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FINAL RI/FS SAMPLING AND ANALYSIS PLAN FOR SITES 40 AND 42 BAYOU GRANDE AND PENSACOLA BAY NAVAL AIR STATION PENSACOLA, FLORIDA

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19. Abstract

This Sampling and Analysis Plan concludes the Phase I portion of the Remedial Investigation at Sites 40 and 42, Bayou Grande and Pensacola Bay, at NAS Pensacola and presents the sampling approach for its continuation. Based on a review of all Installation Restoration sites, site history, previous sample locations, and sediment distribution within the bay and the bayou, Phase IIA sample locations within both water bodies were chosen. These sediment and surface water samples shown in this plan will be collected as part of the Pheae IIA portion of the investigation. This plan also summarizes all sample locations, sampling techniques, data quality requirements. and provides a framework for characterizing ecological and human health risks.

Section 1 broadly outlines the objectives of the entire RI at Sites 40 and 42. Section 2 describes the site charactenstics, history, and physical setting. Section 3 discusses the plan for preliminary survey., including the contaminant source survey, habitat and biota survey, and Phase I sediment assessment. Section 4 identifies the basic characteristics of the bay and the bayou, including sediment distribution, sample strategy, justification, and locations for Phase IIA of the investigation. Section 5 describes the framework of the ecological risk assessment at Sites40 end 42, including key assumptions, known and potential stressors, receptors, exposure scenarios, endpoints. and the conceptual model. Section 6 describes the framework for the human health risk assessment, including key assumptions, development of baseline risks, and uncertainty analysis.

Only areas of the bayou and the bay adjacent to NAS Pensacola possibly impacted by any of the IR sites, or areas which serve as an appropriate control, will be investigated during the Phase IIA portion of the investigation. Included with the justification for further study at a particular area of the bay and bayou will be a historical summary of any site-related contamination identified within each area as well as diagrams of sediment distribution showing the likelihood of contaminant distribution in the sediment. Additional sample locations may be required to fully characteriza the nature and magnitude of contamination. Information from Phase I, Phase IIA and any subsequent phases of the RI will be incorporated into an ecological and human health risk assessment for Sites 40 and 42.

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List of Acronyms

The following list contains many of the acronyms, initials, abbreviations, and units of measure used in this report.

ABF	Absorption Factor
ARAR	Applicable, Relevant, and Appropriate Requirement
ASTM	American Society for Testing and Materials
BaP	Benzo(a)pyrene
BRA	Baseline Risk Assessment
CDI	Chronic Daily Intake
CF	Contact Factor
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
cm^2/Day	Square Centimeters per Day
COC	Chemicals of Concern
COPC	Chemicals of Potential Concern
CPSS	Chemicals Present in Site Samples
CSAP	Comprehensive Sampling and Analysis Plan
CT	Central Tendency
DQO	Data Quality Objective
E/A&H	EnSafe/Allen & Hoshall
E&E	Ecology and Environment, Inc.
EF	Exposure Frequency
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
FDEP	Florida Department of Environmental Protection
FDWS	Florida Drinking Water Standards
FS	Feasibility Study
FSGS	FDEP Soil Cleanup Goals
G&M	Geraghty and Miller, Inc.
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
IF	Ingestion Factor
ILCR	Incremental Lifetime Cancer Risk
IR	Installation Restoration
IRIS	Integrated Risk Information System
IWTP	Industrial Wastewater Treatment Plant
L/Day	Liters per Day
L/kg	Liters per Kilogram
MCL	Maximum Contaminant Level
msl	mean sea level

mg/cm^2	Milligrams per Square Centimeter
mg/day	Milligrams per Day
mg/kg	Milligrams per Kilogram
mg/kg/day	Milligrams per Kilogram per Day
mg/L	Milligrams per Liter
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
NAS Pensacola	Naval Air Station Pensacola
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
OU	Operable Unit
PAHs	Polyaromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
ppb	Parts Per Billion
ppm	Parts Per Million
RI	Remedial Investigation
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentrations
RfD	Reference Dose
RGO	Remedial Goal Options
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
SAP	Sampling and Analysis Plan
SF	Slope Factor
SMCL	Secondary MCLs
SMP	Site Management Plan
SOP/QAM	Standard Operating Procedures and Quality Assurance Manual
SOUTHNAVFACENGCOM	Southern Division, U.S. Navy, Naval Facilities Engineering command
SSV	EPA Region IV Sediment Screening Value
ST	Shelby Tube
SVOC	Semivolatile Organic Compound
TAL/TCL	Target Analyte List/Target Compound List
TAL	Target Analyte List
TCL	Target Compound List
TEF	Toxicity Equivalency Factor
TOC	Total Organic Carbon
TRPHs	Total Recoverable Petroleum Hydrocarbons
UCL	Upper Confidence Limit
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
WQC	Water Quality Criteria

EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) concludes the Phase I portion of the Remedial Investigation (RI) at Sites 40 and 42, Bayou Grande and Pensacola Bay, at NAS Pensacola and presents the sampling approach for its continuation. Based on a review of all Installation Restoration sites, site history, previous sample locations, and sediment distribution within the bay and the bayou, Phase IIA sample locations in both water bodies were chosen. The sediment and surface water samples shown in this plan will be collected as part of the Phase IIA portion of the investigation. This plan also summarizes all sample locations, sampling techniques, and data quality requirements, and provides a framework for characterizing ecological and human health risks.

Section 1 broadly outlines the objectives of the entire RI at Sites 40 and 42. Section 2 describes the site characteristics, history, and physical setting. Section 3 discusses the plan for preliminary surveys, including the contaminant source survey, habitat and biota survey, and Phase I sediment assessment. Section 4 identifies the basic characteristics of the bay and the bayou, including sediment distribution, sample strategy, justification, and locations for Phase IIA of the investigation. Section 5 describes the framework of the ecological risk assessment at Sites 40 and 42, including key assumptions, known and potential stressors, receptors, exposure scenarios, endpoints, and the conceptual model. Section 6 describes the framework for the human health risk assessment, including key assumptions, development of baseline risks, and uncertainty analysis.

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1.0 INTRODUCTION

This Remedial Investigation/Feasibility Study (RI/FS) is being performed under the U.S. Navy's Comprehensive Long-Term Environmental Action Navy (CLEAN) program at Sites 40 and 42 — Bayou Grande and Pensacola Bay at NAS Pensamla. This plan has been developed by E/A&H as tasked by the Southern Division, U.S. Navy, Naval Facilities Engineering Command under Contract Number N62467-89-D-0318/CTO-036..

Primary references include the *Final Comprehensive Sampling and Analysis Plan for Naval Air Station Pensacola* (CSAP) (E/A&H 1995), the *Draft Final RI/FS Work Plan, Sites 40 and 42, Bayou Grande and Pensacola Bay* (E/A&H, June 1995) and the United States Environmental Protection Agency (EPA) Region IV *Standard Operating Procedures and Quality Assurance Manual* (SOP/QAM). This investigation will be completed to fulfill requirements in the work plan for Sites 40 and 42 and this *SAP* and also adhere to the SOP/QAM and *CSAP*.

One of the requirements of the RI of Sites 40 and 42 was completion of the Phase I qualitative survey of the bay and bayou to determine how they might be impacted by any of the sites identified as part of the IR program. There were two major goals of Phase I: 1) identify those assumptions and endpoints used in determining risks to human health and the environment, and (2) identify and justify the initial sediment and surface water sample locations within the bay and bayou as the first step in determining risks to human health and the environment. Figure 1-1 shows the current status of the Sites 40 and 42 investigation in relation to the RI flow chart and the remaining phases that may need to be performed. The remaining phases are summarized below from the work plan for Sites 40 and 42 and Section 8 of the *CSAP*.

The procedure used in assessing Sites 40 and 42 is divided into three phases. Phase I, described above, leads into Phase IIA, which characterizes the nature, magnitude, and sources of contamination in portions of the bay and bayou surrounding NAS Pensacola potentially impacted

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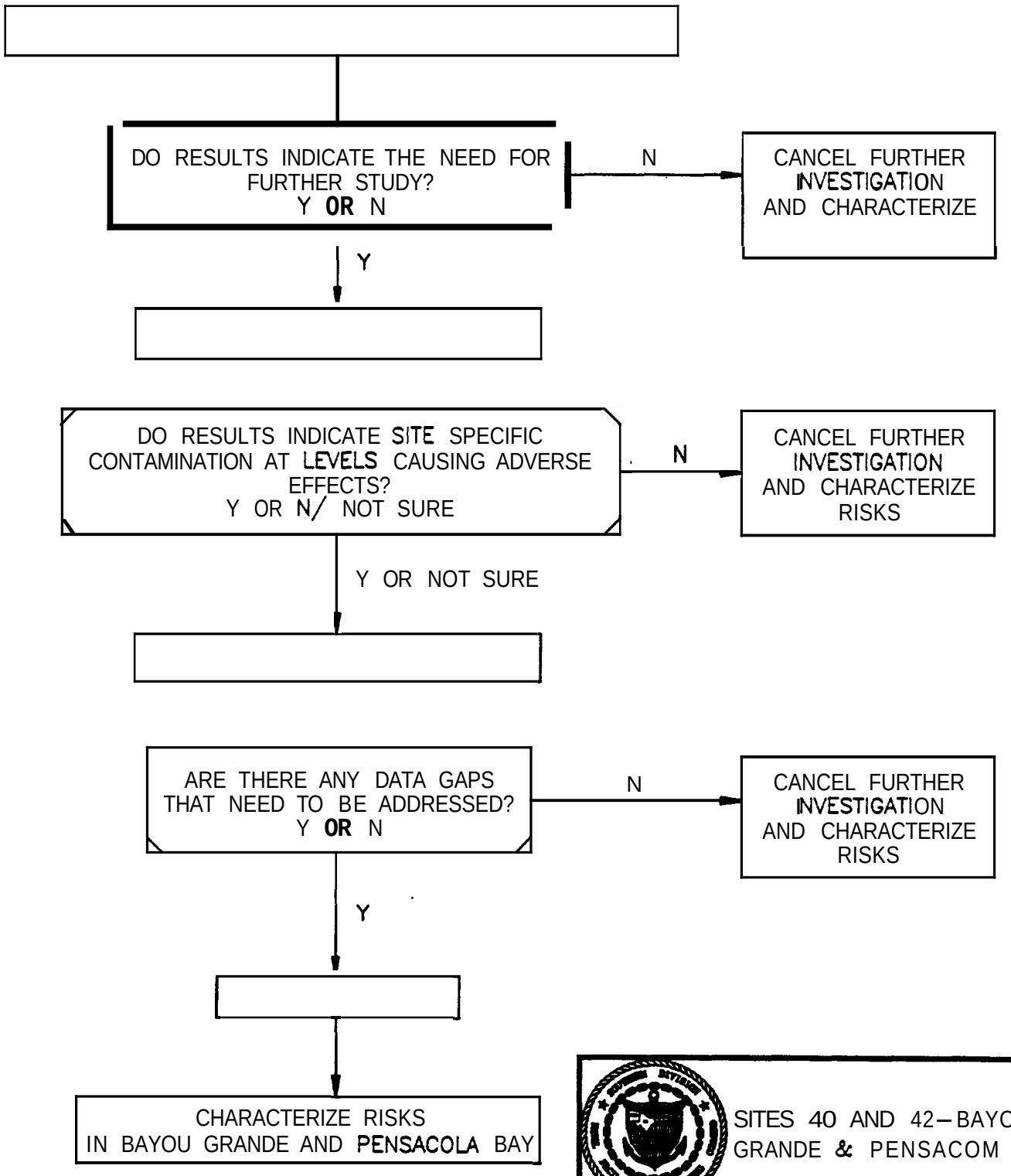

SITES 40 AND 42—BAYOU GRANDE & PENSACOM BAY

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by any IR site. Phase IIA sampling will include sediment and surface water sampling to identify site contaminants. By establishing this link between source and the receptor, remedial strategies can be better developed for both the bay and bayou and their associated IR sites. Once nature, magnitude and sources of contamination are known, the investigation may move into Phase IIB. But before Phase IIB begins, E/A&H will present its findings from Phase IIA to the Tier I Partnering Team and the other resource trustees. In doing so, E/A&H will justify its initial decisions for further study at each area within the bay and bayou as quantitatively as possible. However, modeling techniques described in the work plan for Sites 40 and 42 and other procedures may also be used to yield more information about potential impacts to human health and the environment.

After the areas of the bay and bayou planned for further investigation are selected, Phase IIB will be implemented to determine any impacts to human health and the environment that may have been caused within known areas of contamination. Since ecological receptors are primarily of concern within the bay and the bayou, impacts may be measured through the use of toxicity tests and diversity studies of select organisms. If there are any data gaps in quantifying risks after Phase IIB, the investigation may move into Phase III . After Phase III is complete, risks in all potentially impacted areas of the bay and the bayou should be adequately characterized to make decisions about remedial options. Areas of the bay and the bayou which do not require a complete investigation may not be further investigated and will only be considered in the full risk assessment in the RI in a limited manner. E/A&H will justify decisions for not proceeding further in the investigation of these areas.

This SAP is organized into six major sections. Section 1 broadly outlines the objectives of the entire RI at Sites 40 and 42. Section 2 describes the site characteristics, history, and physical setting. Section 3 discusses the plan for preliminary surveys, including the contaminant source survey, habitat and biota survey, and Phase I sediment assessment. Section 4 identifies the basic characteristics of the bay and the bayou, including sediment distribution, sample strategy,

justification, and locations for Phase IIA of the investigation are also explained. Section 5 describes the framework of the ecological risk assessment at Sites 40 and 42, including key assumptions, known and potential stressors, receptors, exposure scenarios, endpoints, and the conceptual model. Section 6 describes the framework for the human health risk assessment, including key assumptions, development of baseline risks, and uncertainty analysis.

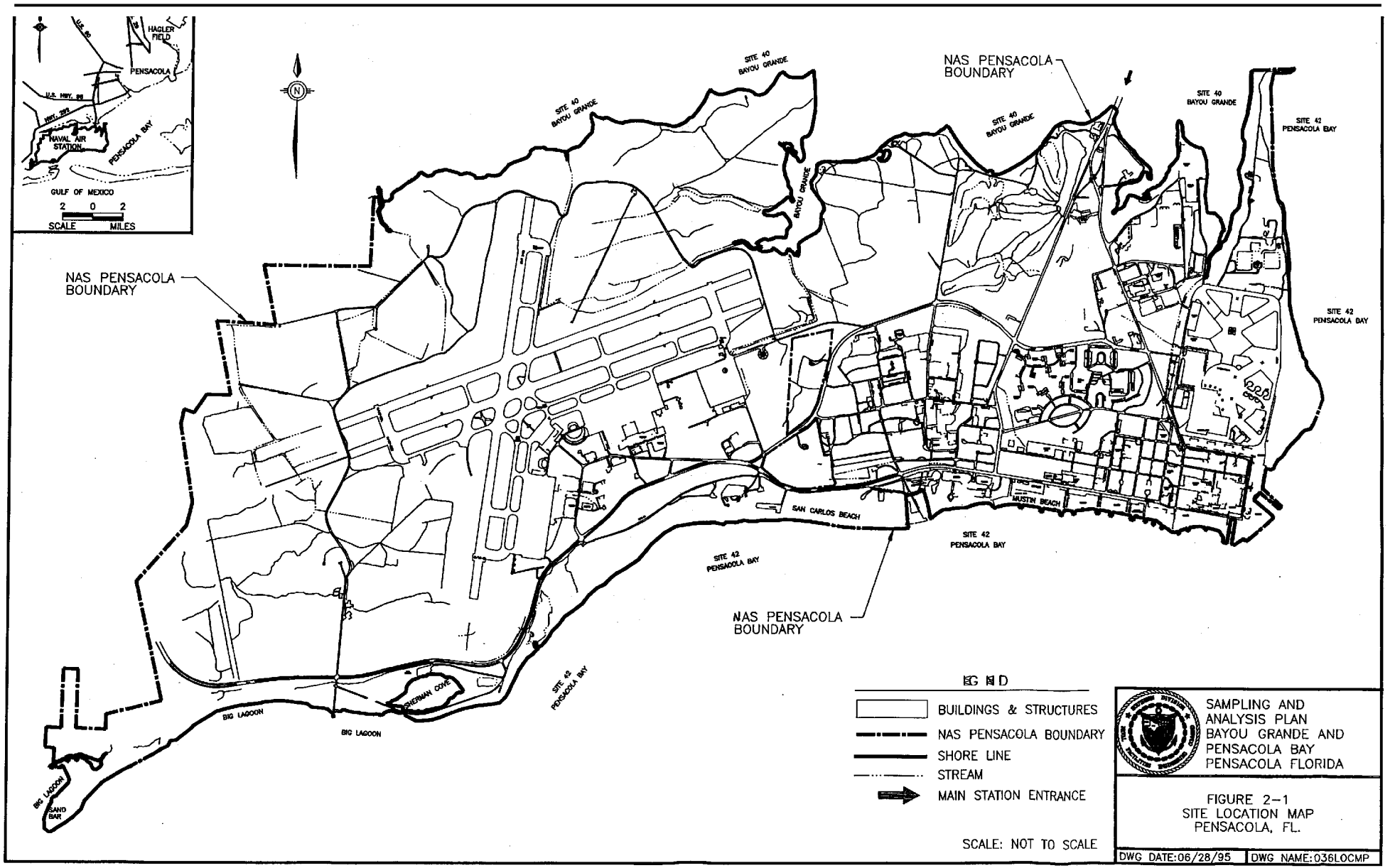
The goal of this RI is to assess the nature, magnitude, and sources of potential impact from site-related contamination in portions of Pensacola Bay and Bayou Grande surrounding NAS Pensacola. Chemical analyses will be completed by a laboratory approved by the Naval Facilities Engineering Service Center (NFESC) using Contract Laboratory Program (CLP) protocol. A State of Florida-approved laboratory will analyze any biological samples in accordance with EPA or American Society for Testing and Materials (ASTM) approved protocols. As appropriate, field sampling, analytical methods, and reporting will be conducted at EPA Level IV protocol.

When the investigative work and laboratory analyses are complete, an RI report will be submitted to the EPA, the Florida Department of Environmental Protection (FDEP), and the other resource trustees, summarizing the activities, results, and conclusions of the investigation. The RI report will also include the human health and ecological risk assessment at Sites 40 and 42. The FS will be completed separately.

2.0 BACKGROUND INFORMATION

2.1 Site Description

As shown on Figure 2-1, Bayou Grande (Site 40) is an estuarine water body adjacent to the northern border of NAS Pensacola in Escambia County. It extends roughly east to west approximately 5 miles inland into the south-southwestern portion of Escambia County. The northern and central portions of NAS Pensacola, and areas of west Pensacola adjacent to the


HAGLER FIELD
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U.S. HWY. 29
NAVAL AIR STATION
PENSACOLA BAY
GULF OF MEXICO
2 0 2
SCALE MILES
NAS PENSACOLA BOUNDARY
SITE 40 BAYOU GRANDE
BAYOU GRANDE
SITE 42 PENSACOLA BAY
SAN CARLOS BEACH
MUSTIN BEACH
SHERMAN COVE
BIG LAGOON
SAND BAR
LEGEND
BUILDINGS & STRUCTURES
NAS PENSACOLA BOUNDARY
SHORE LINE
STREAM
MAIN STATION ENTRANCE
SCALE: NOT TO SCALE
SAMPLING AND ANALYSIS PLAN
BAYOU GRANDE AND PENSACOLA BAY
PENSACOLA FLORIDA
FIGURE 2-1
SITE LOCATION MAP
PENSACOLA, FL.
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bayou, drain into Bayou Grande. Bayou. Grande flows eastward into Pensacola Bay near NAS Pensamla's Magazine Point.

Bayou Grande is a tributary to Pensacola Bay, which is at the lowest extent part of a larger surface water system known as the Pensacola Bay System (PBS). A full description of the PBS is included in the Work Plan for Sites 40 and 42. Primarily located in Escambia County, Pensacola Bay occupies approximately 52 square miles of surface area (Olinger et al. 1975). Approximately 11 miles of Pensacola Bay coastline borders NAS Pensacola property (Figure 2-1). Near NAS Pensacola, Pensacola Bay receives waters from Bayou Chico, as well as Bayou Grande. The mean depth of Pensacola Bay is approximately 19.5 feet (Collard 1991).

2.2 Site History

Since the early 1950s, numerous investigations have been conducted in and around the PBS to monitor the ecological health of the bay and bayou and to determine the impact of commercial, industrial, and municipal activities on the PBS. Previous investigations have documented site activities at NAS Pensacola discharging to the bay and bayou. Other studies have been associated with industrial activities of the entire PBS area.

A recent report by Collard (1991) summarizes *the* environmental-biological *history* of the PBS, documenting published as well as previously unpublished data from numerous studies conducted from the 1950s to the present. These studies were conducted to identify biological trends and help understand the current status of the PBS. Many studies have been performed with varying sampling methods, locations and analytical procedures. A synthesis of these studies is presented in the work plan for Sites 40 and 42. Notably, Collard's biological trends analysis based on review of previous studies concluded: (1) the data did not support distinct, discernable trends and (2) future investigations should not attempt to evaluate existing data for these trends because of significant deficiencies in the database.

Facility-specific studies related to NAS Pensacola summarized below are taken from E&E (1991a, 1991b and 1992b).

NAS Pensacola Facility-Specific Studies

1982 **NACIP** — Environmental studies were conducted under the Navy Assessment and Control of Installation Pollutant Department (NACIP). Elevated concentrations of lead and chromium were detected in nearshore sediment samples, although approved FDEP methods were not used.

1984 **Thompson Engineering** & Testing — Analysis of sediment samples collected from the turning basin in the bay did not show elevated concentrations of metals or polychlorinated biphenyls (PCBs). The turning basin is off the southeast comer of NAS Pensacola. Currently approved methods for marine sediment analysis were not used for all of the analyses.

1984 G&M — Sediment samples were taken from storm sewer outfalls approximately 300 feet offshore of the facility's southeastern waterfront. Samples were analyzed using extraction procedure (EP) toxicity methods. Trace amounts of arsenic were detected in some samples, but there was evidence that the samples were improperly handled and analyzed.

1982-1985 FDEP — Sediment samples were taken from Pensacola Bay's turning basin south of the waterfront, and from the Big Lagoon and the mouth of Bayou Grande. Results showed elevated concentrations of mercury and lead for some sites. Ratios of Total Kjeldah Nitrogen: Total Organic Carbon (TKN:TOC) indicated nitrogen-enriched sediments at the turning basin, south of the facility, and at the mouth of Bayou Grande.

1986 **United States Navy** — Water and sediment samples were collected from the turning basin and analyzed for heavy metals during a supporting study for an environmental impact statement. Results were suspect because incorrect analytical methods were used and detection limits and laboratory QA/QC data were not provided. According to the consultant's report, elevated concentrations of chromium and zinc existed in sediments.

1991 **Ecology and Environment — A Phase I Contamination Assessment/Remedial** Activities Investigation was conducted at Site 2, the waterfront sediments, to identify source areas and contaminants of concern and provide recommendations for the next phases of the investigation. Results indicated sediment contamination as outlined below.

Primary Sediment Contaminants at Site 2:

- metals
- volatile organic compounds (VOCs)
- total recoverable petroleum hydrocarbons (TRPHs)
- polynuclear aromatic hydrocarbons (PAHs)

At Site 2, most of the contamination appeared associated with past discharge of untreated industrial waste from outfalls on the eastern end of the waterfront. Other sources possibly contributing to the sediment contamination cited above include operations at the aircraft carrier berth and naval boatyard, commercial shipping, and private industrial facilities discharging effluent to the bay. E/A&H recently submitted an RI report for Site 2. Results of this investigation are summarized in Section 4 of this SAP.

2.3 Physical Setting

Climatology, biological resources, physiography, and hydrogeology for Sites 40 and 42 and NAS Pensacola are detailed in Section 2 of the work plan for these sites.

3.0 PHYSICAL SURVEYS

A Phase I sediment mapping survey was completed before the preparation of this SAP to aid in developing the sampling strategy for Phase IIA. The results of this survey are discussed in Section 4. Two other physical surveys will conducted before and during the Phase IIA field work: a contaminant source survey and a habitat and biota survey.

3.1 Contaminant source survey

The contaminant source survey will be conducted to determine any potential sources and any present or past waste streams from any IR site. The survey will include a review of previous investigative reports, interviews with present and former NAS Pensacola personnel, aerial photograph analysis, and a utility survey.

To the greatest extent possible, the survey will include the identification and mapping of the following:

- Past and present chemicals used at an IR site.
- Locations of any known surface spills.
- Locations of any known historical outfalls.
- Locations and contents of any known present or former underground storage tanks.
- Contaminant distribution from an IR Site.

3.2 Habitat and Biota Survey

The habitat and biota survey will begin with a review of all relevant data from NAS Pensacola and the general area, including information from previous studies, topographic maps, aerial

photographs, and any other pertinent information relative to biological communities within the bay and bayou. This information will be used primarily to determine sources of potential contamination and potential receptors of concern in the bay and bayou. During the Phase IIA field work, field observances of biota and potential receptors will be recorded.

3.3 Phase 1 sediment Mapping

Within Bayou Grande and Pensacola Bay, water depth and overall distribution of grain size and total organic carbon in the sediments were mapped during the Phase I assessment. Distribution of sediments will be compared to the contaminant source survey to help relate source to receptor. This will enable E/A&H to determine the areas with the highest probabilities of contaminant accumulation and overall ecological effect. The results of the Phase I sediment mapping are discussed in Section 4 of this SAP

4.0 SAMPLING APPROACH

4.1 Sampling Rationale

Sampling locations within Bayou Grande and Pensacola Bay were selected based on evaluation of three criteria. First, identified RI sites were evaluated to determine the potential for contaminant input to bay and bayou areas. Sites with higher concentrations were given a higher degree of significance than other sites. Sites with potential or unknown contaminant input were given limited priority. Second, the potential for contaminant input from these identified RI sites was assessed to determine the most likely point(s) of discharge into the bay or bayou for identified contaminants. This determination took into account the presence of drainage ditches, outfalls, groundwater discharge and other pertinent transport mechanisms which may or may not have been identified during the RI process. Third, a sediment assessment phase for the bay and bayou was conducted to determine areas where deposition would likely occur. Areas of fine-grained sediment were considered to have a high potential for absorption of contaminants discharged from onshore sites and thus were emphasized in the prioritization process. Finally, by subjectively assessing all of the information collected from the three criteria, low and high

probability sampling locations were selected which best represented the potential contaminant loading to the water bodies surrounding NAS Pensacola.

The following sections describe how these criteria were developed and provide detailed information relative to applicable areas within Bayou Grande and Pensacola Bay. For ease of assessment and discussion, sections of Bayou Grande and Pensacola Bay shoreline were separated based on known site influences and sediment type.

Bayou Grande was separated in four segments and Pensacola Bay was separated into five segments. Descriptions of the shoreline segments are provided along with the qualitative infomation used to distinguish the sections from adjoining shoreline segments.

Criterion Descriptions

RI and other pertinent reports on NAS Pensacola were reviewed to determine the contaminants of concern for sites that could feasibly impact portions of the bay and bayou (Figure 4-1). Inorganic and/or organic constituents were identified at these sites. For those sites identified as having a potential for impacting the water bodies, transport pathways were identified. Table 4-1 provides information on pathway determination relative to sites at NAS Pensacola.

To assess bottom sediment characteristics at shoreline areas, a field survey was conducted to determine both qualitative and quantitative information. Throughout the bay and bayou, approximately 400 locations were sampled to determine sediment type. The qualitative assessment involved visual description of sediments using the Unified Soil Classification System (USCS) procedures along with noting relative significant differences in bottom type between surrounding locations (Figure 4-2). The quantitative assessment involved collection of 167 samples representative of the various bottom types to be laboratory analyzed for. total organic carbon (TOC) and grain size. Grain-size distributions are presented in Figure 4-3.

