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FINAL TECHNICAL MEMORANDUM FOR ECOLOGICAL ASSESSMENT METHODOLOGY OPERABLE UNITS 1, 2 AND 7 NAS CECIL FIELD FL

12/1/1992

ABB ENVIRONMENTAL SERVICES, INC

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FINAL

TECHNICAL MEMORANDUM

ECOLOGICAL ASSESSMENT METHODOLOGY OPERABLE UNITS 1, 2, AND 7

NAVAL AIR STATION CECIL FIELD

JACKSONVILLE, FLORIDA

DECEMBER 1992

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA
29411-0068

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Previous investigations have determined that Naval Air Station (NAS) Cecil Field has 18 waste sites that may pose a threat to human health or the environment. This Technical Memorandum (TM) provides methodology that will be used in an assessment of ecological risks for Operable Units 1, 2, and 7 at NAS Cecil Field (7 sites). The TM includes the methodology that will be used in the selection of chemicals of concern, selection of endpoints, exposure assessment, ecotoxicity assessment, and risk characterization. The ecological assessment will be completed as part of the Remedial Investigation and Feasibility Study for these operable units.

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FINAL

TECHNICAL MEMORANDUM

ECOLOGICAL ASSESSMENT METHODOLOGY
OPERABLE UNITS 1, 2, AND 7
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

UIC: N60200

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FOREWORD

The Department of the Navy developed the Installation Restoration (IR) program to locate, identify, and remediate environmental contamination from the past disposal of hazardous materials at Navy and Marine Corps installations. The Navy IR program follows the Department of Defense Environmental Restoration Program mandated by the Superfund Amendments and Reauthorization Act of 1986 to address waste sites that may pose a threat to human health or the environment.

The IR program consists of Preliminary Assessment and Site Inspection, Remedial Investigation and Feasibility Study (RI/FS), and Remedial Design and Remedial Action at sites where chemicals were allegedly disposed. The Preliminary Assessment and Site Inspection identifies the presence of pollutants. The RI/FS analyzes the nature and extent of contamination and determines the optimum remedial solution. The Remedial Design and Remedial Action complete the implementation of the solution.

Previous investigations have determined that Naval Air Station (NAS) Cecil Field has 18 waste sites that may pose a threat to human health or the environment. Therefore a RI/FS will be performed to address the extent, magnitude, and impact of possible contamination at these waste sites.

This Technical Memorandum provides methodology to be used for the assessment of ecological risks for operable units 1, 2, and 7 at NAS Cecil Field. The information includes the methodology that will be used in the selection of chemicals of concern, selection endpoints, exposure assessment, ecotoxicity assessment and risk characterization.

Questions regarding this report should be addressed to the Commanding Officer, Code OOB, P.O. Box 111, NAS Cecil Field, Jacksonville, Florida 32215-0111.

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EXECUTIVE SUMMARY

This Technical Memorandum (TM) describes the methodology for completing the ecological portion of the Baseline Risk Assessment (BRA) of the Remedial Investigation (RI) to be conducted for three operable units containing seven waste sites located at Naval Air Station (NAS) Cecil Field near Jacksonville, Florida. The operable units, grouped according to either similar location or media, contain confirmed sources of contaminants. The RI and Feasibility Study (FS) are being conducted as part of the Navy's Installation Restoration program and the objective is to identify and evaluate past hazardous waste sites and control the migration of hazardous contaminants from those sites.

The TM provides information to be used for the assessment of ecological risks for Operable Units (OUs) 1, 2, and 7 at NAS Cecil Field. The information includes the methodology that will be used in the selection of chemicals of concern, selection endpoints, exposure assessment, ecotoxicity assessment, and risk characterization.

The methodology for selection of chemicals of concern is based on: comparisons of detected concentrations of each chemical with concentrations in background samples, field blanks, and laboratory blanks; ecotoxicity; and availability of ecotoxicity information.

Potential migration of contamination from the sources to aquatic and terrestrial habitats is considered in identification of potential receptors and exposure routes for the receptors. Exposure routes for ecological receptors which will be evaluated are identified based on current sampling information, and conditions and habitats present at the OUs.

The methodology for assessment of risks for aquatic receptors includes two potential phases. The Phase I assessment compares predicted chemical exposure concentrations in surface water and sediments with respective Reference Toxicity Values (RTVs) in order to evaluate risks for four groups of aquatic receptors (invertebrates, plants, fish and amphibians). The RTVs represent the lowest reported concentration of the contaminant causing adverse effects to reproduction, survival, behavior, or growth of related aquatic species. If the Phase I assessment does not provide enough information for developing remedial action objectives, appropriate Phase II methods will be implemented which provide the necessary information and reduce uncertainties of the Phase I assessment.

The methodology proposed for assessment of risks for terrestrial receptors is also phased. Phase I compares predicted chemical exposures in surface soils, diet, surface water, and sediments with respective RTVs. Risks will be evaluated for seven representative wildlife species. If the Phase I assessment does not provide enough information for characterization of risks for terrestrial receptors and the subsequent development of remedial action objectives, Phase II methods will be implemented.

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services Inc.
AIMD	Aircraft Intermediate Maintenance Department
ASTM	American Society for Testing and Materials
AWQC	Air and Water Quality Criteria
BAF	bioaccumulation factor
BCF	bioconcentration factor
BHC	benzene hexachloride
BRA	Baseline Risk Assessment
bls	below sea level
COC	chemical of concern
DCV	Detected Comparison Value
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethylene
ECT	Environmental Consulting and Technology, Inc.
EP-T	Equilibrium Partitioning Theory
FAC	Florida Administrative Code
FDER	Florida Department of Environmental Regulation
FNAI	Florida Natural Areas Inventory
FS	Feasibility Study
IR	Installation Restoration
LOEL	Lowest Observed Effect Level
NAS	Naval Air Station
NCP	National Contingency Plan
NFA	No Further Action
NOAA	National Oceanographic and Atmospheric Administration
NPL	National Priorities List
OLF	Outlying Landing Field
OU	operable unit
PCBs	polychlorinated biphenyls
PDE	potential dietary exposure
QSARS	Quantitative Structure Activity Relationships
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RTV	Reference Toxicity Values
SFF	Site Foraging Frequency
SJWMD	St. Johns Water Management District
SOUTHNAVFAC-ENGCOM	Southern Division Naval Facilities Engineering Command
SVOCs	semivolatile organic compounds

TAL	Target Analyte List
TCL	Target Compound List
TIC	Tentatively Identified Compound
TM	Technical Memorandum
TOC	total organic carbon
TPH	total petroleum hydrocarbons
UCL	Upper Confidence Limit
USEPA	U.S. Environmental Protection Agency
USFWS	U. S. Fish and Wildlife Service
VOCs	volatile organic compounds
mg/kg	milligrams per kilogram
mg/ℓ	milligrams per liter
μg/kg	micrograms per kilogram
μg/l	micrograms per liter

1.0 INTRODUCTION

This Technical Memorandum (TM) provides information on the methods to be used for assessing the ecological risks associated with seven hazardous waste sites at Naval Air Station (NAS) Cecil Field. These seven sites have been grouped into three distinct areas called Operable Units (OUs). The TM identifies the methodology that will be used in the selection of chemicals of concern (COC), selection of endpoints, exposure assessment, ecotoxicity assessment, and risk characterization that will be used in the Baseline or No Further Action (NFA) ecological assessment for each operable unit. The Baseline Risk Assessment (BRA) is required as part of the Remedial Investigation (RI) for hazardous waste sites under U.S. Environmental Protection Agency (USEPA) guidance (USEPA, 1988a). An evaluation of ecological risks associated with the NFA alternative is required as part of the Feasibility Study (FS) for each site.

The ecological assessments for OUs 1, 2, and 7 at NAS Cecil Field will be completed according to current USEPA guidance for conducting assessments at Superfund sites (USEPA, 1989a, 1989b, 1991a, 1992a and 1992b) and USEPA Region IV guidance for Superfund risk assessments (USEPA, 1991b). The ecological assessments for each of the operable units will be completed and submitted with the RI/FS report for each of the respective operable units. The ecological assessments will further be incorporated into an overall Ecological Assessment for the NAS Cecil Field facility. Ecological assessments completed for other operable units will subsequently be added to the overall assessment as they are completed. The BRA will include both human health and ecological assessments. The methodology for performing the human health risk assessment has been addressed in a separate TM (ABB-ES, 1992a).

This report is organized to provide information on the methods that will be used to complete ecological risk assessments at hazardous waste sites at NAS Cecil Field. The environmental setting of NAS Cecil Field is described in Section 2.0 and includes topography, surface hydrology, regional geology, and ecology. The individual waste sites within each of the operable units are described in Section 3.0 including waste disposal history, past sampling, and plans for future investigations. Potential pathways of contaminant migration from the individual waste sites and potential receptors are discussed in Section 4.0. The methodology for selecting chemicals of concern for inclusion in the ecological assessment is described in Section 5.0. The methodology proposed for evaluation of risks for aquatic life is presented in Section 6.0, and the methodology proposed for evaluation of risks to terrestrial receptors is included in Section 7.0. Section 8.0 provides the scope for the ecological assessment of the No Further Action remedial alternative.

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2.0 ENVIRONMENTAL SETTING

NAS Cecil Field is located in the northeastern part of Florida, primarily within Duval County with the remaining portion located in the southernmost part of Clay County (Figure 2-1). Downtown Jacksonville lies approximately 14 miles northeast of the facility's main entrance. The Georgia state line is located approximately 15 miles north.

NAS Cecil Field was established in 1941 and has grown in size to occupy more than 31,000 acres. The facility can be divided into four distinct areas: the main station (NAS Cecil Field) which occupies 9,516 acres; the Yellow Water Weapons Area which occupies 8,091 acres; Outlying Landing Field (OLF) Whitehouse which occupies 2,587 acres; and the 11,072-acre Land Target Complex Detachment Astor which includes Pinecastle, Electronic Warfare Range, Stevens Lake, Lake George, and Rodman Ranges (Envirodyne Engineers, 1985). NAS Cecil Field and the Yellow Water Weapons Area are bisected by State Road 228, effectively separating the two areas. OLF Whitehouse lies approximately seven miles north of the main entrance, which is located near the intersection of State Road 228 and 103rd Street.

The official mission of NAS Cecil Field is to provide facilities, services, and material support for the operation and maintenance of naval weapons and aircraft and other units of the operating forces as designated by the Chief of Naval Operations. Some of the tasks required to accomplish this mission include (1) operation of fuel storage facilities, (2) performance of aircraft maintenance, (3) maintenance and operation of an engine repair facility and test cells for designated turbo-jet engines, and (4) support of special weapons systems.

2.1 TOPOGRAPHY. The topography of Duval County's 840 square miles is controlled by a series of ancient marine terraces that have been dissected and modified by stream erosion. These terraces were formed during Pleistocene times when the ocean stood at higher levels. As the ocean dropped to a lower level, the ocean floor emerged as a terrace marked by a low scarp. A gently undulating topography is formed by these north to south paralleling terraces. Generally, these terraces are interspaced with poorly drained areas and swamps (Jacksonville Area Planning Board, 1980).

2.2 SURFACE HYDROLOGY. Surface drainage in Duval County consists of many short streams which serve as tributaries to four major water courses: the St. Johns River, the St. Marys River, the Nassau River, and the Intracoastal Waterway. Along the divides between the major drainage divisions, erosion has not been pronounced and, as a result, relatively wide and flat swampy areas remain. The flat swampy areas make delineation of some drainage areas difficult.

Locally, surface runoff from NAS Cecil Field is conveyed by a system of storm sewers and vegetated ditches to receiving streams bordering the facility, as indicated on Figure 2-2.

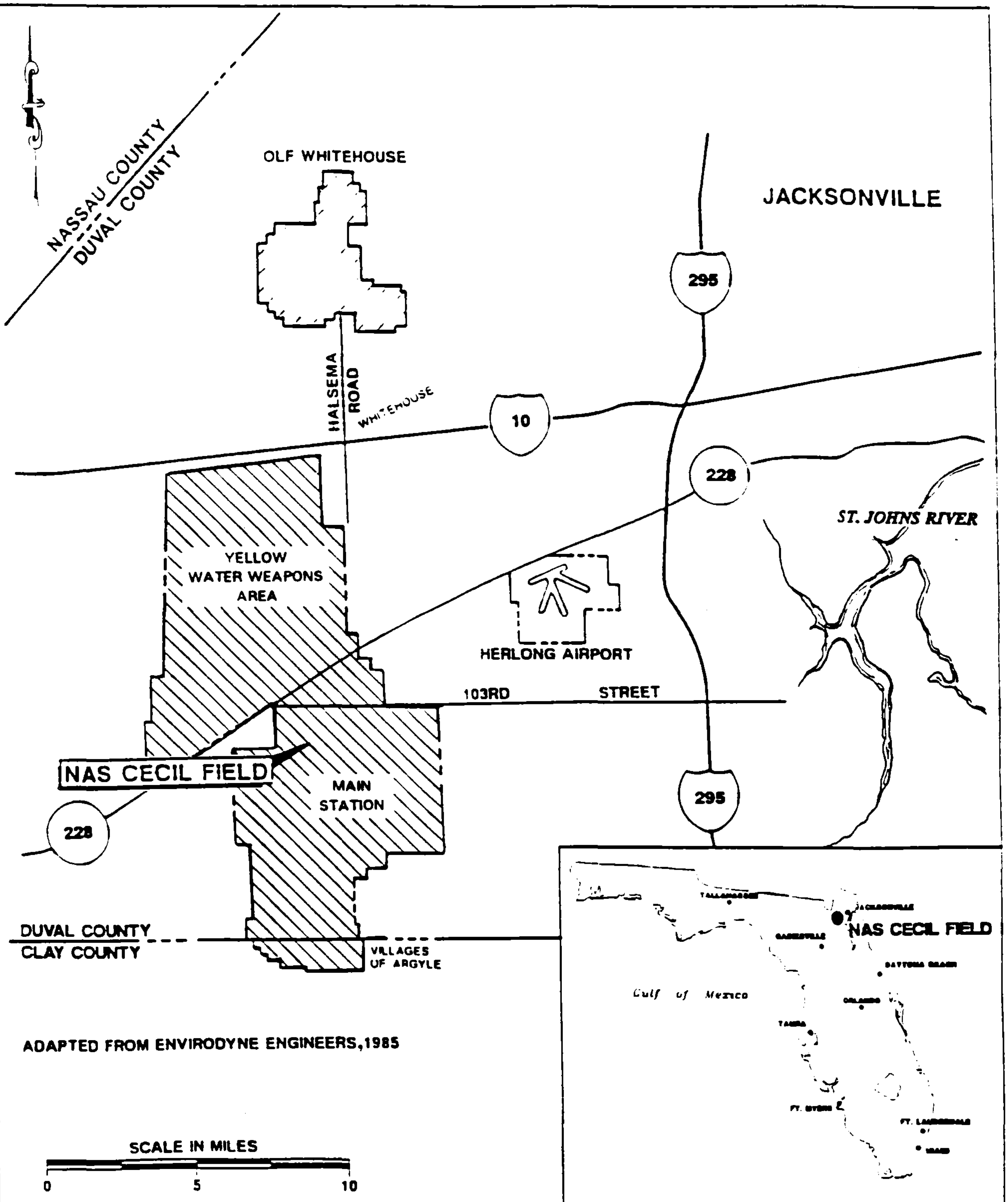

FIGURE 2-1
GENERAL LOCATION MAP

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ECOLOGICAL ASSESSMENT
METHODOLOGY
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Generally, the eastern and southern parts of NAS Cecil Field drain to Sal Taylor Creek, and the northern and western parts drain to Lake Newman, Lake Fretwell, or to Rowell Creek, which eventually discharge south to Sal Taylor Creek. Sal Taylor Creek drains in a westerly direction, discharging into Yellow Water Creek, which drains south to the St. Johns River via Black Creek. The St. Johns River drains to the Atlantic Ocean with the lower section influenced by tides.

Sal Taylor Creek, Rowell Creek, Yellow Water Creek, Black Creek, and the St. Johns River are all classified by the Florida Department of Environmental Regulation (FDER) as Class III Waters and, as such, are designated for recreation, propagation, and management of fish and wildlife (Jacksonville Area Planning Board, 1980; Florida Administrative Code [FAC], 1992). Lake Fretwell, approximately eight acres in area, is stocked with bass for sportfishing. A recreational complex has been developed along its northeastern shoreline (Southern Division, Naval Facilities Engineering Command [SOUTHNAVFACENGCOM], 1989).

