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SAMPLING AND ANALYSIS PLA
SITE 41, WETLANDS
NAVAL AIR STATION
PENSACOLA, FLORIDA

SOUTHNAVFACENGCOM
CONTRACT NUMBER:
N62467-89-D-0318

CTO - 0036

N00204.AR.001509
NAS PENSACOLA
5090.3a

Prepared for:

Comprehensive Long-Term
Environmental Action Navy
Naval Air Station
Pensacola, Florida

Prepared by:

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September 18, 1997

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SAMPLING AND ANALYSIS PLAN – ADDENDUM
SITE 41, WETLANDS
NAVAL AIR STATION – PENSACOLA, FLORIDA

SOUTHNAVACENGCOM
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The Contractor, EnSafe/Allen & Hoshall, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0318 is complete, accurate, and complies with all requirements of the contract.

Date: 18 September 1997

Signature: Henry H. Beiro

Name: Henry H. Beiro

Title: Task Order Manager

	Form approved *OMB No. 0704-0188*
ep u ifi	1b. Restrictive Marking N/A
a. u s i i	3. Distribution/Availability of Report See Cover Letters
Performing) ep (s)	5. Monitoring Organization Report Number(s) N/A
6a. of Performing rganization nSafe/Alle & ll / 6b. Office symbol *(if applicable)* E/A&H	7a. Name of Monitoring Organization Naval Air Station Pensacola
6 *and* Co	7b. Address *(City, State and Zip Code)* Pensacola, Florida 32501
8a. Name of Funding/ Sponsoring Organization SOUTHNAVFACENGCOM / 8b. Office symbol (if applicable) N/A	9. Procurement Instrument Identification Number N62467-89-D0318/0036
	10. Source of Funding Numbers: Program Element No. / Project No. / Task No. / Work Unit Accession No.

11. Title *(Include Security Classification)*

Sampling and Analysis Plan - Addendum, Site 41, Wetlands, NAS Pensacola, Pensacola, Florida

12. Personal Author(s)

Beiro, Henry, (P.G. #1847, Florida [Exp. Date July 31, 1998])

13a. Type of Report	13b. Time Covered	14. Date of Report	15. Page Count
Final	From 10/01/92 To 09/18/97	1997 September 18	41

17. COSATI Codes			18. Subject Terms *(Continue on reverse if necessary and identify by block number)*
Field	Group	Sub-Group	

19. Abstract:
This addendum of the sampling and analysis plan is part of the remedial investigation at Site 41 for the Naval Air Station Pensacola, Wetlands, assessing the nature and extent of contaminants resulting from Navy activities which discharge to base wetlands. Site 41 represents the wetland ecological resources a NAS Pensacola requiring additional study. The sampling and analysis plan amendment for Site 41 provides the objectives and methodology in order to complete the Phase III sampling at selected wetlands.

20. Distribution/Availability of Abstract ☒ Unclassified/Unlimited ☐ Same as Rept ☐ DTIC Users	21. Abstract Security Classification N/A	
22a. Name of Responsible Individual William Hill	22b. Telephone (*Include Area Code*) (803) 820-7324	22c. Office Symbol

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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.

ASTM	American Society for Testing and Materials
BW	Body Weight
E/A&H	EnSafe/Allen & Hoshall
Florida WQS	State of Florida Water Quality Standards
IRP	Installation Restoration Program
kg BW/Day	Kilogram of body weight per day
mg	Milligram
mg/L	Milligrams per Liter
mg/kg	Milligrams per Kilogram
NAS Pensacola	Naval Air Station Pensacola
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PDE	Potential Dietary Exposure
PSEP	Puget Sound Estuary Program
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
SSV	[Draft] EPA Region IV Sediment Screening Value
SVOCS	Semi-Volatile Organic Compounds
TAL/TCL	Target Analyte List/Target Compound List
TAL	Target Analyte List
TCL	Target Compound List
TEL	Threshold Effects Levels
TOC	Total Organic Carbon
TRV	Toxicity Reference Value
USEPA	United States Environmental Protection Agency
vocs	Volatile Organic Compounds
WQC	Water Quality Criteria

EXECUTIVE SUMMARY

This addendum of the sampling and analysis plan is part of the remedial investigation at Site 41 for the Naval Air Station Pensacola, Wetlands, assessing the nature and extent of contaminants resulting from Navy activities which discharge to base wetlands. Site 41 represents the wetland ecological resources at NAS Pensacola requiring additional study. The sampling and analysis plan amendment for Site 41 provides the objectives and methodology in order to complete the Phase IIb sampling at selected wetlands. Completing the ecological risk assessment for the wetlands requires three sources of information. The first is chemical analyses to establish the presence, concentrations, and distribution of any chemical contaminants. The second is data from toxicity tests and diversity studies to link exposure effects with observed chemical concentrations. The third is tissue concentrations which *can* further define ecological impacts and suggest whether impacts may be *occurring* in higher trophic levels of the food chain. All of this information is critical to establishing a causal link between contaminants and ecological effects (U.S. EPA, 1992).

The information gathered will be integrated, using a weight-of-evidence approach, into a risk characterization. A weight-of-evidence approach considers all available information to predict ecological impact. Each result will be considered in relation to the others to determine the extent and severity of impact. All factors will be considered to yield an overall picture of risk needed to develop remedial options.

INTRODUCTION

This *Sampling* and Analysis Plan *(SAP)* Addendum amends *the* previous EnSafe/Allen and Hoshall (E/A&H) Site 41 *SAP* (E/A&H, 1995). It addresses changes in scope from the original *SAP* due to Phase IIA sediment and surface water data analysis during the Remedial Investigation (RI). Other technical memoranda referenced in this report describe sample results from Phase IIA of *this* investigation. Specific details in this report include:

- Wetland groupings
- Wetland-specific conceptual models
- Wetland-specific assessment and measurement endpoints
- Sample locations for Phase IIB
- Proposed food chain model to predict impacts to assessment endpoint species

The original Site 41 *SAP* (E/A&H, 1995) describes the structure of the entire Site 41 RI, results from previous investigations, the *history* of particular Installation Restomtion Program (IRP) sites of concern, and key terms used in characterizing ecological risk.

10 ECOLOGICAL RISK ASSESSMENT FRAMEWORK

Approximately 81 wetlands or groups of wetlands have been identified at the Naval Air Station (NAS) Pensacola (Figure 1-1). These wetlands include a wide variety of palustrine wetlands inland, with estuarine emergent wetlands and *estuarine* aquatic beds found along shoreline areas. These wetlands may have been impacted by industrial activities at many of the NAS Pensacola sites identified under the IRP. Section *2* of the Site 41 Work Plan details the wetlands and historical information for NAS Pensacola and the general area (E/A&H, 1995).

OVERSIZED PAGE

SCANNED IN SECTIONS

TO FOLLOW

ON SUBSEQUENT IMAGES.

Attachment A

WETLANDS LEGEND

- Palustrine Forested
- Palustrine Forested/Emergent
- Palustrine Scrub Shrub
- Palustrine Forested/Scrub Shrub
- Palustrine Scrub Shrub/Emergent
- Palustrine Emergent
- Estuarine Emergent
- Estuarine Aquatic Bed
- Site 36 Sewer Line

SITES LEGEND

Site Number

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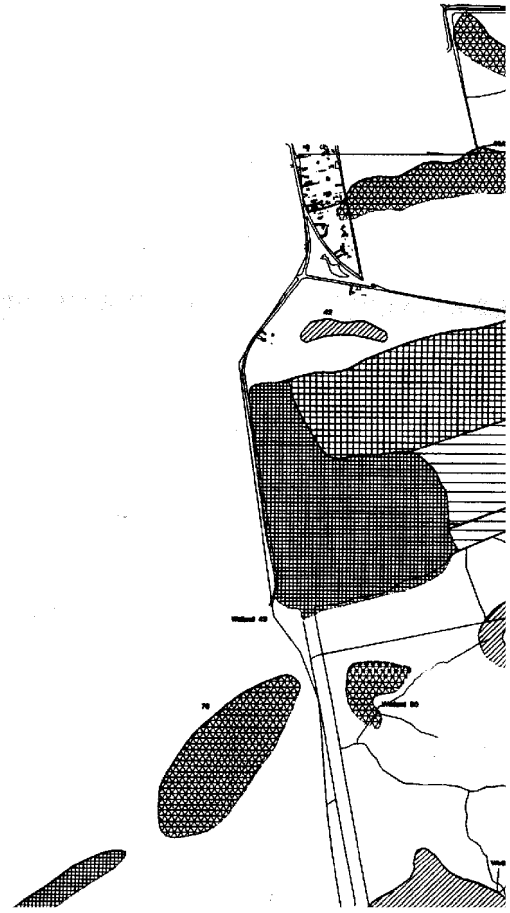

