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NAS CECIL FIELD
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BASEWIDE ECOLOGICAL ASSESSMENT REPORT NAS CECIL FIELD FL

9/1/1998

ABB ENVIRONMENTAL

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

UNIT IDENTIFICATION CODE: N60200
CONTRACT NO.: N62467-89-D-0317/090

SEPTEMBER 1998

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29418

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JACKSONVILLE, FLORIDA

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

SEPTEMBER 1998

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

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NAVAL FACILITIES ENGINEERING COMMAND
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29419-9010

Harding Lawson Associates

2523-3284

September 22, 1998

Ms. Debbie Vaughn-Wright
Remedial Project Manager
Federal Facilities Branch
Waste Management Division, 10th Floor
USEPA Region IV
61 Forsyth Street
Atlanta, Georgia 30303

Subject: Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida
Contract No. N62467-89D-0317/090

Dear Ms. Vaughn-Wright:

Harding Lawson Associates ES, Inc. is pleased to forward two copies of the subject report for your files.

The Basewide Ecological Assessment Report (BEAR) evaluates potential adverse ecological effects associated with exposures to contamination from all hazardous waste sites and potential sources of contamination (PSCs) at Naval Air Station (NAS) Cecil Field.

Comments or questions you may have concerning this report should be directed to Mr. Mark Davidson at 843-820-5526.

Sincerely,

HARDING LAWSON ASSOCIATES ES, INC.

Rao Angara
Task Order Manager

Enclosure

cc: M. Deliz, FDEP (2 copies)
D. Kruzicki, NASCF (1 copy)
D. Obenauer, BEI (1 copy)
M. Davidson, SDIV (1 copy)
D. Porter, SDIV (1 copy)
S. Pratt, TtNUS (2 copies)
M. Speranza, TtNUS (1 copy)
File

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Unit Identification Code: N60200

Contract No. N62467-89-D-0317/090

Prepared by:

Harding Lawson Associates
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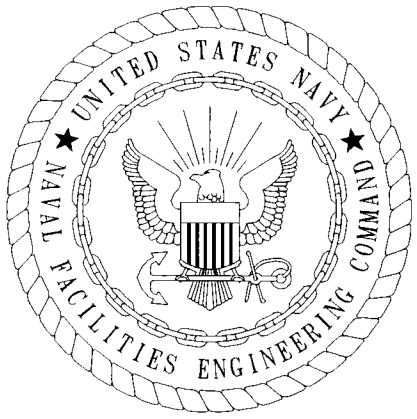
September 1998



CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, Harding Lawson Associates, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/090 are complete and accurate and comply with all requirements of this contract.

DATE: September 15, 1998

NAME AND TITLE OF CERTIFYING OFFICIAL: Rao V.R. Angara
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Eric Blomberg, P.G.
Project Technical Lead

(DFAR 252.227-7036)

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 disposal of chemicals allegedly occurred. 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, an RI/FS will be performed to address the extent, magnitude, and impact of possible contamination at these waste sites.

This Basewide Ecological Assessment Report (BEAR) evaluates potential adverse ecological effects associated with exposures to contamination from all operable units and potential sources of contamination. The BEAR contains information on the ecological setting of NAS Cecil Field, the general methodology for ecological risk assessments (ERAs) for individual sites, summaries of the ERA results for each of the sites, and an evaluation of risks for watersheds associated with all sites.

Questions regarding the report should be addressed to the Commanding Officer, Code 00B, P.O. Box 111, NAS Cecil Field, Jacksonville, Florida 32215-0111.

EXECUTIVE SUMMARY

This Basewide Ecological Assessment Report (BEAR) assesses potential ecological risks for aquatic and terrestrial receptors resulting from the release of contaminants from the Installation Restoration program hazardous waste sites and potential sources of contamination (PSCs). The risks that are estimated using multiple conservative assumptions tend to be biased high to be protective of ecological receptors.

The purpose of the BEAR is to provide a summary of all ecological studies conducted at Naval Air Station (NAS) Cecil Field. The primary objectives of the BEAR are to

- describe the ecological setting of NAS Cecil Field,
- describe the methodology used to complete individual ecological risk assessments (ERAs) for each of the hazardous waste sites,
- synopsize the ERA results for each site, and
- assess the total ecological risks for watersheds at NAS Cecil Field represented by multiple sites and PSCs.

In addition, the BEAR presents the results of the ERA for Lake Fretwell and Rowell Creek upstream of Lake Fretwell.

NAS Cecil Field presents a range of ecological settings from lakes, blackwater streams, and wetlands to disturbed uplands and pine and hardwood forests (some used for timber production). These settings provide habitat for a variety of plant and animal species, including some federally and state-listed threatened and endangered species. The predominantly undisturbed portions of NAS Cecil Field provide a key role in fostering a regional north-south ecological corridor for terrestrial wildlife.