2.3 REGIONAL GEOLOGY AND HYDROLOGY. NAS Cecil Field is located on the Duval Upland, which is a gently sloping ancient marine terrace that abuts westward into the sand ridges of central Florida. The sedimentary sequence that underlies the Duval Upland consists of unconsolidated sands with layers of clay, silts, and calcareous shells. These deposits range in age from upper Miocene to Holocene and contain the surficial aquifer. The surficial aquifer ranges in depth from 40 to 90 feet below land surface (bls) at the installation. The surficial aquifer sediments grade downward into the Hawthorn group. The Hawthorn group consists of interfingering units of calcareous and phosphatic clays, sands, and limestone and dolomite of middle Miocene age. The Hawthorn group deposits are encountered between 75 and 400 feet bls (Geraghty and Miller, 1983).

The upper units in the Hawthorn group constitute the secondary artesian aquifer. The lower units in the Hawthorn group function as confining units, thus separating and confining the underlying Floridan Aquifer from the secondary artesian aquifer.

2.4 ECOLOGY. Information on the ecological setting of NAS Cecil Field is available in the "Initial Assessment Study" completed by Envirodyne Engineers in 1985. This information is summarized in the following sections for aquatic and terrestrial wildlife habitats. Further characterization of habitats will be completed as part of the ecological assessment for each OU.

2.4.1 Aquatic Habitat Small streams, totaling approximately 8 miles, are present on NAS Cecil Field property (Figure 2-2). These streams include Yellow Water Creek, Sal Taylor Creek, and Rowell Creek, as well as smaller tributaries. Two man-made lakes are located on the facility: Newman Lake and Lake Fretwell. Both lakes are a part of the Rowell Creek drainage area. These waters are classified as Class III Waters for recreation, propagation, and management of fish and wildlife by the FDER (FAC, 1992).

2.4.2 Terrestrial Wildlife Habitat Three major terrestrial habitat types were identified at NAS Cecil field during the Initial Assessment Study (IAS). These habitats are pine flatwoods association, sandhill communities, and swamp forest associations (Envirodyne Engineers, 1985).

The pine flatwoods association are the most extensive forest in Duval County. The soils are sandy with a moderate amount of organic matter in the top few centimeters and an acidic, organic hardpan 0.3 to 1.0 m (1 to 3 feet) beneath the surface. This hardpan reduces rainfall percolation and impedes root penetration during droughts. Thus standing water is common during the rainy season (Envirodyne Engineers, 1985).

Three major types of pine flatwoods occur in Florida: (1) longleaf pine (*Pinus palustris*) with long leaf pine as the dominant overstory trees in well drained areas; (2) slash pine (*P. elliottii*) flatwoods with slash pine as the dominant overstory species in areas of intermediate wetness; and, (3) pond pine (*P. serotina*) flatwoods with the pond pine as the dominant tree species typical in poorly drained areas (Envirodyne Engineers, 1985).

The forestry program at NAS Cecil Field, which began in 1963, has resulted in reforestation of 97% of the area with slash pine. Thus pine flatwoods are the predominant community type for the NAS Cecil Field vicinity. Vegetation characteristics of disturbed locations found within the reforested areas include: fennel (*Eupatorium* sp.), beggar's tick (*Bidens* sp.), greenbriar (*Smilax* sp.), sandbur (*Cenchrus* sp.) and rattlebox (*Sesbania* sp.) (Envirodyne Engineers, 1985).

Sandhill communities occur on well-drained white to yellowish sands. Longleaf pines (*P. palustris*) form the overstory while a variety of oaks (*Quercus* sp.) form the understory in mature natural stands. However, due to forestry and prevention of fires, oaks became predominant and prevent the reestablishment of pine. When this situation is perpetuated, the sandhill community becomes similar to a xeric or mesic hammock with a dense stand of oaks and changes in the growth and development of the underbrush. This situation occurs infrequently at NAS Cecil Field. Many of the former sandhill areas are predominated by plant species characteristic of disturbed areas including fennel, beggar's tick, green briar, sandbur, and rattlebox (Envirodyne Engineers, 1985).

The swamp forest association is predominated by deciduous hardwoods that border rivers and streams where the forest floor is saturated or submerged during part of the year. The southern portion of Rowell Creek, Sal Taylor Creek and some of its lesser tributaries to the east are typified by this association at NAS Cecil Field. Red maple (*Acer rubrum*), water oak (*Quercus nigra*), swamp bay (*Persea palustris*), and sweet gum (*Liquidambar styraciflua*) are common along these drainage pathways. Occasional bayheads, scattered about in the pine flatwoods, harbored many of the same species stated above as well as an occasional bald cypress (*Taxodium distichum*) (Envirodyne Engineers, 1985).

2.4.3 Wetlands Wetlands identified at NAS Cecil Field include bay swamp, cypress domes, and hardwood swamp (SOUTHNAVFACENGCOM, 1988). The locations of wetlands are mapped on Figure 2-3.

Bay swamp wetlands are associated with Sal Taylor Creek to the east of the runways with additional acreage north of 103rd Street and Normandy Boulevard. Bay swamp areas are located at the slower moving headwaters of the various creeks. Some bay swamps on the facility are isolated. These areas include loblolly bay (*Gordonia lasianthus*), sweet bay (*Magnolia virginiana*), swamp bay (*Persea palustris*) and red maple (*Acer rubrum*). Other canopy species include sweetgum (*Liquidambar styraciflua*), Carolina willow (*Salix caroliniana*), Chinese tallow tree (*Sapium sebiferum*), and bald cypress (*Taxodium distichum*). Loblolly bay, sweet bay, swamp bay, red maple, and wax myrtle (*Myrica cerifera*) dominate the subcanopy. Ground cover species include cinnamon fern (*Osmunda cinnamomea*), shield fern (*Thelypteris kunthii*), and elderberry (*Sambucus canadensis*) (SOUTHNAVFACENGCOM, 1988).

Hardwood swamps are found in association with Rowell Creek and Yellow Water Creek. Dominant canopy species found in the hardwood swamps include tupelo (*Nyssa sylvatica* var *biflora*), red maple (*Acer rubrum*), and sweetgum (*Liquidambar styraciflua*). Other canopy species include bald cypress (*Taxodium distichum*), water oak (*Quercus nigra*), laurel oak (*Quercus lauifolia*), and Carolina willow (*Salix caroliniana*). Along the edges of the hardwood swamp, loblolly pine (*Pinus taeda*) and pond pine (*Pinus serotina*) can also be found. The subcanopy within the swamp is dominated by smaller tupelo, red maple, sweetgum, and wax myrtle (*Myrica cerifera*). The ground cover is dominated by cinnamon fern (*Osmunda cinnamomea*), shield fern (*Thelypteris kunthii*), and elderberry (*Samubucus canadensis*). The main stream channel is vegetated along the edge by such species as pickerelweed (*Ponteria* sp.), alligator weed (*Alternanthera philoxeroides*), spatterdock (*Nuphar luteum*), and lizard's tail (*Saururus cernuus*) (SOUTHNAVFACENGCOM, 1988).

A series of drainage ditches are connected to the hardwood swamps. These drainage ditches often connect to a low cypress dome or bay swamp. The drainage ditches are vegetated mostly with cattail (*Typha latifolia*), pickerelweed, alligator weed, spatterdock, and lizard's tail (SOUTHNAVFACENGCOM, 1988).

Cypress domes are scattered across the base. These are generally isolated circular depressional wetlands found among pine trees. They are often dry for part of the year. Dominant canopy species include bald cypress (*Taxodium distchum*), tupelo (*Nyssa sylvatica* var. *biflora*), and either slash pine (*Pinus elliottii*) or loblolly pine (*Pinus taeda*). Other common trees include red maple and wax myrtle. The subcanopy is generally dominated by the same vegetation as the canopy. Ground cover species include cinnamon fern, Virginia chain fern (*Woodwardia virginica*), St. John's wort (*Hypericum fasciculatum*), and Red root (*Lachnanthes caroliniana*) (SOUTHNAVFACENGCOM, 1988).

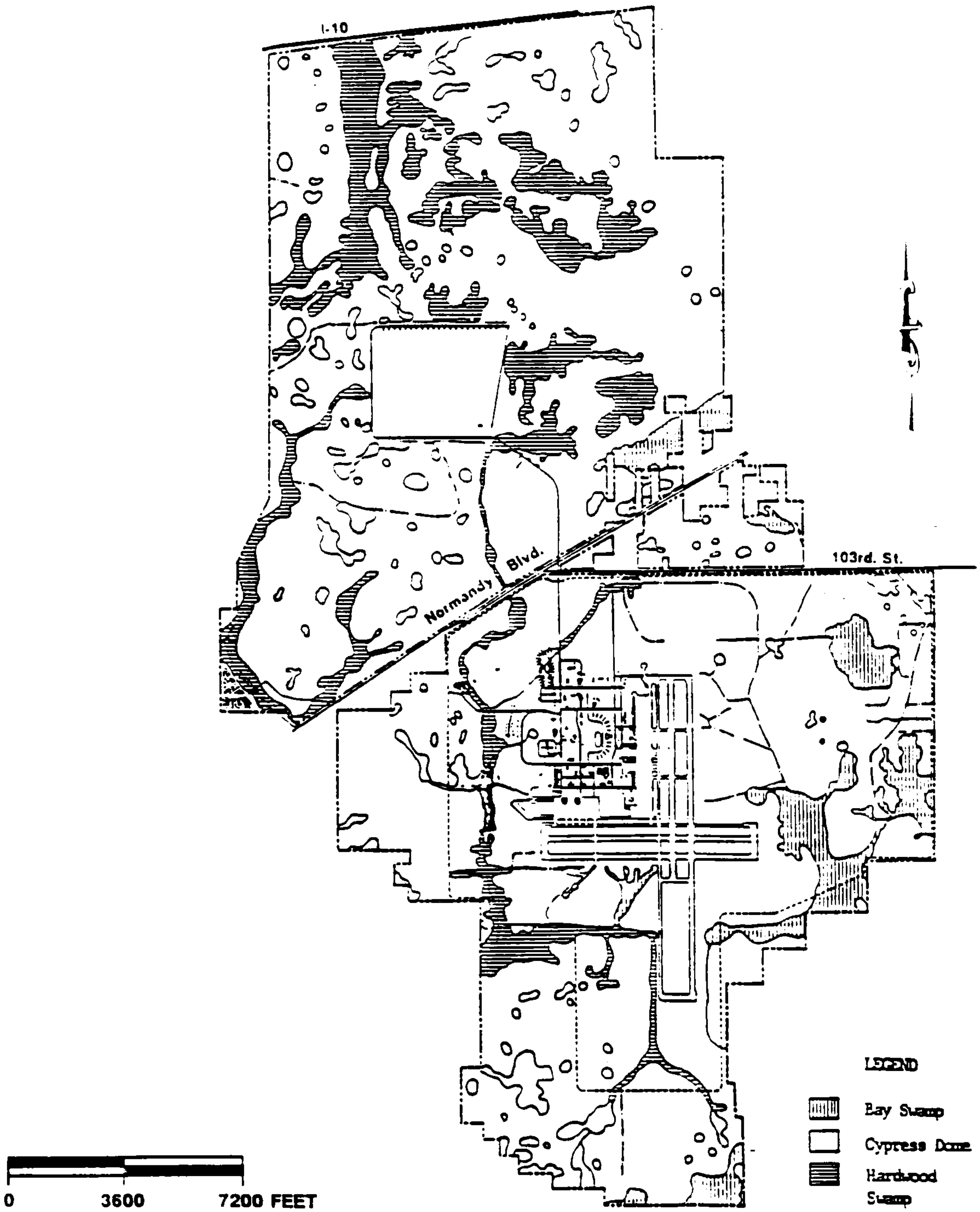

FIGURE 2-3
LOCATIONS OF WETLANDS

SOURCE: SOUTHNAVFACENGCOM, 1988

TECHNICAL MEMORANDUM
ECOLOGICAL ASSESSMENT
METHODOLOGY
FOR OUs 1, 2, AND 7
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

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2.4.4 Rare, Endangered, and Threatened Species Rare, endangered, and threatened species identified as potentially residing on NAS Cecil Field are listed in Table 2-1 with corresponding state and federal designations. The list is based on a review of available information including the Initial Assessment Study (Envirodyne Engineers, 1985), a rare and endangered plant survey report (ESP, 1990), and the Technical Memorandum for Supplemental Sampling at OUs 1, 2, and 7 (ABB-ES, 1991a). Correspondence has been initiated to confirm this information with appropriate personnel of the United States Fish and Wildlife Service (USFWS), base personnel, the Florida Game and Fresh Water Fish Commission, the National Oceanographic and Atmospheric Administration (NOAA), and the Florida Natural Areas Inventory (FNAI).

Table 2-1
Rare, Endangered and Threatened Flora and Fauna at NAS Cecil Field

Naval Air Station Cecil Field
Jacksonville, FL

Common Name	FGFWFC[1]	FNAI[2]	USFWS[3]	Comments
Gopher tortoise (*Gopherus polyphemus*)	SSC		T	Confirmed resident
American alligator (*Alligator mississippiensis*)	SSC		T(S/A)	Confirmed resident
Eastern indigo snake (*Drymarchon corais couperi*)	T		T	Confirmed resident
Wood stork (*Mycteria americana*)	E		E	Lake Fretwell
Southeastern kestrel (*Falco sparverius paulus*)	T		UR2	Confirmed Migrant
Artic Peregrine falcon (*Falco peregrinus tundrius*)	E		T	Confirmed Migrant
Bald eagle (*Haliaeetus leucocephalus*)	T		E	Confirmed Migrant
Florida gopher frog (*Rana areolata aesopus*)	SSC		UR2	Suitable Habitat Present
Sherman's fox squirrel (*Sciurus niger shermani*)	SSC		UR2	Possible resident of pine woods. Confirmed resident of similar habitat at NAS Jacksonville.
Florida black bear (*Ursus americanus floridanus*)	T		UR2	Evidence of black bears reported in outlying areas in 1982.
Florida mouse (*Peromyscus floridanus*)	SSC		UR2	Known from Clay County, may range into habitats (sand pine scrub and longleaf pine-turkey oak communities) present at NAS Cecil.
Florida threeawn (*Aristida rhizomorpha*)		S2S3		Widespread in pine flatwoods/pine plantations at NAS Cecil Field.
Florida toothache grass (*Ctenium floridanum*)		S2	UR5	Found at one location at NAS Cecil in ecotone between slash pine plantation and sandhill.

Table 2-1
Rare, Endangered and Threatened Flora and Fauna at NAS Cecil Field

Naval Air Station Cecil Field
Jacksonville, FL

Common Name	FGFWFC[1]	FNAI[2]	USFWS[3]	Comments
Spoon-leaved sundew (*Drosera intermedia*)	T			Found at one location at Yellow Water Weapons area in drainage ditch.
Bartram's ixia (*Sphenostigma coelestinum*)	T		UR2	
Wood Stork (*Mycteria americana*)	E		E	Known forager in Lake Fretwell. Nesting attempted and discouraged.
Variable-leaf crown beard (*Verbesina heterophylla*)			UR1	Found at one location at NAS Cecil Field in sandhill habitat.

E = Endangered
T = Threatened
SSC= Species of Special Concern
UR1= Under review for federal listing, with substantial evidence in existence indicating at least some degree of biological vulnerability and/or threat
UR2 = Under review for listing, but substantial evidence of biological vulnerability and/or threat is lacking.
UR5= Still formally under review for listing, but no longer considered for listing because recent information indicates species is more widespread or abundant than previously believed.
T(S/A) = Threatened due to similarity of appearance
S2 = Imperiled in state because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some biological or man made factor.
S3 = Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction because of other factors (ESP, 1990).
[1] Florida Game and Fresh Water Fish Commission (list published in Section 39-27.003-005, Florida Administrative Code).
[2] Florida Natural Areas Inventory (FNAI) list rankings (ESP, 1990).
[3] United States Fish and Wildlife Service (list published in List of Endangered and Threatened Wildlife and Plants, 50 CFR 17.11-12).

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3.0 WASTE SITES AND OPERABLE UNITS.

