA POINTS

- ● TAMPA
- ⬢ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE

MEAN TKN CONCENTRATION VS. SALINITY

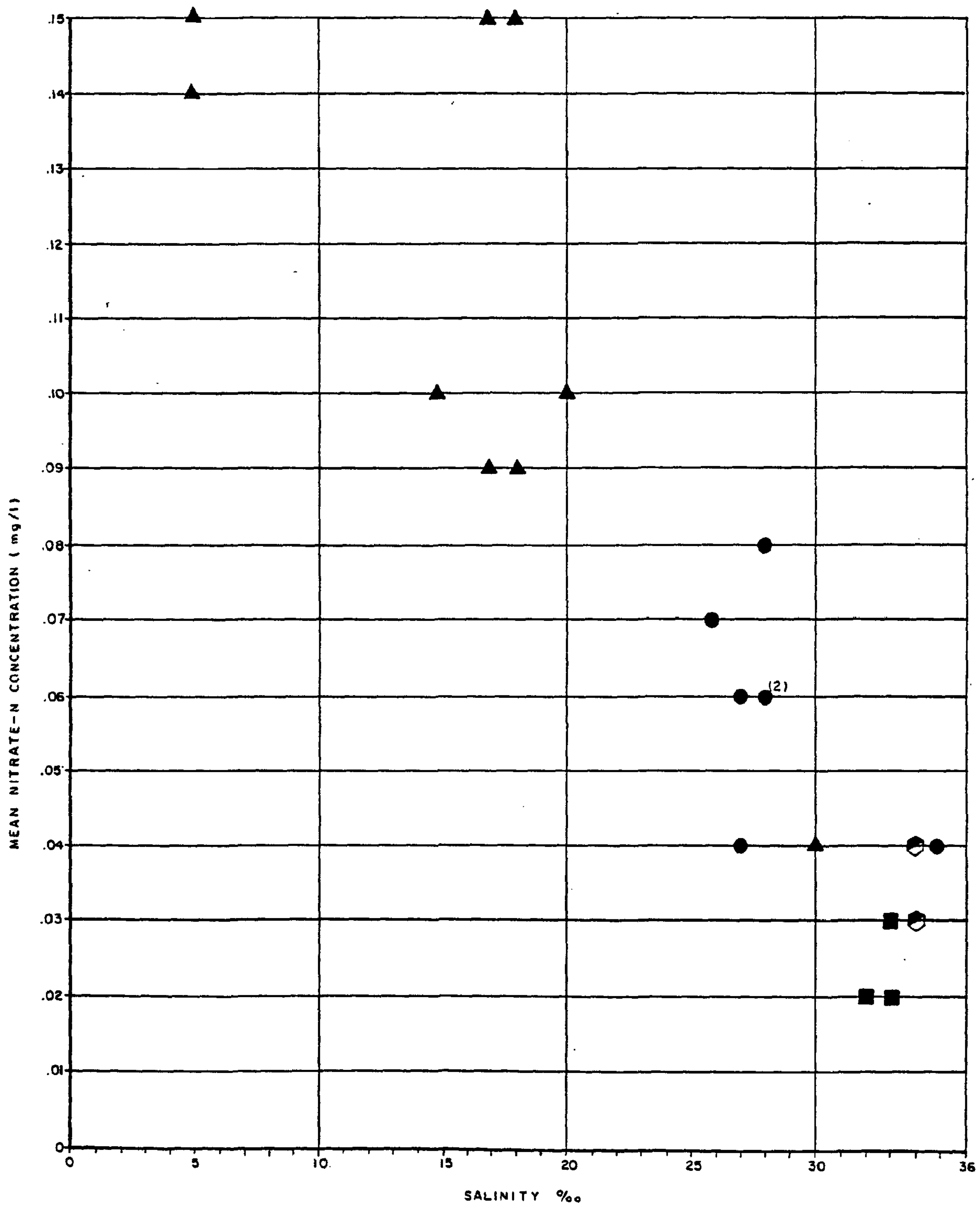
SPRING / DRY SEASON

PROJECT: DER DEEPWATER PORTS

LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-2



KEY :

- ● TAMPA
- ◓ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE
- (2) INDICATES NUMBER OF DATA POINTS

MEAN NITRATE-N CONCENTRATION VS. SALINITY

SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-3

BY ______ DATE ______ CHECKED BY ______ DATE ______ APPROVED BY ______ DATE ______

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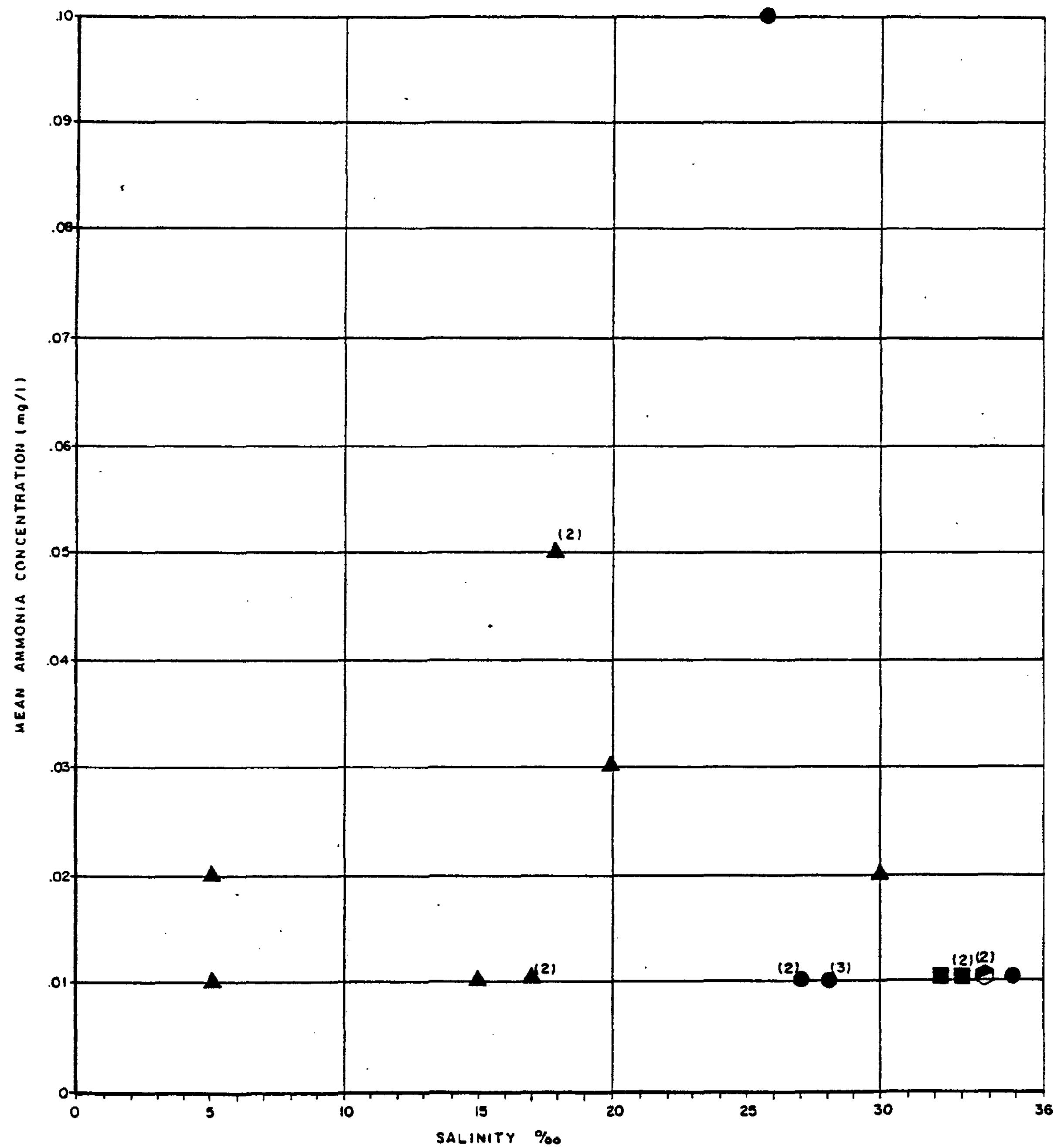

KEY:

- ● TAMPA
- ⬡ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE
- (2) INDICATES NUMBER OF DATA POINTS

MEAN AMMONIA CONCENTRATION VS. SALINITY

SPRING / DRY SEASON

PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-4

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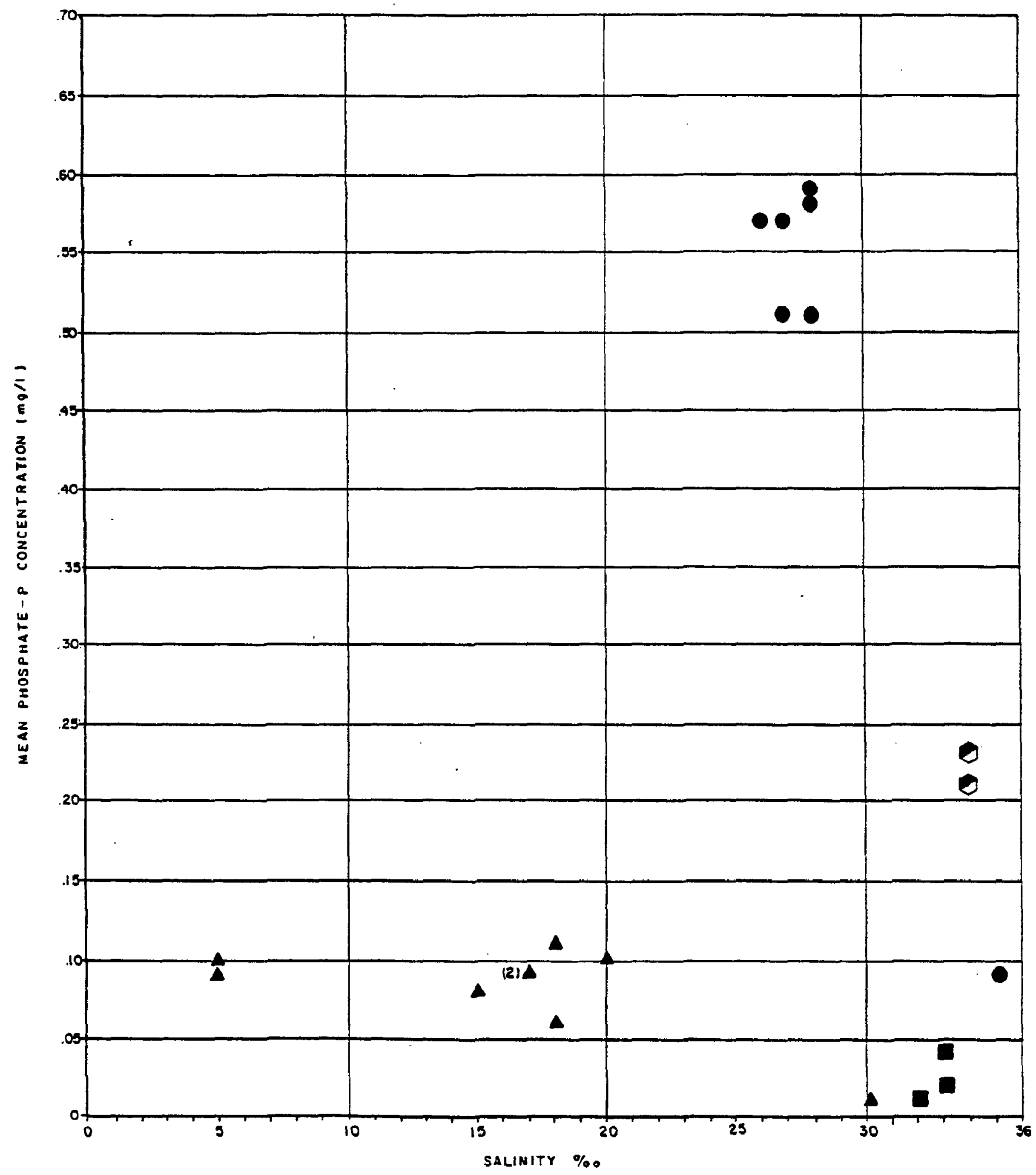


KEY :

● TAMPA

⬢ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

(2) INDICATES NUMBER OF DATA POINTS

MEAN PHOSPHATE P CONCENTRATION VS. SALINITY

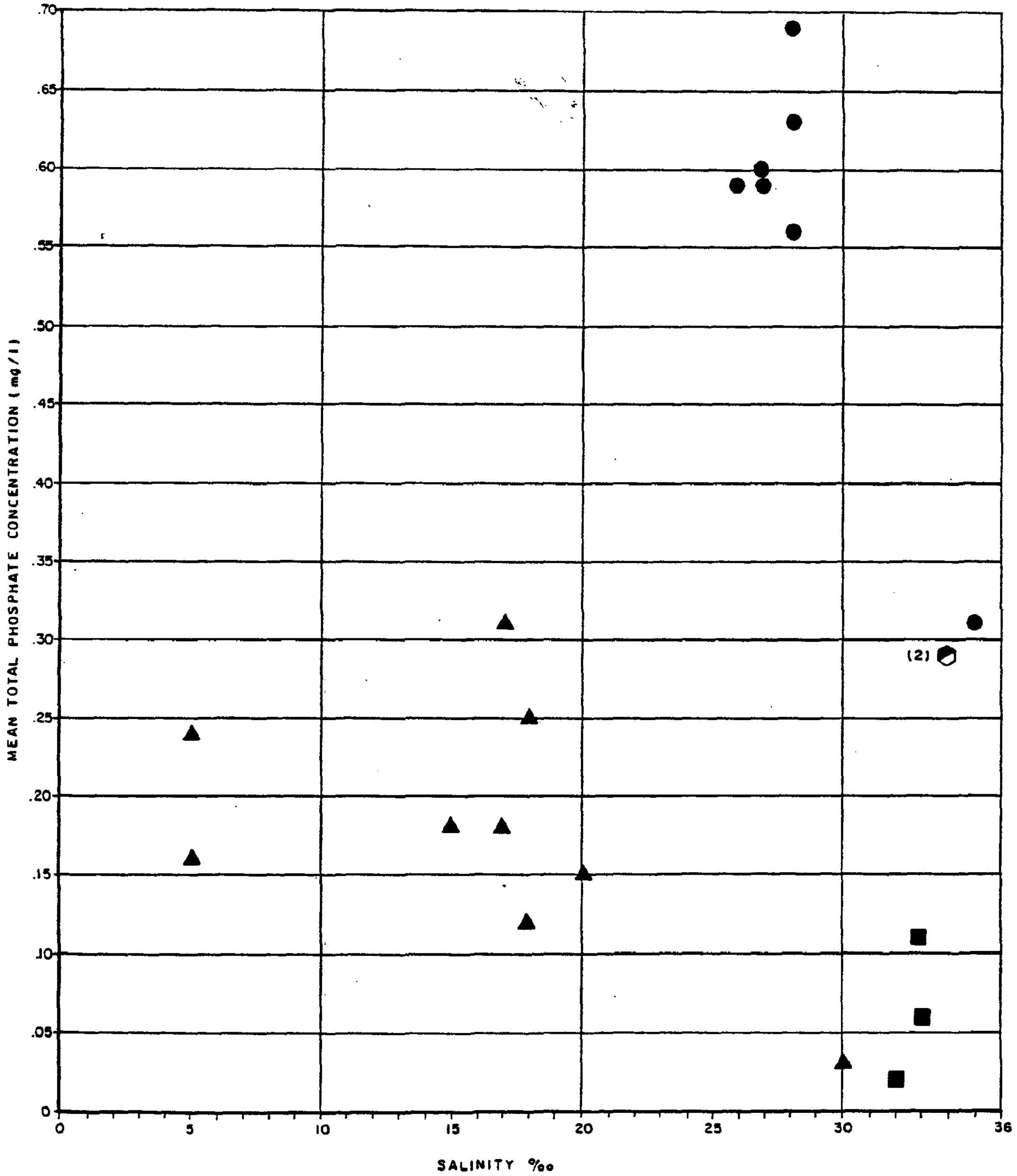
SPRING / DRY SEASON

PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-5

1273900426 (8/82)



MEAN TOTAL PHOSPHOROUS CONCENTRATION VS. SALINITY

SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS

LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-6

BY ______ DATE 8-82

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REVISIONS BY ______ DATE ______

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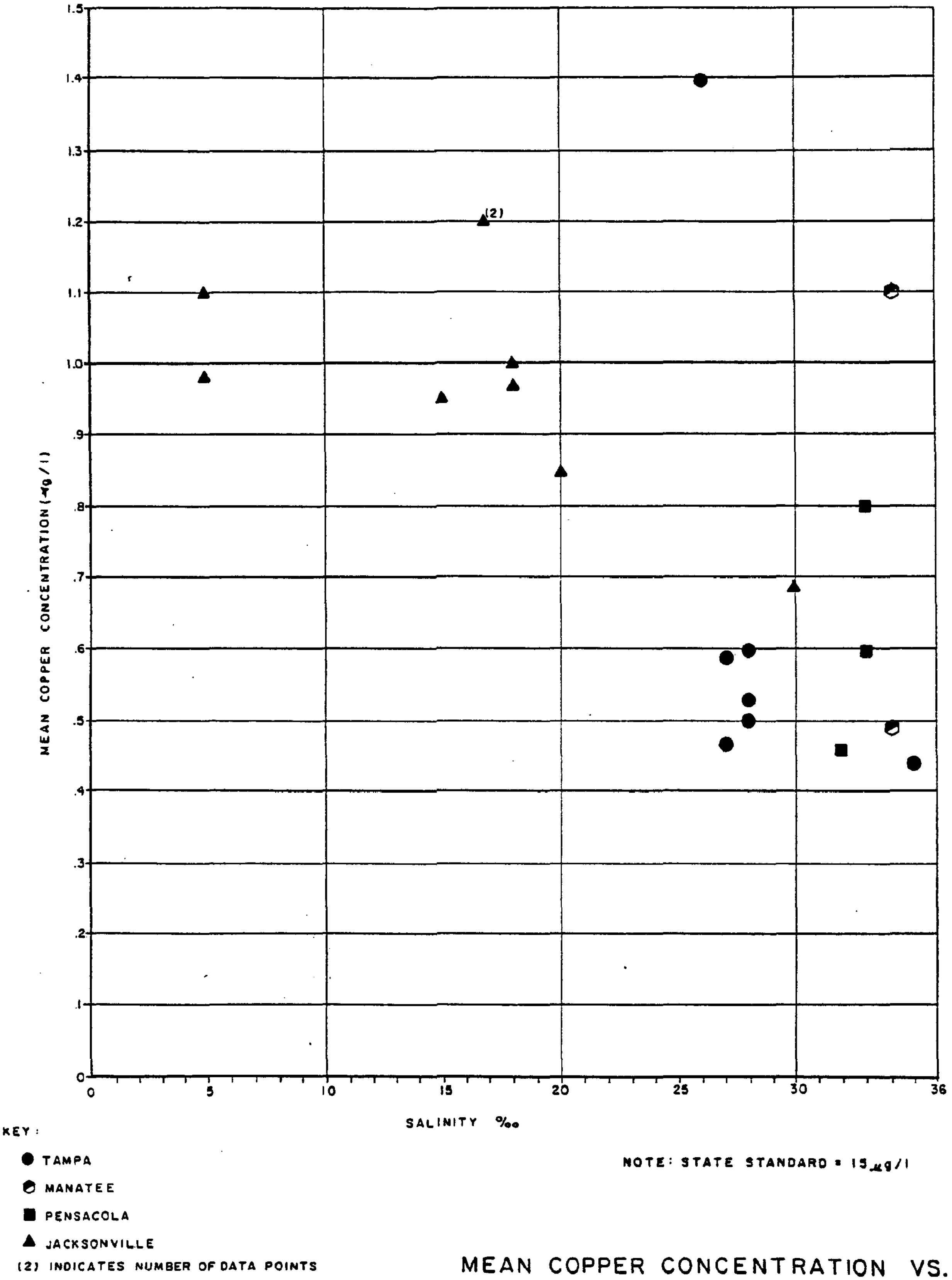
12739004 26 (8/82)