ERAs on which the BEAR is based were completed following a procedure that is consistent with Federal and State guidance and regulations. This procedure consists of the following five major components: ecological characterization, problem formulation, analysis (including selection chemicals to evaluate, and exposure and effects assessments), risk characterization, and uncertainty analyses. From this process, conclusions about potential risks to ecological receptors at each of the OUs and PSCs were made, the results of which are presented in Table ES-1.

Total ecological risks from exposure to chemicals that have migrated from multiple sites were evaluated for the various watersheds at NAS Cecil Field. A summary of the risks is presented in Table ES-2.

ERA conclusions for Lake Fretwell and Rowell Creek upstream of Lake Fretwell are summarized in Table ES-3.

Table ES-1
Operable Unit and Other Ecological Risk Assessment Summary

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit/ PSC	Site	Media			
		Surface Soil	Surface Water	Sediment	Groundwater
OU 1	Site 1	No risk.	No risk.	Limited risk within 700 feet reach of Rowell Creek	No risk.
OU 1	Site 2	No risk.	No risk.	Risk to benthic receptors in man-made drainage structure (likely related to iron flocculation).	No risk.
OU 2	Site 5	No risk to terrestrial wildlife. Possible risk to terrestrial plants and soil invertebrates from TRPH and PCBs.	No risk.	Risk to benthic receptors from TRPH, Aroclor-1250, and total DDT in limited reach of drainage ditch.	No risk.
OU 2	Site 17	No risk to terrestrial wildlife or soil invertebrates. Limited or no risk to terrestrial plants.	No risk.	No risk.	NM
OU 3	Site 7	No risk to terrestrial wildlife. Negligible risk to plants and invertebrates.	NM	NM	NM
OU 3	Site 8	No risk to terrestrial wildlife. Limited risk to invertebrates and plants; however, there are no correlation with chemicals possible.	No risk to semi-aquatic wildlife. Negligible risks for aquatic receptors.	No risk to terrestrial wildlife. Negligible risk for invertebrates, possibly from TRPH.	No risk to invertebrates and plants. Negligible risk to aquatic receptors from aluminum.
OU 4	Site 10	No risk to terrestrial wildlife or soil invertebrates. Negligible or no risk to plants.	NM	NM	Negligible risks to terrestrial plants and aquatic receptors.
OU 5	Site 14	No risk to terrestrial wildlife. Negligible risk to plants and invertebrates.	No risk to semi-aquatic wildlife. Negligible risks to aquatic receptors.	No risk to semi-aquatic wildlife. Negligible risks to aquatic receptors.	Negligible or no risk to plants and invertebrates.
OU 5	Site 15	Risks to small mammals, small birds, plants, and invertebrates from exposure to lead.	No risk to semi-aquatic wildlife. Potential risks to aquatic receptors from lead.	No risk to semi-aquatic wildlife. Potential risks to aquatic receptors from PAHs, pesticides, and lead.	Negligible risks to aquatic receptors.
OU 6	Site 11	No risk to terrestrial wildlife or soil invertebrates. Negligible risk to plants from inorganics.	NM	NM	NM

See notes at end of table.

Table ES-1 (Continued)
Operable Unit and Other Ecological Risk Assessment Summary

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit/ PSC	Site	Media			
		Surface Soil	Surface Water	Sediment	Groundwater
OU 7	Site 16	NM	No risk.	No site related risk	No risk.
OU 8	Site 3	No risk to terrestrial wildlife or soil invertebrates. Negligible risk to plants.	No risk.	No risk.	Limited risk to aquatic receptors in Rowell Creek from dichloroebenzenes.
PSC	4	No risk.	NM	NM	No risk.
PSC	6	No risk.	No risk.	No risk.	No risk.
PSC	9	No risk.	NM	NM	No risk.
PSC	12	No risk.	NM	NM	NM
PSC	18	No risk.	No risk.	No risk.	No risk.
PSC	19	No risk.	No risk.	No risk.	No risk.

Notes: ERA = ecological risk assessment.
OU = operable unit.
TRPH = total recoverable petroleum hydrocarbons.
PCB = polychlorinated biphenyl.
DDT = dichlorodiphenyltrichloroethene.
NM = not a medium of concern.
PSC = Potential Source of Contamination.

