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Contamination Assessment/ Remedial Activities Investigation Naval Air Station Pensacola Pensacola, Florida

Data Summary and Preliminary Scoping for Ecological Risk Assessment Work Plans

November 1992

Southern Division
Naval Facilities
Engineering Command
Charleston, South Carolina
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CONTAMINATION ASSESSMENT/ REMEDIAL ACTIVITIES INVESTIGATION NAVAL AIR STATION PENSACOIA PENSACOLA, FLORIDA

DATA SUMMARY AND PRELIMINARY SCOPING FOR ECOLOGICAL RISK ASSESSMENT WORK PLANS

November 1992

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This report summarizes the results of Phase I of the contamination assessment/remedial activities investigations conducted at 22 sites located on the Naval Air Station in Pensacola, Florida, as part of the U.S. Navy's Installation Restoration Program (IRP). The report also summarizes information from previously developed work plans for 17 other IRP sites which have not been subject to Phase I investigations. The objective of this report is to facilitate scoping of ecological risk assessment work plans for Bayou Grande, NAS Pensacola wetlands, and Pensacola Bay (operable units 15, 16, and 17, respectively). Potential contaminant (continued)

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sources, pathways, and biological receptors were identified for each operable unit. Sediment and surface vater contaminant concentrations measured during Phase I investigations were used to develop a quantitative estimate of potential ecological risk. The results of this preliminary assessment indicate that ecological risk assessments should initially be focussed in the vicinity of the southeastern waterfront of Pensacola Bay, the yacht basin within Bayou Grande, and in six wetlands associated with sites 1, 11, and 30. Additional sediment and surface water contaminant data are needed to evaluate the extent of risk assessments for other areas of operable units 15, 16, and 17.

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Page 2-5	Reasoning provided to explain why the number of contaminants for which risk quotients were calculated is not inclusive of all measured parameters.
Page 3-1	Rationale provided in new Table 3-1 to explain why certain sites were judged to have minimal potential to impact Pensacola Bay, Bayou Grande, or NAS Pensacola wetlands.
Sections 3.2 and 3.3; Figures 3-2 and 3-3; Tables 3-8 and 3-10	Site 12 was added as a potential source impacting Bayou Grande and NAS Pensacola wetlands.
Figures 4-1 through 4-11	Figures added to depict the number and location of recommended surface water and sediment samples.
All Sections	Vording changed to reflect that findings are not intended to determine whether ecological risk assessments are warranted, but to identify and prioritize areas where ecological assessments should initially be focused.

EXECUTIVE SUMMARY

This report summarizes data collected by Ecology and Environment, Inc., (E & E) during work plan development and Phase I contamination assessment/remedial activities investigations conducted at Naval Air Station (NAS) Pensacola under the U.S. Navy's Installation Restoration Program. This summary is intended to support scoping of work plans for operable units (OUs) 15, 16, and 17 (Bayou Grande, NAS Pensacola wetlands, and Pensacola Bay, respectively) and aid in determining the priority for risk assessments of these wetland and aquatic ecosystems. Phase I data on sediment and surface water contaminant levels and existing information concerning potential contaminant sources, pathways, and receptors were examined to assess the potential cumulative impact of contamination on biological communities within Pensacola Bay, Bayou Grande, and NAS Pensacola wetlands. In addition, a quantitative ecological risk assessment method, which compares environmental concentrations of contaminants to toxicological benchmark concentrations, was used to estimate ecological risk levels where both environmental and benchmark concentrations are known. Based on this method and aided by professional judgment, ecological risk assessments should initially focus on OUs or specific areas of OUs where the magnitude of contamination appears to pose a moderate to high level of ecological risk.

Areas of OUs 15, 16, and 17 with levels apparently posing high ecological risk are in the vicinity of the southeastern waterfront (Site 2) of Pensacola Bay; in the yacht basin (sites 11 and 30) of Bayou Grande; and six wetlands located on or adjacent to sites 1, 11, and 30. The geographic scope of the ecological assessments should initially be limited to these areas but may need to be expanded if further contaminant screening or characterization studies (Phase I and II

investigations) vere to indicate a broader extent of contamination at lewls potentially posing significant ecological threats. Finally, the report assesses the adequacy of proposed Phase I and II sampling to aid this determination of need for expanded ecological assessments.

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1. INTRODUCTION

The purpose of this report is to summarize existing relevant data collected by Ecology and Environment, Inc., (E & E) during the Phase I contamination assessment/remedial activities investigations at sites potentially impacting wetlands or water bodies on Naval Air Station (NAS) Pensacola and determine high priority areas for ecological assessments based on potential, adverse impacts to the biological communities within these systems. This summary of existing information and the preliminary determination of potential ecological effects are needed to facilitate the scoping of work plans for operable units (OUs) 15, 16, and 17 (Bayou Grande, NAS Pensacola Wetlands, and Pensacola Bay, respectively).

E & E has conducted Phase I investigations at 22 of the 39 sites designated by Southern Division, Naval Facilities Engineering Command, under the Naval Installation Restoration and Underground Storage Tank programs. These Phase I investigations were designed as screening studies and did not include ecological assessments of any sites or adjacent areas. However, in some cases, sufficient information was collected during Phase I investigations to indicate serious levels of contamination within or adjacent to ecologically significant communities. Using accepted methodologies, this report identifies those areas of OUs 15, 16, and 17 where available evidence indicates ecological risk is sufficiently high to warrant immediate ecological assessments. In addition, the report identifies potentially impacted areas (or subunits) of OUs 15, 16, and 17 for which insufficient data on contaminant concentrations exist to determine the level of ecological risk. In these cases, recommendations for field sampling have been made to enable an informed determination of ecological risk and provide preliminary input for the development of work plans.

Section 2 of the report presents the methods used to evaluate the degree to vhich ecosystems may be impacted by exposure to hazardous materials. Section 3 summarizes and integrates information on contaminant sources, pathways, and biological receptors by OU and assesses the potential ecological risk to each. Section 4 discusses the conclusions of this assessment and provides recommendations, including future field sampling, for incorporation in the work plans for OUs 15, 16, and 17. Section S presents a comprehensive bibliography for this report. Appendix A is a collection of relevant habitat/biota maps from the Phase I interim data reports.

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2. METHODOLOGY

Screening-level determinations of priority areas for ecological risk assessments of Pensacola Bay, Bayou Grande, and base wetlands were made based on information obtained from the contamination assessment/ remedial activities investigations performed to date. Phase I investigations have been performed at 22 of the 39 sites for which work plans have been prepared. Because these investigations did not include quantitative ecological assessments, a qualitative approach was the primary means of evaluating the potential for ecological effects from exposure to hazardous materials.

For sites where Phase I investigations were performed (see Table 2-1), contaminant levels, potential pathways, and biological receptors identified during the investigations were compiled and reviewed. Using professional judgment, this information was integrated to identify which OUs (i.e., Pensacola Bay, Bayou Grande, and NAS Pensacola wetlands) or operable subunits (OSUs; e.g., individual wetlands) appear to have a high potential to suffer adverse ecological effects from contaminants migrating from adjacent or nearby sites. For sites where Phase I investigations have not been conducted, existing information collected during the scoping of work plans was the basis of evaluation.

According to a U.S. Environmental Protection Agency (EPA) review of ecological risk assessment methods (EPA 1988b), professional judgment is an effective means to evaluate ecological effects where minimal quantitative information is available. By integrating many layers of information, professional judgment can be used as a screening procedure to identify sites that warrant further investigation (EPA 1988b).

For sites where sediment and/or surface water samples were collected in wetlands or water bodies (see Table 2-1), a quantitative method was used to determine whether specific levels of the detected

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Table 2-1

SUMMARY OF SITE INVESTIGATIONS AT NAS PENSACOLA

Group	Site	Site Name	Phase I Investigation Performed	No. of Samples (Sediment/Surface Water) Analyzed from Operable Unit[a]		
				15	16	17
A	1	Sanitary Landfill	X	5/3	11[b]/11[b]	
B	11	North Chevalier Disposal Area	X			
	12	Scrap Bins	X			
	26	Supply Department Storage Area	X			
C	2	Waterfront Sediments	X			25[b]/0
	13	Magazine Point Rubble Disposal Area	X			
	14	Dredge Spoil Fill Area	X			6/0
D	15	Pesticide Rinsate Disposal Area	X			
	24	DDT Mixing Area	X			
E	30	Buildings 649 and 755	X	3/2	19[b]/11[b]	
F	9	Navy Yard Dirporal Area	X			
	10	Commodore's Pond	X			
	23	Chevalier Field Pipe Leak Area	X			
	29	Soil South of Building 3460	X			
	34	Solvent North of Building 3557	X			
G	25	Radium Spill Area	X			
	27	Radium Dial Shop Sewer	X			
H	0	Rifle Range Dirporal Area				
	22	Refueler Repair Shop				
I	17	Transformer Storage Yard				
	18	PCB Spill Area				
	20	Transformer Accident Area				

Key at end of table.

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Table 2-1 (Coat.)

Group	Site	Site Name	Phase I Investigation Performed	Io. Of Samples (Sediment/ Surface Water) Analyzed from Operable Unit[a]		
				15	16	17
J	3	Crash Crow Training Area	X			
	19	Fuel Farm Pipeline Leak Area				
	37	Sherman Field Fuel Farm Area				
K	7	Firefighting school	X			
	20	Pier Pipe Leak Area				
	21	Sludge at Fuel Tanks	X			
L	4	Army Rubble Disposal Area				
	5	Borrow Pit				
	6	Fort Redoubt Rubble Disposal Area				
	16	Brush Disposal Area				
M	31	Soil North of Building 648	X			
N	36	Industrial Waste Sewer	X			
O	32	IWTP Sludge Drying Bods				
	33	WWTP Ponds				
	35	Miscellaneous IWTP SWMUs				
P	38	Building 71				
Q	39	Oak Grove Campground				

14[NASP]UI3901:T0495/1932/23

Key:

[a]Operable Units:
15 = Bayou Grande.
16 = NAS Pensacola Wetlands.
17 = Pensacola Bay.
[b]Includes one duplicate sample.

Source: Ecology and Environment, Inc., 1992.

analytes may be of ecological concern. The quantitative aethod applied, the risk quotient (RQ) aethod, compares expected environmental Concentrations (EECs) to toxicological benchmark concentrations (BCs). This method is well-suited for screening-level applications, such as this, because it provides a "yes or no" determination (EPA 1988b). RQs provide quantitative estimates of ecological risk for locations vhere environmental concentrations of contaminants *are* available. Used in conjunction vith professional judgment, this method can be used to corroborate qualitative assessments of ecological risk. A pilot study cosponsored by EPA and the Naval Ocean Systems Center (Munns et at. 1991) deuonstrated the appropriateness and effectiveness of this method in making preliminary assessments of ecological risk.

RQs vere calculated for each contaminant using the formula:

$$RQ = EEC/BC$$

Sediment and water column EECs vere based on Phase I analytical results. Because of the generally small sample sites, maximum contaminant-specific concentrations measured at each site vere used as conservative estimates of EECs. This approach yields the most conservative estimate of ecological risk and eliminates the need for assumptions concerning the extent, magnitude, fate, or bioavailability of contarinants vithin each OU or OSU.

The folloving BCs of sediment and water quality vere applied:

- Sediment BCs--Effects Range-Lov (ER-L) concentrations, developed to analyze sediment data from the National Oceanic and Atmospheric Administration's (NOAA's) National Status and Trends Program (Long and Morgan 1990).

  ER-L concentrations represent the lover 10th percentile of all concentrations of an individual contaminant determined from a number of suitable studies to produce biological effects. An ER-L concentration is the in situ equivalent to the bioassay-derived lovest observed effect level (LOEL), which is the lovest contarinant concentration observed to cause biological effects. Both measures are conservative benchmarks as they represent the lower range of concentrations that have been observed to produce

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biological effects: however, the ER-L approach has the advantage of assessing cumulative effects caused by a natural combination of environmental contaminants.

- Surface water BCs--Florida's Class III water quality criteria, designed to maintain the .integrity of fish and wildlife populations.

BCs for analytes detected in sediment and surface water samples during Phase I investigations are shown in tables 2-2 and 2-3, respectively. BCs are not available for all analytes detected; thus, RQs could only be calculated for those contaminants listed in tables 2-2 and 2-3.

Contaminant-specific RQs greater than 0.1 were regarded as cause for concern (EPA 1988b; Hunns ~~et al.~~ 1991) and as an indication that more sampling is necessary to further characterize the level of contamination and its associated risk. If the RQs for one or more parameters exceeded 1.0 within an OU (or OSU), the OU (or OSU) was identified as warranting an ecological risk assessment.

Table 2-2

TOXICOLOGICAL BENCHMARK CONCENTRATIONS FOR SEDIMENTS

Contaminant[a]	Effect Range-Low[b]
Arsenic	33
Chromium	80
Zinc	120
Lead	35
Cadmium	5
Nickel	30
Copper	70
Silver	1
Total PAHs	4,000

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[a]List is limited to those contaminants detected in Phase I sediment samples.

[b]Concentrations reported in mg/kg for metals and µg/kg for total PAHs.

Key:

PAHs = Polynuclear aromatic hydrocarbons.

Source: Ecology and Environment, Inc., 1992 after Long and Morgan 1990.

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Table 2-3

TOXICOLOGICAL BENCHMARK CONCENTRATIONS FOR SURFACE WATER

contaminant'	?DER Clara III Water quality Standards[b]	
	Freshwater	Marine
Arsenic	50	SO
Chromium	11	SO
Zinc	--[c]	86
Copper	--[c]	2.9
Benzene	71.28[d]	71.28[d]
Trichloroethene	80.7[d]	80.7[d]
Phenols	300	300

14[NASP]UI3901:T0495/1934/35

Key:

[a]List is limited to those contaminants detected in Phase I surface water samples.
[b]Concentrations reported in µg/L.
[c]Standard is dependent on hardness.
[d]At annual average flow condition..

Source: Ecology and Environment, Inc., 1992 after Florida Department of Environmental Regulation 1992.

3. SUMMARY AND ANALYSIS

Thirty-nine IRP sites are located on NAS Pensacola. Host of the 39 sites are located near or adjacent to Pensacola Bay (OU 17) or Bayou Grande (OU 15) and/or have water bodies or wetlands (OU 16) located on site or nearby. It is highly probable that these sites (located near OUs 15 or 17 and/or having water bodies or wetlands on site or nearby) will contribute contaminants to one or more of the OUs 15, 16, and 17. However, some of the 39 sites are sufficiently isolated from wetlands and water bodies that their potential to contaminate these resources is minimal. Table 3-1 identifies eight sites judged to have minimal potential to impact OUs 15, 16, and 17 and provides the rationale (e.g., distance to receptor[s], pathway linkages and flow rates, size of source) for this judgment. Although sufficient information is not available to rule out the possibility of at least low levels of contamination reaching OUs 15, 16, or 17 from these eight sites, these sites are not addressed by this report. Sites judged to have a moderate to high potential to impact Pensacola Bay, Bayou Grande, or NAS Pensacola wetlands are addressed in the following sections.

3.1 PENSACOLA BAY

Pensacola Bay is located adjacent to the southern and eastern margins of NAS Pensacola (see Figure 3-1). During Phase I contamination assessment investigations, elevated levels of metals, total recoverable petroleum hydrocarbons (TRPHs), polynuclear aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) were detected in sediment samples collected along the southeastern waterfront of Pensacola Bay. Eighteen sites on NAS Pensacola are suspected sources of contaminants to Pensacola Bay (see Table 3-2 and Figure 3-1); Phase I investigations have been performed on six of these sites (sites 2, 3, 13, 14, 21, and' 36). The following sections describe the potential sources (sites),

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Table 3-1

RATIONALE FOR SITES JUDGED TO HAVE MINIMAL POTENTIAL TO IMPACT
PENSACOLA BAY, BAYOU GRANDE, OR HAS PENSACOLA WETLANDS

Site	Site Name	Rationale
7	Firefighting school	Over 800 Coot to nearest wotland and/or rurtaco water body (drainage ditch loading to bayou Orando). Flat topoqraphy, no rurtaco pathway identified. Due to absence ot substantial soil/groundwater contamination and dlrtanco to noarort surface wator, a low probability ot significant impact by qroundwator pathway exists.
8	Rifle Range Disposal Area	Over 1,800 Coot to nearest wotland and/or rurtaco wator body (Golf Course Pond). Flat topography, no rurtaco pathway identified. Soil/groundwater rtatur unknown, but a low probability of substantial contamination orlrtr duo to age/type ot source area.
21	Refueler Repair Shop	Ovor 1,800 toot to nearest wotland and/or surface wator body (Golf Course Pond). Flat topography, no rurtaco pathway identified. Soil/groundwater rtatur unknown, but only petroleum suspected. Duo to age of release (1958-1977) and distance to noarort wotland and/or surface wator, a low probability of significant impact by qroundwator pathway exists.
24	DDT Mixing Area	Over 1,100 feet to nearest wotland and/or surface wator body (Golf Course Pond). Flat topography, no rurtaco pathway identified. Moderate levels of soil/groundwater contaminants dotoctod; howovor, duo to dlrtanco to nearest wotland and/or surface wator, a low probabillty of significant impact by qroundwator pathway exists.
25	Radium Spill Area	Ovor 800 toot to noarort wotland and/or rurtaco wator body (drainage ditch loading to Bayou Orando). Flat topography, no rurtaco pathway identified. Low to moderate levels ot soil/groundwater contaminants dotoctod; however, duo to distance to nearest wetland and/or rurtaco water body, a low probability of significant impact by qroundwator pathway exists.
26	Supply Department Outside Storage Area	Ovor 600 Coot to nearest wotland and/or surface wator body (Bayou Orando). Although topography is not flat, no surface pathway has boon identified. Due to absence of substantial soil/groundwater contamination and dlrtanco to noarort wotland and/or rurtaco wator, a low probability of significant impact by qroundwator pathway exists.
27	Radium Dial Shop Sewer	Over 900 Coot to nearest wotland and/or surface wator body (drainage ditch loading to Bayou Orando). Flat topography, no rurtaco pathway identified. Moderate levels of soil/groundwater contaminants dotoctod; howovor, duo to dirtanco to nearest surface water, a low probability of rlqniticant impact by qroundwator pathway exists.
11	Soil North of Building 648	Ovor 800 Coot to noarort wotland and/or rurtaco wator body (stream/drainage ditch loadlnq to Bayou Grande). Flat topoqraphy, no rurtaco pathway identified. Due to absence of substantial soil/groundwater contamination and dirtanco to noarort wetland and/or surface water, a low probability ot significant impact by groundwater pathway exists.

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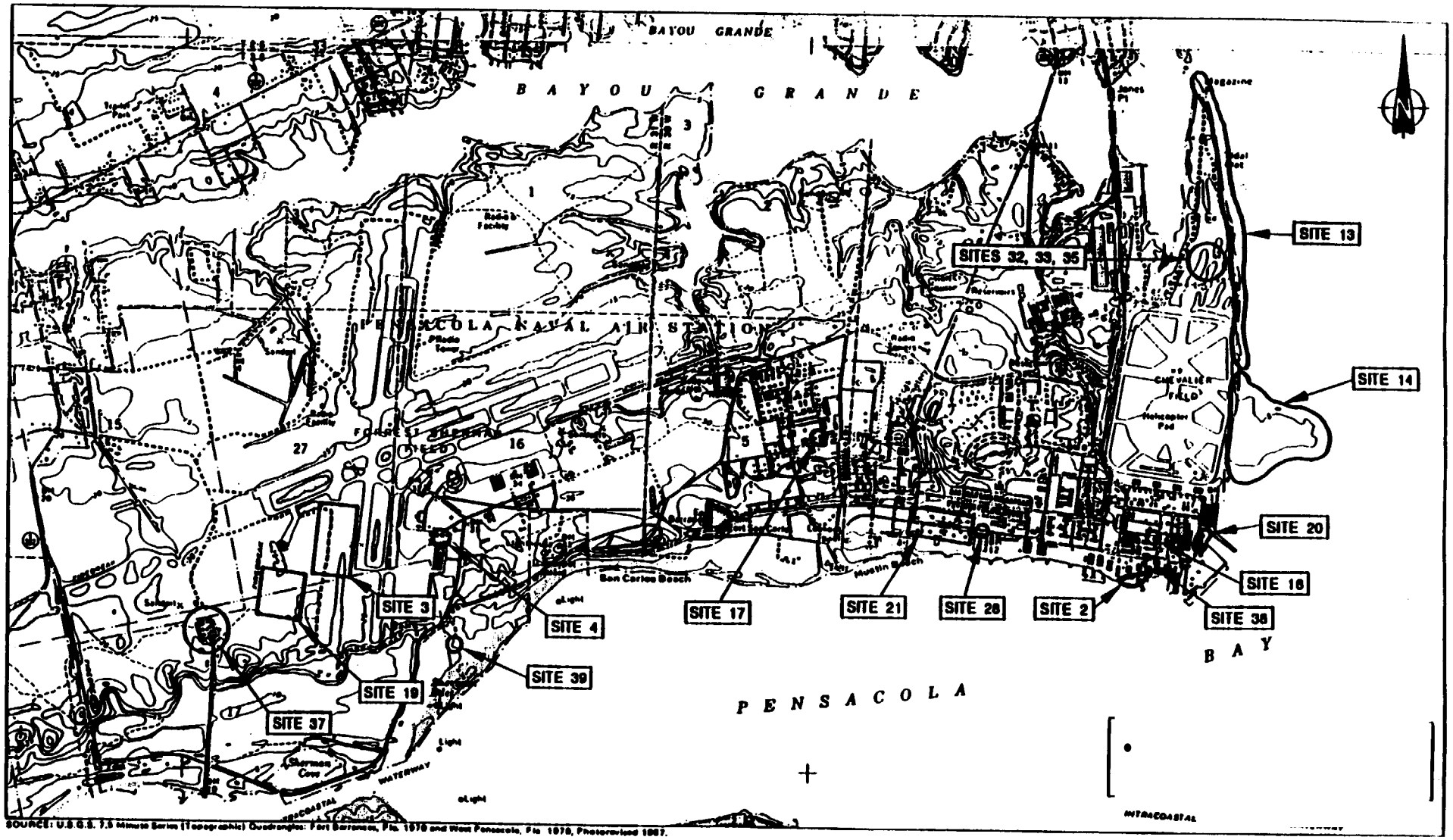
Source: Ecology and Environment, Inc., 1992.



NOTE: Site 36 Not Shown.