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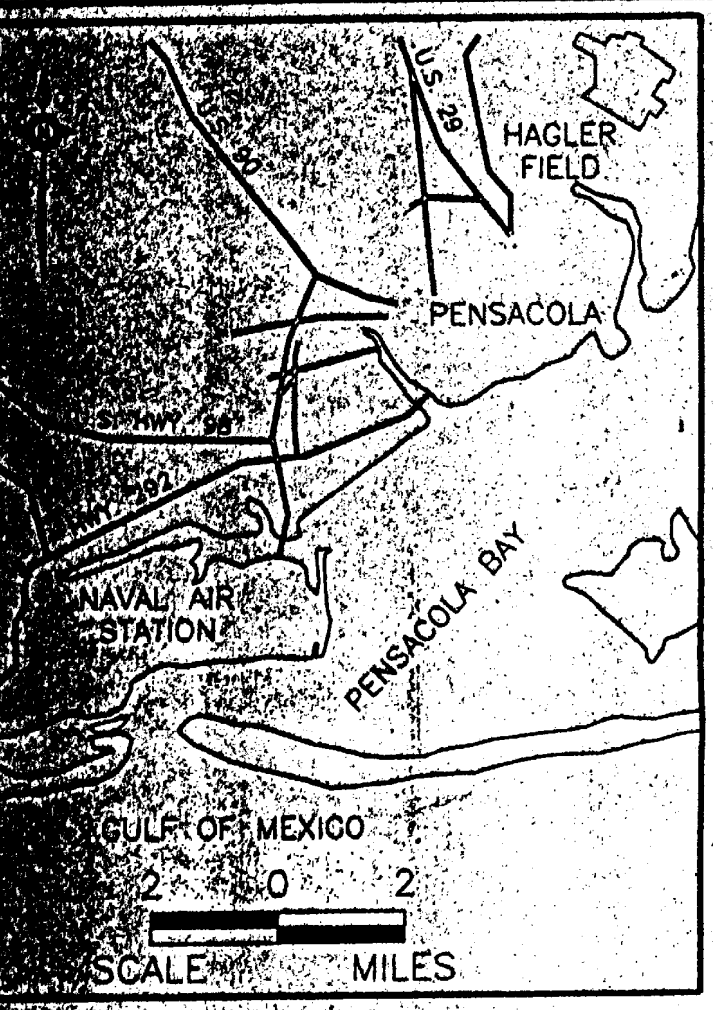
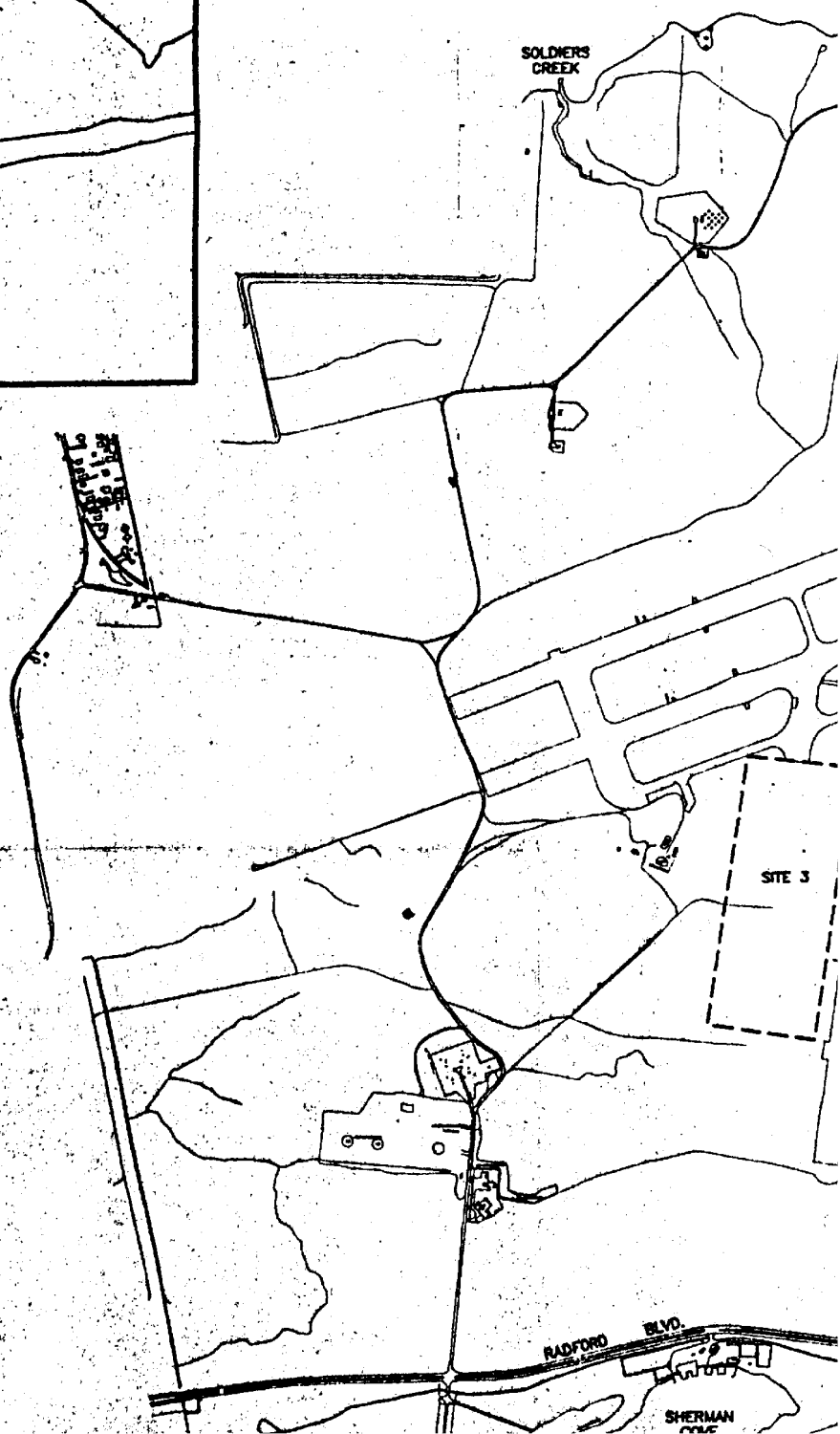
Attachment A


U.S. 29
HAGLER FIELD
PENSACOLA
S. HWY. 98
HWY. 292
NAVAL AIR STATION
PENSACOLA BAY
GULF OF MEXICO
2 0 2
SCALE MILES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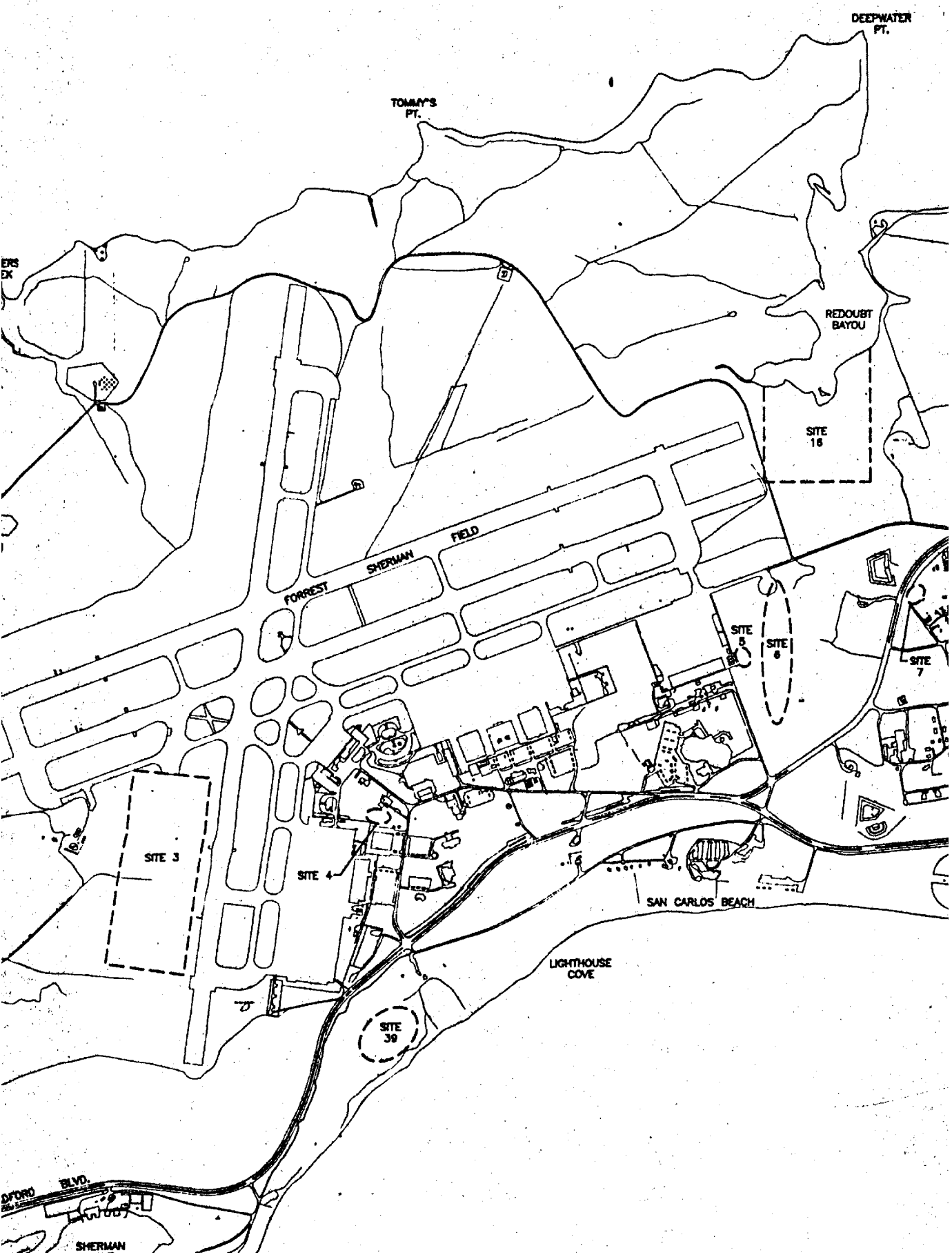
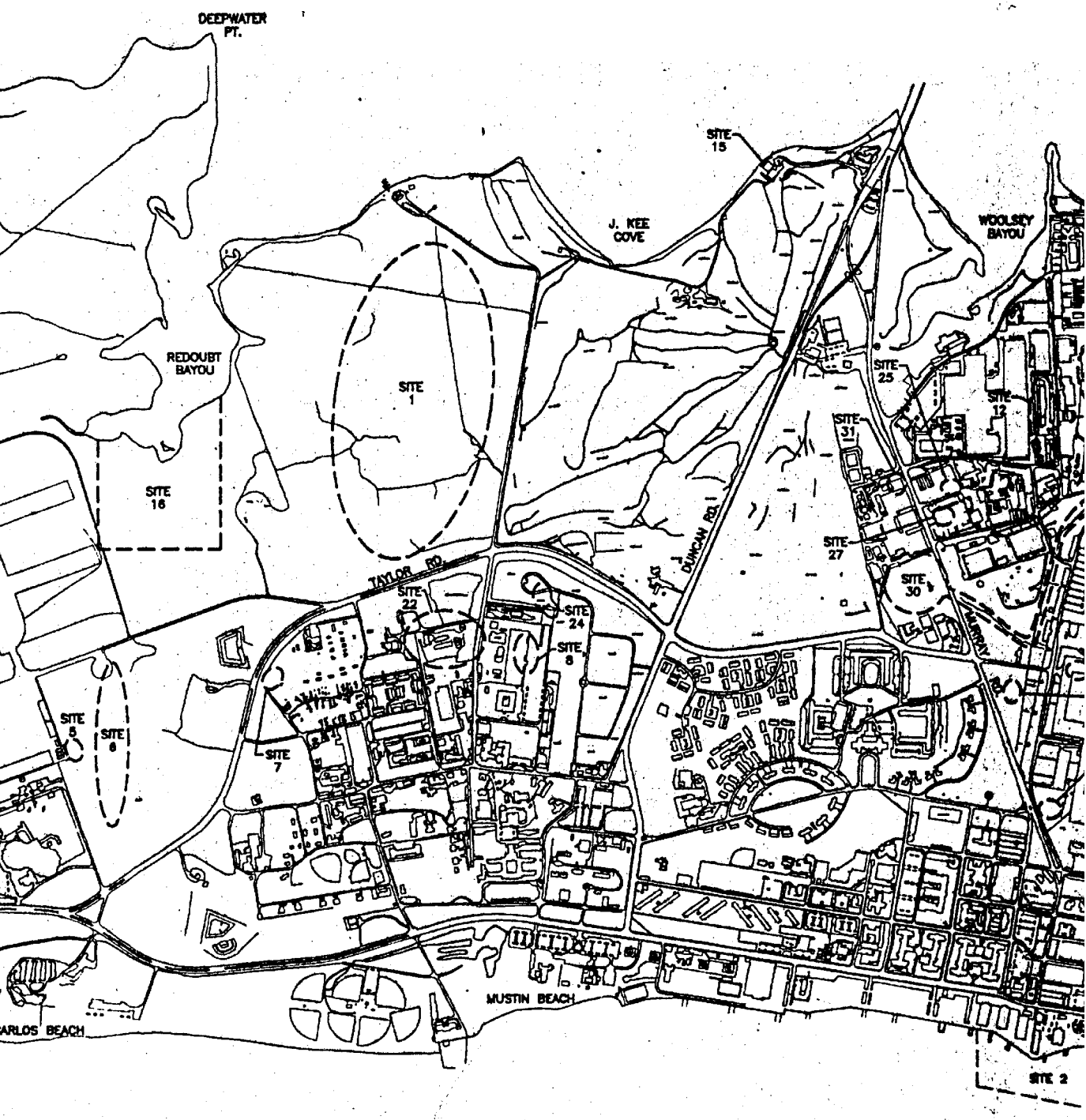
SITE 3
RADFORD BLVD.
SHERMAN COVE

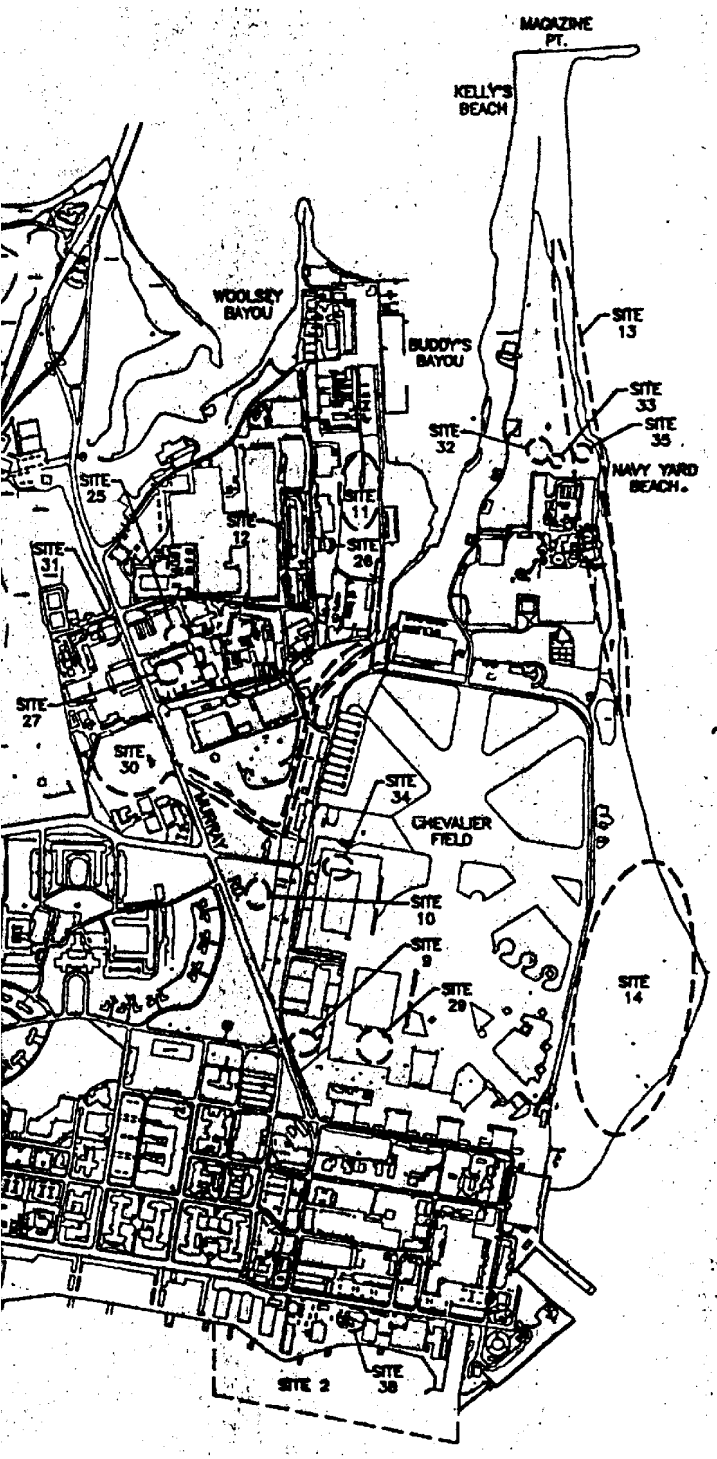
BAYOU CRA


DEEPWATER PT.
TOMMY'S PT.
REDOUBT BAYOU
SITE 16
FORREST SHERMAN FIELD
SITE 5
SITE 6
SITE 7
SITE 3
SITE 4
SAN CARLOS BEACH
LIGHTHOUSE COVE
SITE 39
BLVD.
SHERMAN

BAYOU CRANDE

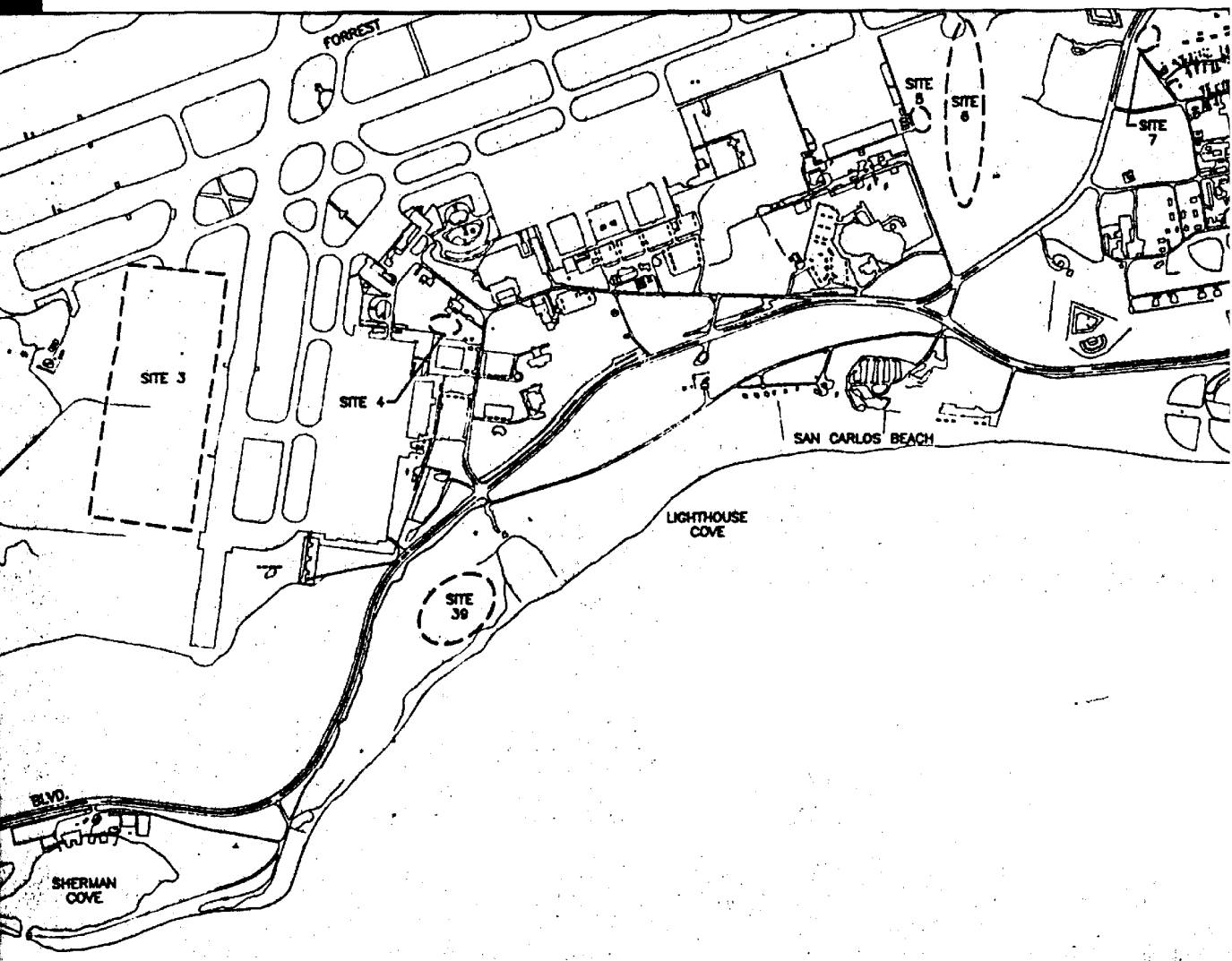


PENSACOLA BAY


MAGAZINE PT.
KELLY'S BEACH
WOOLSEY BAYOU
BUDDY'S BAYOU
SITE 13
SITE 33
SITE 35
SITE 32
NAVY YARD BEACH.
SITE 25
SITE 12
SITE 11
SITE 26
SITE 31
SITE 27
SITE 30
SITE 34
CHEVALIER FIELD
SITE 10
SITE 9
SITE 29
SITE 14
SITE 2
SITE 38

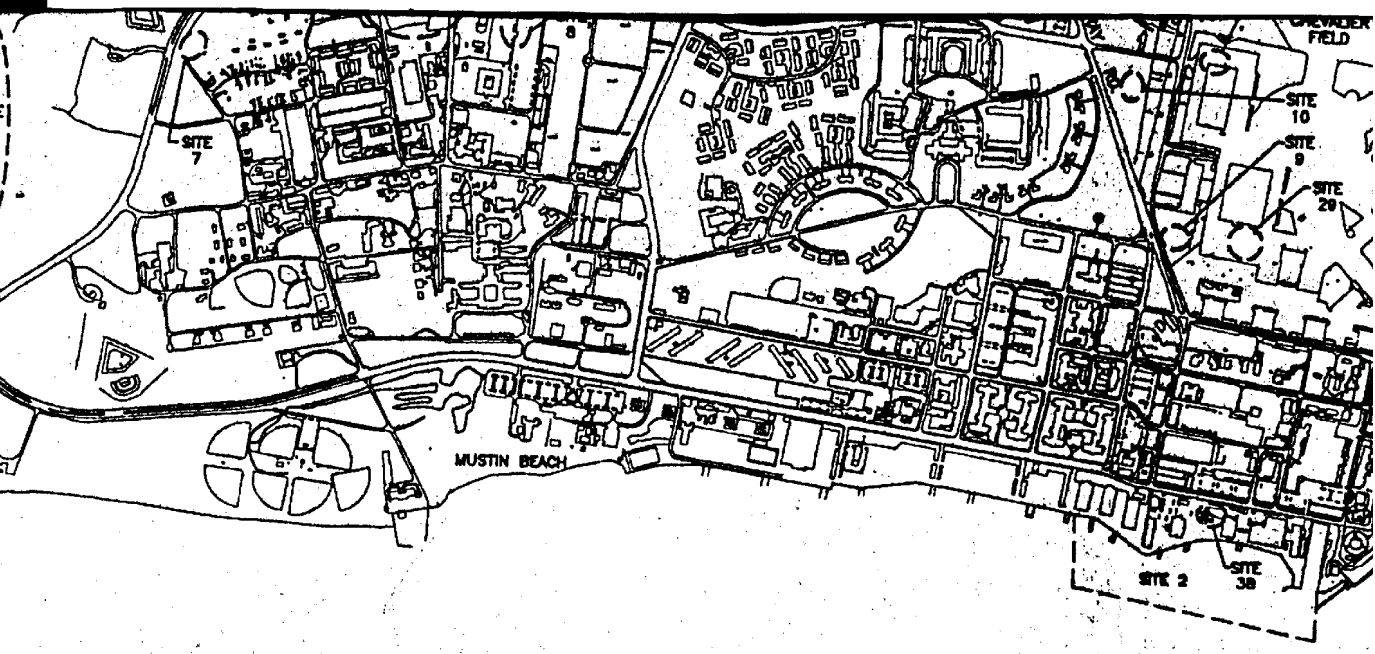
A BAY

SITE 3
RADFORD BLVD.
SHERMAN COVE
BIG LAGOON



LEGEND

Approximate limits of site



PENSACOLA BAY

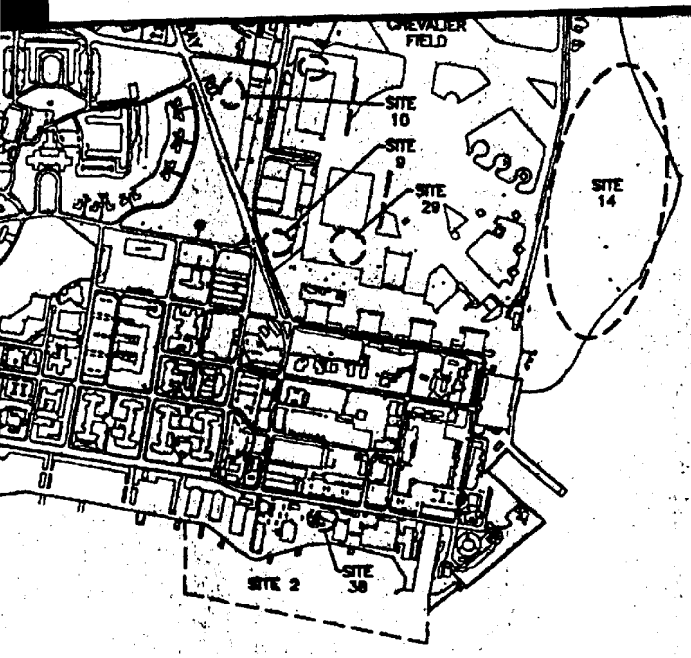
LEGEND

oximate limits of site

GRAPHIC SCALE

2000 0 1000 2000

(IN FEET)
1 inch = 2000 ft.



C SCALE

'EET)
2000 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-1

SITE LOCATIONS POTENTIALLY IMPACTING BAYOU GRANDE AND PENSACOLA BAY

DWG DATE: 5/15/95 | DWG NAME: 42FIG4-1

Explanation:

- OL-CL - [Organic and inorganic *days*, silts, sandy clays, silty clays]
- OL-SM - [Silts, sendy silts, silty sends, clayey silts, sand-siltday mixtures]
- ML-SP - [Silty sands, *clayey* sands, sand-siltclay mixtures]

SP-SW - [Well graded to poorly graded sands, little or no fines]

Figure 4-2

Bottom Sediment Types Based on USCS Descriptions

Sampling and Analysis Plan Sites 40 and 42 NAS Pensacola

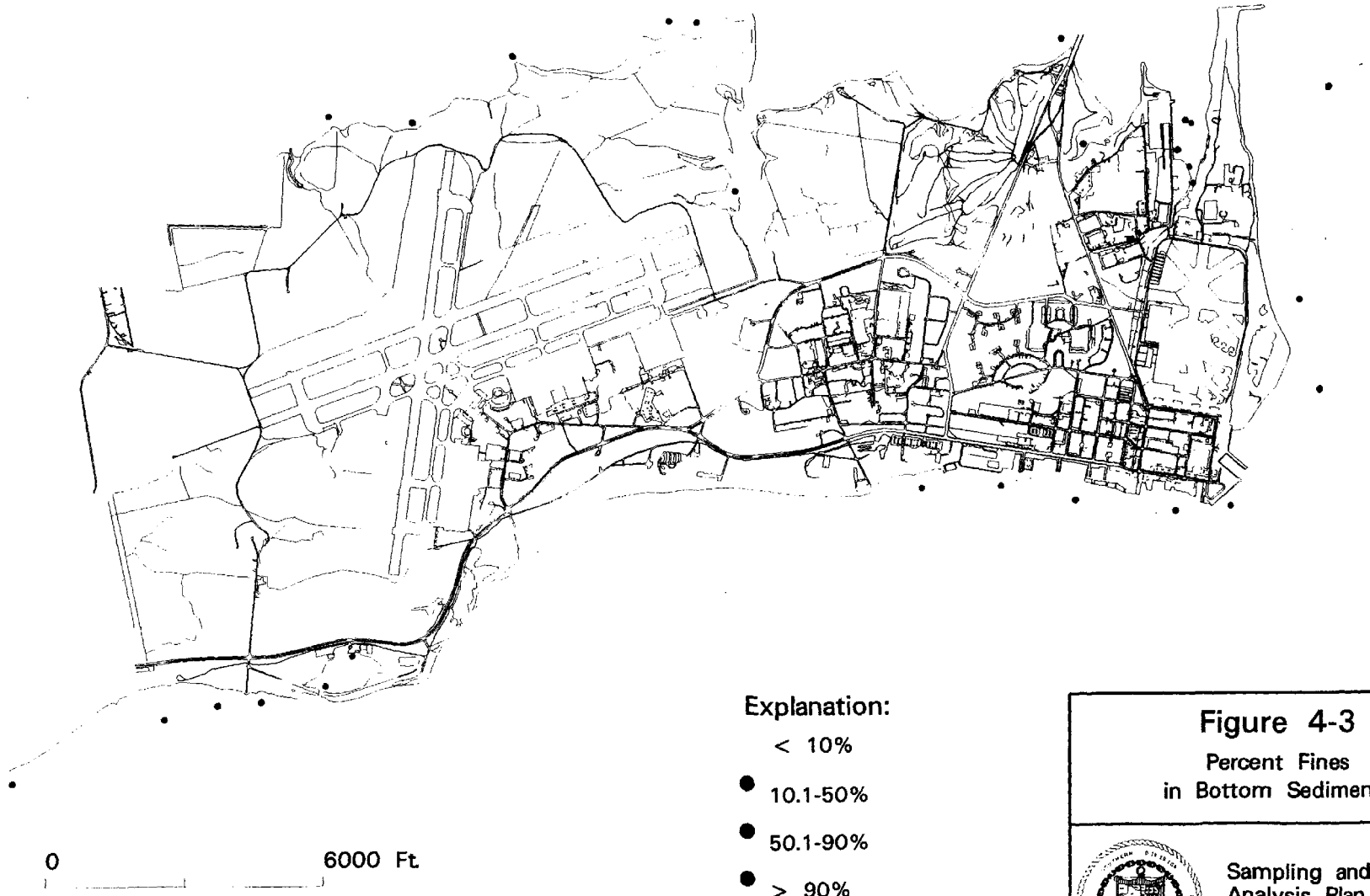


Figure 4-3

Percent Fines
in Bottom Sediments

Sampling and
Analysis Plan
Sites 40 and 42
NAS Pensacola

Table 4-1
Summary of NAS Pensacola Sites Relative to Assessment Zones in Bayou Grande and Pensacola Bay

Assessment Zone	Potential Source Site	Significant Pathway Descriptions	Suspected Contaminants
1	3	Surface water runoff through wetlands 39, 70, 27, 25, & 28	Metals, VOCs
2	1	Surface water and groundwater discharge through wetlands 15, 16, 17, 18, and 4; groundwater discharge to Bayou	Metals, VOCs, SVOCs, Pest/PCBs, PAHs
3	1	Golf Course, Site 1 through wetland 3 and 4	Pesticides, SVOCs, Metals
4	9-13, 29, 30, 36 and OU 10	Discharge into Yacht Basin wetlands 64, 7, 8, 4 and 5	Metals, VOCs, SVOCs, Pest/PCBs, PAHs
5	OU 10	Groundwater discharge into Bay	Metals, VOCs, SVOCs, Pest/PCBs, PAHs
	14	Surface water discharge outfalls (2)	Metals, PCBs, PAHs
	36	Groundwater discharge	Metals, VOCs, SVOCs, Pest/PCBs, PAHs
6	18	Surface water runoff	PCBs
	38	Groundwater discharge	VOCs
	2	Surface water runoff and product discharge	Metals, PAHs, Pest/PCBs
	28	Surface water runoff	PCBs
	21	Surface water runoff	Unknown

Table 4-1
Summary of NAS Pensacola Sites Relative to Assessment Zones in Bayou Grande and Pensacola Bay

Assessment Zone	Potential Source Site	Significant Pathway Descriptions	Suspected Contaminants
7	39	Groundwater discharge	Metals, VOCs
	4	Surface water runoff through wetlands 56, 57, 58	Unknown
8	None	NA-proposed as reference area	NA
9	3	Groundwater and surface water flow through wetland 52	Metals, VOCs

Notes:

NA = Not applicable.
OU 10 = Operable Unit 10

Section Descriptions

The shorelines of NAS Pensacola adjacent to Bayou Grande and Pensacola Bay have been divided into sections referred to as Assessment Zones (AZ) and designated with an alphanumeric system (Figure 4-4). Within each AZ, areas of special interest have been selected based on known or suspected influence by land-based sources. These areas will be referred to as Target Areas (TA) and designated using a lettering system. For instance, if four TAs in AZ-2 are considered, they will be designated as TA-2A through TA-2D. The sampling density within the TAs will be higher than in other portions of the AZ. The following sections detail each shoreline segment designated as an AZ. Discussion of Target Areas within each AZ will be addressed in Section 4.1.