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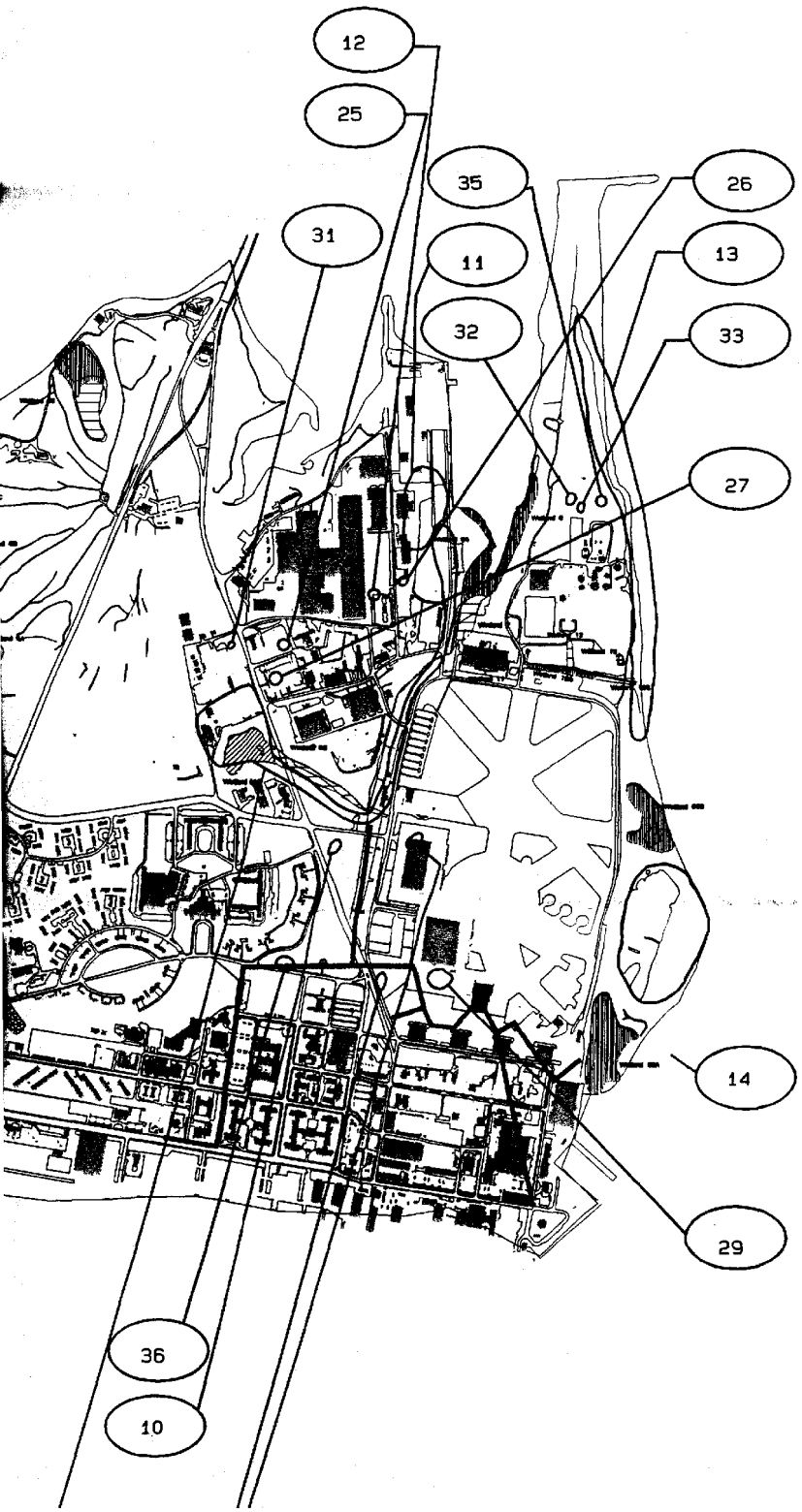
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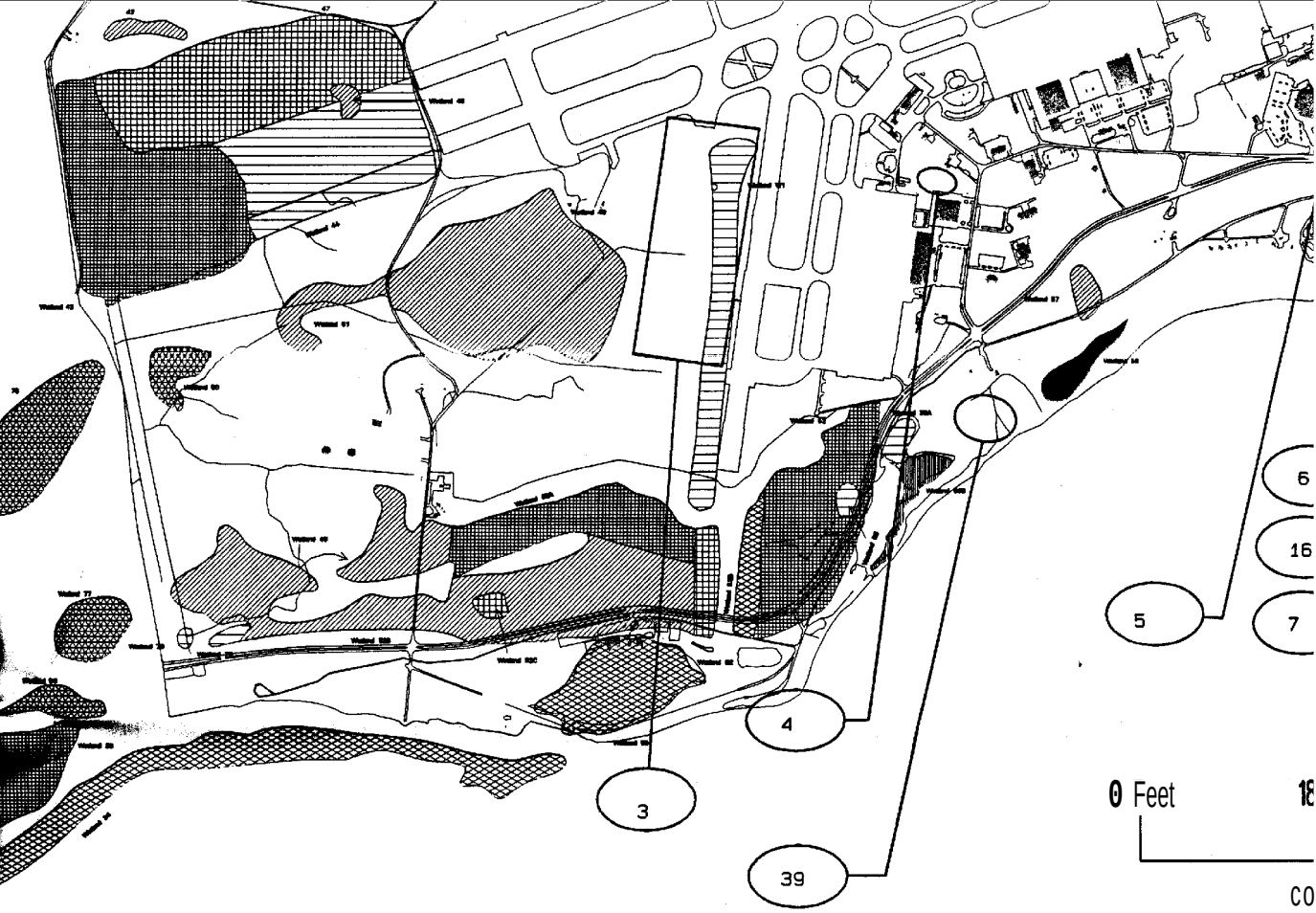
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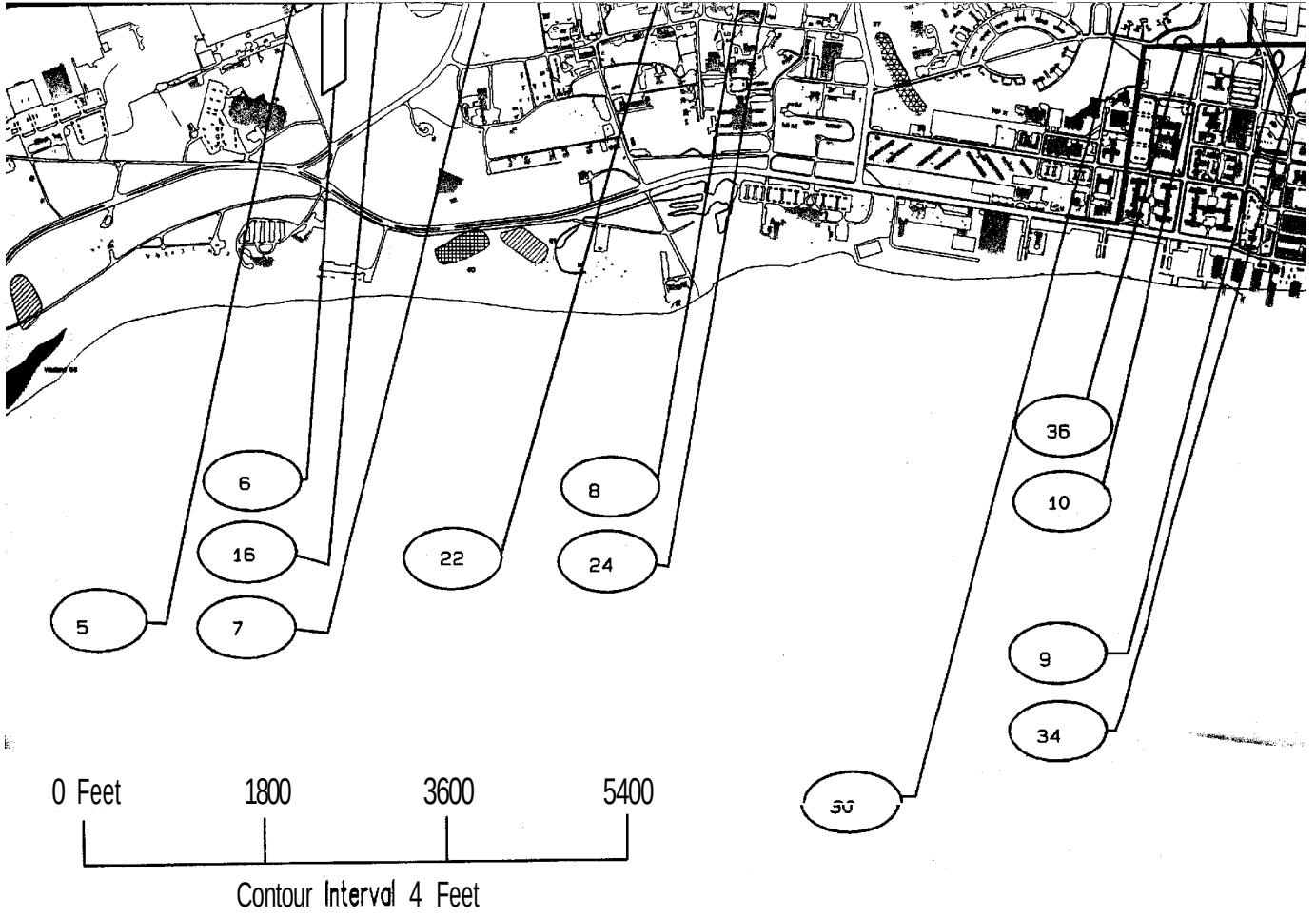
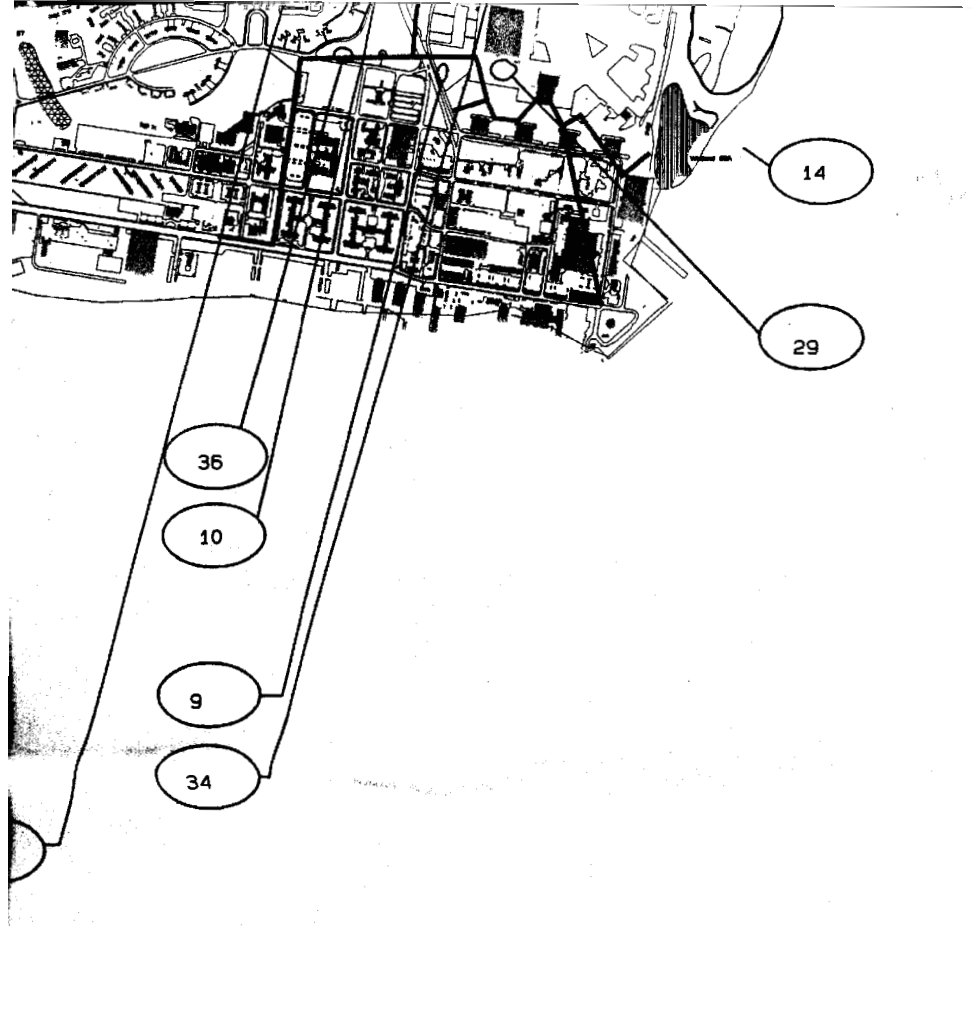


Site **41 SAP** Addendum

Naval Air Station Pensacola

Pensacola, Florida



P Addendum

Station Pensacola

Florida

FIGURE 1-1

Sites Potentially Impacting NAS Pensacola Wetlands

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1.1 Stressors

A stressor is any physical, chemical, or biological entity that can induce an adverse response in an organism. During Phase IIA of the Site 41 RI, 122 sediment samples were collected from 29 wetlands and 51 surface water samples were collected from 27 wetlands. These data are included in the Phase IIA Investigation *Summary* Technical Memorandum (E/A&H, 1996). Stressors identified include a wide *range* of semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and inorganic compounds, from various suspected sources.

1.2 Effects Indices

Chemical data from Phase IIA of the Site 41 investigation collected between November 1995 and January 1996 were initially compared to reference values and screening value effects indices for use in prioritizing wetlands for further study and in developing the wetland-specific conceptual models. If reference and screening indices were exceeded, biological effects will be measured during Phase IIB to determine whether impacts are occurring.

1.3 Wetland Groupings

Wetlands studied in Phase IIA were grouped based on the nature and extent of contamination in those wetlands, in addition to several physical characteristics which could affect contaminant fate and habitat use. Physical characteristics include salinity, depth, total organic carbon, and riparian habitat. Wetland groupings and characteristics used as a basis for these groupings are listed in Table 1-1. Justification for these groupings was based on approval by the NASP Tier I Partnering Team from information provided in a Phase IIA Investigation *Summary* Technical Memorandum (E/A&H, 1996).

Wetlands 64, 5A, 3, 16, and 18 were selected from the wetlands in Table 1-1 and given the highest priority in Phase IIB. Priority was based on the nature and extent of contamination

Table 1-1
Wetland Groupings

Wetland Number	64	5A	3	4D	15	16	18A	18B	63A	10	6	5B	1	W1	48	49
Estuarine	A			C	C	C		C	C							
Fresh		B	B				C			D	D	D	D	D	E	E
TOC > 1%	A	B	B	C	C	C	C	C				D	D	D		
TOC < 1%									C	D	D				E	E
Metals	A	B	B	C	C	C	C	C	C	D	D	D	D	D		
PAH	A	B		C									D			
Pest/PCB	A	B	B	C	C	C	C	C	C	D	D		D	D	E	E
Shallow (< 3')	A	B	B	C	C		C	C	C	D	D	D	D	D	E	E
Deep (> 3')						C										
Predominant Silt	A		B		C		C	C								
Predominant Sand		B		C		C			C	D	D	D	D	D	E	E
Juncus sp.	A				C			C								
Cattails		B	B						C							
Hardwoods		B	B			C	C	C					D			
Mowed Grass				C						D'	D			D	E	E
Disturbed Vegetation	A			C	C	C			C	D	D	D		D		
Viable Benthos	A															

Note:
The letter on the table refers to the designated **wetland grouping and** whether that characteristic was present for **a particular wetland.**
Bolded wetlands **signify** those wetlands given **highest** priority for further sampling.

in *this* group based on their relatively higher levels and extent of contamination. If it is determined that contamination in Wetlands 16 and 18 are at levels producing deleterious effects, then the potential for effects in the remaining Group C wetlands will be assessed through back-calculation or regression analysis. Based on a review of contamination and potential receptors, Wetland groups D and E were removed from any further sampling and analysis.