Figure 3-1
LOCATIONS OF NAS PENSACOLA SITES POTENTIALLY IMPACTING PENSACOLA BAY

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Table 3-2

SUMMARY OF SOURCES AND PATHWAYS OF CONTAMINATION AT NAS PENSACOLA POTENTIALLY IMPACTING PENSACOLA BAY

Source (Site)	Site Name	Known or Suspected Contaminants	Duration of Discharge (yrs.)	Potontlal Pathway(s)	Location of Discharge
2	Waterfront Sediments	Metals, TRPHs, VOCs, PAHs	30 (1935-1973)	storm sewer, surface runoff	Southoartorn watorfront
3	Crash Crow Training Aroa	Metals, TRPHs, VOCs, PAHs, phenols	37 (1955-present)	Stormwater drain, surface runoff	Shorman Inlet
4	Army Rubble Disposal Area	Unknown	Unknown	Groundwater	Shorman Inlet
13	Magazine Point Rubble Disposal Aroa	TRPHs, VOCs, PAHs, phenols	Unknown	Oroundwator, surface runoff	Magazine Point
14	Dredge Spoil Fill Aroa	Metals, TRPHs, VOCs, PAHs, phenols	17 (1975-present)	Groundwater, stormwater overflow	Chevalier Field
17	Transformer Storage Yard	Metals, TRPHs, VOCs, PAHs, PCBs	12 (1964-1976)	Storm sewer	Southoartorn watorfront
18	PCI Spill Area	rotal., TRPHs, VOCs, PAHs, PCBs	Single incident (1966)	Groundwater, surface runoff	Southoartorn watorfront
19	Fuel Farm Pipeline Leak Area	Metals, TRPHs, VOCs, PAHs	Single lncldont (1958)	Oroundwator, surface runoff	Shorman Cove/ Shorman Inlet
20	Pier Pipe Leak Area	Metals, TRPHs, VOCs, PAHs, phonolr	Unknown	Groundwator	Southoartorn watorfront
21	Sludge at Fuel Tanks Area	Metals, TRPHs, VOCs, PAHs, phenols	16 (1951-1967)	Groundwater, surface runoff	Southoartorn watorfront
28	Transformer Accident Area	Metals, TRPHs, VOCs, PAHs, PCBs	Single incident (1969)	Storm sewer	Southeastern watorfront
32,33,35	Industrial Wastewater Treatment Plant	Metals, VOCs, BNAs	11+ (1981-present)	Oroundwator, surface runoff	Magazine Point
36	Industrial Waste Sewer	Metals, TRPHs, VOCs, PAHs, phenols	21+ (1971-present)	Oroundwator	Southoartorn watorfront
37	Shorman Field Fuel Farm Area	Metals, TRPHs, VOCs, PAHs	Single incident (1983)	Orouadwator	Sherman Cove

Key at end of table.

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Table 3-2 (Cont.)

Source (Site)	Site Name	Known or Suspected Contaminants	Duration of Discharge (yrs.)	Potential Pathway(s)	Location of Discharge
38	Building 71	Metals, VOCs, PCBs	~40 (1935-1973)	Wastewater drain, surface runott	Southeastern waterfront
39	Oak Grove Campground	TRPHs, VOCs	Unknown	Groundwater, surface runott	Sherman Inlet

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[a]Suspected source of thoro contaminant8 is tho Industrial Wastewater Treatment Plant (sites 32, 33, and 35).

Key:

TRPHs = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compoundr.
PAHs = Polynuclear aromatic hydrocarbons.
PCBs = Polychlorinated biphenyls.
BNAs = Base/neutral and acid extractable compounds.

Source: Ecology and Environment, Inc., 1992.

pathvays to Pensacola Bay, biological receptors, and estimated risk associated vith the contaminant concentrations measured in Pensacola Bay.

3.1.1 Sources and Pathvays

The 18 sites identified in Table 3-2 potentially discharge or have discharged pollutants into Pensacola Bay at the following general locations: southeastern waterfront (eight sites), eastern side of Magazine Point and Chevalier Field (five sites), and Sherman Inlet/Sherman Cove (five sites).

Half of the 18 sites are related via past or present connections to the NAS Pensacola stormwater/wastewater collection and treatment system. Prior to 1973, a combined stormwater/wastewater sewer system discharged untreated stormwater and industrial wastes into Pensacola Bay along the southeastern waterfront. Building 71 (Site 38), an aircraft paint stripping facility which began operation around 1935, vas the single largest source of untreated industrial wastes discharged to Pensacola Bay. The combined sever system may also have conducted PCB-containing transformer lubricating oils from sites 17 and 28 to the bay. The Waterfront Sediments (Site 2) vas the receptor or sink for much of the untreated stormwater/vastewater discharge until 1973 vhen the industrial vaste stream vas diverted to the industrial vastewater treatment plant (IWTP). Analytical results from Site 2 shoved that the highest concentrations of nearly all the detected analytes (metals, TRPHs, and PAHs) occurred in sediment directly offshore of Building 71 (Site 38). Based on the number of sources discharging hazardous wastes to the sewer system, the extended duration of these discharges, and the indications of Phase I contamination assessments, Site 2 probably represents the single largest sink/source of contamination, originating from the NAS, to Pensacola Bay.

Although operation of the IWTP eliminated the direct discharge of industrial wastes into Pensacola Bay, leaks vithin the industrial vaste sever (Site 36) and malfunctions of various IWTP facilities (sites 32, 33, and 35) have impacted groundvater that may eventually discharge into Pensacola Bay. Elevated levels of TRPHs, VOCs, PAHs, and phenols at the

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Magazine Point Rubble Disposal Area (Site 13) are suspected evidence of contaminated groundwater migration from the IWTP towards Pensacola Bay.

Groundwater and soil contamination detected during the Phase I investigation of Site 36 are not conclusively the result of leakage from the industrial waste sewer line, but may be indicative of other sources. One area with highly elevated soil concentrations of TRPHs, PAHs, and phenols and elevated groundwater concentrations of lead, TRPHs, dichloroethylene (DCE), PAHs, and phenols is within the vicinity of Site 20, the Pier Pipe Leak Area. This site has not yet been investigated. Overall, analytical results from the Phase I investigation of Site 36 provide evidence of numerous locations, if not sources, of groundwater and soil contamination within approximately 400 feet of Pensacola Bay (see E & E 1992e).

Four other sites unrelated to the sewer system are located in the southeastern quadrant of NAS Pensacola and may also be sources of contaminants to Pensacola Bay. The Dredge Spoil Fill Area (Site 14) is located east of Chevalier Field (see Figure 3-1) and, based on analytical results from the Phase I investigation, is an apparent source of moderate metal contamination (chromium, cadmium, and nickel) in groundvater (see E & E 1991c). However, Chevalier Field also appears to be a source of metal, TRPH, and PAH contamination that is migrating across the dredge spoil fill area toward Pensacola Bay. Sediment samples taken in the nearshore area of the site exhibited moderate concentrations of these analytes. No surface water samples were analyzed.

The Sludge at Fuel Tanks Area (Site 21) is located approximately 400 feet north of Pensacola Bay (see Figure 3-1). The results of E & E's Phase I investigation indicated that soil and groundwater contamination is generally concentrated in, around, and downgradient (i.e., toward Pensacola Bay) of former and existing aboveground fuel storage tank locations on Site 21. The primary analytes detected in both media are metals, TRPHs, VOCs, PAHs, and phenols. Some of the highest groundwater contaminant concentrations were detected in samples collected furthest hydraulically downgradient from existing tanks (approximately 250 feet from Pensacola Bay). These data may indicate

contaminant migration via groundwater or that an additional past or present source(s) of petroleum compounds in groundwater may exist in closer proximity to the bay (see E 6 E 1992i).

The PCB Spill Area (Site 18) and Pier Pipe Leak Area (Site 20) are both located near the southeastern corner of NAS Pensacola (see Figure 3-1). Neither site has been the subject of a Phase I investigation. Site 18, the location of a SO-gallon spill of polychlorinated biphenyl (PCB)-containing transformer oil in 1966, is located approximately 750 feet north of Pensacola Bay. Shallow groundwater flow in the area is thought to be to the south toward the bay. Thus, because the spill occurred on a pervious area and groundwater may serve as a potential pathway, this site may be or have been a source of petroleum compounds and PCBs to Pensacola Bay (see E & E 1991q).

Site 20 is located directly adjacent to a berthing pier on Pensacola Bay (see Figure 3-1). A buried fuel pipeline leading to the pier leaked fuel oil for an unknovn duration until it was discovered in 1981 during construction of new pilings. Excavation activities associated with construction released oil into Pensacola Bay. Oil-soaked soils that had been excavated were removed and the release cleaned up; however, oil slicks were reportedly observed near the berthing pier in the early 1980s (see E & B 1992p). Although no investigations have been performed on Site 20, results of the Phase I investigation of Site 36 indicate significant soil and groundwater contamination in this vicinity. Because of its proximity to Pensacola Bay, Site 20 is certainly a past, if not present, source of petroleum compounds to the bay.

Five sites (3, 4, 19, 37, and 39) located near Sherman Inlet and Sherman Cove, embayments of Pensacola Bay, are potential sources of contamination to the bay's ecosystem. Only Site 3 has been subject to a Phase I investigation. Site 3, the Crash Crew Training *Area,* is located west of the north-south runway on Sherman Field approximately 2,000 feet northwest of Sherman Inlet (see Figure 3-1). *An* underground stormwater drain directs surface runoff from the site to an intermittent stream that flows into Sherman Inlet. The Phase I investigation results indicate that although elevated concentrations of metals, TRPHs, VOCs, PAHs, and phenols were found on site, little off-site migration of

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contaminants has occurred. Only slightly elevated concentrations of zinc and phenols were detected in sediment and surface water samples collected at the stormwater outfall. The presence of these minor concentrations could reflect contributions from off-site or ambient sources (see E & E 1992c).

The Army Rubble Disposal Area (Site 4) is located approximately 2,400 feet north and northwest, respectively, of Sherman Inlet and Pensacola Bay (see Figure 3-1). Nonhazardous wastes and rubble from a demolished U.S. Army barracks were disposed of at Site 4 in the early 1950s. To date, no samples have been collected at the site for analysis of potential contaminants. The site consists of well-drained sandy soil, and groundwater flow in the surficial zone is thought to be towards the southeast (i.e., towards Pensacola Bay; see E & E 1991r). Because the groundwater provides a potential pathway, an assessment of the site's potential to impact Pensacola Bay must await on-site screening sampling and analyses.

The Fuel Farm Pipeline Leak Area (Site 19) is located approximately 3,400 feet north-northwest of Sherman Cove and 3,600 feet northwest of Sherman Inlet (see Figure 3-1). This site was the location of a reported 360,000-gallon JP-4 fuel oil spill from an aboveground pipeline that occurred in 1958. Groundwater samples collected by Geraghty and Miller, Inc., from monitoring wells in 1986 exhibited high concentrations of VOCs. The general direction of groundwater flow in the area is towards Pensacola Bay. Based on data collected from on-site monitoring wells, Geraghty and Miller (1986) calculated shallow groundwater flow velocity to be approximately 130 feet per year (see E & E 1992o). Thus, given the direction and velocity of groundwater flow and the time interval since the occurrence of the spill, groundwater discharge from the area could potentially serve as a contaminant pathway to Pensacola Bay. Also, because the water table in the area is intermittently above land surface and surface drainage is generally towards the bay, a surface water pathway is also a possibility.

The Sherman Field Fuel Farm Area (Site 37) is located approximately 3,000 feet northwest of Sherman Cove and 3,200 feet north of Pensacola Bay proper (see Figure 3-1). This site was the location of a reported

48,000-gallon JP-4 fuel oil spill that occurred in 1983 from an aboveground storage tank. Groundvater monitoring conducted during 1984 and 1985 indicated the presence of free product and petroleum compounds south of the site (Thompson Engineering Testing, Inc., 1985). The direction of groundvater flov vas determined to be to the south-southeast at an approximate, average velocity of 0.7 feet per day. Thus, Site 37 is a potential source of petroleum compounds to Pensacola Bay via groundwater migration.

The Oak Grove Campground (Site 39) is located approximately 700 fact northeast of Sherman Inlet and *500* feet northvest of Pensacola Bay (see Figure 3-1). The site consists of a 150-foot-diameter area of visibly stained soils that emit a distinct hydrocarbon odor. Soil samples analyzed by EPA in 1990 indicated the presence of TRPHs and VOCs; PCBs were not detected. The source of the petroleum compounds is unknown (see E & E 1991t). Because of the site's proximity to Pensacola Bay and the presumption of groundwater flov towards the bay, Site 39 may be a source of petroleum compounds to biological communities in Pensacola Bay.

Regardless of the individual amounts of potentially hazardous materials contributed by *each* of the aforementioned sites, the cumulative input to Pensacola Bay from these sites is potentially significant. Although a portion of these materials is potentially exported from Pensacola Bay by flushing action, results of the Phase I investigations indicate that contamination is present in nearshore sediments offshore of NAS Pensacola. The contributions of other industrial waste sources in Pensacola Bay to this contamination is unknown.

3.1.2 Biological Receptors

Habitat/biota surveys were conducted as part of Phase I investigations to identify biological communities that may be exposed to contamination from on-site sources or off-site migration. The only undervater survey of Pensacola Bay vas perforued on the nearshore portion of Site 2 (Waterfront Sediments). Aquatic fauna were not collected or captured and no quantitative sampling was conducted. Beachfront and intertidal areas of Pensacola Bay were also qualitatively

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surveyed at sites 2, 13, 14, and 21. The specific objectives of these reconnaissance-level surveys were to describe the types and conditions of habitats present, identify common plants and animals, and note any obvious ecological effects of contamination.

Site-specific information from these surveys was supplemented in this report with habitat descriptions and species inventories for Pensacola Bay derived from the existing literature (primarily from Collard 1991, a recent, thorough review and synthesis of the Pensacola Bay biological literature). Information presented here from these sources is primarily specific to the lower reaches of Pensacola Bay (i.e., that portion of the estuary in the vicinity of NAS Pensacola); biological data for the upper estuary (i.e., Escambia Bay, Blackwater Bay, and East Bay) are expressly excluded, unless otherwise noted.

Pensacola Bay in the vicinity of NAS Pensacola is a lower estuarine environment characterized by irregular tidal flushing and polyhaline to euhaline salinities (Collard 1991). A master species list compiled by Collard (1991) for Pensacola Bay from a 35-year period of the literature included 408 species, consisting primarily of sessile infaunal macroinvertebrate taxa. He noted that some species on the list may have been represented by transient populations that have since emigrated or become locally extinct due to changing conditions in the bay. For example, some species associated with seagrass beds or oyster reefs may no longer occur since the extent of both habitats has been radically diminished. Secondly, Collard (1991) noted that many of the recent additions to the master species list were identified from samples collected from the NAS Pensacola aircraft carrier turning basin in 1986 (U.S. Department of the Navy [Navy] 1986). Despite a cumulative record of over 400 species, the species diversity of Pensacola Bay is comparatively low, with most individual sampling programs yielding only four to 28 species.

The biota most commonly sampled in Pensacola Bay are the sessile benthic macroinvertebrates. The structure and species composition of benthic communities inhabiting the bay are largely determined by substrate type. Major benthic habitat types (and their percent composition) vithin the Pensacola Bay system, as defined by Olinger et al. (1975), are (1) a broad central mud plain (70%), (2) a nearshore

transition zone vith relatively steep slopes and sediments grading from mud to sand (5%), and (3) a sandy shelf along the bay margins (25%). All three of these substrate types were documented on Site 2 during Phase I sediment sampling. The sand shelf, which partially overlaps the concrete apron, occurs within 30 to *40* feet of the seawall; the transition zone is located between approximately *40* and 100 feet offshore; and a mud plain habitat with a 15- to 30-cm thick layer of gel-like, flocculent, soupy material, as described by Olinger et al. (1975), extends bayward from approximately 100 feet offshore of the sediments and bottom contours of the mud plain have been altered near NAS Pensacola by dredging of the aircraft carrier turning basin.

Natural hard substrates are sparse throughout the bay; those that are present consist primarily of oyster reefs and areas scoured by strong bottom currents. Scoured hard bottom areas may be present in the vicinity of NAS Pensacola because of locally swift currents, but significant oyster reefs are generally distributed in the middle to upper reaches of the bay (Collard 1991). However, in the nearshore areas of NAS Pensacola (particularly along the southeastern waterfront), artificial hard substrates? such as concrete seawalls, waterfront apron, seaplane ramps, and piers, are locally common.

Seagrass beds, once an abundant habitat throughout Pensacola Bay, no longer occur in the lower reaches of the bay, except in the sounds behind the barrier islands (Collard 1991). Seagrass beds occur in Sherman Cove (Parsons and Pruitt 1991) and in Big Lagoon along the southwest portion of the base (Collard 1991).

In soft bottom benthic communities of lower Pensacola Bay, dominant species are tubicolous, surface deposit-feeding polychaetes and amphipods and small, sessile, suspension-feeding bivalve molluscs. Pev individual species are abundant, although more species representing more trophic levels are present in the higher salinity water of the lover bay than in other parts of the estuary. Species abundance is also greater in the winter than during other seasons (Collard 1991). Table 3-3 lists the dominant benthic macroinvertebrates found in lower Pensacola Bay.

Gastropods, hermit crabs, and burrows of tubicolous polychaetes were observed in the nearshore sediments of Site 2. Biota observed on

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Table 3-3

COMMON SPECIES OF BENTHIC MACROINVERTEBRATES OCCURRING IN LOWER PENSACOLA BAY[a]

Major Taxon	Scientific Name
Rhynchocoela	Carinoma tremaphoros
	Tetrastemma candidum
Polychaeta	Capitella capitata
	Paraprionospio pinnata
	Nereis succinoa
	Lumbrinereis tenuis
	Glycera dibranchiata
	Streblospio benedicti
	Haploscoloplos foliosus
	Leitoscoloplos fragillis
	Laeonereis culveri
	Eteone heteropoda
	Spiophanes bombyx
	Robsonia florida
	Glycera cf. dibranchiata
	Mediomastus ambiseta
	Pectinaria gouldi
	Armandia agilis
	Sthenelais sp.
Gastropoda	Retusa canaliculata
Bivalvia	Tellina cf. texana
	Rangia cuneata
	Anomalocardia cuneimeris
Cumacea	Oxyurostylys smithi
Amphipoda	Monoculodes edwardsi
	Acanthohaustorius millsi
	Corophium cf. louisianum
	Grandidierella bonnieroides
	Gammarus macromucronatus
Cephalocordata	Branchiostoma caribaeum

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[a]Includes species occurring in more than 5% of samples collected by the Florida Department of Environmental Regulation between 1980 and 1988.

Source: Ecology and Environment, Inc., 1992 after Collard 1991.

hard substrates at Site 2 included attached algae (primarily Sargassum spp.), sponges, bryozoans, and barnacles.

Little information is available on planktonic, nektonic, or motile epibenthic communities in Pensacola Bay (Collard 1991). Ctenophores are seasonally abundant in Pensacola Bay and vere present on Site 2 during the Phase I habitat/biota survey in October 1990. A ray vas sighted feeding within 30 feet of the seawall at Site 2. Blue crabs were observed in shallow water adjacent to Site 14.

Information on icthyofauna is generally limited to species of recreational or commercial importance. Based on landing statistics, 21 species or species groups comprise the majority of game or commercially caught fish in Pensacola Bay (Collard 1991; see Table 3-4). Fish species diversity is greatest in the higher salinity vater near NAS Pensacola during spring and summer: the number of individuals peak at various periods throughout the summer (Cooley 1978). Menhaden and striped mullet are two of the most important target species of Pensacola Bay fisheries (Collard 1991). Other abundant fish species in Pensacola Bay that are not of major commercial or recreational importance include pinfish (Lagodon rhomboides), bay anchovy (Anchoa mitchelli), longspine porgy (Stenotomus caprinus), il perch l chrysura), southern hake (Urophycis floridanus), inshore z (Synodus foetens) and spotted hake ophycis regius; Cooley 1978).

Commercially harvested shellfish in Pensacola Bay include blue crabs r sapidus), stone crabs (Menippe mercenaria M. i and) shrimp (Penaeus aztecus, P. setiferus, and P.) t rassostrea virginica) scallops (Argopecten irradians), and squid (Loligunculus sp.). The distribution and abundance of these species is mainly determined by their salinity preferences: shrimp, scallops, and squids are more abundant in the lower bay near NAS Pensacola due to affinities for higher salinities, whereas blue crabs and oysters are more common in the brackish vater of the upper estuary. The area of Pensacola Bay in the vicinity of NAS Pensacola is permanently closed to oyster harvesting due to the proximity of the effluent outfall of the City of Pensacola Main Street sewage treatment plant. Scallops are found principally in seagrass beds in Santa Rosa Sound and Big Lagoon (Collard 1991).

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Table 3-4

FISH SPECIES OF MAJOR COMMERCIAL OR RECREATIONAL IMPORTANCE IN THE PENSACOLA BAY SYSTEM

Common Name	Scientific Name
Alewife	Alosa pseudoharengus
Gulf menhaden	Brevoortia patronus
Bluefish	Pomatus saltatrix
Sea catfish	(several species)
Atlantic croaker	Micropogon undulatus
Black drum	Pogonius cromis
Red drum	Sciaenops ocellatus
Flounder	(several species)
King whiting	Mentcirrhus saxatilis
Striped mullet[a]	Mugil cephalus
Silver mullet	Mugil curema
Spotted seatrout	Cynoscion nebulosus
Atlantic weakfish[b]	Cynoscion regalis
Sheepshead	Archosargus probatocephalus
Sand soatrout	Cynoscion arenarius
Pigfish	Orthopristis chrysoptera
King mackeral	Scomberomorus cavalla
Spanish mackeral	Scomboromorus maculatus
spot	Leiostomus xanthurus
Ladyfish[c]	Elops saurus
scup	Stenotomus chrysops

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[a]Known locally as black mullet.
[b]Known locally as white soatrout.
[c]Known locally as tonpoundor.

Source: Ecology and Environment, Inc., 1992 after Collard 1991.

Terrestrial or semiterrestrial animals that feed on aquatic biota from Pensacola Bay include ghost crabs (Ocyopode sp.), vhich are common along the sandy shorelines of Magazine Point (Site 13) and vest of Site 21, and various shore birds. Thirty-six species of shore and vading birds vere identified during Phase I habitat/biota surveys (see Table 3-5). Birds are among the highest level consumers in the Pensacola Bay ecosystem. Some of these species prey exclusively on fish and aquatic organisms, whereas others may also consume terrestrial fauna.

Twenty-one species known or suspected to occur in aquatic or shoreline habitats of Pensacola Bay are designated as threatened, endangered, or species of concern (Florida Natural Areas Inventory [FNAI] 1988a and 1988b; see Table 3-6). These include three species of fish, five species of marine turtles, the American alligator, 11 species of birds, and the Vest Indian manatee. No aquatic plant species occurring in Pensacola Bay are listed for protection. The only listed species recorded during the Phase I habitat/biota surveys were the osprey, brown pelican, and little blue heron.

Hanatees have been sighted irregularly in Pensacola Bay; the most recent sighting occurred in October 1988 (FNAI 1988a and 1988b). Atlantic bottlenose dolphins (Tursiops truncatus) are regular migrants in lover Pcnsacola Bay. However, most of the other 11 species of marine mammals reported for the northeastern Gulf of Mexico are rare to uncommon in Pensacola Bay (see E & E 1991m).

3.1.3 Preliminary Assessment of Ecological Risk

Although species diversity in Pensacola Bay is relatively low, the bay does support significant ecological communities. The bay provides habitat, including critical nesting and nursery areas for many commercially and recreationally important fish and shellfish species. In addition, the bay contains ecologically important habitats, namely seagrass beds and oyster reefs, that are more diverse and productive than other estuarine habitats. Because of major declines in their historical extent, remaining seagrass beds and oyster reefs are critically important to the preservation of species dependent on these habitats.

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Table 3-5

SHORE AND WADING BIRDS OBSERVED AT NAS PENSACOLA DURING PHASE I HABITAT/BIOTA SURVEYS

Common Name	Scientific Name
Rod-wingod blackbird	*Agelaius phoeniceus*
Northern shoveler	*Anas clypeata*
Green-winged teal	*Anas crecca*
Blue-winged teal	*Anas discors*
Mottled duck	*Ana. fulvigula*
Groat blue heron	*Ardea herodias*
Ruddy turnstone	*Arenaria interpres*
Lesser scaup	*Aythya affinis*
Sanderling	*Calidris alba*
Least sandpipor	*Calidris minutilla*
Semi-palmated sandpipor	*Calidris pusilla*
Great egret	*Casmerodius albus*
Willet	*Catoptrophorus semipalmatus*
Belted kingfisher	*Ceryle alcyon*
Semi-palmated plover	*Charadrius semipalmatus*
Northern flicker	*Colaptes auratus*
Fish crow	*Corvus ossifragus*
Little blue boron	*Egrotta caerulea*
Snowy egret	*Egrotta thula*
Tricolored heron	*Egrotta tricolor*
American coot	*Fulica americana*
Common loon	*Gavia immer*
Yellowthroat	*Geothlypis trichas*
Herring gull	*Larus argentatus*
Laughing gull	*Larus atricilla*
Short-billed dowitcher	*Limnodromus griseus*
Osprey	*Pandion haliaetus*
Brown pelican	*Pelecanus occidentalis*

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Table 3-5 (Cont.)