Bayou Grande

Assessment Zone 1 (AZ-1) includes portions of the NAS Pensacola shoreline along Bayou Grande from a point near Soldiers Creek, to Deepwater Point (Figure 4-4). Sediments within this zone are mostly fine-grained and characteristic of a low-energy tidal regime. Very few contaminant source areas were identified for this AZ. Possibly the only one would be Forrest Sherman Field which lies south of the zone. Wetlands which are found in this AZ include 39, 70, 27, 25, and 28. Because of the limited potential for contaminant input, all these wetlands have been considered as low priority for the upcoming Site 41 (Wetlands) RI.

Assessment Zone 2 (AZ-2) extends from Deepwater Point to J. Kee Point and includes Redoubt Bayou. The shoreline in this area is characterized by sandy beaches with shallow broad sandy shelves extending out into the bayou in some areas. In these areas, fine-grained sediment is found at greater distance offshore than in AZ-1. The major contributing source to this area is Site 1, which has been determined to be a potential contributor of inorganic, volatile, semivolatile, pesticide, and polynuclear aromatic hydrocarbons (PAHs) compounds.

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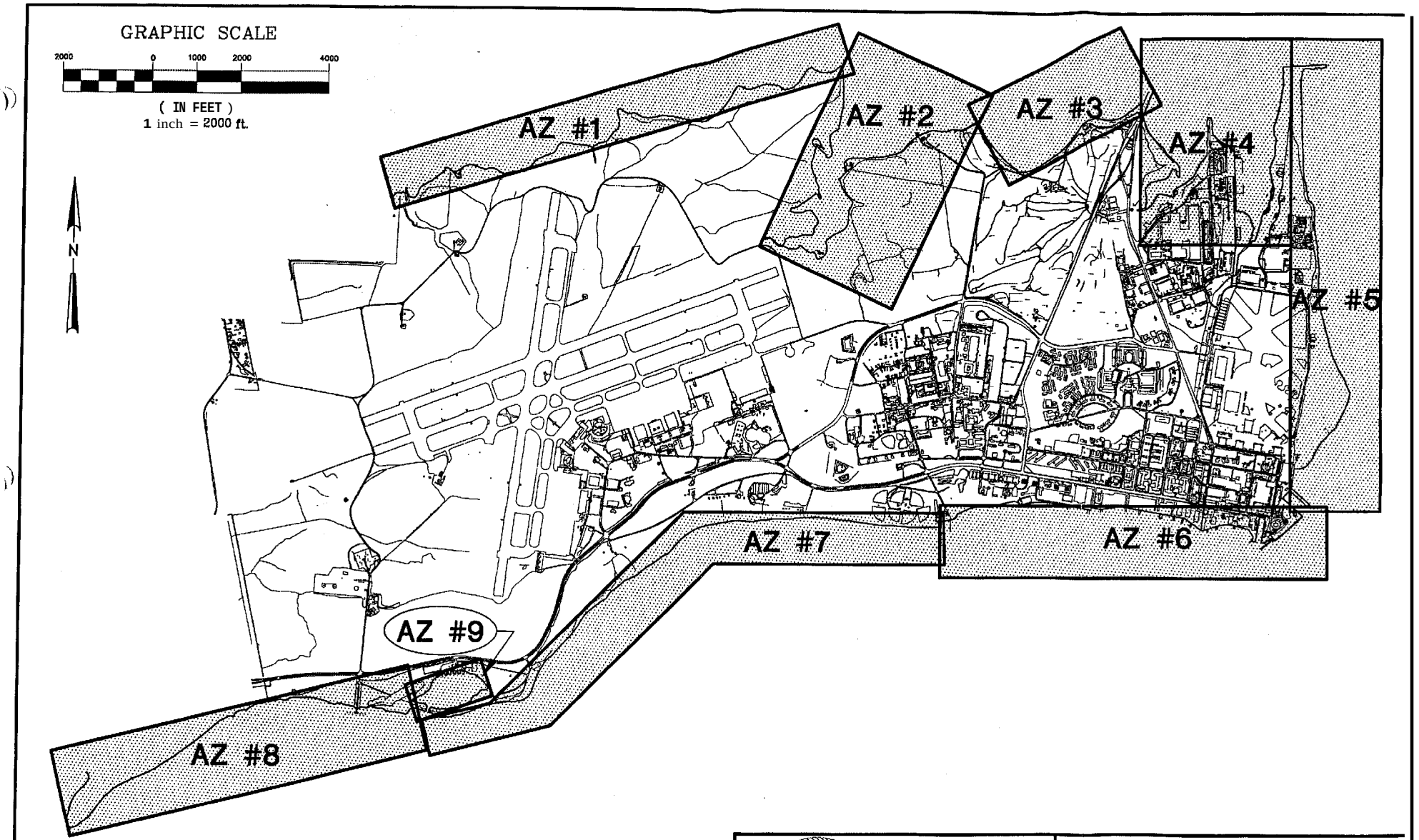

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-4

ASSESSMENT ZONES WITHIN BAYOU GRANDE AND PENSACOLA BAY

DWG DATE: 5/15/95 | DWG NAME: 42FIGBAS

Wetlands 15, 16, **17,** 18 and 4, which discharge into this zone, have been given a relatively high priority for the Site 41 RI. Other wetlands which discharge into the zone but are not considered to have a high potential for contaminant input, include 24, **68,** 22, and **19.** Some nearshore groundwater monitoring wells exhibiting contaminants have increased the priority for those portions of the shoreline.

Assessment Zone 3 (AZ-3) extends from J. Kee Point to the Navy Boulevard bridge. Sediments in this zone are similar to those in AZ-2 with areas of sandy bottom parallel to the shoreline or extending into the bayou as bars. Contaminant input to this area is minimal compared to other portions of the bayou. **[Site 15 is a possible source of contaminants in Assessment Zone 3.]** In addition, pesticides from use on the NAS Pensacola Golf Course may be expected in this area. Contaminant transport to this zone from Site 1 may also have occurred through Wetlands 3 and **4.** Wetland **65** also discharges into this zone.

Assessment Zone **4** (AZ-4) extends from the Navy Boulevard bridge to the pass which connects Bayou Grande to Pensacola Bay. This area includes Woolsey Bayou and portions of Bayou Grande just north of the Yacht Basin (Buddy's Bayou), which will be addressed during the Site 41 RI. Sediments in this zone are similar to those in AZ-3 with small areas of sandy bottom along the shore. Pesticides from use on the NAS Pensacola Golf Course are suspected along with input of other parameters as a result of the Yacht Basin's influence. **[Site 10 and OU10 are also possible sources of contaminants in Assessment Zone 4.]** Contaminants suspected within the Yacht Basin include VOCs, SVOCs, pesticides, inorganics and PAHs as a result of inland RI Sites 9 to 13 and 29, **30,** and **36.**

Pensacola Bay

Assessment Zone **5** (AZ-5) extends from the pass of Bayou Grande south to the most northern point of Allegheny Pier. Sediments within this zone are almost exclusively sand with a few pockets of fine-grained sediments offshore. Primary areas of influence along the zone include:

OU10, which may contribute contaminants from all five categories; Site 13/Wetland 10, which contained pesticides and PCBs; Site 14, which had evidence of metals, PAHs, and PCBs; and Site 36, which could contribute inorganics, VOCs, SVOCs, and pesticides/PCBs via groundwater.

Assessment Zone 6 (AZ-6) extends from the northern point of Allegheny Pier west to the Coast Guard Station. This portion of the bay includes RI Site 2. Results and conclusions from the Site 2 RI will be incorporated into the Site 40/42 report. Sediment along this segment is primarily sand but areas of fine-grained material were also identified. Potential contaminants for this segment include those identified for Site 2; inorganics, SVOCs, and PAHs. Also, numerous stormwater outfalls along this shoreline segment could potentially provide input from inland sites such as 9, 18, 21, 28, 38.

Assessment Zone 7 (AZ-7) extends from the Coast Guard Station west to the inlet to Sherman's Cove. Sediments are mostly sand with scattered areas of silty clayey sand. The primary contaminant source to this zone appears to be Site 39. VOCs, inorganics and PAHs were the major constituents found at this site. Some input to the zone from Wetlands 56, 57 and 58 may occur as a result of downstream transport through these wetlands from Site 4.

Assessment Zone 8 (AZ-8) extends from the western point at the inlet to Sherman's Cove west to the boundary of the naval base. No specific point sources which may impact this zone were identified and this area may be recommended as a reference area based on future assessment.

Assessment Zone 9 (AZ-9) includes Sherman's Cove to the point where it connects with the bay proper. Sherman's Cove has been designated as Wetland 54, but its use as an open water system precludes including it as a true wetland; thus it will be addressed during the Site 40/42 RI process. Sediments within Sherman's Cove are primarily silts and clays. The potential exists for downstream input to the cove through Wetland 52 from Site 3. Major contaminants

4.2 Sampling locations, Methods, and Analysis

As previously discussed, areas within Bayou Grande and Pensacola Bay were chosen based on the potential to show contamination from past activities at RI sites across the base. Sampling locations within these high probability areas (Target Areas) were based on a grid arrangement with random location selection. Within each AZ, areas which were not considered as TAs were sampled at much lower densities.

At TAs within each AZ, a grid matrix with 100-foot nodes will be established to provide higher sampling densities relative to non-TAs. The extent of the grid matrix will be determined individually for each TA but will not extend more than 500 feet from the shoreline. Sampling locations will be determined using a biased approach with number per TA dependent on overall grid size and site conditions such as flow, depth, and grain size.

Generally, in areas not considered TAs, transects will be established approximately 500 feet apart. Along each of these transects, intervals were designated at 100, 250 and 500 feet extending offshore from the shoreline. Samples were located at each crosspoint along the 100-foot interval, at every other crosspoint along the 250-foot interval, and at every fourth crosspoint along the 500-foot interval. The purpose of this design was to increase the likelihood of detecting contaminants from onshore sources at nearshore locations, and to maintain the probability of detecting contamination further from the shoreline. This sampling scheme provides a mechanisms for identification of offshore contaminant migration without the effort of sampling at each interval for each transect. If contamination is observed at the 100-foot interval but not detected at the 250- or 500-foot interval, it will be assumed that contamination at that point is localized. It is possible that more intense sampling may be necessary in the future based on the initial data at some locations or the results of the Site 41 RI.

Bulk sediment and surface water samples will be collected according to procedures outlined in Section 7.2 and 7.3 of the CSAP. In addition to analysis for CLP Target Compound List/Target

Analyte List (TAL/TCL), sediment samples will be submitted for laboratory analysis of TOC and grain size. To assess the bioavailability and potential for toxic effects of constituents in sediments, TAL/TCL constituents will also be measured in sediment elutriates. In cases where this is proposed, sediment samples and water samples will be collected for mixture and separation by press or centrifugal methods and mother liquor or elutriate analyzed in triplicate as typical water samples. In situ physicochemical parameters to be measured include turbidity, pH, temperature, conductivity, dissolved oxygen, and salinity. The elutriate technique was derived from the FDEP district office in Pensacola, Florida, and parallels a similar procedure used by the U.S. Army Corps of Engineers for dredge and fill permits. In addition, approximately 5% of the bulk sediment samples will be split for total digestion of inorganic constituents using a hydrofluoric acid technique endorsed by FDEP. The sampling and analytical requirements for this investigation are summarized in Table 4-2.

Table 4-2
Site 40/42 Sampling and Analytical Requirements

Medium	No. of Samples[a]	Analytical Parameter	DQO Level
Surface Water[b]	23	FSA	IV
Sediment	283 (283) 16	FSA PPS FSA/TD	IV IV NA
Elutriate	15	FSA	IV
TOTAL	321 (283) 16	FSA PPS	IV

Notes:

a = The number of sampler rhown in parentheses will be analyzed for the additional parameters indicated. These numbers do not reflect QA/QC samples.

b = Total number of unfiltered surface water samples = 1 location x 1 sample interval = 1 sample.

FSA = **Fdl** S a n of **Analysis**
Target Compound List volatile organic compounds, TCL base-neutrallacid extractable organic compounds, TCL peaticidee, TCL polychlorinated biphenyls (PCBs, Target Analyte List metals (unfiltered), and TCL cyanide.

PPS = **Physical Parameters (Sediment)**
Total phosphorus, nitrate-N, TKN, heterotrophic plate count, total organic carbon, and cation exchange capacity.

TD = **Total Digestion**

All initial Phase IIA sediment and surface water samples will be collected in accordance with the procedures described in Section 7 of the CSAP. All laboratory analyses, decontamination, sample management, data management, and quality assurance will adhere to the CSAP. Sediment samples may be collected using either a petite Ponar or Ekman dredge. Water samples will be collected using a stainless steel Kemmerer water sampling bottle.

Laboratory analysis of inorganic constituents in saltwater can be difficult because of the high probability of interference from natural minerals present. Matrix interferences can be categorized as overlap of a spectral line from another element, unresolved overlap of molecular band spectra, background contribution from continuous or recombination phenomena, and/or background contribution from stray light from the line emission of high concentration elements. Laboratories can compensate for these interferences, but must be notified ahead of time. E/A&H will give the laboratory adequate notice before it receives any salt water samples so that it can prepare for any analytical problems that may accompany them.

Proposed Sample Locations

Bayou Grande

Within AZ-1, no TAs were identified; therefore sampling locations were selected according to the transect approach as outlined above for low intensity areas. Overall, 39 locations will be sampled from this zone (Figures 4-5 and 4-6). Twenty-two will be along the 100-foot interval, 11 along the 250-foot interval, and six from the most outer interval at 500 feet.

Within AZ-2, six TAs have been designated (Figure 4-7). TA-2A and TA-2B are near Wetland 19; TA-2C is just off Wetland 18; TA-2D includes most of Wetland 17; TA-2E is just off Wetland 16; and TA-2F is near Wetland 15. Sampling locations within each of these TAs are presented on Figures 4-8 through 4-13. All remaining coastline within AZ-2 will be sampled at a low density. Fifty-five sampling locations are proposed for AZ-2.

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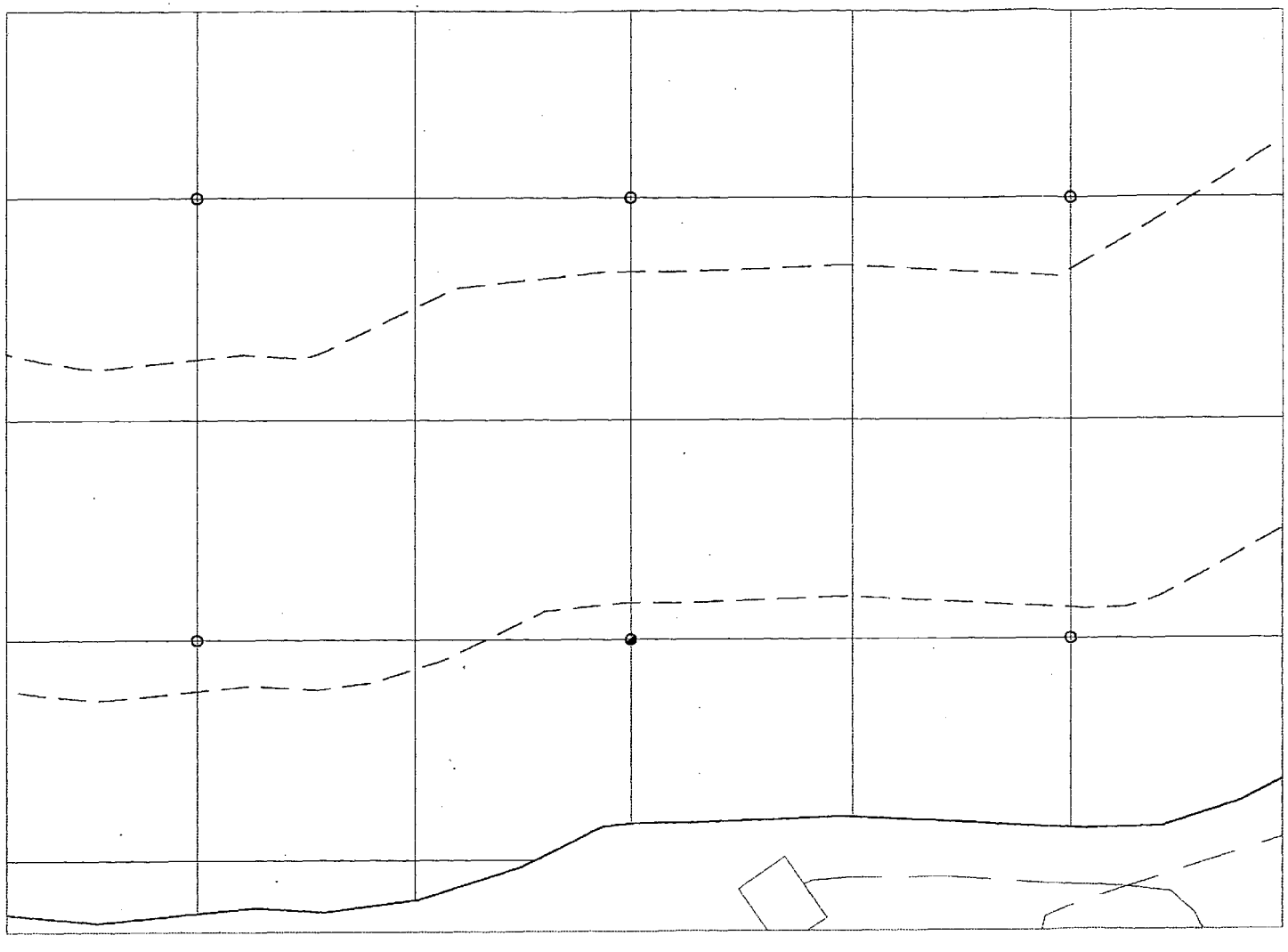


LEGEND

Sediment sampling location

Sediment/Water sampling locati.n

GRAPHIC SCALE

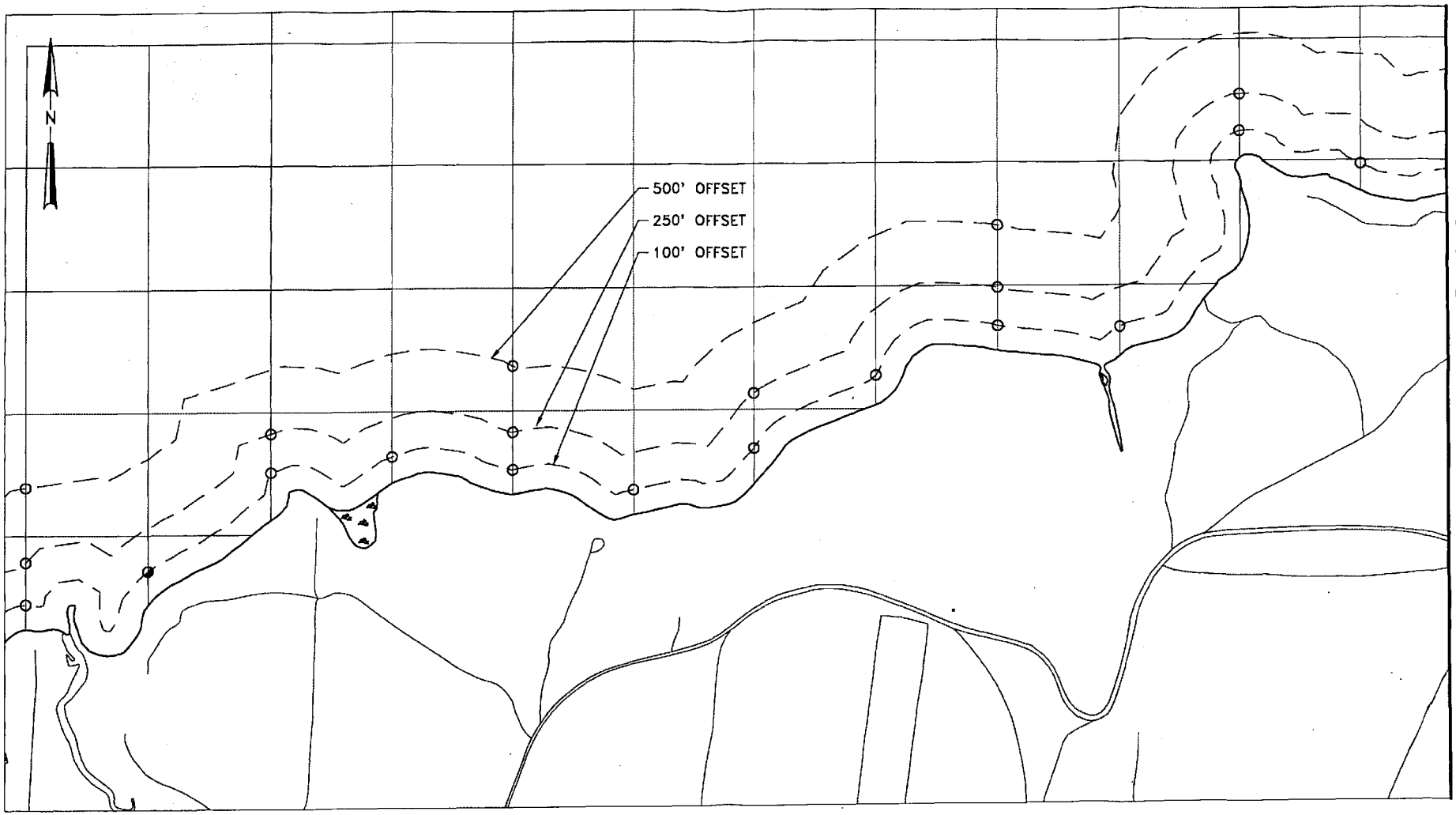
50 0 25 50 100

(IN FEET)
1 inch = 50 ft.

FIGURE 4-3

LOCATIONS
2-F

/G NAME: 42FIGT2F



LEGEND

O Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

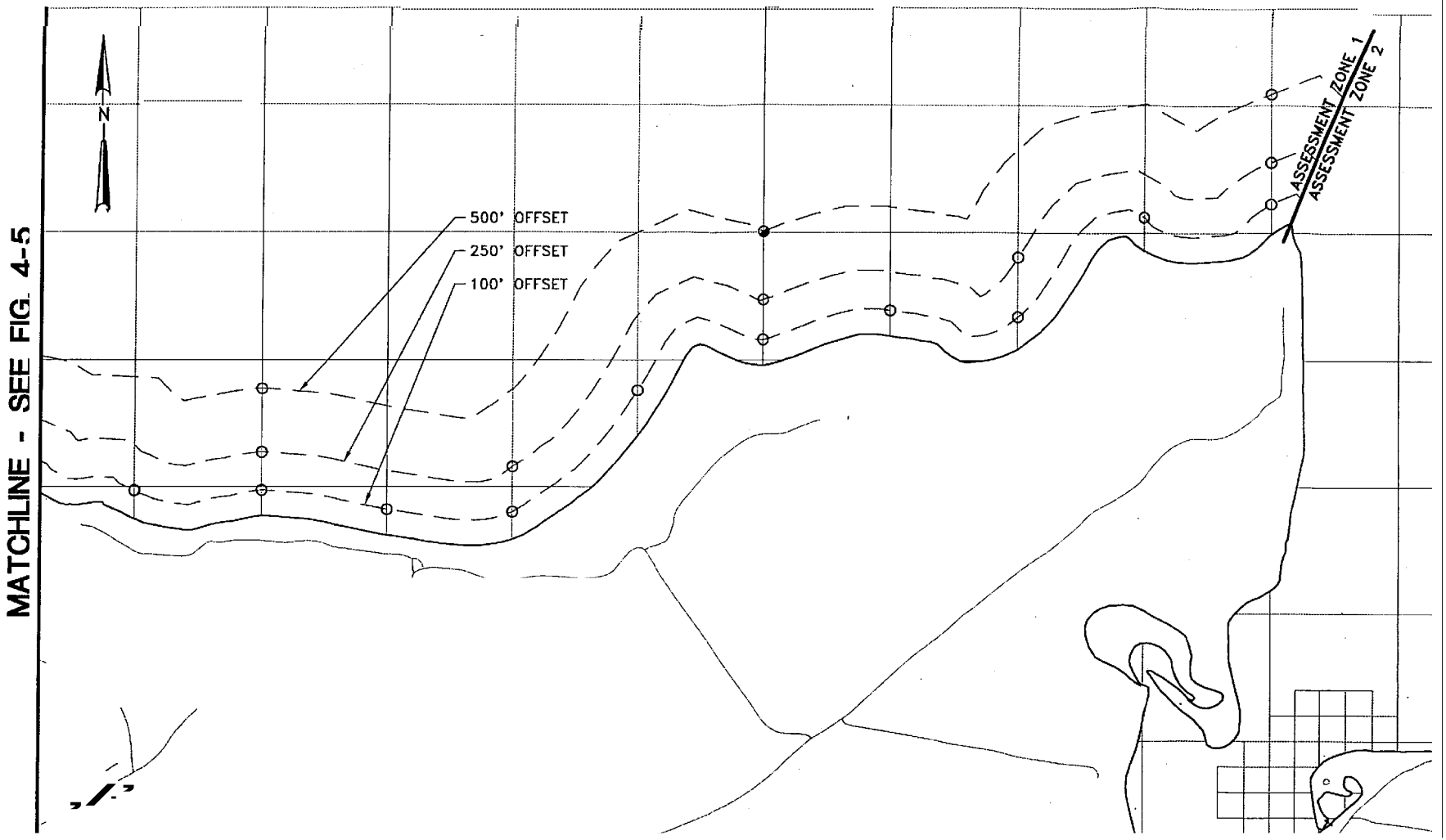
(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-5

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 1

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ1



LEGEND

O Sediment sampling locotion

◕ Sediment/Water sampling locotion

GRAPHIC SCALE

400 0 200 400 800

(FEET)

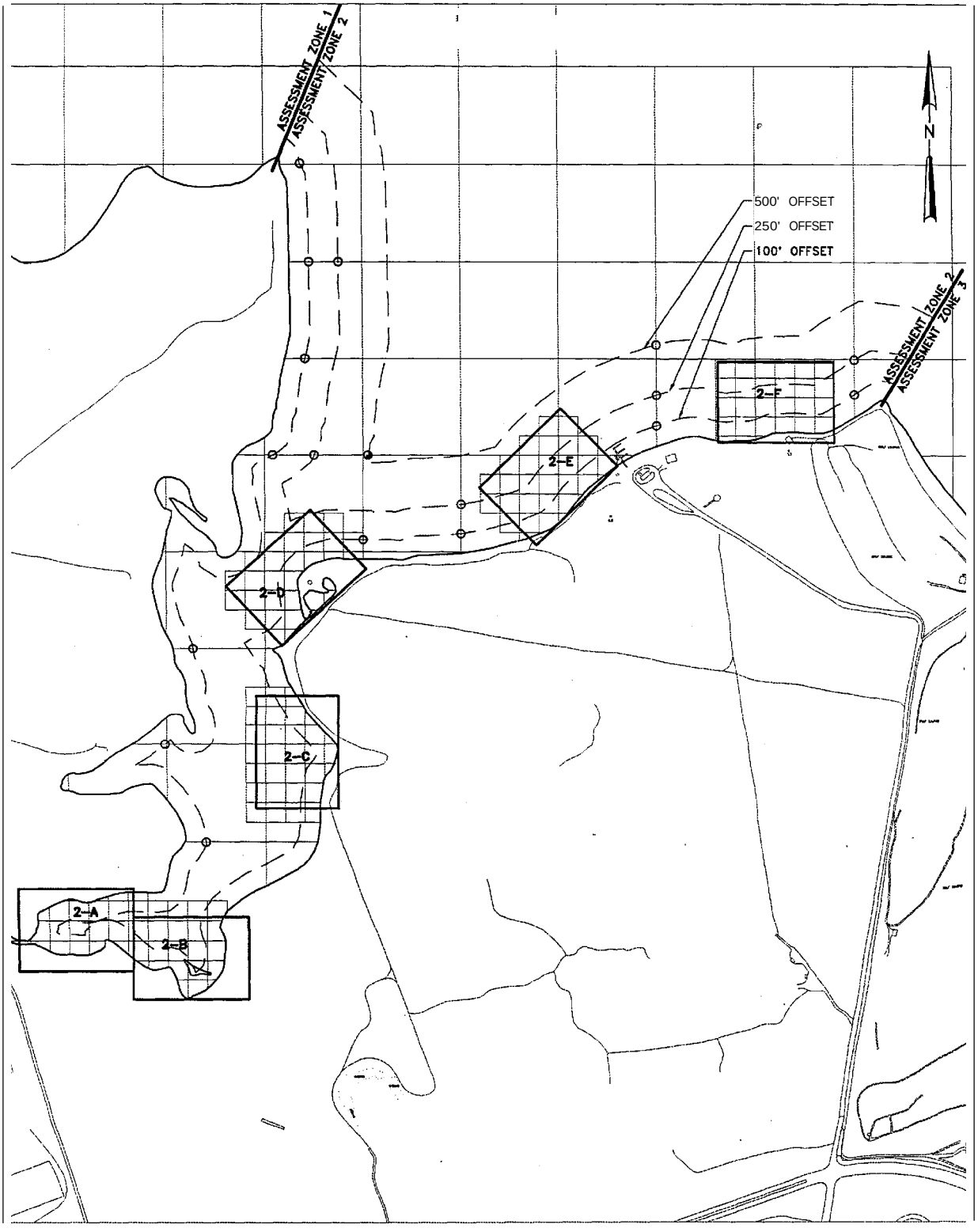
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4—6