Waste sites located at NAS Cecil Field (Figure 3-1) have been divided into seven OUs based on the types of wastes disposed or typical profiles of suspected contaminants (SOUTHNAVFACENGCOM, 1991). OU 1 (Sites 1 and 2), OU 2 (Sites 3, 4, 5, and 17), and OU 7 (Site 16) are the first OUs to be investigated and RI/FS activities are ongoing. The wastes sites in the remaining four operable units will be addressed during RI/FS activities. Separate ecological assessments for each of the operable units will be completed as components of the respective RI/FS reports. Upon completion of the ecological assessment for each Operable Unit, the data will be incorporated into an Interim Ecological Baseline Risk Assessment for the entire NAS Cecil Field facility. Information from each OU will be added to the interim document as it becomes available. The end result will be a Baseline Facility Ecological Assessment which evaluates risks posed by all waste sites on the facility.

The following sections provide information on the history of each waste site including sampling and analyses of soils, sediments, surface water, and groundwater. Field investigations are currently in progress at OUs 1, 2 and 7. A TM for Supplemental Sampling at OUs 1, 2 and 7 (ABB-ES, 1992b) provides a summary of the results of the past investigations and describes future planned investigations. This TM does not repeat the information in the TM for Supplemental Sampling. Discussion of the investigation results is limited to listing the contaminants detected in groundwater, subsurface soils (0 to 2' interval), surface water and sediments. Proposed surface soil, surface water and sediment sampling for each of the waste sites is also discussed as they pertain to assessment of chemical exposures. Once ABB-ES has completed the field investigations at OUs 1, 2 and 7, the baseline ecological assessment will be completed according to the methodology outlined in this TM (Sections 5.0, 6.0, 7.0 and 8.0).

3.1 OPERABLE UNIT 1 (SITES 1 and 2). Sites 1 and 2, the Old and Recent Landfills, respectively, are included in OU 1. These landfills reportedly received solid and liquid wastes from various activities at NAS Cecil Field. The sites physically overlap and have been partially covered with unidentified fill (ABB-ES, 1991a). A ditch runs along the north side of Site 1 (south side of Site 2) and drains to Rowell Creek.

Site 1 was a 9-acre trench and fill landfill (1,250 feet north to south by 425 feet east to west) that was used daily for the burning of solid and some liquid and chemical waste from NAS Cecil Field (Envirodyne Engineers, 1985). During its time of operation (early 1950's through 1965), Site 1 was the only landfill operated at the facility. Wastes were placed in direct contact with groundwater at the time of disposal (Envirodyne Engineers, 1985).

Vegetation at Site 1 is typical of a hardwood swamp habitat. Sweetgum is the dominant overstory tree with occasional swamp bay (ABB-ES, 1991b). Other plants present include various herbs, vines, shrubs, saplings, ferns, and red maple (ABB-ES, 1991b). The NAS Cecil

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Field Stormwater Master Plan (Seaburn and Robertson, 1985) identifies Sites 1 and 2 as being within the 100-year floodplain.

Site 2 is reported to be a 5-acre trench and fill landfill (375 feet north to south by 600 feet east to west) that received all of the solid and some of the chemical and liquid waste from NAS Cecil Field from 1965 through 1975. Trenches approximately 600 feet long, averaging 11 feet wide and 11 feet deep, were reported to be oriented from east to west (Envirodyne Engineers, 1985). Burning was not intentionally done, although fires did periodically occur. Portions of the waste were placed in direct contact with groundwater. Suspected waste types disposed of at Site 2 include metals, polychlorinated biphenyls (PCBs), and pesticides (Envirodyne Engineers, 1985). Vegetation at the site includes herbs, shrubs and slash pine (ABB-ES, 1991b).

A total of 19 groundwater monitoring wells have been installed at OU 1. Volatile Organic Compounds (VOCs) detected in groundwater samples from the wells include 2-butanone, methylene chloride, toluene, and xylene. Naphthalene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, phenol, chromium, and lead were also detected. Groundwater from Sites 1 and 2 generally flows toward Rowell Creek.

Five sets of surface water and sediment samples were collected in the vicinity of sites 1 and 2. Two sets were collected in the tributary north of Site 1 and three additional sets were collected from Rowell Creek. Two VOCs, benzene, and chlorobenzene, were detected in the surface water samples (Figure 3-2). Sediment samples from the same locations contained chlorobenzene, xylene, and carbon disulfide. Semivolatile organic compounds (SVOCs) were detected in all sediment samples except one. SVOCs detected include di-n-butylphthalate, pyrene, bis(2-ethylhexyl)phthalate, fluoranthene, and 4-chlorophenyl-phenylether. Benzoic acid was the only SVOC detected in surface water samples. Dichloro-diphenyltrichloroethane (DDT), dichlorodiphenyldichloroethane (DDD), dichlorodiphenyl-dichloroethylene (DDE), and polychlorinated biphenyls (PCBs) were detected in one sediment sample in Rowell Creek adjacent to Site 1 (Figure 3-2).

Further sampling of sediments and surface water is proposed for Sites 1 and 2 (ABB-ES, 1992a). Two additional sets of samples will be collected from the tributary east of Site 2 (Figure 3-2) and four additional sets will be collected from Rowell Creek, adjacent to Site 1. The purpose of this proposed sampling is to identify migration of contamination from Sites 1 and 2 to Rowell Creek, and to confirm the presence of DDT and PCBs.

Twenty-four surface soil samples will also be collected at Sites 1 and 2 (Figure 3-2). This information will be used to estimate exposures for the ecological assessment. Thirteen surface soil samples will be taken at selected locations within the areas historically defined as the landfill (Figure 3-2). Eight samples will be collected on the perimeter of the landfills. Four of these samples are biased in the direction of overland water flow (the east side of Site 1). All samples will be analyzed for target compound list (TCL) organics, and target analyte list (TAL) inorganics.

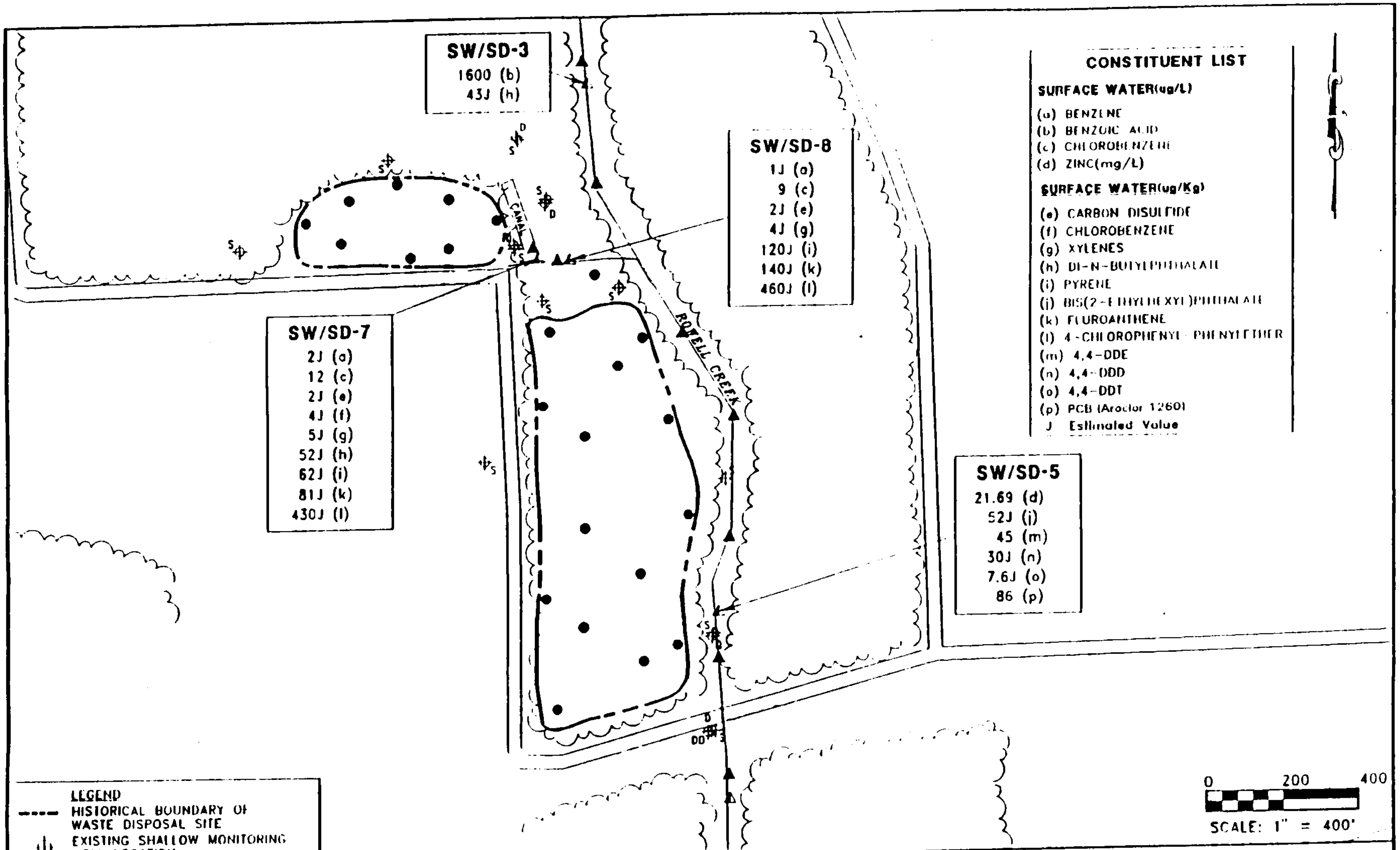

FIGURE 3-2
SURFACE WATER, SEDIMENT, AND SOIL SAMPLING LOCATIONS, SITES 1 AND 2

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ECOLOGICAL ASSESSMENT METHODOLOGY FOR OUs 1,2, & 7

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Sediment samples will also be analyzed for total organic carbon (TOC) and surface water samples will be analyzed for hardness.

3.2 OPERABLE UNIT 2 (SITES 3, 4, 5, and 17). Sites 3, 4, 5, and 17 were reportedly used for the disposal of oil and/or grease wastes. In general, these sites contain mixed oil, sludge, and grease wastes that were disposed of in unlined shallow pits. In some areas, liquids were burned. The pits were generally covered with fill when full. The source of this fill was not identified. Portions of each site are cleared while other areas are overgrown with shrubs and slash pines (ABB-ES, 1991b).

3.2.1 Oil and Sludge Disposal Area (Site 3) The Oil and Sludge Disposal Area (Site 3) is reported to be a 50- to 100-foot diameter pit, 3 to 5 feet deep, that was used to dispose of liquid wastes and sludge. The wastes were reportedly burned once every 3 months (Envirodyne Engineers, 1985). The disposal pit operated from the mid-1950's through 1975.

Ten monitoring wells have been installed at Site 3 (Figure 3-3). Trichloroethene, 1,1-dichloroethane, 1,2-dichloroethene, 1,1,1-trichloroethane, naphthalene, 4-methylphenol, beta-benzene hexachloride (BHC), and chromium were detected in groundwater samples collected from the wells (ABB-ES, 1992b). Groundwater from Site 3 is believed to flow east toward Rowell Creek.

Eight soil borings were installed at Site 3 (Figure 3-3). Two soil samples were collected from each boring for a total of 16 soil samples. Samples were collected from 0 feet to 2 feet bls and 2 feet to 4 feet bls in each boring. VOCs detected in the 0 to 2 foot interval soil samples include carbon disulfide, xylenes, and toluene. SVOCs detected include bis(2-ethylhexyl)phthalate, benzo(g,h,i)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene (ABB-ES, 1992b).

Surface soil sampling at Site 3 is proposed during the next field investigation. Information from the proposed sampling will be used to estimate chemical exposures in the ecological assessment (ABB-ES, 1992a). Locations for eleven samples have been proposed within the 160,000 ft^2 shown on Figure 3-3. The surface soil samples will be collected from a depth of 0 to 4 inches bls. The samples will be analyzed for TCL organics and TAL inorganics (ABB-ES, 1992b).

3.2.2 The Grease Pits (Site 4) The Grease Pits (Site 4) encompass an area of approximately 9 acres, and is located to the west of Lake Fretwell along Perimeter Road. Semi-solid wastes (including grease from messes and liquid wastes from shops) were disposed of in these pits from the 1950's until 1983 (Envirodyne Engineers, 1985). Typical disposal operations at the site consisted of placing wastes into excavated pits, where they were allowed to seep into the soil or evaporate. The pit was covered with soil when full and a new pit was excavated. Numerous pits of varying sizes reportedly exist throughout the site. Investigations completed thus far have

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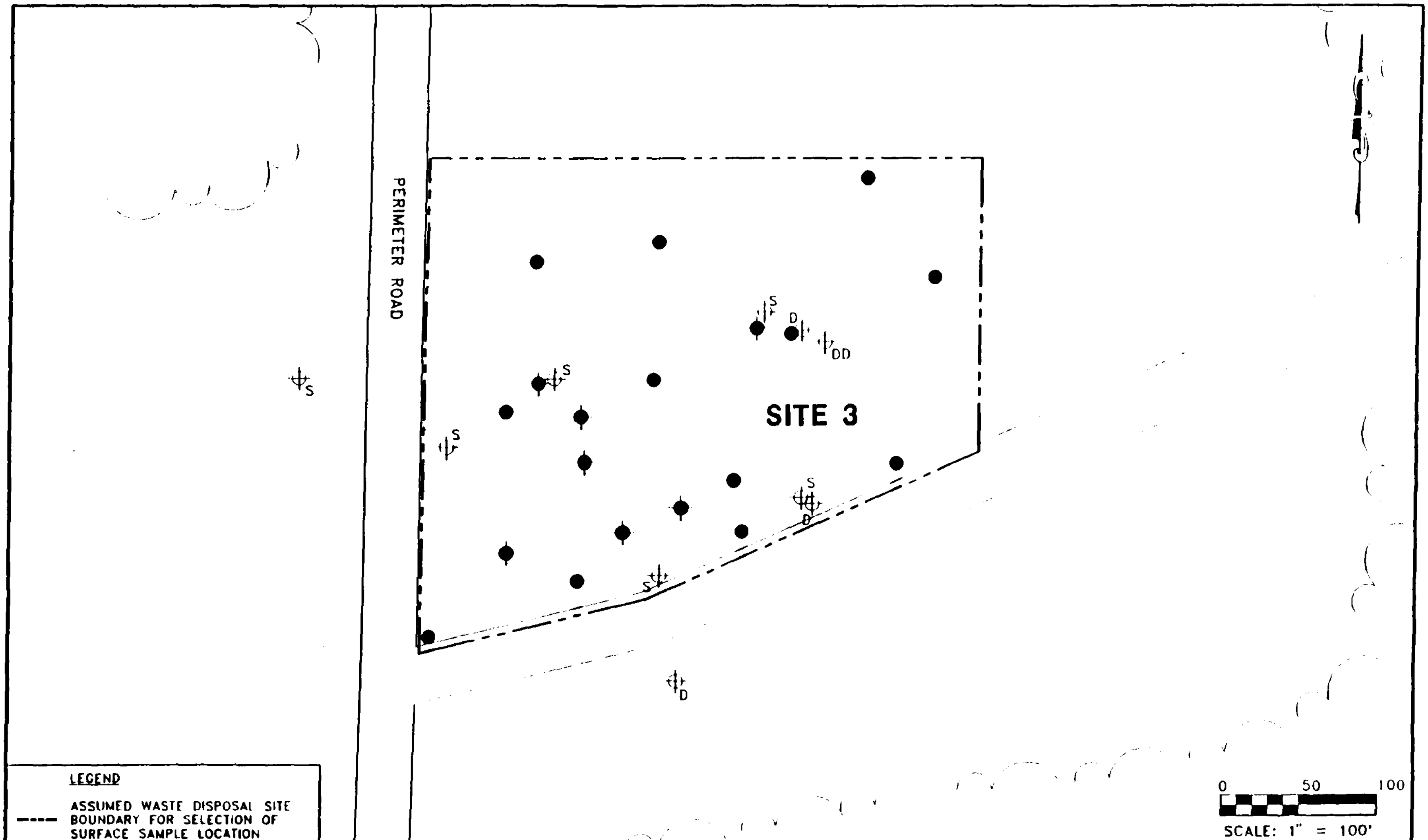

LEGEND

- ASSUMED WASTE DISPOSAL SITE BOUNDARY FOR SELECTION OF SURFACE SAMPLE LOCATION
- EXISTING SHALLOW MONITORING WELL LOCATION
- EXISTING INTERMEDIATE MONITORING WELL LOCATION
- EXISTING DEEP MONITORING WELL LOCATION
- EXISTING SOIL BORING SAMPLE LOCATION
- PROPOSED SURFACE SOIL SAMPLE LOCATION

FIGURE 3-3
MONITORING WELL AND SOIL SAMPLING LOCATIONS, SITE 3

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been unable to define the location of the site or determine the nature or extent of contamination of the reported multiple pits. The location of the disposal area will be identified with soil gas techniques during future investigations (ABB-ES, 1992b).