REVISIONS BY ____ DATE ____



NOTE: STATE STANDARD = 15 µg/l

MEAN COPPER CONCENTRATION VS. SALINITY

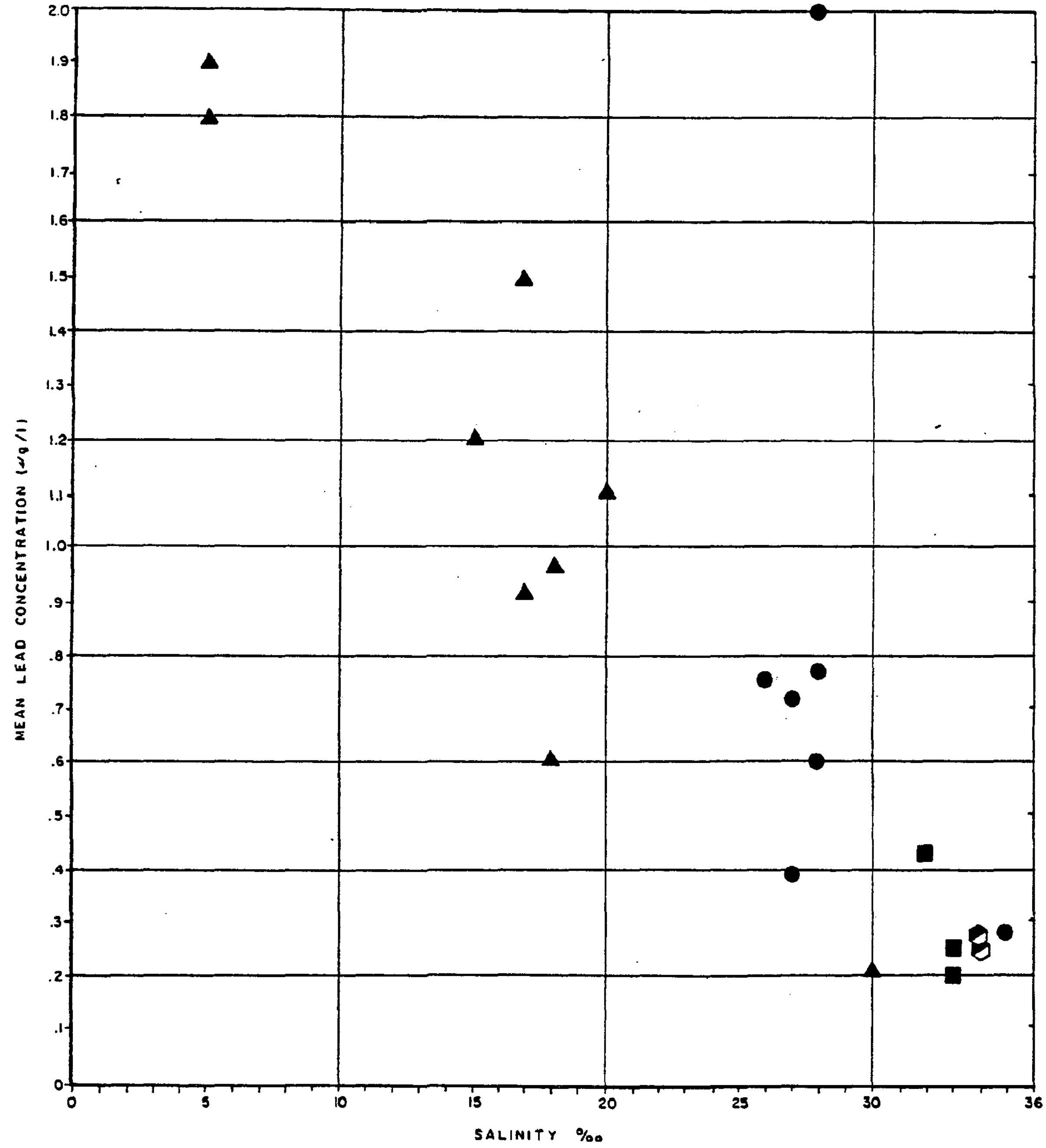
SPRING / DRY SEASON

PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-7

1273900426 (8/82)



NOTE: STATE STANDARD = 50 µg/l

KEY:
- ● TAMPA
- ⬡ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE

MEAN LEAD CONCENTRATION VS. SALINITY

SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE, AND PENSACOLA

DAMES & MOORE

FIGURE 3-9

BY ____ DATE 6-82 CHECKED BY ____ DATE ____ APPROVED BY ____ DATE ____
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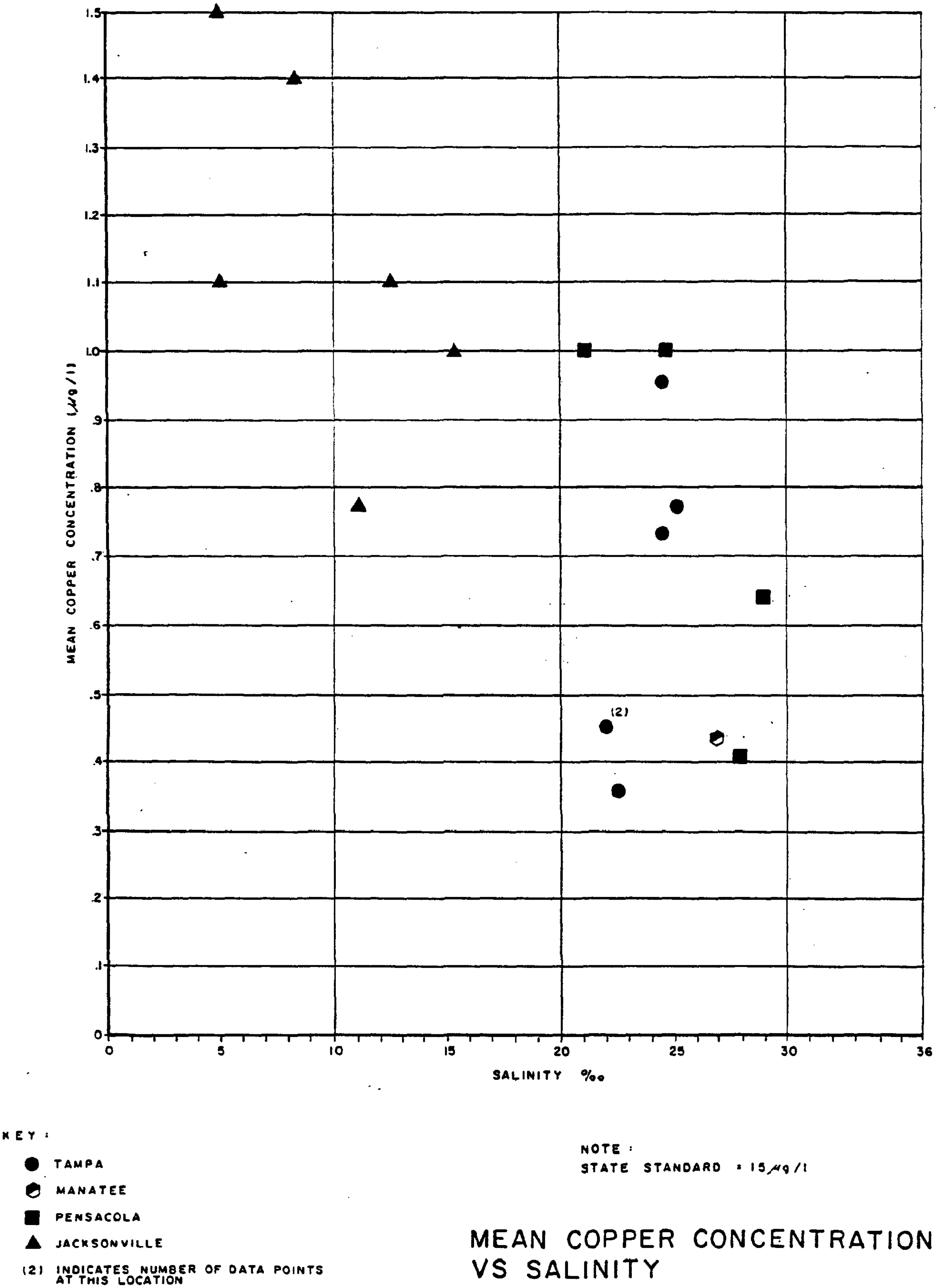

NOTE:
STATE STANDARD = 15 µg/l

MEAN COPPER CONCENTRATION VS SALINITY

FALL / WET SEASON

PROJECT: DER DEEP WATER PORTS
LOCATION: JACKSONVILLE, PENSACOLA, TAMPA, MANATEE

DAMES & MOORE

FIGURE 3-9

BY
DATE 1/83
CHECKED
DATE
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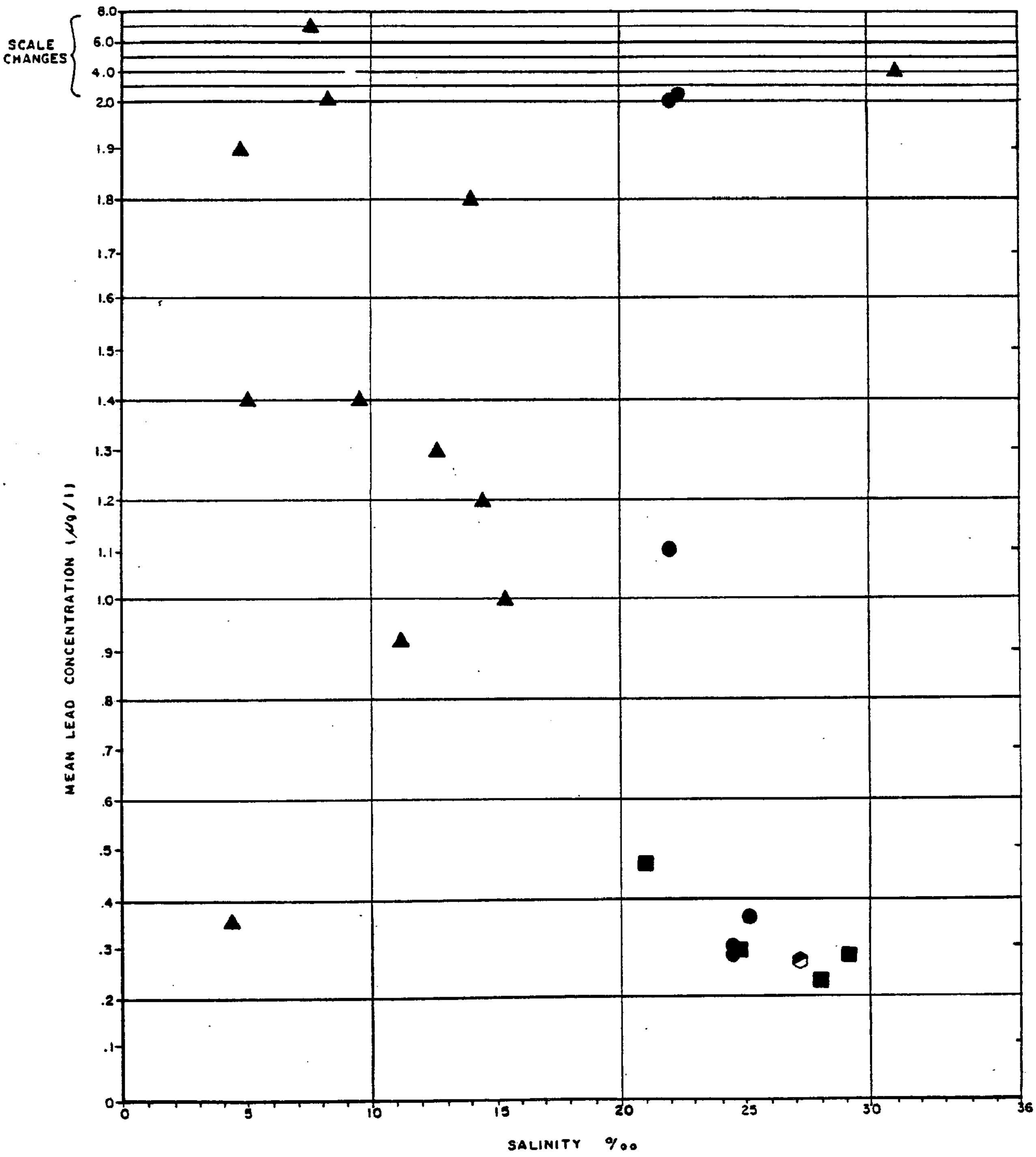
DATE



NOTE :
STATE STANDARD = 50 µg/l

KEY :

- ● TAMPA
- ⬢ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE

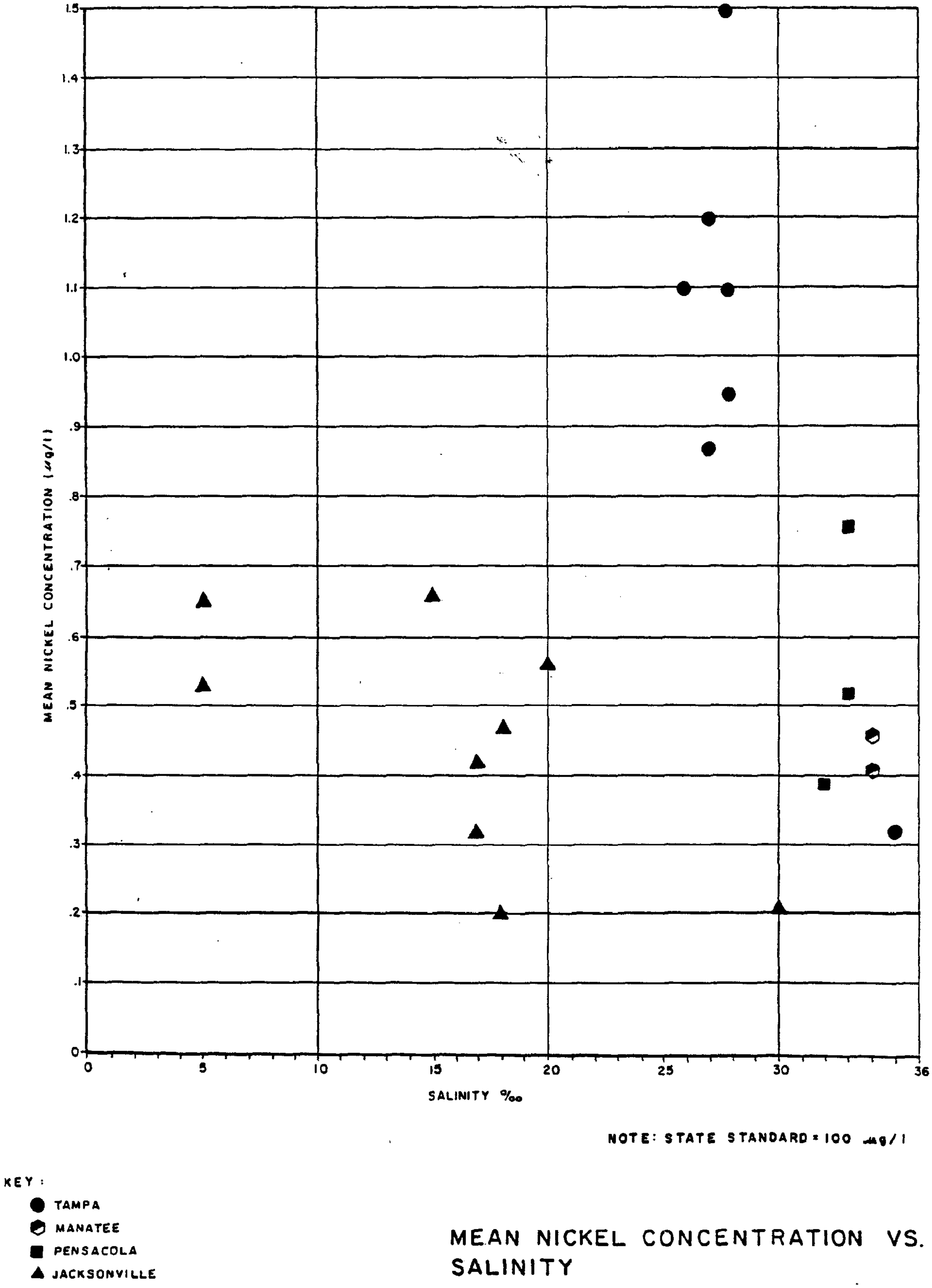
MEAN LEAD CONCENTRATION VS. SALINITY

FALL / WET SEASON

PROJECT : DER DEEP WATER PORTS
LOCATION : JACKSONVILLE , PENSACOLA, TAMPA , MANATEE

DAMES & MOORE
FIGURE 3-10

273900426 (12/82)



NOTE: STATE STANDARD = 100 µg/l

MEAN NICKEL CONCENTRATION VS. SALINITY

SPRING/DRY SEASON

PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

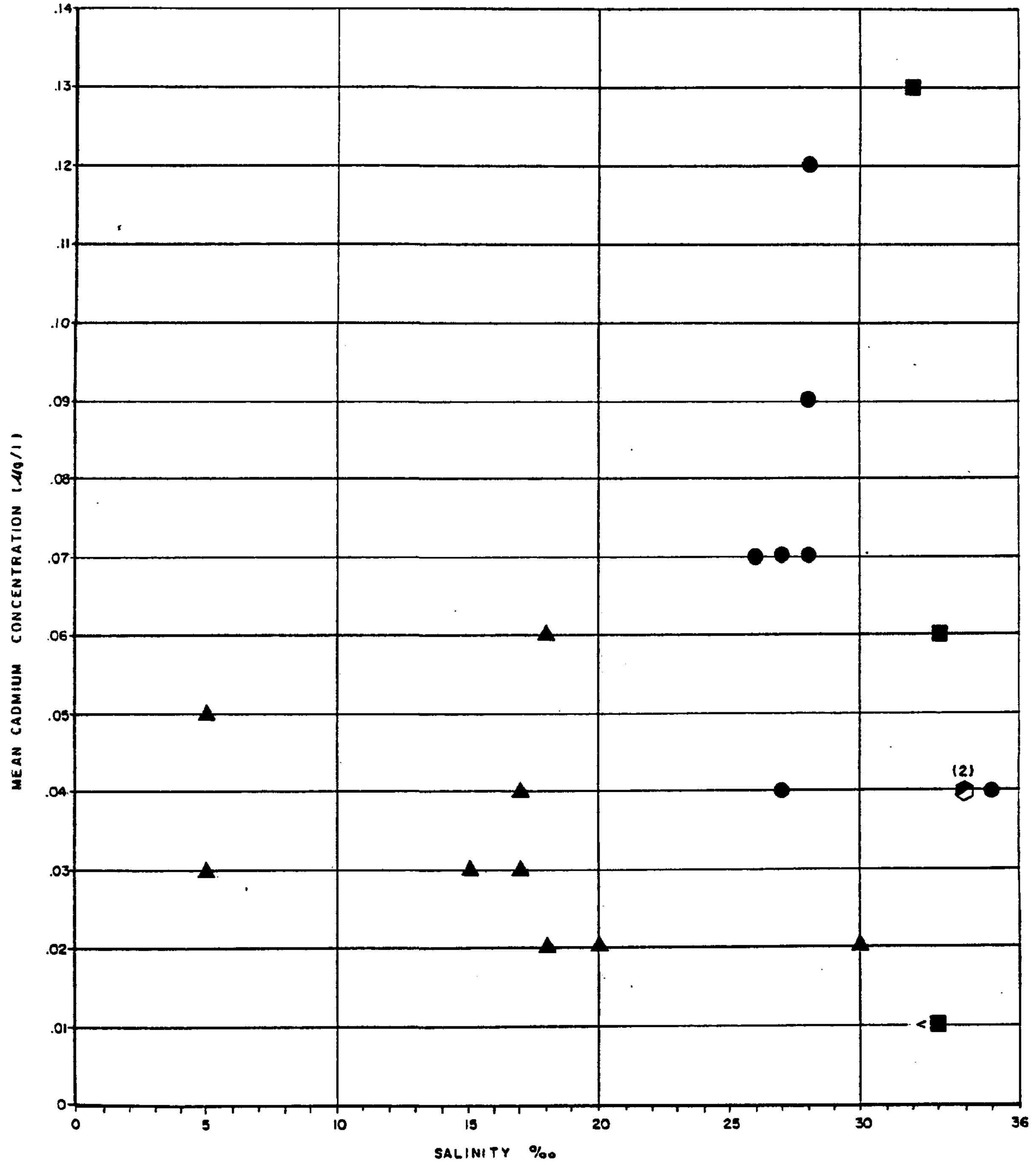
DAMES & MOORE

FIGURE 3-11

BY ______ DATE 8-82 CHECKED BY ______ DATE ______ APPROVED BY ______ DATE ______

REVISIONS BY ______ DATE ______

1273900426(8/82)



NOTE: STATE STANDARD = 5.0 µg/l

KEY :