PROPOSED SAMPLING **LOCATIONS**
ASSESSMENT ZONE 1

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ1B



LEGEND

O Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE

500 0 250 500 1000

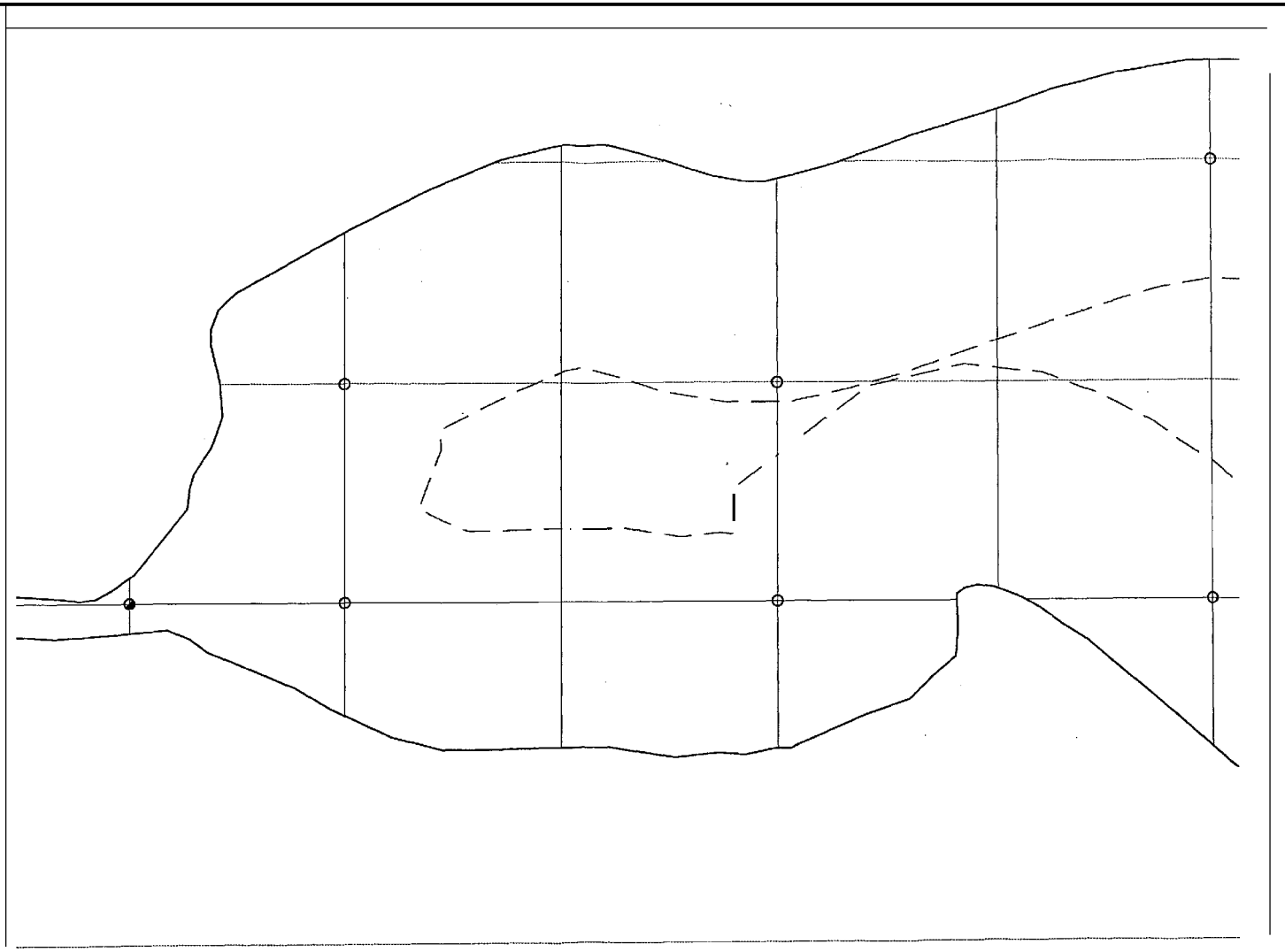
(IN FEET)
1 inch = 500 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-7

PROPOSED SAMPLING LOCATIONS AND DESIGNATED TARGET AREAS
ASSESSMENT ZONE 2

DWG DATE: 5/15/95 DWG NAME: 42FIGZ2

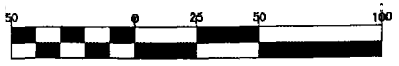


LEGEND

O Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE



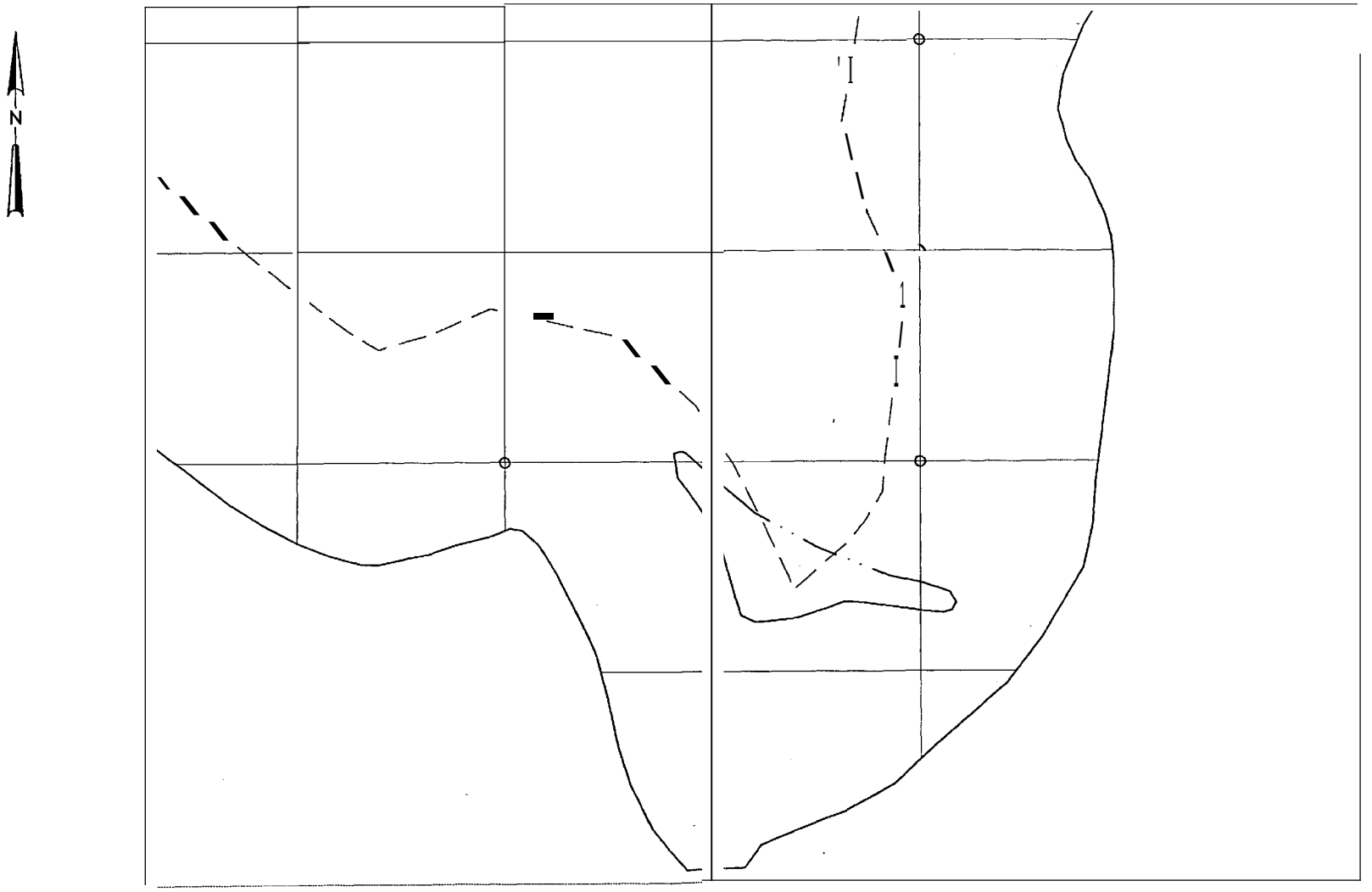
(IN FEET)
1 inch = 50 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-8

PROPOSED SAMPLING LOCATIONS IN TARGET AREA 2-A

DWG DATE: 5/15/95 | DWG NAME: 42FIGT2A

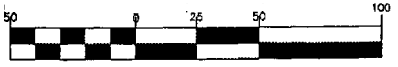


LEGEND

O Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE



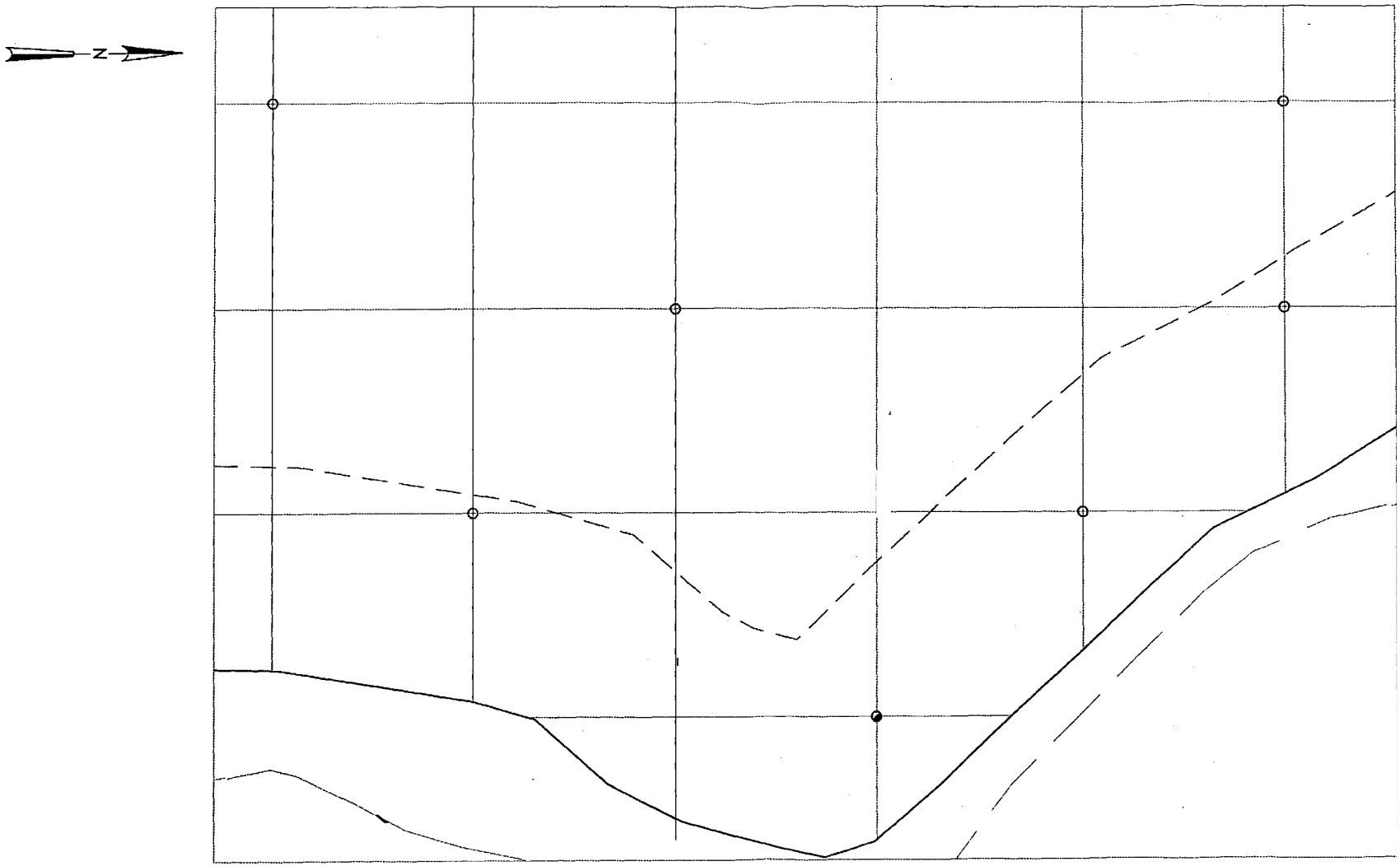
(IN FEET)
1 inch = 50 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-9

PROPOSED SAMPLING LOCATIONS IN TARGET AREA 2-8

DWG DATE: 5/15/95 | DWG NAME: 42FIGT2B



LEGEND

GRAPHIC SCALE

50 0 25 50 100

(IN FEET)
1 inch = 50 ft.

O Sediment sampling location

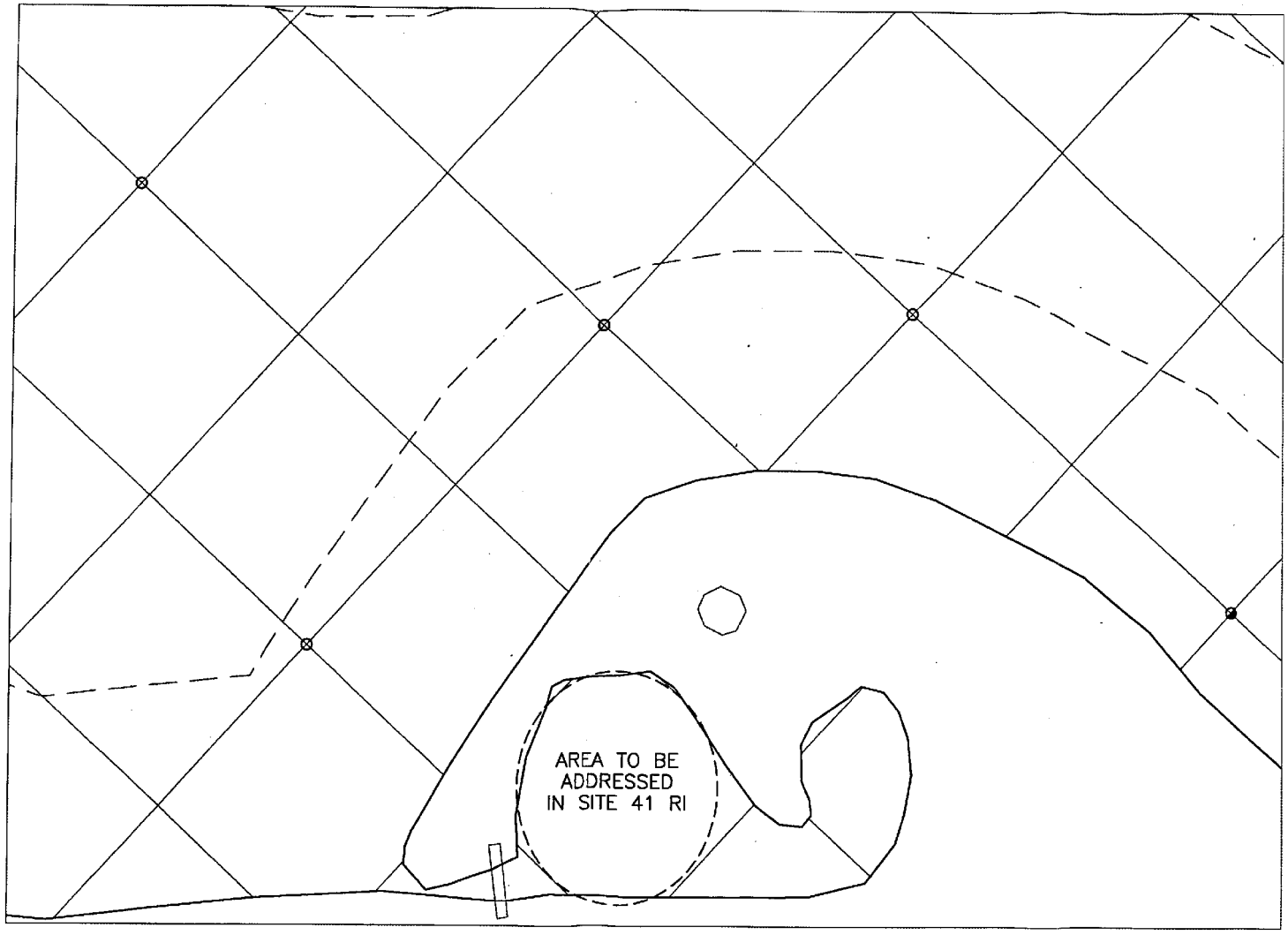
Sediment/Water sampling location

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-10

PROPOSED SAMPLING LOCATIONS IN TARGET AREA 2-C

DWG DATE: 5/15/95 | DWG NAME: 42FIGT2(



LEGEND

GRAPHIC SCALE

50 0 25 50 100

(IN FEET)
.1 inch = 50 ft.

○ Sediment sampling location

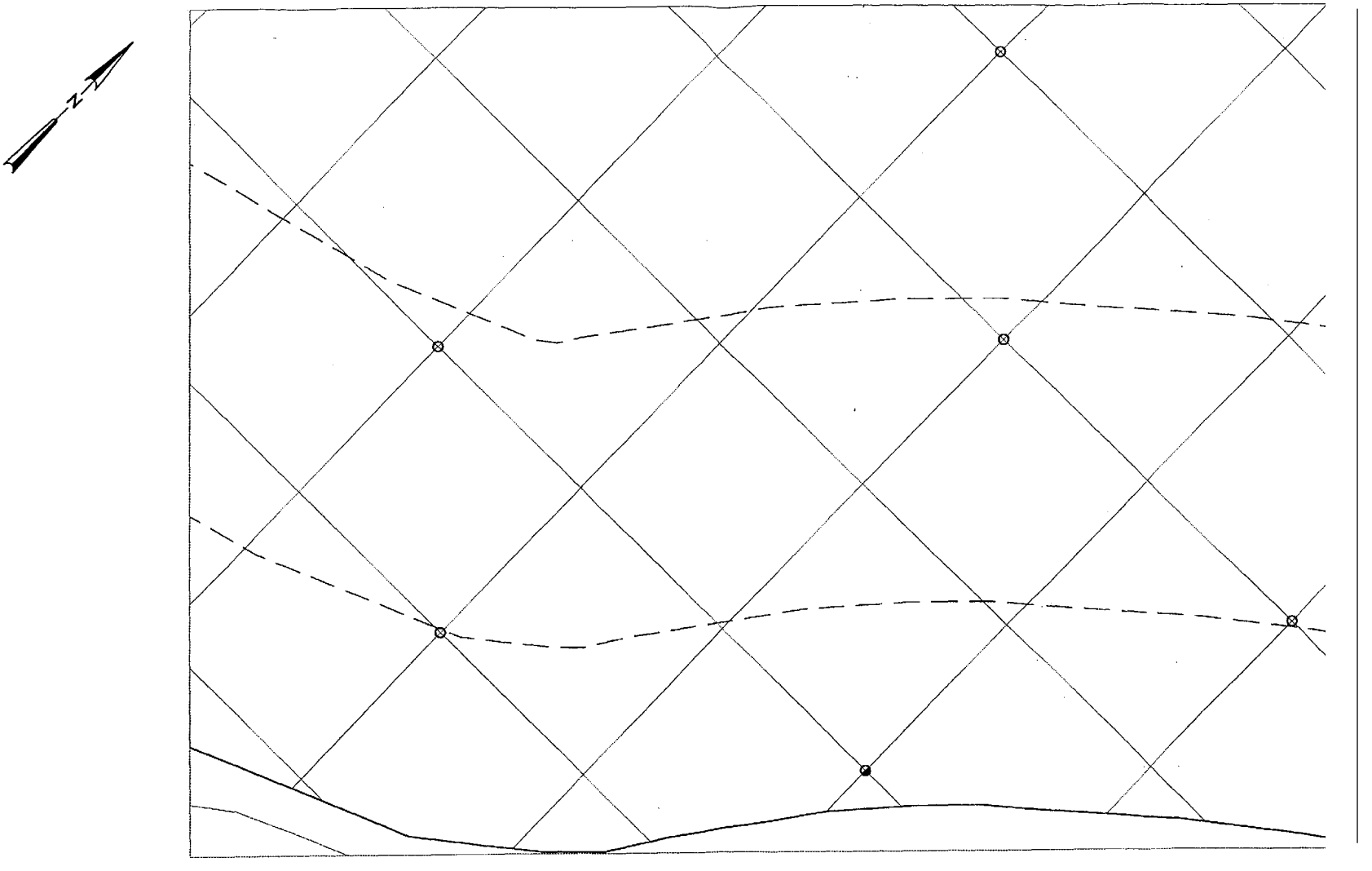
◐ Sediment/Water sampling location

SAMPLING AND
ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4–11

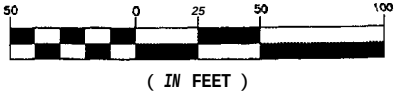
PROPOSED SAMPLING LOCATIONS
IN TARGET AREA 2–D

DWG. DATE: 5/15/95 | DWG NAME: 42FIGT2D



LEGEND

GRAPHIC SCALE



(IN FEET)
1 inch = 50 it.

Sediment sampling location

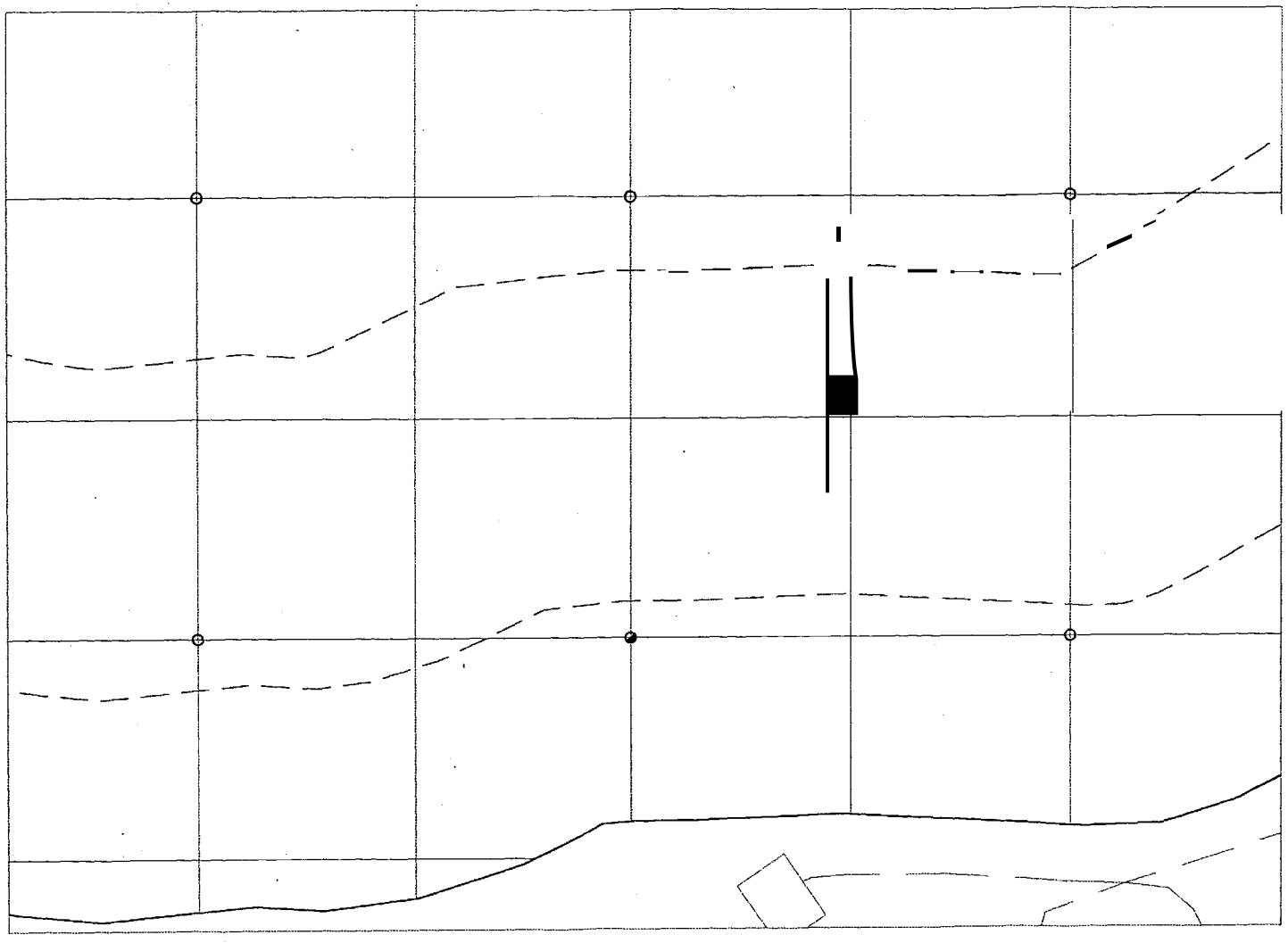
Sediment/Water sampling location

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-12

PROPOSED SAMPLING LOCATIONS IN TARGET AREA 2-E

DWG DATE: 5/15/95 | DWG NAME: 42FIGT2E



LEGEND

GRAPHIC SCALE

50 0 25 50 100

(IN FEET)
1 inch = 50 ft.

○ Sediment sampling location

◐ Sediment/Water sampling location

3

LOCATIONS
2-F

/G NAME: 42FIGT2F

49

Two TAs are designated for AZ-3; TA-SA is near Wetland 4 and TA-3B is adjacent to Wetland 65 (Figure 4-14). Sampling locations are presented on Figures 4-15 and 4-16. Low density sampling is proposed for all other portions of the coastline within this AZ. Twenty-four sampling locations are proposed for AZ-3:

Within AZ-4 (Figure 4-17), the area just outside of the Yacht Basin will be designated TA-4A and TA-4B (Figures 4-18 and 4-19). This area may be downgraded to a low priority status, based on data collected during the Site 41 RI. Other portions of AZ-4 will be sampled using low density methods. Twenty-four sampling locations are proposed for AZ-4.

In all, 142 sampling locations are proposed near the NAS Pensacola shoreline within Bayou Grande.

Pensacola Bay

Two TAs are within AZ-5 (Figures 4-20 and 4-21). TA-5A is near Wetland 10 (Figure 4-22) and TA-5B is near the discharge point from Site 14 (Figure 4-23). Other portions of the AZ will be sampled at low density. Forty-five sampling locations are proposed for AZ-5.

No TAs were in AZ-6 (Figures 4-24 and 4-25). All portions of the shoreline, except for Site 2, will be sampled using low density methods. Twenty-three sampling locations are proposed for AZ-6.

No TA were identified within AZ-7 (Figures 4-26, 4-27 and 4-28). All of AZ will be sampled using low density methods. Forty sampling locations are proposed.

All sampling locations in AZ-8 will be based on low density methods (Figures 4-29 and 4-30). Twenty-seven sampling locations are proposed.