1.4 Assessment and Measurement Endpoint Development

Because ecological risk is the focus of the Site 41 RI, assessment and measurement endpoint selection is an important part of focusing risk assessment goals and designing remedial options for the wetlands of concern.

Assessment Endpoints

Assessment endpoints, representing different levels of the food chain and specific for Site 41, are: (1) Piscivorous and/or wading bird health and reproduction, (2) survival, growth, and reproduction of macroinvertebrates associated with the benthic environment, (3) health and reproductive impacts to fish and protection of fish viability, and (4) reproductive *impacts* to terrestrial species. These assessment endpoints were chosen because they represent critical components of a wetland ecosystem and *can* indicate impacts from different types of contaminants. Justification for selecting these assessments endpoints is described below.

Piscivorous/Wading Bird Health and Reproduction: The great blue heron (*Ardea herodias*) is chosen for several factors relevant to assessing risk in the NAS Pensacola wetlands. The great blue heron is common throughout NAS Pensacola and data are available on its habitat use and feeding characteristics. The heron is considered an ideal assessment endpoint species for measuring contaminant effects through the food chain based on its diet, feeding characteristics, and limited home range. For example, the heron feeds on some of the measurement endpoint species chosen. Impacts to these measurement endpoint species, either through toxicity or body

burden effects, may help establish a correlation between effects to the measurement endpoint and effects in the heron. Specific factors making the heron an attractive assessment endpoint species include:

- Diet — The great blue heron feeds primarily on fish, but it also eats amphibians, reptiles, and other organisms. Fish consumed by the heron are typically small (less than 20 centimeters) with small home ranges. The limited home range of the fish prey species simplifies the prediction of impacts from these fish species. Food, body weight, and water ingestion rates for the heron are also known.

- Feedii Characteristics — Herons like to fish in shallow waters by slowly wading to catch their prey. This characteristic makes the shallow wetlands around NAS Pensacola ideal for catching prey. In deeper wetlands, herons have been observed feeding around the edges.

- Home Range — The great blue heron is widely distributed, making either freshwater or estuarine wetlands suitable habitat. Herons have limited home ranges and do not venture far from their nesting sites. Because herons do not venture very far to feed, it will be assumed that they spend a significant amount of time feeding in wetlands where they have been observed. Also, herons do not appear to be sensitive to human presence, typically feeding in wetlands located near developed areas of the base.

- Correlation with Accepted Measurement Endpoints — Based on their diet, feeding habits, and range, impacts to the great blue heron may be correlated with a measurement endpoint. For example, body burdens determined during bioaccumulation studies, may be used to predict reproductive impacts to herons. Positive toxicity results to amphipods and fish can also be related to losses in potential food sources.

Survival, Growth, and Reproduction of Macroinvertebrates Associated with the Benthic Environment: Impacts to the survival, reproduction, and growth of benthos will be measured through acute and chronic toxicity tests, diversity studies, community indices, and tissue concentration studies. This assessment endpoint is chosen because it is easily measurable and significantly impacts organisms at higher levels in the food chain. Benthic macroinvertebrates, for example, are an important biomonitoring tool because they are relatively sessile, have long life cycles, and represent a range of ecological niches. In addition to showing acute and chronic toxic effects, benthic organisms may also accumulate metals and other contaminants at several orders of magnitude above ambient levels in the sediment or surface water. Benthic macroinvertebrates are also very localized in their habitat, meaning that effects to benthic organisms can usually be directly related to contamination in that area. The ability to focus on effects in particular areas may in turn help focus remedial decisions.

Health and Reproductive Impacts to Fish and Protection of Fish Viability: Fish were chosen because they can be exposed to contamination through either diet or absorption, and typically have a limited home range. Body burden and toxicity data from fish species will also be important for the following reasons:

- Higher Food Chain Impacts — Fish are prey for a variety of other species, such as the great blue heron, which was chosen as another assessment endpoint. Data can be correlated to impacts to the heron.

- Biotransfer — Fish may ingest sediment as a source of food and become a direct transfer pathway from contaminants present in the sediment or surface water to other species.

- Toxicity from direct exposure to surface water — Toxicity to fish species can be correlated with different contaminant levels in sediment and surface water.

Reproductive Impacts to Terrestrial Species: Terrestrial vertebrates occupy a significant niche within wetland ecosystems. They may feed on live or dead aquatic and semi-aquatic species and thus can be impacted through biotransfer of contaminants. Terrestrial vertebrates also can use wetlands as a source of drinking water and thus may be exposed to contamination.

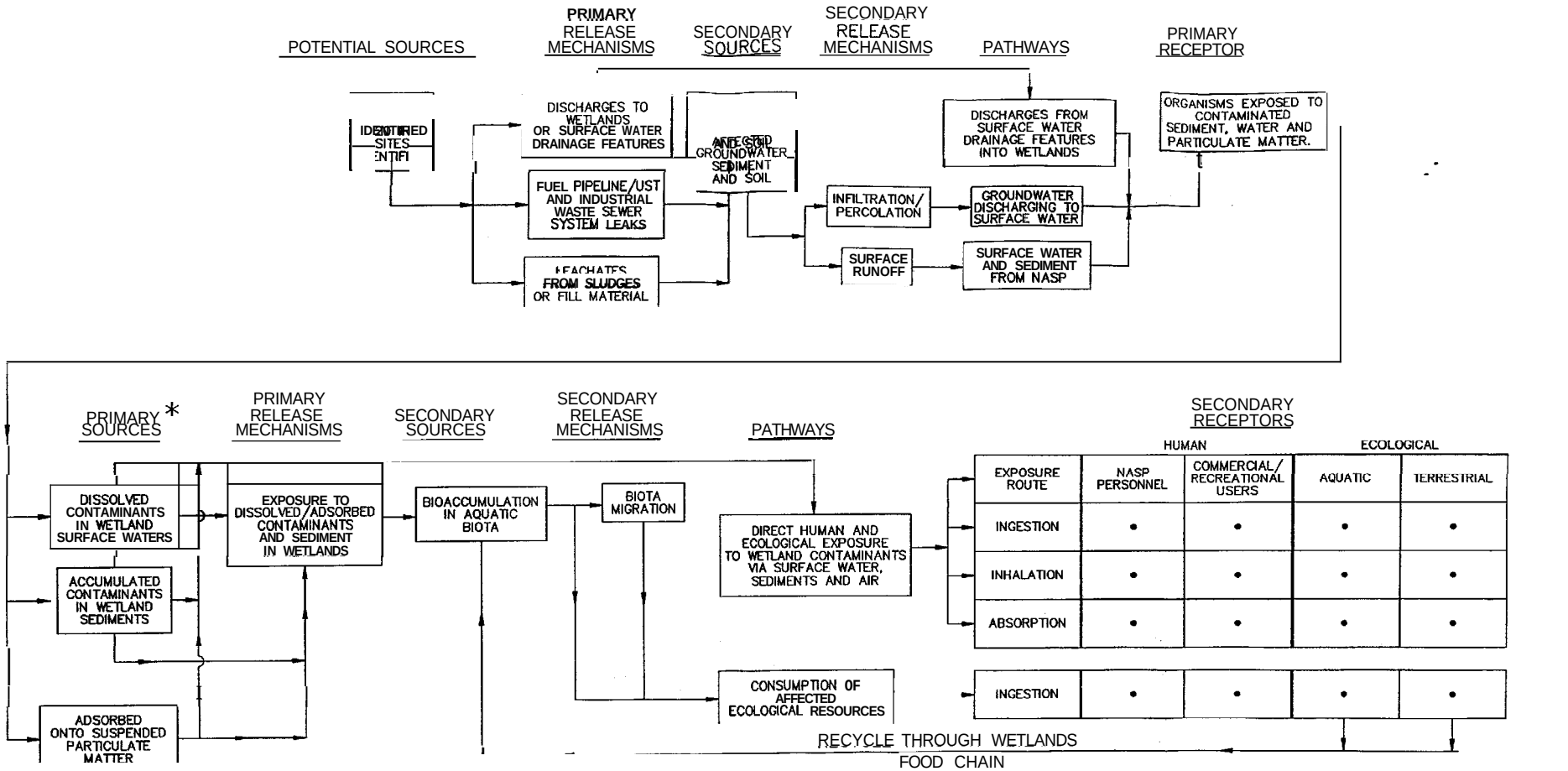
Measurement Endpoints

Measurement endpoints are measurable responses to a stressor that can be related to the valued characteristic chosen as the assessment endpoint. The NASP Tier I Partnering Team Eco-subcommittee proposed measurement endpoints for the selected wetlands to the NASP Tier I Partnering Team for approval that could best be related to the assessment endpoints. Measurement endpoints for these wetlands are described in Section 1.5.

Biological effects to measurement endpoint species can be measured through toxicity, diversity, and tissue concentration studies. To evaluate the assessment endpoints, multiple measurement endpoints at lower levels of biological organization were chosen in the wetlands of concern. These measurement endpoints may include responses at the organism level in sediment and surface water toxicity bioassays, and population abundances of benthic macroinvertebrate species (USEPA, 1993b).

1.5 Wetland-Specific Conceptual Models, Assessment Endpoints, and Measurement Endpoints

Based on knowledge of the selected wetlands and their contaminants, wetland-specific conceptual models were developed. These models are based on the more general conceptual model shown on Figure 1-2 and serve as the basis for the assessment and measurement endpoints chosen for each of the selected wetlands. A description of each of these wetlands and their contaminants, followed by justification for conceptual model and assessment and measurement endpoint



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

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PENSACOLA, FLORIDA

FIGURE 1–2
CONCEPTUAL SITE MODEL

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selection, are included in this section. Pathways leading to wading birds, fish, and benthic macroinvertebrates were considered the most likely routes of exposure. The assessment and measurement endpoints for each of the wetlands prioritized for further study are described in detail in this section. This information is summarized on Table 1-2.

Decision points are described for each of the measurement endpoints selected. Decision points were proposed by the NASP Tier I Partnering Team Eco-subcommittee to the NASP Tier I Partnering Team for approval.