● TAMPA

◐ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

(2) INDICATES NUMBER OF DATA POINTS

MEAN CADMIUM CONCENTRATION VS. SALINITY

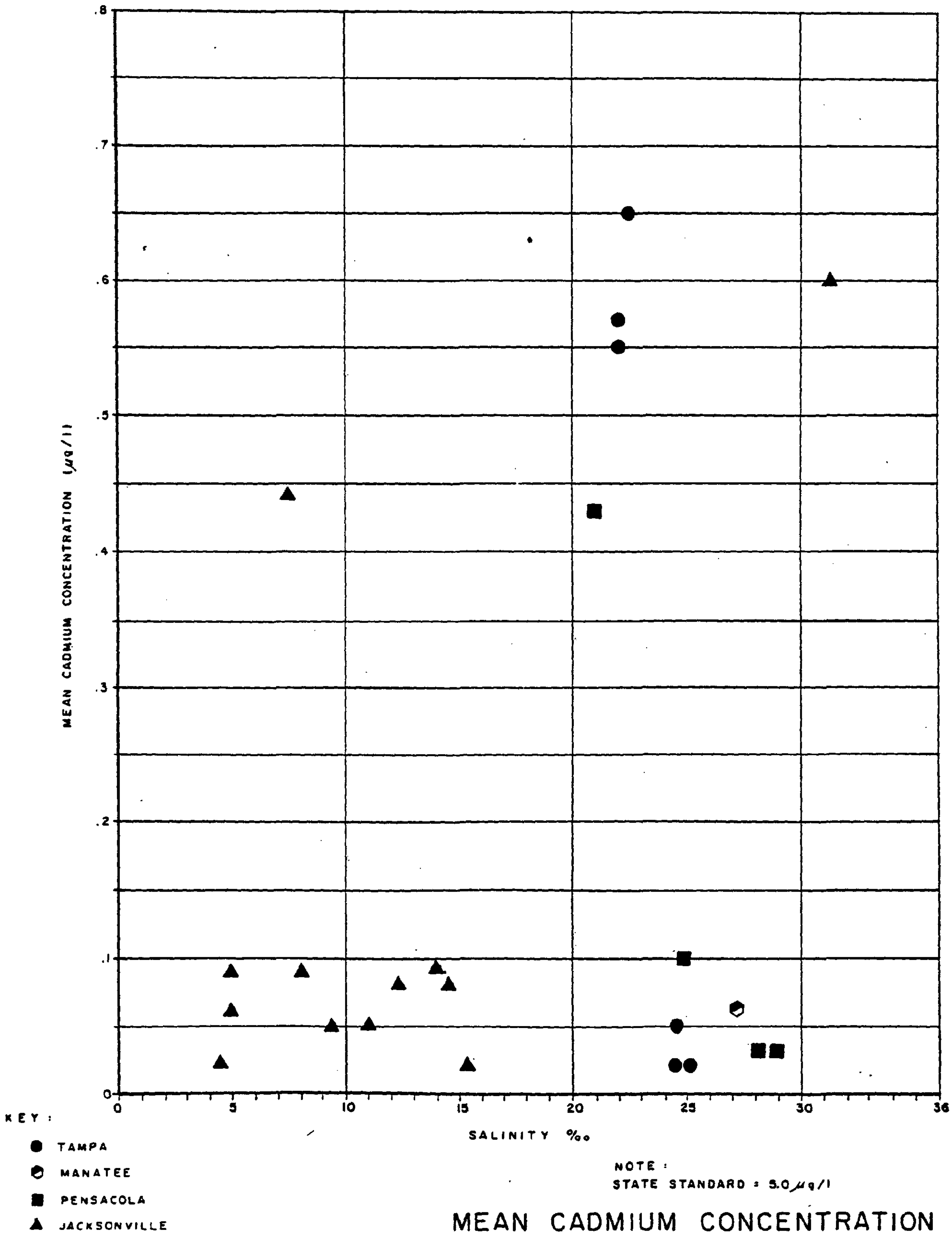
SPRING/DRY SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-12

CHECKED ______ DATE ______ APPROVED ______ DATE ______



NOTE:
STATE STANDARD = 5.0 µg/l

MEAN CADMIUM CONCENTRATION VS. SALINITY

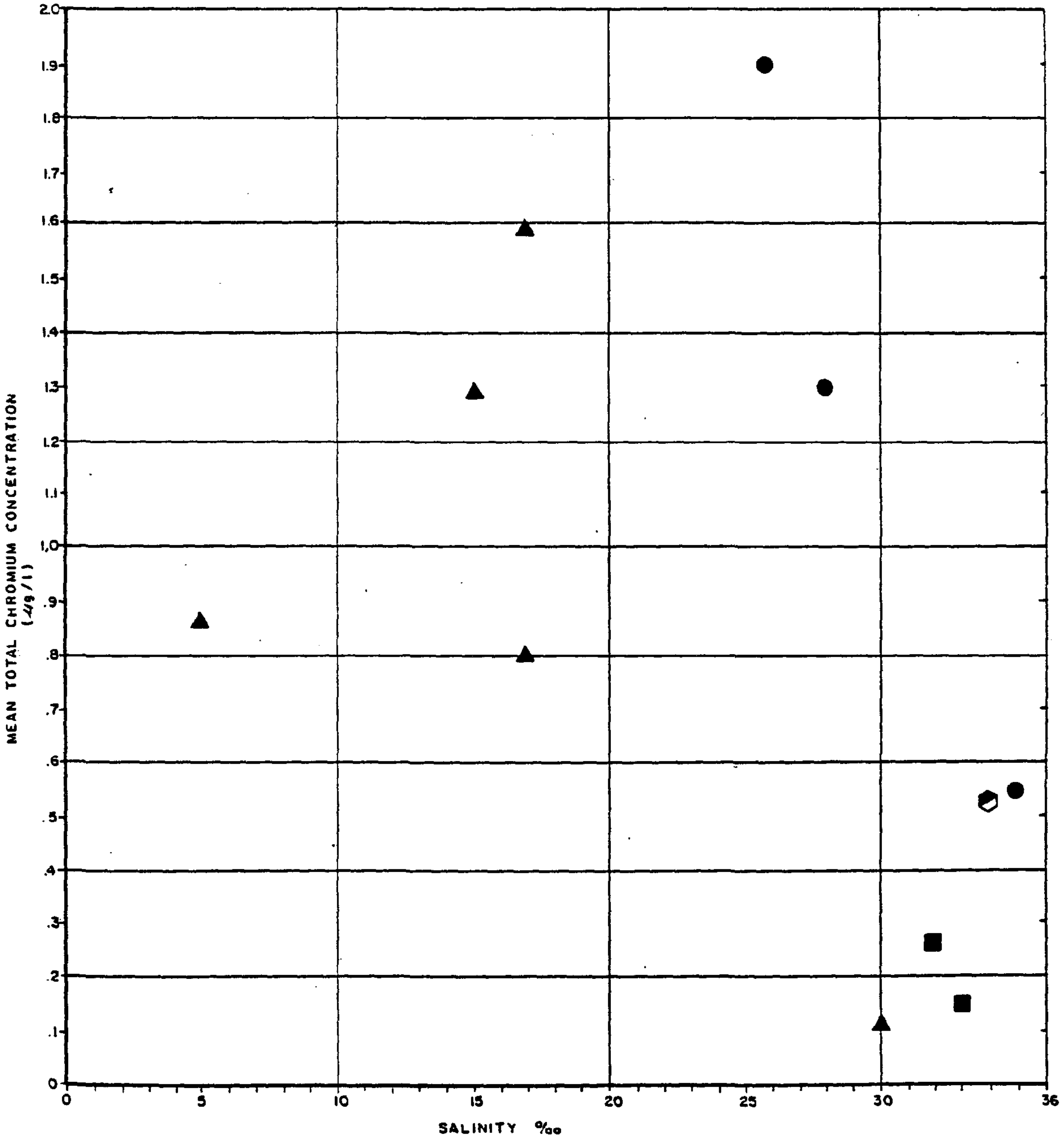
FALL / WET SEASON

PROJECT: DER DEEP WATER PORTS
LOCATION: JACKSONVILLE, PENSACOLA, TAMPA, MANATEE

DAMES & MOORE

FIGURE 3-13

1273900426 (12/82)



NOTE: STATE STANDARD = 50 µg/l

KEY:

- ● TAMPA
- ⬢ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE

MEAN TOTAL CHROMIUM CONCENTRATION VS. SALINITY

SPRING /DRY DENSITY

PROJECT : DER DEEPWATER PORTS
LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 3-14

BY ______ DATE 8-82 CHECKED BY ______ DATE ______ APPROVED BY ______ DATE ______

REVISIONS BY ______ DATE ______

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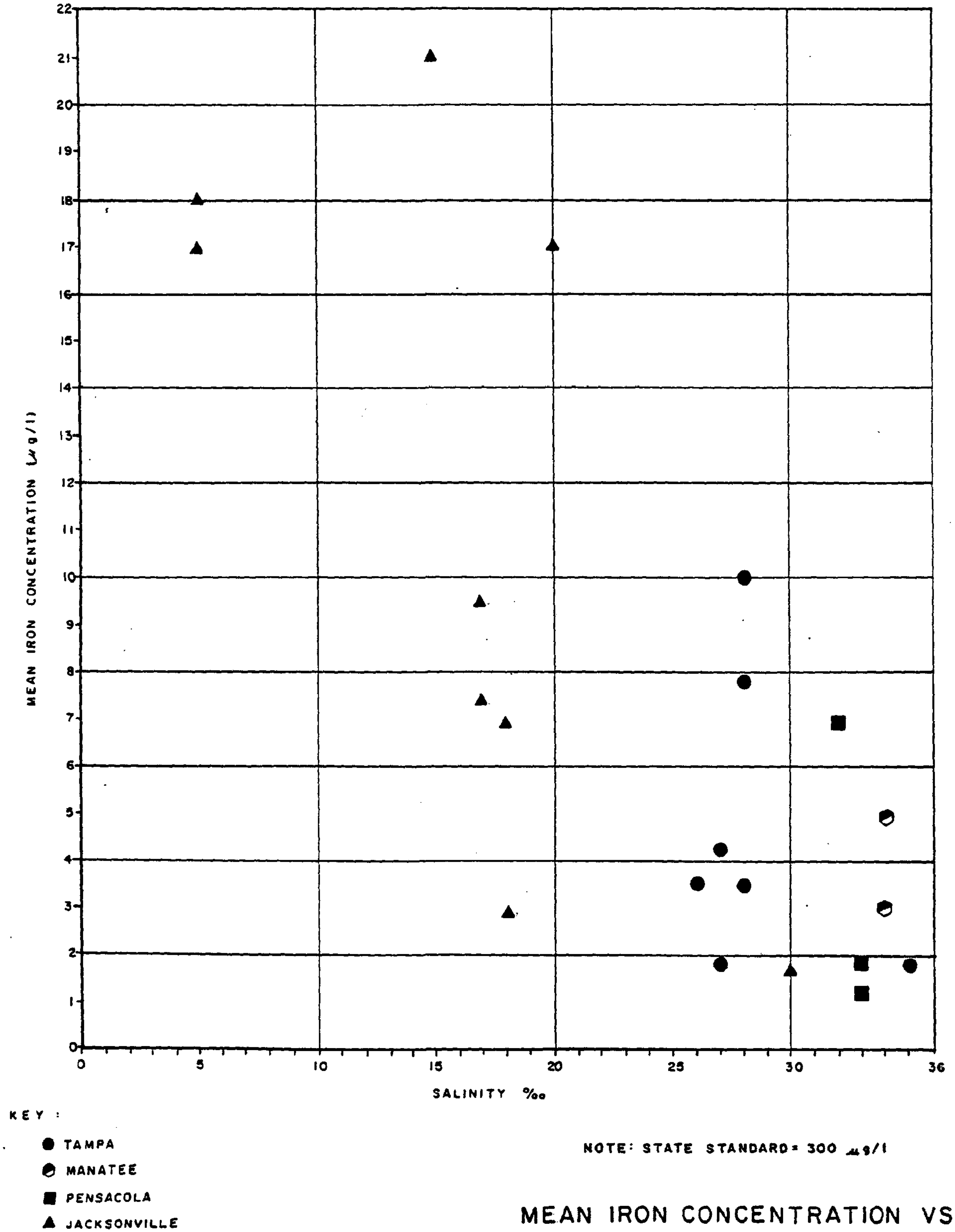


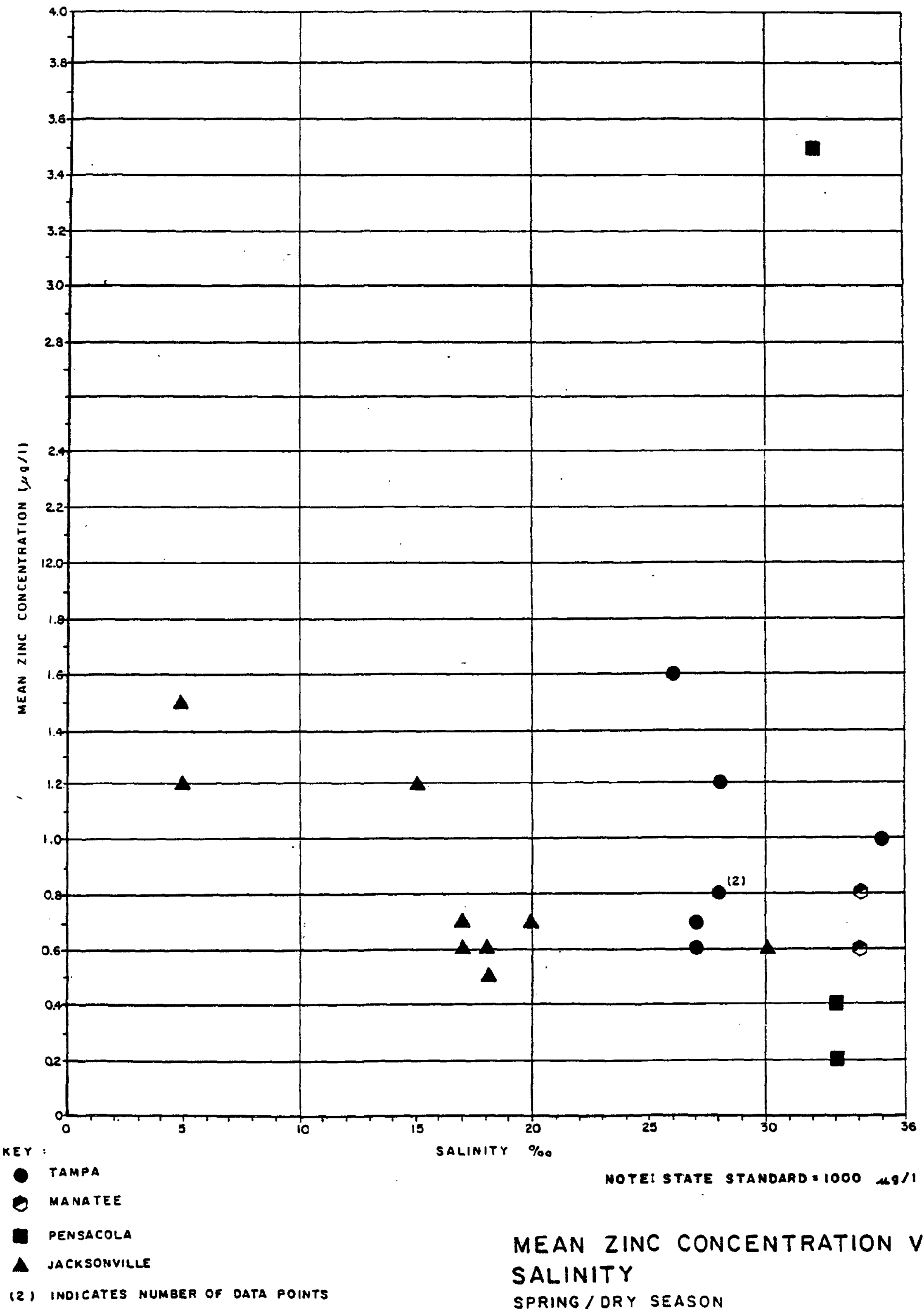
NOTE: STATE STANDARD= 300 µg/l

MEAN IRON CONCENTRATION VS. SALINITY

SPRING / DRY SEASON

PROJECT: DER DEEP WATER PORTS LOCATION : JACKSONVILLE , PENSACOLA, TAMPA , MANATEE	DAMES & MOORE FIGURE 3-15

1273900426 (9/82)



NOTE: STATE STANDARD = 1000 µg/l

MEAN ZINC CONCENTRATION VS. SALINITY

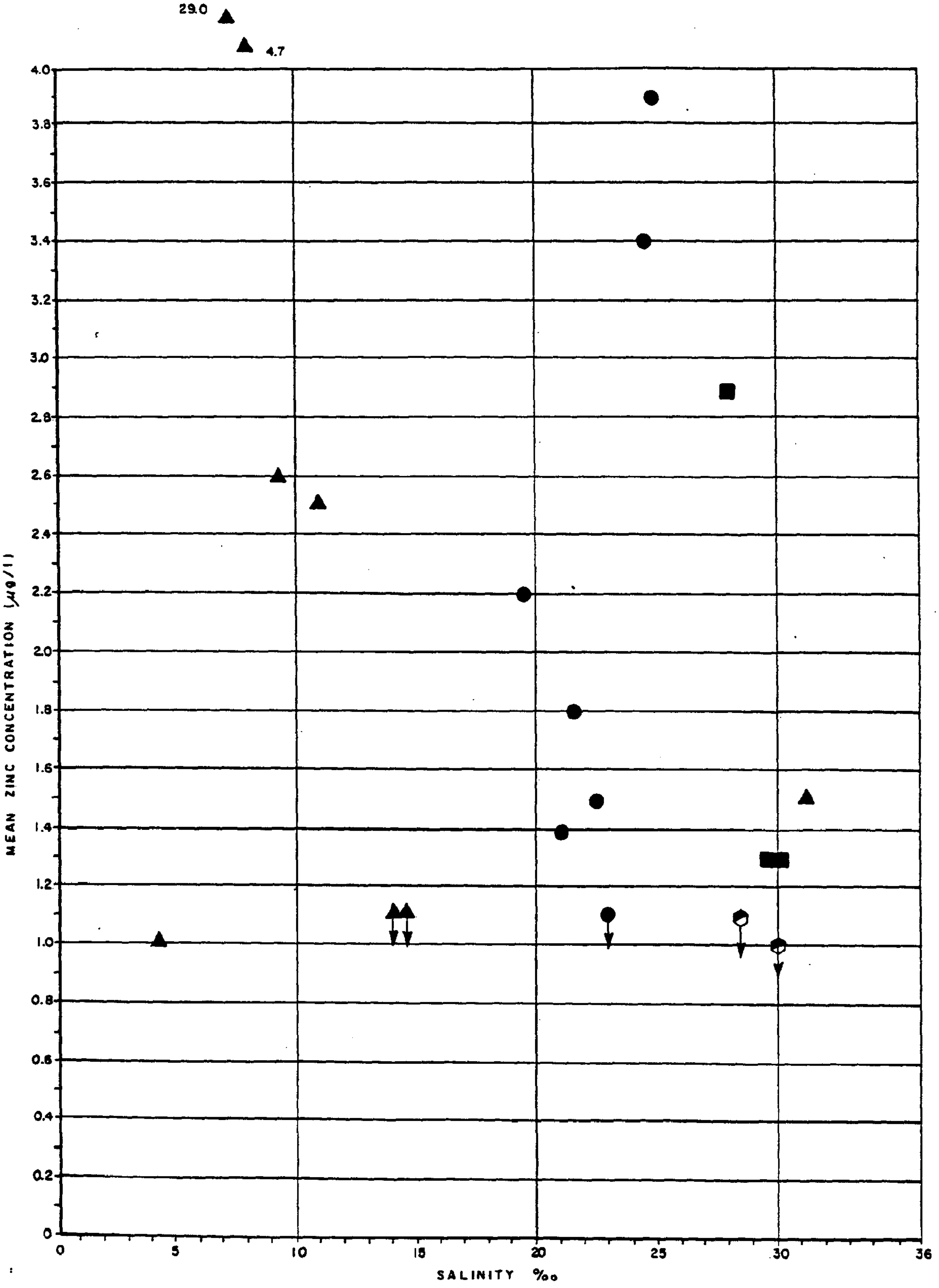
SPRING / DRY SEASON

PROJECT: DER DEEP WATER PORTS
LOCATION: JACKSONVILLE, PENSACOLA, TAMPA, MANATEE

DAMES & MOORE
FIGURE 3-16

BY ___ DATE 9/12 CHECKED ___ DATE ___ APPROVED ___ DATE ___
REVISION ___ DATE ___

1273900426 (9/82)