Common Name	Scientific Name
Double-crested cormorant	Phalacrocorax auritus
Black-bellied plover	Pluvialis squatarola
Died-billed grebe	Podilymbus podiceps
Roseate tern	sterna dougallii
Forester's tern	sterna forsteri
Common tern	~~Sterna hirundo~~
Royal tern	~~Sterna maxima~~
Sandwich tern	Sterna sandircensis

14[NASP]UI3901:T0495/1937/31

Source: Ecology and Environment, Inc., 1992.

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Table 3-6

THREATENED AND ENDANGERED FLORA AND FAUNA OBSERVED OR LIKELY TO OCCUR WITHIN HABITATS OF PENSACOLA BAY

Scientific Name	Common Name	Base Status[a]	status[b] FGFWFC (or FDA)	status[b] USFWS	Habitat
FISHES					
Acipenser oxyrhynchus	Atlantic sturgeon	M	SSC	u R 2	Gulf coast, estuarine
Fundulus jenkinsi	Salt marsh topminnow	P	SSC		Salt, fresh, brackish waters
Lepisosteus spatula	Alligator gar	U	SSC		Brackish, fresh, salt water
AMPHIBIANS AND REPTILES					
Alligator mississippiensis	American alligator	R	SSC	T(S/A)	Swamps, marshes, ponds
Caretta caretta caretta	Loggorhoad turtle	M?	T	T	Marine, coastal
Chelonia mydas mydas	Green turtlo	M?	E	E	Marine, coastal
Dermochelys coriacea	Leatherback turtlo	M	E	E	Marine, coastal
Eretmochelys imbricata	Hawksbill turtlo	M?	E	E	Marine, coastal
Lepidochelys kempi	Atlantic ridley turtlo	M?	E	E	Marine, coastal
BIRDS					
Charadriur melodus	Piping plover	P	T	t	Open, dry, sandy beaches
Charadrius alexandrinus	Snowy plover	P	T	UR 2	Open, dry, sandy beaches
Haematopus palliatus	American oystercatcher	U	SSC		Coastal habitats
Egretta rufescens	Reddish egret	P-U	SSC	UR 2	Freshwater/coastal wetlands
Egretta caerulea	Little blue heron	P-U	SSC		Freshwater/coastal wetlands
Egretta thula	Snowy egret	P-U	SSC		Freshwater/coastal wetlands

Key at end of table.

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Table 3-6 (Cont.)

Scientific Name	Common Name	Base Status[a]	Status[b] FGFWFC (or IDA)	Status[b] USW	Habitat
Falco peregrinus tundrius	Arctic peregrine falcon	M	E	T	Winters on coasts
Haliaeetus leucocephalus	Bald eagle	P-U	T	E	Pine forests/coastal habitat
Pandion haliaetus	Osprey	R	SSC		Near water
Pelecanus occidentalis	Brown pelican	R	SSC	AC	Mangrove trees, coasts
Sterna antillarum	Least torn	U	T		Coastal habitats
MAMMALS					
Trichechus manatus latirostris	West Indian manatee	M	C	E	Atlantic and Gulf coartr

14[NASP]UI3901:T0495/1938/2

[a]status of species on tho NAS Pensacola facility:
I = Resident.
M = Migrant.
SI = Suspected resident.
P = Possible resident duo to available habitat; survey required.
U = Unknown; survey required.
N/A = Not expected to occur on tho NAS Pensacola fac lity.

[b]State and federal status:
E = Endangered.
T = Threatened.
T(S/A) = Threatened due to similarity in appearance
AC = Agency concern; not currently listed or a candidate Cor listing.
UR 2 = Under review, insufficient biological data available.
FDA = Florida Department of Agriculture.
FGFWFC = Florida Game and Freshwater Fish Commission.
USFWS = U.S. Fish and Wildlife Service.

Source: Ecology and Environment, Inc., 1992 after Florida Natural Areas Invontory 1988.

Aquatic biota in Pensacola Bay may potentially be exposed to dissolved contaminants in the surface water. However, several communities may be at increased risk through additional exposure to sediment-sorbed contaminants. Sessile benthic macroinvertebrates, many of which are deposit- and suspension-feeders, are susceptible to toxic effects from ingestion of, as well as contact with, impacted sediment. Bottom-feeding epibenthic and nektonic fauna are also at risk due to consumption of impacted prey and sediment.

Changes in benthic community structure from toxicological effects of contamination can potentially disrupt trophic connections, adversely affecting higher trophic levels. Species occupying higher trophic levels, including predatory fish, birds, and marine mammals, may also be at increased risk to toxic effects because of exposure to magnified concentrations caused by the phenomenon of bioaccumulation.

Review of existing information on the potential sources and pathways of potentially hazardous materials at the 39 IRP sites at NAS Pensacola indicates that 18 sites may contribute contaminants that pose risks to Pensacola Bay communities. However, Phase I documentation of contaminant levels in Pensacola Bay media is limited to the analytical results of 31 sediment samples. These samples were collected from areas offshore of the southeastern waterfront and Chevalier Field (sites 2 and 14, respectively). Although the analytical results indicate that at least some area sediments exhibited elevated levels of these parameters (see E & E 1991j and 1991c), the biological effects of these levels were not investigated and are unknown. Uithout direct knowledge of ecological effects, a preliminary assessment of the potential ecological risk to the estuarine ecosystem must be made on the basis of measured contaminant concentrations and their potential to cause biological effects as ascertained by other studies of environmental toxicity. This assessment was performed using the RQ method (see Section 2).

RQs calculated from maximum analyte concentrations detected in sediment at Site 2 indicate a potentially high risk to the nearshore communities of Pensacola Bay (see Table 3-7). RQs for five of the seven analytes exceeded 1.0. Lead and total PAHs had the highest RQs (5.4 and 4.3, respectively). RQs calculated on the basis of concentrations detected in sediment at Site 14 ranged from <0.1 to 0.5. These

Table 3-7

RISK QUOTIENTS CALCULATED FOR CONTAMINANTS IN SEDIMENTS FROM PENSACOLA BAY

Medium	Contaminant	Risk Quotient (Maximum)	
		Site 2	Site 14
Sediment	Chromium	1.4	0.3
	Zinc	1.2	0.4
	Lead	5.4	0.2
	Cadmium	1.0	<0.1
	Nickel	<0.1[a]	0.4
	Copper	0.8	0.1
	Total PAHs	4.3	0.5

14[NASP]UI3901:T0495/1945/26

[a]Compound not detected; risk quotient based on detection limit.

Key:

PAHs = Polynuclear aromatic hydrocarbons.

Source: Ecology and Environment, Inc., 1992.

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quotients indicate less risk of ecological effects than do Site 2 results, but are still cause for concern. Because of the limited sample size and distribution at Site 14, more sampling is needed to characterize the level of risk.

Although future phases of investigations will further characterize the extent and magnitude of sediment and surface water contamination in Pensacola Bay, contamination measured during Phase I investigations appears to be sufficiently high in the vicinity of the southeastern waterfront to cause ecological effects. Consequently, the southeastern waterfront should be a high priority area for an ecological risk assessment.

3.2 BAYOU GRANDE

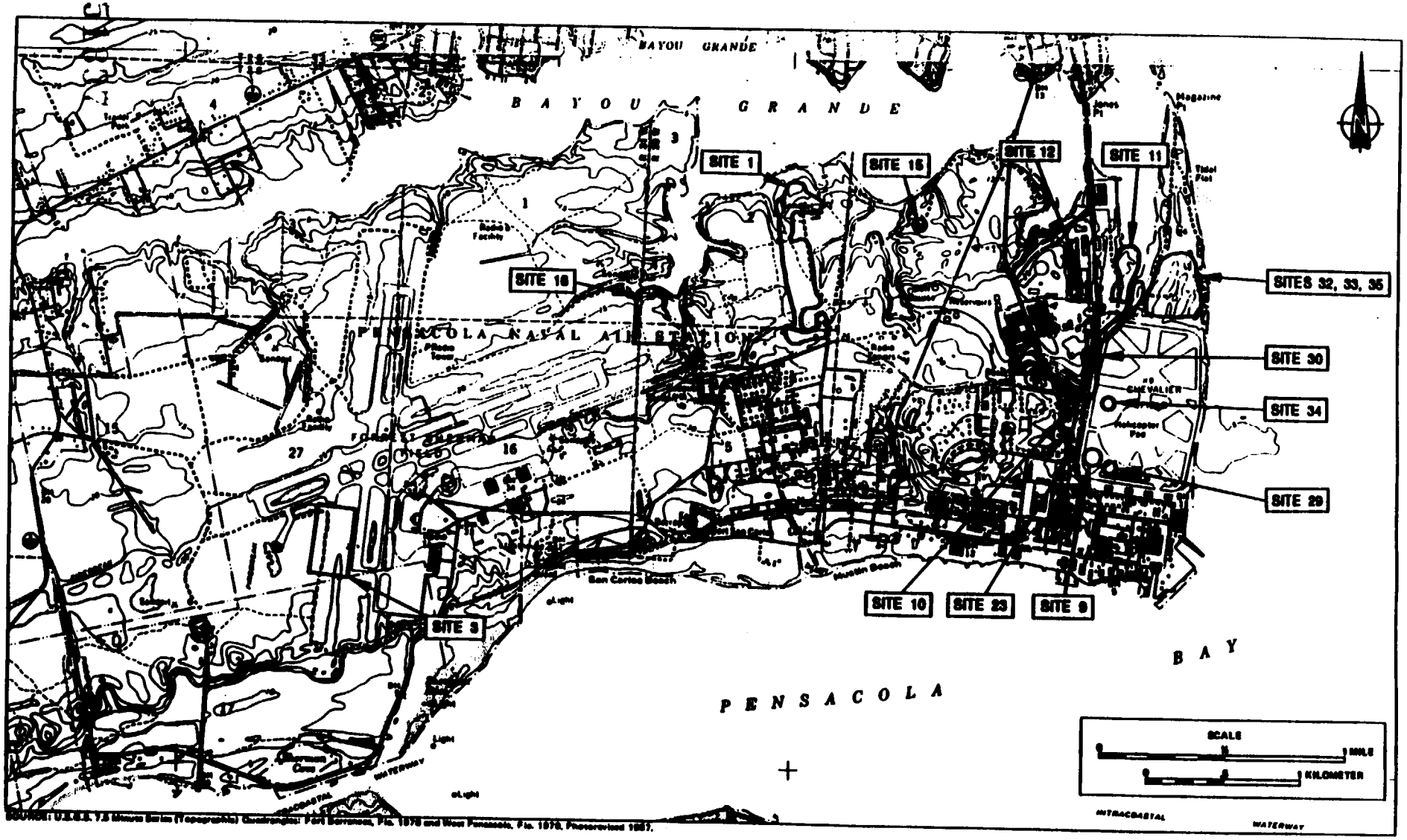
Bayou Grande, an estuarine water body connected to Pensacola Bay, lies adjacent to the northern boundary of NAS Pensacola (see Figure 3-2). During Phase I contamination assessment investigations, medium to high levels of TRPHs and high levels of metals, PAHs, and phenols were detected in nearshore Bayou Grande sediment samples, and high levels of metals were detected in nearshore Bayou Grande surface water samples. Sixteen sites are believed to potentially contribute to the concentrations found in Bayou Grande samples (see Table 3-8 and Figure 3-2).

The following sections contain a brief description of the potential sources (sites), pathways into Bayou Grande, biological receptors, and estimated risk associated with the contaminant levels found in Bayou Grande.

3.2.1 Sources and Pathways

The 16 sites identified in Table 3-8 potentially discharge or have discharged contaminants into Bayou Grande at the following general locations: the yacht basin west of Magazine Point (12 sites), central Bayou Grande (three sites), and western Bayou Grande (one site).

The 12 sites that potentially discharge into Bayou Grande in the area of the yacht basin do so via groundwater migration and surface runoff. The North Chevalier Disposal Area (Site 11) potentially discharges contaminants to Bayou Grande via surface drainage and



NOTE: Site 36 Not Shown.

Figure 3-2

LOCATIONS OF NAS PENSACOLA SITES POTENTIALLY IMPACTING **BAYOU** GRANDE

Table 3-8

SUMMARY OF SOURCES AND PATHWAYS OF CONTAMINATION AT NAS PENSACOLA POTENTIALLY IMPACTING BAYOU GRANDE

Source (Sit.)	Site Name	Known or Suspected Contaminants	Duration of Discharge (years)	Potentia1 Pathway(s)	Location of Discharge
1	Sanitary Landfill	Metals, TRPHa, VOCs, PAHs, phonola	30 (1950-1980)	Surface runoff, groundwator	Central Bayou Grande
3	Crash Crow Training Area	Metals, TRPHa, VOCs, PAHs, phonola	37 (1955-present)	Stormwater drain	Western Bayou Grande
9	Uavy Yard Diapoaal Area	Metals, TRPHs, PAHs	13 (1917-1930s)	Groundwator, aurfaco runoff	Yacht basin
10	Commodore's Pond	Metals, TRPHa, PAHs, phenols	Unknown (1800s)	Groundwator, aurfaco runoff	Yacht baain
11	North Chevalier Diapoaal Area	Metals, TRPHa, VOCs, PAHs, phonols	Unknown (1930s-present)	Groundwator, surface runoff, direct discharge	Yacht baain
12	Scrap Bins	Metals, TRPHs, PAHs, phonola, PCBs	60 (early 1930s-present)	Stormwater drain	Yacht baain
15	Pesticide Rinsate Disposal Area	Metals, TRPHs, VOCs, PAHs, pesticides	16 (1963-1979)	Grounduator, surface runoff	Central Bayou Grande
16	Brush Disposal Area	Metals	Unknown (1960s-1973)	Groundwator, aurfaco runoff	Sherman Field embayment
23	Chevalier Field Pipe Leak Area	Metals, TRPHa, PAHs, phonols	Two incidents (1965, 1970)	Surface runoff, groundwater	Yacht baain
29	Soil South of Building 3460	Metals, TRPHs, PAHs, VOCs	Unknown (1970s-1980s)	Groundwator	Yacht basin
30	Buildings 649 and 755	Metals, TRPHs, VOCs, PAHs, phonols	30 (1940s-1970s)	Direct discharge, rurfaco runoff, groundwator	Yacht basin

14[NASP]UI3901:T0495/1939/6

Key at end of table.

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Table 3-8 (Cont.)

Source (Sit.)	Site Name	Known or Suspected contaminants	Duration of Discharge (years)	Potential Pathway(s)	Location of Discharge
32,33,35	Industrial Wastewater Treatment Plant	Metals, VOCs, BNAs	11+ (1981-present)	Groundwater, surface runoff	Yacht basin (Magazine Point)
34	Solvent Worth of Building 3557	Metals, TRPHs, PAHs, phenols	Single incident (1984)	Groundwater, surface runoff	Yacht basin
36	Industrial Waste Sewer	Metals, TRPHs, VOCs, PAHs, phonolr	21+ (1971-present)	Groundwater	Yacht basin

14[NASP]UI3901:T0495/1939/6

Key:

TRPHs = total recoverable petroleum hydrocarboar.
VOCs = Volatile organic compounds.
PAHs = Polynuclear aromatic hydrocarbons.
BNAs = Base/neutral and acid extractable compounds.

Source: Ecology and Environment, Inc., 1992.

groundwater migration. Site 11 encompasses an area which the Navy used as a landfill for unknovn quantities and types of waste during the 1930s and 1940s (see Figure 3-2). The site extends into Bayou Grande, and some shoreline areas contain exposed refuse. Elevated concentrations of metals, TRPHs, VOCs, PAHs, and phenols were detected at Site 11.

Site 12 (Scrap Bins) is located on the bluff to the vest of Site 11, approximately 600 feet from the southern end of the yacht basin (see Figure 3-2). Four stormwater drains are present on the site; the outfall for the drainage system is unknown, but is presumed to be into Bayou Grande or the drainage ditch that empties into the bayou. Evidence of metal, TRPH, PAH, and PCB contamination vas detected in soil from the stormwater drains (E & E 1991h).

Site 30 (Buildings 649 and 755) includes a wetland area and channelized stream. The stream discharges into a stormwater drainage ditch, which, in turn, empties into Bayou Grande near Site 11 (see Figure 3-2). Metal-plating wastes were periodically discharged from Buildings 649 and 755 over a period of 30 years (1940s to 1970s) into the wetland area adjacent to these buildings. The sediments in this wetland and stream, as well as the sediments in Bayou Grande, act as a sink for the discharged plating wastes. Elevated concentrations of metals, TRPHs, PAHs, VOCs, and phenols were detected at Site 30 (see E & E 1991a).

The other nine sites that potentially discharge into the yacht basin of Bayou Grande are concentrated around the Chevalier Field area or are associated with the IWTP and/or the sewer line serving this plant (see Table 3-3). The main pathways from these sources are groundwater discharge to Bayou Grande and/or surface runoff into the drainage ditch that discharges into Bayou Grande.

The four sites that potentially discharge into the central and western portions of Bayou Grande do so directly through a stormwater drain (Site 3) or by groundwater migration and surface runoff (sites 1, 15, and 16). Of these four sites, the greatest sources of potential contamination are sites 1 and 3. Stormwater from Site 3, the Crash Crew Training Area, discussed in Section 3.1.1, is discharged to an inlet in western Bayou Grande via an underground stormwater drain pipe and drainage ditch. Sediment and surface vater in the stormwater drain exhibited elevated levels of metals, TRPHs, PAHs, VOCs, and phenols.

Site 1, the Sanitary Landfill, encompasses an 80-acre area adjacent to Bayou Grande. Evidence of metal, TRPH, PAH, VOC, and phenol contamination was found in the soil and groundwater on the landfill and in the surface water and sediments of adjacent brackish and freshwater ponds and Bayou Grande. Pathways probably include groundwater migration and surface runoff with Bayou Grande sediment acting as a sink.

Given the cumulative contributions of the aforementioned contaminant sources to Bayou Grande and the relatively restricted circulation within the bayou (particularly in semi-enclosed embayments such as the yacht basin), the accumulation of significant levels of contaminants appears likely. Analytical results for sediment and surface water samples generally support this conclusion. Eowever, other sources within Bayou Grande and Pensacola Bay may also contribute to this accumulation.

3.2.2 Biological Receptors

Bayou Grande is a shallow (average depth = 6 feet) bayou connected to Pensacola Bay by a narrow pass north of Magazine Point (see Figure 3-2). The bayou drains freshwater from Garcon Swamp to the west, urban watersheds of western Pensacola to the north, and NAS Pwacola to the south. Because of the concentration of freshwater inputs and the constricted opening to the bay, Bayou Grande is an oligohaline or mesohaline environment in contrast to the lower reaches of Pensacola Bay.

The types of biological communities that comprise the Bayou Grande ecosystem are similar to those that occur in Pensacola Bay (see Section 3.1.2). However, the species composition of aquatic communities in Bayou Grande is more euryhaline or oligohaline than that of lower Pensacola Buy. Also, communities adapted to low energy environments (e.g., intertidal mud flats) are more prevalent in Bayou Grande than in the bay.

The intertidal margin of Bayou Grande along NAS Pensacola generally consists of two different habitats. Relatively narrow, sandy strands with emergent vegetation, predominantly marshhay cordgrass (Spartina patens) and needlerush (Juncus roemerianus), occur along exposed portions of the shoreline, such as that to the north of Site 1. These

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exposed habitats support a relatively low diversity of species; fiddler crabs (*Uca* spp.) and marsh perivinkles (*Littorina irrorata*) are two of the more common fauna. In contrast, intertidal mud flats, which occur within protected embayments of the bayou (such as those adjacent to sites 11 and 16), harbor relatively diverse assemblages of species, including surface deposit-feeding polychaetes, amphipods, and bivalve molluscs. During flooding tides, these intertidal mud flat areas are common feeding grounds for rays and bottom-feeding fish. During low tides, shore and vading birds, such as ducks, teals, herons, and egrets (see Table 3-5) forage on the exposed flats.

Although the shallow depth of Bayou Grande is conducive to benthic photosynthesis, submerged aquatic vegetation does not occur in the bayou (Collard 1991). Likewise, oyster beds are not knovn to occur in the bayou (Nelson 1992).

Many of the commercially and recreationally harvested fish species present in Pensacola Bay (see Table 3-4) are also likely residents or migrants in Bayou Grande. Threatened or endangered species or species of concern, knovn or likely to occur in the Pensacola Bay vicinity, are listed in Table 3-6.

3.2.3 Preliminary Assessment of Ecological Risk

Bayou Grande supports ecologically important communities, including diverse intertidal benthic communities that serve as a primary food source for bottom-feeding fish and motile epibenthic fauna such as rays and crabs. The bayou also provides nesting and nursery habitat for several commercially and recreationally harvested fish and invertebrates, including striped mullet, spotted seatrout, and blue crab. Species such as these that utilize bayou habitats during larval and juvenile stages are at enhanced risk of adverse population effects due to the increased vulnerability of these early life history stages to toxic effects.

Populations potentially at risk in Bayou Grande include submerged aquatic vegetation, sessile benthic macroinvertebrates, motile epibenthic and nektonic fauna, and birds and marine mammals. Potential routes of exposure, including important trophic connections, are discussed in Section 3.1.3.

Sixteen contaminant sources vith potential pathways to Bayou Grande vere identified (see Section 3.2.1). The majority (12) of these sites likely discharge impacted surface vater and/or groundwater to the yacht basin located vest of Magazine Point. The concentration of multiple sources in this area of Bayou Grande increases the likelihood that cumulative inputs have significantly affected sediments in the basin. Documentation of contaminant levels in this area of Bayou Grande is limited to the analytical results from three sediment and two surface vater samples collected at the distal end of Site 30 (adjacent to Site 11) during Phase I investigations.

RQs calculated from the maximum analyte concentrations detected in these samples support the contention that impacted media occur within the yacht basin and may pose a serious threat to biological communities (see Table 3-9, Site 30). Sediment RQs exceeded 1.0 for five of eight metals and for total PAHs. RQs for chromium and lead (22.5 and 15.7, respectively) vere greater than those calculated for any analytes detected at any site. Of the surface water analytes detected (arsenic, chromium, and zinc), all three had RQs exceeding 1.0.

Of the four contaminant sources to Bayou Grande not in the area of the yacht basin, only Site 1 appears to be a significant source of contaaination that potentially could impact bayou communities. Five sediment and three surface water samples vere taken nearshore. RQs based on maximum analyte concentrations detected in these samples indicate low to moderate risk to biological communities (see Table 3-9, Site 1). Only RQs for lead and total PAHs in sediment and zinc in surface vater exceeded 0.1 (0.3, 0.4, and 0.2, respectively). However, the sediment samples vere composed primarily of coarse-grain sediments; finer-grain sediments further offshore may exhibit higher concentrations of these parameters.