Group A: Wetland 64

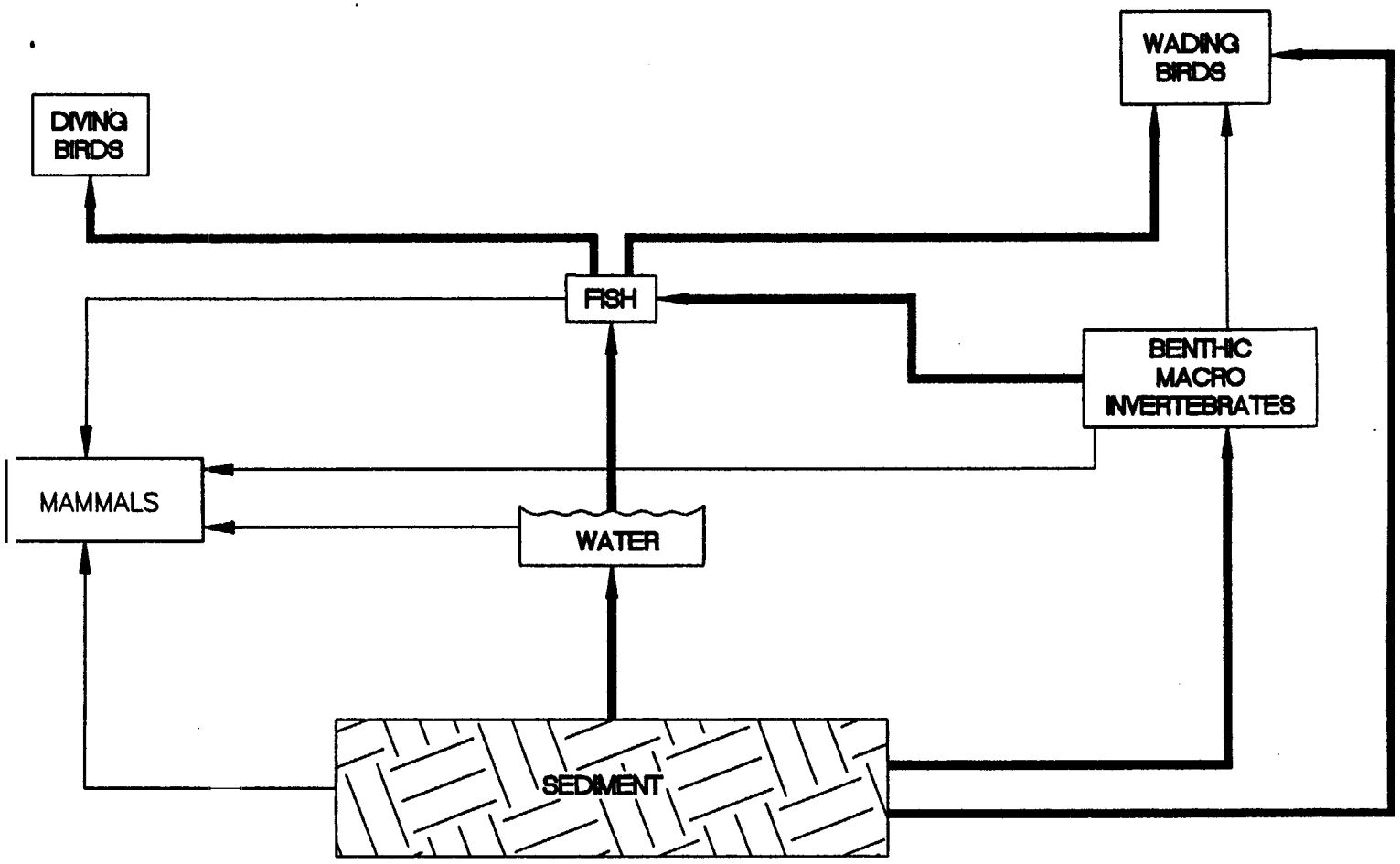
Wetland 64

Estuarine Wetland 64 begins as Wetland 6 flows under Pat Bellinger Road. It is surrounded by roads and buildings, with a 50 to 100 foot buffer of vegetation on the eastern and western sides. The open water portion of the wetland ranges from 2 feet to 15 feet deep and 15 to 100 feet wide. Sediment in the wetland is highly organic, with TOC detected at up to 20%. On its eastern bank, a vegetative buffer consists primarily of *Juncus sp.* near the wetland area with mowed grass within the upland area. On its western bank, disturbed hardwoods and scrub vegetation are prevalent upland, with *Juncus* sp. more prevalent in the wetland area as it flows north. Great blue herons have been observed feeding in this wetland, possibly on the fish known to inhabit this wetland.

This wetland receives drainage from a large portion of the base, and subsequently contains a diverse group of contaminants. Contaminants detected in this wetland include metals, PAHs, pesticides, and PCBs. Benthic macroinvertebrates, fish, wading birds, and diving birds have been observed in this wetland. The range of contaminant types means that effects may be manifested through both food chain and direct toxic effects. The conceptual model for this wetland is shown as Figure 1-3.

Table 1-2
Wetlands, Assessment Endpoints, and Measurement Endpoints

Wetland Group and Wetland(s) Chosen to Represent that Group	Assessment Endpoints	Measurement Endpoints
Group A (Wetland 64)	A) Piscivorous Bird Health and Reproduction	A) Whole body contaminant levels in a foraging fish species (such as a killifish).
	B) Survival, growth, and reproduction of macroinvertebrates associated with the benthic environment	B1) 10-day *Leptocheirus plumulosus* acute toxicity sediment test. B2) 20-day *Neanthes arenacoedentata* chronic toxicity test. B3) Benthic community indices
	C) Protection of fish viability	C1) Correlation of fish body burden values to effects values in literature. C2) Comparison of surface water data to state and federal water quality standards.
Group B (Wetlands SA and 3)	A) Survival, growth, tad reproduction of macroinvertebrates associated with the benthic environment	A) 10-day *Hyalella azteca* survival, growth. and reproduction.
	B) Protection of fish viability	B) 7-day *Pimephales promelas* survival and growth
Group C (Wetlands 16 and 18)	A) Survival, growth, tad reproduction of macroinvertebrates associated with the benthic environment.	Al) 10-day *Leptocheirus plumulosus* acute toxicity sediment test. A2) 20-day *Neanthes arenacoedentata* chronic toxicity test. A3) Benthic community indices
	B) Health of birds and terrestrial fauna (Wetland 18 only).	B) Whole body contaminant levels in the fiddler crab (*Uca* sp.) m Wetland 18 only.



NOTE: BOLD LINES INDICATE COMPLETE PATHWAY

SITE 41 SAP ADDENDUM
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

FIGURE 1-3
WETLAND 64
CONCEPTUAL MODEL

DWG DATE: 04/28/97 | DWG NAME: 36S412

Group A (Wetland 64) Assessment Endpoints

A. Piscivorous bird health and reproduction.

B. Survival, growth, and reproduction of macroinvertebrates associated with the benthic environment.

C. Protection of fish viability.

Measurement Endpoints

A. Whole body contaminant levels in a foraging fish species (killifish) measured using target compound list (TCL) organics (USEPA, 1994a) and target analyte lit (TAL) norganics (USEPA, 1994b). The decision point for an unacceptable whole body level will be defined as those tissue concentrations which are known to produce reproductive impairment in an assessment endpoint species. Exposure to assessment endpoint species will be determined using a food chain model, described in Section 1.6.

B1. 10-day *Leptocheirus plumulosus* acute toxicity solid phase sediment test (American Society for Testing and Materials (ASTM), 1994). The decision point will be statistically significant difference in mortality, growth, or fecundity compared to that of reference Wetland 33 and a laboratory control.

B2. 20-day *Neanthes arenacoedentata* chronic toxicity test (Puget Sound Estuary Program (PSEP), 1991). The decision point will be statistically significant difference in mortality, growth, or fecundity compared to that of reference Wetland 33 and a laboratory control.

B3. Benthic community indices. There will not be a significant decision point in analyzing these results. E/A&H will investigate the potential for impacts from physical and chemical variables and compare the benthic macroinvertebrate community indices in Wetland 64 to those in Wetland 33.

C1. Correlation of fish body burden values to effects values from the scientific literature. The decision point will be exceedance of levels shown to elicit a sublethal effect.

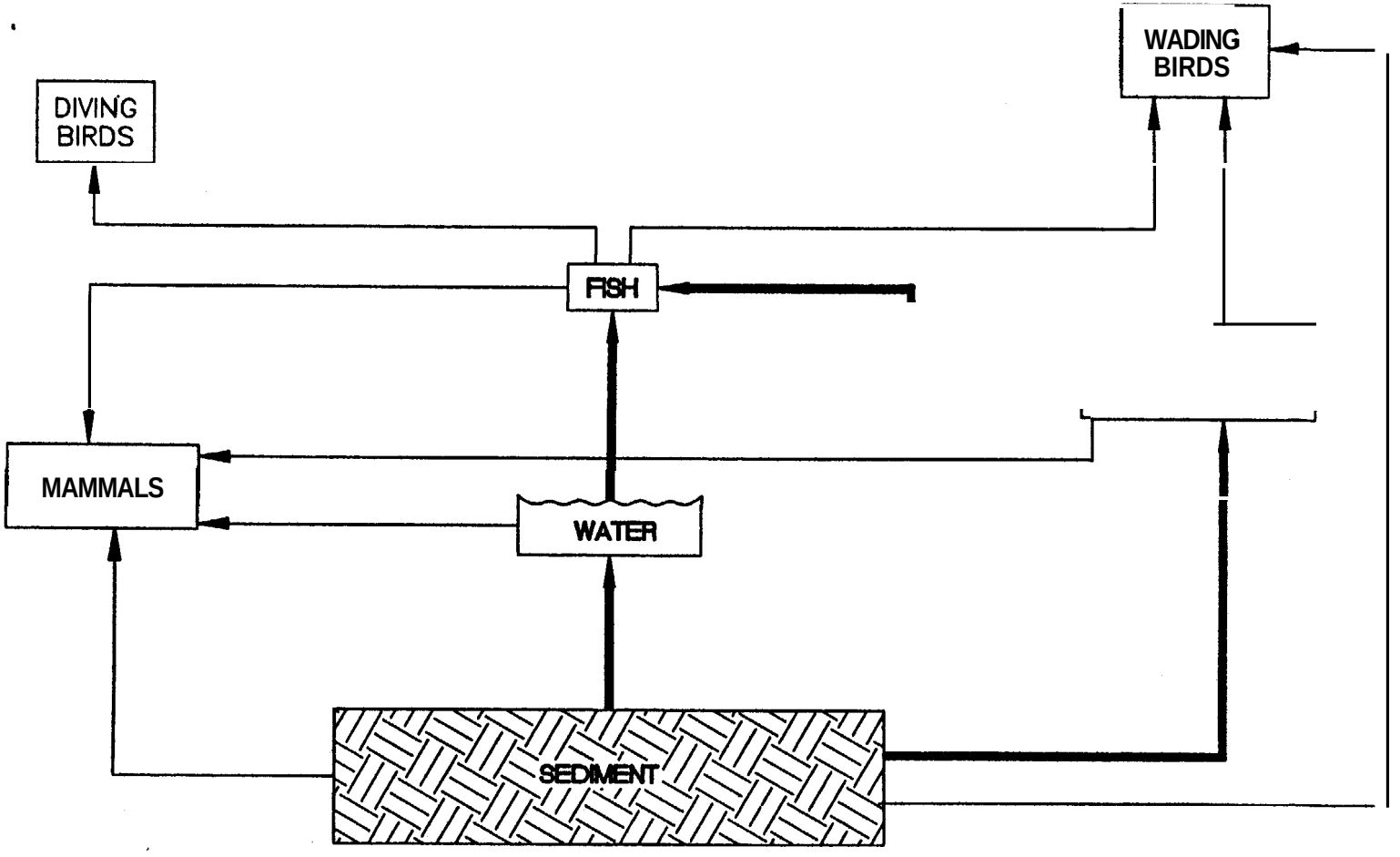
C2. Collection of surface water samples for comparison to state and federal standards. The decision point will be exceedances of state and federal chronic water quality standards and correlation with known sediment contamination or groundwater contamination in adjacent Site 11.

Group B: Wetlands 5A and 3

Wetland 5A

Freshwater Wetland 5A has *surface* water and groundwater sources at its western side. Wetland 5A is bordered by Murray Road to the east, the golf course to the west, and buildings to the north and south. There is a 200-300 foot vegetative buffer surrounding the wetland, which may provide habitat and cover for certain terrestrial species. The open water portion of the wetland ranges from 0 to about 5 feet deep and from about 5 to 300 feet wide. Sediment in most of the wetland is highly organic, with TOC detected at up to 40%. The open water portion contains several freshwater plant species such as lizard tails and cattails. Beaver dams and lodges have also been noted in this wetland. Great blue herons have been observed in this wetland. Fish and benthic macroinvertebrates have been seen in this wetland, but it is not considered likely that this wetland would provide a permanent habitat because of variables in water level and other physical factors. The conceptual model for Wetland 5A is shown on Figure 1-4.

Wetland 5A is adjacent to Site 30 and once contained an oil water separator (or other waste receiving structure) that has since been removed. A wide range of sediment contaminants have been detected in this wetland, including metals, PAHs, pesticides, and PCBs. However, the most prevalent are metals, which are primarily a concern from a benthic and fish toxicity perspective



NOTE: BOLD **LINES INDICATE** COMPLETE **PATHWAY**

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FIGURE 1-4
WETLAND 5
CONCEPTUAL MODEL