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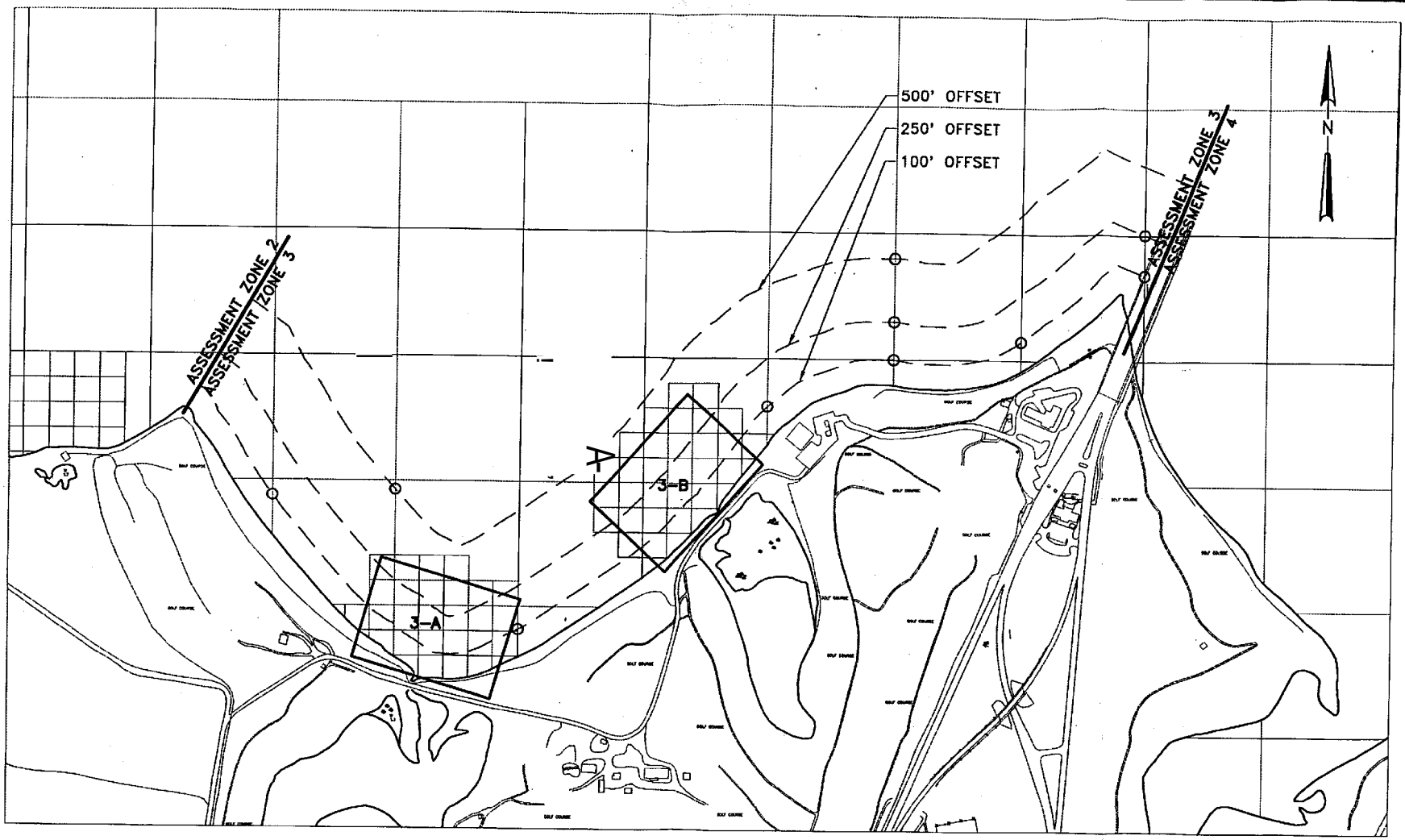


LEGEND

○ Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

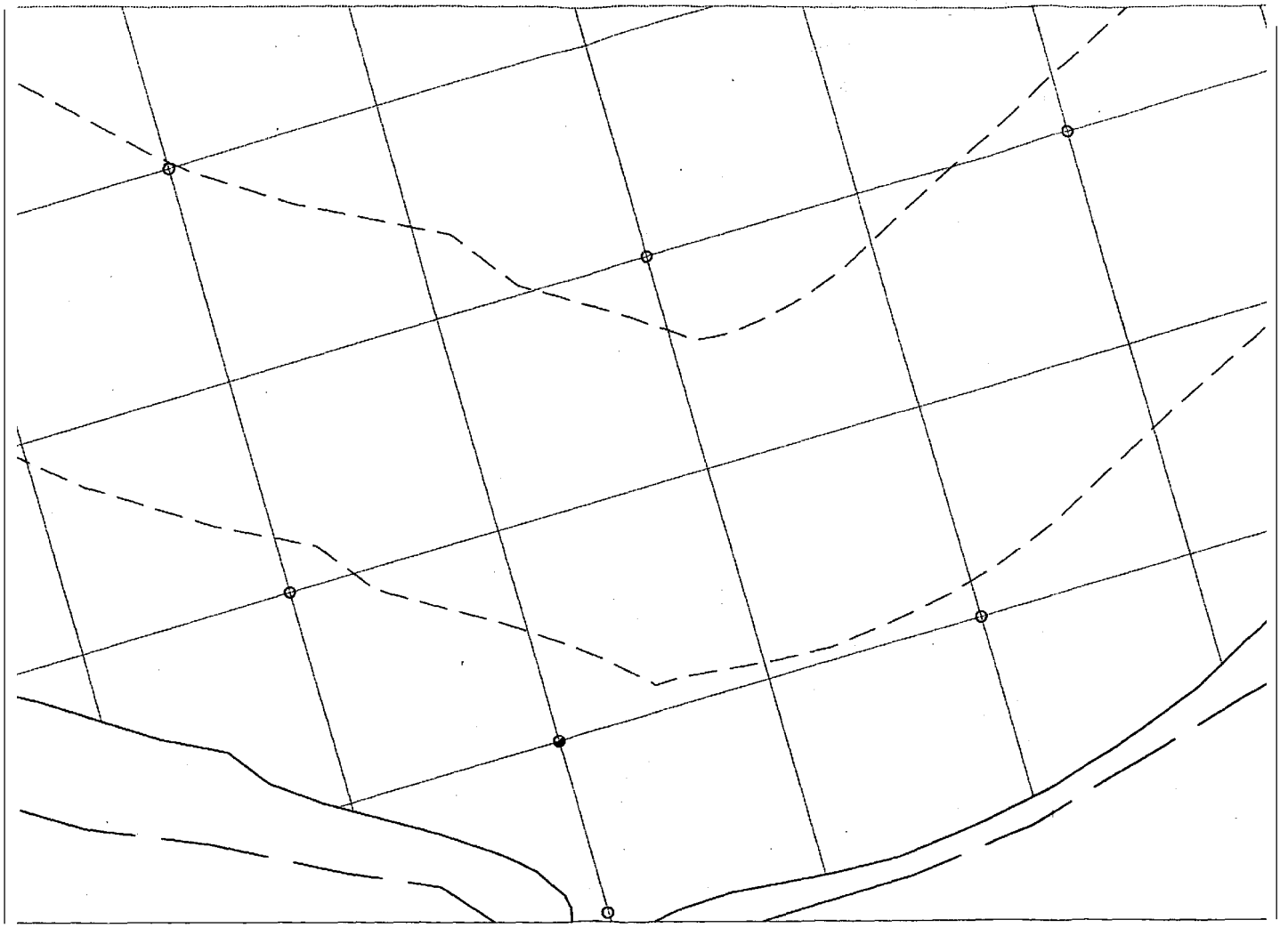
(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-14

PROPOSED SAMPLING LOCATIONS AND DESIGNATED TARGET AREAS ASSESSMENT ZONE 3

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ3



LEGEND

O Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE

50 0 25 50 100

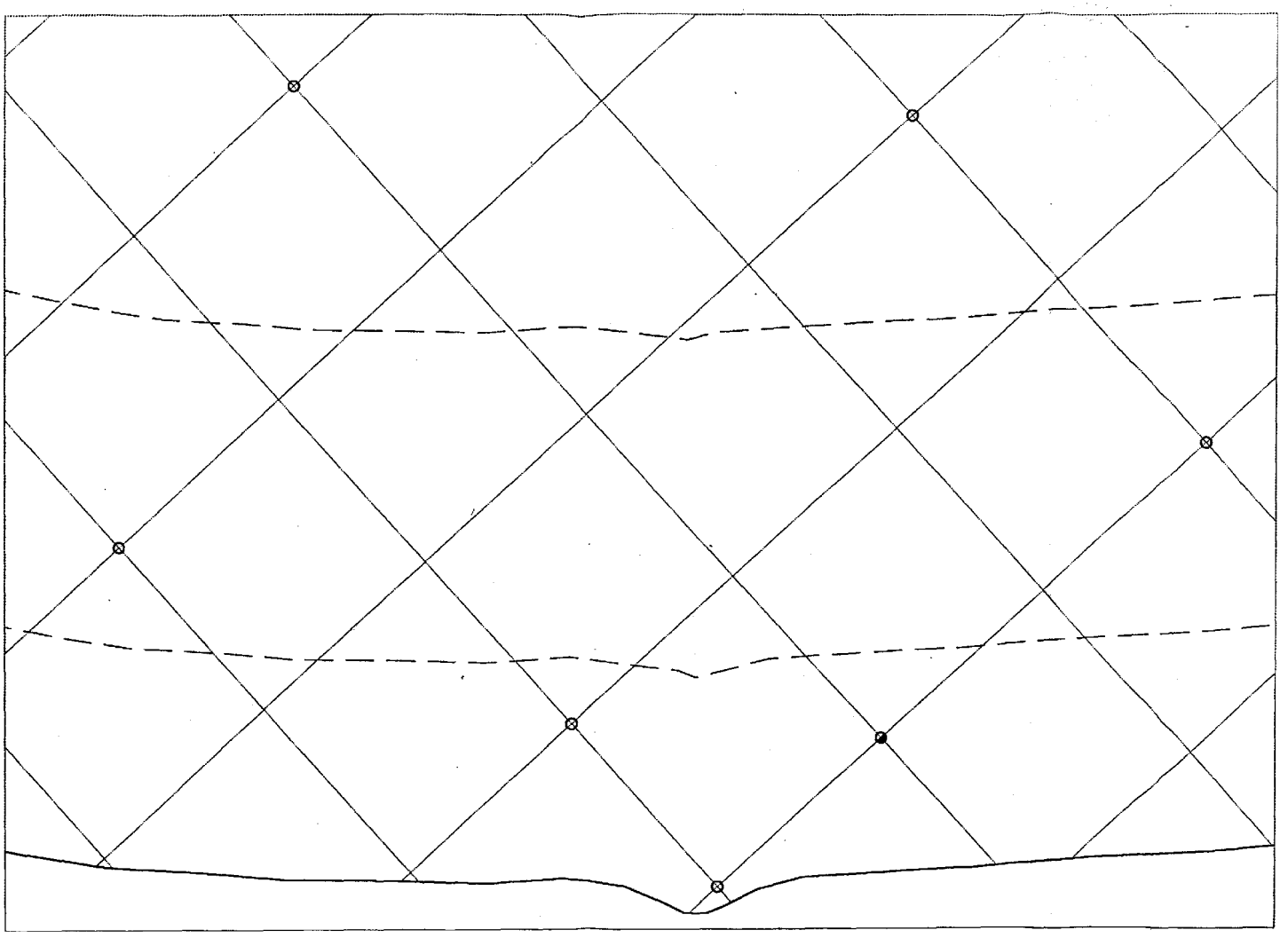
(IN FEET)
1 inch = 50 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-15

PROPOSED SAMPLING LOCATIONS IN TARGET AREA 3-A

DWG DATE: 5/15/95 | DWG NAME: 42FIGT3A



LEGFND

GRAPHIC SCALE

(IN FEET)
1 inch = 50 ft.

O Sediment sampling location

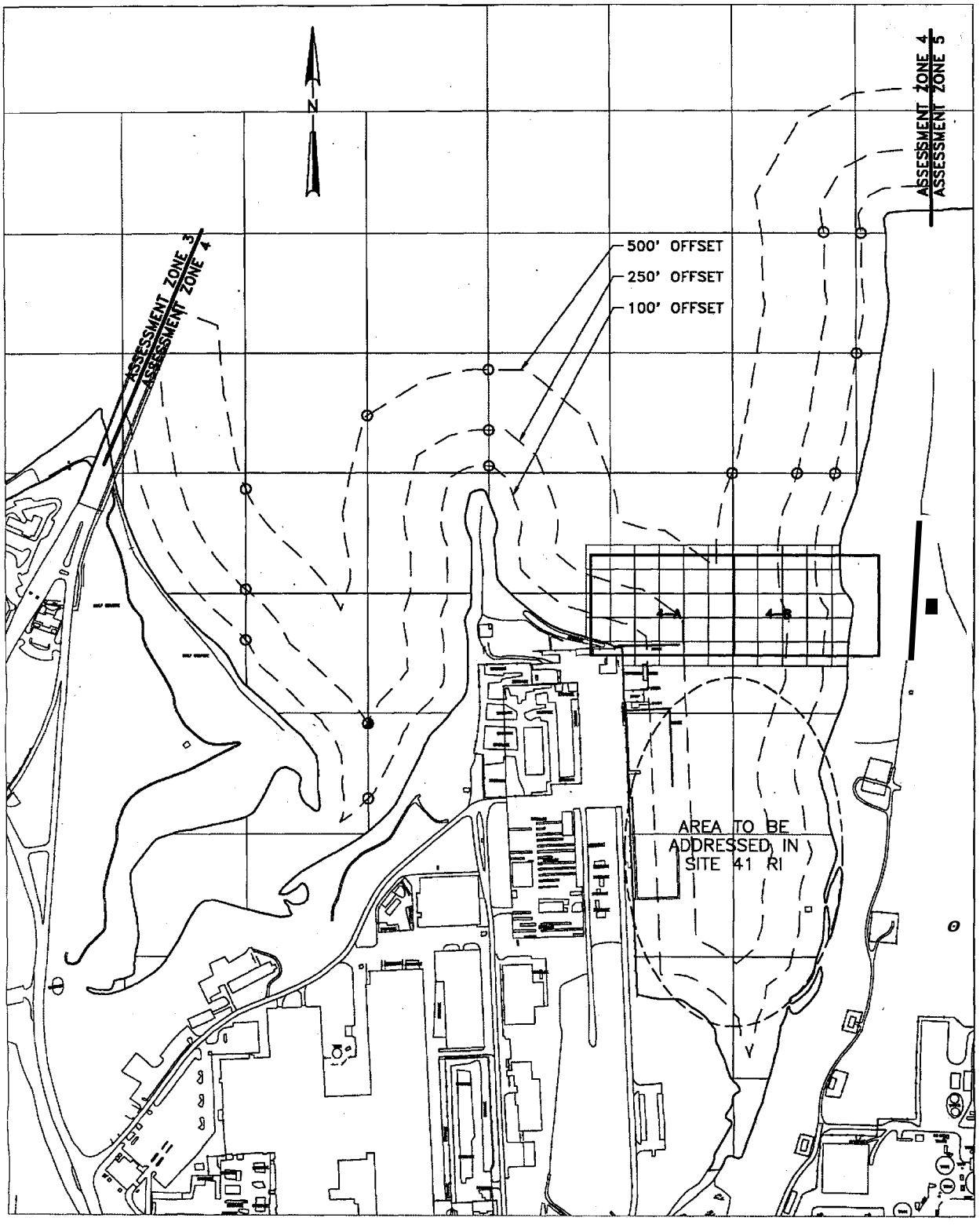
◐ Sediment/Water sampling location

SAMPLING AND
ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-16

PROPOSED SAMPLING LOCATIONS
IN TARGET AREA 3-B

DWG DATE: 5/15/95 | DWG NAME: 42FIGT3E



LEGEND

- o Sediment sampling location
- ◐ Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

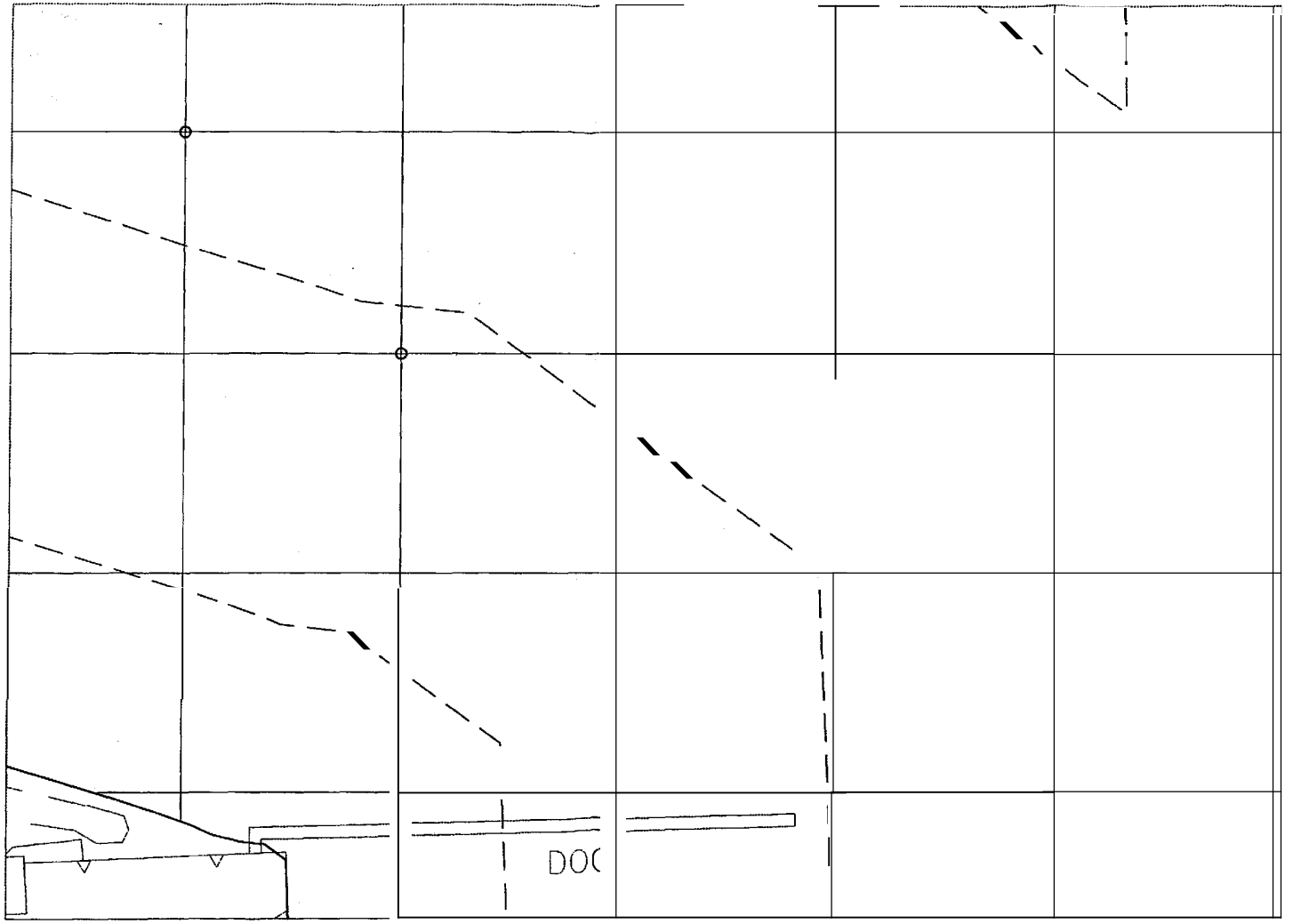
(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-17

PROPOSED SAMPLING LOCATIONS AND DESIGNATED TARGET AREAS ASSESSMENT ZONE 4

DWG DATE: 5/15/95 DWG NAME: 42FIGZ4



LFGEND

GRAPHIC SCALE

50 0 25 50 100

(IN FEET)
1 inch = 50 ft.

o Sediment sampling location

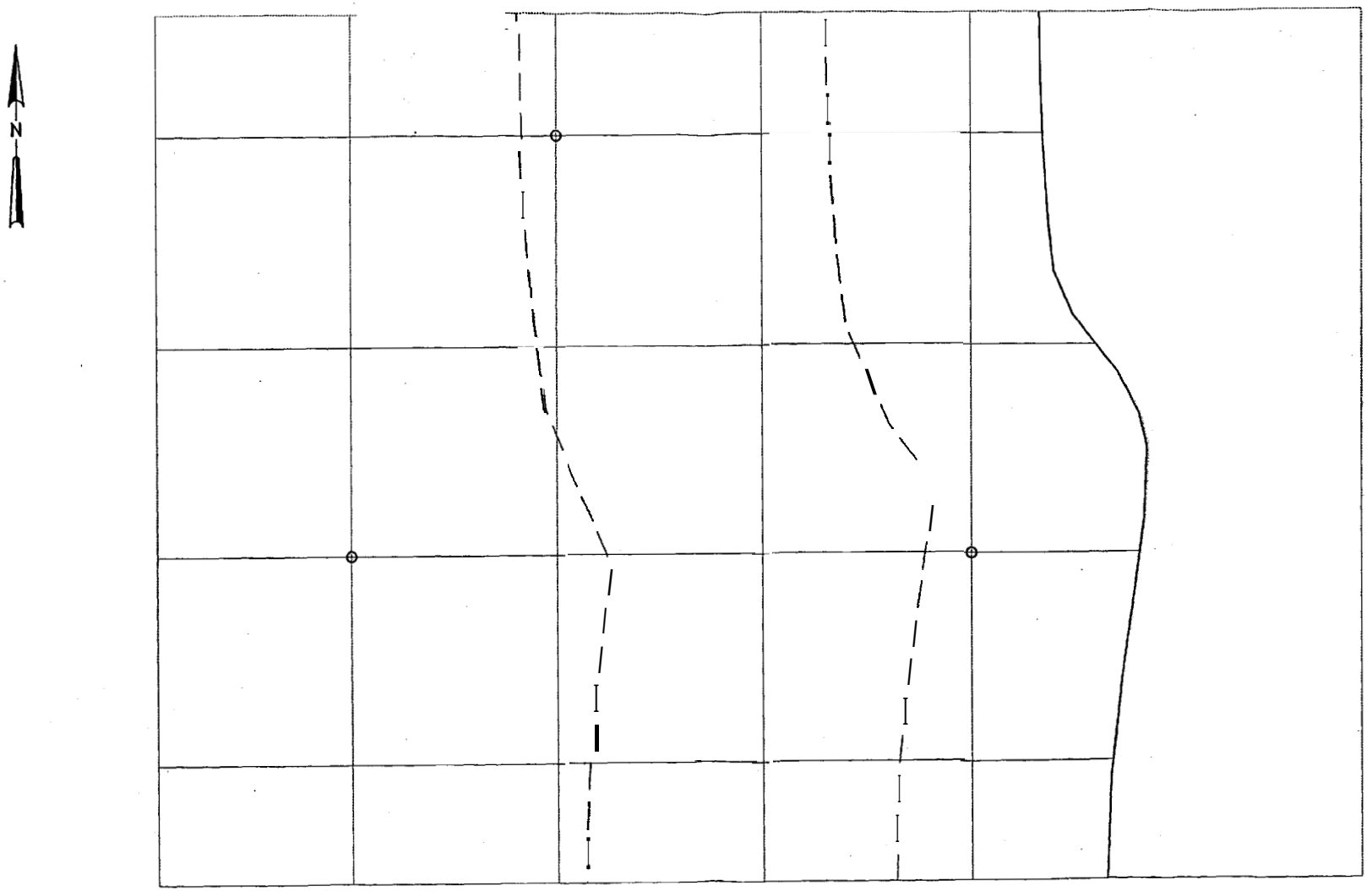
◕ Sediment/Water sampling location

SAMPLING AND
ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-18

PROPOSED SAMPLING LOCATIONS
IN TARGET AREA 4-A

DWG DATE: 5/15/95 | DWG NAME: 42FIGT4A



LEGEND

GRAPHIC SCALE

(IN FEET)
1 inch = 60 ft.

Sediment sampling location

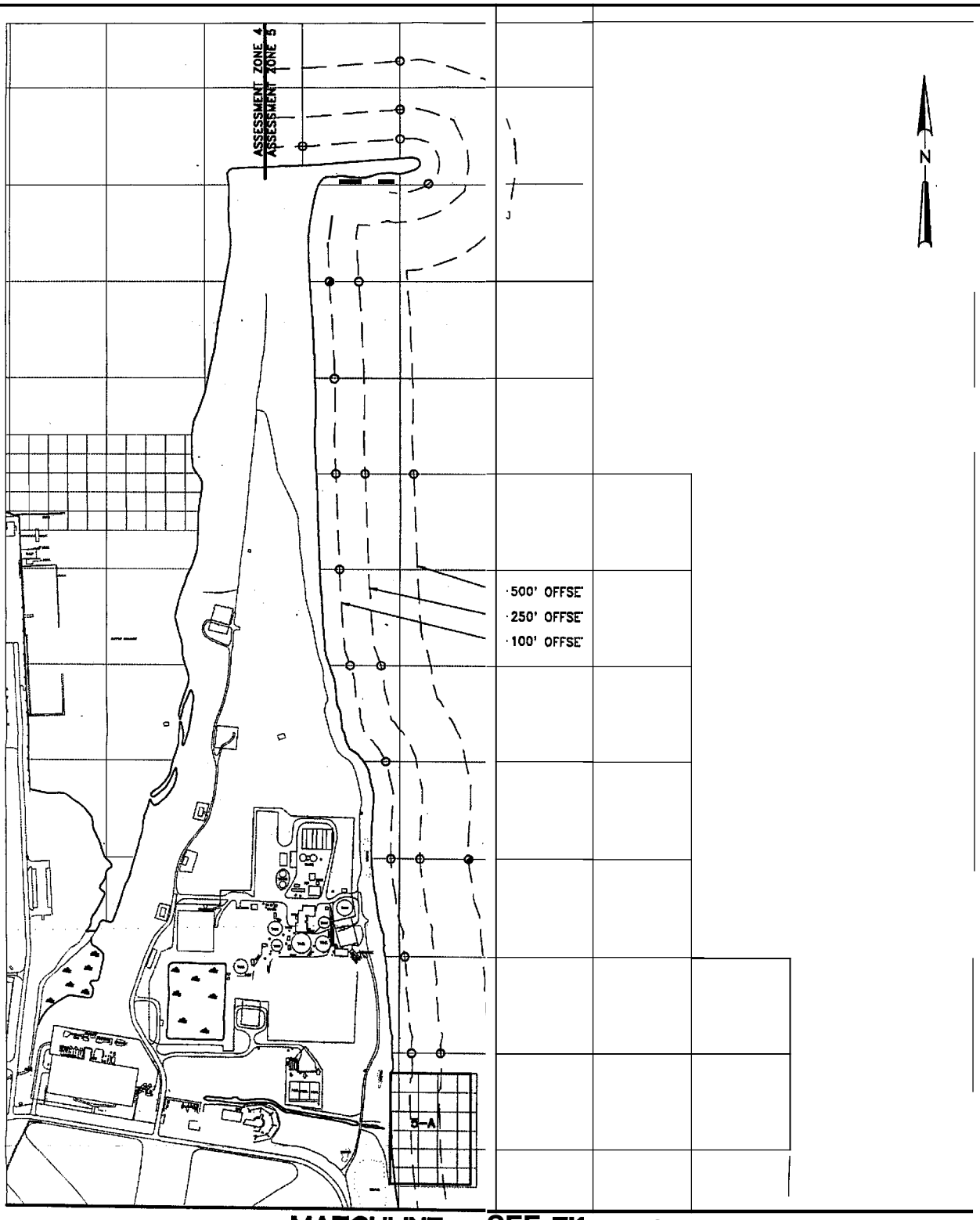
Sediment/Water sampling location

SAMPLING AND
ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-19

PROPOSED SAMPLING LOCATIONS
IN TARGET AREA 4-B

DWG DATE: 5/15/95 | DWG NAME: 42FIGT4B



MATCHLINE - SEE FIG 4-21

LEGEND

O Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE

500 0 250 500 1000

(IN FEET)
1 inch = 500 ft.