KEY:

● TAMPA

⬢ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

↓ DENOTES VALUE DETERMINED USING ONE OR MORE VALUES BELOW DETECTION LIMIT (SEE APPENDIX C)

NOTE:
STATE STANDARD = 1000 µg/l

MEAN ZINC CONCENTRATION VS. SALINITY

FALL / WET SEASON

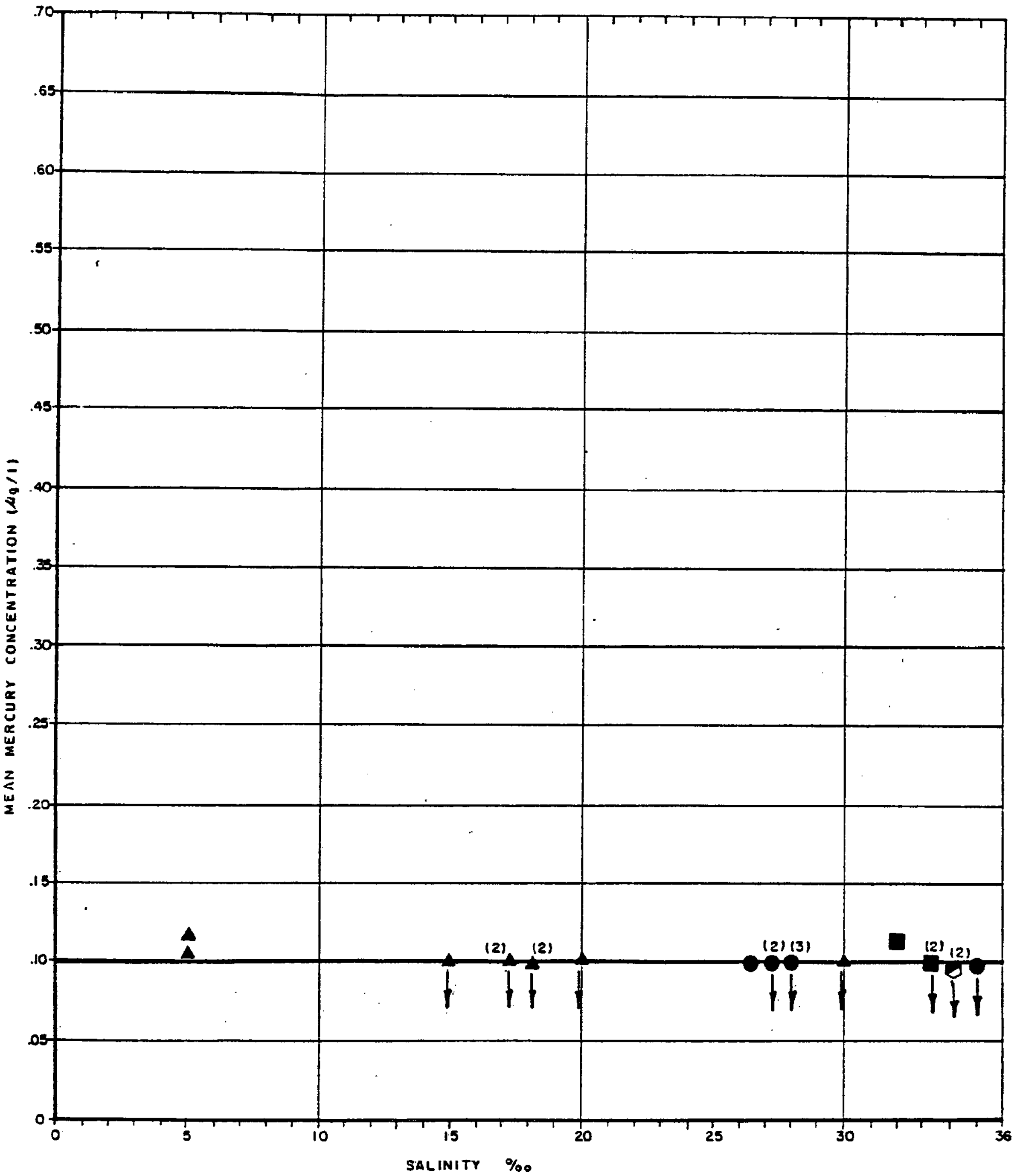
PROJECT: DER DEEP WATER PORTS
LOCATION: JACKSONVILLE, PENSACOLA, TAMPA, MANATEE

DAMES & MOORE

FIGURE 3-17

APPROVED ______ DATE ______ CHECKED ______ DATE ______ DATE ______

273900426 (12/82)



KEY:

- ● TAMPA
- ⬢ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE
- (2) INDICATES NUMBER OF DATA POINTS
- ↓ DENOTES VALUES BELOW DETECTION LIMIT

NOTE: STATE STANDARD = 0.1 µg/l

MEAN MERCURY CONCENTRATION VS SALINITY

SPRING / DRY SEASON

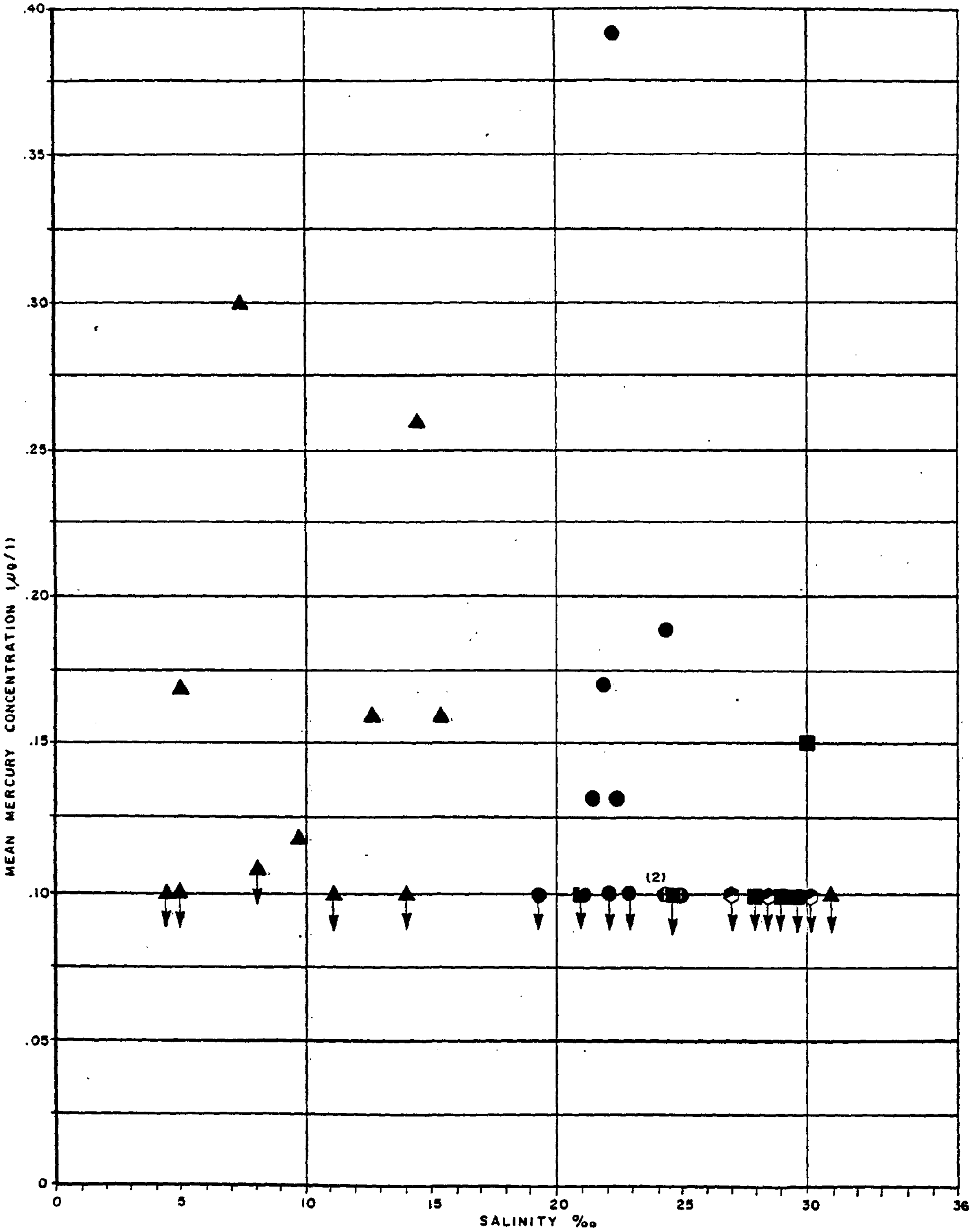
PROJECT: DER DEEPWATER PORTS
LOCATION: PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-18

BY ___ DATE ___ CHECKED ___ DATE ___ APPROVED ___ DATE ___ REVISIONS BY ___ DATE ___

12739004 26(8/82)



KEY:

● TAMPA

⬡ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

(2) INDICATES NUMBER OF DATA POINTS AT THIS LOCATION

↓ DENOTES VALUE DETERMINED USING ONE OR MORE VALUES BELOW THE LABORATORY DETECTION LIMIT (SEE APPENDIX C)

NOTE:
STATE STANDARD = 0.1 µg/l

MEAN MERCURY CONCENTRATION VS. SALINITY

FALL / WET SEASON

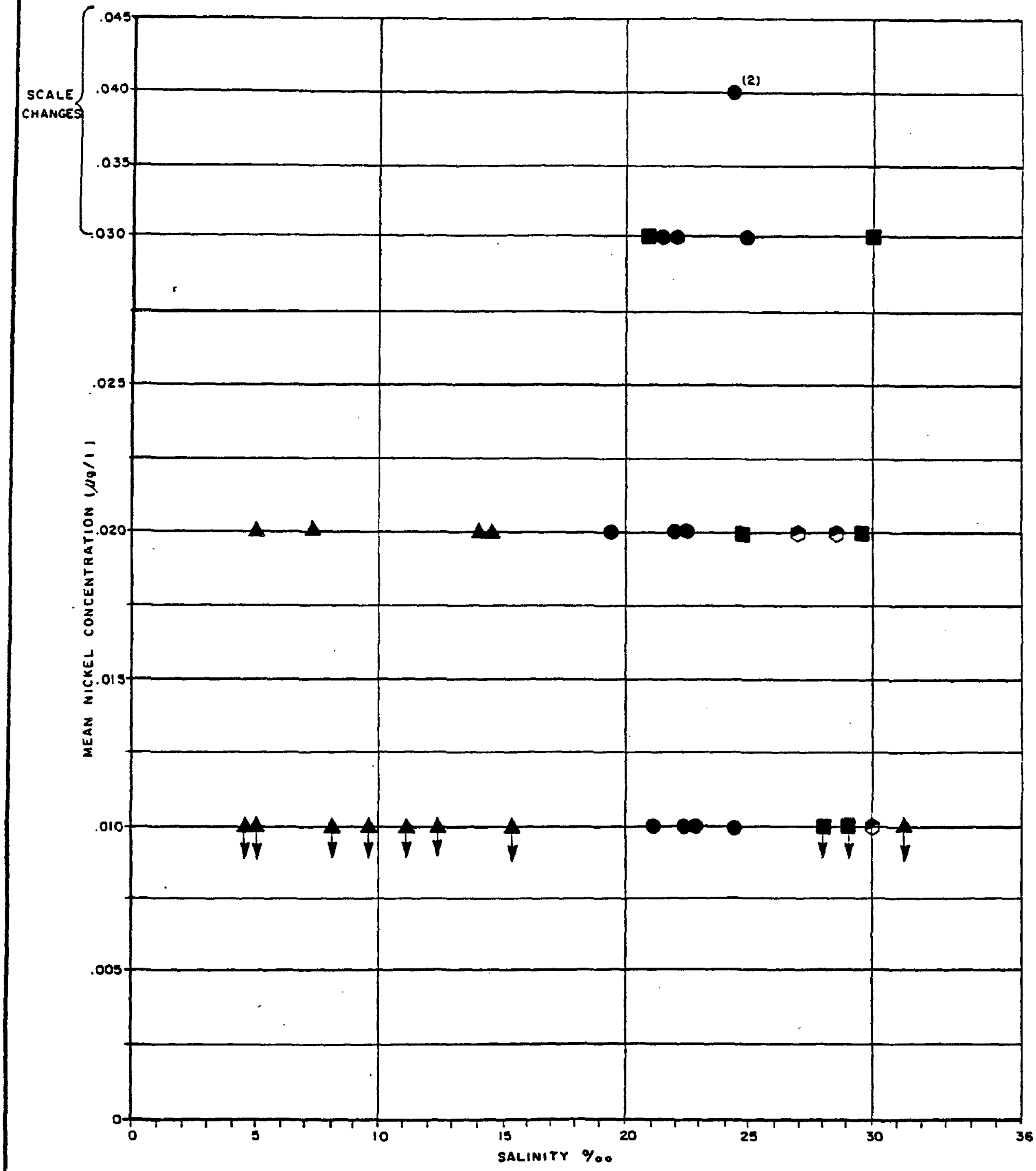
PROJECT: DER DEEP WATER PORTS
LOCATION: JACKSONVILLE, PENSACOLA, TAMPA, MANATEE

DAMES & MOORE
FIGURE 3-19

DATE
CHECKED
DATE
APPROVED
DATE

1273900426 (12/82)

Y ______ DATE 1/83 CHECKED ______ DATE ______ APPROVED ______ DATE ______



KEY:

- ● TAMPA
- ◒ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE
- (2) INDICATES NUMBER OF DATA POINTS AT THIS LOCATION
- ↓ DENOTES VALUE DETERMINED USING ONE OR MORE VALUES BELOW THE LABORATORY DETECTION LIMIT (SEE APPENDIX C)

NOTE:
STATE STANDARD = 100 µg/l

MEAN SILVER CONCENTRATION VS. SALINITY

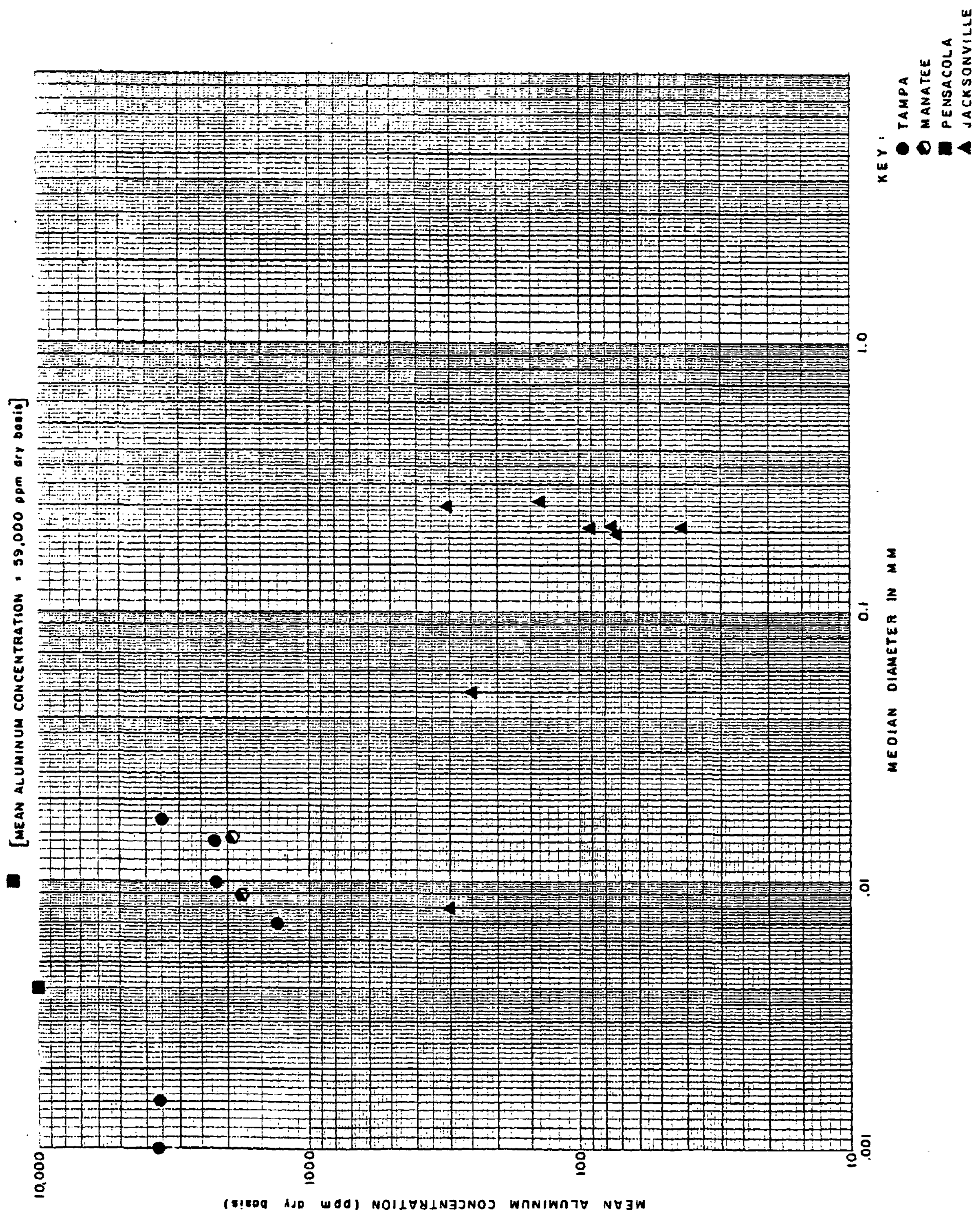
FALL / WET SEASON

PROJECT: DER DEEP WATER PORTS
LOCATION: JACKSONVILLE, PENSACOLA, TAMPA, MANATEE

DAMES & MOORE
FIGURE 3-20

DATE ——— CHECKED ——— DATE ——— APPROVED ——— DATE ———

REVISION ——— DATE ———

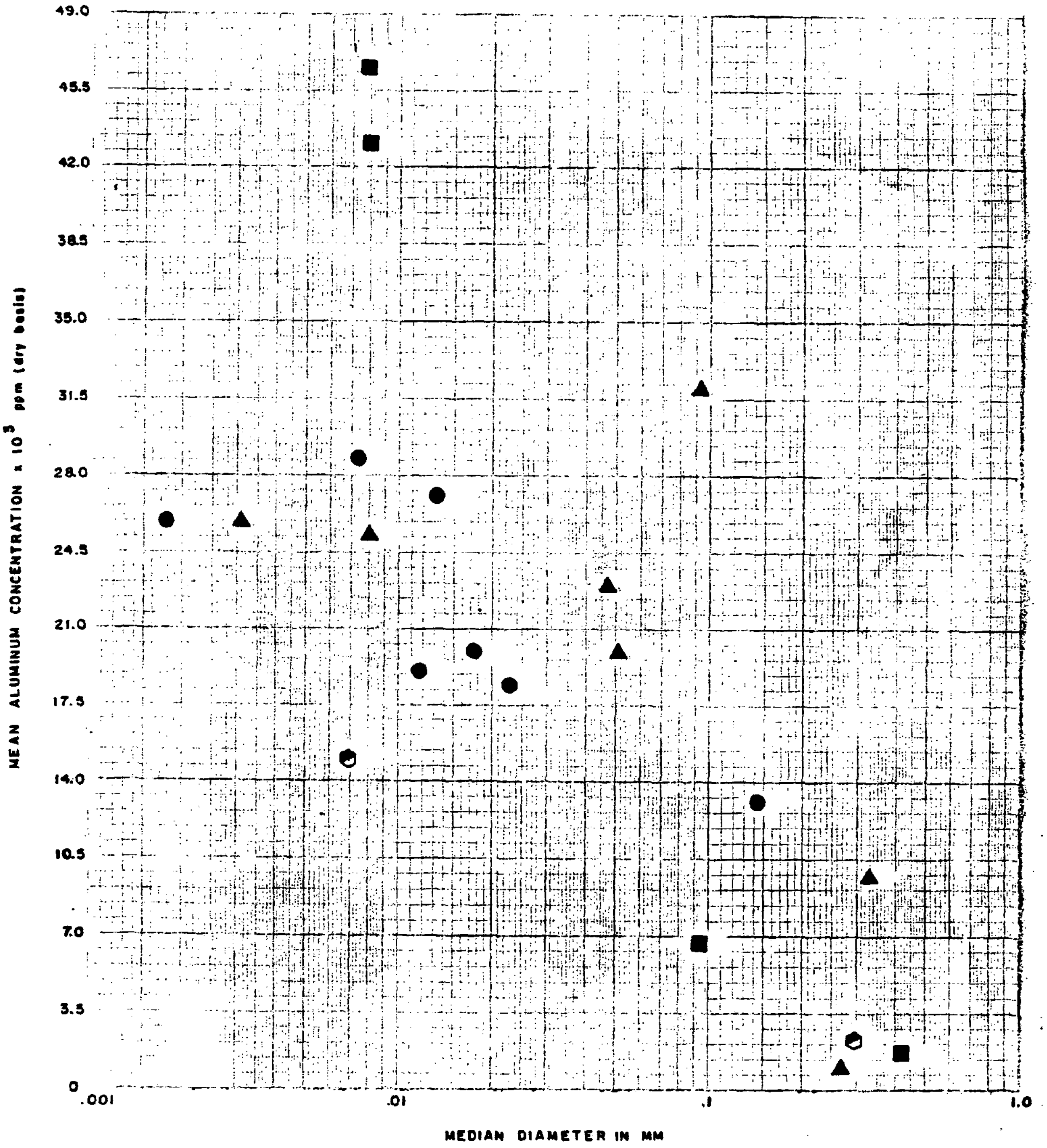


MEAN ALUMINUM CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

SPRING / DRY SEASON

PROJECT: DER DEEP WATER PORTS LOCATION: JACKSONVILLE, PENSACOLA, TAMPA, MANATEE	**DAMES & MOORE** FIGURE 3-21

12739004 26 (9/82)