Although this assessment was based on contaminant concentrations from only a fev samples, existing information suggests that Bayou Grande communities may be at ecological risk, particularly in the yacht basin and perhaps in other embayments vith restricted circulation and fine-grained sediments that act as sinks for contaminants discharged into Bayou Grande. Further investigations are necessary to define the extent and magnitude of sediment and surface water contamination in

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Table 3-9

RISK QUOTIENTS CALCULATED FOR CONTAMINANTS IN SEDIMENTS AND SURFACE WATER FROM BAYOU GRANDE

Medium	Contaminant	Risk Quotient (Maximum)	
		Sit. 1	Site 30
Sediment	Arsenic	<0.1[a]	0.3
	Chromium	<0.1	22.5
	Zinc	<0.1	1.1
	Lead	0.3	15.7
	Cadmium	<0.1	9.0
	Nickel	<0.1[a]	0.2
	Copper	<0.1	0.1
	Silver	<1.0[a]	2.3
	Total PAHs	0.4	8.3
Surface Water	Arsenic	<1.4[a]	1.4
	Chromium	<0.2[a]	1.0
	Zinc	0.2	1.3

14[NASP]UI3901:T0495/1940/25

[a]Compound not detected; risk quotient based on detection limit.
[b]Compound present in method blank.

Key:

PAHs = Polynuclear aromatic hydrocarbons.

Source: Ecology and Environment, Inc., 1992.

Bayou Grande. However, an ecological assessment of Bayou Grande should initially focus on the NAS Pensacola yacht basin based on the potential for biological effects from analyte concentrations documented during Phase I investigations.

3.3 WETLANDS

An EPA inventory of wetlands (Parsons and Pruitt 1991) identified and enumerated 79 wetlands or wetland complexes on NAS Pensacola. Two additional vetlands vere identified during Phase I habitat/biota surveys; these are identified on Figure 3-3 and Table 3-10 as W1 and V2. (For the purposes of this report, freshwater and brackish water ponds, drainage ditches, and seagrass beds are included as vetlands.) The majority and largest of the wetlands on the NAS are located in the vestern portion of the installation, primarily south and vest of Sherman Field (see Figure 3-3). Only about a third of the 81 wetlands are located east of Sherman Field vhere most of the IRP sites are located, and these are exclusively small, remnant wetlands that have been heavily impacted by base activities.

Contamination was detected in all eight vetlands that were sampled during Phase I contamination assessments. Tventy-three sites on NAS Pensacola are suspected sources of contamination to wetlands (see Table 3-10 and Figure 3-3). Phase I investigations have been conducted at 13 of these sites. The folloving sections summarize the potential sources (sites), pathways to wetlands, biological receptors, and estimated risk associated vith the contaminant concentrations measured in wetlands.

3.3.1 Sources and Pathvays

The 23 sites identified in Table 3-10 potentially discharge or have discharged pollutants into 31 wetlands at the following general locations: Chevalier Field vicinity (14 sites, 10 wetlands), landfill and vicinity (four sites, 11 wetlands), south of Sherman Field (five sites, eight wetlands), and north of Sherman Field (one site, two vetlands). (The total number of sites equals 23 because Site 3 drains to both north and south of Sherman Field.)

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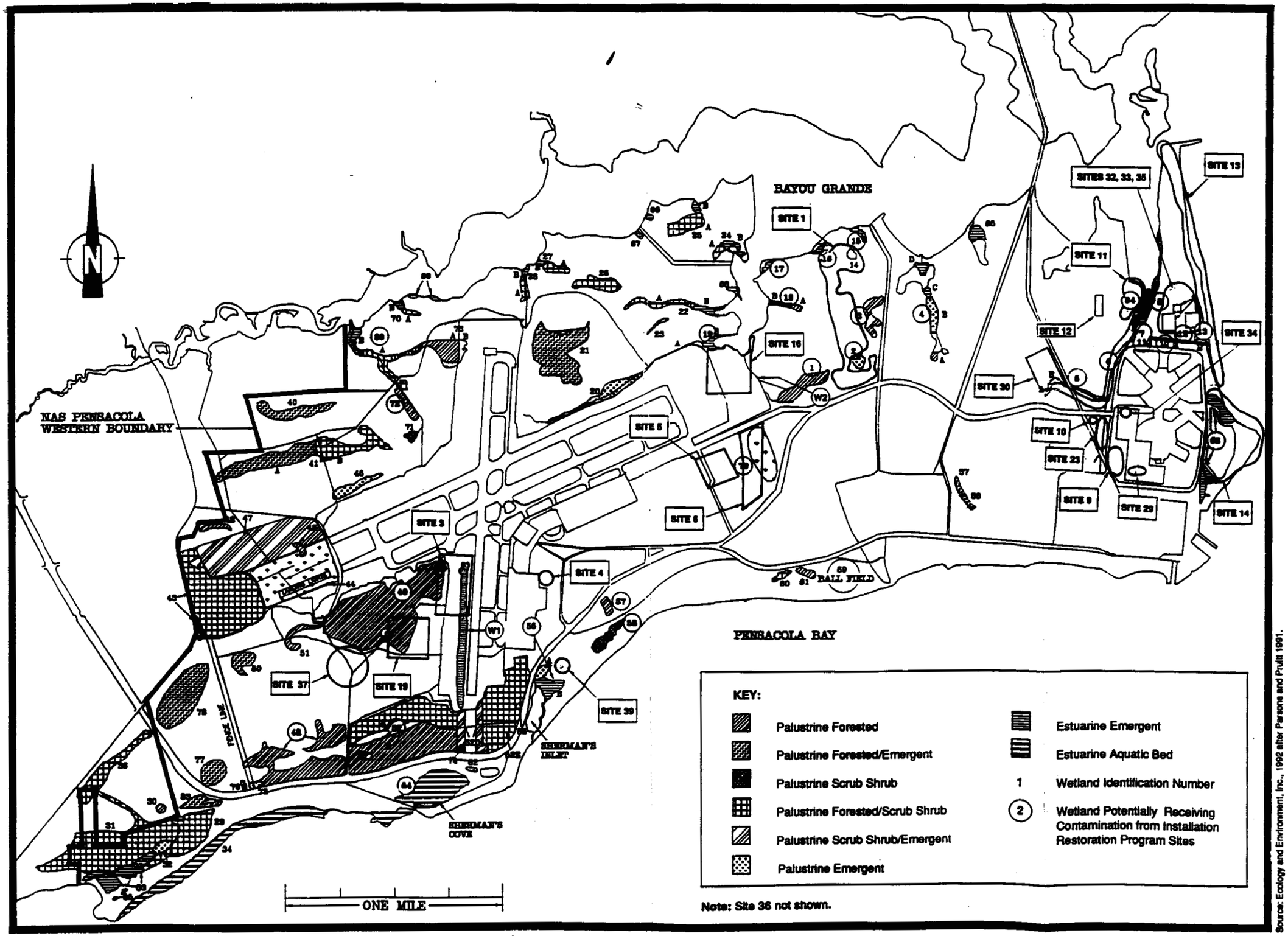
Of the 14 sites in the vicinity of Chevalier Field, eight (sites 10, 11, 23, 30, 32, 33, 35, and 36) are potentially major sources of



Source: Ecology and Environment, Inc., 1992 after Parsons and Pruitt 1991.

Figure 3-3
LOCATIONS OF NAS PENSACOLA SITES POTENTIALLY IMPACTING WETLANDS

Table 3-10

SUMMARY OF SOURCES AND PATHWAYS OF CONTAMINATION AT NAS PENSACOLA POTENTIALLY IMPACTING WETLANDS

Source (Site)	Site Name	Known or Suspected Contaminants	Duration of Discharge (years)	Potential Pathway(s)	Potentially Impacted Wetland(s)[a]
1	Sanitary Landfill	Metals, TRPHs, VOCs, PAHs, phenols	30 (1950-1980)	Surface runoff, groundwater	1-4, 15-18
3	Crash Crew Training Area	Metals, TRPHs, VOCs, PAHs, phenols	37 (1955-present)	Surface runoff into stormwater drain	39, 52, 72, W1b
4	Army Rubble Disposal Area	Unknown	Unknown	Groundwater	52, 56-58
5	Borrow Pit	Unknown	Unknown	Surface water, groundwater	79
6	Ct. Redoubt Rubble Disposal Area	Unknown	Unknown	Surface water, groundwater	79
9	Navy Yard Disposal Area	Metals, TRPHs, PAHs	13 (1917-1930s)	Groundwater, surface runoff	6-8
10	Commodore's Pond	Metals, TRPHs, PAHs, phenols	Unknown (1800s)	Groundwater, surface runoff	6-8
11	North Chevalier Disposal Area	Metals, TRPHs, VOCs, PAHs, phenols	Unknown (1930s-present)	Groundwater, surface runoff, direct discharge	7, 8, 64
12	Scrap Bins	Metals, TRPHs, PAHs, phenols, PCBs	60 (early 1930s-present)	Stormwater drain	6-8, 64
13	Magazine Point Rubble Disposal Area	TRPHs, VOCs, PAHs, phenols[c]	Unknown	Groundwater	10
14	Dredge Spoil Fill Area	Metals, TRPHs, VOCs, PAHs, phenols	17 (1975-present)	Groundwater, stormwater overflow	63
16	Brush Disposal Area	Metals	Unknown (1960s-1973)	Groundwater, surface runoff	19, w2[b]
19	Fuel Farm Pipeline Leak Area	Metals, TRPHs, VOCs, PAHs	Single incident (1958)	Groundwater, surface runoff	49, 52. 54

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Key at end of table.

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Table 3-10 (coot.)

Source (Site)	Site Name	Known or Suspected Contaminants	Duration of Discharge (years)	Potential Pathway(s)	Potentially Impacted Wetland(s)[a]
23	Chevalier Field Pipe Leak Area	Metals, TRPHs, PAHs, phonols	Two incidents (1965, 1970)	Surface runoff, groundwater	6-8
29	Soil South of Building 3460	Metals, TRPHs, PAHs, VOCS	Unknown (1970s-1980s)	Orounduator	6-8
30	Buildings 649 and 755	Metals, TRPHs, VOCs, PAHs, phonols	30 (1940s-1970s)	Direct discharge, surface runoff, groundwater	5-8
32,33,35	Industrial Wastowator Treatment Plant	Metals, VOCs, BNAs	11+ (1981-present)	Orounduator, surface runoff	7-13
34	Solvent worth of Building 3557	Metals, TRPHs, PAHs, phonols	Single incident (1984)	Oroundwator	6-8
36	Industrial Waste Sewer	Metals, TRPHs, vocs, PAHs, phonols	21+ (1971-present)	Oroundwator	5-13
37	Sherman Field Fuel Farm Area	Metals, TRPHs, VOCs, PAHs	Single incident (1983)	Oroundwator	48, 52, 54
39	Oak Grove Campground	TRPHs, VOCs	Unknown	Oroundwator	56

14[NASP]UI3901:T0495/1941/6

[a]Wetland number corresponds to U.S. Environmental Protection Agency (EPA) wetland inventory (Parsons and Pruitt 1991); see Figure 3-3.
[b]Wetlands not identified in EPA wetland inventory (Parsons and Pruitt 1991).
[c]Suspected source of these contaminants is tho Industrial Wastowator Treatment Plant (sites 32, 33, and 35).

Key:

TRPHs = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.
PAHs = Polynuclear stomatic hydrocarbons.
BNAs = Base/neutral and acid extractable compounds.

Source: Ecology and Environment, Inc., 1992.

detected parameters to wetlands (see Table 3-10). Wetlands 5, 6, and 7, which are located west and north of Chevalier Field (see Figure 3-3), exhibited elevated concentrations of metals, TRPHs, VOCs, PAHs, and phenols. Buildings 649 and 755 (Site 30), which historically discharged metal-plating wastes into Wetland 5, is believed to be the single largest source of contaminants to this wetland complex. Sediment in Wetland 5, which served as a contaminant sink during periods of hazardous waste discharge, is now a potential source to downstream wetlands via the surface drainage system (i.e., Wetland 6, which is a paved drainage ditch). Commodore's Pond (Site 10), Chevalier Field Pipe Leak Area (Site 23), and the Industrial Waste Sewer (Site 36) are potential sources of metals, TRPHs, PAHs, and phenols to Wetland 6 via groundwater migration. The North Chevalier Disposal Area (Site 11), which surrounds and comprises wetlands 7, 8, and 64 '(see Figure 3-3), is a major source of multiple contaminants (metals, TRPHs, VOCs, PAHs, and phenols) to these three wetlands (see E & E 1991e). Groundwater migration, surface runoff, and direct discharge are potential pathways of Site 11 contamination. The Scrap Bins site (Site 12) is also a potential source of numerous contaminants (metals, TRPHs, PAHs, phenols, and PCBs) to wetlands 6, 7, 8 and 64 via an on-site stormwater drain (see E & E 1991h).

The Industrial Wastewater Treatment Plant (IWTP; sites 32, 33, and 35) may also contribute contamination to wetlands 7 and 8 as well as to another wetland complex adjacent to the facility (wetlands 10, 11, 12, and 13; see Figure 3-3). Although a Phase I contamination assessment has not been performed on these sites, other sampling has indicated that the IWTP is a source of metals, VOCs, and base/neutral and acid extractable compounds (BNAs). Wetlands 10, 11, 12, and 13 may be subject to contamination from the IWTP via surface runoff; both groundwater migration and surface runoff are potential pathways to wetlands 7 and 8 (see 1992w).

The Dredge Spoil Fill Area (Site 14) is a potential source of contamination to Wetland 63, which comprises two estuarine emergent wetlands located north and south of the fill area (see Figure 3-3). Phase I analytical results showed highly and slightly elevated TRPH concentrations in the sediment of the southern and northern wetlands,

respectively. Contaminated surface runoff and groundwater from Chevalier Field may also be sources of this contamination (see E & E 1991c).

Of the 11 wetlands in the vicinity of the Sanitary Landfill (Site 1), eight (vetlands 1 through 4 and 15 through 18) are likely receptors of contamination from the landfill (see Table 3-10 and Figure 3-3). (Although enumerated in the EPA inventory, Wetland 14 is a sand pit and does not qualify as a wetland, according to Parsons and Pruitt [1991].) Sediment and surface water samples were collected and analyzed from four of these eight wetlands (3, 4, 15, and 16) during the Phase I investigation of Site 1. Each of these wetlands exhibited some type of contamination. Moderately to highly elevated concentrations of metals vere detected in sediments from vetlands 4, 15, and 16; elevated concentrations of zinc were measured in surface vater from Vetland 3. Low to moderately elevated levels of TRPHs, PAHs, and phenols were also found in most sediment samples from these vetlands (see E & E 1991g). Most of the detected contamination can be attributed to leachate migration from the landfill via discharge of contaminated groundwater. The extent of contamination in the other four wetlands adjacent to Site 1 (wetlands 1, 2, 17, and 18) is unknovn; however, groundwater migration and surface runoff from the landfill are potential pathways to these wet lands.

The Brush Disposal Area (Site 16) is located adjacent to Wetland 19, an estuarine emergent wetland, and surrounds a drainage ditch wetland (W2; undesignated in EPA's wetland inventory [Parsons and Pruitt 19911) that empties into Bayou Grande (see Figure 3-3). South of Site 16, Wetland 79 is located adjacent to the Barrow Pit (Site 5) and within the Fort Redoubt Disposal Area (Site 6; see Figure 3-3). Although Phase I contamination assessments have not been performed on these three sites, there is no historical evidence of hazardous vaste disposal in these areas. Thus, these sites are not expected to be significant sources of contaminants to these vetlands.

Five sites located south of Sherman Field (sites 3, 4, 19, 37, and 39) are potential sources of contamination to eight vetlands or wtland complexes (see Figure 3-3 and Table 3-10). The types and magnitude of contamination at each of these sites are discussed in Section 3.1.1.

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Although Phase I contamination assessments have not yet been performed on them, sites 19 and 37 appear to be the most significant potential sources of contamination to wetlands in this area of NAS Pensacola. Past accidental discharges of petroleum products from these two sites might have impacted or may continue to impact wetlands 48, 49, 52, and 54 via leachate migration and/or surface runoff. In contrast to potentially impacted wetlands on the eastern side of the NAS, these wetlands are significant in size and quality. Wetland 54 is particularly significant because it represents one of the few remaining areas of seagrass beds along the margin of NAS Pensacola.

Although potential groundwater pathways from the Army Rubble Disposal Area (Site 4) may transport contaminants to wetlands 52, 56, 57, or 58 (depending on the direction of groundwater flow), this site is not a suspected significant source of toxic contamination. The Oak Grove Campground (Site 39) is a more likely source of contamination in this vicinity due to its proximity to Wetland 56 and the known presence of soil contamination (see Section 3.1.1). However, Phase I investigations have not been performed on either of these sites.

The Crash Crew Training Area (Site 3) is a potential source of contamination to wetlands north and south of Sherman Field via a stormwater drainage system, as well as to on-site wetlands (see Figure 3-3). Based on Phase I analytical results, an emergent wetland (W1) in the drainage swale on Site 3 receives the highest concentrations of contaminants. Sediment samples were found to contain metals (primarily lead), TRPHs, xylenes, PAHs, and phenols; surface water samples contained chromium, TRPHs, aromatic-type VOCs, and phenols (see E & E 1992c). Receiving wetlands downstream from the outfalls of the stormwater drainage system include wetlands 39 and 72 to the north and Wetland 52 to the south. Sediment and surface water contamination at the northern outfall was nonexistent to minimal. However, low levels of metals and moderate levels of phenols were detected in sediment and surface water samples collected from the southern outfall (see E & E 1992c). This contamination may have originated from Site 3; however, other off-site or ambient sources may also be contributors. Regardless, Wetland 52 may be subject to sediment and surface water contamination from surface drainage.

In summary, Phase I investigations have documented two general areas where wetlands appear significantly affected by contaminant input: (1) vetlands 5, 6, 7, and 8 (from multiple sources, principally sites 10, 11, 23, 30 and 36); and (2) vetlands 15 and 16 (from Site 1). In addition, sites 19 and 37 are potentially significant sources that may impact vetlands 48, 49, 52, and/or 54. However, Phase I contamination assessments have not yet been performed on these latter two sites, and contaminant levels within these vetlands are unknown.

3.3.2 Biological Receptors

Of the 31 vetlands potentially impacted by IRP sites, eight are wetland complexes, comprising two or more vetland types. Altogether, there are 44 vetland segments including nine palustrine forested, two palustrine forested/emergent, one palustrine scrub-shrub, four palustrine forested/scrub-shrub, two palustrine scrub-shrub/emergent, 11 palustrine emergent, 12 estuarine emergent, one estuarine aquatic bed, and tvo open water (see Figure 3-3). Eighteen of these wetlands vere surveyed during Phase I habitat/biota surveys. Potential biological receptors are summarized for each wetland type using information from the habitat/biota surveys, Parsons and Pruitt (1991), and U.S. Fish and Wildlife Service (USPVS; 1987). Threatened and endangered species potentially occurring in NAS Pensacola wetlands are listed in Table 3-11.

Palustrine forested vetlands primarily comprise vet pine flatwoods, as typified by wetlands 49 and 52B. These forested wetlands have canopies dominated by slash pine (Pinus elliottii), sweetbay magnolia (Magnolia virginiana), and pond cypress (Taxodium ascendens). Uater tupelo (Nyssa sylvatica) is a codominant in vetlands 48 and 49 (Parsons and Pruitt 1991). *The* understory generally consists of wiregrass (Aristida stricta), saw palmetto (Serenoa repens), wax myrtle (Myrica cerifera), fetterbush (Lyonia lucida), dahoon holly (Ilex cassine), and gallberry (Ilex glabra). Birds common to wet pine flatwoods include red-shouldered hawk, blue jay, northern mockingbird, boat-tailed grackle, and marsh wren. Other typical fauna include ringneck snake, narrow-wuthed toad, squirrels, rabbits, raccoons, tufted titmouse, cotton rat, and opossum USPVS 1987).

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Table 3-11

THREATENED AND ENDANGERED FLORA AND FAUNA OBSERVED OR LIKELY TO OCCUR WITHIN NAS PENSACOLA WETLANDS

Scientific Name	Common Name	Base Status[a]	status[b] FGFWFC (or FDA)	status[b] USFWS	Habitat
FISHES					
Ammocrypta asprella	Crystal darter	U	T	uR2	Fresh water
Etheostoma histrio	Harlequin darter	U	SSC		Fresh water
Cundulus jenkinsi	Salt marsh topminnow	P	SSC		Salt, frosh, brackish waters
Lepisosteus spatula	Alligator gar	U	SSC		Brackish, frosh, salt water
Moxostoma carinatum	River redhorse	U	SSC		Fresh water
AMPHIBIANS AND REPTILES					
Alligator mississippiensis	American alligator	R	SSC	T(S/A)	Swamps, marshes, ponds
Drymarchon corais coupori	Eastern indigo snake	P	T	T	Open areas near water
Graptemys pulchra	Alabama map turtle	U	SSC		Swamps, streams, marshos, ponds
Macroclemys temmincki	Alligator snapping turtle	SR	SSC	UR 2	Swamps, marshes, ponds
BIRDS					
Charadrius melodus	Piping plover	P	T	T	Open, dry, sandy beaches
Charadrius alexandrinus	Snowy plover	P	T	UR 2	Open, dry, sandy beaches
Dendroida dominica rtoddardi	Stoddard's yellow throated warbler	P-u		UR 2	Wooded habitats

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Key at end of table

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Table 3-11 (Cont.)

Scientific Name	Common Name	Base Status[a]	Status[b] FGFWFC (or FDA)	Status[b] USFWS	Habitat
Dendroica kirtlandii	Kirtland's warbler	U	E	C	Woodod habitats
Haematopus palliatus	American oystercatcher	U	SSC		Coastal habitats
Egretta rufescens	Reddish egret	0-U	SSC	UR 2	Freshwater/coastal wotlandr
Cqrotta caerulea	Little blue heron	0-U	SSC		Freshwater/coastal wotlandr
Egretta thula	Snowy egret	P-U	SSC		Freshwater/coastal wotlandr
Grus canadensis pratensis	Florida sandhill crane	U	T		Freshwater wotlandr
Falco peregrinus tundrius	Arctic peregrine falcon	M	E	T	Winters on coasts
Falco sparverius paulus	Southeastern kestrel	R	T	UR 2	Open pine forests, clearings
Haliaeetus leucocephalus	Bald eagle	P-u	T	e	Pine forests/coastal habitat
Pandion haliaetus	Osprey	R	SSC		Near water
Pelecanus occidentalis	Brown pelican	R	SSC	AC	Mangrove trees, coasts
Picoides borealis	Red-cockaded woodpecker	P-U	T	E	Cavity nests/old pine stands
Vermivora bachmanii	Bachmann's warbler	U	C	C	Wooded habitats
Campophilus principalis	Ivory-billed woodpecker	U	e	E	Woodod habitats
Sterna antillarum	Least torn	U	T		Coastal habitatr
Mycteria americana	Wood rtork	U	e	e	Freshwater/coastal wotlandr
Rostrhamus sociabilis	Snail kite	U	E	E	Freshwater/coastal wotlandr
PLANTS					
Drosera intermedia	Spoon-leaved sundew	R	T		Aquatic habitats
Kalmia latifolia	Mountain laurel	U	T		Rich, moist, rhady woods

Key A of table.

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Table 3-11 (Cont.)

Scientific Name	Common Name	Base Status[a]	status[b] FGFWFC (or FDA)	status[b] U S W	Habitat
Lilaeopsis carolinensis	Carolina lilaeopsis	R		UR 2	Aquatic habitats
Lilium iridollae	Panhandlo lily	U	E	UR 2	Black, mucky soils
Pinguicula planifolia	Chapman's buttorwort	U	RE	UR 2	
Rhododendron austrinum	Orange azalea	U	E	UR 5	Moist, woody habitats
Sarracenia loucophylla	White-top pitchorplant	R	E		Opon acid bogs
Sarracenia rubra	Sweet pitchorplant	U	E	UR 2	Acid bogs/slash pine woods

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[a]Status of species on tho NAS Pensacola facility:
R = Resident.
M = Migrant.
SR = Suspected rosidont.
P = Possible rosidont duo to available habitat; survey roquirod.
U = Unknown, survey roquirod.