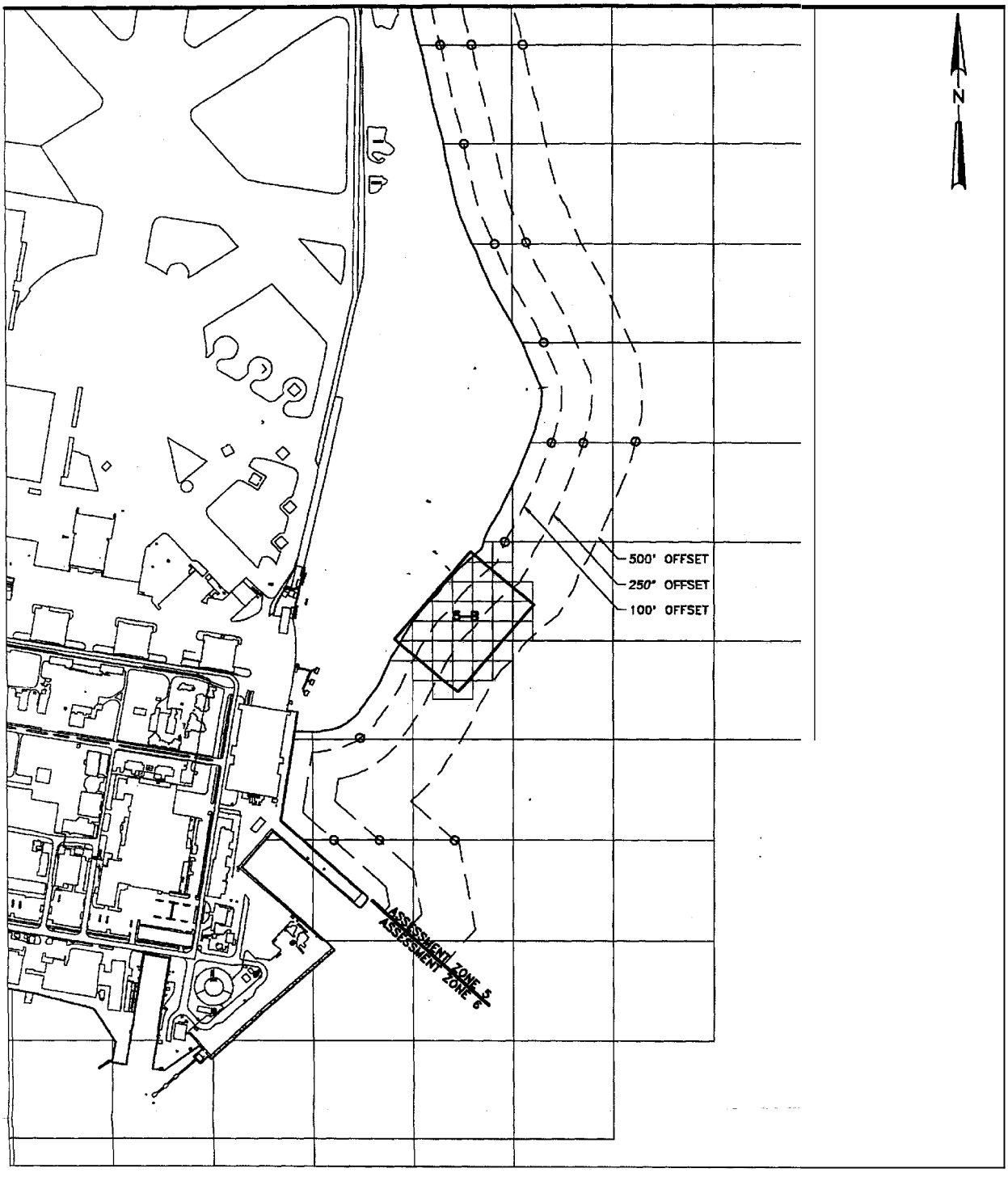
SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-20

PROPOSED SAMPLING LOCATIONS AND DESIGNATED TARGET AREAS ASSESSMENT ZONE 5

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ5A

MATCHLINE - SEE FIG. 4-20



LEGEND

- o Sediment sampling location
- ◐ Sediment/Water sampling location

GRAPHIC SCALE

500 0 125 250 500

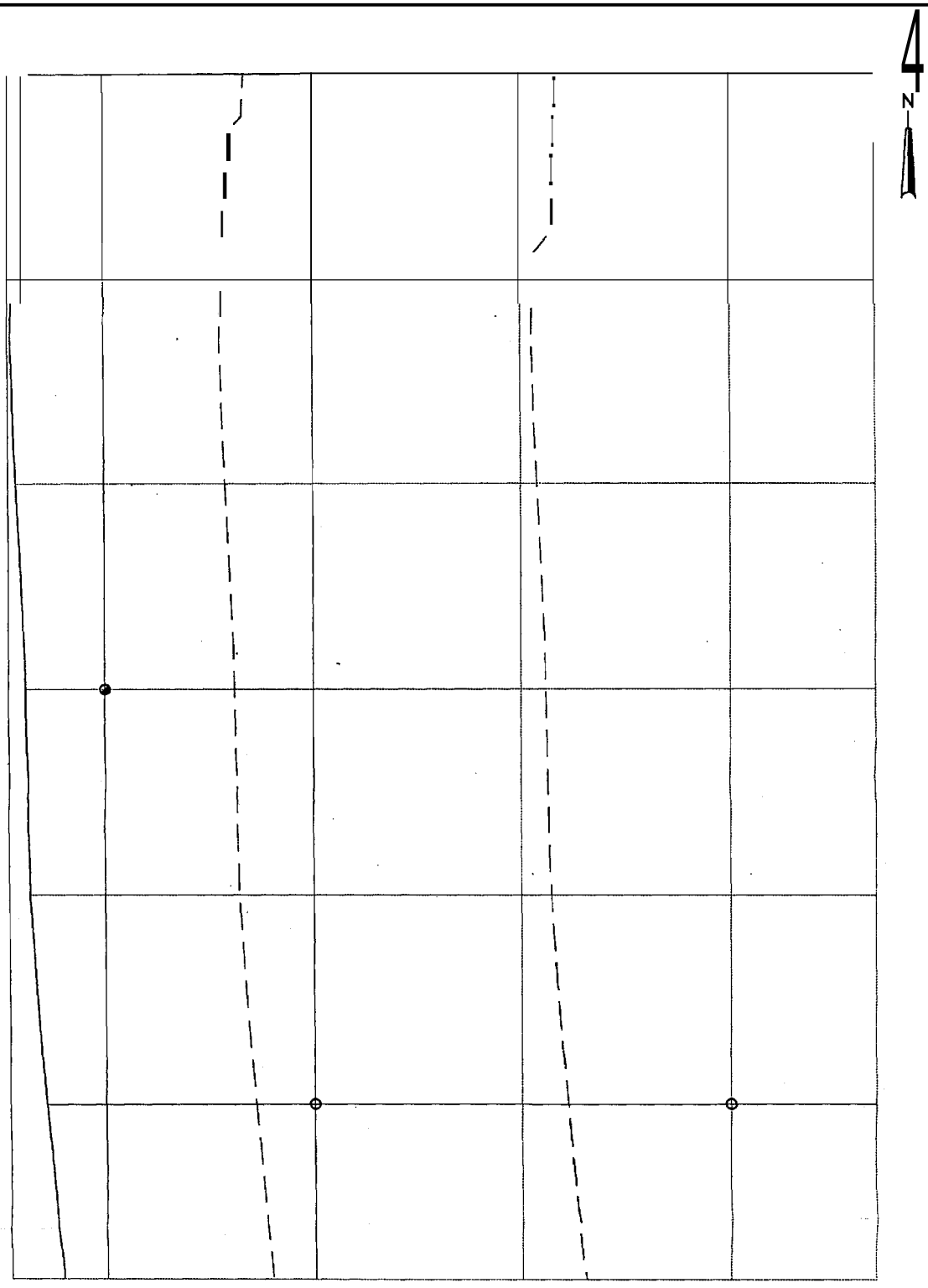
(IN FEET)
1 inch = 500 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-21

PROPOSED SAMPLING LOCATIONS AND DESIGNATED TARGET AREAS ASSESSMENT ZONE 5

DWG DATE: 5/15/95 DWG NAME: 42FIGZ5E



I FGFND

- ○ Sediment sampling location
- ◐ Sediment/Water sampling location

GRAPHIC SCALE

50 0 25 50 100

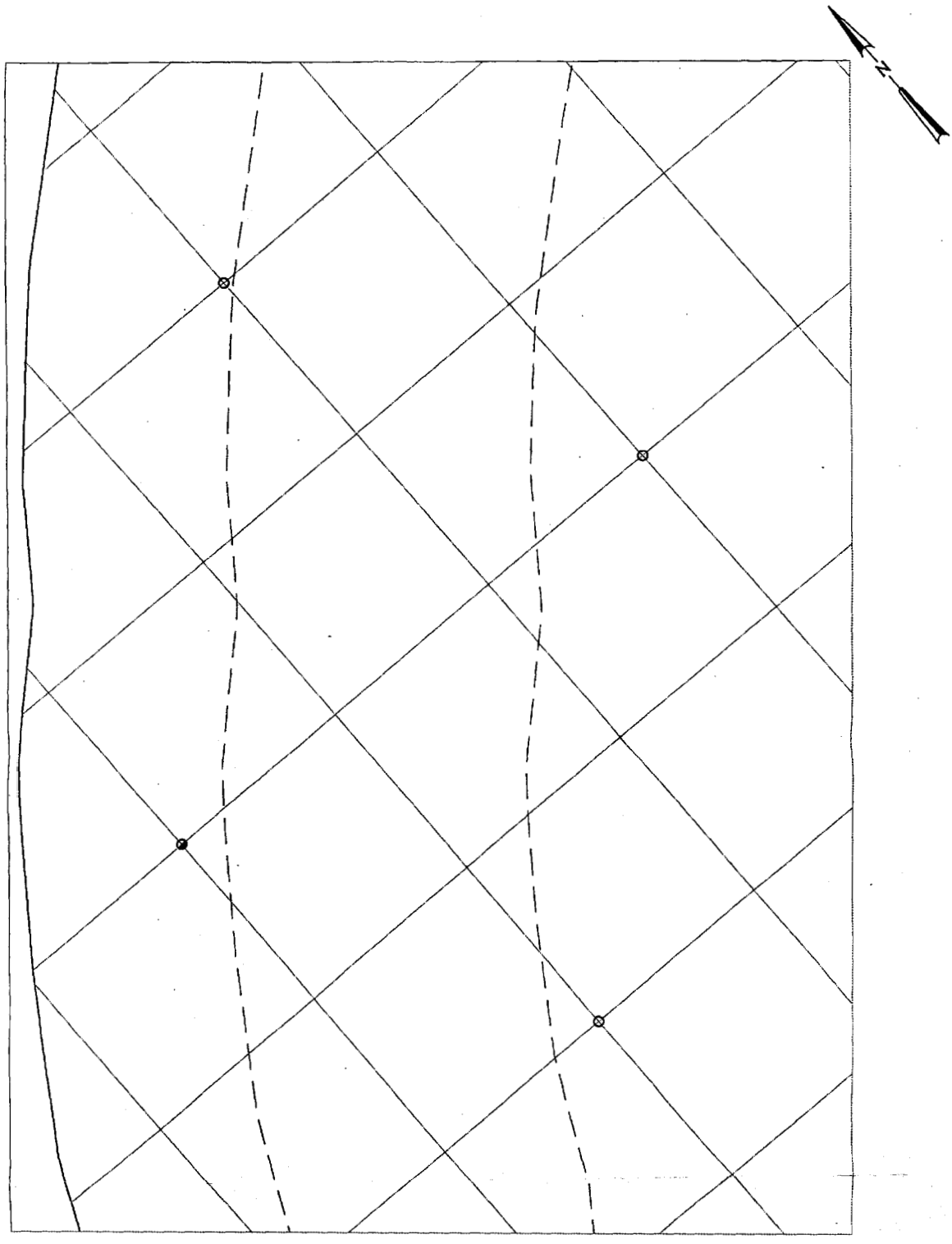
(IN FEET)
1 inch = 50 ft.

SAMPLING AND
ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-22

PROPOSED SAMPLING LOCATIONS
IN TARGET AREA 5-A

DWG DATE: 5/15/95 | DWG NAME: 42FIGT5



LEGEND

- Sediment sampling location
- Sediment/Water sampling location

GRAPHIC SCALE

50 0 25 50 100

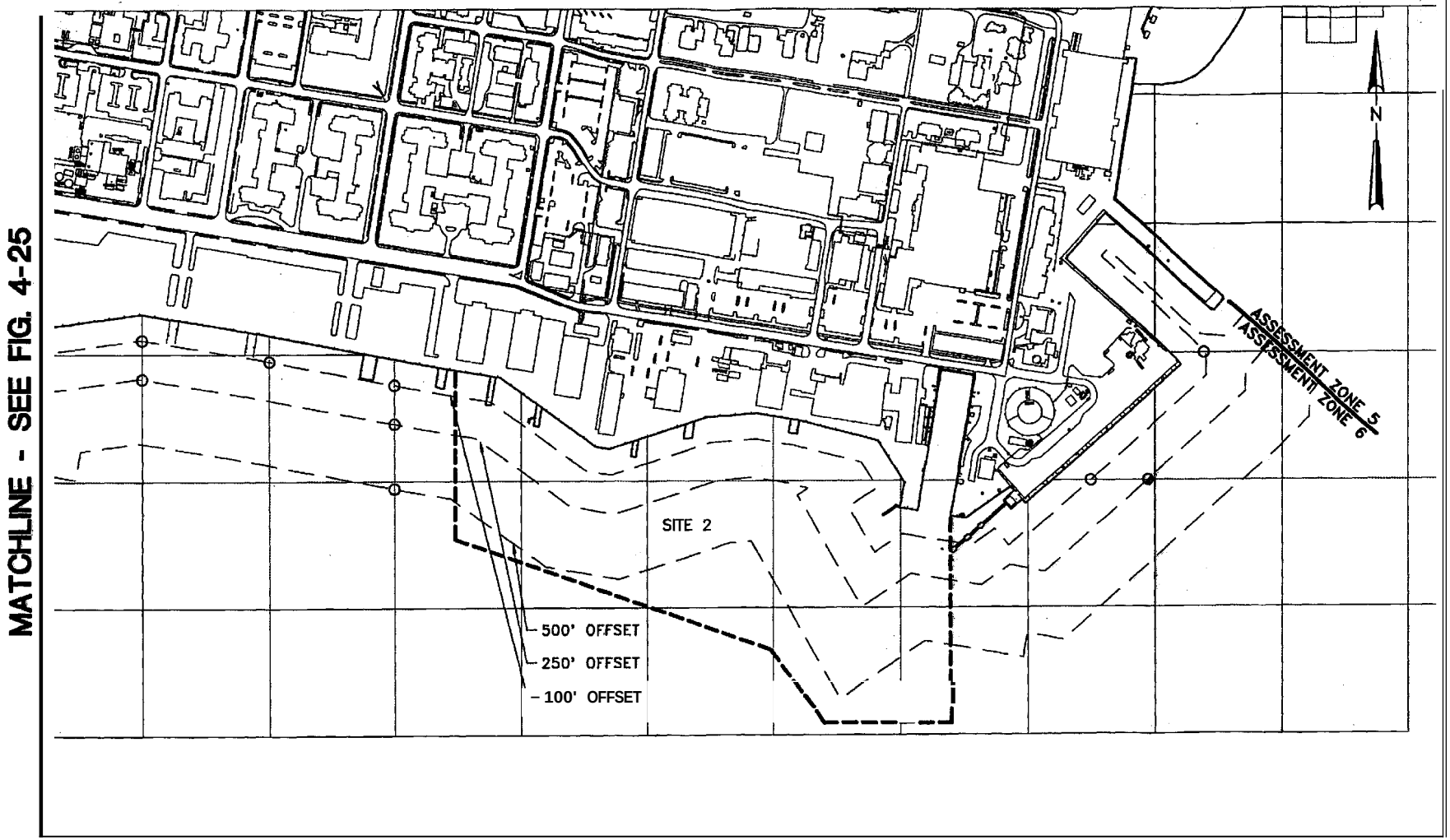
(IN FEET)
1 inch = 60 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-23

PROPOSED SAMPLING LOCATIONS IN TARGET AREA 5-B

DWG DATE: 5/15/95 DWG NAME: 42FIGT5B



LEGEND

O Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

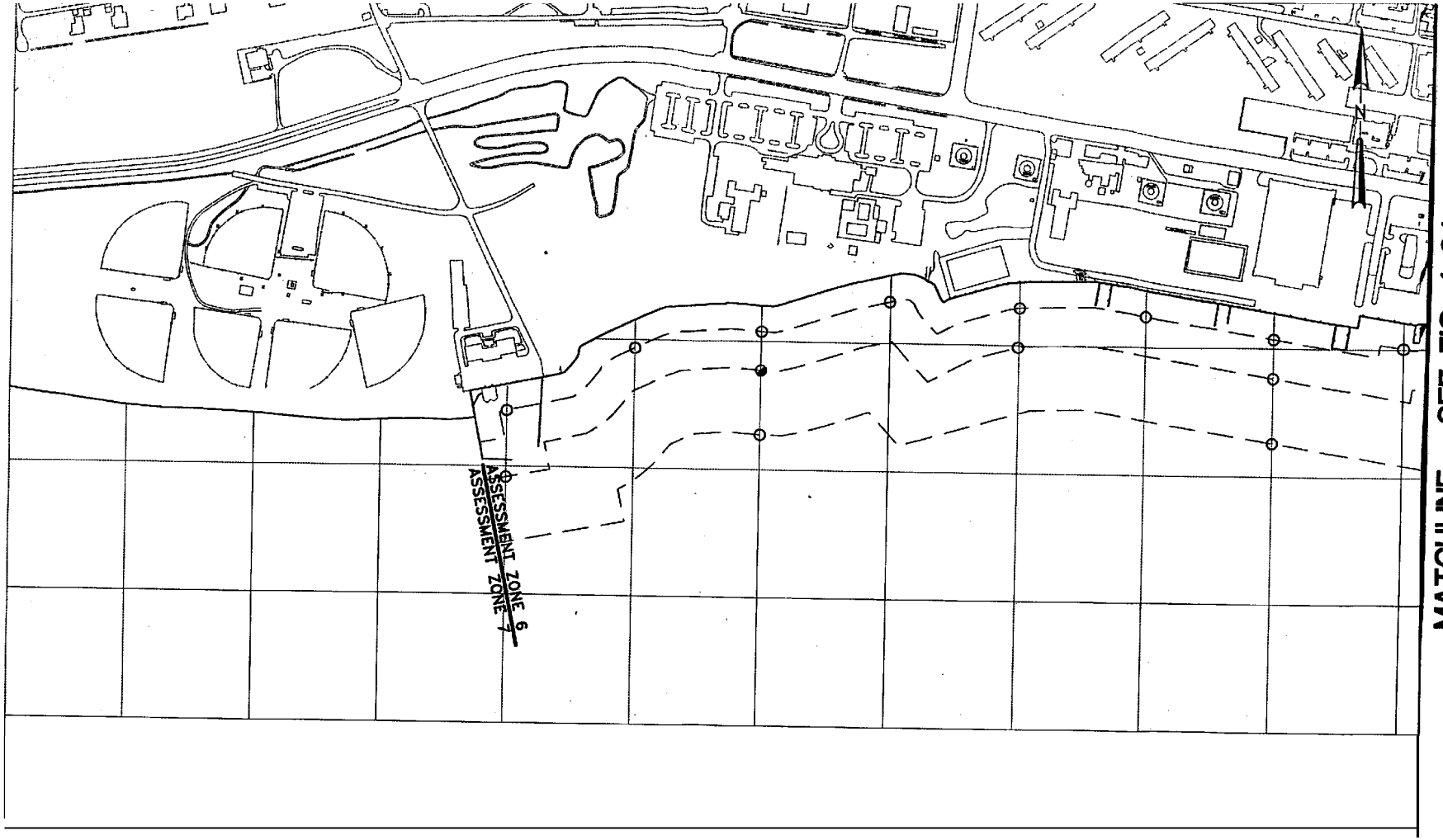
(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-24

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 6

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ6A



LEGEND

○ Sediment sampling location

◐ Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

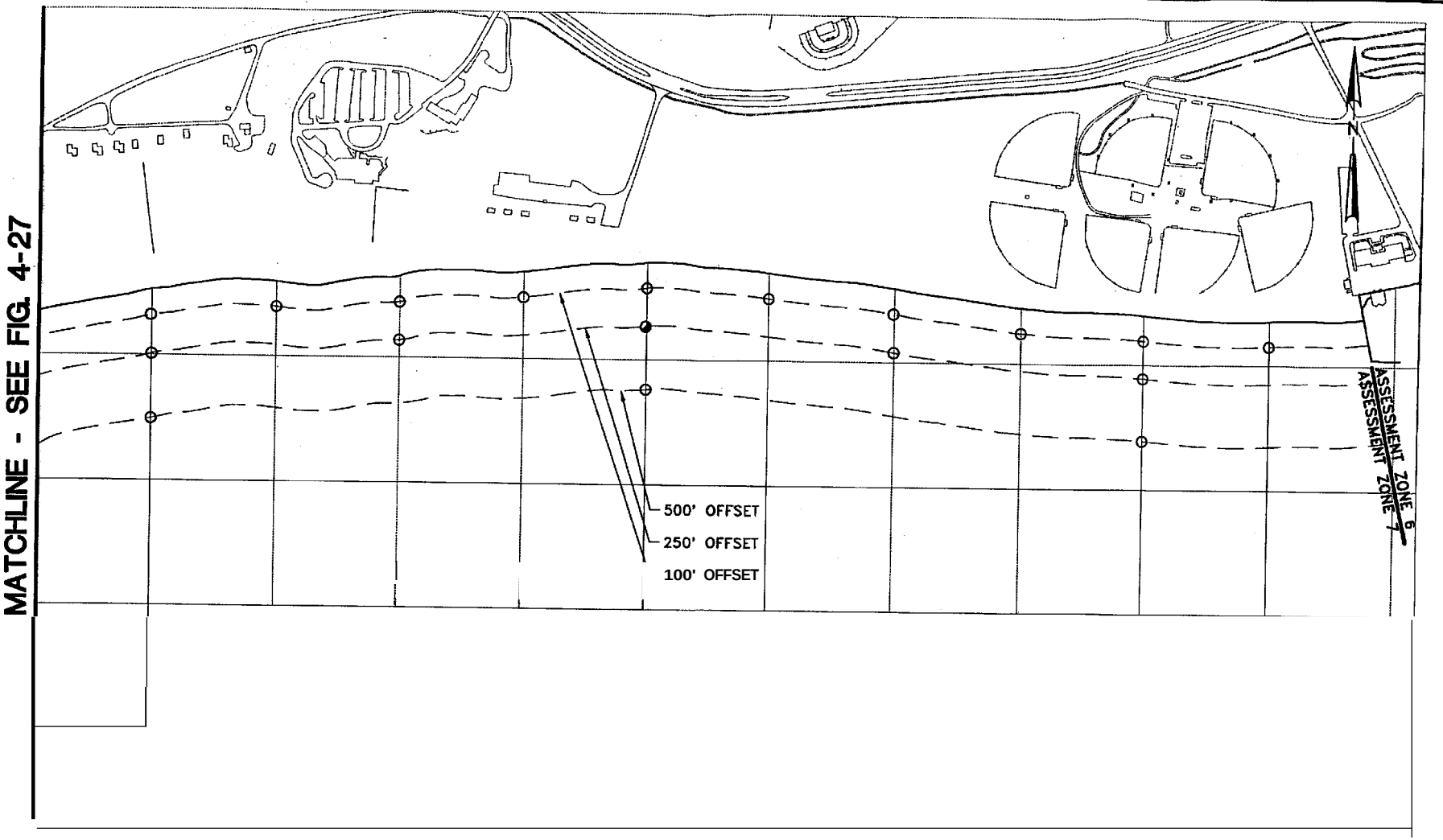
(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-25

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 6

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ6B



LEGEND

- Sediment sampling location
- Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

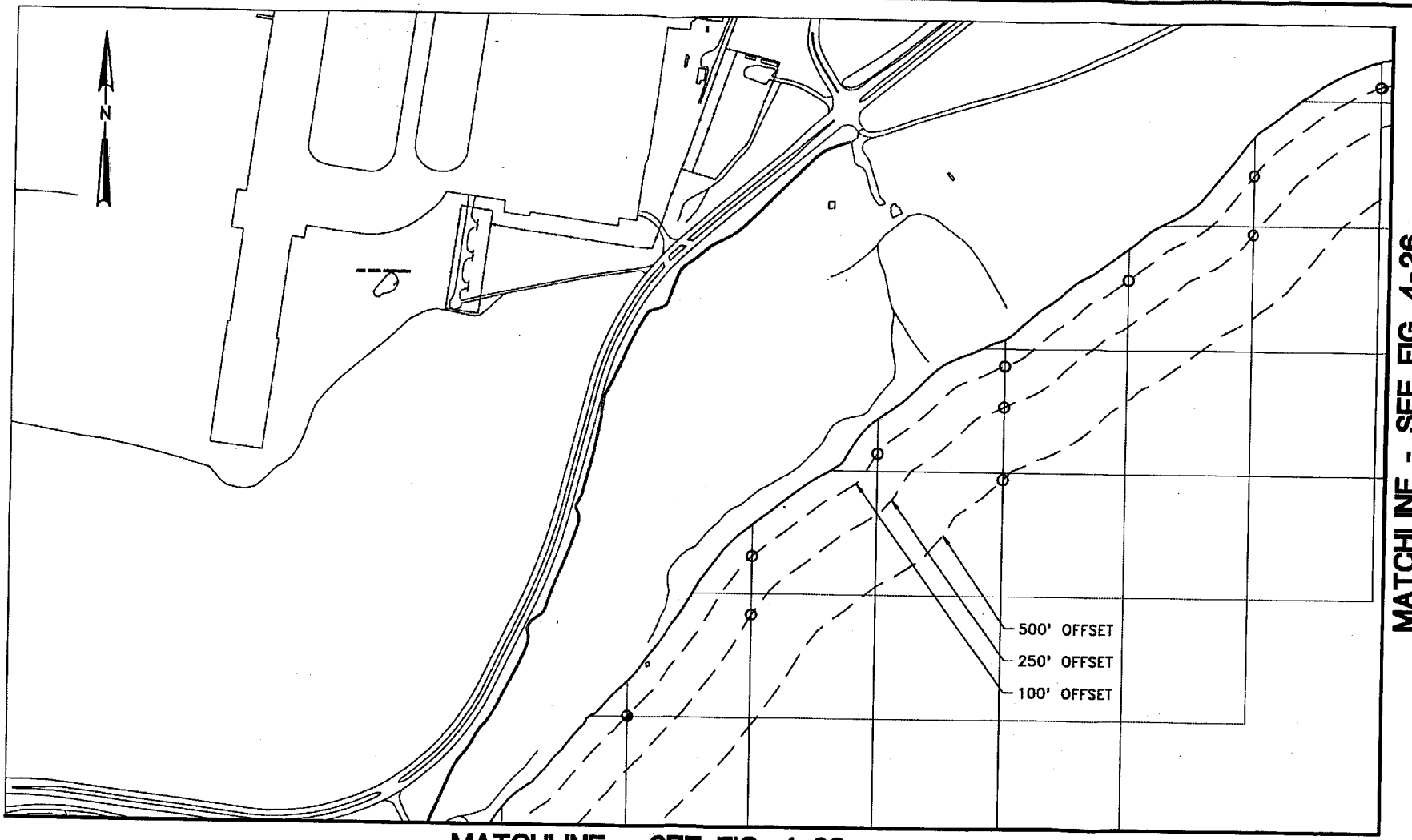
(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-26

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 7

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ7A



GRAPHIC SCALE

400 0 200 400 800

(IN FEET)
1 inch = 400 ft.

LEGEND

○ Sediment sampling location

◐ Sediment/Water sampling location

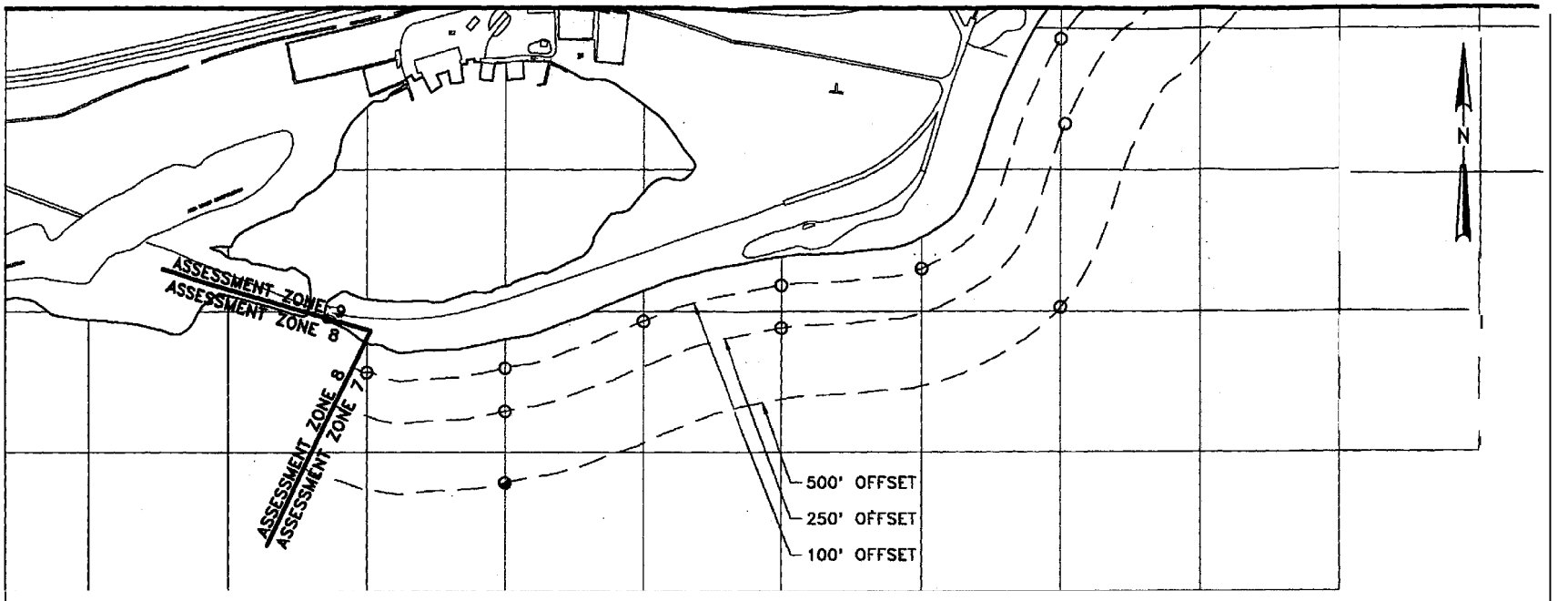
SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-27

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 7

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ7B

MATCHLINE - SEE FIG. 4-27



LEGEND

o Sediment sampling location

a Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

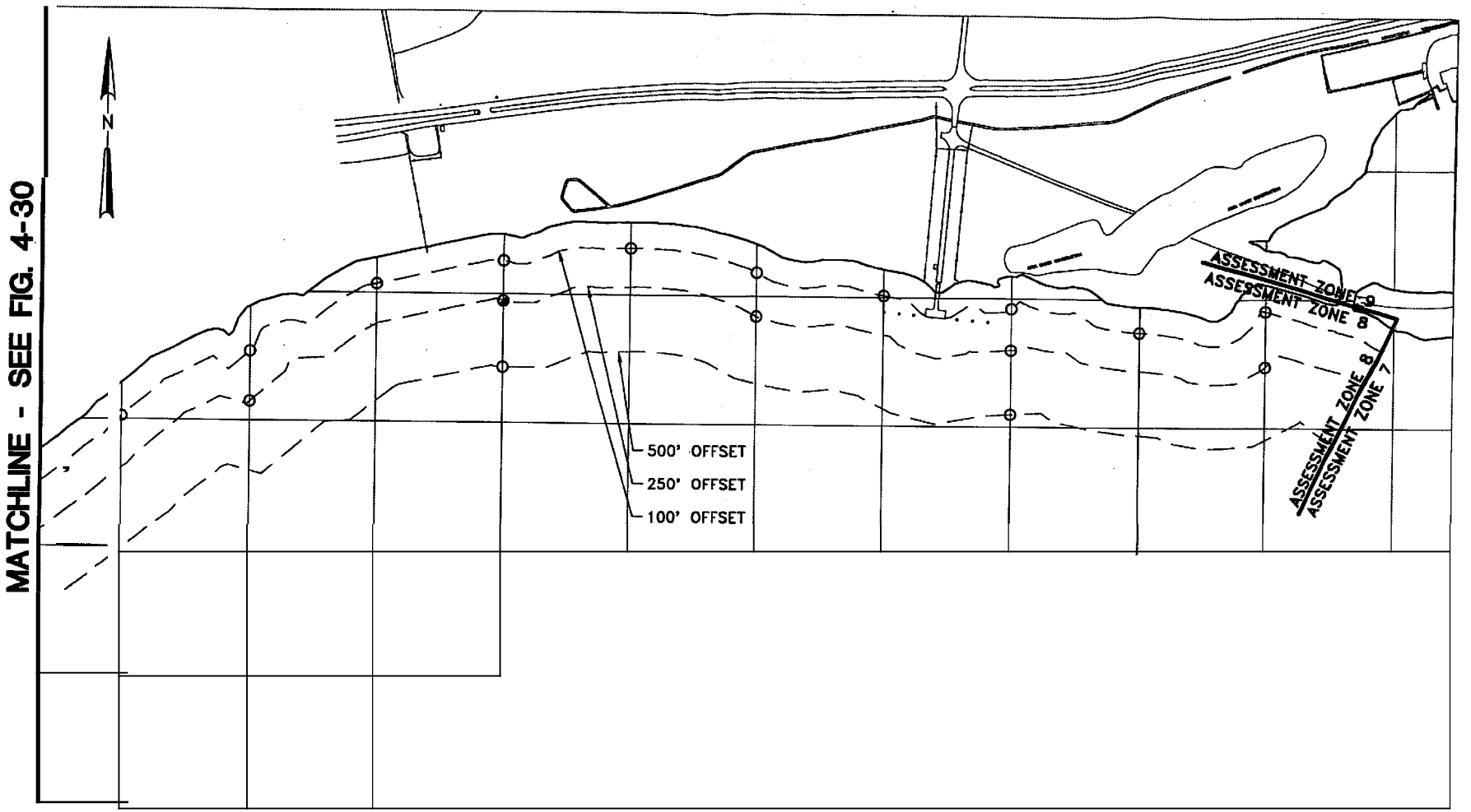
(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-28