Six monitoring wells have been installed at Site 4. Naphthalene, bis(2-ethylhexyl)phthalate, 4-methyl-2-pentanone, and chromium were detected in groundwater samples from two of the wells screened within the surficial aquifer. The organic chemicals detected were measured at concentrations close to detection limits (ABB-ES, 1992b). Groundwater from Site 4 generally flows to the east toward Rowell Creek.

Six soil borings were installed at Site 4 with two subsurface soil samples collected in each boring from 0 to 2 feet bls and from 2 to 4 feet bls (Figure 3-4). Samples were analyzed for TCL organics and TAL inorganics. VOCs detected in the 0 to 2 foot interval samples included 1,2-dichloroethene and xylenes. Diethylphthalate, 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, aluminum, chromium, copper, lead, manganese, zinc, and total petroleum hydrocarbons (TPHs) were also detected in the soil samples (ABB-ES, 1992b).

Sampling and analyses of surface soils is proposed for Site 4 (ABB-ES, 1992b). Because the extent of the site is unknown, the location and number of samples of samples is undetermined. The total number of a surface soil samples to be collected is not anticipated to exceed 16 samples (ABB-ES, 1992b). The location of the samples will be based on the results of the field screening.

<u>3.2.3 Disposal Area Northwest (Site 5)</u> Disposal Area Northwest (Site 5) is a 100-foot diameter disposal area, consisting of approximately 0.5 acres (Envirodyne Engineers, 1985). The site operated in the 1950's. Unknown quantities of petroleum wastes (fuels and oils), solvents, paints, thinners, and waste paint with cadmium, chromium, and lead were disposed of at Site 5. Oil or fuel disposal after the 1950's is probable (Envirodyne Engineers, 1985). Portions of the site are currently oil-stained and void of vegetation (ABB-ES, 1992c). Ponding of water has been observed on the site and petroleum odor was reported in 1985 (Envirodyne Engineers, 1985).

Seven monitoring wells have been installed at Site 5 and screened within the surficial aquifer. Acetone, 2-butanone, toluene, 4-methylphenol, benzoic acid, naphthalene, phenol, 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, chromium, and lead were detected in groundwater samples from these wells (ABB-ES, 1992c). Groundwater from Site 5 is believed to flow southeast toward Rowell Creek and a tributary.

A tributary to Rowell Creek flows from west to east along the southern boundary of Site 5 (Figure 3-4). Surface water and sediments were sampled at two locations in the tributary, one upstream of the site and one downstream of the site. The samples were analyzed for TCL, TAL, TPH, TOC and hardness according to USEPA Level 2 requirements (NEESA, 1988). Two SVOCs (bis(2-ethylhexyl)phthalate and di-n-butylphthalate were detected in the upstream sediment sample. PCBs (Aroclor 1260) were detected in the downstream sediment sample. Mercury was detected in the surface water sample. Several other metals were measured in the surface water samples including aluminum, iron, magnesium, potassium, and sodium. Aluminum, beryllium, iron, lead, magnesium, manganese, vanadium, and zinc were detected in sediment samples (ABB-ES, 1992b). Further sampling of sediments and surface water at four locations is planned within the tributary (ABB-ES, 1992b). Additional sediment and surface water sampling is planned for Rowell Creek and Lake Fretwell which are downstream of the tributary (ABB-ES, 1992b).

A total of eight soil borings were installed at Site 5 (Figure 3-4). Two soil samples were collected per boring at 0 to 2 feet bls and 2 to 4 feet bls in each boring. PCBs (Aroclor 1260) were detected in both of the soil intervals sampled. Toluene, xylenes, dibenzofurans, naphthalene, 2-methylnaphthalene, bis(2-Ethylhexyl)phthalate, aluminum, copper, iron, lead, manganese, selenium, thallium, vanadium, and zinc were also detected in the upper interval soil samples (ABB-ES, 1992b).

A total of eleven surface soil samples from Site 5 are proposed to support the ecological risk assessment. The surface soil samples will be collected from depths of 0 to 6 inches bls at the approximate locations shown on Figure 3-4. The samples will be analyzed for TCL, TAL, and TPH. Five of the eleven samples will be collected to identify the maximum concentration of contaminants. These samples are located within the known area of contamination and will be taken from areas with observed soil stains where possible. The remaining six surface soil samples will be collected on the perimeter of the site to assess migration potential via runoff. Drainage swales will be sampled where possible (ABB-ES, 1992b).

<u>3.2.4 Oil and Sludge Disposal Pit Southwest (Site 17)</u> The Oil and Sludge Disposal Pit Southwest (Site 17) is an unlined disposal pit, approximately 50 feet in diameter and 3 to 5 feet deep. The pit was operated from the late 1960's to the early 1970's (Envirodyne Engineers, 1985). The exact location of the pit, within the 2-acre site, has not been determined. Soil and groundwater screening techniques will be used to locate the pit during future site investigations (ABB-ES, 1992b). Once located, a minimum of three surface soil samples will be taken within the boundaries of the pit in areas of observed soil stains. An additional six perimeter soil samples will be taken to identify migration of contamination via runoff. Drainage swales will be sampled where possible.

Three soil borings were installed at Site 17. Two soil samples were collected per boring at intervals of 0 to 1 foot and 1 to 2 feet bls. Samples were analyzed for TCL organics and TAL inorganics. VOCs detected in the upper interval samples included acetone, 2-butanone, ethyl benzene, 4-methyl-2-pentanone, methylene chloride, toluene, trichloroethene, and xylenes. SVOCs detected included 4-methylphenol, 2,4-dimethylphenol, benzoic acid, fluoranthene, fluorene, naphthalene, pyrene, 2-methylphenol, and bis(2-ethylhexyl)phthalate. Beta-BHC, aluminum, chromium, copper, iron, lead, manganese, and zinc were also detected (ABB-ES, 1992b).

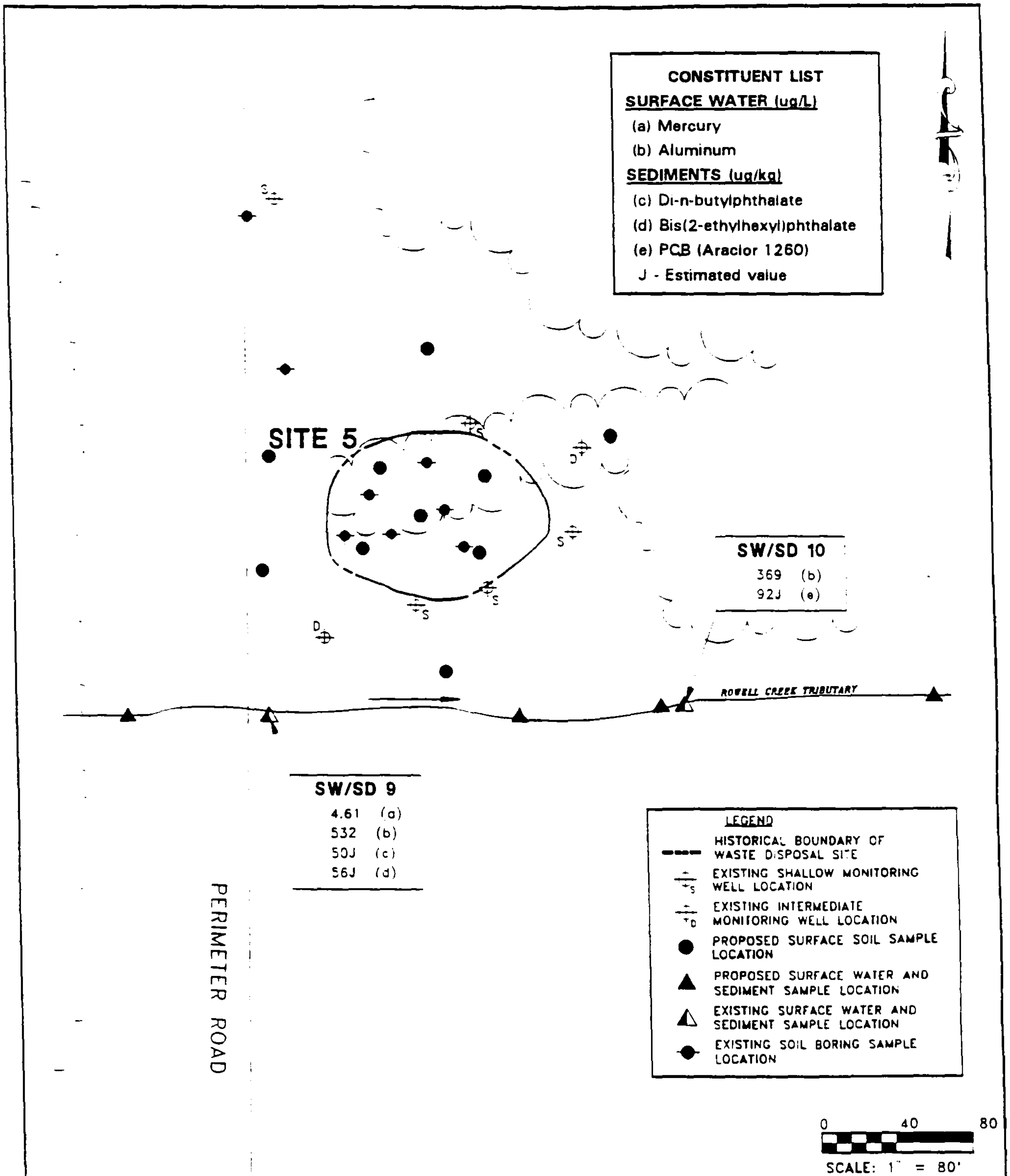

FIGURE 3-4
MONITORING WELL, SOIL, SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS SITE 5

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Six monitoring wells have been installed at Site 17. Toluene, 1,1-dichloroethane, trichloroethene, xylenes, 4-methylphenol, 2,4-dimethylphenol, 2-methylphenol, di-n-butylphthalate, bis(2-ethylhexyl)phthalate, chromium, and lead were detected in samples from three of the wells. Groundwater from Site 17 generally flows east toward Rowell Creek.

3.3 OPERABLE UNIT 7 (Site 16). Operable Unit 7, Site 16, is the Aircraft Intermediate Maintenance Department (AIMD) Seepage Pit and adjacent area. Site 16 is located adjacent to the jet runways at NAS Cecil Field. The seepage pit, approximately 40 feet long by 2.5 feet wide by 9.5 feet deep, was constructed of slotted, concrete blocks and was designed to allow for drainage of waste waters generated during operations conducted in Building 313 into the surrounding soils (Envirodyne Engineers, 1985). A holding tank for waste waters also was installed at Site 16 adjacent to the seepage pit. The exact time of the tank installation is undetermined; however, it is believed to have been installed concurrently with the seepage pit. Waste waters were then routed from Building 313 to the holding tank and then to the seepage pit.

Liquid waste, primarily rinse waters, were disposed of through the seepage pit from 1960 to 1980. Wastes contained in the rinse water include sodium cyanide, trichloroethene, creosol, phenol, methylene chloride, and oil. Additionally, grease, rust, scale, and paint removed during cleaning of jet engine parts was disposed of in the seepage pit (Envirodyne Engineers, 1985).

In the late 1960's, waste water began to back up into the holding tank and underground piping. At this time, a discharge pipe was added to the seepage pit. The discharge pipe was located approximately 3 feet above the base of the seepage pit and connected to a stormwater drainage pipe that discharged to a series of open ditches that drain into Sal Taylor Creek. When the level of waste waters in the pit reached the level of the discharge pipe, the waste waters flowed through the discharge piping to the drainage ditch, thus preventing further backup within the system. Flow of waste waters into the ditch reportedly occurred throughout the 1970's until disposal to the pit ceased in 1980. In 1980, the discharge lines leading to and from the seepage pit were disconnected, the pit partially removed, and the remaining area filled with sand. The holding tank will be closed under a Resource Conservation and Recovery Act (RCRA) permit. Site 16 is vegetated with grass, which is mown at regular intervals. The general area adjacent to Site 16 is covered with asphalt and concrete.

A total of 14 monitoring wells have been installed at Site 16. VOCs detected in groundwater samples include 1,1-dichloroethane, 1,1-dichloroethane, 1,2-dichloroethene, 1,1,1-trichloroethane, and trichloroethene. Naphthalene, 2-methylphenol, 2,4-dimethylphenol, lead, and chromium were also detected. Groundwater flows from Site 16 to the southeast toward Sal Taylor Creek.

Five surface soil samples were collected at Site 16. Five VOCs including methylene chloride, acetone, toluene, ethyl benzene, and xylenes were detected in at least one of the samples. Nineteen SVOCs and eighteen inorganics were also detected. The list of analytes detected includes: Naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, butylbenzylphthalate, benzo(a)anthracene, chrysene, bis(2-ethylhexyl)phthalate, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz (a,h)anthracene, benzo(g,h,i)perylene, aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel potassium, selenium, silver, vanadium, and zinc.

Sediment and surface water samples will be collected from five locations in the ditch system draining Site 16 to Sal Taylor Creek. The samples will be analyzed for TCL organics, TAL inorganics. Sediment samples will be analyzed for TOC and surface water samples will be analyzed for hardness.

3.4 PROPOSED SAMPLING OF WATERSHED AT NAS CECIL FIELD. The sediment and surface water sampling for each of Operable Units 1, 2 and 7 discussed in this TM are part of a larger proposed investigation of potential contamination within the watersheds at NAS Cecil Field. This proposed investigation includes surface water and sediment sampling at fifty-one locations in Rowell Creek, Lake Fretwell, Sal Taylor Creek, and Yellow Water Creek. The locations were chosen to identify potential migration of contamination from hazardous waste sites within the watersheds. Sediment samples will be collected from depositional areas to maximize the chances of identifying contaminant migration (ABB-ES, 1992b). The proposed sampling is described in more detail in ABB-ES, 1992b.

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4.0 CONTAMINANT MIGRATION PATHWAYS AND POTENTIAL RECEPTORS.

Migration pathways for contamination from waste sites at NAS Cecil Field to receptors are shown as conceptual models for each operable unit in Figures 4-1 through 4-3. The conceptual models identify exposure routes for five groups of ecological receptors including terrestrial wildlife (mammals, birds and reptiles), aquatic life (fish, invertebrates, plants), terrestrial plants, amphibians, and terrestrial invertebrates.

4.1 OPERABLE UNIT 1. Contaminated media at OU 1 includes groundwater and subsurface soils (Section 3.1). Potential pathways of contaminant migration from the OU 1 to ecological receptors are depicted in Figure 4-2.

There is evidence of migration of contamination from Sites 1 and 2. The detection of VOCs in surface water and sediments in .the tributary suggests that it serves as a discharge point for groundwater and surface water runoff from Site 1. The presence of DDT (DDE and DDD) and PCBs (Aroclor 1260) suggests the release of contamination from Site 1 into Rowell Creek via overland flow.

Terrestrial wildlife, aquatic life, and amphibians may be exposed to contamination in surface water and sediments via direct contact and ingestion. Receptors may also be exposed as a result of ingestion of food contaminated as a result of exposure to surface water and/or sediment contamination (Figure 4-1).

Potential exposures for terrestrial wildlife, terrestrial invertebrates, and plants are related to contamination in surface soils. Potential routes of exposure for terrestrial wildlife to surface soils contamination include direct ingestion, direct contact and ingestion of food. Potential routes of exposure for plants and invertebrates are by direct contact (Figure 4-1). Surface soil exposure pathways will be evaluated based on the results of proposed sampling of surface soils (Section 3.1).