KEY:

● TAMPA

⬢ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

MEAN ALUMINUM CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

FALL / WET SEASON

PROJECT: DER DEEPWATER PORTS
LOCATION: JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-22

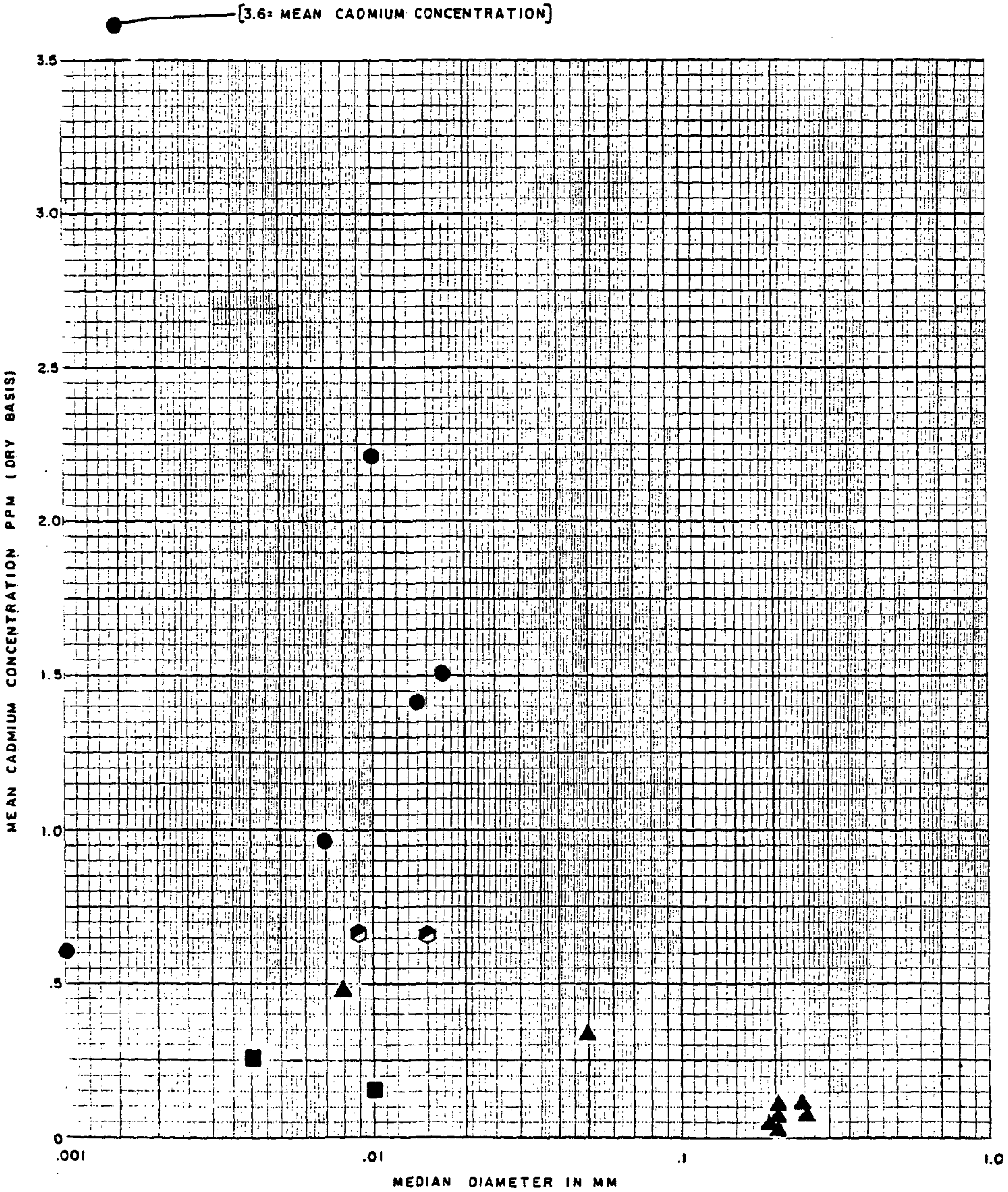
APPROVED ______ DATE ______

CHECKED ______ DA ______

DATE 1/83

12739004261(1/83)

REVISIONS BY ________ DATE ________



KEY :

- ● TAMPA
- ⬡ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE

MEAN CADMIUM CONCENTRATION VS MEDIAN DIAMETER OF SEDIMENT

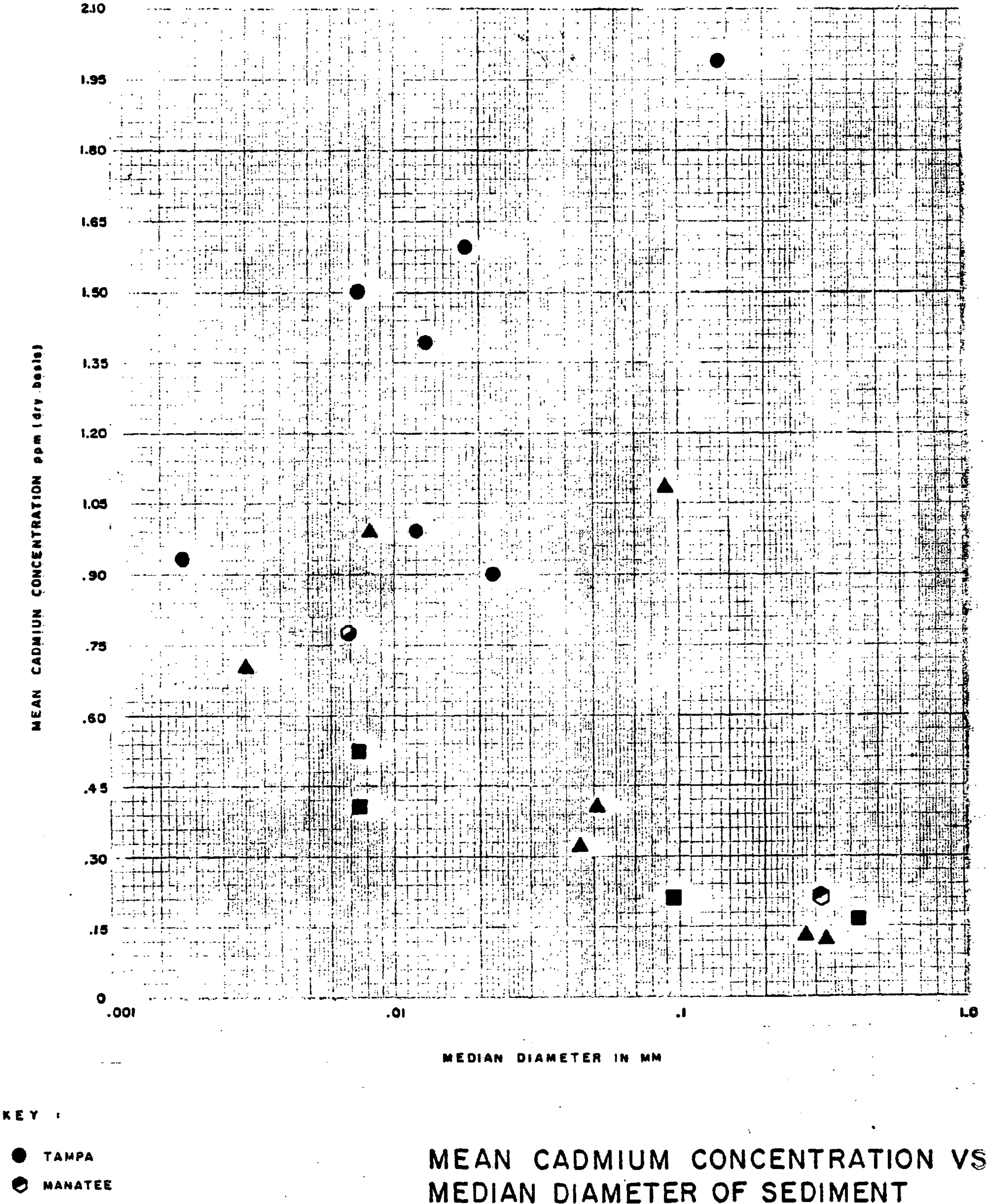
SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE , TAMPA , MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-23

1273900426(8/82)



MEAN CADMIUM CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

FALL / WET SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE , TAMPA , MANATEE AND PENSACOLA

DAMES & MOORE

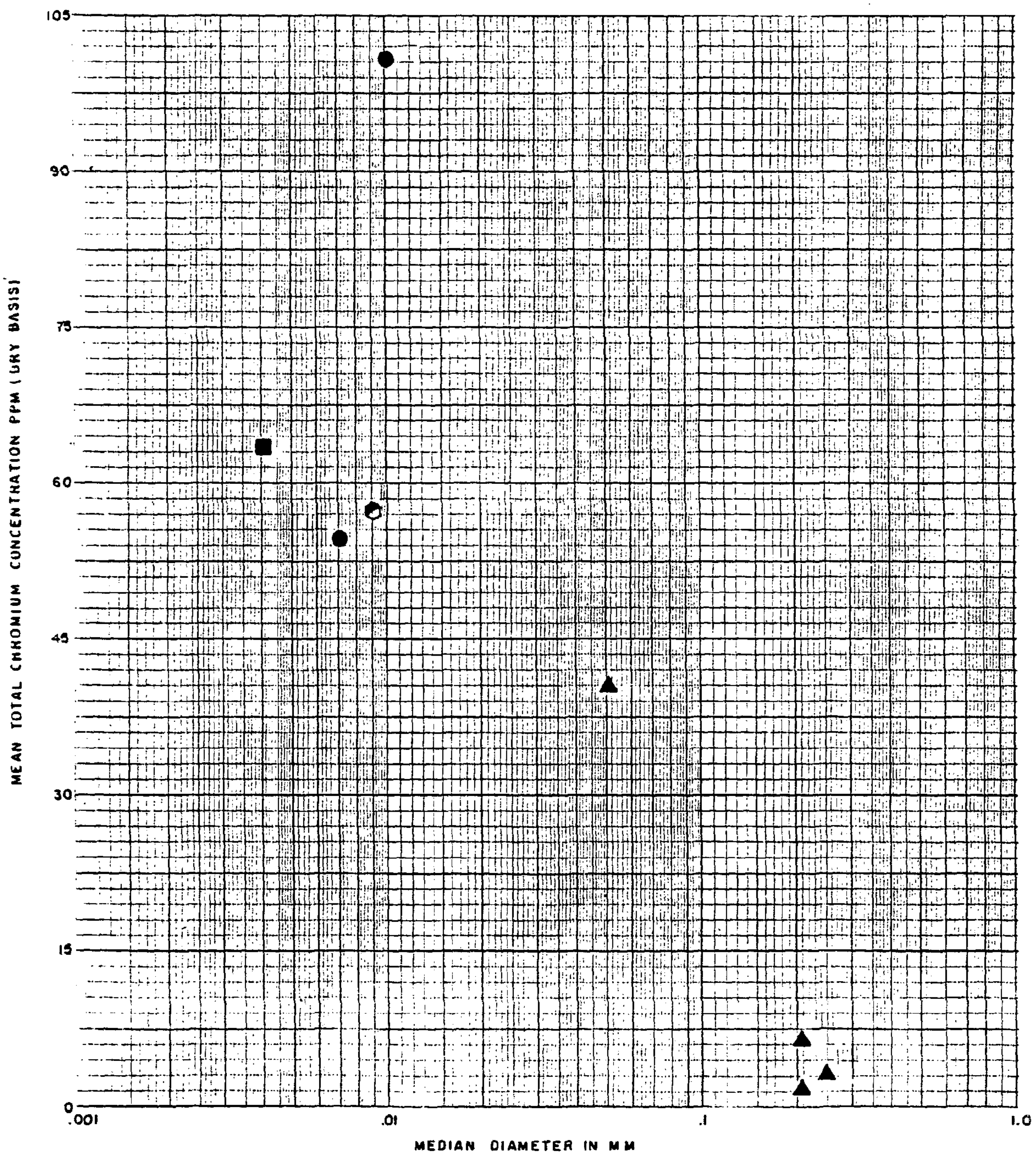
FIGURE 3-24

DATE
APPROVED
DATE
CHECKED
DATE

1273900426 (1/83)

CHECKED ______ TE ______ APPROVED BY ______ DATE ______

REVISIONS ______ DATE ______



KEY :

● TAMPA

◐ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

MEAN TOTAL CHROMIUM CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

SPRING / DRY SEASON

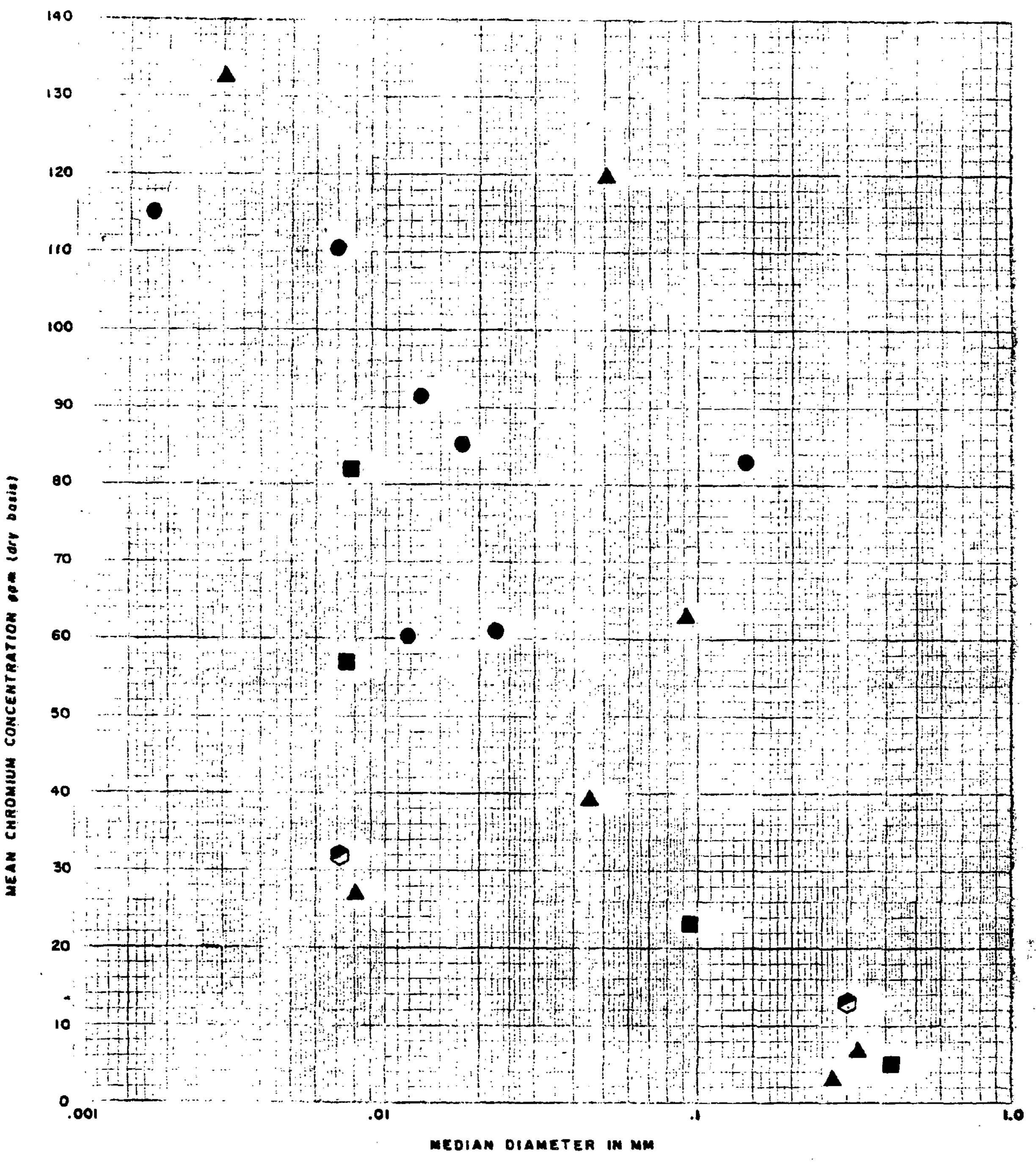
PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-25

1273900426 (8/82)

DATE ______ APPROVED ______ DATE ______ D ______ CHECKED ______ DATE 1/23 ______



KEY :

● TAMPA
◓ MANATEE
■ PENSACOLA
▲ JACKSONVILLE

MEAN TOTAL CHROMIUM CONCENTRATIO VS. MEDIAN DIAMETER OF SEDIMENT

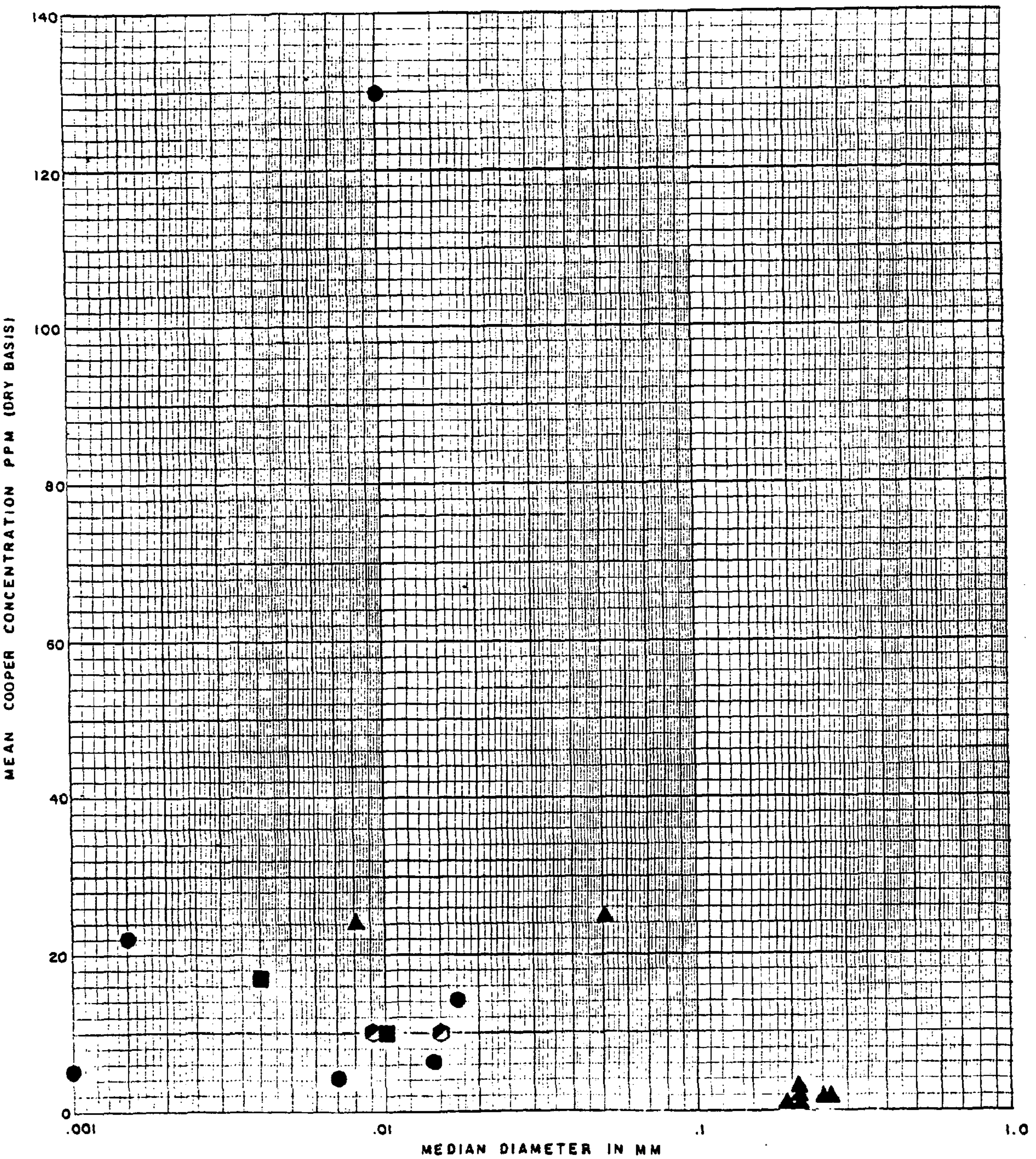
FALL / WET SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE , TAMPA , MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 3-26