DWG DATE: 04/28/97 | DWG NAME: 36S413

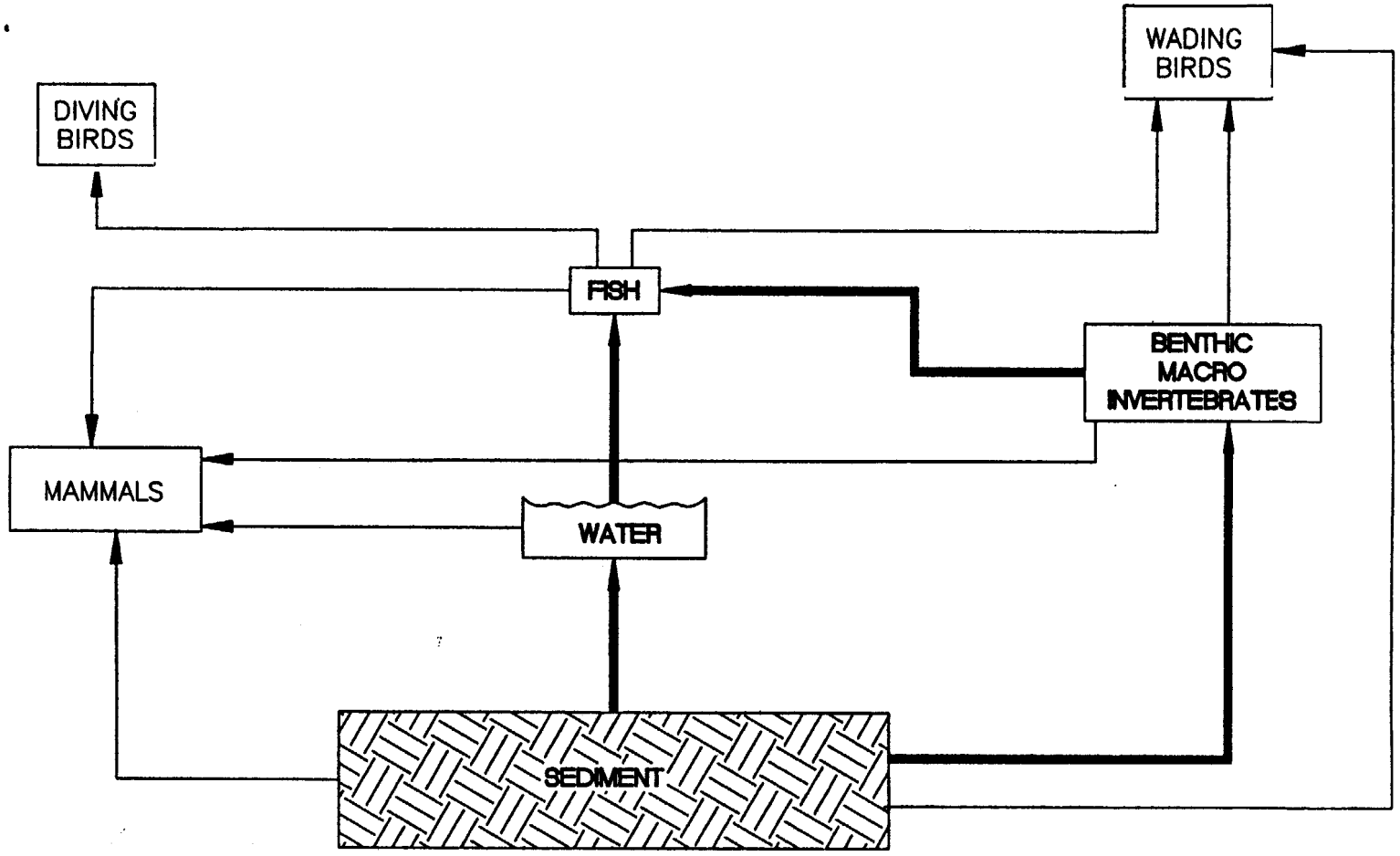
rather than through food chain impacts. Therefore, the conceptual model focuses on benthic macroinvertebrates and fish exposed to metal-contaminated sediment.

Wetland 3

Wetland 3 (freshwater) begins as several groundwater seeps in its Southeastern portion and flows east under John Tower Road where it drains into Wetland 4D. Wetland 3 is bordered by Site 1 to the north, south, and west, and John Tower Road and the golf course to the east. A narrow surface water channel in this wetland is about 4 inches deep and one to two feet wide. The remaining portion of the wetland is mostly saturated sediment with a thin layer of surface water overlaying it. This surface water layer is absent throughout most of the wetland during naturally dry times of the year.

Sediment in much of Wetland 3 is highly organic, with TOC detected at up to 24%. The shallow open water portion contains several freshwater vegetative species such as lizard tail and cattails. The lower section adjacent to John Tower Road has recently been excavated to clear a drainage culvert into Wetland 4D. Small fish have been observed in the culvert area. This area is expected to provide the most desirable habitat to great blue herons, which have been observed in this wetland. Raccoon and opossum tracks have also been seen in this wetld. The conceptual model for Wetland 3 is shown on Figure 1-5.

Contaminants of concern in Wetland 3 are primarily inorganics and pesticides. Exposure to the benthic community and fish are considered the most likely pathways of possible contaminant exposure. Although mammals and bird species have been observed in this wetland, they are not considered as likely to be exposed to any contaminants and will not be considered to form a complete pathway in the wetland-specific conceptual model.



NOTE: BOLD LINES INDICATE COMPLETE PATHWAY

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FIGURE 1-5
WETLAND 3
CONCEPTUAL MODEL

Group B (Wetlands 5A and 3) Assessment Endpoints

A. Survival, growth, and reproduction of macroinvertebrates associated with the benthic environment.

B. Protection of fish viability.

Measurement Endpoints

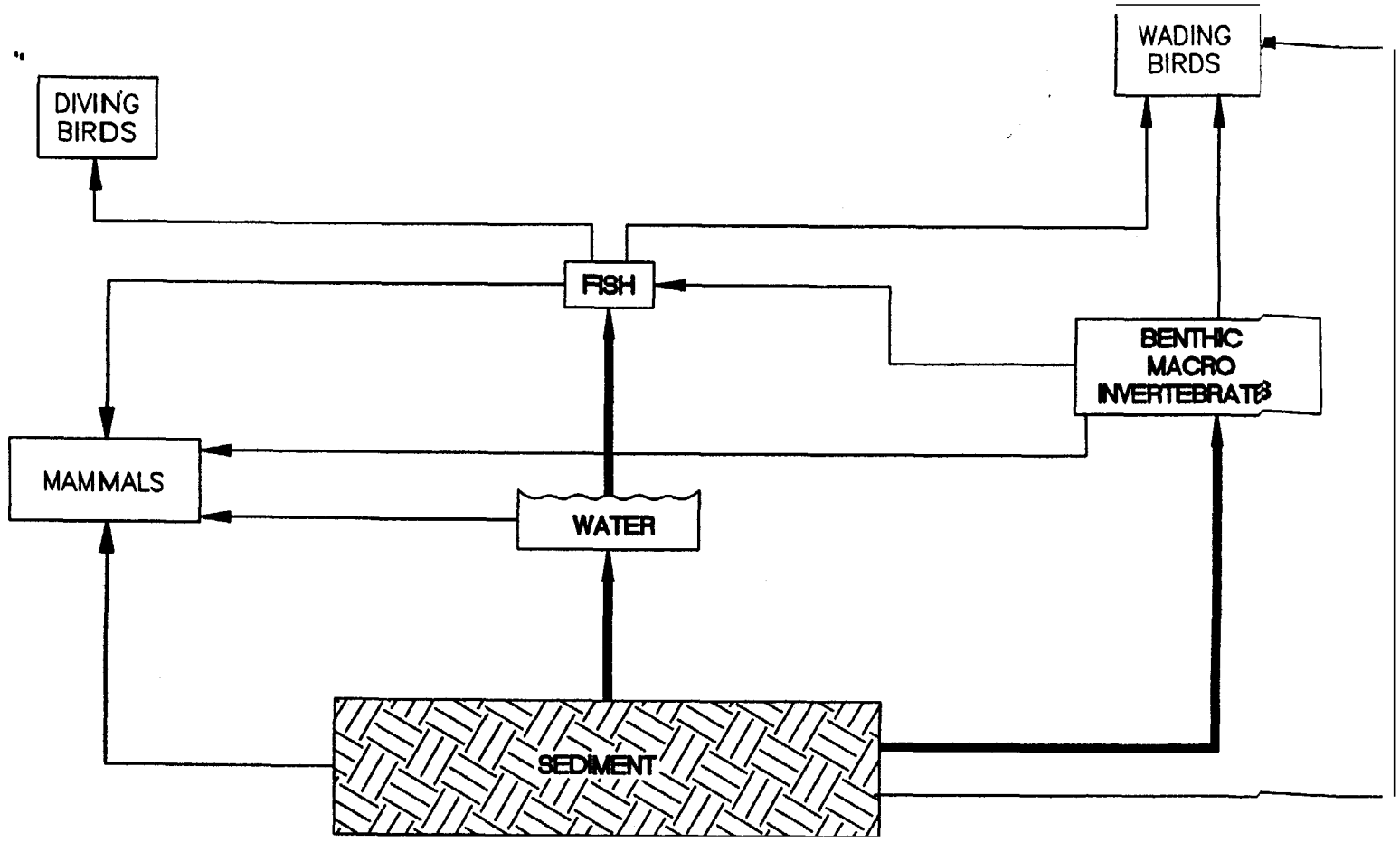
A. 10-day amphipod (*Hyalella azteca*) survival, growth, and reproduction chronic bulk sediment bioassay (USEPA, 1994c). The decision point will be statistically significant difference in survival, growth, or reproduction compared to that of reference Wetland 75 and a laboratory control.

B. 7-day fathead minnow (*Pimephales promelas*) survival and growth test. The decision point will be statistically significant difference in survival and growth compared to that of reference Wetland 75 and a laboratory control (USEPA, 1994d).

Group C: Wetlands 16 and 18

Wetland 16

Estuarine Wetland 16 is fed from the east and south by groundwater from the area of Site 1, and from the northwest by tidal influences from Bayou Grande. Wetland 16 generally flows northwest into Bayou Grande through a drainage channel about 3 feet wide. It is bordered by Site 1 to the south, the Naval Air Station picnic area to the east, and Bayou Grande to the north and west. The open water portion of the wetland ranges from 1 to 5 deep and has a maximum width near 200 feet. Sediment in the wetland is mostly sand, with TOC detected up to 6%. The riparian zone surrounding Wetland 16 is highly disturbed vegetation affected by rubble deposits south from Site 1, maintained grass, or sand near where it drains into Bayou Grande. *Juncus sp.* is prevalent in the western portion of the wetland. Great blue herons have been observed in this wetland. The conceptual model for Wetland 16 is shown on Figure 1-6.



NOTE: BOLD **LINES INDICATE** COMPLETE **PATHWAY**

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FIGURE 1-6
WETLAND 16
CONCEPTUAL MODEL

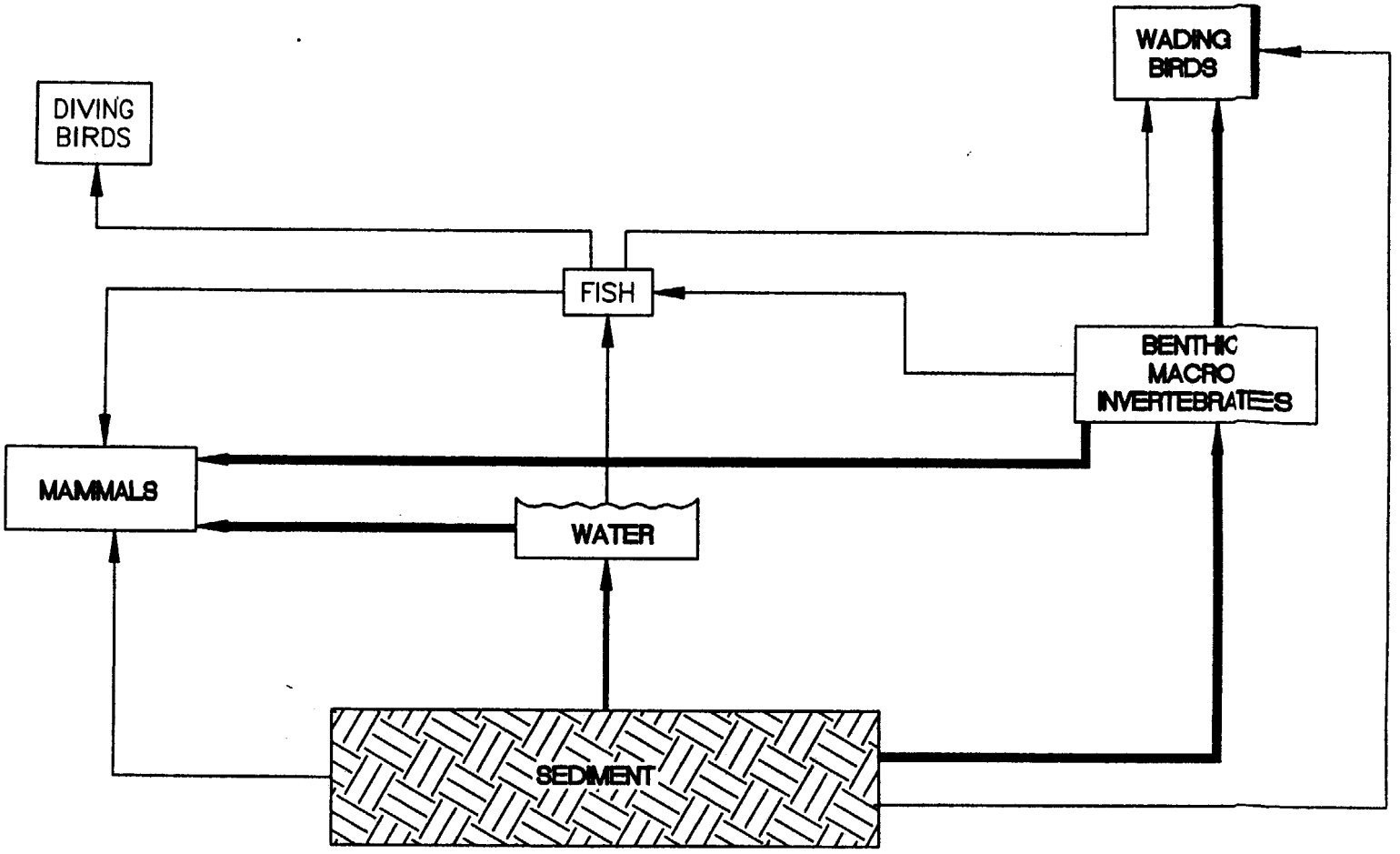
DWG DATE: 04/28/97 | DWG NAME: 36S415

Wetland 16 is suspected of being impacted by Site 1. The contaminants of concern are primarily select inorganics. Any impacts would be expected to result more from direct toxicity than from food chain impacts. Therefore, exposure routes to benthic macroinvertebrates and fish, which have been observed in this wetland, are expected to be the most significant.