Table ES-2
Summary of Watershed Ecological Risks

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Watershed	Potential Source(s) of Contamination	Ecological Risks
ROWELL CREEK		
1. Rowell Creek Upstream of Lake Fretwell		
Rowell Creek North of 6th Street.	None	None
Golf Course Tributary	Golf course	ERA not undertaken for Golf course tributary; however, potential risks associated with exposures to PCBs and pesticides in sediment may exist for terrestrial wildlife and aquatic receptors.
Rowell Creek East of PSC 19	Site 11 and PSC 19	Sublethal effects were estimated for piscivorous mammals exposed to Aroclor-1260. Risks for certain aquatic macroinvertebrates in vicinity of at RC-SD-18.
2. Lake Fretwell		
Site 5 Drainage Ditch and Wetlands Area	Site 5	Risks for certain aquatic macroinvertebrate receptors at SD/TOX-5-1, SD/TOX-5-3, and SD/TOX-5-4 associated with Aroclor-1260, DDT_R, or TRPH in sediment.
Lake Fretwell	Site 11, PSC 19, PSC 6, and Site 5	Sublethal effects for all representative wildlife species associated with ingestion of PCBs and metals in fish tissue. Risks for certain aquatic macroinvertebrates at SD/TOX-LF-7, SD/TOX-LF-9, SD/TOX-LF-11, and SD/TOX-LF-12 based on mortality observed in sediment toxicity tests.
3. Rowell Creek Downstream of Lake Fretwell		
Northernmost section	Site 3 and wastewater treatment plant	No risks predicted.
Southernmost section	Site 3, wastewater treatment plant, Site 1, Site 2, and PSC 10	Risks for certain aquatic macroinvertebrates based on sediment toxicity and impairment of benthic community at SD/TOX-RC-6 and SD/TOX-RC-7. Responses may be associated with discharge of tributary draining from Site 2 to Rowell Creek.
4. Tributaries to Rowell Creek		
Site 2 Tributary	Site 2	Lethal risks for small mammals associated with ingestion of iron in sediment. Risks for certain aquatic macroinvertebrates based on sediment toxicity and impairment of benthic community. Adverse responses associated with metals in surface water and sediment and orange-red flocculent material present in Site 2 tributary.

See notes at end of table.

Table ES-2 (Continued)
Summary of Watershed Ecological Risks

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Watershed	Potential Source(s) of Contamination	Ecological Risks
SAL TAYLOR CREEK		
1. Upstream and East of Flight Line	Site 16, North Fuel Farm (1991 JP-5 fuel spill), and flight line	Risks for certain aquatic macroinvertebrates at STC-1 and STC-3 based on mortality observed in sediment toxicity tests. Risks may be associated with TRPH in sediment; however the presence of TRPH is not related to Site 16. Risks for aquatic receptors in wetlands associated with exposures to bis(2-ethylhexyl)phthalate, aluminum, iron, and zinc in groundwater.
2. Downstream of Site 8 Tributary	Site 8, Site 16, and North Fuel Farm (1991 JP-5 fuel spill)	No risks predicted.
3. Site 8 Tributary	Site 8	Risks for certain aquatic macroinvertebrates may occur from exposure to aluminum in groundwater, and Aroclor-1260 and TRPH in sediment, based on the toxicity benchmark evaluation for surface water, sediment, and groundwater, and on the sediment toxicity testing results. Risks may also occur for terrestrial plants due to elevated concentrations of aluminum in groundwater.
YELLOW WATER CREEK	Site 15	Lethal risks for small mammals associated with ingestion of lead in sediment. Potential risks to terrestrial plants and invertebrates based on results of toxicity tests. Invertebrate effects may be associated with aluminum and lead in soil. Plant effects are not correlated with any one chemical in linear regressions. Potential risks for certain aquatic macroinvertebrates from exposure to lead in surface water and sediment, and possibly PAHs in sediment.

Notes: NAS = Naval Air Station.
ERA = ecological risk assessment.
PCB = polychlorinated biphenyl.
PSC = Potential Source of Contamination.
DDT_r = dichlorodiphenyltrichloroethane (and its daughter products).
TRPH = total recoverable petroleum hydrocarbons.

Table ES-3
Lake Fretwell and Upstream Rowell Creek
Ecological Risks

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Location/Receptors	Surface Water	Sediment
Lake Fretwell		
Terrestrial	Negligible risks to avian receptors and terrestrial wildlife from PCBs, copper, and mercury.	See surface water.
Aquatic	Negligible risk.	Potential risks to macroinvertebrates in southern portion of lake.
Rowell Creek Upstream of Lake Fretwell		
Terrestrial	Negligible risks to terrestrial wildlife from PCBs.	See surface water.
Aquatic	No risk.	Limited risks to macroinvertebrates at one location.

Note: PCB = polychlorinated biphenyl.