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 7

DWG DATE: 5/15/95 DWG NAME: 42FIG77C



LEGEND

- Sediment sampling location
- Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

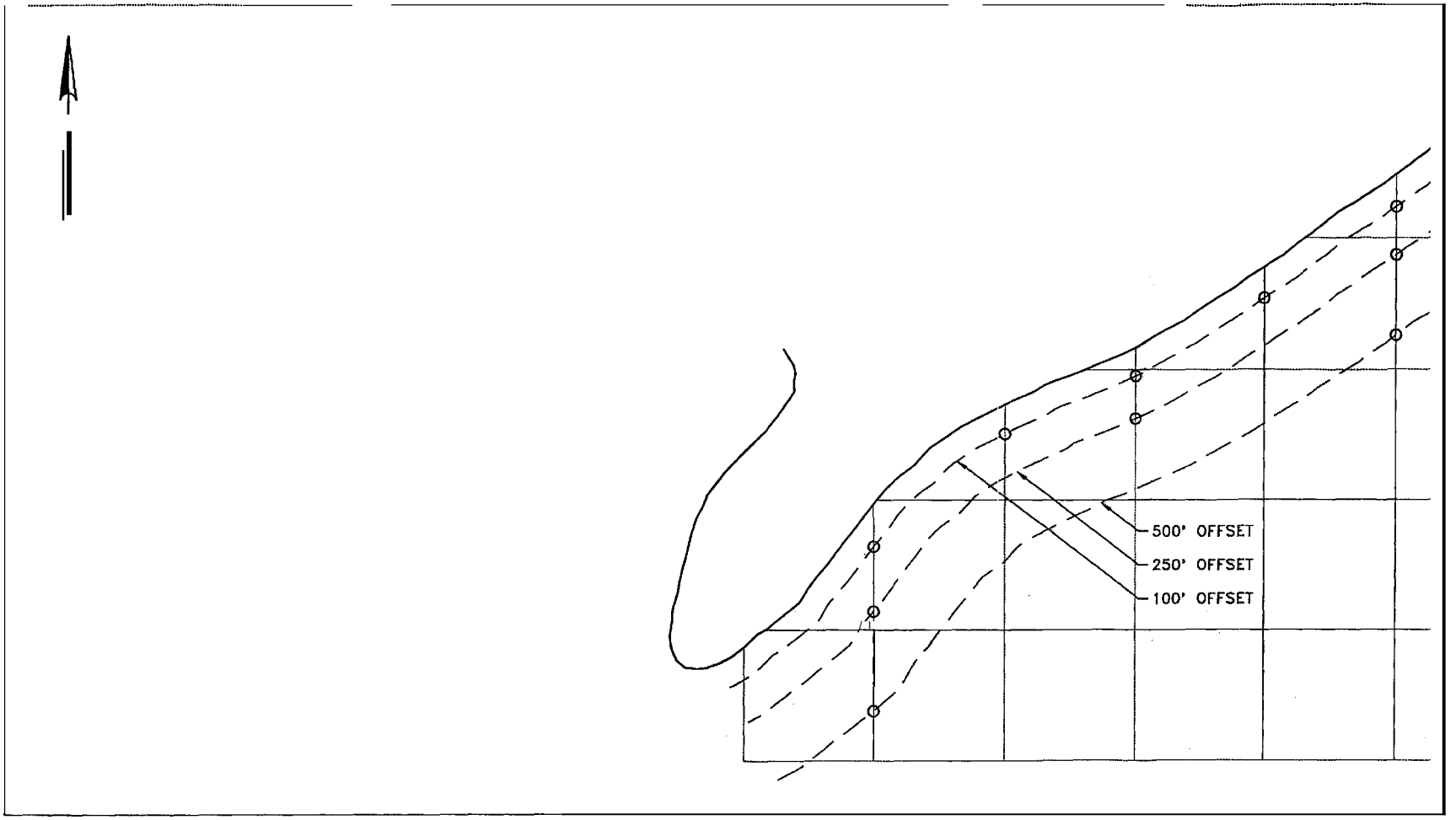
(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4–29

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 8

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ8A



LEGEND

o Sediment sampling location

a Sediment/Water sampling location

GRAPHIC SCALE

400 0 200 400 800

(IN FEET)
1 inch = 400 ft.

SAMPLING AND ANALYSIS PLAN
SITES 41 & 47
NAS PENSACOLA

FIGURE 4-30

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 8

DWG DATE: 5/15/95 | DWG NAME: 42FIGZ8B

For sampling purposes, all of AZ-9 will be considered as the TA. Thus, sampling locations in AZ-9 will be based on high density methods (Figure 4-31). Six sampling locations are proposed.

In all, 141 sampling locations are proposed along the NAS Pensacola shoreline within Pensacola Bay.

Proposed Reference Locations

Reference sampling locations within Bayou Grande will be determined during the field sampling program. Selected locations will be based on an initial bottom sediment type assessment to ensure that the qualitative nature of sediments are comparable to those within the study area. Also, locations will be selected to best represent portions of the bayou which would not be impacted by sources at NASP. The objective here is to provide a reference for contaminants currently in the marine environment near NAS Pensacola. The number of reference locations within the bayou will be field determined, but a data quality objective of at least 5 percent of the number of locations within the study area will be set.

Reference locations in Pensacola Bay will also be determined during the field sampling phase. Locations will be assessed based on sediment type present and the probability of input from onshore sources. It is believed that samples from AZ-8 may represent current background bay conditions. Field evaluation to identify any potential non point sources to the area will be critical to this determination. **[Although fine grained silty sediments, and not sandy sites, were the goal of this sampling strategy, at least two or three sandy sediment reference samples will be collected.]** The number of reference locations within the bay will be field determined but a data quality objective of at least 5 percent of the number of locations within the study area will be set.

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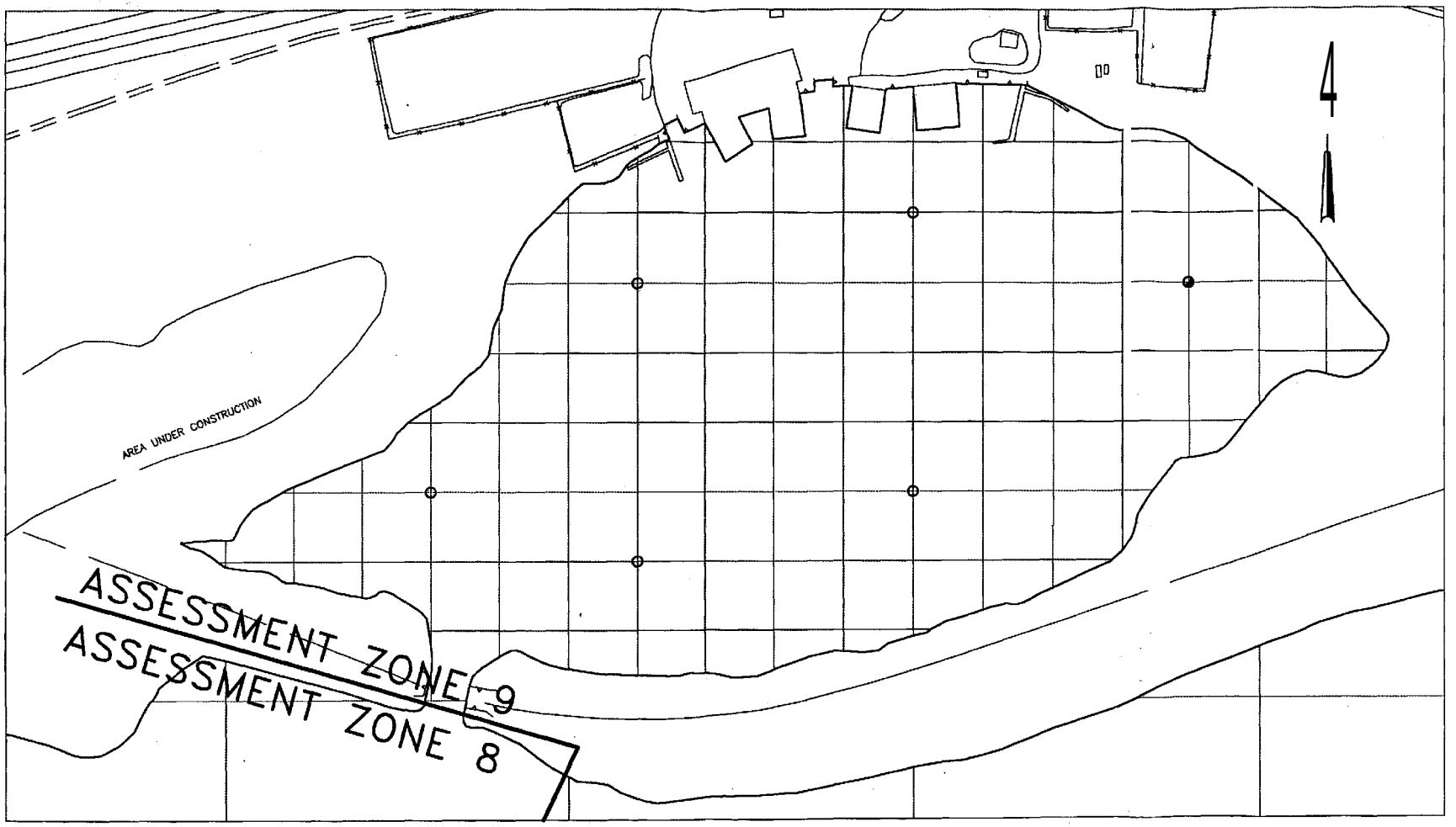


LEGEND

- ○ Sediment sampling location
- ◐ Sediment/Water sampling location

GRAPHIC SCALE

150 0 75 150 300

(IN FEET)
1 inch = 150 ft.

SAMPLING AND ANALYSIS PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 4-31

PROPOSED SAMPLING LOCATIONS
ASSESSMENT ZONE 9

DWG DATE 5/15/95 | DWG NAME: 42FIGZ9

5.0 ECOLOGICAL RISK ASSESSMENT FRAMEWORK

Phase I information was used to develop measurement and assessment endpoints and the site-specific conceptual model for estimating risk to the bay and the bayou. The conceptual model is based on the more generalized Conceptual model found in the work plan for Sites 40 and 42 and included in Section 2.4 of this *SAP*. Although not every aspect of this model *can* be directly measured, measurement endpoints were chosen which best represent key exposure and *effects* pathways in relation to assessment endpoints. Justification for these endpoints is based on the following information. Section 4 of the work plan detail many of the key ecological terms used in the following sections. .

5.1 Stressors

A stressor is any physical, chemical, or biological entity that *can* induce an adverse response in an organism. By identifying key stressors within the bay and bayou, risk and subsequent remedial options *can* be better focused. Within Sites 40 and 42, chemical contaminants resulting from IR site activities are anticipated to be the stressors of concern. In initially evaluating these chemical stressors, E/A&H reviewed results from RI studies at Site 2 and other sites suspected of impacting the bay or the bayou. E/A&H has also reviewed USEPA and E/A&H data from more limited studies performed in certain NAS Pensacola wetlands, of which some drain directly into the bay and bayou. Phase IIA samples will be focused in areas of contaminant migration and deposition in the bay and bayou, such as areas of fine-grained sediment deposits and other depositional areas.

In addition to chemical stressors, other stressors may impact the bay and bayou. These could be caused by natural conditions, habitat alteration, habitat destruction caused by dredging, operations, or many other more subtle factors not related to any activities at an associated IR site. Because risk will be the major determinant of remedial options, it is important to consider the effects of other stressors as well as chemical stressors when quantifying risk.

5.2 Ecological Receptors

In addition to identifying stressors, organisms exposed to and possibly impacted by that stressor should also be distinguished and quantified. Identifying these potential receptors and determining the likelihood of exposure will be important in determining impact and remedial options within the bay or bayou. General ecological receptors in the bay and bayou are described below.

Although species diversity in the Pensacola area has been characterized as relatively low (NFWMD 1991), the area does support significant ecological communities. The bay and the bayou are an important part of the Pensacola Bay ecosystem, which, among other important functions, supports important fishery resources. Many commercially and recreationally important species include speckled trout, redfish, mullet, flounder, blue crabs, and various shrimp species. There are also many ecologically important fish species such as pinfish, menhaden, croaker, and grass shrimp, which use the Pensacola Bay ecosystem for all or part of their life cycle. Other ecological resources significant to this investigation include waterfowl species which use the bay and bayou for habitat, feeding, and nesting.

Benthic macroinvertebrates are an integral part of the Pensacola Bay ecosystem in the estuarine and marine habitats of Pensacola Bay and Bayou Grande. Many species are sedentary and may either consume or otherwise be exposed to contaminants found in organically enriched sediments. This is important, because contaminants tend to accumulate more readily in organic-rich portions of the sediment. Because of their direct interaction with sediments and their sensitivity to chemical contamination in organic matter, benthic macroinvertebrates may serve as indicators of the areal extent and magnitude of environmental stress.

Benthic macroinvertebrates can also serve as environmental indicators of any at-risk populations or communities. Toxicity to benthic macroinvertebrates may be acute or chronic, depending on the contaminant, its concentration, and the sensitivity of the receptor. Even if toxicity is not

established in the benthic macroinvertebrate, impacts can also occur through bioaccumulation of the contaminant and subsequent transfer through the food chain. For example, many fish, crab, and other species that live close to the sediment may feed on benthic macroinvertebrates. These consumers may become *exposed* to contaminants which may not be toxic, but may bioaccumulate and show their effects in *other* ways. Therefore, benthic macroinvertebrates *can* serve as indicators of varying types of contaminant effects and also serve as test surrogates for contaminant exposure to various groups of organisms including fish, crustaceans, bivalves, and other higher-order species.

Lower food-chain aquatic species can serve in a capacity similar to the benthic macroinvertebrates. However, there is much more variability involved in their analysis. Although lower food-chain aquatic organisms have a limited habitat range and *can* serve as a food source to higher-level consumers, the medium they live in is highly variable. For example, contaminant concentrations in surface water are likely to vary depending on factors such as precipitation, tides, temperature, and other influences. Habitat range, although limited, is not as limited as a relatively stationary benthic macroinvertebrate, so it may not be as easy to correlate a contaminant concentration with an observed effect in a particular area on a consistent basis. Remedial strategies amy also be difficult based on surface water toxicity, because it might be difficult to establish which — should be remediated. However, it is important to establish contaminant effects in surface water in addition to sediment to yield a better idea of how the contaminant may be interacting in both media. This information *can* be important in making risk-based decisions for remedial action.

5.3 Endpoint Selection and Effects Indices

Because ecological concerns are so prevalent at Sites 40 and 42, selection of measurement and assessment endpoints is an important part of focusing risk assessment goals and designing remedial options for the areas *of concern* in the bay and bayou. Measurement and assessment endpoints are ecologically based criteria that are relevant to decisions about protecting the

environment. Measurement endpoints are measurable responses to a stressor that can be related to the valued characteristics chosen as the assessment endpoints. Assessment endpoints are defined as the ecological components that am of value in the risk assessment. Assessment endpoints allow for the prediction or measure of explicit expressions of environmental values to be protected. They are the ultimate focus in risk characterization, and link the measurement endpoints with the risk management process (EPA 1992).

53.1 Measurement Endpoint Effects Indices

The initially selected measurement endpoints for this study are quantitative toxicological responses of benthic macroinvertebrates and lower food-chain aquatic species to contaminated sediment and surface water. Two major indices may be used as the basis for this assessment: (1) reference values and screening values, and (2) biological effects indices. Each provides information relative to contaminant exposure and effects.

Reference and Screening Values — Reference concentrations will be derived from sediment and surface water samples collected from the reference locations in the bay and bayou, which are described in Section 4. All contaminant values detected in areas of concern will be compared to reference concentrations and ranges of concentrations for contaminants within reference areas. If a contaminant is determined to be present at concentrations greater than the reference concentration, it may be compared to its sediment screening value (SSV) or water quality criteria value (WQC), if one of these values exists. Initial screening values used in this plan are EPA Region IV SSVs, State of Florida Sediment Quality Assessment Guidelines (SQAGS), EPA fresh or marine acute and chronic WQC, and Florida fresh or marine water quality criteria based on the protection of aquatic life (Florida WQC). These values exist for a limited number of contaminants, but will be used whenever possible. The lowest applicable Florida SQAGS are either below practical quantitation limits or are equal to the SSV. Therefore, all constituents detected in sediment will be listed in comparison to SSVs.

For water quality criteria, EPA lists both acute and chronic values. The State of Florida lists chronic water quality values only. Whenever EPA or Florida chronic WQC exist for the same contaminant, the most conservative value will be used and referred to as the WQC for that contaminant.

Whenever a reference value or one of the screening values is exceeded for a contaminant, additional study in Phase IIA may be needed to better characterize its distribution. In sediment, the decision for additional study depends to a certain degree on the weight of evidence of impact. Specific variables in the weight of evidence approach for evaluating impact include bioavailability of the contaminant in specific sediment types and results of any applicable contaminant modeling techniques, which may help determine whether that contaminant would adversely affect the ecosystem at its detected concentration. In surface water, important physical and chemical components that impact WQC must be considered. If a screening value does not exist for a particular contaminant, further study may be needed, based on a comparison to reference values and weight of evidence only.

Biological Effects Indices — Biological effects indices may be measured through toxicity, diversity, and bioaccumulation studies. These may be used to assess potential biological effects at different levels of the food chain by predicting effects to assessment endpoints. To evaluate assessment endpoints, multiple measurement endpoints at lower levels of biological organization are chosen. These measurement endpoints may include organism-level responses in sediment and surface water toxicity bioassays, population abundances of benthic macroinvertebrate species, community indices through benthic macroinvertebrate species richness and community similarity, and biomarkers through bioaccumulation in select species (EPA 1993). Species initially chosen for the toxicity analysis are shown on Table 5-1.

Table 5-1
Initially Chosen Measurement Endpoints for Toxicity Tests

Type of Media	Organism Chosen	Common Name
Marine Sediment	*Ampelisca abdita* *Cyprinidon variegatus* *Mysidopsis bahia*	Marine Amphipod Sheeps Head Minnow Mysid Shrimp
Marine Surface Water	*Menindia berrylina* *Mysidopsis bahia*	Silverside Minnow Mysid Shrimp

5.3.2 Assessment Endpoints

The information above may be used to predict potential impacts to assessment endpoints, which are ecological components within the bay and the bayou surrounding NAS Pensacola. The initial assessment endpoints are chosen based on the following assumptions:

- Contaminants present in the sediment and surface water of the bay and the bayou may impact the overall benthic ecosystem.

- Contaminants present in the sediment and surface water of the bay and bayou may impact aquatic and sediment-dwelling invertebrates and other lower food-chain organisms.

- Primary consumers and organisms higher in the food chain may be exposed to elevated concentrations of contaminants in sediment, surface water, and lower trophic food sources (Pascoe and DalSoglio 1994).

Primary species initially chosen to represent these assessment endpoints, located at different levels of the food chain and specific for the bay and the bayou, are the white shrimp (*Penaeus (Litopenaeus) setiferus*), the great blue heron (*Ardea herodias*), and the osprey (*Pandion haliaetus*). However, other species may be used if they are later found to better serve as assessment endpoints based on habitat conditions in a particular area of the bay or bayou. These

species were chosen because of their role in the food chain, the relatively abundant amount of information known about their breeding and life cycles, and their possible response to ecological stress. The white shrimp was selected also because of its economic importance and its potential use of estuarine areas of the bay and the bayou. The white shrimp is also relatively low in the food chain and uses tidal areas for breeding and habitat. The white shrimp *can* also be used in Phase III, if needed, to determine contaminant bioaccumulation in their tissue. The great blue heron was chosen because of its role as a predator in the tidal habitats, and because it is known to feed almost exclusively in shallow water bodies. The osprey was chosen because it is a higher order consumer that feeds almost exclusively on fish and is known to inhabit NAS Pensacola.

Specific assessment endpoint characteristics which may be predicted are mortality, reproductive alterations, bioaccumulation of contaminants, or loss of habitat for feeding or reproduction. Because these values may be predicted or estimated, uncertainty is inevitable and will be stated. Uncertainty will be quantified as much as possible. Possible sources of uncertainty are physical stressors, the predictive abilities of the conceptual model, completeness of the data, natural variability of habitat use, feeding patterns of assessment endpoint species, and errors in laboratory analysis.

Impacts to the assessment endpoint species may be analyzed and predicted using information found in the EPA *Wildlife Exposure Factors Handbook* (EPA, December 1993). This publication provides information on habitat range, body weight, food and water ingestion rates, population density, and other factors specific to some of the organisms chosen as assessment endpoints. Potential contaminant exposure to assessment endpoints *can* be estimated based on the information found in this publication. After exposures are analyzed, effects can be predicted and quantified based on published effects-level threshold values. E/A&H recognizes the inherent uncertainty of these estimations. All sources of uncertainty will be minimized as much as possible, but will be stated in the final risk assessment.

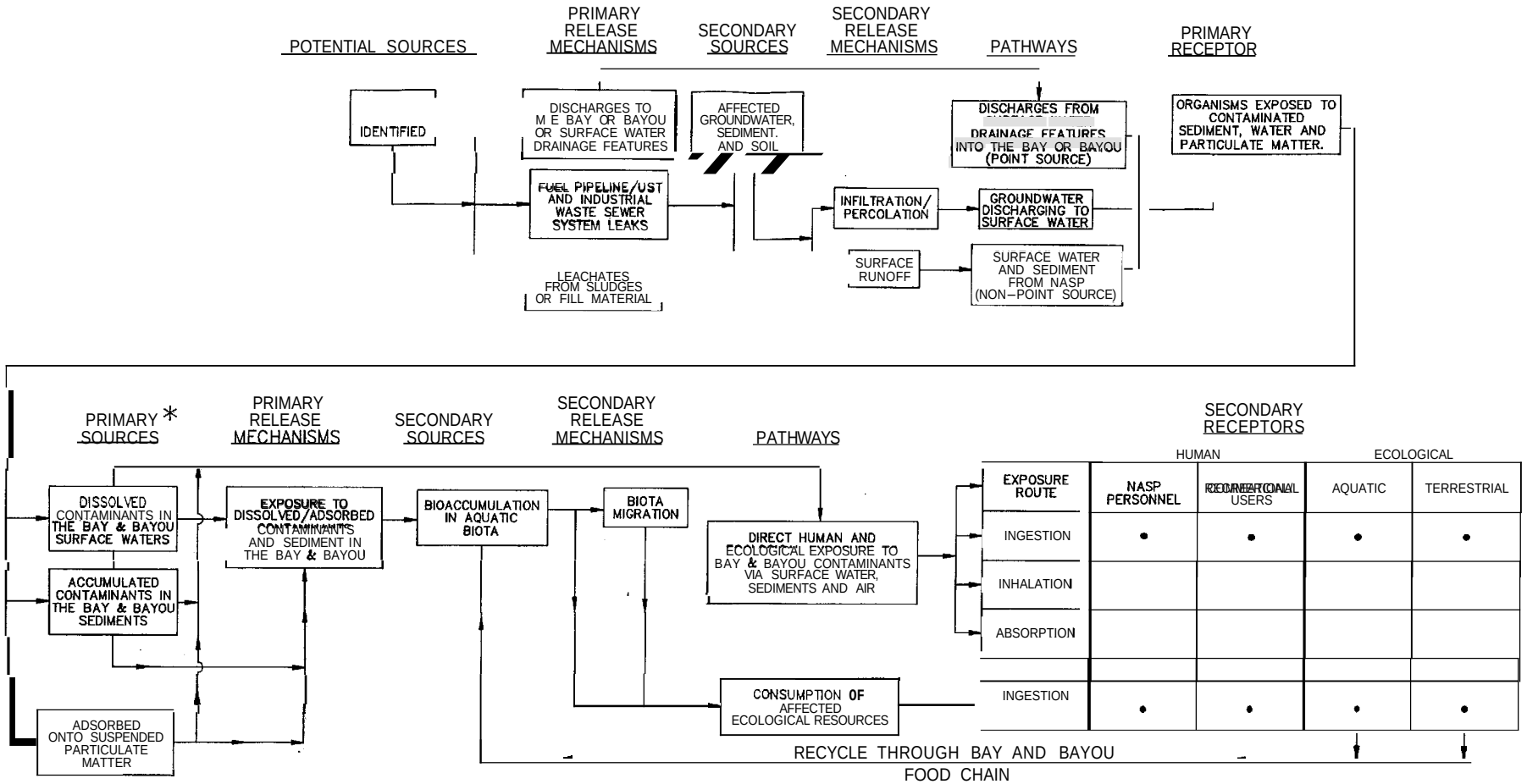
5.4 Conceptual Model

The conceptual model is based on the above information and is framed around the conceptual model shown in Figure 5-1. In summary, spatial distribution of site-related contaminants in particular areas of the bay and bayou will be measured in Phase IIA. The exposure scenario will consider the sources from each site of concern and the physical, chemical, and biological transport and distribution of contamination in each area of concern in the bay and bayou. Based on the nature, extent, and predicted contaminant impacts, effects to benthic macroinvertebrates may be measured. These effects may be quantitatively assessed based on toxicity, diversity, and bioaccumulation studies. Site-specific indices of ecological impact may be developed based on the results. This information may be used to predict impacts to the white shrimp, the great blue heron and the osprey.

5.5 Ecological Risk Assessment Framework Summary

Completion of the RI and the risk assessment is based on three sources of information; not all may be required to completely assess risk. The first source is chemical analyses to establish the presence, concentrations, distribution, and possible effects of any chemical contaminants. The second source is data from toxicity tests and diversity studies to link exposure effects with the chemical analyses. The third is bioaccumulation studies to further refine ecological impact and determine whether any influences are occurring at higher levels of the food chain. As noted in EPA guidance, this information is important in establishing a causal link between contaminants and ecological effects.

The information above will be integrated, using a weight-of-evidence approach, into a risk management decision and remedial design strategy based on risk to human health and the environment. The weight-of-evidence approach considers all available information to predict human health and ecological impact. All factors must be considered to yield an overall picture of risk so remedial options can be developed.



* CONTAMINANT CONCENTRATIONS AND MEDIA CHARACTERISTICS CAN DETERMINE WHETHER CONTAMINATED SEDIMENT ACTS AS A SOURCE OR PATHWAY OF CONTAMINATION

SAMPLING AND ANALYSIS PLAN
SITES 40 AND 42-BAYOU GRANDE & PENSACOLA BAY
PENSACOLA, FLORIDA

FIGURE 5-1
CONCEPTUAL SITE MODEL

DATE: 06/28/95 | DWG NAME 36CM4051

6.0 HUMAN HEALTH RISK ASSESSMENT FRAMEWORK

The human health risk assessment at Sites 40 & 42 will analyze and quantify risk to human receptors (real or hypothetical) that may result under various exposure Scenarios if no remedial actions are taken to reduce the extent of environmental contamination. The human health risk assessment will adhere to guidelines in USBPA documents. The list below is dynamic — documents will be included and excluded when applicable and as new guidance is published:

- *Risk Assessment Guidance for Superfund, Volume I — Human Health Evaluation Manual, Part A,* EPA/OERR, EPA/540/1-89/002, December 1989 (Interim) (RAGS Part A).

- *Risk Assessment Guidance for Superfund, Volume I — Human Health Evaluation Manual, (Part B, Development of Risk-based Preliminary Remediation Goals),* EPA/OERR, EPA/540/R92/003, December 1991 (Interim) (RAGS Part B).

- *Risk Assessment Guidance for Superfund, Volume I — Human Health Evaluation Manual, Supplemental Guidance-Standard Default Exposure Factors-Interim Final,* EPA/OERR, OSWER Directive: 9285.6-03, March 25, 1991 (RAGS Supplement).

- *Dermal —sure Assessment: Principles and Applications. Interim Report* EPA/ORD, EPA/6008-91/011B, January 1992 (Dermal Guidance).

- *Risk Assessment Guidance for Superfund, Volume I — Human Health Evaluation Manual, Supplemental Guidance-Dermal Risk Assessment-Interim Guidance,* EPA/OERR, August 18, 1992 (Supplemental Dermal Guidance).

- *Supplemental Guidance to RAGS: Region IV Bulletin Default Oral Absorption Values for Dermal Reference Dose Adjustment (Dermal Adjustment Supplement).*

- *Supplemental Guidance to RAGS: Region IV Bulletin, Development of Health based Preliminary Remediation Goals, Remedial Goal Options and Remediation Levels (Supplemental R W Guidance).*

- *Supplemental Guidance to RAGS: Region IV Bulletin, Exposure to VOCs during Domestic Water Use: Contributions from Ingestion, Showering and Other Uses (Supplemental Groundwater VOC Guidance).*

- *EPA Region III Contaminant of Concern Screening Table, March 18, 1994, (Roy L. Smith); (RBC Screening Tables).*

6.1 Objectives

The objectives of the human health risk assessment are to:

- Characterize the source media and determine the chemicals of potential concern (COPCs) for Sites 40 and 42 at NAS Pensacola.