CHECKED BY ________ DATE ________ APPROVED BY ________ DATE ________

REVISIONS BY ________ DATE ________



KEY :
- ● TAMPA
- ⊘ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE

MEAN COPPER CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

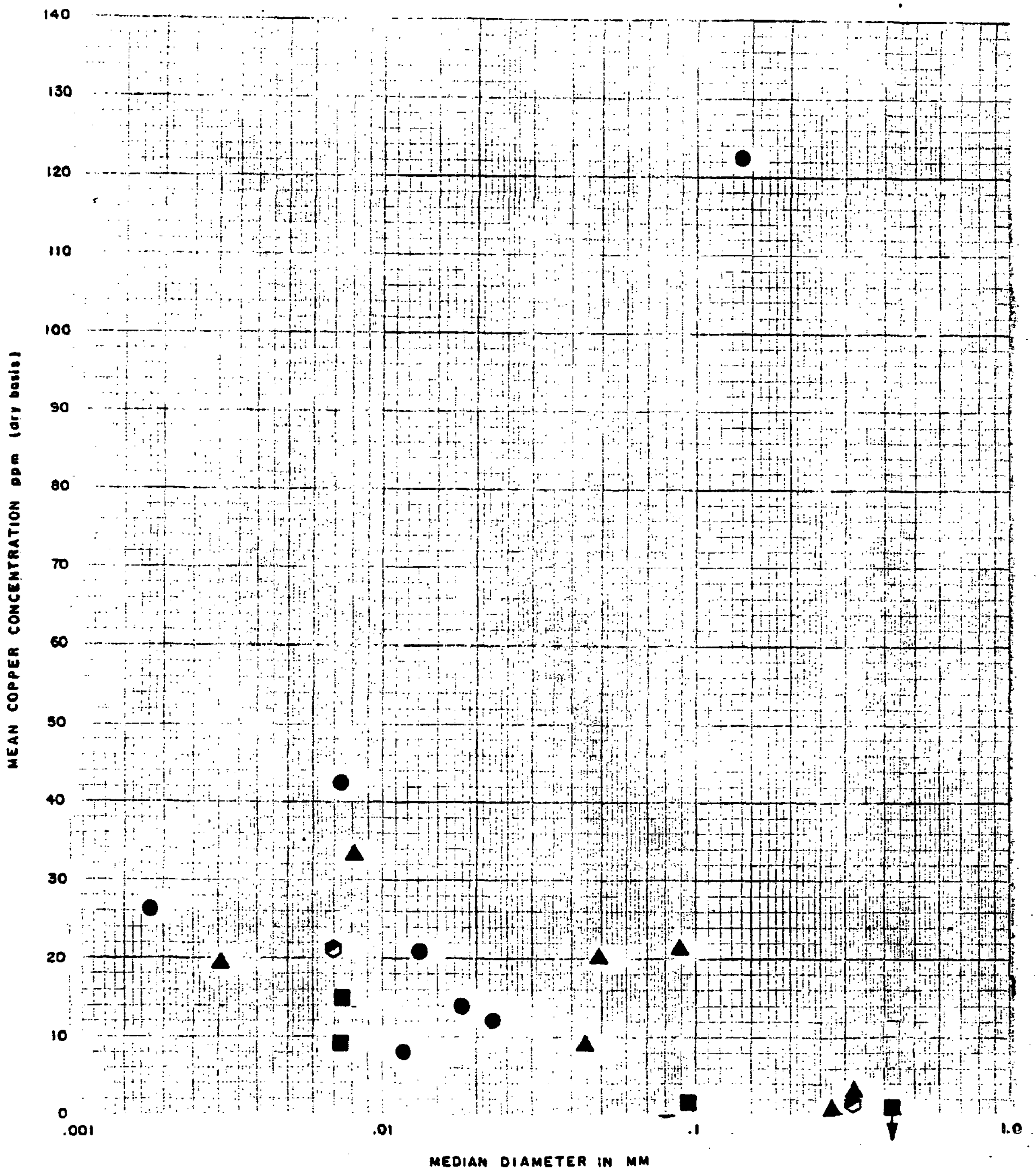
SPRING / DRY SEASON

12739004 26 (8/82)

PROJECT DER DEEPWATER
LOCATION : JACKSONVILLE , TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-27



KEY :

● TAMPA

⬡ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

↓ DENOTES VALUE DETERMINED USING ONE OR MORE VALUES BELOW THE LABORATORY DETECTION LIMIT (SEE APPENDIX C)

MEAN COPPER CONCENTRATION VS MEDIAN DIAMETER OF SEDIMENT

FALL / WET SEASON

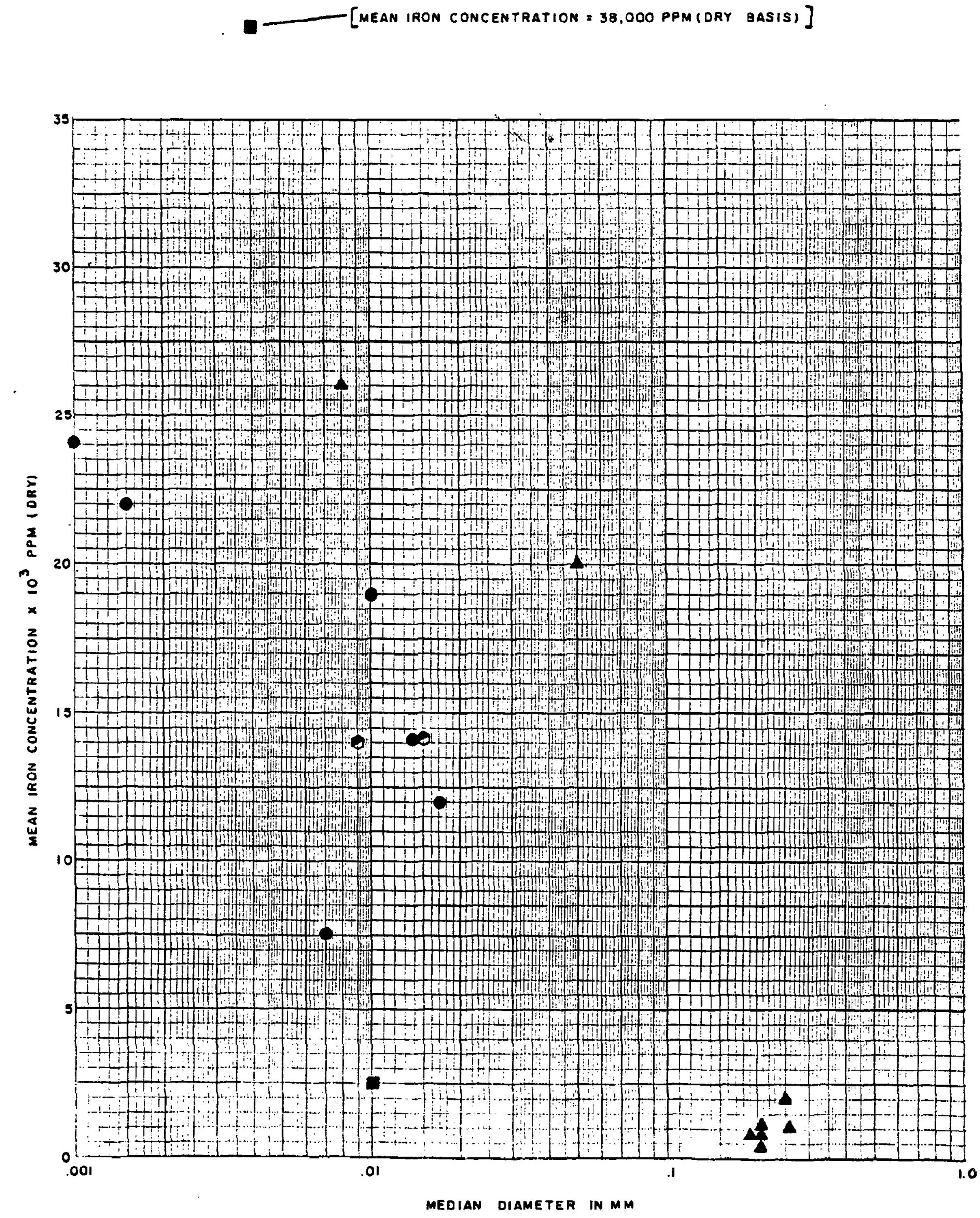
DATE 1/83 CHECKED DATE APPROVED DATE

1273900426(1/83)

PROJECT : DER DEEPWATER PORTS
LOCATION: JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-28



MEAN IRON CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : PORTS OF JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

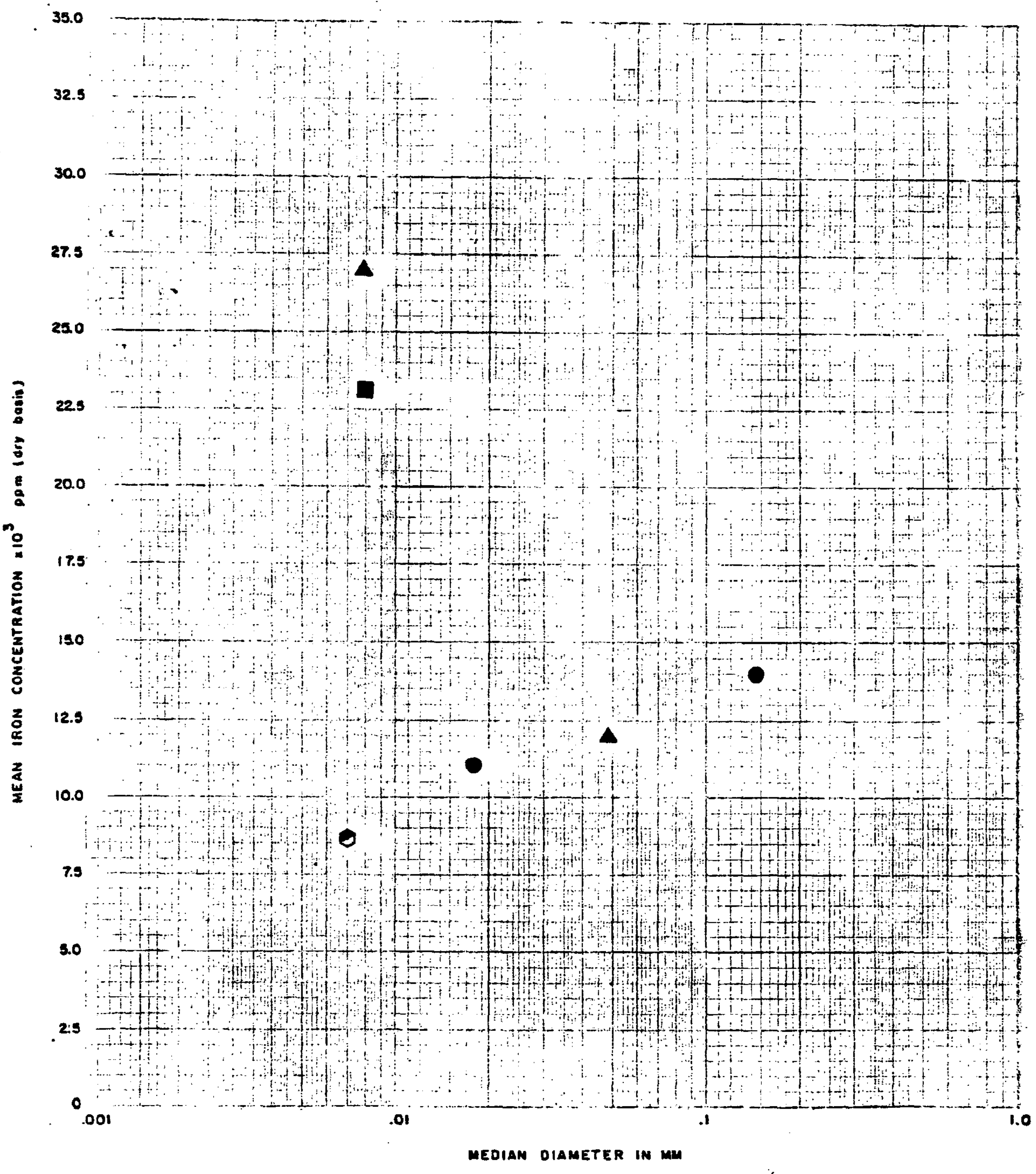
DAMES & MOORE

FIGURE 3-29

REVISIONS BY ______ DATE ______

12739004 26(8/82)

DATE 1/83 CHECKED DA APPROVED DATE



KEY :

● TAMPA

⬢ MANATEE

■ PENSACOLA

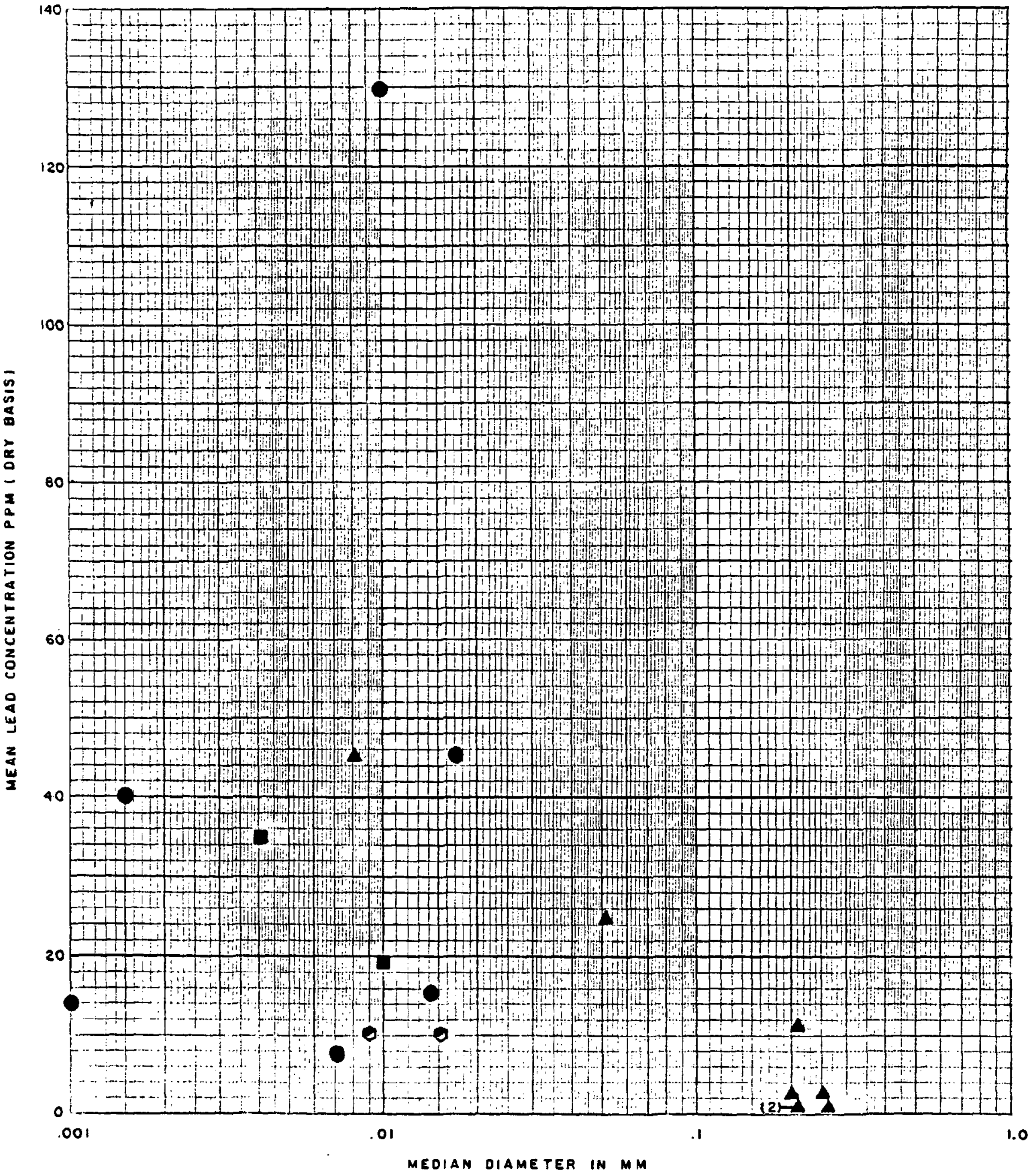
▲ JACKSONVILLE

MEAN IRON CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

FALL / WET SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 3-30



KEY :

(2) INDICATES NUMBER OF DATA POINTS

● TAMPA

⬢ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

MEAN LEAD CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

SPRING / DRY SEASON

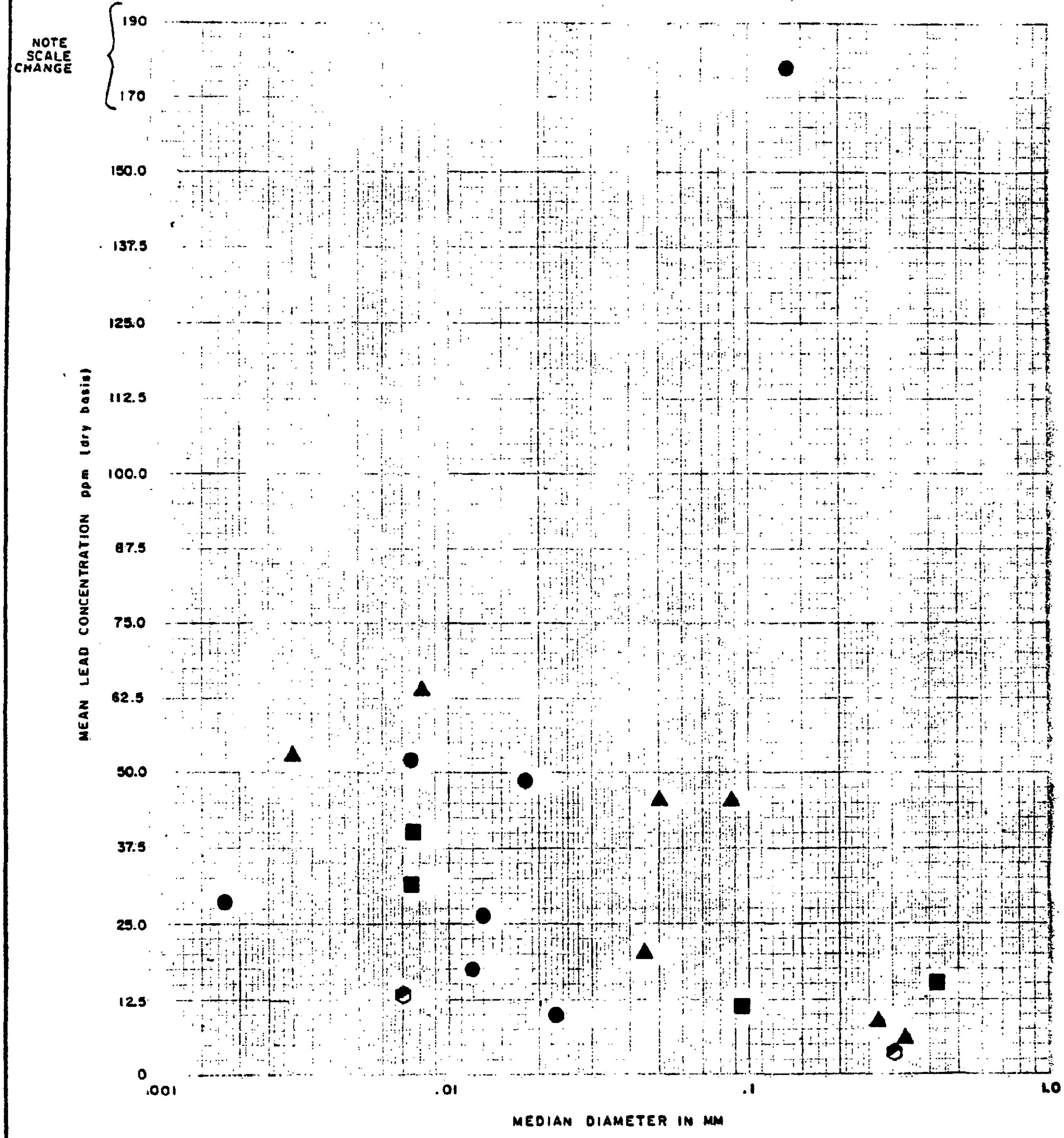
REVISIONS BY ________ DATE ________

1273900426 (8/82)