[b]State and federal status:
E = Endangered.
T = Throatonod.
T(S/A) = Throatonod duo to similarity in appearance.
AC = Agency concern; not currently listed or a candidate for listing.
UR 2 = Under review, insufficient biological data available.
UR 5 = Candidate species but taxa has proven to bo more widespread than previously believed and/or those species that are not subject to any identifiable throat.
FDA = Florida Department of Agriculture.
FGFWFC = Florida Game and Freshwater Fish Commission.
USFWS = U.S. Fish and Wildlife Service.

Source: Ecology and Environment, Inc., 1992 after Florida Natural Areas Inventory 1988.

Two palustrine forested/emergent wetlands are potential receptors of contaminant migration. Wetland 13, located south of the IWTP (sites 32, 33, and 35), is an isolated 0.3-acre wetland dominated by black willow (Salix nigra) and smartweed (Polygonum spp.; Parsons and Pruitt 1991). The second palustrine forested/emergent wetland, not identified by Parsons and Pruitt (1991), occurs northeast of Vetland 49 (see Appendix A, Site 3 Biota/Habitat Map). Hundreds of white-top pitcherplants (Sarracenia leucophylla), a state-listed endangered species, occur within an opening in the canopy of slash pine. Birds observed in this habitat include blue jay, northern mockingbird, boat-tailed grackle, and marsh wren.

Only one palustrine scrub-shrub wetland occurs on NAS Pensacola (Vetland 58). This 4.2-acre vetland is dowinated by titi (Cyrilla racemiflora) and buttonbush (Cephalanthus occidentalis; Parsons and Pruitt 1991).

Four palustrine forested/scrub-shrub wetlands (wetlands 12, 39A, 52A, and 52E), ranging in size from 0.2 to 27.9 acres, are potentially affected by contaminant migration. These wetlands are dominated, respectively, by black willow and cabbage palm (Sabal palmetto), slash pine and black titi (Cliftonia monophylla), sveet bay and black titi, and slash pine and titi (Parsons and Pruitt 1991). The larger of these dense, shrubby thickets provide escape cover for wildlife populations such as raccoons, deer, and wood duck. Permanent residents are primarily reptiles and amphibians (USFWS 1987).

Wetlands 3 and 52C are the only scrub-shrub/emergent wetlands potentially receiving contaninant input. Vetland 3, located adjacent to Site 1, is doninated by common cattail (Typha latifolia), sveet bay, blue mistflower (Eupatorium coelestinun), and sawgrass (Cladium jamaicense). Notably, approxlnately 30 individuals of Carolina lilaeopsis (Lilaeopsis carolinensis), a federal candidate species, were observed near the northeastern end of the 5.5-acre vetland (see E 6 E 1991g and Appendix A). Black titi and arrovhead (Sagittaria lancifolia) are codominants in the 1.1-acre Vetland 52C (Parsons and Pruitt 1991). Both of these wetlands have standing water and are likely inhabited by reptiles and anphibians; unidentified turtles were observed in Vetland 3.

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Emergent marshes comprise 23 of the 43 wetland components potentially impacted by contamination. Eleven of these emergent wetlands are palustrine; 12 are estuarine. Common cattail is a dominant or codominant in five of the 11 palustrine emergent marshes (wetlands 5B, 7, 11, 19A, and 56A; Parsons and Pruitt 1991). Dominant plants in other palustrine emergent marshes include maidencane (Panicum hemitomon) and broomsedge (Andropogon glomeratus; Wetland 2), common arrowhead (Sagittaria latifolia) and smartweed (Polygonum hydropiperoi; Wetland 4B), pennywort (Hydrocotyle spp.; Wetland 10A), lizard's-tail (Saurus cernuus) and redroot (Lachnanthes caroliniana; Wetland 52D), and coinwort (Centella asiatica), spikerush (Eleocharis sp.), and sundew (Drosera tracyi; Wetland W1; Parsons and Pruitt 1991; see E & E 1992c).

The dominant fauna occurring in emergent marshes are amphibians, especially frogs, and reptiles. The American alligator, which is a state-listed species of concern, is an intermittent inhabitant of deeper marshes and may occur in marshes with connections to Bayou Grande. Common bird species in freshwater marshes include red-winged blackbird, belted kingfisher, osprey, herons, and egrets. Active dam building also indicated the presence of beaver in the headwaters of Wetland 5.

Nearly all of the estuarine emergent marshes potentially receiving contaminated leachate or runoff consist of monocultures of black needlerush (Juncus roemerianus). Host of these marshes surround brackish water ponds with intermittent connections to Bayou Grande or Pensacola Bay. However, wetlands 10B and 63B are dominated by marshhay cordgrass (Spartina patens). Other common vegetation at Wetland 63B includes dense stands of giant reed (Phragmites australis), torpedo grass (Panicum repens), and primrose (Ludwigia sp.). Wetland 63A, located south of the Dredge Spoil Fill Area (Site 14), has been disturbed by ditching and planting of slash pine. This wetland is dominated by giant reed; other common plants include catbrier (Smilax sp.), wax myrtle, marshhay cordgrass, cattails, snowbush (Baccharis halimifolia), and broomsedge (see E & E 1991c).

Hacroinvertebrates are found in large numbers in tidal marshes and are the basis of the trophic network. Raccoons and otters commonly forage on invertebrates, especially bivalves, and carrion. The saltmarsh snake and terrapin turtle are characteristic reptiles.

Waterfowl are abundant in these estuarine marshes, feeding on benthic fauna and fish. Common marsh birds include egrets, herons, ducks, osprey, gulls, terns, skimmers, and sandpipers (USFWS 1987; see Table 3-11).

Two drainagevays that may be receptors of contamination are classified as open vater vetlands. Vetland 6 is primarily a linear channel lined with concrete. Bank vegetation includes smartweeds, climbing hempvine (Mikania scandens), torpedo-grass, and frog's-bit (Limnobium spongia). Fauna observed in the ditch include polychaetes, amphipods, blue crab, killifish (Fundulus sp.), darters (Etheostoma sp.), and mollies (Poecilia sp.). Vetland W2 is a drainagevay that winds through a maintained grass upland and empties into Bayou Grande vest of Site 1. Vegetation along the ditch includes marshhay cordgrass, black needlerush, snovbush, and broomsedge. Cottonmouth and copperhead snakes, toads, and frogs vere observed along the banks of the drainageway (see E & E 1991g).

Vetland 54, a 26-acre seagrass bed vithin Sherman's Cove, comprises turtle grass (Thalassia testudinum), manatee grass (Cymodocea filiforme), and shoal grass (Halodule vrightii; Parsons and Pruitt 1991). Seagrass beds support a diverse marine community, described in Section 3.1.2. Important transient species may include sea turtle and manatee, which are threatened or endangered species (see tables 3-6 and 3-11).

3.3.3 Preliminary Assessment of Ecological Risk

Although nearly all vetlands on NAS Pensacola have been physically altered by base activities, most retain at least some habitat value. Amphibians, reptiles, and birds are common in all vetlands surveyed during Phase I investigations. Small mammals (raccoons, opossums, otters, rice, and rats) may be locally colon, but larger mammals, such as deer, are probably limited in distribution to the less disturbed, larger vetlands south and vest of Sherman Field. Despite fragmentation and reduction in the historical extent of vetlands on NAS Pensacola, even vetlands highly impacted by hydrological changes and long-term contaminant input appear to provide adequate habitat for species adapted to anthropogenic change. A prime example is the presence of beaver and

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dam building in Wetland 5, which has numerous outfalls, highly contaminated sediment and surface water, and a minimal vegetational buffer from surrounding activities.

Despite the obvious presence or abundance of vertebrates in most wetlands, ecological effects of contamination may be manifested in more subtle ways, such as reduced population carrying capacity due to declines in food supply (i.e., secondary effects of contamination on population dynamics via trophic interference, similar to that described for the marine trophic system in Section 3.1.3).

Review of existing information on the potential sources and pathways of hazardous materials at the 39 IRP sites on NAS Pensacola indicates that 23 sites may contribute contaminants to 31 wetlands. However, only eight wetlands were sampled during Phase I investigations (wetlands 3, 4, 5, 6, 15, 16, 63, and W1). Although the analytical results for samples collected from these wetlands indicate that at least some areas exhibit elevated concentrations of contaminants (see E & E 1991g, 1992c, 1991c, and 1991a), the biological effects of these levels were not investigated and are unknown. Without direct knowledge of ecological effects, a preliminary assessment of the potential ecological risk to these wetland ecosystems must be made on the basis of measured contaminant levels and their potential to cause biological effects. This preliminary assessment was performed using the RQ method (see Section 2).

RQs calculated from maximum sediment and surface water concentrations exhibited in Site 1 samples indicate a potentially high risk to communities of wetlands 15 and 16 (see Table 3-12). RQs exceeded 1.0 for three sediment analytes and one surface water analyte at Wetland 15 and two sediment analytes at Wetland 16. RQs calculated for wetlands 3 and 4 were less than 1.0, but exceeded 0.1 for several analytes, indicating a potentially moderate level of ecological risk.

Although calculated RQs indicate the potential for adverse ecological effects at Wetland W1 on Site 3 (see Table 3-13), this emergent wetland is located adjacent to a runway on Sherman Field and is mowed regularly; consequently, it provides minimal ecological value.

Wetland 63 at Site 14 appears to be at low risk of ecological effects from all measured contaminants except total PAHs, which had an

Table 3-12

RISK QUOTIENTS CALCULATED FOR CONTAMINANTS IN SEDIMENTS AND SURFACE WATER FROM WETLANDS WITHIN OR ADJACENT TO SITE 1

Medium	Contaminant	Risk Quotient (Maximum)			
		Wetland 3	Wetland 4	Wetland 15	Wetland 16
Sediment	Chromium	<0.1	0.2	<0.1	0.3
	Zinc	<0.1	0.2	0.3	1.2
	Lead	<0.1[a]	0.8	2.6	1.8
	Cadmium	<0.1[a]	<0.1[a]	2.2	0.1
	Copper	<0.1[a]	<0.1	<0.1	<0.1
	Total PAHs	<0.3[a]	<0.3[a]	1.5	<0.3[a]
Surface Water	Chromium	0.5	<0.2[a]	0.7	0.4
	zinc	0.5	0.3	1.2	0.6

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'Compound not detected; risk quotient based on detection limit.

Key:

PAHs = Polynuclear aromatic hydrocarbons.

Source: Ecology and Environment, Inc., 1992.

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Table 3-13

RISK QUOTIENTS CALCULATED FOR CONTAMINANTS
IN SEDIMENTS AND SURFACE WATER FROM WETLANDS WITHIN
SITES 3, 14, AND 30

		Risk Quotient (Maximum)		
Medium	Contaninant	Site 3 (Wetland W1)	Site 14 (Wetland 63)	Site 30 (Wetlands 5,6)
Sediment	Chromium	<0.1	<0.1	1.5
	Zinc	0.3	<0.1	2.0
	Lead	5.1	<0.1[a]	5.1
	Cadmium	0.3	<0.1[a]	3.8
	Nickel	<0.1[a]	<0.1[a]	0.4
	copper	0.4	<0.1[a]	1.3
	Silver	<0.1[a]	<1.0[a]	1.6
	Total PAHs	0.4	1.2	7.5
Surface Water	Arsenic	<1.4[a]	NS	2.4
	Zinc	NA	IS	WA
	copper	IA	IS	NA
	Benzene	0.8	≤0.1[a]	<0.1[a]
	Trichloroethene	≤0.1[a]	IS	0.2
	Phenol8	0.5	<0.3[a]	<0.3[a]

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[a]Compound not detected; risk quotient based on detection limit.

Key:

NS = Medium not sampled.
NA = Wot available: benchmark standard is based on water hardness, which was not measured.
PAHs = Polynuclear aromatic hydrocarbons.

Source: Ecology and Environment, Inc., 1992.

RQ of 1.2 (see Table 3-13). This RQ, based on a single sediment sample collected in Wetland 63A, located south of the dredge spoil fill area, may not be representative of most of the wetland. Thus, more sampling is required to determine the level of ecological risk to this wetland.

Based on contaminant-specific RQs, the level of ecological risk to vetlands 5 and 6 appears to be very high. RQs exceeded 1.0 for seven sediment analytes and one surface water analyte (see Table 3-13). The highest RQs vere for lead, cadmium, and total PAHs. Arsenic concentrations in surface water were 2.4 times Florida's Class III vater quality standard.

Uetlands 7 and 8 are located downstream from wetlands 5 and 6 and therefore are potentially subject to contaminant input. Although vetlands 7 and 8 were not sampled during Phase I investigations, as receptors of significant upstream contamination, they likely are at an elevated level of ecological risk.

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4. CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Based on the analytical results of Phase I contamination assessment/remedial activities investigations performed by E & E, sediment and surface water contaminant levels at some sites pose high levels of ecological risk to the three OUs: Pensacola Bay (17), Bayou Grande (15), and NAS Pensacola wetlands (16). Table 4-1 identifies the areas of the three OUs that appear to warrant the highest priority for performing ecological risk assessments. The areas most impacted are the southeastern waterfront of Pensacola Bay, the yacht basin within Bayou Grande and west of Magazine Point, and wetlands downgradient from the Sanitary Landfill (wetlands 15 and 16) and Buildings 649 and 755 (wetlands 5 through 8). However, although sufficient evidence exists to recognize a potential threat to ecosystem health in some areas of NAS Pensacola, there is generally a scarcity of data (concerning both contaminant levels and related ecological effects) with which to justify a full ecological risk assessment of each OU in question. Therefore, more contaminant data must be gathered from potential receptor wetlands and water bodies before the scope of any ecological risk assessments can be fully defined.

It is appropriate at this stage to emphasize that this preliminary assessment was intended to identify the potential for ecological effects caused by contaminated media on the NAS. Consequently, given the screening nature of the data collected and the generally limited sampling of sediment and surface water, a conservative approach was implemented (see Section 2) to ensure that all potentially affected areas would be included in the development of proposed ecological risk assessments. Thus, areas determined to warrant ecological risk assessments may not necessarily exhibit significant ecological impacts.

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Table 4-1

PRIORITY RECOMMENDATIONS FOR ECOLOGICAL RISK ASSESSMENTS (ERAs) IN OPERABLE UNITS 15, 16, AND 17

Operable Unit[a]	Area	Priority for Ecological Assessment	Rationale	Potential Major Sources (Sites)	Other Potential Contributing Sources (Sites)
Pensacola Bay	Southeastern waterfront	High	High RQs, multiple major sources	2, 20, 30	17, 18, 21, 28, 36
	Chevalier Field/ Magazine Point	Uncertain	Insufficient analytical data		13, 14, 32, 33, 35
	Sherman Inlet/ Sherman Cove	Uncertain	No analytical data	19, 37	3, 4, 39
Bayou Grande	Yacht Basin	High	High RQs, multiple major sources	9, 10, 11, 23, 30, 36	12, 29, 32, 33, 34, 35
	Central Bayou Grande	Uncertain	Moderate RQs, insufficient analytical data	1	15, 16
	Western Bayou Grande	Uncertain	No analytical data		3
NAS Pensacola Wetlands	Wetlands 5-8, 64	High	High RQs, multiple major sources	9, 10, 11, 23, 30, 36	12, 29, 32, 33, 34, 35
	Wetlands 15-16	Moderate	Moderate to high RQs	1	
	Wetlands 1-4, 17-18, W2	Uncertain	No analytical data	1	

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Table 4-1 (Cont.)

Operable Unit[a]	Area	priority *rot* Ecological Assessment	Rationale	Potential Major Sources (Sites)	Other Potential Contributing Sources (Sites I
	Wetlands 10-13	Uncertain	No analytical data		13, 32, 33, 35
	Wetland 63	Uncertain	Low to moderate RQs, insufficient analytical data		14
	Wetlands 39, 72, W1	Uncertain	Insutticiont analytical data		3
	Wetlands 48-49, 52 54, 56-58	Uncertain	No analytical data	19, 37	3, 4, 39
	Wetlands 19, 79	Uncertain	No analytical data		5, 6, 16

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[a]Operable Units:
15 = Bayou Grande.
16 = NAS Pensacola wetlands.
17 = Pensacola Bay.

Key :

RQ = Risk quotient.

Source: Ecology and Environment, Inc., 1992.

4.2 RECOMMENDATIONS

Further sediment and surface water sampling should be performed in conjunction with proposed Phase I and Phase II contamination assessments to facilitate scoping of ecological risk assessments for OUs 15, 16, and 17. Although the level of ecological risk appears high for some areas, the magnitude and extent of contamination in wetlands and vater bodies not sampled (or not sufficiently sampled) during the initial Phase I investigations must be determined prior to defining the geographic scope of the ecological assessments. Table 4-2 summarizes the sampling effort recommended to achieve adequate coverage of potentially affected wetlands and nearshore vaters. Proposed sample locations are illustrated on figures 4-1 through 4-11. Generally, several additional samples are recommended to supplement sampling locations proposed in the work plans for Phase I or II investigations. In some cases (e.g., Sherman Cove), samples are recommended for wetlands or surface vater bodies far downgradient from potential sources. Although any contamination documented in these receiving media may not be attributable to a specific source vithout further extent delineation, for the purposes of supporting scoping for ecological risk assessments, it is important to determine the presence or absence of contamination in potentially affected areas at an early phase.

Recommended sampling in areas deemed high priority areas for ecological risk assessments is intended to focus the geographic extent of contamination; the purpose of sampling recommended for other areas is to provide adequate contaminant data to assess potential levels of ecological risk. Following additional sampling efforts, sufficient analytical results should be available to determine meaningful estimators (i.e., means or medians) of contaminant concentrations. Subsequently, mean RQs can be calculated using mean EECs, which are more indicative of broad-scale environmental conditions than the maximum RQs calculated for this assessment. These mean RQs should provide the best tool for defining the scope of the ecological risk assessments.

Evaluating the ecological impact of contaminants requires an understanding of the magnitude, extent, fate, bioavailability, and toxicity of those contaminants. Site-specific information on these parameters in the Pensacola Bay system is meager, and therefore must be derived from

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Table 4-2

RECOMMENDED SEDIMENT AND SURFACE WATER SAMPLING TO SUPPORT DEVELOPMENT OF ECOLOGICAL RISK ASSESSMENT WORK PLANS FOR OPERABLE UNITS 15, 16, AND 17

Operable Unit[a]	Area	Recommended Sediment and Surface Water Sampling[b]: As Proposed in Work Plan	Recommended Sediment and Surface Water Sampling[b]: Additional Samples[c]	Rationale
Pensacola Bay	Southeastorn waterfront	Phase 11 —Sit. 2	None	Adequate sample coverage.
		Phaso 11--Site 21	Add 2 nearshore SW and SD samples, 1 of each noar drainage ditch outfall and 1 of each east of outfall.	To determine prosenco or absence of contamination offshore of Site 21.
	Chevalier Field/ Magazine Point	Phase II--sites 13, 14	None	Adequate sample covorago.
	Sherman Inlet/ Sherman Field	Phaso II--Site 3	Add 2 SD and 1 SW sample in Sherman Inlot noar discharge point of drainage ditch/creek from Sit. 3.	To determine prosenco or absence of contamination in Sherman Inlot.
		Phaso I--Site 19	Add 3 SD and 2 SW sample8 in Sherman Cove aproad along tho northern shoreline.	To determine prosenco or absence of contamination in Sherman Cove.
Bayou Grande	Yacht Basin	Phase II--Site 30	Add 4 SD and SW samplos in tho central part of tho yacht basin.	To delineate extent of contamination in tho basin.
	Central Bayou Grande	Phase II--Site 1	None	Adequate sample coverago.
		Phase I--Site 16	Add 2 nearshore SD and SW samplos, 1 noar discharge point of drainage ditch (Wetland W2) and 1 further offshore.	To determine presence or absence of contamination offshore of drainage ditch.
	Western Bayou Grand.	Phaso 11--Site 3	Add 2 SD and SW samplos, 1 near mouth of tidal creek (Wetland 39B) and 1 further offshore.	To determine prosenco or absence of contamination in tidal creek and Bayou Grand..

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Table 4-2 (Cont.)

Operable Unit[a]	Area	Recommended Sediment and Surface Water Sampling[b]		Rationale
		As Proposed in Work Plan	Additional Samples[c]	
Wotlandr	Wotlandr 5-8, 64	Phase 11—Sit. 11	None	Adequate sample coverage for wotlandr 7, 0, and 64.
		Pharo 11—Sit. 30	None	Adequate sample coverage for wotlandr 5 and 6.
	Wotlandr 1-4, 15-10	Pharo 11—Sit. 1	Add 2 SD samples in oach of wetlands 1 and 2.	To dotormino proronco or abronco of contamination in these off-mito wotlandr; adequate sample coverage in other wotlandr (3-4, 15-18).
	Wetlands 10-13	Pharo I—Group O (sites 32, 33, 35)	*Add* 1 SD sample in each of wetlands 11 and 13.	To dotormino presence or absence of contamination in thoro wotlandr; adequate sample coverage for wotlandr 10 and 12.
	Wetlands 63	Pharo It—Sit. 14	Add 2 SD and 1 SW sample in Wotland 63B and 1SD and 1SW sample in Wotland 63A.	To supplement proposed ramplor to estimate spatial variability of contamination.
	Wotlandr 39, 72, W1	Pharo 11—Sit. 3	Add 2 ID and SW ramplor oach in wetlands 39 and 72.	To delineate extent of contamination downstream of outfall AA; adequate sample coverage for Wotland W1.
	wotlandr 48-49, 52, 54, 56-50	Phase II—Site 3	Add 2 ID and SW ramplor in Wotland 52 adjacent to tho creek/ditch channel.	To delineate extent of contamination duo to flooding of creek/ditch downatroam from outfall LL.
		Pharo I--Site 19	Add 2 SD and SW samples-- in Wotland 52 hydraulically downqradiont from site 19.	To dotormino proronco or abronco of off-mito contamination.
		Phase I—Site 19	Add 2 SD and SW ramplor in each of wotlandr 48 and 52 hydraulically downqradiont of site 37.	To determine presence or abronco of off-mito contamination.

14[NASP]UI3901:T0495/1573/7

Y at end of table.