Wetland 18

Freshwater Wetland 18A is an approximately 2 foot wide stream fed by a groundwater seep from Site 1 to the east. Wetland 18A widens as it transitions to estuarine Wetland 18B, which is influenced by Bayou *Grande.* Wetland 18 is surrounded by Site 1, except to the west where it is bordered by Bayou Grande. The open water portion of Wetland 18A is less than 1 foot deep and has a maximum width of about 2 feet. Wetland 18B ranges from about 0 to 1 foot deep, and has a maximum width of about 50 feet. Sediment in both wetland portions is highly organic, with TOC detected to 34%. The upland vegetation surrounding Wetland 18A and 18B is mostly pines. Wetland 18B also contains significant concentrations of *Spartina* sp. The relative abundance of vegetation in the area could serve as a source of habitat and cover for several species. Fish species and benthic macroinvertebrates have been observed in the extreme lower end of this wetland near Bayou Grande. Raccoon and opossum tracks have been noted in this wetland. The conceptual model for Wetland 18 is shown on Figure 1-7.

Wetland 18 is suspected of being impacted by Site 1. Contaminants of concern are select metals and pesticides. Any impacts would be expected to result either through direct toxicity to macroinvertebrates or crabs, or through food chain *impacts* to mammals and birds via crab or fish ingestion. Most exposures will likely occur at the lower end of the wetland where it drains into Bayou Grande. Although a potential exposure route to mammals exists, their expected use of the wetland is considered to be minimal. The dense vegetation throughout most of the wetland limits accessibility.



NOTE: BOLD LINES INDICATE COMPLETE PATHWAY

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FIGURE 1-7
WETLAND 1B
CONCEPTUAL MODEL

DWG DATE: 04/28/97 | DWG NAME: 36S416

Assessment Endpoints

Group C (Wetlands 18 and 16)

A. Survival, growth, and reproduction of macroinvertebrates associated with the benthic environment.

B. Health of wading birds and terrestrial fauna (Wetland 18 only).

Measurement Endpoints

A1. 10-day *Leptocheirus plumulosus* acute toxicity test (ASTM, 1994). The decision point will statistically significant difference in mortality, growth, or fecundity to that of reference Wetland 33 and a laboratory control.

A2. 20-day *Neanthes arenacoedentata* chronic toxicity test (PSEP, 1991). The decision point will statistically significant difference in mortality, growth, or fecundity to that of reference Wetland 33 and a laboratory control.

A3. Benthic community indices will also be measured. There will not be a significant decision point in analyzing these results. E/A&H will investigate the potential for impacts from physical and chemical variables and compare the benthic macroinvertebrate community indices to samples from Wetland 33.

B1. In Wetland 18 only, whole body contaminant levels in a foraging fish species (killifish) measured using target compound list (TCL) organics (USEPA, 1994a) and target analyte list (TAL) inorganics (USEPA, 1994b). The decision point for an unacceptable whole body level will be defined as those tissue concentrations which are known to produce reproductive impairment in an assessment endpoint species. Exposure to assessment endpoint species will be determined using a food chain model, described in Section 1.6.

1.6 Sample Locations and Methods

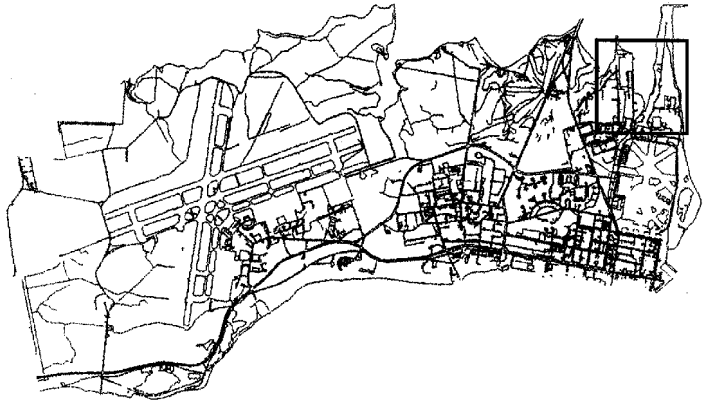
Sample locations for Phase IIB were proposed by the Eco-subgroup to the NASP Tier I Partnering Team for approval. Sample locations were selected in areas of the wetlands exhibiting relatively high, medium, and low levels of contamination. Sampling a contaminant level gradient will yield a better idea of relative risk posed in *certain* portions of the wetland. Proposed sample locations in each selected wetland were chosen *among* the existing sample locations in Phase IIA. In addition, at each sediment sample location for Phase IIB analysis, a sediment sample will be collected and analyzed using full TCL organics (USEPA, 1994a) and TAL inorganics analysis (USEPA, 1994b) (less VOCs), total organic carbon, and grain-size analysis to better correlate the sediment contaminants with the toxicity results. VOCs will be included in the TCL organics (USEPA, 1994a) analysis for the sediments in Wetland 3 only.

Sample locations within the wetlands chosen for further study are shown on Figures 1-8 through 1-17 and support the following text which describes those sample locations. The first figure for each wetland chosen for Phase IIB study shows the sample locations within the wetland boundary as defined by Parsons and Pruitt (1991). The second figure for each wetland shows the sample locations laid over an aerial photograph of that wetland. The photograph will give the reader an appreciation of the wetland itself and its surroundings.

- Wetland 64 — Sediment samples for sediment toxicity analysis, sediment chemistry, TOC, grain size, and benthic diversity will be collected from sample locations 4, 5, and 6 (Figures 1-8 and 1-9). Samples for benthic diversity will be a composite of three grabs collected within 10 feet of each sample location to account for spatial variability. For tissue concentration analysis, fish will be composited from sample locations 4, 5, and 6.

LEGEND

- SAMPLE LOCATIONS
- ESTUARINE EMERGENT
- SHORELINE



350 0 350

SCALE FEET

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FIGURE 1-8
PROPOSED PHASE II B
WETLAND 64
SAMPLE LOCATIONS

DWG DATE: 04/28/97 | DWG NAME: 36S417

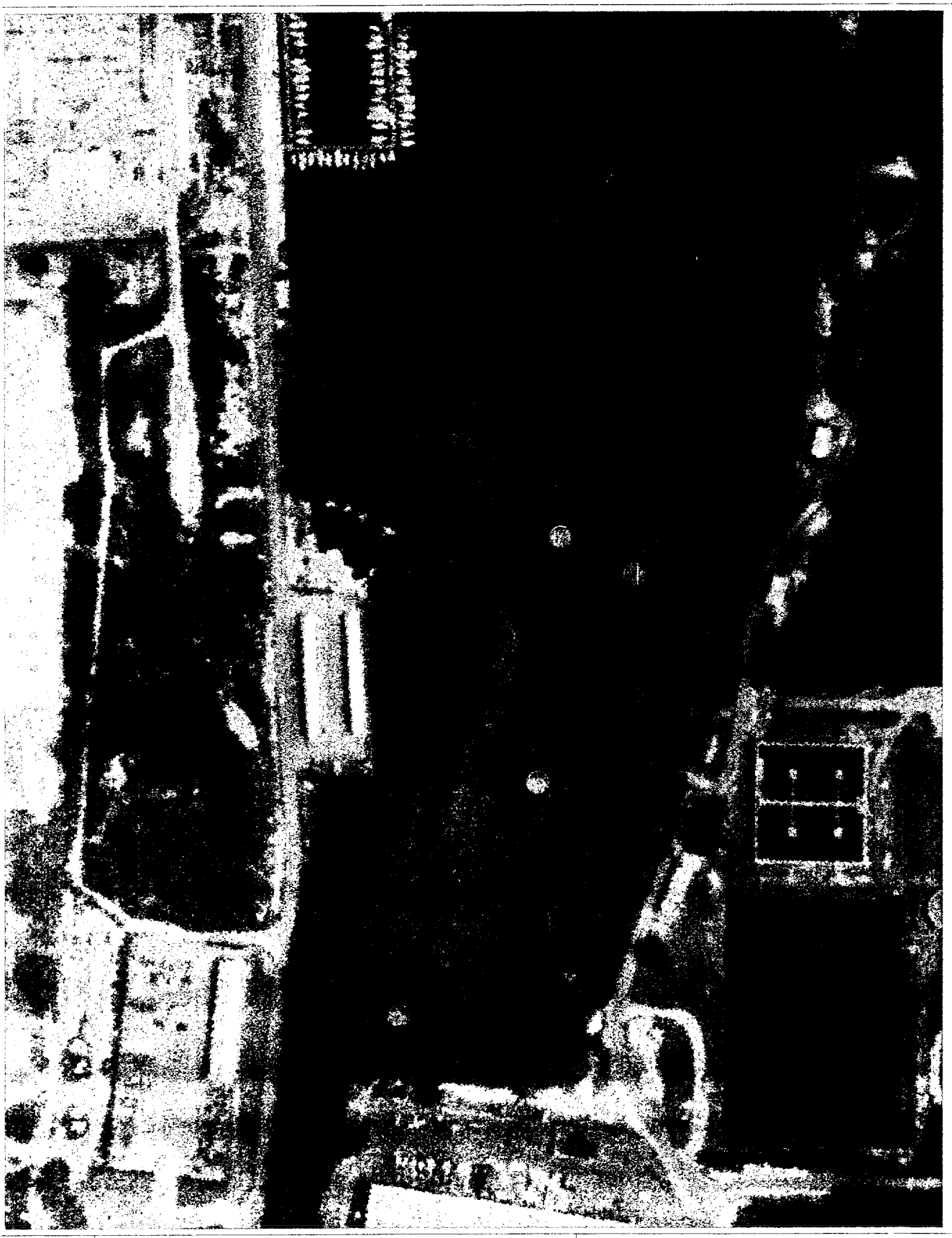

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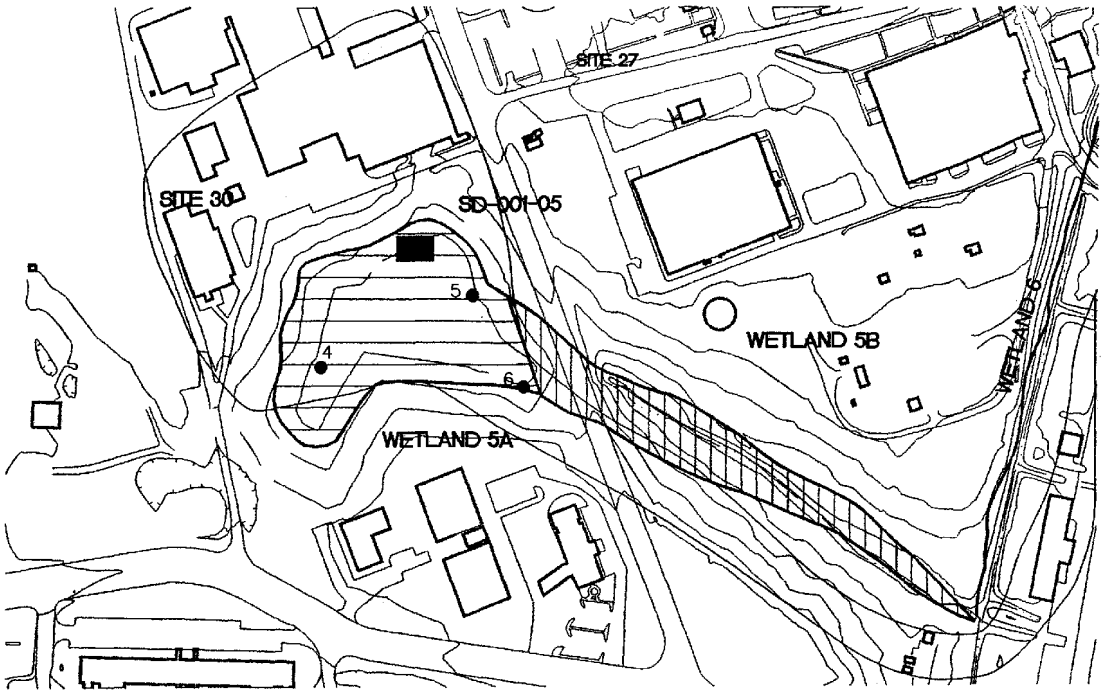
Figure 1-9
Proposed Phase IIB
Wetland 64
Sample Locations