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-31



KEY :

- ● TAMPA
- ⬢ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE

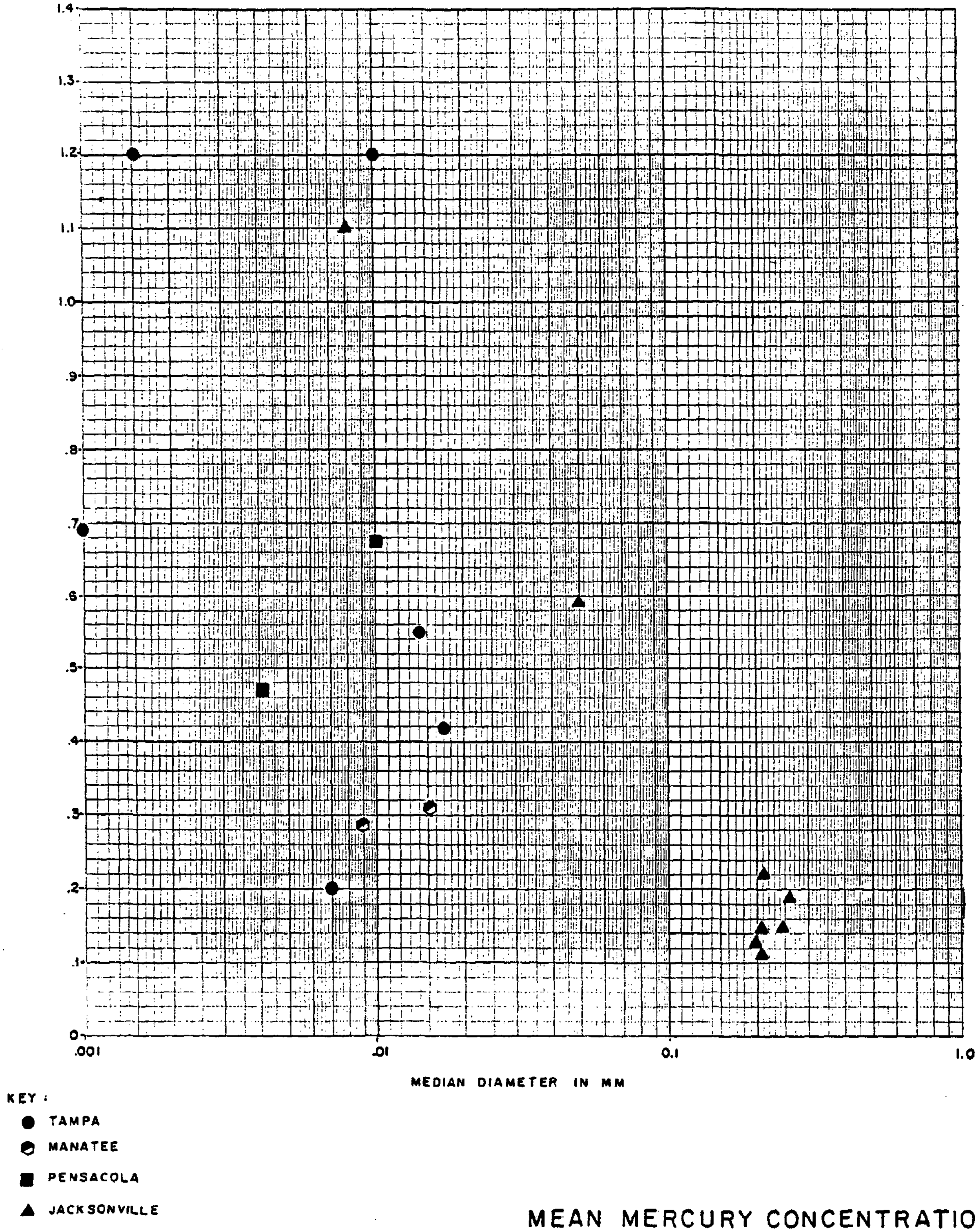
MEAN LEAD CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

FALL / WET SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE , TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 3-32

DATE ______ APPROVED ______ DAY ______ CHECKED ______ DATE 1/13 ______ DATE ______



MEAN MERCURY CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

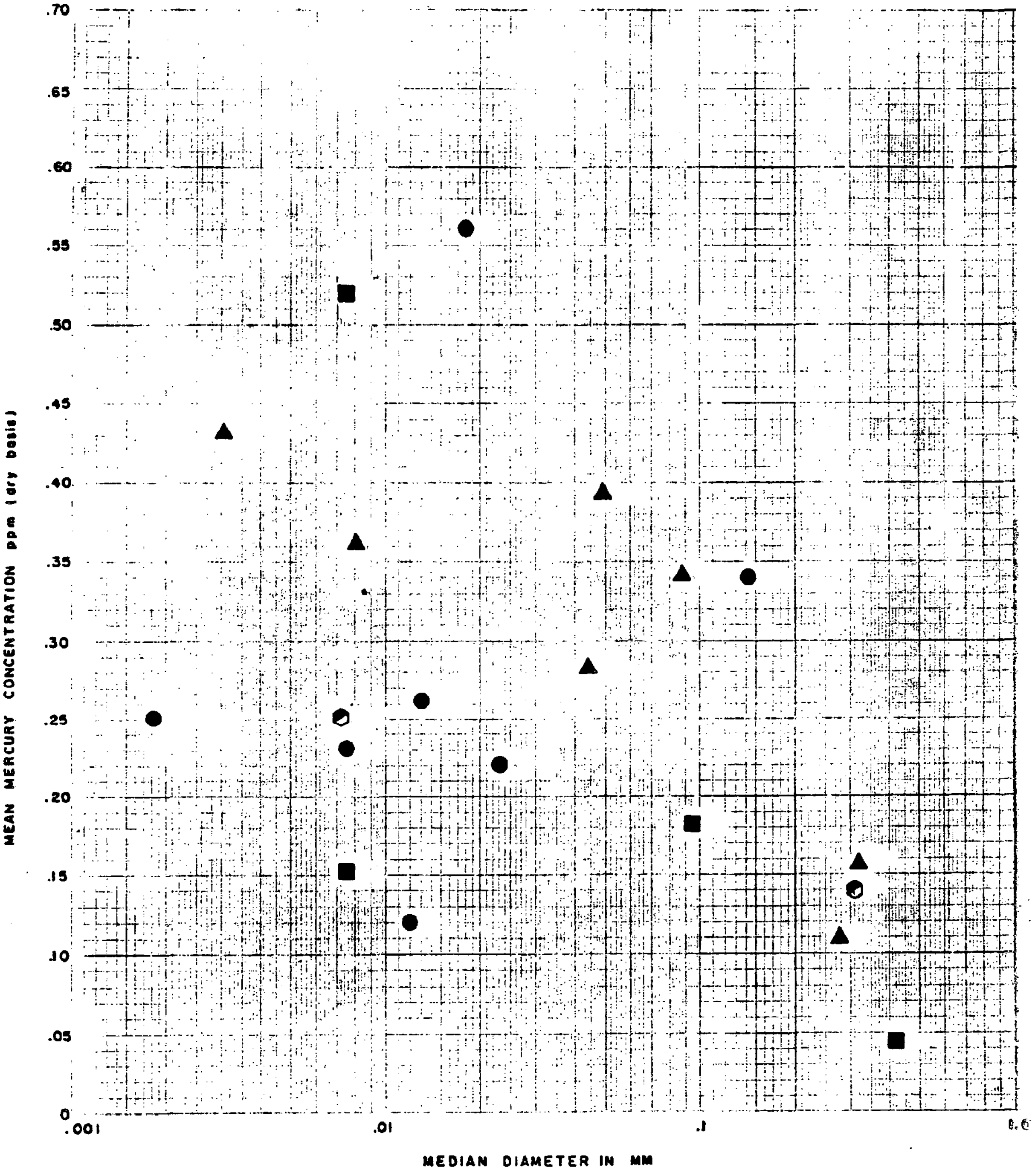
SPRING/ DRY SEASON

PROJECT: DER DEEP WATER PORTS LOCATION : JACKSONVILLE , PENSACOLA, TAMPA, MANATEE	**DAMES & MOORE** FIGURE 3-33

CHECKED ______ DATE ______ APPROVED ______ DATE

REVISION ______ DATE ______

1273900426 (9/82)



KEY :

● TAMPA

⬢ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

MEAN MERCURY CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

FALL / WET SEASON

PROJECT : DER DEEPWATER PORTS

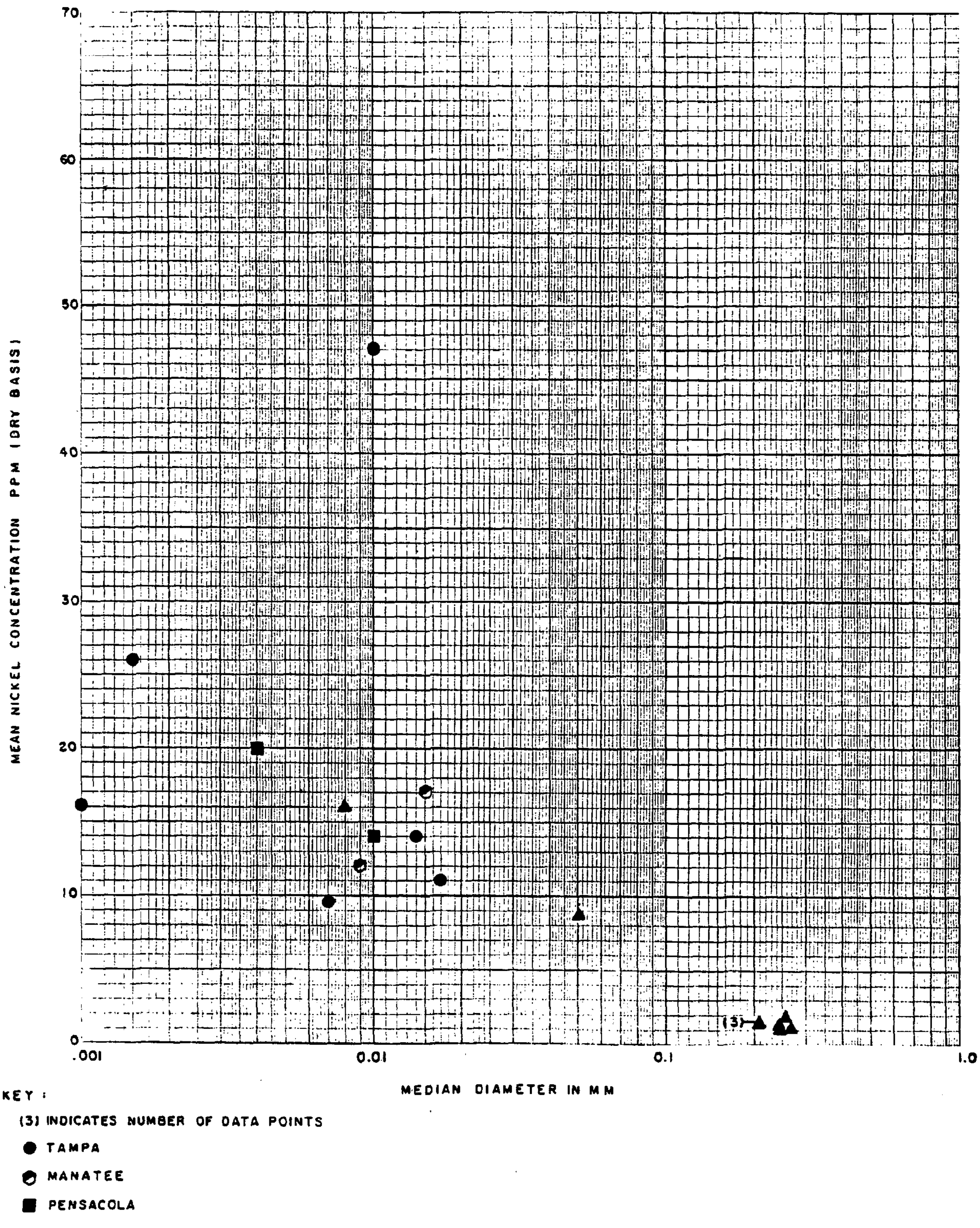
LOCATION : JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-34

DATE 1/13 CHECKED DA APPROVED DATE

REVISIONS ___ DATE ___



MEAN NICKEL CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

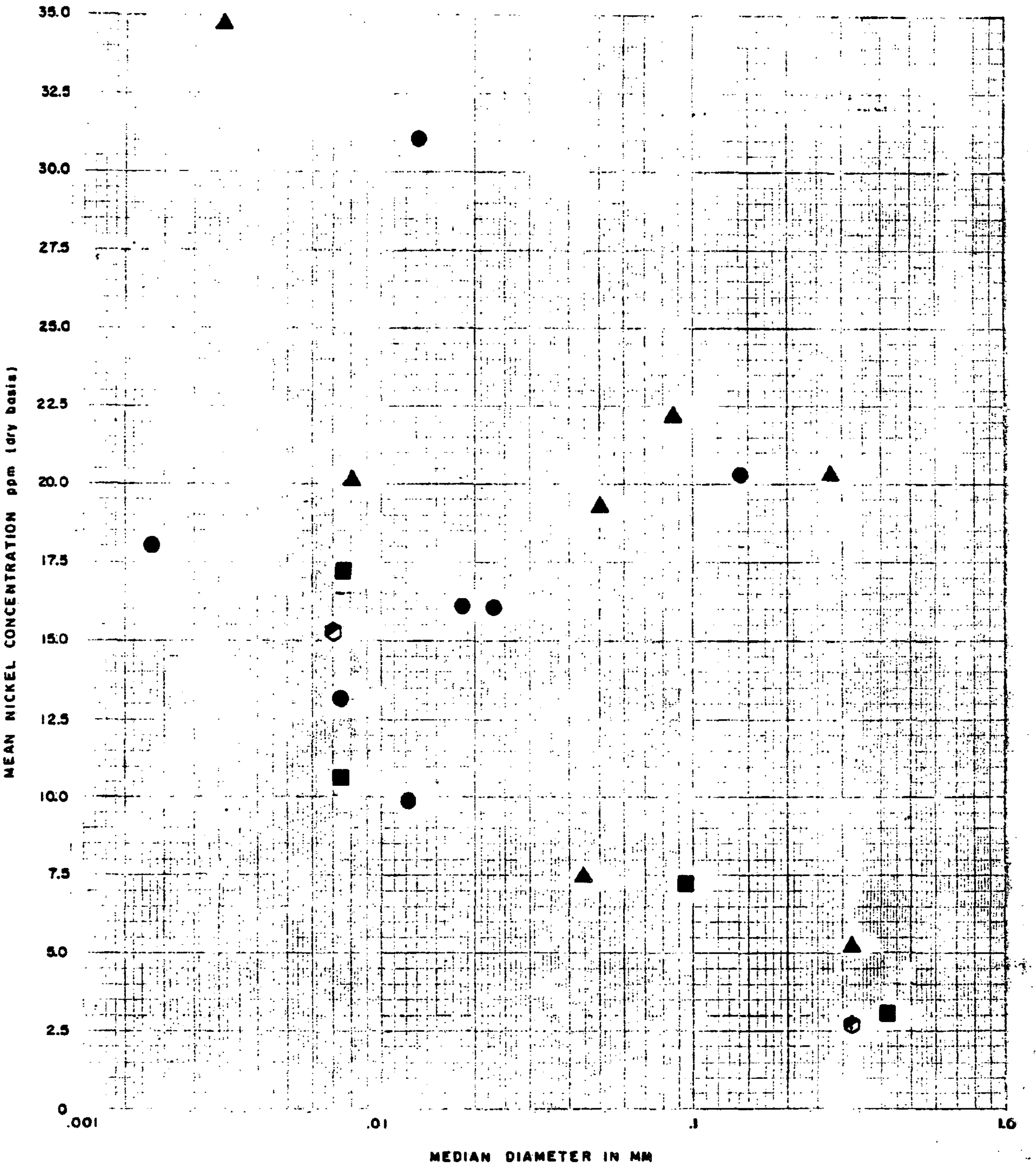
DAMES & MOORE
FIGURE 3-35

1273900426 (8/82)

DATE ________ APPROVED ________ DATE ________ CHECKED ________ DA

DATE 1/13 lge

12739004261(1/83)



KEY :

● TAMPA

⬢ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

MEAN NICKEL CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

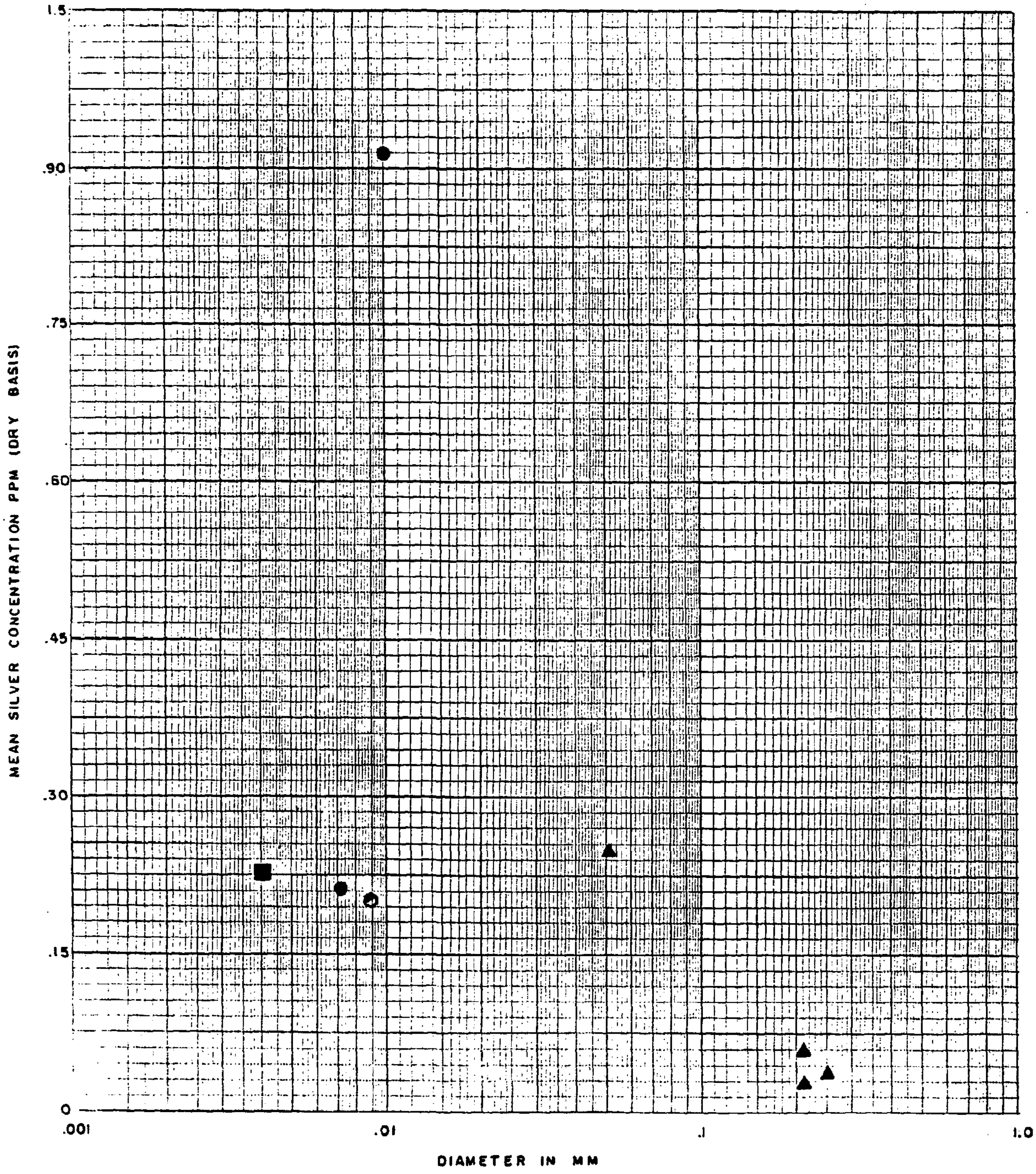
FALL / WET SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE , TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-36