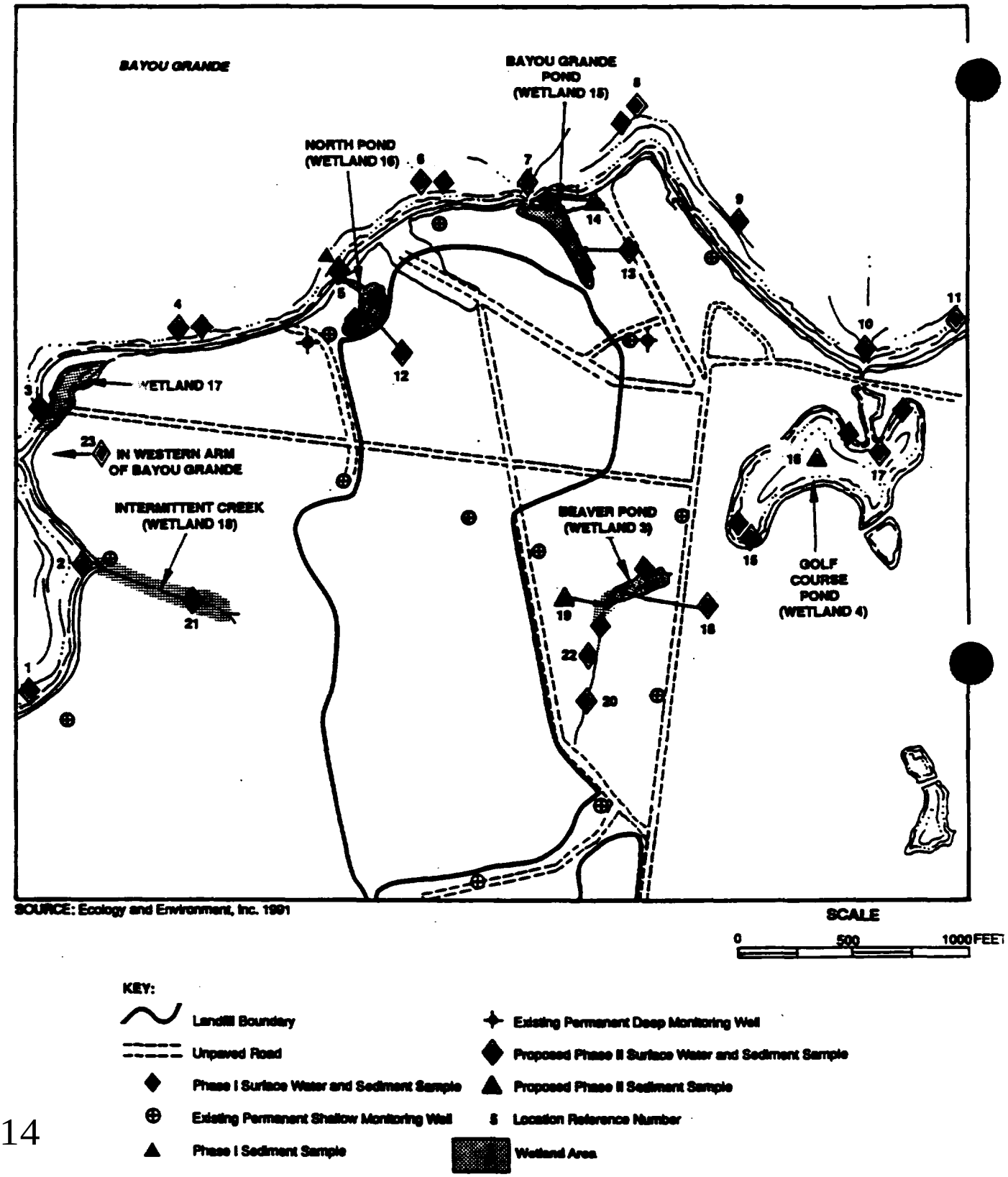
Table 4-2 (Cont.)

Operable Unit[a]	Area	Recommended Sediment and Surface Water Sampling[b]		Rationale
		As Proposed in Work Plan	Additional Samples[c]	
Wetlands (Cont.)		Phase I — Site 39	Add 2 SD and 1 SW sample in Wetland 56.	To determino presence or absence of contamination
	Wetlands 19, 79, W2	Phase I — Group L (sites 5, 6, 16)	Add 2 SD and 1 SW sample to Wetland 19	To determino presence or absence of contamination; adequate sample coverage of wetlands 79 and W2.

14[NASP]UI3901:T0495/1573/7

[a]Operable Units:
15 = Bayou Grande.
16 = NAS Pensacola Wetlands.
17 = Pensacola Bay.
[b]See figures 4-1 through 4-11 tor sample locations.
[c]SD = sediment.
SW = Surface water.

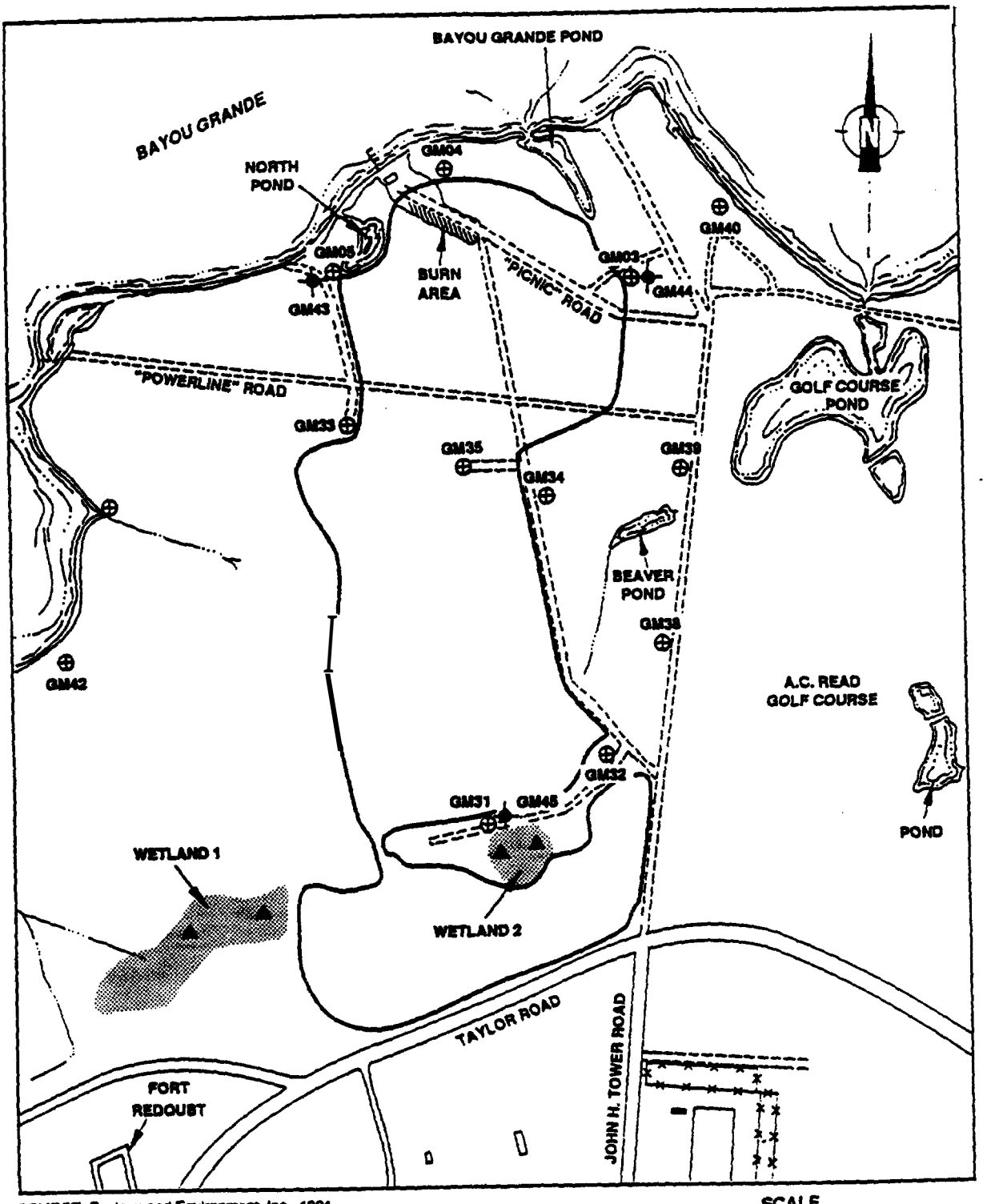
Source: Ecology and Environment, Inc., 1992.



SOURCE: Ecology and Environment, Inc. 1991

151414

4-1 PROPOSED SURFACE WATER *AND* **SEDIMENT SAMPLING LOCATIONS — NAS PENSACOLA SITE 1 — PHASE II**

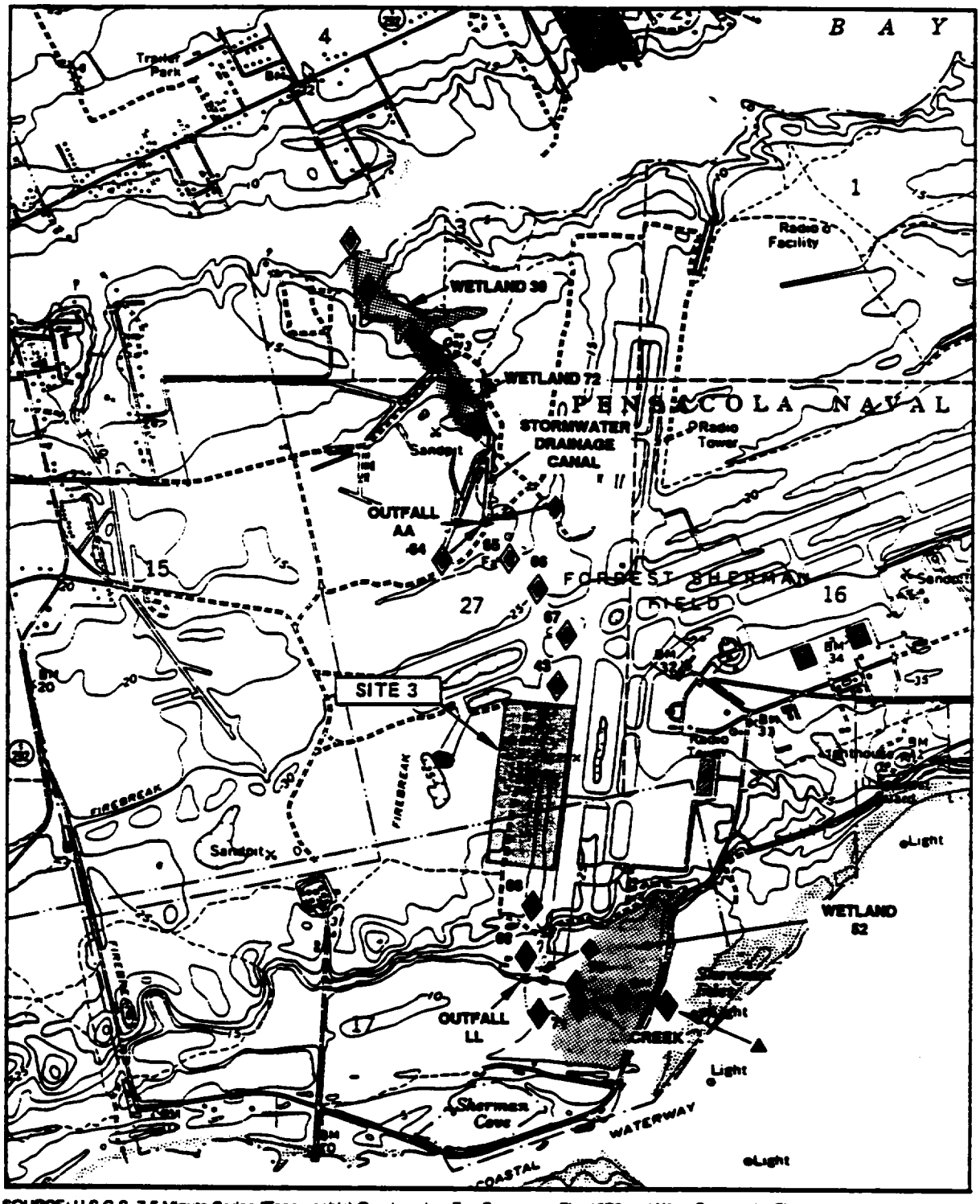


SOURCE: Ecology and Environment, Inc., 1991

KEY:

- Landfill Boundary
- Unpaved Road
- Fence
- Existing Permanent Shallow Monitoring Well
- Existing Permanent Deep Monitoring Well
- Proposed Phase II Sediment Sample Location
- Wetland Area

Figure 4-2 PROPOSED OFF-SITE SEDIMENT SAMPLING LOCATIONS — NAS PENSACOLA SITE 1 — PHASE II



SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970. Photorevised 1987; Ecology and Environment, Inc., 1991

KEY:

- Phase I Surface Water and Sediment Sample
- Proposed Phase II Surface Water and Sediment Sample
- Proposed Phase II Sediment Sample
- 49 Location Reference Number

SCALE

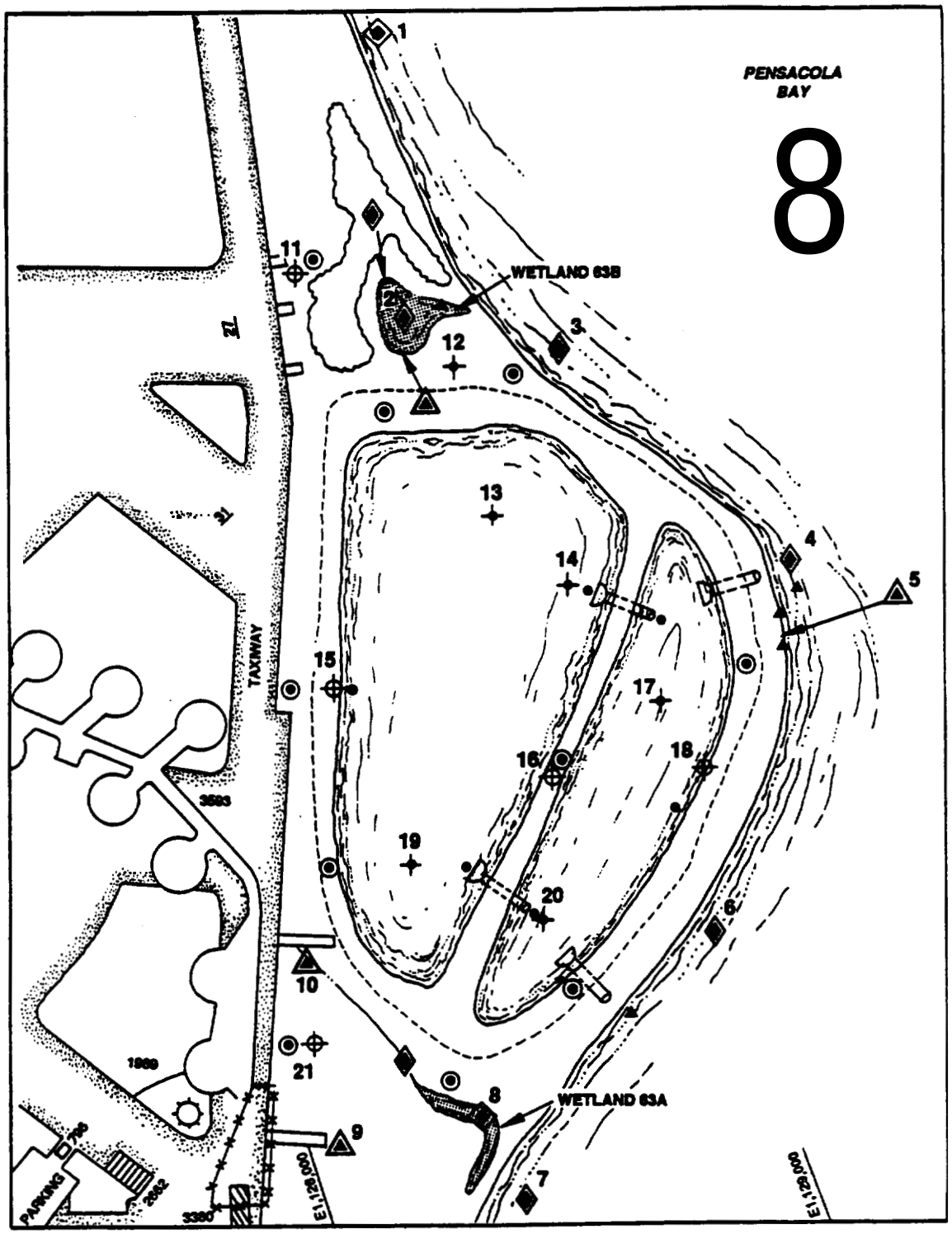
0 ½ 1 MILE

0 .5 1 KILOMETER

Wetland Area

151415

Figure 4-3 PROPOSED OFF-SITE SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS — NAS PENSACOLA SITE 3 — PHASE II



SOURCE: Ecology and Environment, Inc. 1991

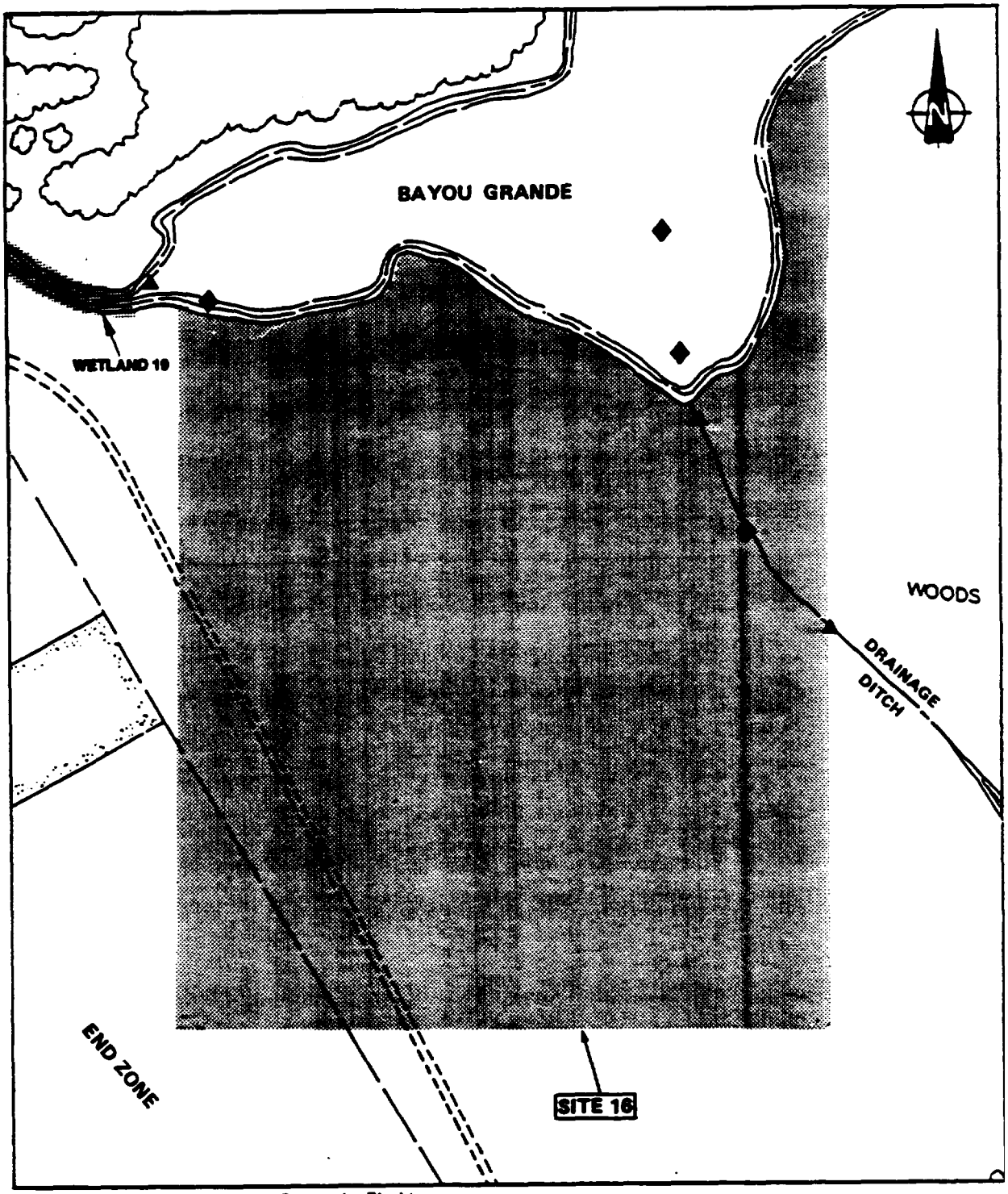
SCALE

0 200 400 FEET

KEY:

- Water Control Structure
- Phase I Soil Boring
- Phase I Temporary Monitoring Well
- Berm
- Phase I Sediment Sample
- Proposed Phase II Sediment Sample
- Proposed Phase II Surface Water and Sediment Sample
- Wetland Area
- Proposed Phase II Soil Boring
- Proposed Phase II Soil Boring and Shallow Monitoring Well
- 1 Location Reference Number

Figure 4-4 PROPOSED SURFACE WATER/SEDIMENT SAMPLE, SOIL BORING, AND MONITORING WELL LOCATIONS — NAS PENSACOLA SITE 14 — PHASE II



SOURCE: U.S. Naval Air Station, Pensacola, Florida.