LEGEND

- SAMPLE LOCATIONS
- PALUSTRINE FORESTED
- PALUSTRINE EMERGENT
- APPROXIMATE LOCATION OF FORMER WASTE-RECEIVING STRUCTURE
- SHORELINE

530 0 250
SCALE FEET

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PENSACOIA. FLORIDA

FIGURE 1-10
PROPOSED PHASE II B
WETLAND 5
SAMPLE LOCATIONS

DWG DATE:04/28/97 | DWG NAME:36S418

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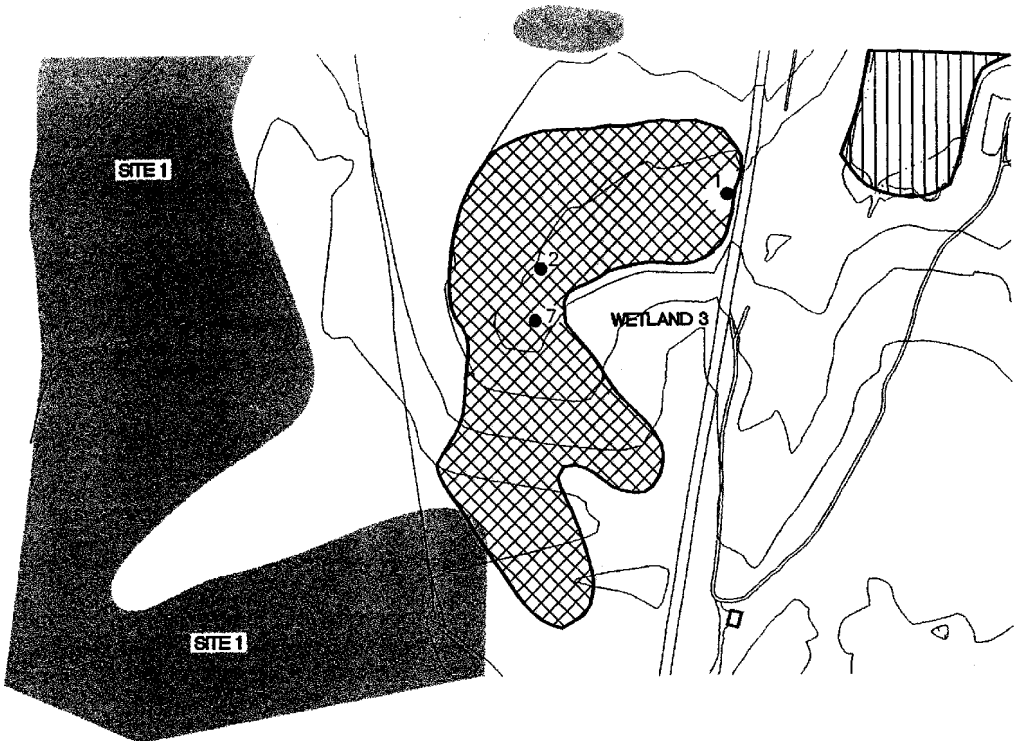
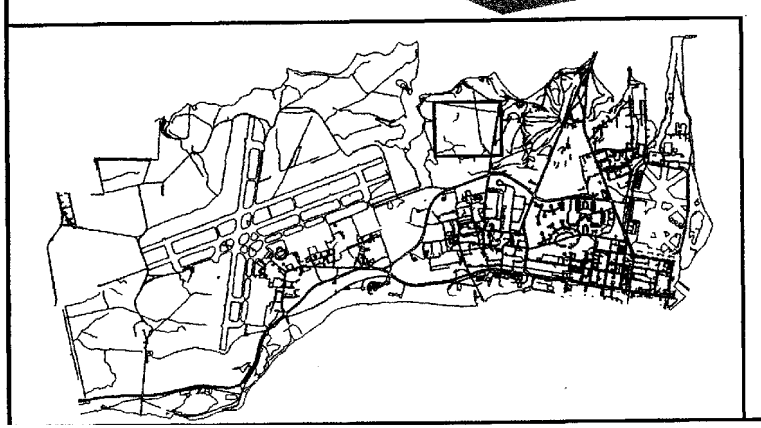
Pensacola, Florida

Figure 1-10
Proposed Phase IIB

Wetland 5A
Sample Locations





N

LEGEND

- SAMPLE LOCATION
- PALUSTRINE SCRUB SHRUB/EMERGENT
- PALUSTRINE EMERGENT
- SITE AREA
- SHORELINE
- ROADS

250 0 250
SCALE FEET

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FIGURE 1-12
PROPOSED PHASE II B
WETLAND 3
SAMPLE LOCATIONS

DWG DATE:04/28/97 | DWG NAME:36S419

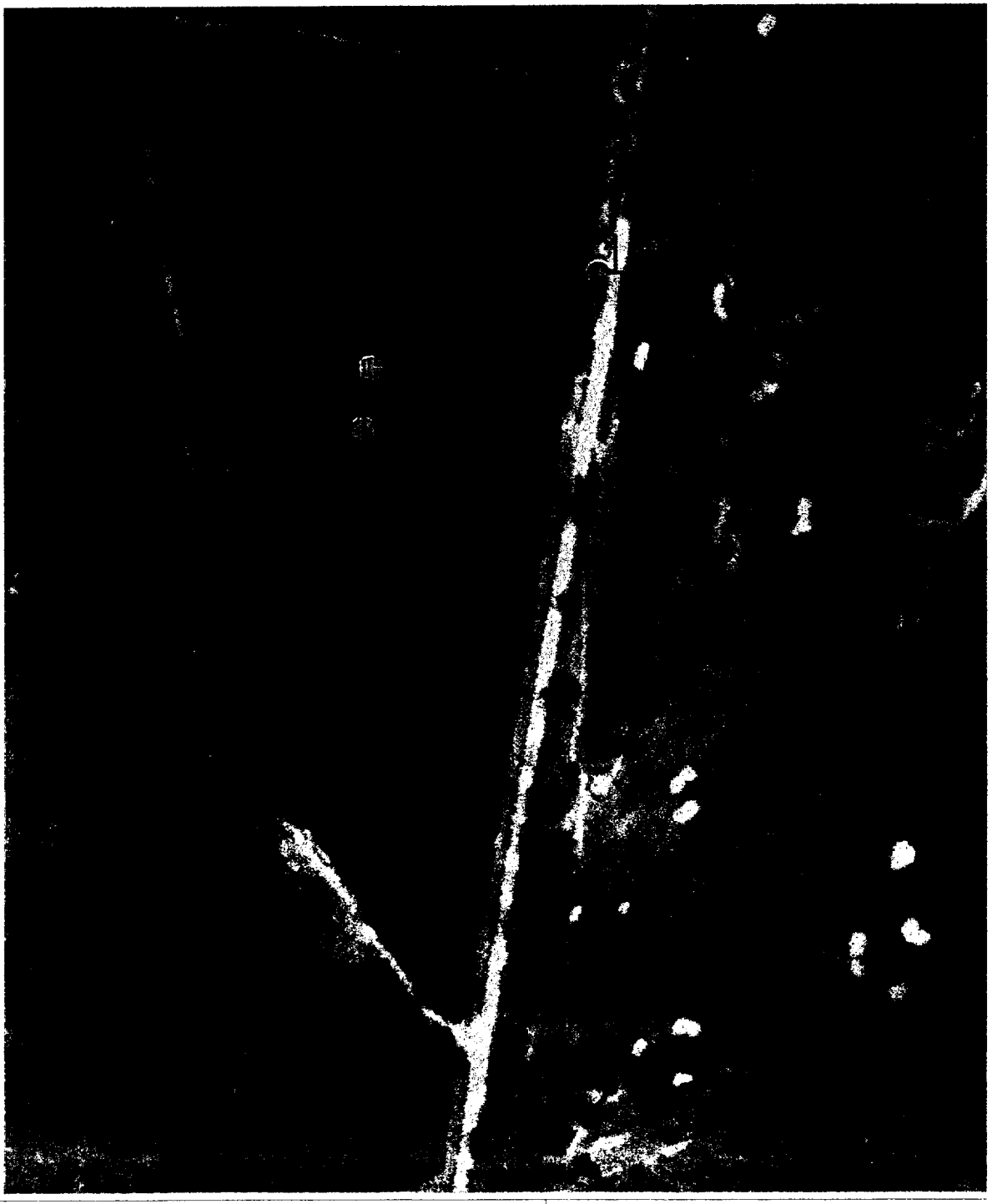

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Figure 1-13
Proposed Phase IIB
Wetland 3
Sample Locations