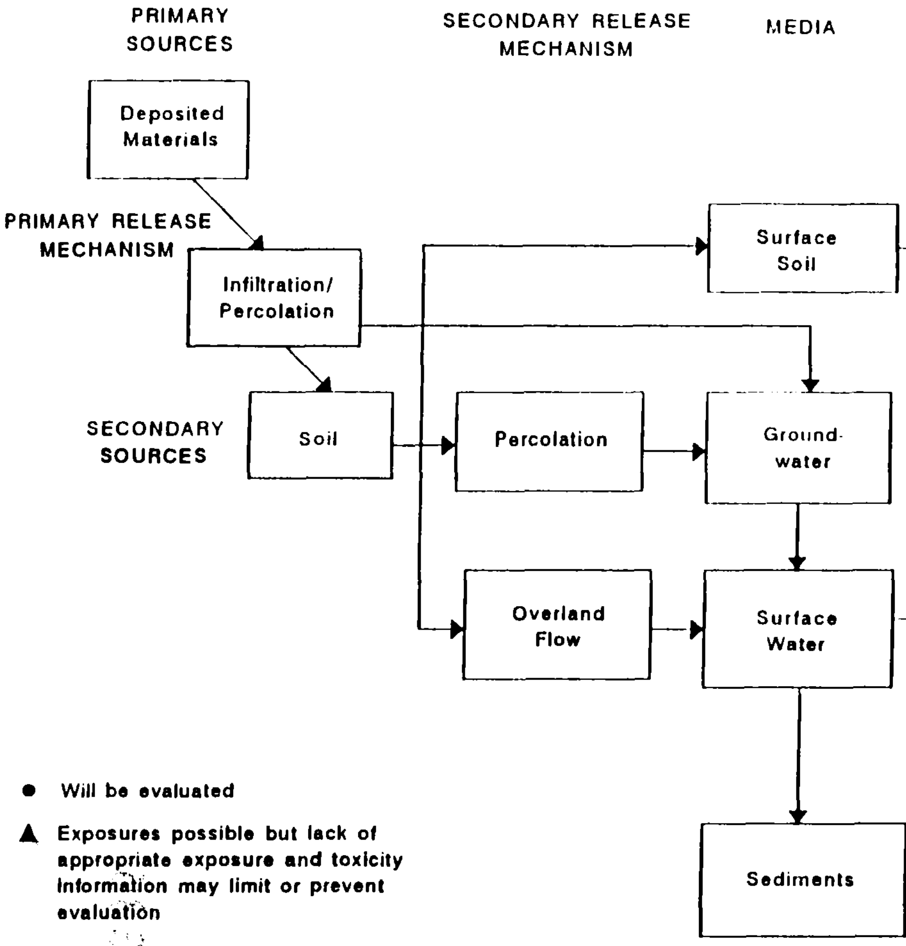
4.2 OPERABLE UNIT 2 Contaminated media at OU 2 includes groundwater and subsurface soils at Site 3, 4, 5 and 17 and sediments at Site 5. Potential pathways of contaminant migration from the waste sites to ecological receptors are depicted in Figure 4-2. Receptors may be exposed to contamination in surface soils, surface water, and sediments.

Currently, information is not conclusive on the extent of chemical contamination in surface soils for OU 2 sites. Potential routes of exposure for terrestrial wildlife, invertebrates, and plants are indentical to those identified for OU 2. These pathways will be evaluated in the ecological assessment based on the results of proposed surface soil sampling.

Contamination in groundwater or soils at OU 2 sites may be transported via discharge or overland flow to Rowell Creek and tributaries resulting in contamination of surface water and sediments. There is some evidence of transport of contamination from Site 5 to the tributary at its southern boundary as PCBs were detected in one sediment sample. Potential exposure routes for the terrestrial wildlife, aquatic life, and amphibians to surface water and sediment contamination are shown on Figure 4-2 and are the same as those identified for OU 2.

4.3 OPERABLE UNIT 7 Contamination is present in groundwater and subsurface soils at OU 7. Potential migration of contamination from the site to ecological receptors are depicted on Figure 4-3. Ecological receptors may potentially be exposed to contamination that migrates from Site 16 to Sal Taylor Creek as a result of transport via groundwater discharge or stormwater discharge. It is not known if migration of contamination from Site 16 to Sal Taylor Creek has occurred. Sediment and surface water sampling of Sal Taylor creek is planned for the next field investigation. Potential exposure routes for terrestrial wildlife, aquatic life, and amphibians to surface water and sediment contamination are shown on Figure 4-3 and are the same as those identified for OUs 1 and 2.

Potential exposures to surface soil contamination are not identified at OU 7. Site 16 is an industrial area which is paved and covered by mowed grass with an immediate area that does not provide habitat for terrestrial wildlife. As ecological receptors are not expected to be present on or near the site, potential exposure routes for contaminated soils were not identified.



RECEPTOR

Surface Soil:

Exposure Route	Terrestrial Wildlife	Aquatic Life	Plants	Amphibians	Terrestrial Invertebr.
Ingestion	●				
Direct Contact	▲		●	▲	●
Ingestion of Food	●				

Surface Water:

Exposure Route	Terrestrial Wildlife	Aquatic Life	Plants	Amphibians	Terrestrial Invertebr.
Ingestion	●			▲	
Direct Contact		●		●	
Ingestion of Food	●	▲		▲	

Sediments:

Exposure Route	Terrestrial Wildlife	Aquatic Life	Plants	Amphibians	Terrestrial Invertebr.
Direct Contact	▲	●		▲	
Ingestion of Food	▲	▲		▲	
Ingestion	▲	▲		▲	

FIGURE 4-1

**CONTAMINANT PATHWAY MODEL-
OPERABLE UNIT 1
SITES 1 AND 2 (LANDFILLS)**

**TECHNICAL MEMORANDUM
ECOLOGICAL ASSESSMENT
METHODOLOGY OUs 1, 2, AND 7**

**NAS CECIL FIELD
JACKSONVILLE, FLORIDA**

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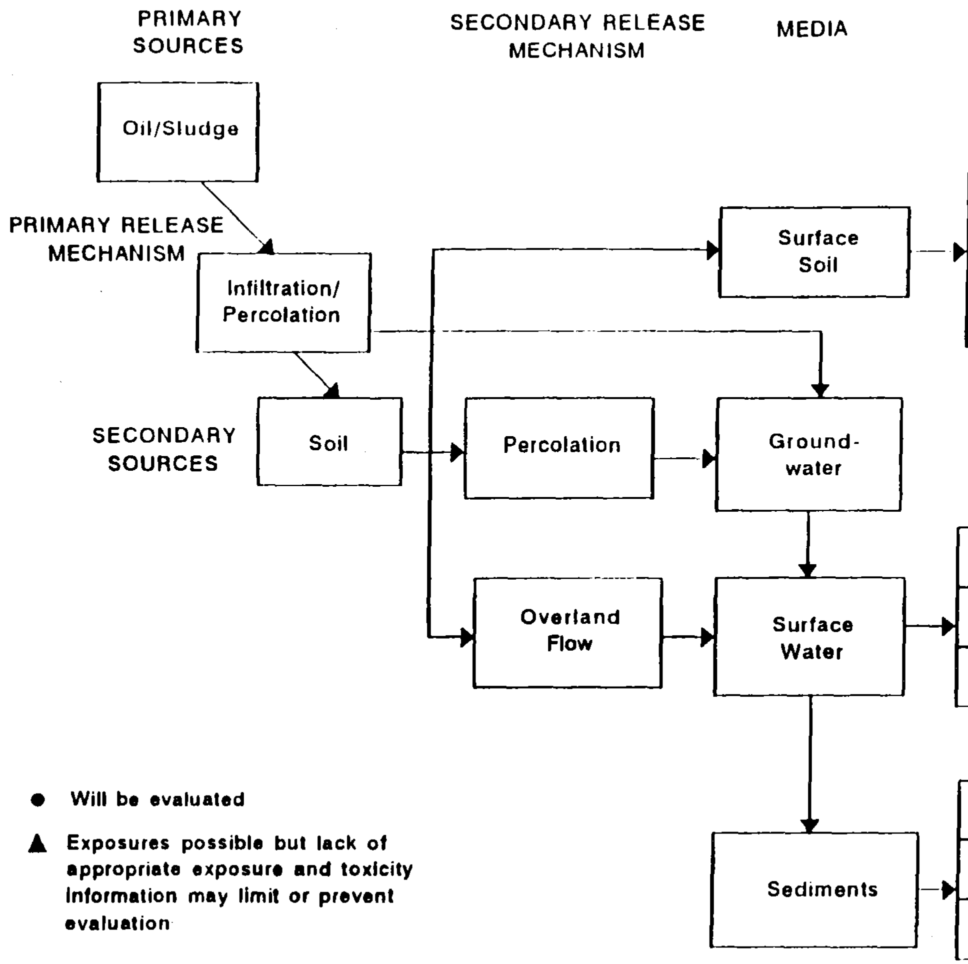

RECEPTOR

Media	Exposure Route	Terrestrial Wildlife	Aquatic Life	Plants	Amphibians	Terrestrial Invertebr
Surface Soil	Ingestion	●				
	Direct Contact	▲		●	▲	●
	Ingestion of Food	●				
Surface Water	Ingestion	●			▲	
	Direct Contact		●		●	
	Ingestion of Food	●	▲		▲	
Sediments	Direct Contact	▲	●		▲	
	Ingestion of Food	▲	▲		▲	
	Ingestion	▲	▲		▲	

● Will be evaluated

▲ Exposures possible but lack of appropriate exposure and toxicity information may limit or prevent evaluation

FIGURE 4-2

CONTAMINANT PATHWAY MODEL-OPERABLE UNIT 2 SITES 3, 4, 5, AND 17 (OIL/SLUDGE DISPOSAL PITS)

TECHNICAL MEMORANDUM ECOLOGICAL ASSESSMENT METHODOLOGY OUs 1, 2, AND 7

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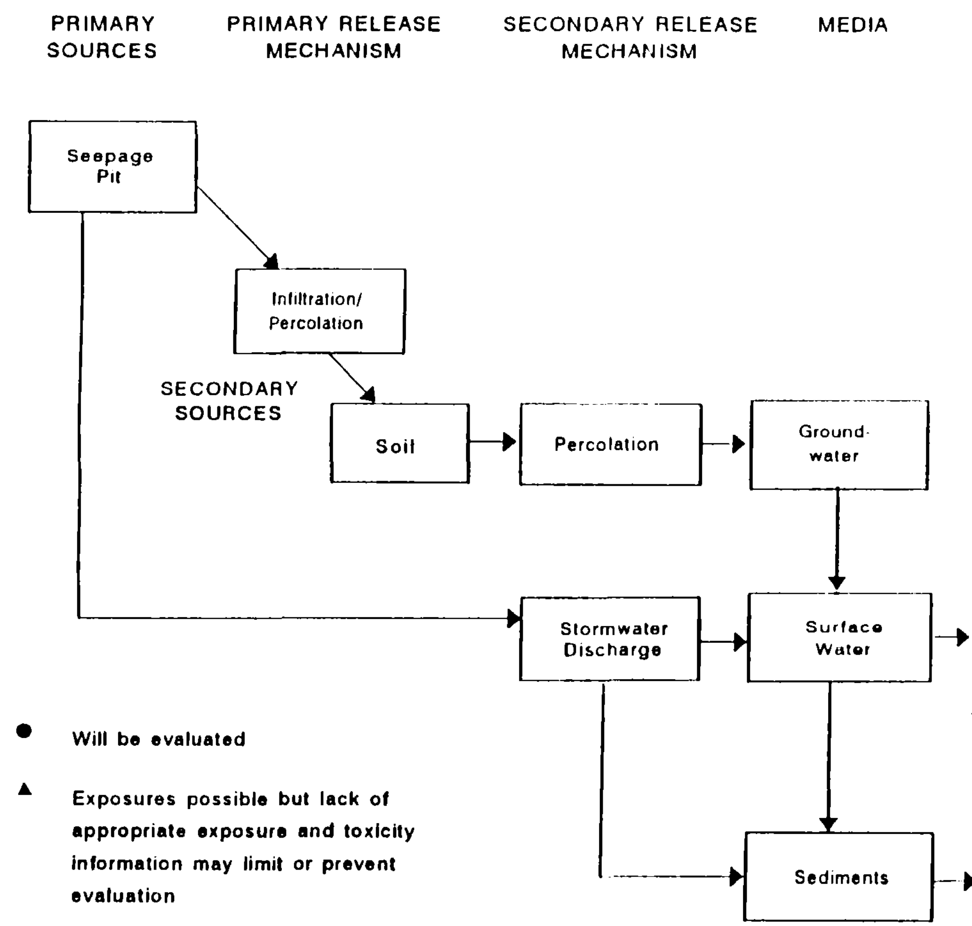

Media	Exposure Route	Terrestrial Wildlife	Aquatic Life	Plants	Amphibians	Terrestrial Invertebr
Surface Water	Ingestion	●			▲	
Surface Water	Direct Contact		●		●	
Surface Water	Ingestion of Food	●	▲		▲	
Sediments	Direct Contact	▲	●		▲	
Sediments	Ingestion of Food	▲	▲		▲	
Sediments	Ingestion	▲	▲		▲	

● Will be evaluated

▲ Exposures possible but lack of appropriate exposure and toxicity information may limit or prevent evaluation

FIGURE 4-3

CONTAINMANT PATHWAY MODEL
OPERABLE UNIT 7
SITE 16(AIMD SEEPAGE PIT)

TECHNICAL MEMORANDUM
ECOLOGICAL ASSESSMENT
METHODOLOGY OUs 1, 2, AND 7

NAS CECIL FIELD
JACKSONVILLE, FLORIDA

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5.0 METHODOLOGY FOR THE SELECTION OF CONTAMINANTS OF CONCERN.

COCs will be determined on a per site basis for each medium (surface soils, surface water, groundwater, and sediments). The COCs will be selected from validated analytical data. Historical non-validated data will not be used in the ecological assessment. Analytical results for surface soils, surface water, and sediments will be summarized for each site including the frequency of detection, the range of sample quantitation limits, and the maximum and minimum concentrations for all analytes detected in each medium. Once the data from each site specific medium are summarized, the maximum detect of each analyte will be used as the Detected Comparison Value (DCV) to determine COCs. COCs will be selected based on consideration of laboratory blank contamination, background concentrations, and inherent toxicity.

5.1 COMPARISON WITH BLANK DATA. Each DCV will be compared to procedure control "blank data" (e.g., trip blank, field blank, laboratory calibration blank, or laboratory method blank) according to procedures recommended in USEPA guidance (1989a). The blank data will be compared to the DCVs with which the blanks are associated. Common laboratory contaminants will be retained as a COC if the DCV exceeds 10 times the maximum amount detected in the blank. Chemicals that are not common laboratory contaminants will be retained if the DCV exceeds five times the maximum amount detected in a blank. The difference between "common" and "not common" contaminants is described in USEPA guidance (1989a).

5.2 COMPARISON WITH BACKGROUND. The DCV for each analyte will be compared to the background concentrations measured in samples taken from areas that have not been influenced by hazardous waste sites at NAS Cecil Field. If the DCV of an inorganic or organic analyte is present at a site at less than 2 times the background concentration (2 times the geometric mean), that analyte will be not be considered in the ecological assessment (USEPA, 1991b).

5.3 ANALYTES CONSIDERED NON-TOXIC. Detected analytes not considered to be toxic to the environment will be removed from the list of COC. In general, calcium, sodium, magnesium, iron, aluminum, and potassium will not be considered as contaminants of concern for soils or sediments. Calcium, sodium, magnesium and potassium are nutrients and are not considered to be toxic (USEPA, 1989a), and iron and aluminum are natural components of soil. Iron and aluminum will be considered for inclusion as contaminants of concern for surface water as these metals are potentially toxic in the aquatic environment.

5.4 TENTATIVELY IDENTIFIED COMPOUNDS. Tentatively identified compounds (TICs) will be evaluated based on suspected presence at each site under consideration, contaminant concentration, migration potential via each of the identified exposure pathways, and the chemical's toxicity. A list of TICs of concern will be formulated after consideration of these factors. The TICs of concern will be evaluated qualitatively in the ecological assessment.

6.0 METHODOLOGY FOR AQUATIC ASSESSMENT.

The assessment of risks for aquatic receptors will be conducted in two phases. Implementation of Phase II may not be required if the results of Phase I are sufficient to characterize risks and develop ecological remedial objectives for each of the operable units.

The Phase I terrestrial wildlife assessment (Figure 6-1) represents a chemical-specific analyses where risks are assessed for exposures related to individual chemicals. The assessment uses the chemical concentrations measured in sediments and surface waters to estimate exposures for receptors and compares the exposure concentrations with those reported to cause adverse effects. This method may over or underestimate the actual risks posed by individual chemicals as it does not account for the actual bioavailability of chemicals in the environment, potential synergistic and antagonistic effects of mixtures of chemical mixtures, or other in-situ environmental factors which influence toxicity.

The scope of the Phase II assessment will be developed based on a review of the Phase I results. Phase II methods are used to reduce the uncertainties associated with Phase I and to provide site specific ecotoxicity information. Portions of the Phase I assessment, including characterization of the extent of contamination, receptors, and exposure routes, are necessary for implementation of the Phase II methods.