SCALE

0 250 500 FEET

451416

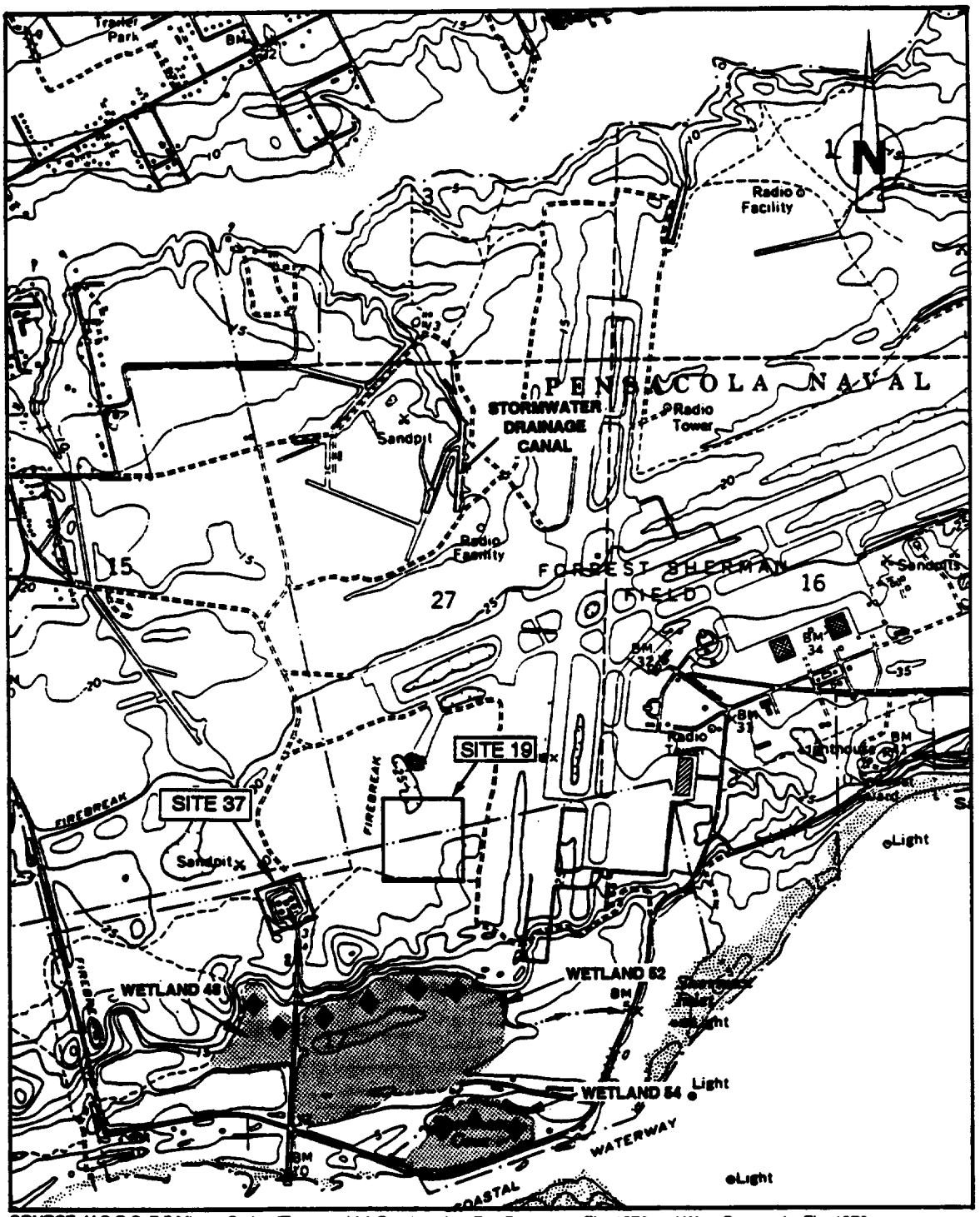
KEY:

▲ Proposed Phase I Sediment Sample

◆ Proposed Phase I Surface Water and Sediment Sample

Wetland Area

Figure 4-5 PROPOSED SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS — NAS PENSACOLA SITE 16 — PHASE I



SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970, Photorevised 1987; Ecology and Environment, Inc., 1991

KEY:

▲ Proposed Phase I Sediment Sample

◆ Proposed Phase I Surface Water and Sediment Sample

Wetland Area

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure 4-6 PROPOSED OFF-SITE SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS — NAS PENSACOLA SITES 19 AND 37 — PHASE II

151411

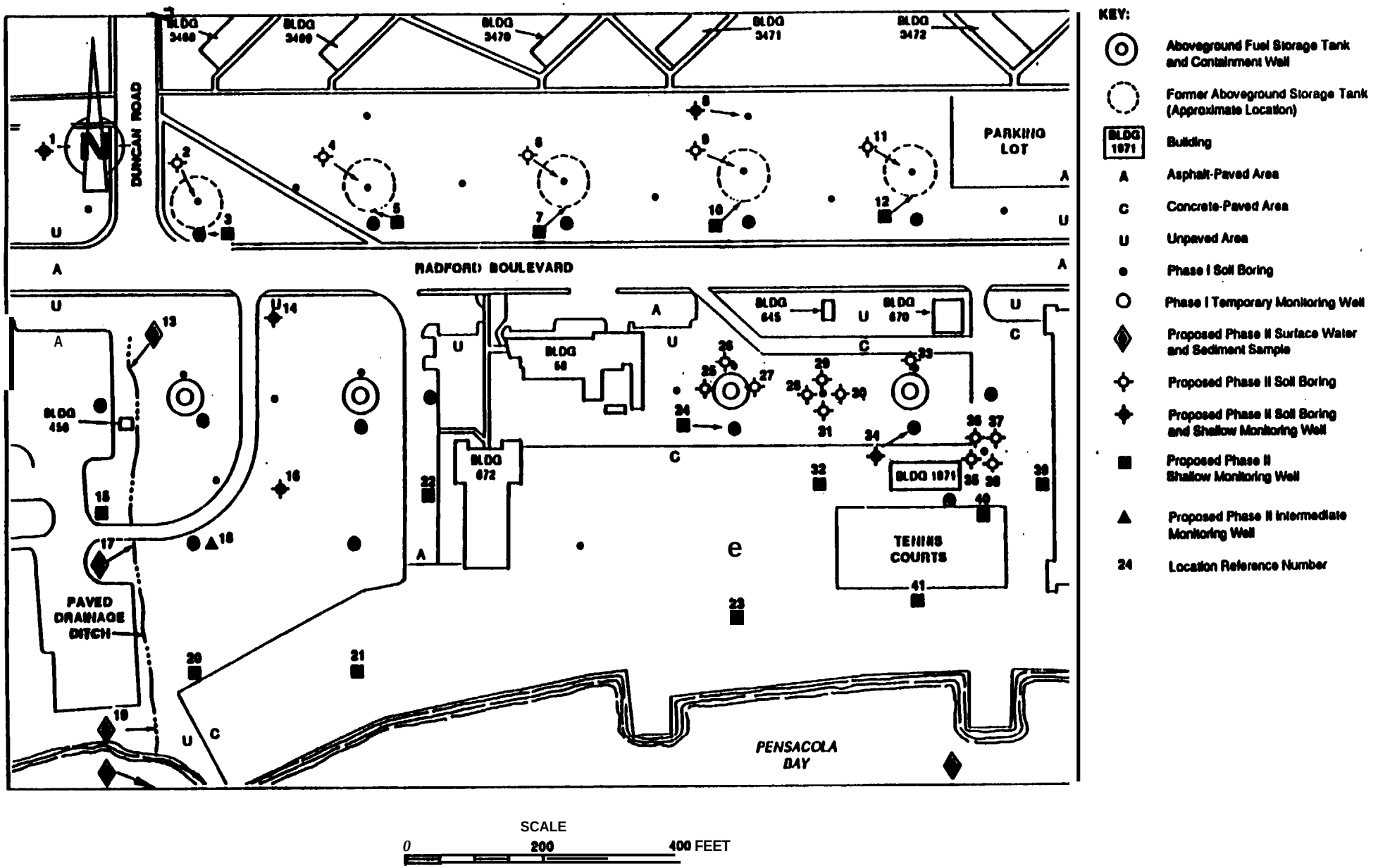
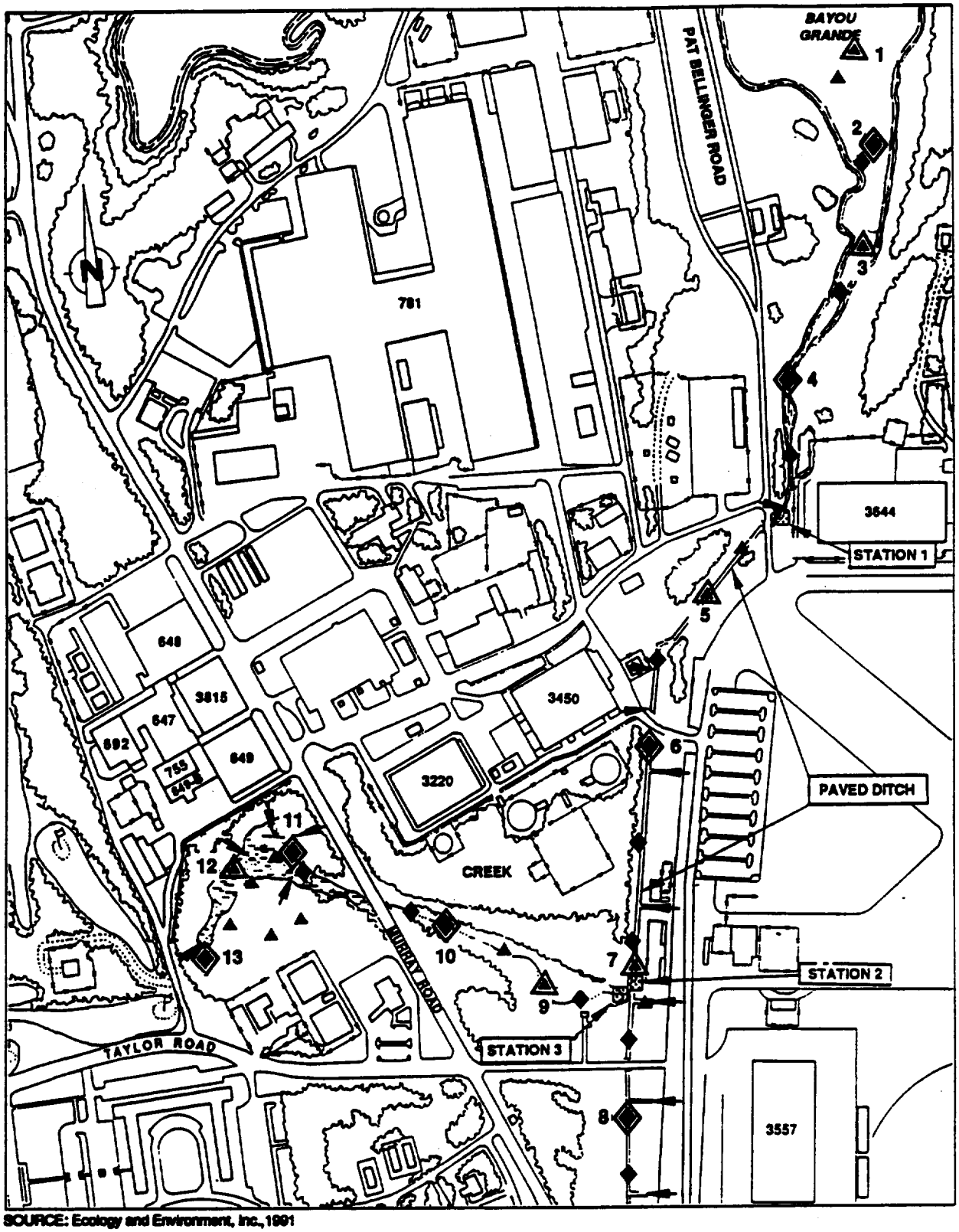


Figure 4-7

PROPOSED SURFACE WATER AND SEDIMENT SAMPLE, SOIL BORING, AND MONITORING WELL LOCATIONS — NAS PENSACOLA SITE 21 — PHASE II



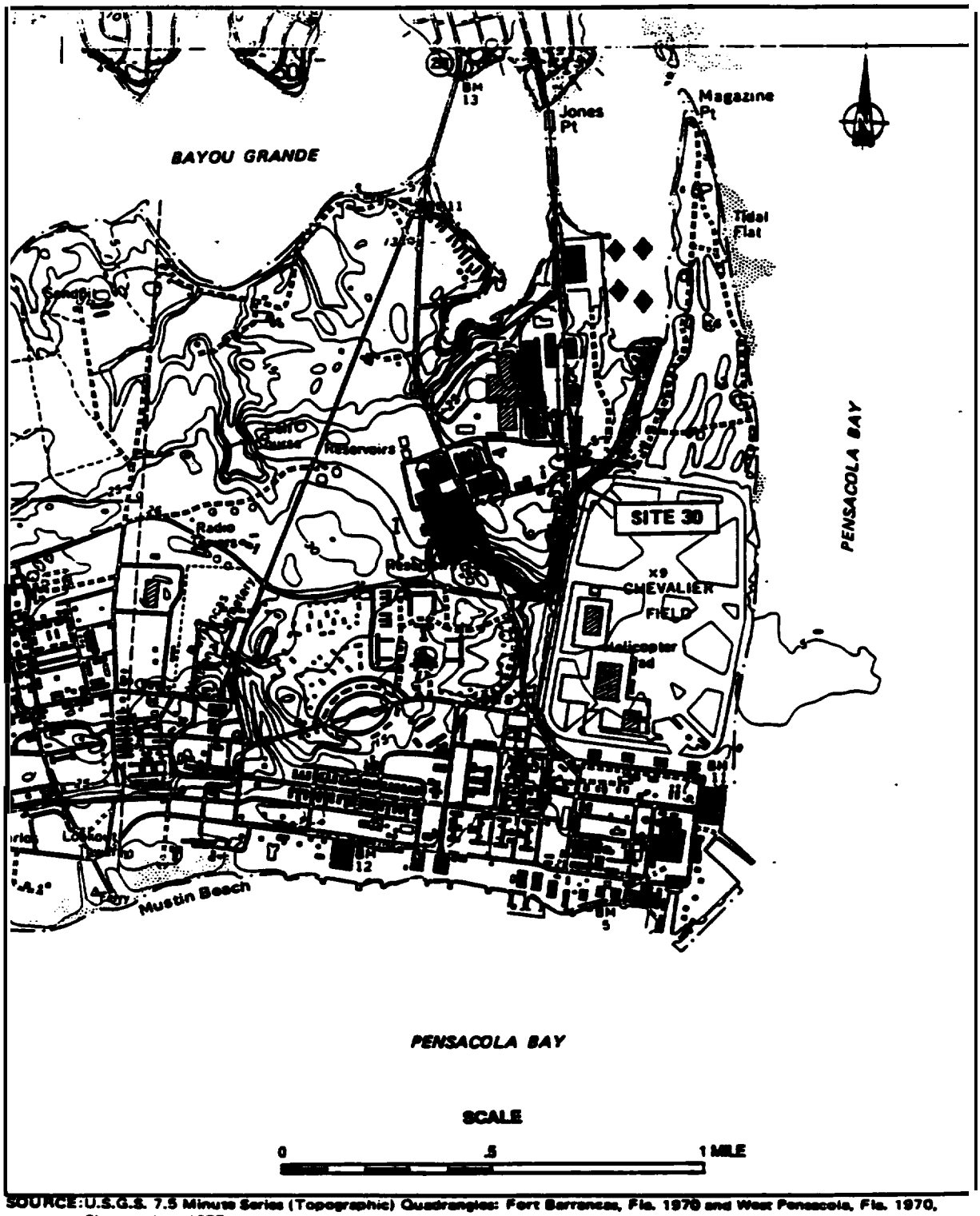
SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 200 400 600 FEET

KEY:

- ▲ Phase I Sediment Sample Location
- ◆ Phase I Surface Water and Sediment Sample Location
- ▲ Proposed Phase II Sediment Sample
- ◆ Proposed Phase II Surface Water and Sediment Sample
- 1 Location Reference Number
- Outfall

Figure 4-8 PROPOSED SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS — NAS PENSACOLA SITE 30 — PHASE II



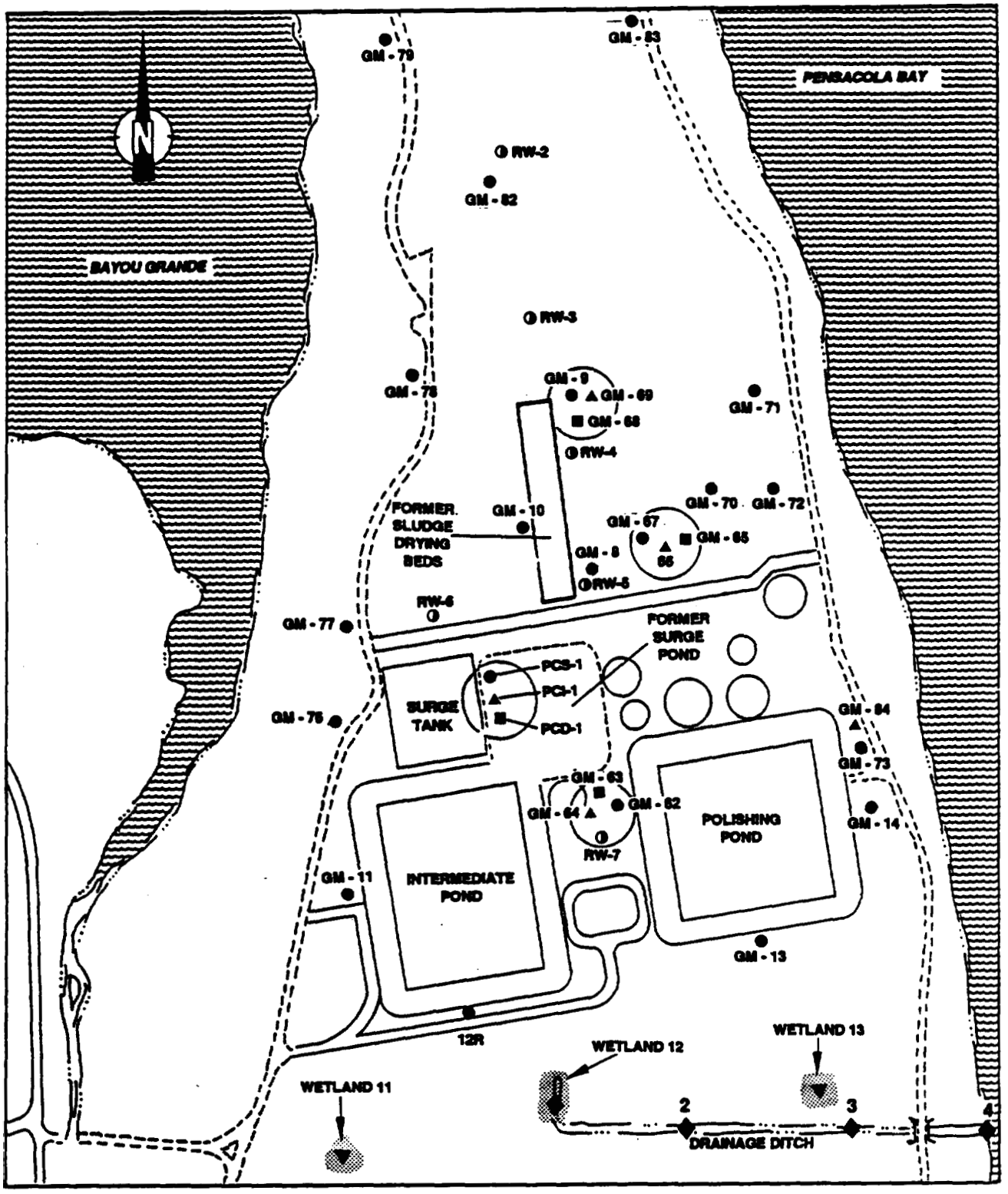
SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970, Photorevised 1987

KEY:

◆ Proposed Phase II Surface Water and Sediment Sample

151413

Figure 4-9 PROPOSED OFF-SITE SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS — NAS PENSACOLA SITE 30 — PHASE II



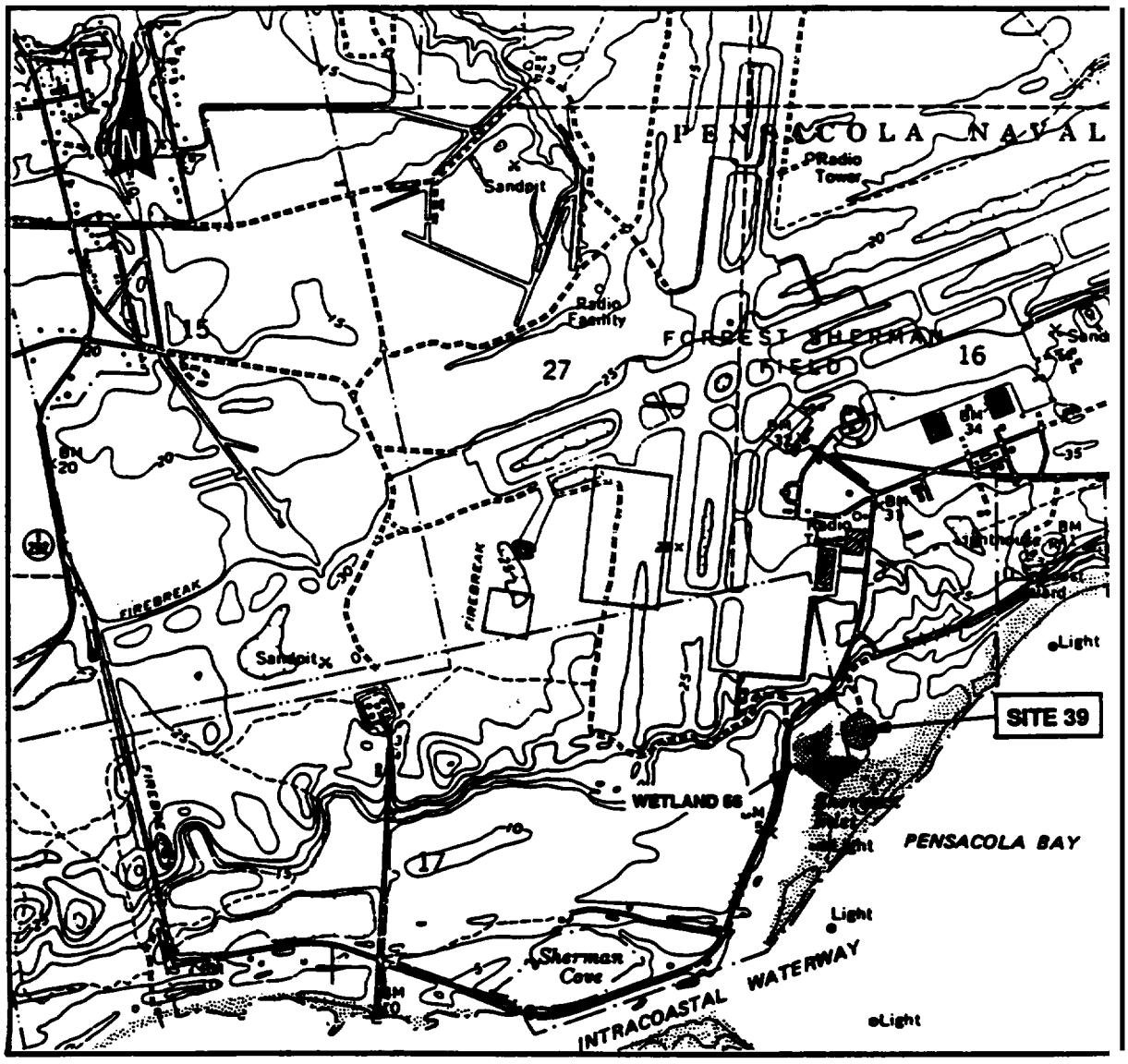
SOURCE: Ecology and Environment, Inc. 1991

SCALE
0 300 600 FEET

KEY:

- Recovery Well
- Shallow Monitoring Well (12 - 15 Feet BLS)
- Intermediate Monitoring Well (40 - 40 Feet BLS)
- Deep Monitoring Well (65 Feet BLS
- 2 Location Reference Number
- Wetland Area
- Clustered Well Sites
- Proposed Phase I Sediment Sample
- Proposed Phase I Surface Water and Sediment Sample

Figure 4-10 TENTATIVE SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS— **NAS PENSACOLA SITES 32, 33, AND 35**



SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Florida, 1970 and West Pensacola, Florida 1970, Photorevised 1987, Ecology and Environment, Inc., 1991

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

KEY:

▲ Proposed Phase I Sediment Sample

◆ Proposed Phase I Surface Water and Sediment Sample

Wetland Area

151419

Figure 4-11 PROPOSED OFF-SITE SURFACE WATER **AND SEDIMENT** SAMPLING **LOCATIONS** — NAS **PENSACOLA SITE 39 — PHASE I**

available information on sources of industrial and municipal waste, circulation patterns and flushing rates, water quality and physiochemical properties, and sediment composition and distribution in Pensacola Bay. Ecological data on community structure and function, bioaccumulation rates and pathways, potential cumulative and synergistic toxic effects, and species-specific responses to acute and chronic toxicity are also required to assess potential ecological impacts from contamination. A recent, comprehensive synthesis of published and unpublished literature on Pensacola Bay and its ecology by Collard (1991) summarizes the current environmental status of the bay ecosystem and identifies biological trends within this system. This report is a thorough source of existing information and should be referenced in the development of ecological risk assessment work plans for Pensacola Bay and Bayou Grande.