- Identify potential receptors and quantify potential exposures under current and future conditions, if applicable.

- Qualitatively and quantitatively evaluate the adverse effects associated with the site-specific COPCs.

- Characterize the potential human health risks associated with Sites 40 and 42 under current and future conditions.

- Evaluate the uncertainties related to exposure predictions, toxicological data, and resultant carcinogenic risk and noncarcinogenic hazard predictions.

The value of the risk assessment as a basis for making remedial decisions depends on adequately characterizing chemical contamination. Variables considered in characterizing the study area and its associated risk are the amount, type, and location of sources, the potential pathways of exposure (media type and migration mutes), and the type, sensitivities, exposure duration, and dynamics of the potentially exposed populations *(receptors).* The focus of the investigation at Sites 40 and 42 will be assessing of the effects *of* past practices and contamination identified in environmental media on and near the sites.

6.2 Organization

Site Background

Data regarding site geography, geology, hydrogeology, climate, and demographics of populations in the area are described in this section. This information will be used to compare site-specific exposure and effects.

In addition to steps specifically discussed in this plan, the human health risk assessment will include the following steps, as defined by RAGS Part A:

- Site characterization: Data regarding site geography, geology, hydrogeology, climate, and demographics of populations in the area are evaluated.

- Data collection: Samples of environmental media, including reference samples, *are* analyzed.

- **Data evaluation:** The analytical data are analyzed statistically to identify the nature and extent of contamination and establish a preliminary list of COPCs that will subsequently be refined to identify chemicals of concern (COCs).

- **Exposure assessment:** Potential receptors are identified under current and future conditions, potential exposure pathways are identified, and exposure point concentrations and chemical intakes are quantified.

- **Toxicity assessment:** The adverse effects of the COPCs are qualitatively evaluated, and the relationship between exposure and severity or probability of effect are quantitatively estimated.

- **Risk characterization:** The output of the exposure assessment and the toxicity assessment are combined to quantify the total noncancer and cancer risk to the hypothetical receptors.

- **Uncertainty:** Areas of recognized uncertainty in human health risk assessments are discussed and evaluated in addition to medium- and exposure pathway-specific influences.

- **Risk/Hazard summary:** The results of the exposure quantification (risk and hazard) for the potential receptors and their exposure pathways identified under the current and future conditions are presented and discussed.

- **Remedial goal** options (RGOs): Quantify exposure concentrations within the USBPA target risk range of 10^{-6} to 10^{-4} for carcinogenic COCs and 0.1, 1, and 10 for noncarcinogenic COCs.

63 Identification of Chemicals of Potential Concern

When assessing a human health risk, data for environmental media are compiled to determine potential site-related chemicals and exposures for each medium as outlined in RAGS Part A.

6.3.1 Data Sources

Data from Sites 40 and 42 will be gathered in accordance with this SAP.

632 Data Validation

Data validation is an after-the-fact, independent, systematic process of evaluating data and comparing them to previously established criteria to confirm that they are of the technical quality necessary to support the decisions made in the RI/FS process. Specific parameters associated with the data are reviewed to determine whether they meet the stipulated data quality objectives (DQOs). The quality objectives address five principal parameters: precision, accuracy, completeness, comparability, and representativeness. To verify that these objectives axe met, field measurements, sampling and handling procedures, laboratory analysis and reporting, and nonconformances and discrepancies in the data are examined to determine compliance with appropriate and applicable procedures. The procedures and criteria for validation axe defined in the RI/FS Data Validation Program Guidelines, which are based on the USEPA National Functional Guidelines for Data Review. Data validation is discussed further in the CSAP.

633 Site-Related Data

All environmental sampling data will be evaluated for suitability for use in the quantitative human healtb risk assessment. Data obtained via the following analytical methods will not be considered appropriate for the quantitative human health risk assessment:

- Analytical methods that are not specific for a particular chemical, such as total organic carbon or grain size.

- Field screening instruments including total organic vapor monitoring units (HNu) and organic vapor analyzers.

After the data set is complete, statistical methods will be used to evaluate the RI analytical results to: (1) identify COPCs and (2) establish exposure point concentrations of potential receptor locations. The statistical methods to be used in data evaluation are discussed below. The rationale used to develop this methodology and the statistical techniques are based on the following sources, RAGS Part A and *Statistical Methods for Environmental Pollution Monitoring* (Gilbert 1987).

Quattro Pro 5.0 will be used to perform most of the statistical calculations. For each set of data used to describe the concentration of chemicals in a contaminated area, the following information will be tabulated: frequency of detection, range of detected values, and the arithmetic mean of the detected concentrations. In addition, the upper confidence limit (UCL) on the mean of the concentration (assuming a lognormal distribution, as requested by EPA Region IV) will be calculated for all data sets having 10 or more sample locations. The maximum concentration will be used as the exposure point concentration (discussed in Section 6.4.1) for all data sets with less than 10 sample locations.

63.4 Selection of Chemicals of Potential Concern

The objective of this section of the human health risk assessment is to screen information that is available for the substances detected at Sites 40 and 42 (chemicals present in site samples or [CPSSs]) to develop a list or group of chemicals referred to as COPCs. The infoxmation to be discussed within this section consists of both federal and State of Florida cleanup criteria and standards for soil and groundwater. COPCs are those chemicals selected in consideration of their comparison to screening concentrations (risk-based and NAS Pensawla-specific reference concentrations), intrinsic toxicological properties, persistence, fate and transport characteristics, and cross-media transfer potential. Any COPC that meets the following criteria will be referred

to as a chemical of concern (COC): (1) is carried through the risk assessment process and found to contribute to an exposure pathway that exceeds a 10^{-6} risk or hazard index (HI) greater than 1 for any of the exposure scenarios evaluated in this risk assessment, and (2) has an individual incremental lifetime cancer risk (ILCR) greater than 10^{-6} or hazard quotient greater than 0.1, will be referred to as a chemical of concern (COC).

Before evaluating the potential risks/hazards at Sites 40 and 42, it will first be necessary to determine the nature and magnitude of the contamination at each area of concern by noting the chemicals detected in each medium. These chemicals will represent the CPSS for Sites 40 and 42. The nature and extent of CPSSs will be discussed in detail in the Nature and Extent of Contamination of the RI. To reduce the list of CPSSs and produce a more focused Baseline Risk Assessment (BRA), the following tasks will be performed.

6.3.5 Comparison of Site!-Related Data to Screening Concentrations

The maximum concentrations of CPSS detected in various media at Sites 40 and 42 will be compared to medium-specific EPA Region III risk-based residential COC screening concentrations (RBCs) dated Match 18, 1994, and FDEP Soil Cleanup Goals for DOD Sites (FSCGs) as established in a FDEP memorandum dated July 1994. These screening concentrations have been conservatively adjusted to represent hypothetical recreational use of the bay and bayou. USEPA screening concentrations are based on a target risk of 1E6 and a target hazard quotient of 0.1. FDEP screening concentrations are based on a target risk of 1E-6 and a hazard quotient of 1.0.

RBCs apply to tap water and soil exposure for site residents. The media of concern at Sites 40 and 42 are marine or estuarine surface water and sediment, and RBCs do not directly apply to these media (i.e., saltwater is not a viable potable water source). Adjusted sediment and surface water RBCs will be calculated and used for comparison. These adjusted RBCs are calculated based on the assumption that adult and child receptors living near Sites 40 and 42 play at the

site. Because recreational activities would likely result in lower exposure frequencies (EF), the RBCs will be adjusted to account for incidental exposure to surface water and sediment during recreation. In addition to adjusting EF, the ingestion rate of surface water and sediment (i.e., recreational/swimming) are employed assuming a receptor was swimming in the bay and bayou. In order to retain the conservatism inherent in the risk-based screening process, all other exposure assumptions applicable to the default residential scenario will be retained. The most recent RBCs will be used to update the screening values as applicable one month prior to the report deadline.

Sediment RBCs are calculated in order to account for the difference in EF recommended by EPA Region IV for swimming exposure. Because of the linear relationship between RBC and EF, RBCs are adjusted from an EF of 350 to an EF of 45 days per year by multiplying the original RBC by 45 and dividing by 350 days per year. The ingestion rates reflect a 2.4 hour event per day incidental ingestion while swimming. Similarly, surface water RBCs are calculated using the linear proportion mentioned above to adjust RBCs for the recommended EF and ingestion rates.

If both carcinogenic and noncarcinogenic RBCs for sediment and/or surface water are calculated for a particular chemical, then the lower of the two values is considered to be the appropriate RBC for the given contaminant. This screening process will be used to focus the risk assessment and thereby reduce the number of CPSS for each medium in terms of formal assessment. CPSS with a detected concentration in Sites 40 and 42 media exceeding the lowest of the chemical-specific RBCs and FSCGs will be evaluated further in the screening process, with respect to NAS Pensacola-specific reference concentrations. In addition, essential nutrients (i.e., iron, calcium, magnesium, sodium, and potassium) will be eliminated from the risk assessment as requested by USEPA Region IV.

6.3.6 Comparison of Site-Related Data to NAS Pensacola-Specific Reference Concentrations

Reference data will be collected from locations specified in Section 4 and compared to site-related data as second phase screening. For any maximum concentration that exceeds both screening values and reference concentrations, the corresponding chemical will be considered a COPC and will be addressed in the human health assessment.

As previously mentioned, CPSS that exceed screening concentrations, goals, levels, and/or standards will be compared to NAS Pensacola-specific reference concentrations established fur Sites 40 and 42. The procedure for comparing the concentrations of inorganic chemicals onsite with those in reference samples is referred to as the 2-times reference concentrations rule or the "twice reference value criterion." Inorganic CPSS from Sites 40 and 42 whose maximum detected concentrations exceed corresponding reference concentrations will be retained for further consideration as COPCs in the BRA. This comparison assists in accounting for naturally occurring chemicals that are ubiquitous in nature (aluminum, silicon, sodium, potassium, magnesium, calcium, iron, and chloride, etc.).

For organic CPSS, such as pesticides, the twice reference value criterion can be applied eliminate chemicals from the risk assessment. However, it will be assumed that organic chemicals are not present in reference samples. Any deviations from this assumption will be discussed in the Risk Characterization section (6.6) of this plan. Those chemicals with maximum concentrations less than 2-times reference concentrations are not considered further in this risk assessment unless deemed appropriate based on chemical-specific characteristics.

6.4 Exposure Assessment

The purpose of this section of the human health risk assessment is to determine the magnitude of contact that a potential receptor may have with site-related COPCs. Exposure assessment involves four stages that will be detailed in the human health risk assessment:

- Characterization of the physical setting and land use of the site.

- Identification of COPC release and migration pathways.

- Identification of the potential receptors, under various land use or site condition scenarios, and the pathways by which they might be exposed.

- Quantification of intakes, or contact rates, of COPCs.

6.4.1 Exposure Point Concentrations

The exposure point concentration (EPC) is the concentration of a contaminant in an exposure medium that will be contacted by a real or hypothetical receptor. Determining EPC depends on variables such as:

- Availability of data
- Amount of dafa available *to* perform statistical analysis
- Reference concentrations not attributed to site impacts
- Location of the potential receptor

USEPA Region IV guidance *calls* for the assumption of lognormal distributions for environmental data and the calculation of *95* percent upper confidence limit of the mean (UCL) for use in exposure quantification. Because of the uncertainty associated with characterizing potentially nonhomogeneous areas, both the mean (natural log transformed) and the UCL on the mean for a lognormal distribution will be reported for each COPC identified in Site 40 and 42 media. In general, outliers will be included in calculating the UCL because high values seldom appear as outliers for a lognormal distribution. Including outliers will increase the overall uncertainty of the calculated risks and increase *the* estimate of the risk in a conservative manner. As previously mentioned, the UCL will not be *calculated* for data sets having fewer than 10 samples.

The UCL will be calculated for a lognormal distribution as follows:

$$UCL = e^{\{\bar{a}+(0.5s_a^2)+[(H_{0.95})*(s_a)/(n-1)^{0.5}]\}}$$

where:

$\bar{a}$	=	$(\Sigma a)/n$ = sample arithmetic mean of the log-transformed data, $a = \ln(x)$
s_a	=	sample standard deviation of the log-transfoxmed data
$H_{0.95}$	=	value for computing the one-sided upper 95 percent confidence limit on a lognormal mean from standard statistical tables (Gilbert 1987)
n	=	number of samples in the data set.

The calculated values for upper 95 percent confidence limit will be presented in table form for COPCs identified in site media. The tables will also statistically summarize COPCs identified within Sites 40 and 42 which include, for each COPC, the frequency of detection, mean (including nondetects) and standard deviation of the natural log transformed data, the H-statistic, the maximum of detected concentrations, default concentrations (discussed below), and the reference criterion, where applicable. For each medium, the lowest of either the maximum of positive detections or the 95 percent UCL mean concentration of each COPC identified in soil or groundwater will be used as the EPC to compute the corresponding risk/hazard. The tables will also clearly indicate whether the maximum or UCL will be used to quantify exposure. Use of this algorithm as suggested in RAGS Part A is a reasonable compromise between use of zero and use of the sample quantitation limit to reduce the bias (positive or negative) in the calculated UCL.

The UCL is dependent upon the number of samples and the standard deviation of the transformed data. A factor that influences standard deviation is the inclusion of nondetects in the mean and standard deviation calculations. Analytical results are presented as nondetects

whenever chemical concentrations in samples do not exceed the detection or quantitation limits for the analytical procedures.

Generally, the quantitation limit is the lowest concentration of a chemical that *can* be quantified above the normal, random noise of an analytical instrument or method. To apply the above-mentioned statistical procedures to a data set with reported nondetects, the assumption will be made that the chemical is present at a default concentration. One-half of the lowest sample quantitation limit and one-half the lowest reported hit for a specific medium will be compared, and the lesser of the two values will be used as the default concentration. This default concentration will be inserted into all reported nondetects, and the UCL will be statistically calculated for this data set.

6.4.2 Possible Exposure Pathways Assessed in the Human Health Risk Assessment

Because the focus of this report will be Pensacola Bay and Bayou Grande, a highly conservative exposure scenario would be recreational use of surface water and sediment. Potable use assumptions will not be made, as these water bodies are marine or estuarine and would not be used as potable water sources. Using standard default residential assumptions, and modifying the exposure frequency from residential (350 days per year) to recreational (45 days per year) would be a reasonable assumption to address maximal exposure. Based on the surface water and sediment concentrations detected onsite, uptake modeling might be appropriate. In addition, fishing is a common recreational activity in both the bay and bayou, and the tissue ingestion exposure pathway will be considered if *appropriate.* These issues will be discussed during a risk assessment scoping meeting between the Navy, E/A&H, FDEP, and USEPA Region IV to determine exposure pathways and exposure assumptions to be used in the Site 40 and 42 human health risk assessment.

6.4.3 Quantification of Exposure

Exposure will be quantified using methods outlined in RAGS Part A and the applicable Supplemental Guidance to RAGS. These methods employ equations and exposure assumptions which *can* have great effect on the risk results. Most exposure pathways are quantified assuming several exposure scenarios, and the exposure scenario of primary concern will be the recreational use of Sites 40 and 42. Due to the *regulatory* restrictions on land development in wetlands, the recreational scenario would be the most conservative exposure scenario to assess risk. Assuming potential receptors would frequently contact the sediment and surface water (including incidental ingestion while swimming) at Sites 40 and 42, Figure 6-1 presents an example equation that will be used to quantify exposure in the human health risk assessment.

6.5 Toxicity Assessment

Relevant toxicological information will be discussed and presented in this section of the risk assessment for all COPCs, including brief toxicological profiles. Toxicity Equivalency Factors (TEFs) will be used, if applicable. TEFs are chemical-specific values used to relate the carcinogenic potential of various polyammatic hydrocarbons (PAHs) to that of benzo(a)pyrene (B(a)P). As USEPA Region IV guidance suggests, the exposure point concentrations associated with the family of compounds that constitute PAHs will be multiplied by a chemical-specific TEF. The following TEFs are used to convert the PAH concentrations to an equivalent concentration based on B(a)P:

Compound	TEF
Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene	0.1

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Figure 6-1

Formulae for Calculating CDI for Surface Water

WATER INGESTION PATHWAY

Recreational **Scenario:**

Non-Carcinogens - Child:

$$CDI_{NC\text{-}C} = \frac{C_w \times IR_{water/age1\text{-}6} \times EF_{rec} \times ED_{age1\text{-}6}}{AT_{NC\text{-}C} \times BW_{age1\text{-}6}}$$

Non-Carcinogens - Adult:

$$CDI_{NC\text{-}A} = \frac{C_w \times IR_{water/age7\text{-}31} \times EF_{rec} \times ED_{age7\text{-}31}}{AT_{NC\text{-}A} \times BW_{age7\text{-}31}}$$

Carcinogens (combined child and adult exposure - based** on a **lifetime** weighted **average):

$$CDI_C = \frac{\quad}{AT_C} \times \frac{IR_{water/age1\text{-}6} \times EF_{rec} \times ED_{age1\text{-}6}}{BW_{age1\text{-}6}} + \frac{IR_{water/age7\text{-}31} \times EF_{rec} \times ED_{age7\text{-}31}}{BW_{age7\text{-}31}}$$

Figure 6-1 (continued)

Formulae for Calculating CDI for Surface Water

Variable	Description
BW_{age1-6}	average body weight from ages 1-6 (kg)
$BW_{age7-31}$	average body weight from ages 7-31 (kg)
ED_{age1-6}	exposure duration during ages 1-6 (yr)
$ED_{age7-31}$	exposure duration during ages 7-31 (yr)
EF_{rec}	recreational exposure frequency (days/year)
$IR_{water/age1-6}$	water intake rate – age 1-6 (L/day)
$IR_{water/age7-31}$	water intake rate – age 7-31 (L/day)
AT_C	Averaging time (carcinogen)
AT_{NC-A}	Averaging time (non-carcinogen adult)
AT_{NC-C}	Averaging time (non-carcinogen child)
C_W	Chemical concentration in surface water

Notes:
CDI indicates Chronic Daily Intake

In accordance with Supplemental Guidance to RAGS from USEPA Region IV regarding the inhalation of VOCs in groundwater, inhalation CDI is equivalent to ingestion CDI.

6.5.1 Carcinogenicity and Noncancer Effects

EPA has established a classification system for rating the potential carcinogenicity of environmental contaminants based on the weight of scientific evidence. The cancer classes are described below. Cancer weight of evidence class "A" (human carcinogens) means that human toxicological data have shown a proven correlation between exposure and the onset of cancer (in varying forms). The "B1" classification indicates some human exposure studies have implicated the compound as a probable carcinogen. Weight-of-evidence class "B2" indicates a possible human carcinogen, a description based on positive laboratory animal data (for carcinogenicity) in the absence of human data. Weight-of-evidence class "C" identifies possible human carcinogens, and class "D" indicates a compound not classifiable with respect to its Carcinogenic potential. The EPA has established slope factors (SF) for carcinogenic compounds. The SF is defined as a "plausible upper-bound estimate of the probability of a response (cancer) per unit intake of a chemical over a lifetime."

In addition to potential carcinogenic effects, most substances can also produce systemic toxic responses at doses greater than experimentally derived threshold levels. The EPA has derived Reference Dose (RfD) values for these substances. A chronic RfD is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime." These toxicological values are used in risk formulae to assess the upper-bound level of cancer risk and noncancer hazard associated with exposure to a given concentration of contamination.

For carcinogens, the potential risk posed by a chemical will be computed by multiplying the CDI (in milligrams per kilogram per day [mg/kg-day]) by the SF (in reciprocal mg/kg-day). The hazard quotient (for noncarcinogens) will be computed by dividing the CDI by the RfD. The USEPA has set standard limits (or points of departure) for carcinogens and noncarcinogens to evaluate whether significant risk is posed by a chemical (or combination of chemicals). For

carcinogens, the USEPA point-of-departure is 1E-6 with a generally accepted range of 1E-4 to 1E-6. FDEP's exposure pathway risk threshold is 1E-6. These risk values correlate with 1 in 10,000 and 1 in 1,000,000 excess cancer incidence resulting from excess exposure (i.e., greater than background or reference area) to xenobiotics. Pathways of concern will be identified using the conservative threshold suggested by FDEP, 1E-6.

For noncarcinogens, *other* toxic effects *are* generally considered possible if the hazard quotient (or sum *of* hazard quotients for a pathway or hazard index) *exceeds* unity (a value of 1). Although both *cancer* risk and noncancer hazard are generally additive (within each group) only if the target organ is common to multiple chemicals, a most conservative estimate of each may be obtained by summing the individual risks or hazards regardless of target organ. The Sites human health risk assessment of sites 40 and 42 will take the universal summation approach for each class of toxicants. Toxicological information related to target organs, possible interactions, and critical toxicological effect might be used to qualify the calculated risk values. This information will be presented in the Uncertainty Section of the human health risk assessment. Additional details regarding the risk formulae *applied* to Sites 40 and 42 media will be provided in the Risk Characterization Section.

A table which summarizes toxicological data in the form of RfDs and SFs obtained for each COPC identified in Sites 40 and 42 media will be presented in this section. Critical studies used in establishing toxicity classifications by EPA *am* shown in the Integrated Risk Information System (IRIS) database (primary source) and/or Health Effects *Assessment* Summary Tables (HEAST) Fiscal Year 1994 (secondary source). In addition, the EPA Region III, Risk-based Concentration Tables, Fourth Quarter 1994, contains toxicological values not listed in primary or *secondary* sources. Where applicable, these values were also included in the database for this BRA. Drinking standards in the form of federal and State of Florida maximum contaminant levels (MCLs) and guidance levels will not be considered ARARs for surface water due to the salinity of the bay and bayou and their lack of suitability for potable use.

6.5.2 Evaluating Dermal Toxicity

Dermal RfD values and SFs are derived from the corresponding oral values. In deriving a dermal RfD, the *oral* RfD is multiplied by an oral absorption factor (ABF), expressed as a decimal fraction. The resulting dermal RfD is based on the absorbed dose. The RfD based on absorbed dose is the appropriate value with which to compare a dermal dose, because dermal doses are expressed as absorbed rather than administered (intake) doses. For the same reasons, a dermal SF is derived by dividing the oral SF by the ABF. The oral SF is divided rather than multiplied because SFs am expressed as reciprocal doses.

Appendix A of RAGS, Part A states that in the absence of specific data, an assumption of 5% oral absorption efficiency would be a relatively conservative assumption. The Supplement Guidance to RAGS: Region IV Bulletin indicates that in the absence of specific data, EPA Region IV suggests an oral to dermal absorption factor of 80% for volatile organic chemicals, 50% for semivolatile organic chemicals, and 20% for inorganic chemicals. These percentages (or associated fractions) will be used in the BRA and will be reflected in the applicable chronic daily *intake* (CDI) results.

6.53 Toxicity Profiles for COPCs

As required for BRAs by EPA Region IV, brief toxicological profiles will be included for all COPCs. Most information for the brief profiles will be gleaned from IRIS as a primary source, and HEAST, as mentioned in the preceding text. Another source of information will be Smith, R.L., *EPA Region III Risk-Based Screening Concentrations Table* (EPA March 18, 1994). Any additional references will be noted specifically in the briefs (in parentheses). The profiles will summarize adverse effects of COPCs and the amount of *the* COPC associated with these effects. This means the inhalation reference dose (RfDi), oral reference dose (RfDo), inhalation slope factor (SFi), and oral slope factor (SFo) will be included in the discussion where applicable.

6.6 Risk Characterization

Risk characterization combines the results of the exposure assessment and toxicity assessment to yield qualitative and quantitative expressions of risk for the potentially exposed receptors. The quantitative component is an expression of the probability of developing cancer, or a nonprobabalistic comparison of estimated dose with a reference dose for noncancer effects. These quantitative estimates are developed for individual chemicals, exposure pathways, transfer media and source media, and for each receptor for all media to which one may be exposed. The qualitative component usually involves comparing COPC concentrations in media with established criteria or standards for chemicals for which them are no suitable toxicity values. The risk characterization is used to guide risk management decisions.

Generally, the risk characterization will follow the methodology prescribed by RAGS Part A, as modified by more recent information and supplemental guidance cited in the earlier Sections of this plan. The EPA methods are, appropriately, designed to be health-protective, and tend to overestimate, rather than underestimate, risk. The risk results, however, are generally overly conservative, because risk characterization involves multiplying the conservatisms built into the exposure and toxicity assessments.

This section will characterize the potential health risks associated with the intake of chemicals originating from Sites 40 and 42. The methods used to estimate the types and magnitudes of health effects associated with exposure to chemicals will also be presented.

6.6.1 Risk Characterization Methodology

Potential risks to humans following exposure to COPCs will be estimated using methods established by KPA, when available. As previously mentioned, these methods are health-protective and are likely to overestimate, rather than underestimate risk. Risks from hazardous chemicals will be calculated for both carcinogenic and noncarcinogenic effects (if applicable), because some carcinogenic chemicals may also pose a noncarcinogenic hazard. The

potential human health effects associated with chemicals which may produce systemic toxic and carcinogenic influences will be characterized for both types of health effects.

6.6.2 Identification of Contaminants Of Concern

FDEP defines a contaminant of concern (COC) as any chemical having an individual cancer risk threshold of 10^{-6} or an individual hazard quotient of 1. Identification of COCs will be a two-step process: first, an exposure pathway of concern will be identified using FDEP's definition. Subsequently, any COPC which individually exceeds the 10^{-6} threshold or a has a hazard quotient greater than 0.1 in an exposure pathway of concern will be identified as a COC. The Toxicity Assessment section of this plan *discusses cancer* risk thresholds and noncancer toxicity in greater detail.

6.6.3 Carcinogenic Effects of Chemicals

The risk attributed to exposure to Carcinogens is estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. In the low-dose range, which would be expected for most environmental exposures, cancer risk is estimated from the following linear equation (EPA 1989):

$$ILCR = (CDI)(SF)$$

where:

ILCR = incremental lifetime cancer risk, a unitless expression of the probability of *developing* cancer, adjusted for reference value incidence

CDI = chronic daily intake, averaged over 70 years (mg/kg-day)

SF = *cancer* slope factor $(mg/kg\text{-}day)^{-1}$

For a given pathway with simultaneous exposure of a receptor to several carcinogens, the following equation is used to sum cancer risks:

$$Risk_t = ILCR(chem_1) + ILCR(chem_2) + \ldots ILCR(chem_i)$$

where:

$Risk_t$ = total pathway risk of cancer incidence
$ILCR(chem_i)$ = individual chemical cancer risk

Cancer risk for a given receptor across pathways and across media is summed in the same manner.

6.6.4 Noncarcinogenic Effects of Chemicals

The risks associated with the noncarcinogenic effects of chemicals are evaluated by comparing an exposure level or intake with a reference dose. The hazard quotient (HQ), defined as the ratio of intake to RfD is defined as *(RAGS,* Part A):

$$HQ = CDI/RfD$$

where:

HQ = hazard quotient (unitless)
CDI = chronic daily intake of chemical (mg/kg-day
RfD = reference dose (mg/kg-day)

Chemical noncarcinogenic effects are evaluated *on* a chronic basis, using chronic RFD values. An HQ of unity or 1 indicates that the estimated intake equals the RfD. If the HQ is greater than unity, there may be a concern for potential adverse health effects.

In the case of simultaneous exposure of a receptor to several chemicals, a hazard index will be calculated as the *sum* of the HQs by:

$$HI = HQ(chem_1) + HQ(chem_2) + \ldots HQ(chem_i)$$

where:

HI = Hazard Index (unitless)

$HQ(chem_i)$ = Hazard Quotient for the ith toxicant

6.7 Risk Uncertainty

The uncertainty inherent in the risk assessment process, in addition to medium- and exposure pathway-specific influences, will be presented and discussed in this section. Sections of the risk assessment will be discussed separately, and specific examples of uncextainty sources wilt be included, where appropriate. Alternative risk projections will also be included which provide estimates of the range of risk. These altemative risk results are based on central tendency exposure (average or 50th percentile) rather than Reasonable Maximum Exposure (RME) as presented in the Risk Characterization Section for comparison. Central tendency will be assessed for pathways of concern only.

6.8 Risk Summary

This section will present and discuss the results of the quantification of exposure (risk and hazard) for the potential receptors and their exposure pathways identified under the current and future land use conditions.

6.9 Remedial Goal Options

Remedial Goal Options are chemical concentrations computed to equate with specific risk and/or hazard goals that may be established for particular wetlands. RGOs will be calculated for all COCs identified in the risk assessment. In accordance with EPA Supplemental RGO Guidance, RGOs will be calculated at 1E-4, 1E-5, and 1E6 risk levels for carcinogenic COCs and hazard quotient goals of 10, 1, and 0.1 for noncarcinogenic COCs.

7.0 QUALITY ASSURANCE PLAN

The Quality Assurance Plan presented in Section 15 of the *CSAP* will be followed throughout the Sites 40 and 42 RI.

8.0 DATA MANAGEMENT PLAN

The Data Management Plan presented in Section 14 of the *CSAP* will be followed throughout this RI, except for the sample location digits in the sample numbering scheme. The fifth, sixth, seventh, and eighth digits of a sample number specify the sample location. *Target* areas within an AZ will be designated TA followed by the AZ number and target area alpha designator. For example, TA2A would define Assessment Zone 2, Target Area A. Assessment zone samples not located within a target area will be labeled as: AZ02, defining Assessment Zone 2. The final *two* digits in the 10 digit numbering system will be a serial number of the sample in that zone or target area.

9.0 REFERENCES

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10.0 FLORIDA PROFESSIONAL GEOLOGIST SEAL

I have read and approve of this Final Sampling and Analysis Plan for Sites 40 and 42 at NAS Pensacola and seal it in accordance with Chapter 492 of the Florida Statutes. In sealing this document, I certify the geological information contained in it is true to the best of my knowledge and the geological methods and procedures included herein are consistent with currently accepted geological practices.

Name:	Steven J. Parker
License Number:	#1651
State:	Florida
Expiration Date:	July 31, 1996

Steven J. Parker

9/26/95
Date