Potential Phase II aquatic assessment methods (Figure 6-1) include analyses of the site specific toxicity of contaminated sediments to aquatic invertebrates or fish, measurement of chemical exposures (concentrations of chemicals in aquatic invertebrates or sediment pore water), measurement of impacts to benthic macroinvertebrate and/or fish communities, and measurement of the bioavailability of chemicals from sediments in laboratory bioaccumulation testing. If Phase II methods are implemented, the results, along with the results from the Phase I assessment, will be used to develop remedial objectives for each of the OUs (Figure 6-1).

6.1 SELECTION OF ENDPOINTS. An endpoint is an expected or anticipated effect of a contaminant on an ecological receptor. There are two types of endpoints. Assessment endpoints describe the effects that drive decision making. Measurement endpoints approximate, represent, or lead to the assessment endpoint using field or laboratory methods (USEPA, 1991b). The assessment endpoint of the Phase I assessment is conservative, as the purpose of the assessment is to screen for any potential adverse effect to any aquatic receptor. For the Phase I aquatic assessment, the assessment endpoint is any adverse effect on growth, reproduction, or survival. The measurement endpoints are laboratory toxicity test results that show reduced growth, or adverse effects on reproduction, behavior, or mortality. Endpoints for the Phase II assessment will be related to the types of methods used and the objectives of the assessment.

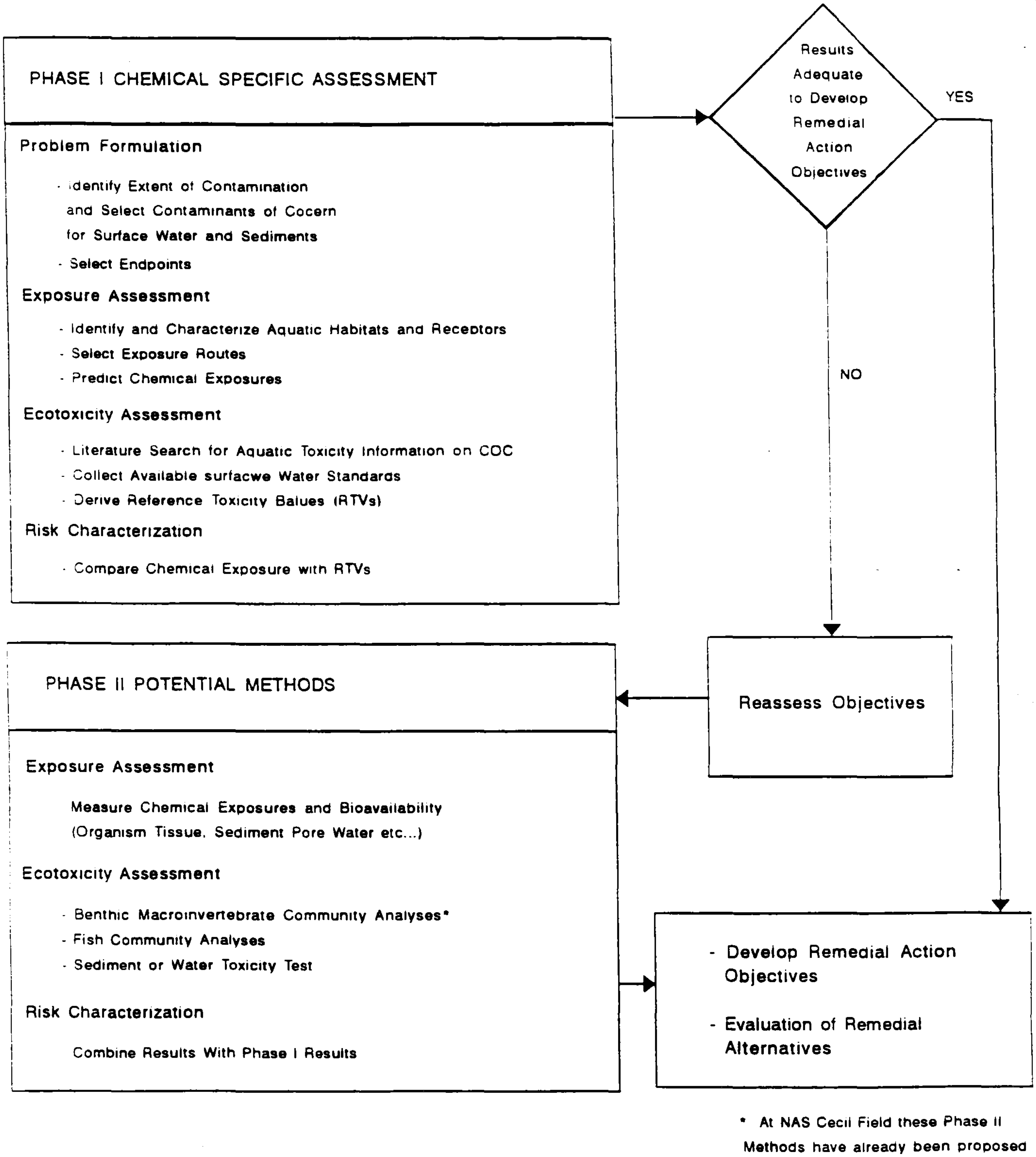

FIGURE 6-1

PHASED APPROACH FOR ASSESSMENT OF RISK TO AQUATIC RECEPTORS

TECHNICAL MEMORANDUM
ECOLOGICAL ASSESSMENT METHODOLOGY OUS 1, 2 AND 7

NAS CECIL FIELD
JACKSONVILLE, FLORIDA

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6.2 EXPOSURE ASSESSMENT. Exposure assessment is the process of identification and characterization of receptors, identification of routes of exposure for the receptors, and the concentrations of chemicals to which receptors are exposed.

6.2.1 Identification and Characterization of Receptors Aquatic environments potentially exposed to contamination from waste sites at OUs 1, 2 and 7 include Rowell Creek, Lake Fretwell, Sal Taylor Creek, and associated tributaries. Aquatic organisms potentially exposed to contamination include fish, invertebrates, aquatic plants, and amphibians. The aquatic habitat provided by Rowell Creek, Sal Taylor Creek, and associated tributaries will be characterized, and aquatic receptors identified based on the results of two field sampling episodes described below.

An initial survey of aquatic life was conducted by Environmental Consulting and Technology, Inc. (ECT) in November of 1991. Macroinvertebrates and fish were collected from six sampling locations in Rowell Creek (Figure 6-2). The methods and results of the sampling are specified in a separate report (ECT, 1992). The purpose of this sampling was to: 1) identify potential receptors of contamination; 2) provide a baseline of information on aquatic habitat; and, 3) to identify areas of gross macroinvertebrate community disruption.

Further biological sampling is proposed in concurrence with surface water and sediment sampling of Rowell Creek, Lake Fretwell, and Sal Taylor Creek (ABB-ES, 1992b). The details of the biological sampling will be specified under a separate work plan. The results of the sampling will be used to characterize the aquatic communities of Rowell Creek and Sal Taylor Creek and to identify receptors. Information from both of the biological field surveys will be used to characterize the aquatic habitats, aquatic communities, and receptors.

6.2.2 Exposure Routes and Chemical Exposure Point Concentrations Exposure routes for aquatic receptors that will be evaluated in the ecological assessment include direct contact with surface water, direct contact with sediment, and ingestion of contaminated food (Figures 4-1 to 4-3). Concentrations of chemicals measured in surface water will be used as the exposure concentrations for evaluation of direct contact with surface water. The exposure concentrations will be compared with toxicity values (Section 6.3) to assess risks (Section 6.4).

Chemical exposure concentrations for direct contact with sediments will be the concentration of the chemical measured in sediment or the concentration of the chemical predicted to partition into sediment pore water. The type of sediment exposure-point concentration used in the risk characterization will be dependant upon the type of toxicity data available for each COC.

Equilibrium Partitioning Theory (EP-T) will be used where appropriate to predict the concentrations of chemicals in sediment pore water based on the concentration of the chemical measured in the sediment sample, the TOC content of the sediment and partition coefficients for the chemical (USEPA, 1989d).

Aquatic receptors may also be exposed to contaminants that have accumulated in food resources. Chemicals in aquatic sediments may be accumulated by benthic infauna which are subsequently consumed by other invertebrates or fish. Dietary chemical exposure concentrations for fish will be estimated based on the concentration of chemicals in surface waters or predicted sediment pore water concentrations and reported bioconcentration factors (BCF) for the respective chemicals. The dietary exposure concentrations will be compared with dietary toxicity studies available in the literature for freshwater fish. This type of toxicity data is limited and may prevent evaluation of risks associated with the ingestion of food exposure pathway.

Migration of groundwater contamination with subsequent discharge to Rowell Creek, Sal Taylor Creek, Lake Fretwell or associated tributaries has only been identified for OU 1. Therefore, potential exposures for aquatic receptors to contaminated groundwater will only be addressed at this OU. Exposure point concentrations for groundwater will be based on modeling groundwater discharge from the site to the tributary adjacent to Site 1. If groundwater discharge to Rowell Creek from Sites 3, 4, 5 and 17 or to Sal Taylor Creek from Site 16 is identified during future field investigations, the groundwater exposure pathway will be evaluated for those sites.

6.3 ECOTOXICITY ASSESSMENT. The ecotoxicity assessment for the Phase I aquatic assessment will consist of a literature review of available aquatic toxicity information for each COC (Section 6.2.1). Potential Phase II aquatic methods include toxicity testing and field studies (Figure 6-1). One Phase II method, macroinvertebrate sampling community analyses, has already been proposed for NAS Cecil Field. Implementing the macroinvertebrate sampling during the field investigation and prior to completion of Phase I is necessary to allow for concurrent sampling and analyses of sediment and biological samples. Upon completion of the Phase I assessment, the Phase I results and the macroinvertebrate sampling results will be used to develop ecological remedial objectives for OUs 1, 2 and 7. In the event that data is not sufficient to develop the remedial objectives further Phase II methods (including toxicity tests and bioaccumulation tests) will be considered (Section 6.2.2).

6.3.1 Literature Information The ecotoxicity assessment for the Phase I aquatic assessment includes a review of the Aquatic Toxicity Information Retrieval (AQUIRE) database, USEPA Ambient Water Quality Criteria (AWQC), FDER Surface Water Quality Standards and Quantitative Structure Activity Relationships (QSAR) information. All of the information collected will be used to derive RTVs.

The AQUIRE database was established in 1981 by the USEPA, Office of Pesticides and Toxic Substances. AQUIRE includes the following types of information: 1) scientific papers published both nationally and internationally on the toxicity of chemicals to aquatic organisms and plants, 2) independently compiled data files that meet AQUIRE parameter and quality assurance criteria, and 3) selected toxicity test results and related testing information for any individual chemical from laboratory and field aquatic toxicity tests. Acute, sublethal, and bioconcentration effects are included for tests with freshwater and marine organisms.

The AQUIRE database includes review codes which indicate the type and completeness of the toxicity test method and documentation of accompanying the data. Review code assignments for AQUIRE data are as follows:

Review Code = 1: Meets all the following criteria:
Review Code = 2: Procedures generally satisfactory but one or more of pieces of information are missing:
Review Code = 3: Procedures poorly documented.
Review Code = 4: Abstract or untranslated non-English language paper:
Review Code = 5: Gilford File (data meet the AQUIRE minimum data parameter requirements)

The AQUIRE database will be searched for information on each COC for freshwater organisms. Search results used for the ecotoxicity assessment will include only information with a review code of 1, 2, or 5. The search information will also be further limited to information available for aquatic receptors identified as being present in Rowell Creek (or closely related species). This may be necessary in instances where an unmanageable amount of information is available. The usable search results will be summarized according to groups of information for algae and plants, fish, invertebrates, and amphibians.

The AQUIRE database generally contains information from toxicity studies which do not employ standardized test procedures. Other sources of aquatic toxicity information include annual reviews of aquatic toxicity information available from the Water Pollution Control Federation and searches of databases which review abstracts from aquatic toxicity journals. Searches of this nature will be necessary to identify potential synergistic, antagonistic effects of mixtures of chemicals, behavioral toxicity and other sublethal effects, chemical fate and transport information, or field based test results.

The literature search for aquatic toxicity information will include a search for information associating concentrations of the COC in bulk sediments with adverse responses in aquatic organisms. Available published and peer reviewed literature will be consulted to derive RTVs for sediments for each of the COC.

National AWQC are guidelines developed under the Clean Water Act for use in permitting wastewater discharges to surface water. These criteria specify the concentration of a compound in ambient water which, if not exceeded, should protect most (i.e., 95 percent) species of aquatic life and their uses (USEPA, 1986). AWQC are derived from both aquatic plant and animal data and are developed to protect the types of organisms necessary to support an aquatic community considering both acute (short-term) and chronic (long-term) effects. When data is not sufficient to develop a criteria value, the lowest reported concentration of a compound causing toxicity or a Lowest Observed Effect Level (LOEL) is used.

FDER also issues surface water quality standards (FAC, 1992) for toxic chemicals according to the designated uses of the water body. Rowell Creek, Sal Taylor Creek, and tributaries are designated as Class III waters for recreation, fish and wildlife management. These standards will be used in addition to the AWQC.

In instances where toxicity information and standards are unavailable, QSARs may be used to predict toxicity. QSAR models have been reviewed and compiled by USEPA (Clements 1988, USEPA 1988b). The models are statistical relationships developed for a specific class of compounds that relate physico-chemical properties to some measure of biological activity. Most QSAR models assume that biological activity is a linear function of one or more of three main physico-chemical properties: a compound's hydrophobic, electronic, and stearic aspects (i.e., spatial arrangement of atoms in a molecule) (Hermens, 1986). The parameter most frequently used in QSAR models is the n-octanol/water partition coefficient (P_{oct} or K_{ow}). This term is a measure of a compound's hydrophobicity or tendency to move from aqueous to lipid media, and, consequently, a compound's capacity to reach the target site in the aquatic receptor.

Data from AQUIRE and other searches, AWQC, Florida Water Quality Standards, and QSARs will be evaluated and summarized. The lowest reported exposure concentration eliciting an adverse response on growth, reproduction, behavior, or survival for each of the COCs for plants, invertebrates, fish, and amphibians will be chosen as the RTV for the respective groups. The RTVs are compared with the exposure concentrations (Section 4.3.6) to screen for potential risks as described in subsection 4.3.8.

6.3.2 Toxicity Tests Comparisons of single chemical measurements in sediments or surface water with existing or derived criteria may over or under-estimate the toxicity of an individual chemical as the method does not consider the bioavailability of the chemical to the organism, or effects of chemical mixtures. Toxicity tests, using surface water or sediment samples, provide information on the responses of test organisms to the mixture of waste constituents in the environmental medium under consideration.

Currently, there is not enough data available on the extent of surface water or sediments contamination to propose toxicity testing with field collected surface waters or sediments. Toxicity testing will be considered under the Phase II aquatic assessment upon review of the Phase I results and the results of the Phase I assessment (Figure 6-1). The following subsections describe the types of toxicity tests available for use. The exact methods used will be determined prior to initiation of the Phase II assessment.

6.3.2.1 Sediments Standard laboratory toxicity test protocols for sediment samples are available from the American Society for Testing and Materials (ASTM, 1990a,b). Sediment toxicity tests will be considered in the event that contamination associated with the hazardous waste sites is identified in Rowell or Sal Taylor Creek. Sediment toxicity tests with bulk sediment samples may be used in situations where:

1) It is not possible to derive RTVs based on literature information for COCs;
2) The bioavailability of COCs in sediments is unknown and cannot be reasonably predicted;
3) Additive, synergistic or antagonistic interactions among toxic chemicals or other constituents in the environment are suspected; and/or
4) The analytical sampling results indicate non-detect for toxic constituents.

Sediment toxicity testing would not be considered in instances where specific bioaccumulative chemicals are present that would be better assessed with field methods which directly measure bioaccumulation. In those instances, bioaccumulation tests and sampling of fish and invertebrates for chemical analyses of tissues will be considered. Tissue analyses would be conducted according to guidelines provided by the St. Johns Water Management District (SJWMD, 1991), the FDER (FDER, 1990), and USEPA Region IV (USEPA, 1990).

6.3.2.2 Surface Water Toxicity tests for surface water or effluent samples will be implemented in instances where it is necessary to ascertain the toxicity of point source discharges from waste sites into surface waters. Ambient water tests may also be completed to evaluate the toxicity of contaminated groundwater if it is determined that groundwater discharges to surface water. Two standard aquatic toxicity tests available are the *Pimephales promelas* (Fathead minnow) larval survival and growth test (USEPA Method 1000.0; USEPA, 1989e) and the *Ceriodaphnia dubia* (cladoceran) survival and reproduction test (USEPA Method 1002; USEPA, 1989e).