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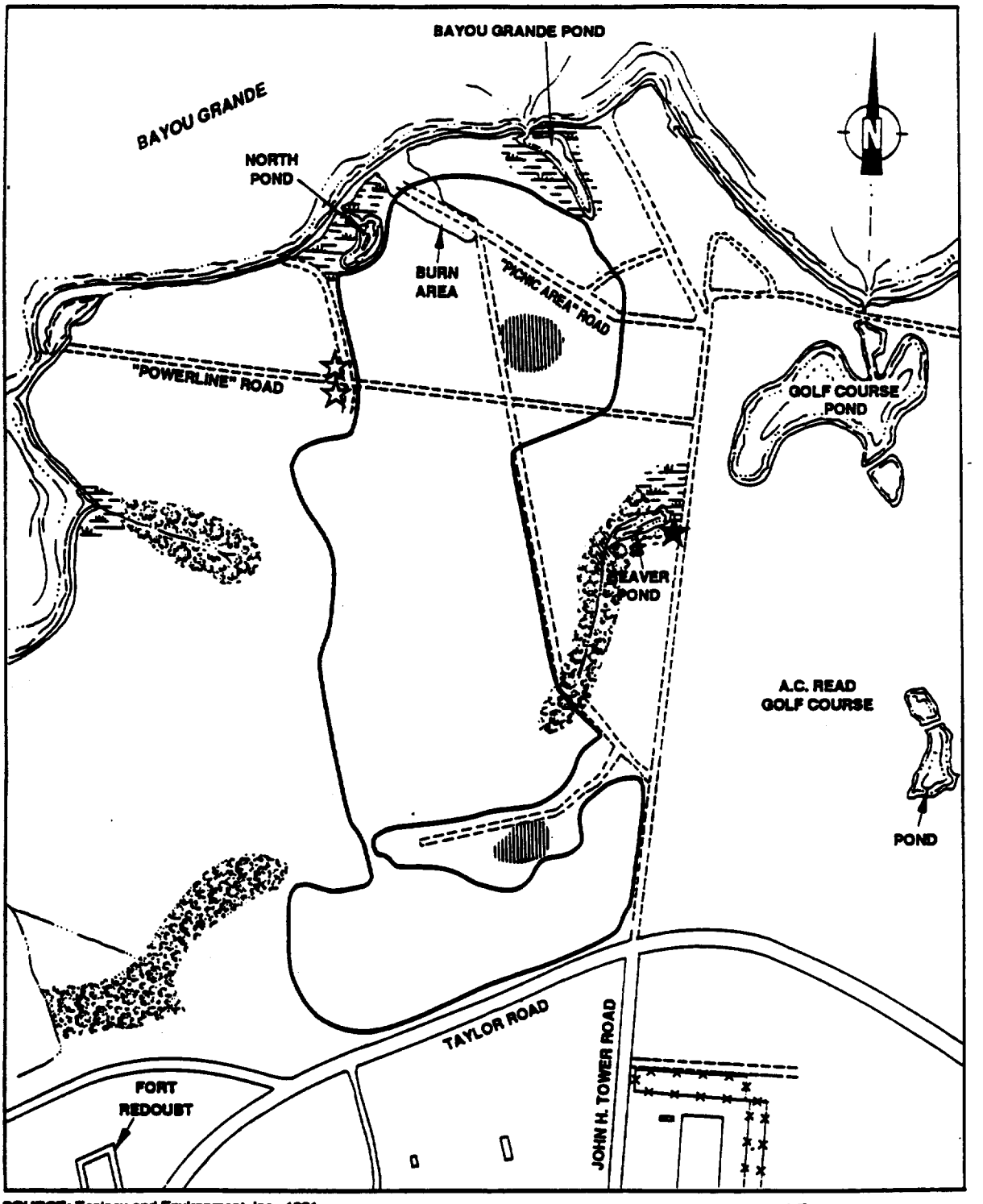
APPENDIX A

HABITAT/BIOTA MAPS

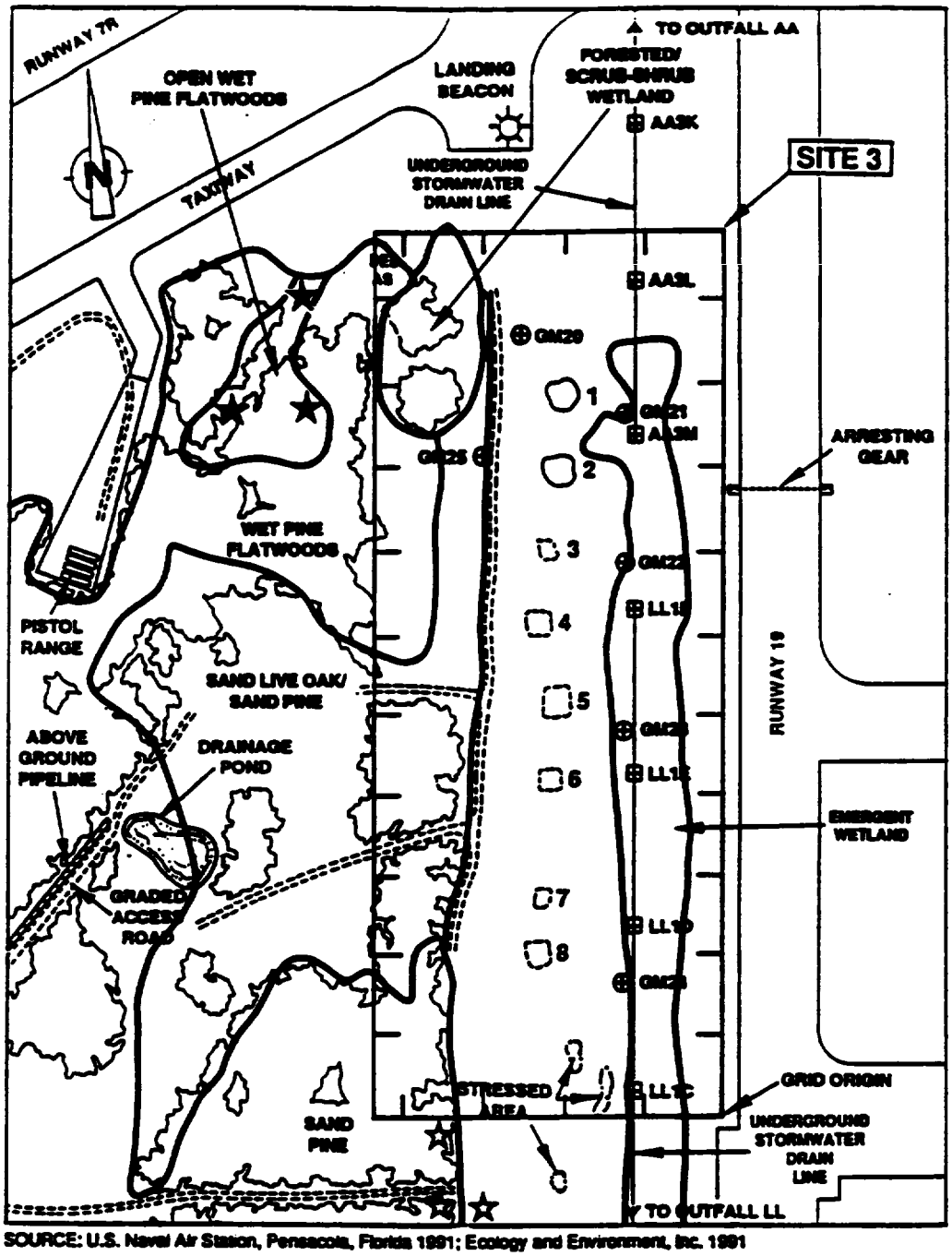


SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 500 1000 FEET

KEY:
- Landfill Boundary
- Unpaved Road
- Fence
- Location *Liparopsis carolinensis*
- Location *Polygonella macrophylla*
- Emergent Marsh
- Forested Wetland
- Scrub Shrub, Emergent Wetland

Figure 3-2 HABITAT/BIOTA *MAP* — NAS PENSACOLA SITE 1



SOURCE: U.S. Naval Air Station, Pensacola, Florida 1991; Ecology and Environment, Inc. 1991

SCALE

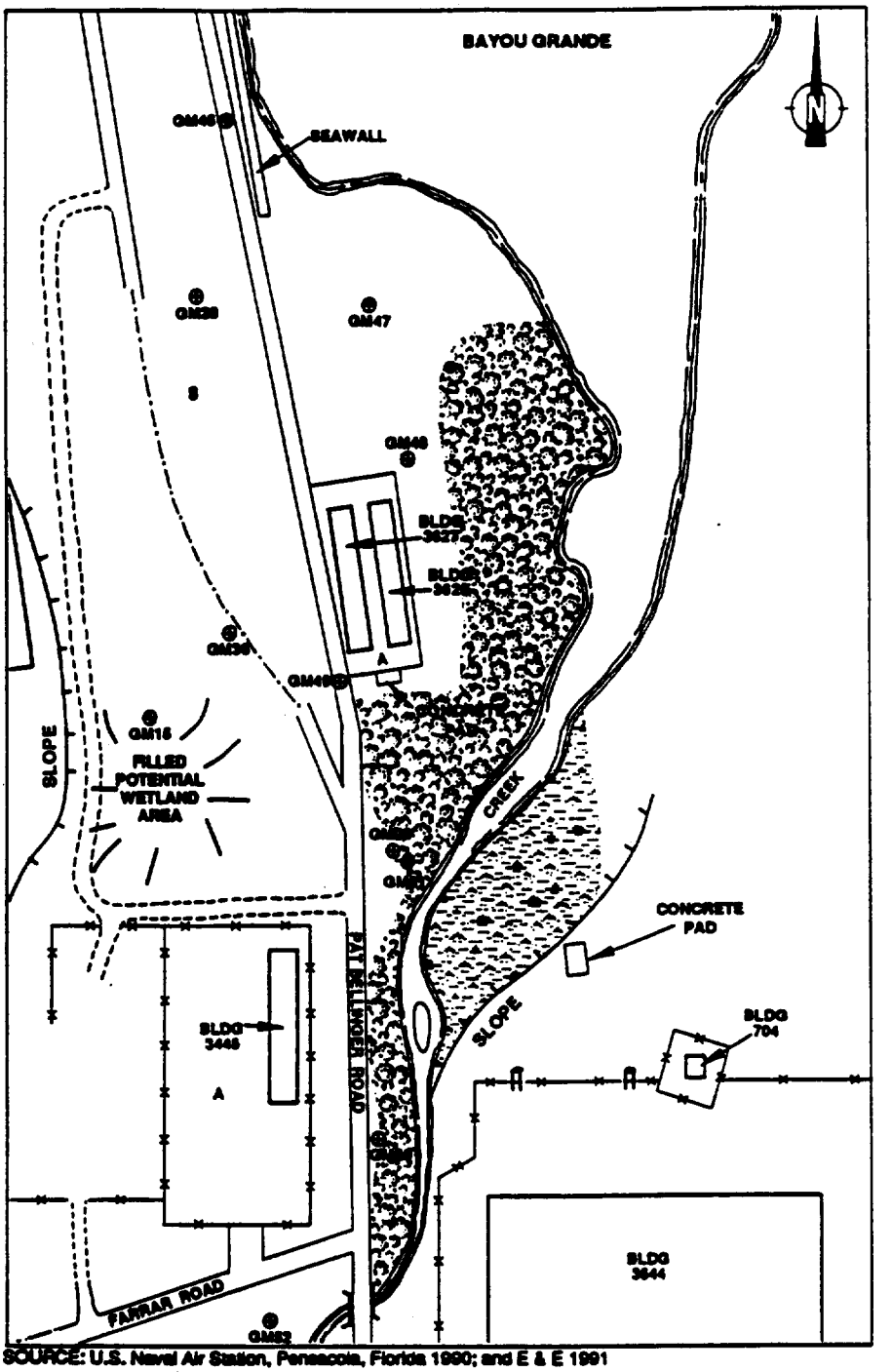
0 100 200 400 600 800 FEET

KEY:

= = = =	Jeep Trail	1	Burn Area Number
⊞	Stormwater Catch Basin with Grate	⊕	Existing Permanent Shallow Monitoring Well
AA3K/LL1C	Stormwater Catch Basin Designation	GM21	Permanent Monitoring Well Number
⬭	Active Burn Area	☆	Large-Leaved Jointweed
⬭	Former Burn Area	★	White Top Pitcher Plant

151428

Figure 3-1 HABITAT BIOTA MAP — NAS PENSACOLA SITE 3



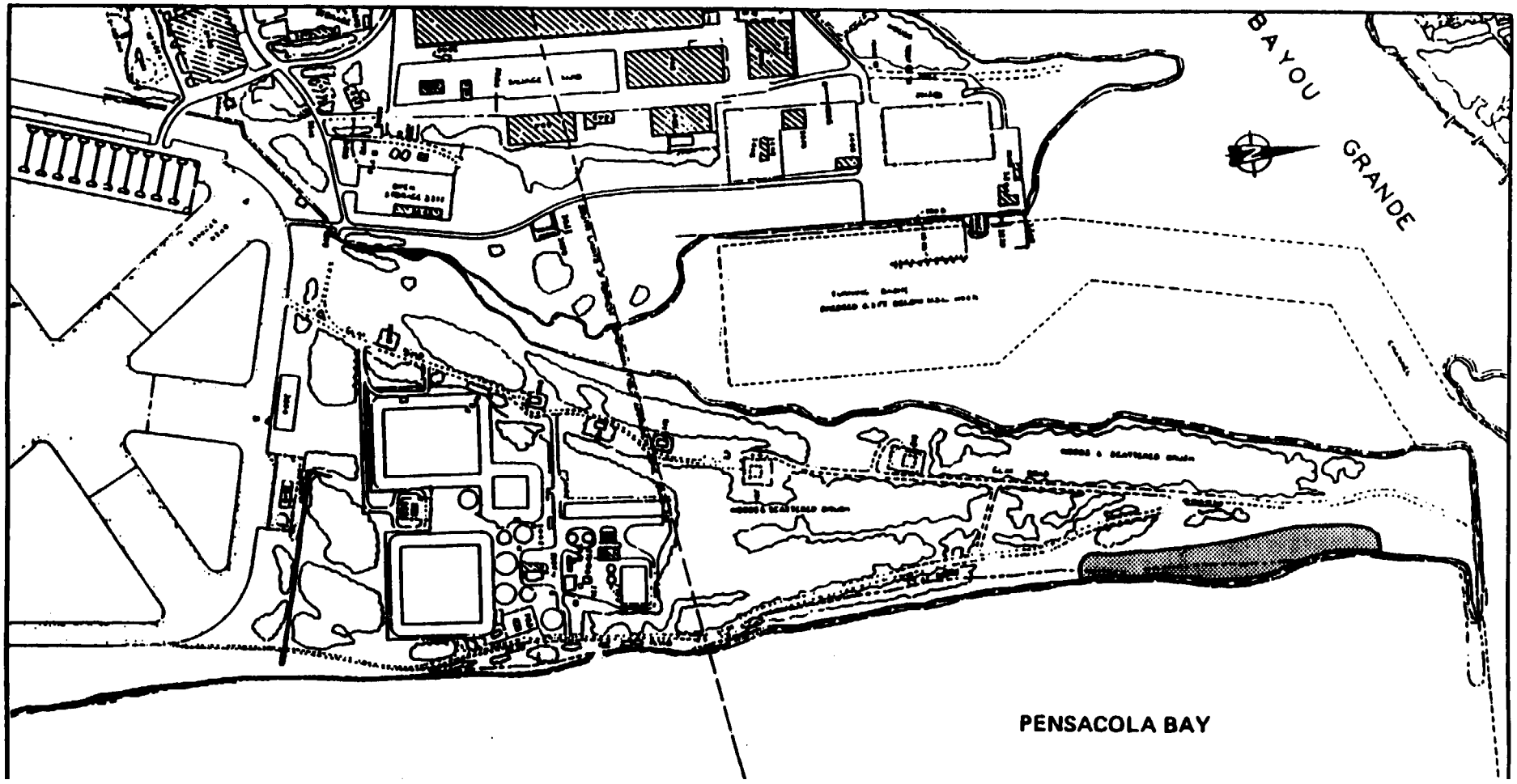
SOURCE: U.S. Naval Air Station, Pensacola, Florida 1990; and E & E 1991

KEY:

	Unmaintained Road		Outfall Pipe		Existing Permanent Deep Monitoring Well
	Abandoned Road	A	Asphalt Paved Area		Emergent Marsh
BLDG 664	Building	S	Sand		Forested Wetland
	Fence		Existing Permanent Shallow Monitoring Well		

Figure 3-1 HABITAT/BIOTA *MAP* — NAS PENSACOLA SITE 11

151423



SOURCE: U.S. Naval Air Station, Pensacola, Florida 1987 and 1988.

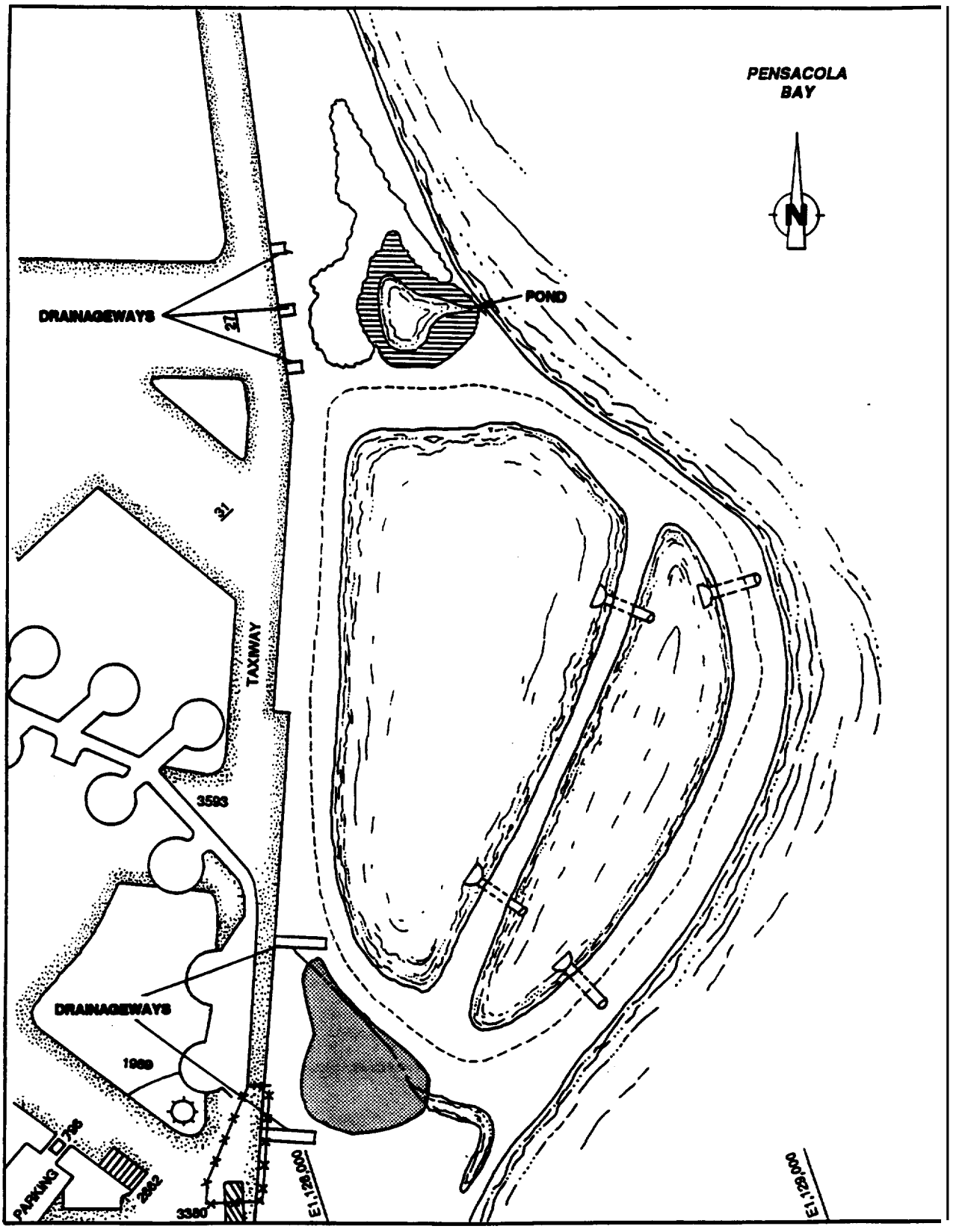
KEY:

Location of *Chrysopsis godfrey*

SCALE

0 200 400 600 800 1000 FEET

Figure 3-1 SENSITIVE HABITAT/BIOTA MAP — NAS PENSACOLA SITE 13



SOURCE: Ecology and Environment, Inc. 1991

KEY:

Water Control Structure

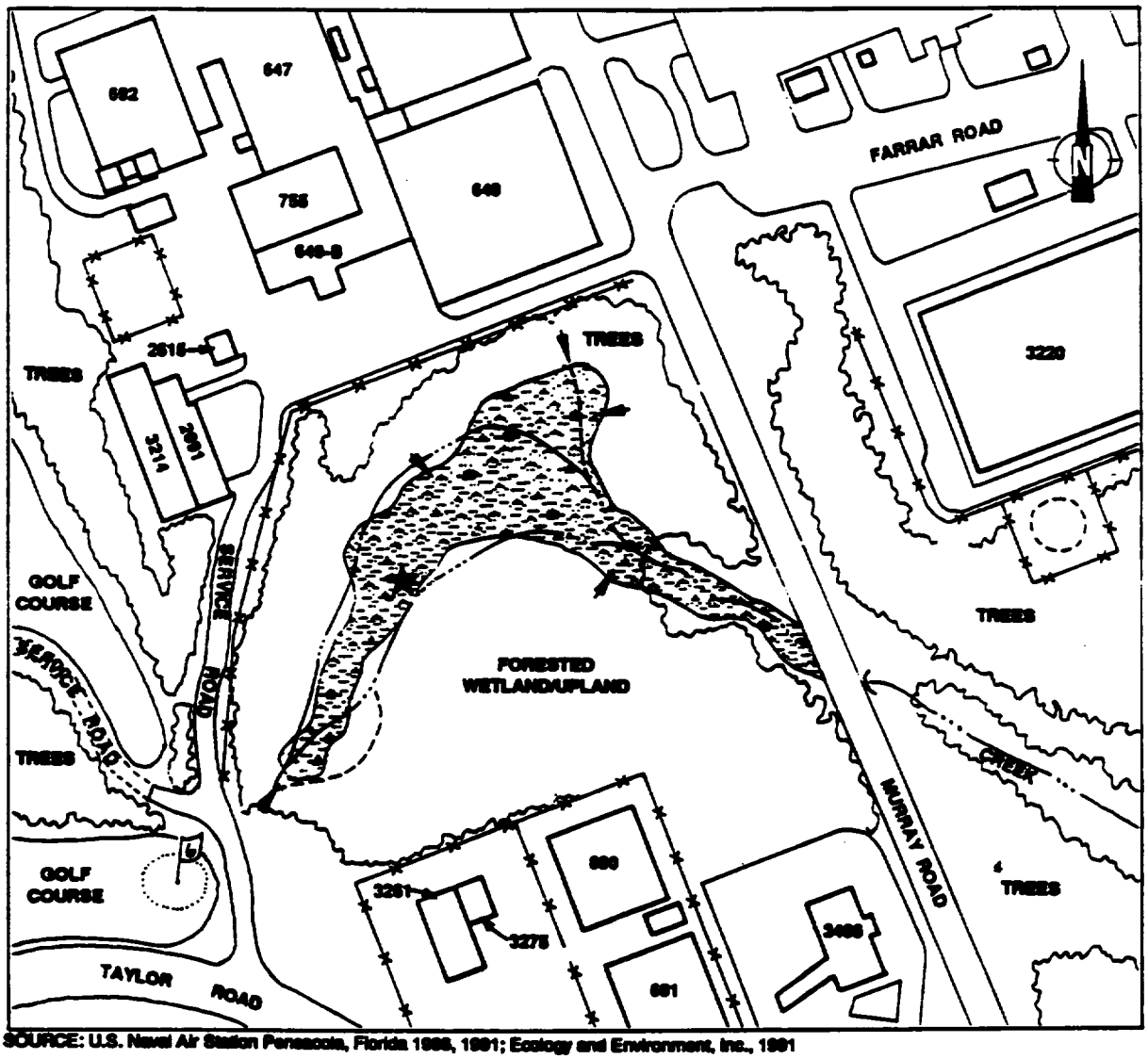
Emergent Scrub/Shrub Wetland

Disturbed Wetland Area

SCALE

200 400 FEET

Figure 3-1 SENSITIVE HABITAT/BIOTA MAP — NAS PENSACOLA SITE 14



SOURCE: U.S. Naval Air Station Pensacola, Florida 1988, 1991; Ecology and Environment, Inc., 1991

SCALE

0 200 400 FEET

KEY:

Emergent Marsh

Creek

Intermittent Creek

151430

Figure 3-1 HABITAT/BIOTA MAP — NAS PENSACOLA SITE 30