REVISIONS BY ________ DATE ________



KEY·

● TAMPA

◐ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

MEAN SILVER CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

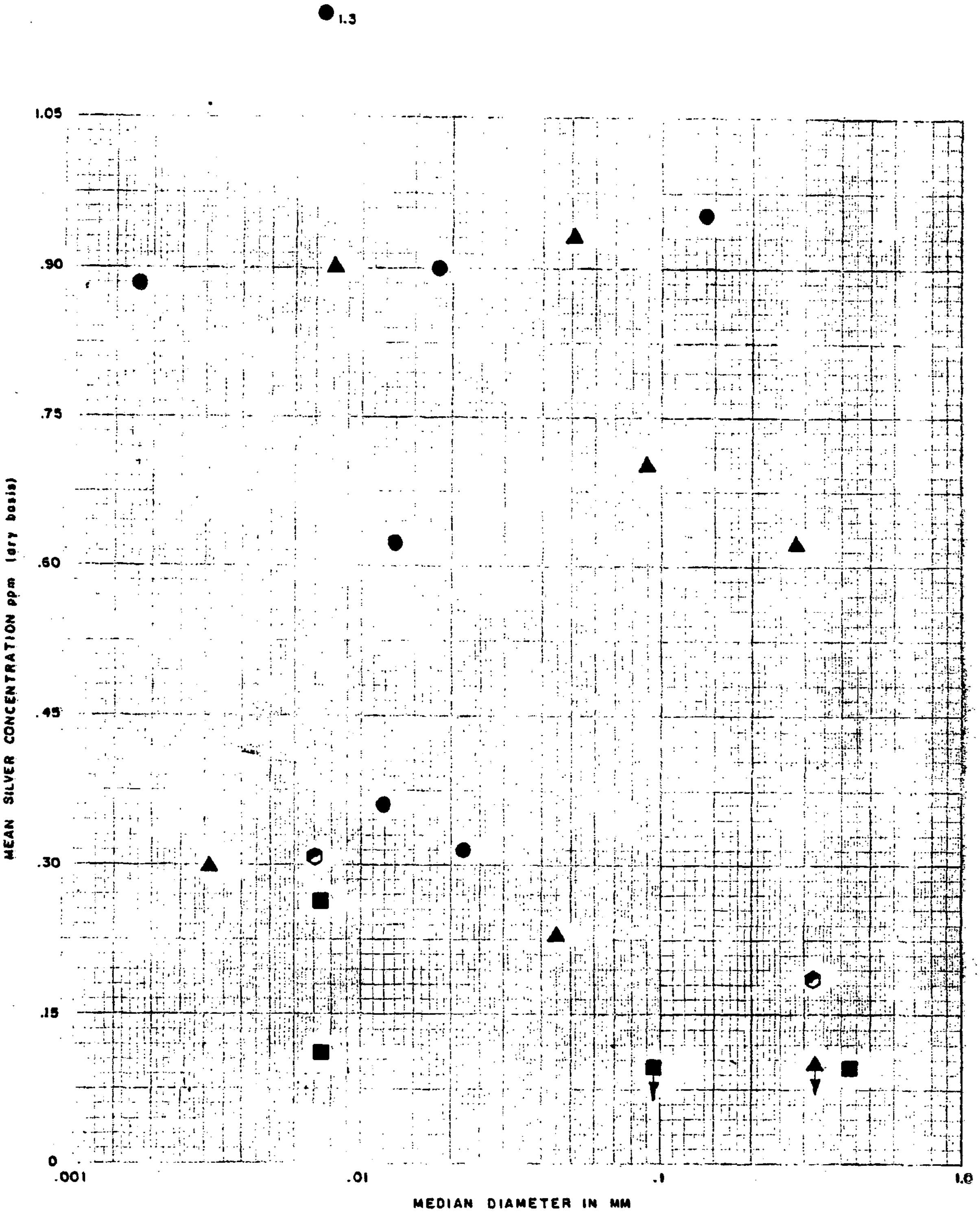
SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE

FIGURE 3-37

1273900426 (8/82)



MEAN SILVER CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

FALL / WET SEASON

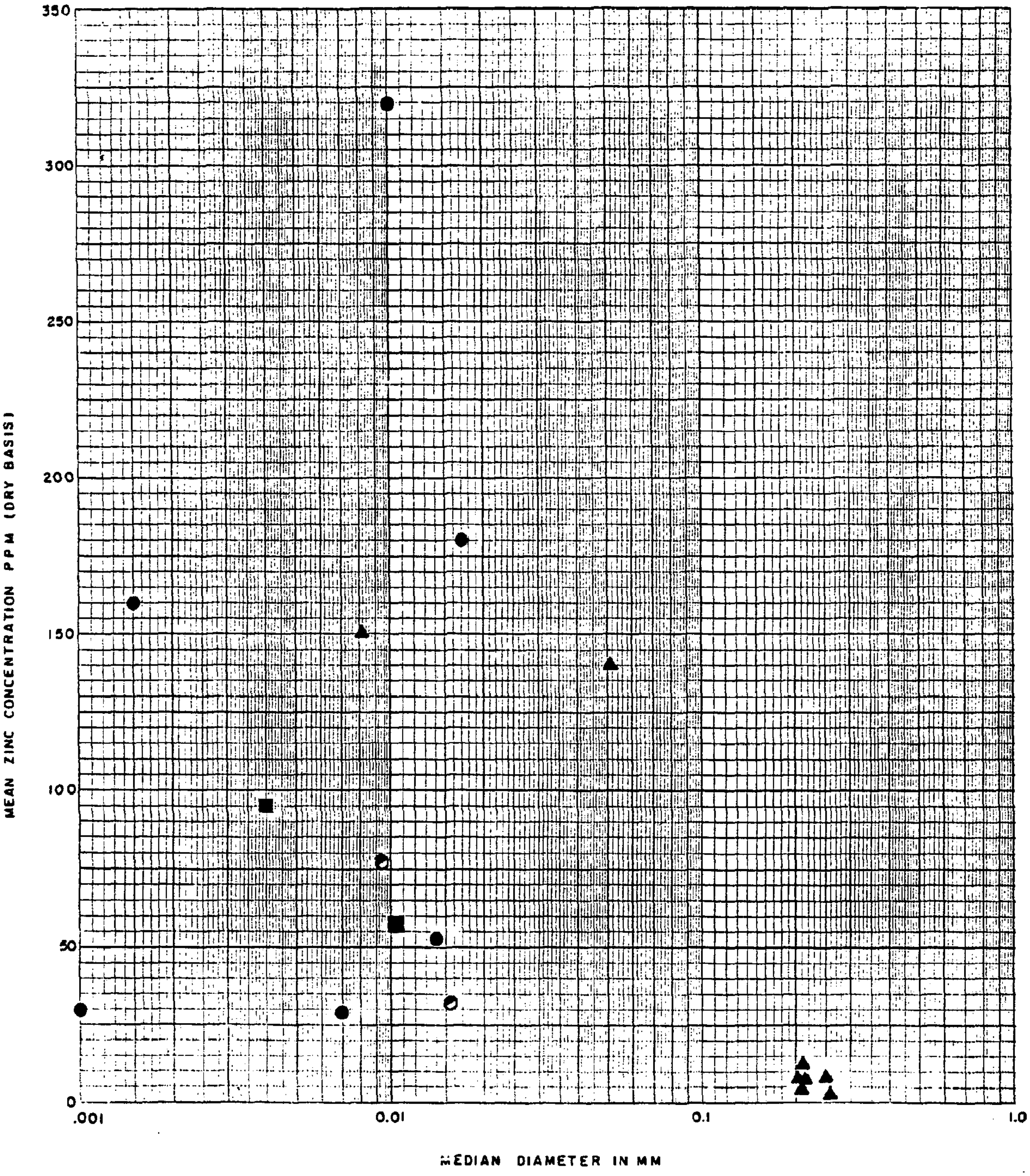
PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE, TAMPA, MANATEE AND PENSACOLA

DAMES & MOORE
FIGURE 3-38

CHECKED ______ DATE 1/13 ______ APPROVED ______ DATE ______ QA ______

12739004261(1/83)

REVISIONS BY ______ DATE ______



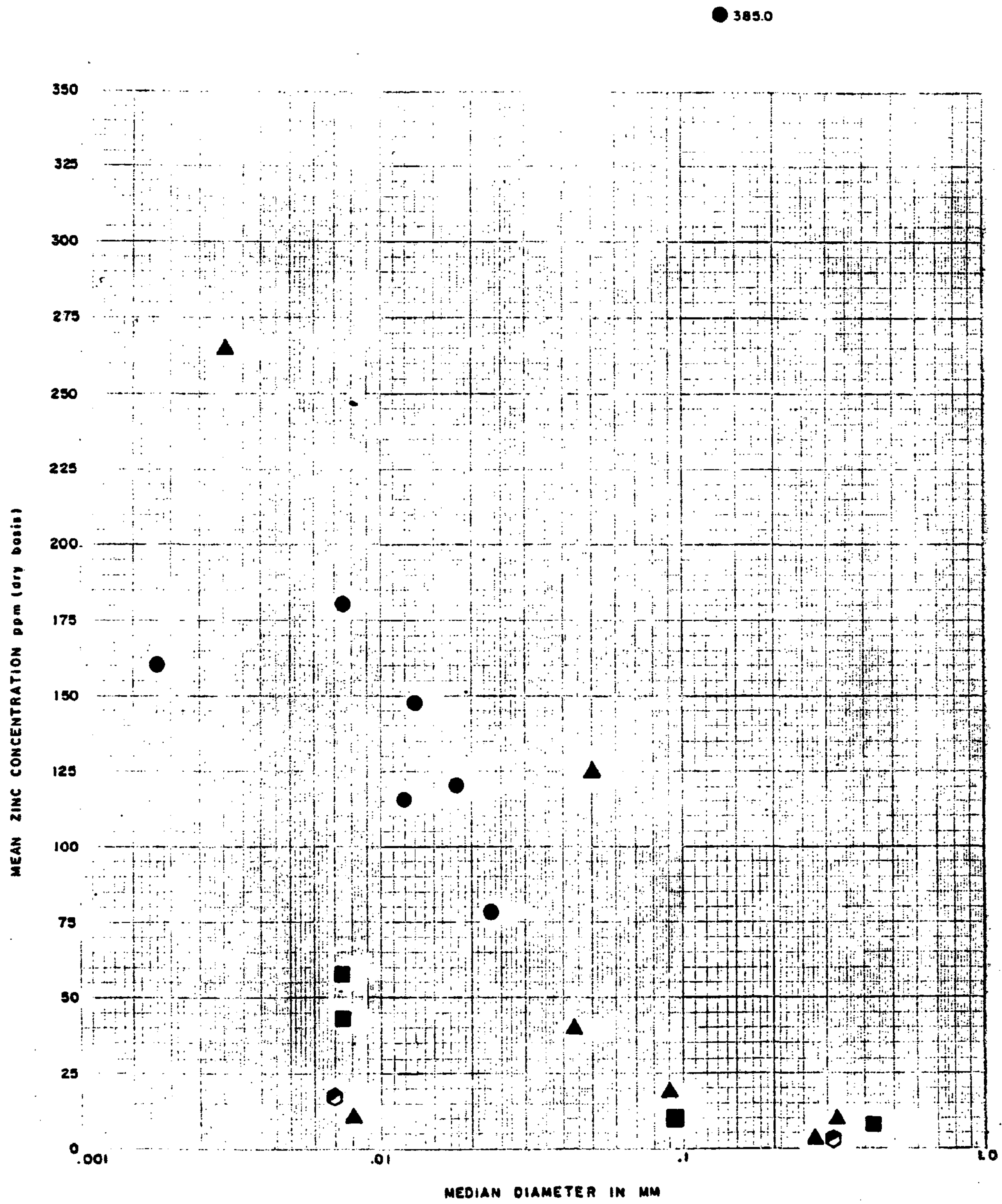
KEY :
- ● TAMPA
- ◐ MANATEE
- ■ PENSACOLA
- ▲ JACKSONVILLE

MEAN ZINC CONCENTRATION VS.
MEDIAN DIAMETER OF SEDIMENT
SPRING / DRY SEASON

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE, TAMPA, MANATEE AND JACKSONVILLE

DAMES & MOORE
FIGURE 3-39

1273900426 (8/82)



KEY :

● TAMPA

⬢ MANATEE

■ PENSACOLA

▲ JACKSONVILLE

MEAN ZINC CONCENTRATION VS. MEDIAN DIAMETER OF SEDIMENT

FALL / WET SEASON

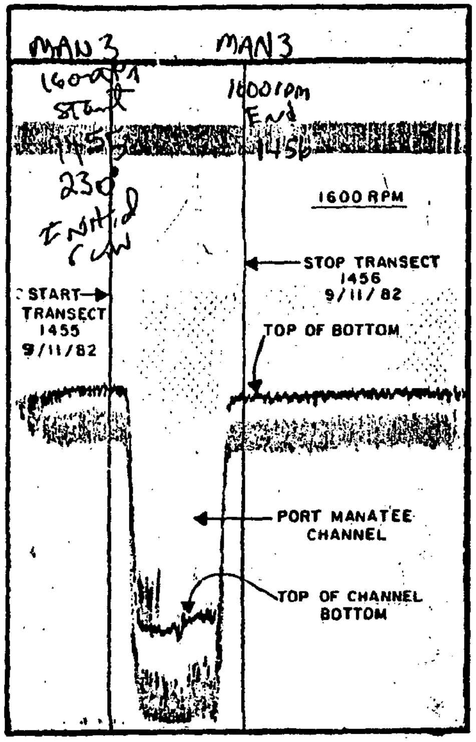
DATE 1/83 CHECKED DA APPROVED DATE

PROJECT : DER DEEPWATER PORTS
LOCATION : JACKSONVILLE , TAMPA , MANATEE AND PENSACOLA

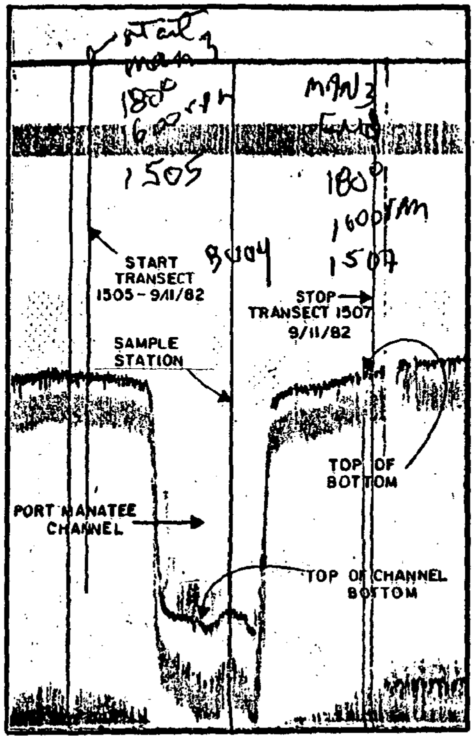
DAMES & MOORE
FIGURE 3-40

DATA ______ CHECKED ______ A APPROVED ______ DATA ______

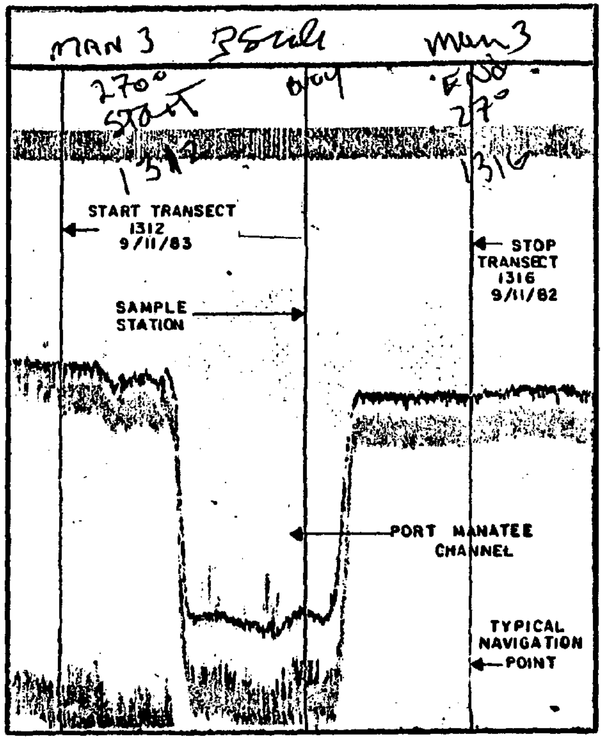
12739004 26 (5/83)



TRANSECT I



TRANSECT II

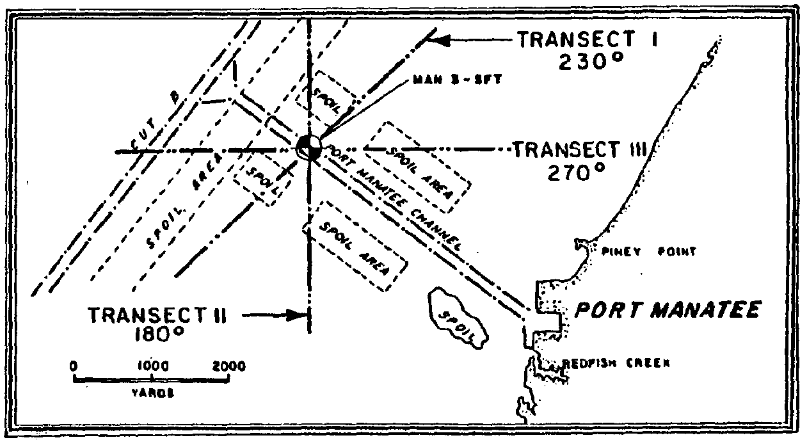


TRANSECT III

TRANSECTS NOT TO SCALE

NOTE :

DATA COLLECTED 9/11/82 , USING PRESIDENT MODEL 412 RECORDING FATHOMETER



PORT MANATEE

FATHOMETER PROFILE
PORT MANATEE
STATION MAN 3-SFT

PROJECT : DER-DEEP WATER PORTS
LOCATION : JACKSONVILLE - PENSACOLA - TAMPA - MANATEE

DAMES & MOORE
FIGURE 5-1

METEOROLOGICAL AND GENERAL CONDITIONS

Deep Water Ports Maintenance Dredging Study

1.1 Location (Port/Harbor) ________________

1.2 Station Identification ________________

1.3 Job Number: 12739-004

1.4 Client/Owner: Department of Environmental Regulation

1.5 Date (mo, day, year) ________________

1.6 Observation by: ________________

1.7 Previous Nights Weather (to include rainfall, wind conditions, cloud cover, sharp drops in ambient air termperature)

1.8 Meteorological Conditions on Station (to include ambient air temperature, cloud cover, rainfall, wind conditions)

1.9 Water Conditions (to include general observation of wave climate, algal blooms, turbidity plumes, foaming, surface oils, etc.)

1.10 General Conditions (to include vessel traffic, outfalls, dredging, wildlife, etc.)

1.11 General Comments

1.12 Recorded by: ________________

FALL/WET SEASON GENERAL OBSERVATION CHECKLIST

DAMES & MOORE

FIGURE 5-2

Job Number:

Owner/Client:

Port:

STATION:

WATER COLUMN

STATION TYPE	STATION I.D.	VESSEL TYPE	QUANTITY NEEDED	QUANTITY COLLECTED
F		1/2-liter POLY	3	
F(Hg)		BOD GLASS	3	
J		1/2- Liter POLY	3	
O (phenol)		1-liter GLASS	3	
O (pesticides)		1-liter GLASS	3	
T*		150 ml. POLY	3	
W		1/2-liter POLY	3	
W(Hg)		BOD GLASS	3	
X		1-Gal. POLY	12	

* Taken at all stations in Port of Tampa and Port Manatee and at JAX 4B-WT(O).

TIME COMPLETED: (time, date)

SIGNATURE/ DATE: /

FALL/WET SEASON INVENTORY
CHECKLIST FOR WATER SAMPLES