6.3.3 Field Methods The Phase I assessment includes a general survey of aquatic habitats. During the general aquatic survey, a biologist completes a field visit and identifies and characterizes the aquatic habitats. Information on water quality parameters including dissolved oxygen, conductivity, pH, bottom substrate, percent cover, flow, water color, and visual observations are collected.

The general aquatic survey was completed in 1992. Macroinvertebrates were collected with Hester-Dendy artificial substrates and a petite ponar dredge during initial biological sampling of Rowell Creek in 1991 (ECT, 1992). Fish were collected, identified, and released by net seining and minnow traps. The purpose of the initial sampling was to identify aquatic habitats and receptors for the ecological assessment. An additional purpose of the macroinvertebrate and fish sampling event was to identify general water quality conditions in Rowell Creek, both upstream and downstream of OUs 1 and 2.

Further sampling of macroinvertebrates and fish is proposed for NAS Cecil Field (Figure 6-1). Macroinvertebrates and fish will be sampled concurrently with collection of surface water and sediment samples in the next field investigation proposed by ABB-ES (1992b).
Macroinvertebrates will be collected according to the FDER Standard Operating Procures Manual for benthic macroinvertebrate sampling (FDER, 1992). The exact scope of the biological sampling is currently being developed and will be specified in a separate work plan. In general, the biological samples will include:

1) Quantitative benthic macroinvertebrate will be sampled in depositional areas concurrent with sediment samples collected for chemical analyses. Replicate samples will be collected with a petite ponar dredge or sediment core. The dredge will be used to collect samples from the Lake Fretwell.

2) Hester-Dendy artificial substrate samplers will be used to collect macroinvertebrates from a subset of the sampling stations. These samplers will be used on a quarterly basis to monitor for seasonal variations.

3) Fish will be sampled from a subset of the sampling locations by use of net seines, minnow traps, and possibly electroshocking. Specimens collected will be identified and released.

4) For sampling locations that are wadable, macroinvertebrate samples will also be collected by use of a D-frame dip net according to sampling protocols developed for FDER. The intent is to sample as many different types of aquatic microhabitats including vegetation, sands, leaf packs, and snags.

The results of the macroinvertebrates sampling will be interpreted with the sediment and surface water analytical results in order to identify areas which may be impacted by contamination and/or other influences associated with the hazardous waste sites. The macroinvertebrate results will be used to assess the need for sediment toxicity tests or further chemical analyses.

6.4 RISK CHARACTERIZATION. The risk characterization for the Phase I aquatic assessment is the process of comparing predicted chemical exposures with appropriate reference toxicity values that are derived in the toxicity assessment in order to evaluate risks. The predicted exposure concentrations are divided by the appropriate RTV in order to calculate a hazard quotient for each individual chemical. For assessment of risks related to total chemical exposure, a hazard index will be calculated by summing the hazard quotients. Separate indices will be calculated for amphibians, fish, invertebrates, and plants. A hazard quotient or index greater than 1 indicates there is a potential for adverse effects on reproduction, growth, or survival. These results will be used to identify which chemicals may be associated with risks and which chemicals may be responsible for adverse effects observed in the macroinvertebrate communities. The risk characterization will include an interpretation of results and a discussion of the uncertainties associated with the assessment.

If the results, in the professional judgement of the assessor and site manager, are not sufficient to develop ecological remedial action objectives for the operable units, then further Phase II methods will be implemented. The Phase II methods would be designed to reduce uncertainties associated with the first assessment and to provide the additional information that is needed to make remedial decisions based on ecological risks.

7.0 METHODOLOGY FOR ASSESSMENT OF RISKS FOR TERRESTRIAL WILDLIFE.

The assessment of risks for terrestrial wildlife will be completed in two phases in the same manner as the aquatic assessment (Figures 7-1 and 7-2). The Phase I terrestrial wildlife assessment (Figure 7-1) is an analyses of risks associated with exposures for individual chemicals. This method has the same limitations and uncertainties as the aquatic assessment chemical-specific analyses. Additional uncertainties may be the prediction of food chain transport of chemical contamination.

The scope of the Phase II assessment will be developed based on a review of the Phase I results. Phase II methods are used to reduce the uncertainties associated with the Phase I assessment and to provide site-specific ecotoxicity information. Potential Phase II terrestrial assessment methods (Figure 7-2) include the analyses of site specific toxicity by exposing terrestrial invertebrates or plants to contaminated surface soils from the site, measurement of chemical exposures (concentrations of chemicals in invertebrates, aquatic organisms, plants, and/or mammals), and measurement of adverse effects in small mammals or plant populations in the field. If Phase II methods are implemented, the results will be used with the Phase I assessment to develop ecological remedial objectives for each of OUs (Figure 7-2).

7.1 SELECTION OF ENDPOINTS. The nature of the Phase I assessment is conservative as its purpose is to screen the chemical data for any potential adverse effects to terrestrial organisms. As such, the endpoints selected are both conservative and general. For the Phase I terrestrial assessment, the assessment endpoint is any adverse effect on growth, reproduction, or survival. The measurement endpoints are laboratory toxicity test results reported in the literature which show reduced growth, adverse effects on reproduction, behavior, or mortality. For the Phase II assessment, measurement and assessment endpoints will be specific to the types of toxicity testing or field studies being implemented. An additional chemical-specific assessment using information from Phase II may also be employed to reassess the Phase I assessment.

7.2 EXPOSURE ASSESSMENT. Exposure assessment for terrestrial wildlife includes identification and characterization of receptors, identification of exposure routes, and prediction or measurement of the chemical intake for each of the exposure routes.

7.2.1 Receptor Identification and Characterization Terrestrial habitats at each of the operable units will be identified and characterized on the basis of field surveys and other available information. The field surveys will include identification of wetlands, vegetative cover, and any wildlife encountered. Plant species identified for each waste site will provide the basis along with information from base personnel and the literature for characterizing habitats. Habitats will be classified according to the definitions provided by the FNAI and Florida Department of Natural Resources (FNAI, 1990). Receptors will be identified based on the reports describing the types of species (mammals, birds, reptiles, and amphibians) expected to reside in the types of habitat present at the site.

A subset of the species identified will be selected to represent the terrestrial wildlife populations inhabiting the OUs and surrounding areas for the purpose of the Phase I chemical-specific assessment. Representative species will be chosen so that the chosen species are the ones who will most likely be exposed to high contaminant concentrations due to their: position in the food web, diet (ingestion rate and food type), home range (contained within the area of soil contamination), and body size. The representative species will include a total of seven species: one small herbivorous and insectivorous mammal and bird, one piscivorous bird and mammal and one reptile. Upper level predators will be added if the COC in soils include chemicals that may potentially transfer within the food chain or biomagnify. The species selected are assumed to be representative of other species within the same trophic level.

For each of the representative species, information on life history will be collected including average body weight, food ingestion rates, water ingestion rates, home range, and life span. This information will be used to estimate chemical intakes from food, water, and soils.

<u>**7.2.2 Exposure Routes and Chemical Exposure Concentrations**</u> Exposure routes for terrestrial wildlife at OUs 1, 2 and 7 that will be evaluated in the ecological assessment are summarized in the conceptual models shown in Figures 4-1 to 4-3. Terrestrial receptors are potentially exposed to contamination in surface soils at OUs 1 and 2, surface waters and sediments at OUs 1, 2 and 7, and air and dust at OU 2. In addition, dietary exposures for terrestrial wildlife are possible as prey may be contaminated as a result of exposure to contaminated media.

7.2.2.1 Chemical Exposure Point Concentrations for Soils Chemical exposure concentrations for surface soils will be calculated for each COC based on the analytical results from sampling. The exposure concentrations will be the mean and the 95% Upper Confidence Interval (UCL) of the mean within a specified medium. If the 95% UCL exceeds the maximum detected concentration the maximum value will be used to estimate the maximum exposure.

The analytical data will be log-transformed before assessment of the exposure point concentrations. Non-detects will be included in calculations at one-half their sample quantitation limit. Duplicates of samples will be averaged, and only one value will be entered into the calculation of the mean and the 95% UCL.

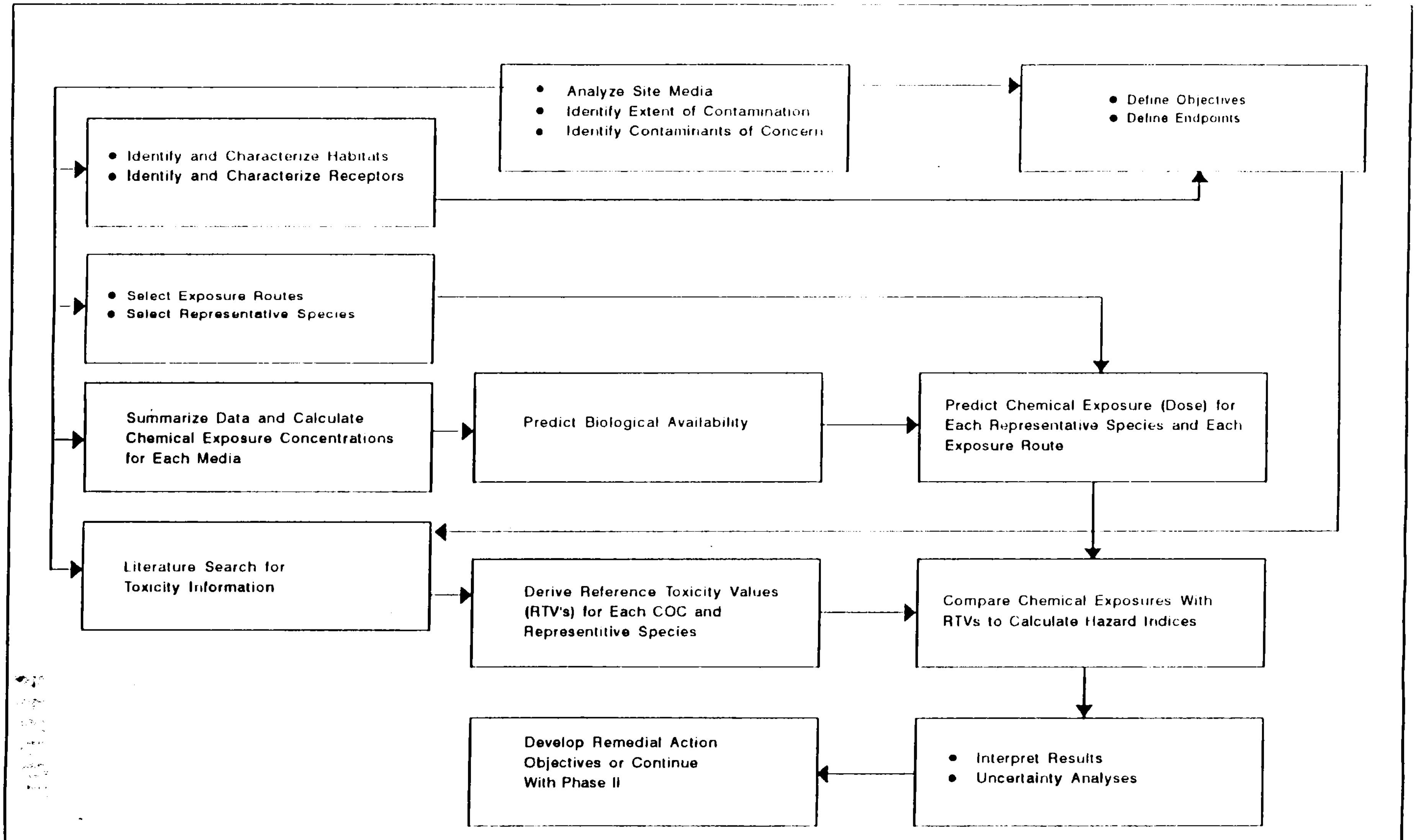

FIGURE 7-1

PHASE I CHEMICAL SPECIFIC SCREENING LEVEL ASSESSMENT FOR TERRESTRIAL RECEPTORS

TECHNICAL MEMORANDUM ECOLOGICAL ASSESSMENT METHODOLOGY OUs 1, 2 AND 7

NAS CECIL FIELD JACKSONVILLE, FLORIDA

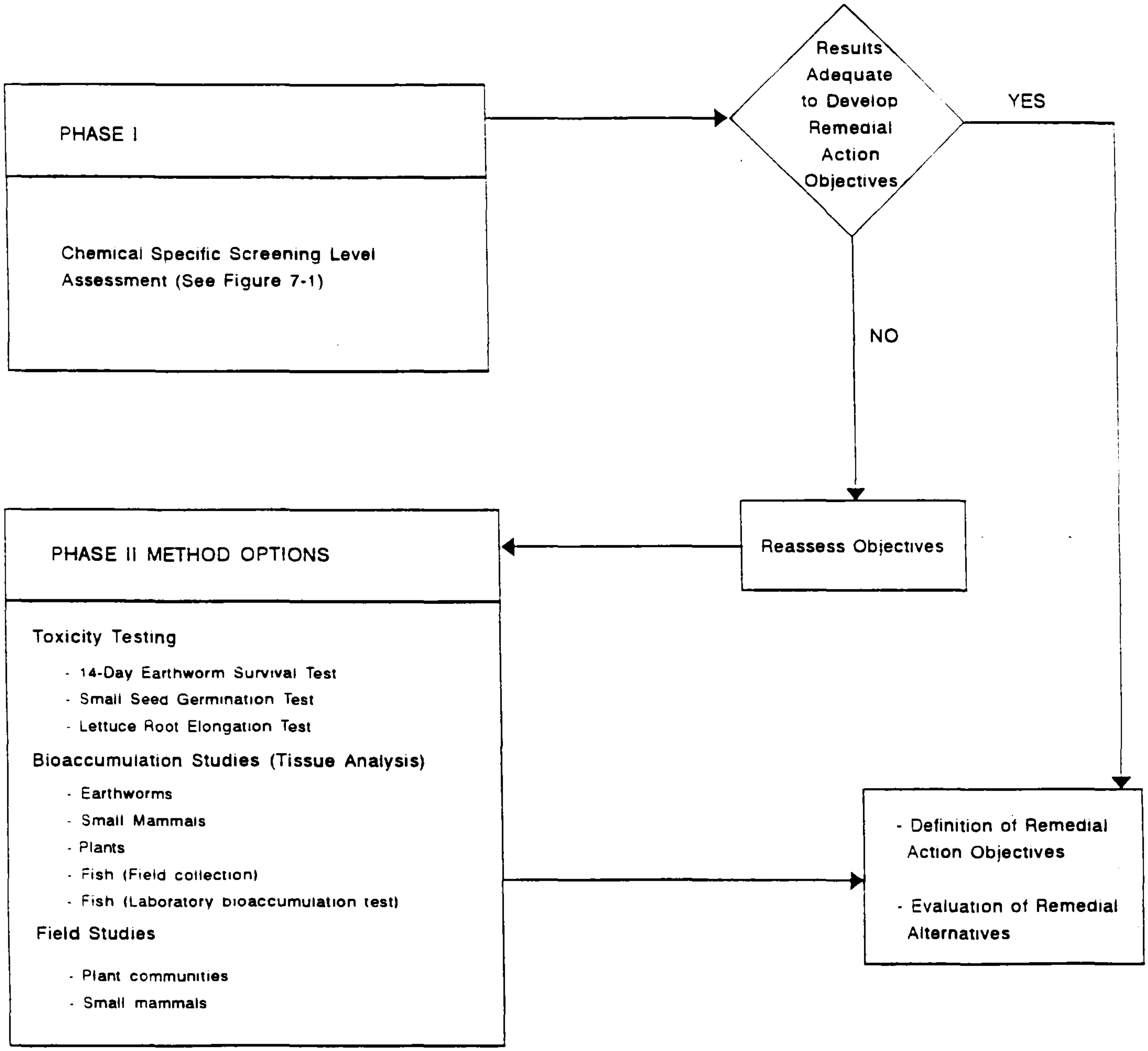

FIGURE 7-2

PHASED APPROACH FOR ASSESSMENT OF RISKS TO TERRESTRIAL RECEPTORS

TECHNICAL MEMORANDUM ECOLOGICAL ASSESSMENT METHODOLOGY OUs 1, 2 AND 7

NAS CECIL FIELD JACKSONVILLE, FLORIDA

The 95% UCL will be calculated in accordance with USEPA risk assessment guidance (USEPA, 1989a; 1991c) as follows:

$$95\%\ UCL = e^{\left(mean + 0.5s^2 + \frac{sH}{\sqrt{n-1}}\right)} \tag{1}$$

Chemical exposure-point concentrations for soils will be used to calculate the chemical intake from soils by incidental ingestion and will be used to predict the concentration of chemicals in the diets of the representative species according to the equations provided in the following subsections.