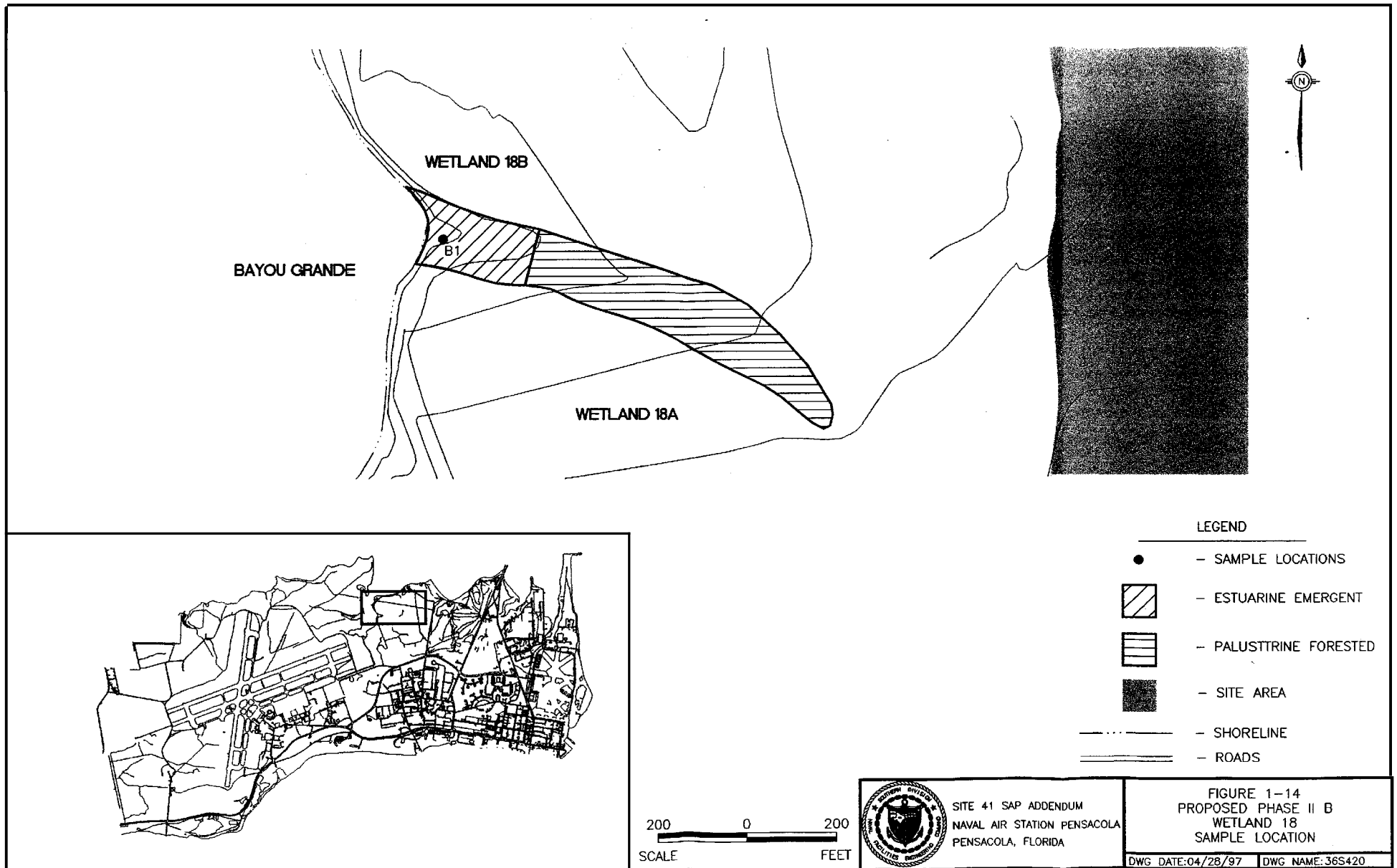

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FIGURE 1-14
PROPOSED PHASE II B
WETLAND 18
SAMPLE LOCATION

DWG DATE:04/28/97 | DWG NAME:36S420

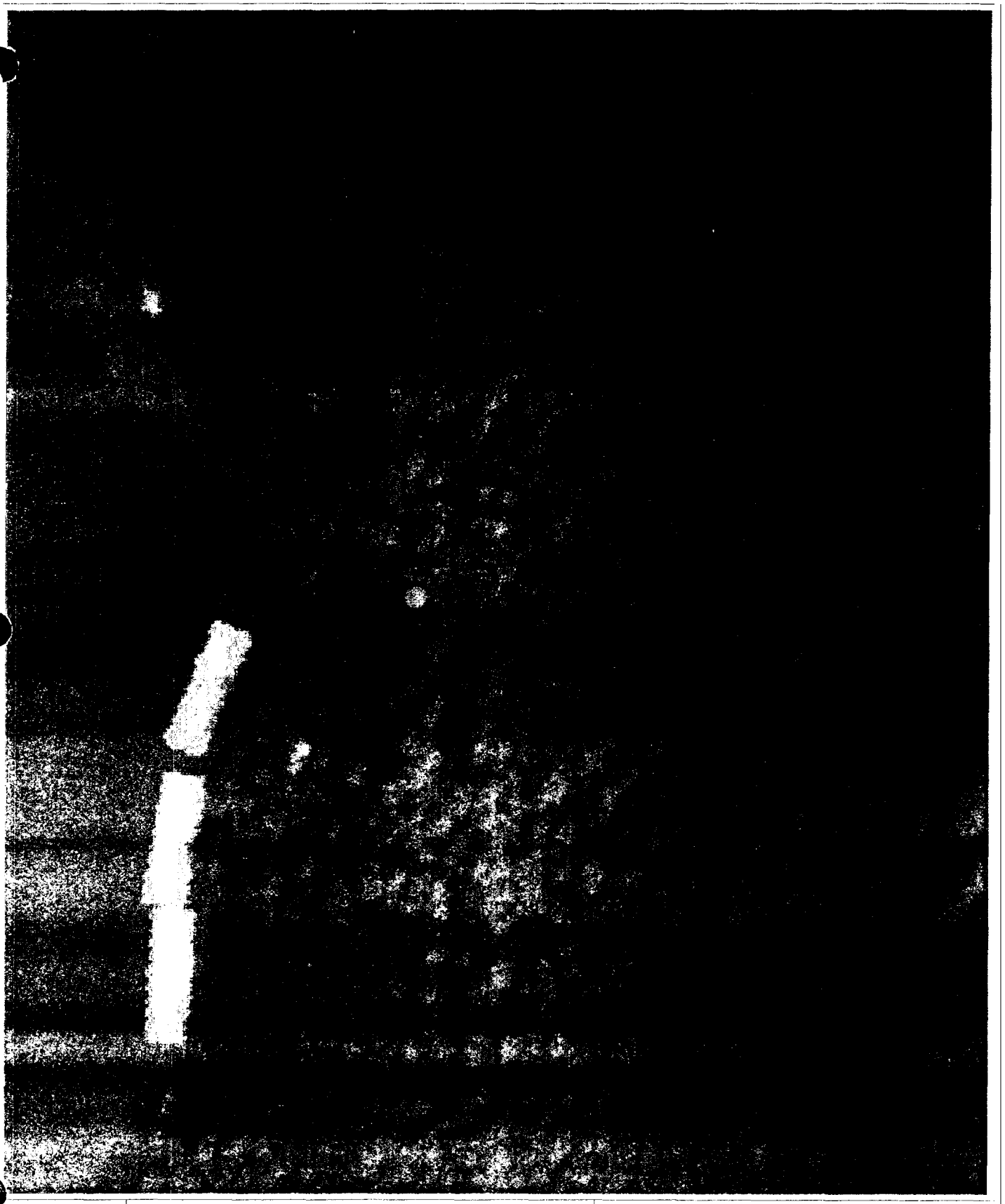

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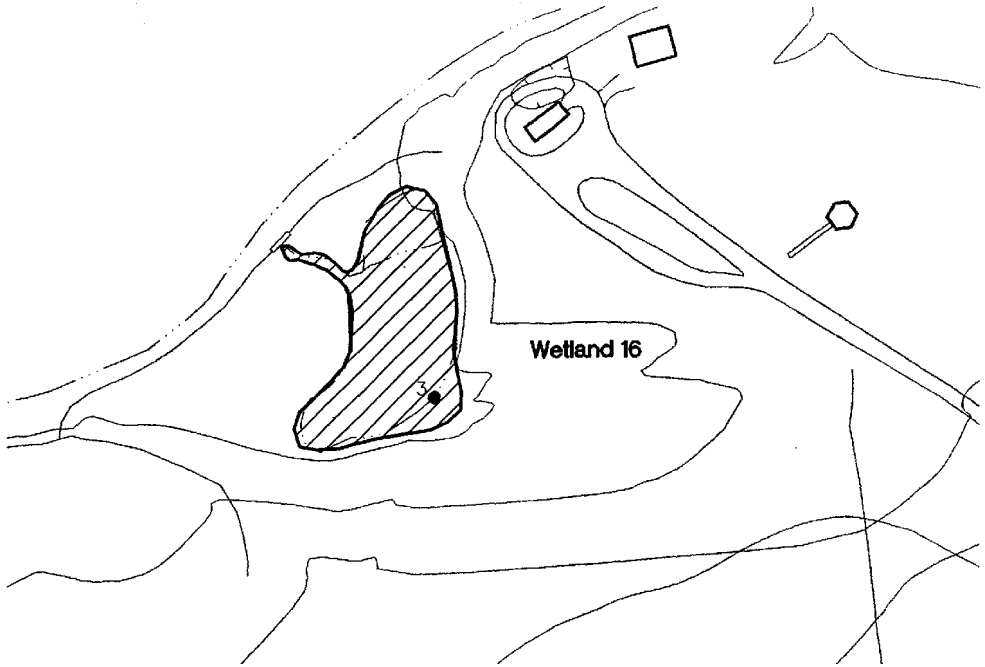
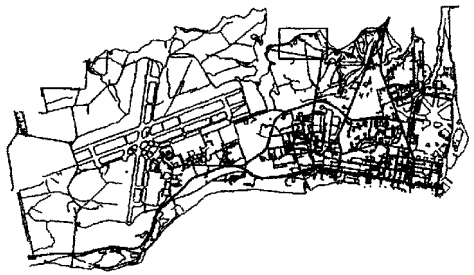
Figure 1-15
Proposed Phase IIB
Wetland 18B
Sample Location





LEGEND

- SAMPLE LOCATION
- ESTUARINE EMERGENT
- SHORELINE
- ROADS

150 0 150

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FIGURE 1-16
PROPOSED PHASE II B
WETLAND 16
SAMPLE LOCATION

DWG DATE:04/28/97 | DWG NAME:36S421

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Figure **7-77**
Proposed Phase IIB
Wetland 1
Sample Location

Two discrete surface water samples will also be collected. One surface water sample will be collected between locations 1 and 2 and the other will be collected between locations 2 and 5.

- Wetland 5A — Sediment samples for toxicity analysis, sediment chemistry, TOC, and grain size will be collected from locations 4, 5, and 6 (Figures 1-10 and 1-11). Samples for benthic diversity will be a composite of three grabs collected within 10 feet of each sample location to account for spatial variability. Discrete samples for surface water chemistry and toxicity will be collected from locations 4, 5, and 6 during Phase IIB.

- Wetland 3 — Sediment samples for toxicity analysis, sediment chemistry, TOC, and grain size will be collected from locations 2 and 7 (Figures 1-12 and 1-13). Samples for benthic diversity will be a composite of three grabs collected within 10 feet of each sample location to account for spatial variability. A surface water sample will be collected from the newly excavated culvert, near sample location 1, for the fathead minnow (*Pimephales promelas*) toxicity analysis.

- Wetland 18B — A sediment sample will be collected at location B1 for toxicity analysis, sediment chemistry, TOC, grain size, benthic diversity, and tissue concentration (Figures 1-14 and 1-15). Samples for benthic diversity will be a composite of three grabs collected within 10 feet of this sample location to account for spatial variability. Fiddler crabs will be collected in the general area around Wetland 18B, as close to sample location B1 as possible.

- Wetland 16 — A sediment sample will be collected at location 3 for toxicity analysis, sediment chemistry, TOC, grain size, and benthic diversity (Figures 1-16 and 1-17).

Samples for benthic diversity will be a composite of three grabs collected within 10 feet of this sample location to account for spatial variability.

All surface water samples for chemical analysis and all sediment samples for acute and chronic toxicity analysis will be collected using the sample collection methods described in Sections 7.2 and 7.3 of the CSAP (E/A&H, 1994). sediment samples will be collected using either a dredge or a scoop depending on the depth of the water above the sediment. Surface water samples will be collected either directly with a laboratory bottle or with a Kemmerer sampler depending on water depth. In-situ fish samples will be collected using standard minnow traps or seines. All fish will be segregated by species and preserved on ice. Traps or nets will be used to capture the fiddler crab (*Uca* sp.). If sufficient quantities of crabs are not available, then tissue concentration studies using *Neanthes* sp. from chronic bioassays will be performed using full TCL organics (USEPA, 1994a) and TAL inorganics (USEPA, 1994b).

1.7 Modeling Approach

Dietary exposure of chemicals to the assessment endpoint species will be modeled using information found in the USEPA *Wildlife* Exposure *Factors Handbook* (USEPA, 1993a).

After exposures are analyzed, effects can be predicted and quantified based on published effects-level threshold values.

Food Chain Assessment Method

For the assessment endpoint "bird health and reproduction", E/A&H will estimate contaminant uptake resulting from an oral exposure of tissue contamination from fish or fiddler crabs. Equation 1 presents the model components that will be used to derive a daily dietary exposure to a heron, other bird, and raccoon. Equation 1 predicts that portion of the potential dietary exposure

(PDE) from contaminated prey tissue. The equation assumes that 100% of the contaminant concentration found in tissue is bioavailable to the receptor species.

(Equation 1)

Receptor Exposure via prey tissue:	Food Exposure (mg/kg)	=	% Diet as Prey	X IR_{diet}	X	Contaminant conc. in fish tissue (mg/kg)

where

IR_{diet} = food ingestion rate of receptor kg of food per day.

Equation 2 predicts that portion of the PDE from contamination in water. The equation assumes 100% contaminant assimilation by the receptor species.

(Equation 2)

Surface Water Contaminant Uptake to Receptor:	Surface Water Contaminant Exposure (mg/kg)	=	Surface Water Contaminant Concentration (mg/L)	X	Water Ingestion Rate (L/day)

Equation 3 predicts that portion of the PDE from incidental ingestion of contaminated sediment by the bird. This portion of the PDE also assumes 100% contaminant assimilation. This portion of the PDE for piscivorous birds is only applicable to wading bird and raccoon; direct exposure to sediment by diving birds is considered negligible.

(Equation 3)

Sediment Ingestion by Receptor:	Sediment Exposure (mg/kg)	=	Sediment as % of Diet	X IR_{diet}	X	Sediment Contam. Conc. (mg/kg)

Equation 4 predicts the total contaminant dietary exposure via tissue, surface water and sediment (as applicable). This equation incorporates the products derived in Equations 1, 2 and 3. To normalize to species body weight, the *sum* of the products from Equation 1-3 are divided by a mean body weight of the receptor selected as the assessment endpoint.

(Equation 4)

$$\text{Total Contaminant Exposure to Receptor: } \text{Total PDE (mg/kg)} = \frac{\text{Fish Tissue Exposure (Eq1)} + \text{Water Exposure (Eq2)} + \text{Sediment Exposure (Eq3)}}{\text{BW}}$$

where

BW = mean body weight (kg) of receptor

Notes:

mg	=	milligrams
mg/L	=	milligrams per liter
kg BW/day	=	kilograms of body weight per day
%	=	percent
mg/kg	=	milligrams per kilogram

To assess the potential risk present to receptors, the total PDE value derived in Equation 4 is then divided by a threshold risk value (TRV) for the endpoint selected (i.e., mortality, reproductive alterations). This will produce a single number, expressed as a bazard quotient, that is a numerical representation of potential risk to the assessment endpoint selected. The TRV will be the lowest observable apparent effects level to a taxonomically related species found in the literature, divided by 10, to estimate a no observable apparent effects level.

Other models may be evaluated later in the RI for use in developing remedial options to address ecological concerns.

1.8 Ecological Risk Assessment Framework *Summary*

Completion of the RI and the risk assessment in the selected wetlands is based on three sources of information, not all of which may be required to completely assess risk. The first source is chemical analyses to establish the presence, concentrations, and distribution of any chemical contaminants. The second source of information is data from toxicity tests and diversity studies to link exposure effects with the chemical concentrations. The third source is tissue concentration

studies to further refine ecological impact and determine whether any impacts may be occurring in higher levels of the food chain. This information is important in establishing a causal link between contaminants and ecological effects (USEPA, 1992).

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 ecological receptors. The weight-of-evidence approach considers all available information to predict ecological impact. Each result will be considered in relation to the others to determine the extent and severity of impact. All factors will be considered to yield an overall picture of risk needed to develop remedial options.

1.9 References

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1.10 Florida Professional Geologist seal

I have read and approve of this *Sampling* and Analysis Plan - Addendum for Site 41, Wetlands at the Naval Air Station Pensacola, Florida, 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:	Henry H. Beiro
License Number:	1847
State:	Florida
Expiration Date:	July 31, 1998

Henry H. Beiro

9-18-97

Date