7.2.2.2 Estimation of Chemical Intake from Surface Water Exposures for mammals and birds related to contaminated surface water will be estimated based on the reported water intake rate of the species and the concentration of the chemical in surface water according to the following equation:

$$Chemical\ Intake\ (mg/day) = \begin{matrix} Surface \\ Water \\ Concentration \\ (mg/\ell) \end{matrix} \times \begin{matrix} Water\ Ingestion \\ Rate \\ (\ell/day) \end{matrix} \tag{2}$$

The maximum concentration of a COC measured in surface water near the site will be used to provide a conservative estimate of exposure. It may be necessary to convert the chemical intake to a chemical dose (mg/kg/day) by dividing by the intake concentration by the body weight of the species.

7.2.2.3 Estimation of Chemical Intake from the Diet Contaminant concentrations in various prey consumed by each representative species (e.g., invertebrates and plants) will be estimated based on modeling. Tissue residues in each prey will be estimated using bioaccumulation factors (BAF) obtained directly, or extrapolated, from values in the literature:

$$\underset{(mg/kg)}{\mathit{Prey\ Chemical} \atop \mathit{Tissue\ Concentration}} = \underset{(mg/kg)}{\mathit{Soil\ Chemical} \atop \mathit{Concentration}} \times BAF \qquad (3)$$

Dietary exposures for the piscivorous representative species will be estimated by use of available models for predicting contaminant levels in fish tissues based on physical and chemical factors for the COCs and respective concentrations in water and sediments. Sampling of fish for analysis of tissues is discussed in Section 7.3.3. If fish tissue analyses are completed, the resulting data will be used to determine dietary exposure in place of the models.

The potential dietary chemical exposure (PDE) for each receptor species will be calculated by multiplying each predicted prey species tissue concentration by the proportion of that prey item in the diet and summing these values and multiplying by the Site Foraging Frequency Factor (SFF):

$$PDE = \sum_{1}^{n} [(P_1 \times T_1) + (P_2 + \times T_2) + \ldots + (P_n \times T_n)] \times SFF \qquad (4)$$

Where:

PDE =	potential dietary exposure (mg/kg)
P_n =	percent of prey item n in diet
T_n =	concentration of the chemical in prey item n tissue (mg/kg) as calculated in equation 4
SFF =	area of contaminated soil (acres) divided by the home range of the species (acres).

The SFF is the areal extent of soil contamination divided by the home range of the species. This factor allows for consideration of the amount of time the species is likely to forage on the area of soil contamination.

7.2.2.3 Total Oral Chemical Intake Total oral chemical intake will be calculated as the water intake plus the dietary intake plus intake from direct or indirect ingestion of the soils. Soil ingestion rates for mammalian and avian representative species will be based on values available from the literature (Beyer, 1991). In some cases, it may be necessary to convert the total oral chemical intake values to a chemical dose based on the body weight of the representative species. Conversion to a chemical dose allows for direct comparison with toxicity information that is expressed as a dose.

7.3 ECOTOXICITY ASSESSMENT. The Phase I ecotoxicity assessment for terrestrial receptors is limited to literature information. Toxicity testing with soils, analyses of chemicals in biological tissues (fish, shellfish, terrestrial invertebrates or plants) and other field studies may be added in Phase II in order to complete the ecotoxicity assessment.

7.3.1 Literature Information The ecotoxicity assessment will include the identification of potential toxic effects for the selected COCs as described in Section 5.0 and a dose-response assessment. An RTV will be selected for each COC based on toxicity studies for the chemical. RTVs will be selected for ingestion and inhalation exposures for the mammalian and avian representative species and ingestion exposures for piscivores, and reptiles. RTVs will also be selected for terrestrial plants and invertebrates.

Toxicity information for each COC will be collected based on database searches and consultation with other available resources. Databases and resources that will be searched include PHYTOTOX, RTECS, IRIS, and the USFWS Contaminant Review Series.

Acute RTVs will be derived from LD_{50} (doses causing 50% mortality in the test population) or LC_{50} (concentration causing 50% mortality in a test population. Chronic RTVs will be selected that represent the lowest reported exposure concentration or dose associated with adverse effects to reproduction, growth or survival. Both acute and chronic RTVs will be compared with the total chemical intake predicted in the exposure assessment to characterize risks.

In the event that wildlife toxicity information is unavailable, RTVs will be derived for the mammalian representative species based on laboratory mice, rat or rabbit tests. Dietary exposure studies are preferred to oral exposure studies. Injection studies will not be used. Inhalation RTVs will be based on inhalation studies.

7.3.2 Toxicity Tests Laboratory toxicity tests that may be completed for soil samples include a lettuce-seed-root-elongation test, lettuce-seed-germination test, and/or a 14-day earthworm-survival test (USEPA, 1988c). Soil toxicity testing will be considered in the event that:

1) It is not possible to derive RTVs based on literature information for COCs;
2) The bioavailability of COCs in soils is unknown and cannot be reasonably predicted,
3) Additive, synergistic or antagonistic interactions among toxic chemicals or other constituents in the environment are suspected; and/or
4) The chemical analyses may not detect toxic constituents actually present.

<u>7.3.3 Field Studies</u> There are two types of field studies available that would provide useful information for the ecological assessment. These methods include those which measure adverse effects to terrestrial wildlife or plants and those that measure the concentrations of chemical concentrations in tissues. Sampling of fish (or shellfish) from Lake Fretwell, Rowell Creek, or Sal Taylor Creek, for the purposes of determining contaminant concentrations in tissues, will be considered upon review of the results of the proposed sediment and surface water sampling (Figure 3-8) within these water bodies and the results of the biological sampling. Sampling of fish will be initiated if two conditions are met: 1) contaminant migration from hazardous waste sites to Rowell Creek, Lake Fretwell, or Sal Taylor creek is identified, and, 2) if that contamination is persistent and bioaccumulative. These measurements would decrease the uncertainties associated with the prediction of dietary exposures in Phase I.

Bioaccumulation studies with earthworms may be used to determine dietary chemical exposures for birds, mammals, and reptiles. Earthworms exposed during laboratory toxicity testing would be sacrificed for chemical analyses upon completion of the test, or worms would be exposed on site, collected, and analyzed. This information would decrease the uncertainty of the chemical dietary intake calculations made in the Phase I assessment.

It is also possible to analyze plants from the waste sites to determine the uptake of chemicals from soils and dietary exposures for herbivores. Several metals (e.g., selenium) are known to accumulate in plant tissues. These measurements would decrease the uncertainties associated with the prediction of chemical dietary intake exposures in Phase I.

<u>7.4 RISK CHARACTERIZATION.</u> The risk characterization for terrestrial receptors consists of the comparison of the predicted exposures with respective RTVs in order to calculate a hazard index. Hazard indices will be calculated for each representative species for each route of exposure. Indices are summed to provide an estimate of potential additive effects. A chronic hazard index above 1 indicates potential adverse effects to reproduction, growth, or survival are possible. An acute hazard index greater than 1 indicates mortality.

The risk evaluation involves making a number assumptions which to varying degrees result in uncertainty in the analysis. At the completion of the risk characterization, these sources of uncertainties will be discussed and evaluated with respect to the conclusions. Because the Phase I approach has been developed as a screening tool, implementation of Phase II methods will be considered to decrease the uncertainties and to provide complementary information. Both Phase I and II assessment results will be used to develop ecological remedial objectives and goals for each of OU.

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8.0 SCOPE OF NO FURTHER ACTION ASSESSMENT.

The NFA assessment will assess risks for aquatic and terrestrial receptors for the no action remedial alternative in the FS. The NFA will rely on the identification of COCs and the ecotoxicity assessment completed as part of the BRA. A separate exposure assessment will be completed that would assess potential changes in contaminant exposure concentrations over time considering that no remedial actions would be implemented. Exposures over time for ecological receptors may change as a result of chemical degradation, soil erosion, groundwater transport, sediment transport, or other processes. The risk characterization will be performed in the same manner as the BRA based on the new exposure information.

The exact scope and methods for the NFA will be determined as more site information becomes available during the subsequent field investigations.

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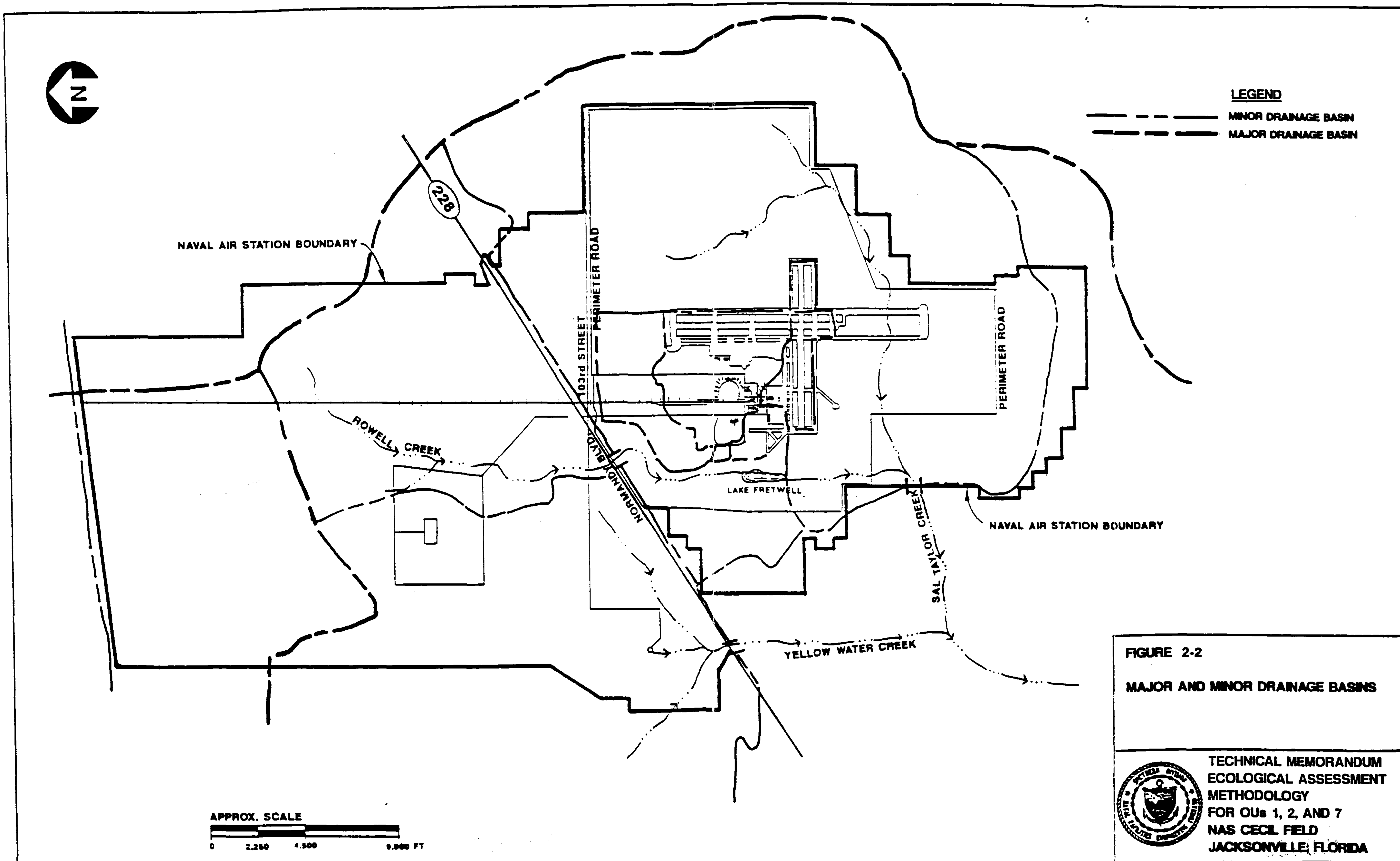

FIGURE 2-2

MAJOR AND MINOR DRAINAGE BASINS

TECHNICAL MEMORANDUM
ECOLOGICAL ASSESSMENT
METHODOLOGY
FOR OUs 1, 2, AND 7
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

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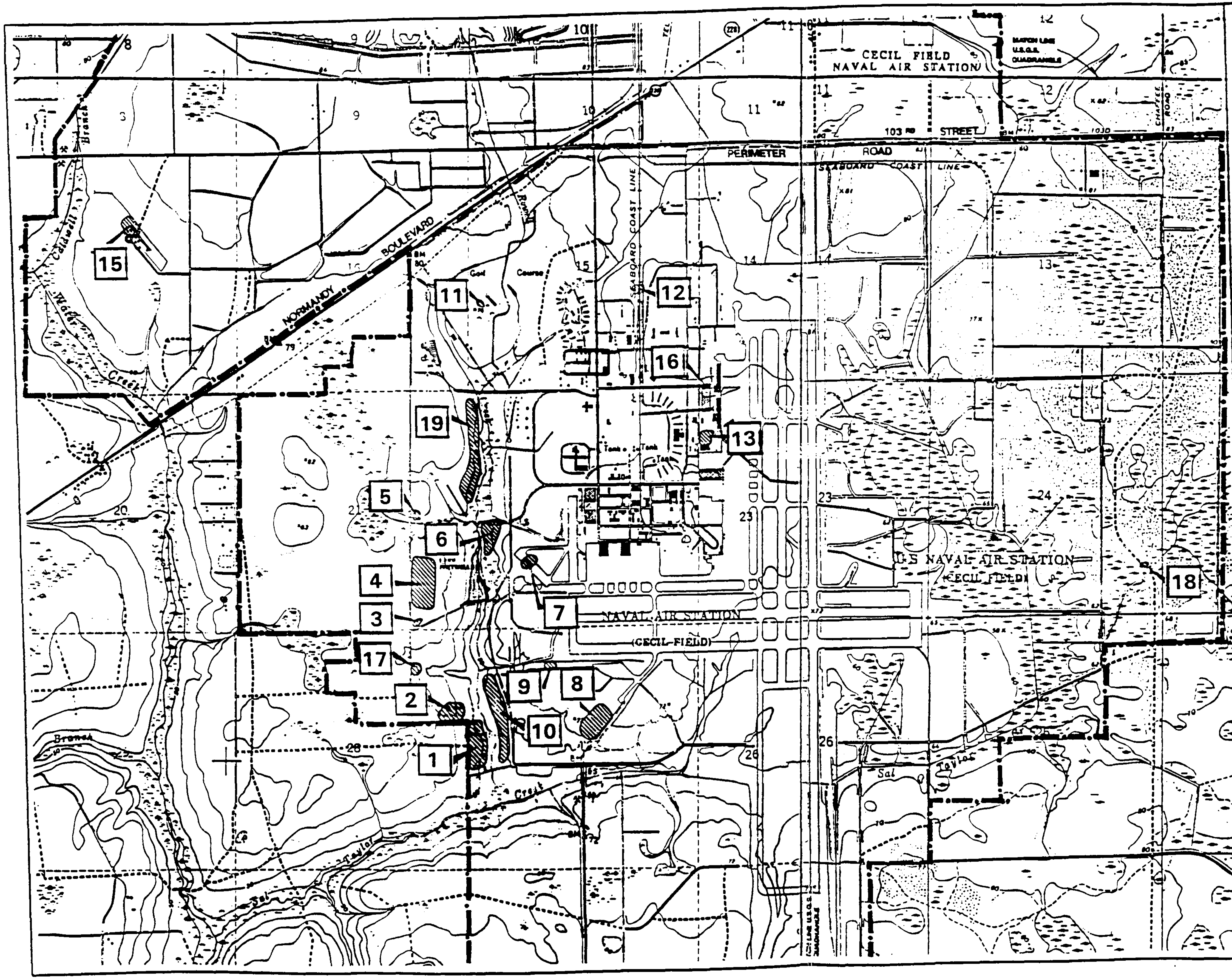

LEGEND

1 LOCATION OF WASTE SITES

FIGURE 3-1
LOCATION OF WASTE SITES
AT NAS CECIL FIELD

TECHNICAL MEMORANDUM
ECOLOGICAL ASSESSMENT
METHODOLOGY
FOR OUs 1, 2, AND 7
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

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