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
AIMD	Aircraft Intermediate Maintenance Department
AOI	area of interest
AQUIRE	Aquatic Information Retrieval
ASTM	American Society for Testing and Materials
AVORD	aviation ordnance
AWQC	ambient water quality criteria
BAF	bioaccumulation factor
BCF	bioconcentration factor
BEAR	Basewide Ecological Assessment Report
BRA	baseline risk assessment
BTAG	Biological Technical Assistance Group
°C	degrees Celsius
CAR	contamination assessment report
CDM	Camp, Dresser, and McKee
CLP	Contract Laboratory Program
C-NOEC	chronic no observed effect concentration
CRDL	contract-required detection limit
CRQL	contract-required quantitation limits
CZR	CZR Incorporated
DCB	dichlorobenzene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
EA	Engineering, Science, and Technology
ECC	ecological contaminant of concern
ECPC	ecological chemicals of potential concern
ECT	Environmental Consulting Technology, Inc.
EPC	exposure point concentration
EPT	ephemeroptera-plecoptera-trichoptera
ER-L	effects range-low
ERA	ecological risk assessment
ER-M	effects range-median
ESE	Environmental Science and Engineering, Inc.
FCREPA	Florida Committee on Rare and Endangered Plants and Animals
FDA	Florida Department of Agriculture
FDEP	Florida Department of Environmental Protection
FGFWFC	Florida Game and Fresh Water Fish Commission
FNAI	Florida Natural Areas Inventory
FS	feasibility study
ft/sec	feet per second
HI	hazard index
HQ	hazard quotient

GLOSSARY (Continued)

IR	installation restoration
IRA	initial remedial action
kg	kilogram
LD_{50}	lethal dose at which 50 percent of test animal population dies
LEL	lower explosive limit
LOEC	lowest observed effect concentration
MATC	maximum acceptable toxicant concentration
mg/ℓ	milligrams per liter
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
µg/ℓ	micrograms per liter
m^2	square meter
µmho/cm	micromhos per centimeter
NAS	Naval Air Station
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NWI	National Wetlands Inventory
OME	Ontario Ministry of the Environment
OU	operable unit
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PDE	potential dietary exposure
PEL	permissible exposure limit
PRE	preliminary risk evaluation
PRGs	preliminary remedial goals
PSC	potential source of contamination
RA	remedial action
RBP	rapid bioassessment protocols
RI	remedial investigation
ROD	Record of Decision
RTVs	reference toxicity values
SFF	site foraging frequency
SMP	site management plan
SQAG	Sediment Quality in Florida Coastal Waters
SQGs	sediment quality guidelines
SSC	species of special concern
SVOC	semivolatile organic compound
TBV	toxicity benchmark values
TCE	trichloroethene
TCL	target compound list

GLOSSARY (Continued)

TEL	threshold effects level
TOC	total organic carbon
TRPH	total recoverable petroleum hydrocarbons
UCL	upper confidence limit
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
VOC	volatile organic compound
WET	Wetland Evaluation Technique
WWTP	wastewater treatment plant

CHAPTER 1.0

1.0 INTRODUCTION

1.1 **PURPOSE**. The Basewide Ecological Assessment Report (BEAR) for Naval Air Station (NAS) Cecil Field assesses the potential ecological risks for aquatic and terrestrial receptors resulting from the release of contaminants from the Installation Restoration (IR) program waste sites and potential sources of contamination (PSCs) (ABB Environmental Services, Inc. [ABB-ES], 1997). The operable units (OUs) and PSCs at NAS Cecil are described in the Site Management Plan (SMP) (ABB-ES, 1997). OUs are used to define investigative sets of sites at NAS Cecil Field based on the types of waste disposed of and the suspected contaminants of concern. Figure 1-1 shows the general location of NAS Cecil Field. Figure 1-2 shows the location of each of the OUs and PSCs at NAS Cecil Field.

Currently, 18 sites are included in the IR program. Twelve of these sites are organized into the following eight OUs:

- OU 1 Site 1 Old Landfill
  Site 2 Recent Landfill
- OU 2 Site 5 Oil Disposal Area
  Site 17 Oil and Sludge Disposal Pit Southwest
- OU 3 Site 7 Old Firefighting Training Area
  Site 8 Boresite Range, Hazardous Waste Storage Area, and Firefighting Training
- OU 4 Site 10 Rubble Disposal Area
- OU 5 Site 14 Blue 5 Ordnance Disposal Area
  Site 15 Blue 10 Ordnance Disposal Area
- OU 6 Site 11 Golf Course Pesticide Disposal Area
- OU 7 Site 16 Aircraft Intermediate Maintenance Department (AIMD) Seepage Pit
- OU 8 Site 3 Oil and Sludge Disposal Pit

Sites where the potential for contamination is present, but little or no confirmatory data are available, are classified as PSCs. These areas require initial confirmation and characterization sampling prior to determining whether or not further investigation is necessary. The remaining six sites include the following PSCs:

- PSC 4 Grease Pits
- PSC 6 Lake Fretwell Rubble Disposal Area
- PSC 9 Recent Grease Pits
- PSC 12 Public Works Disposal Area
- PSC 18 Ammunition Disposal Area
- PSC 19 Rowell Creek Rubble Disposal Area

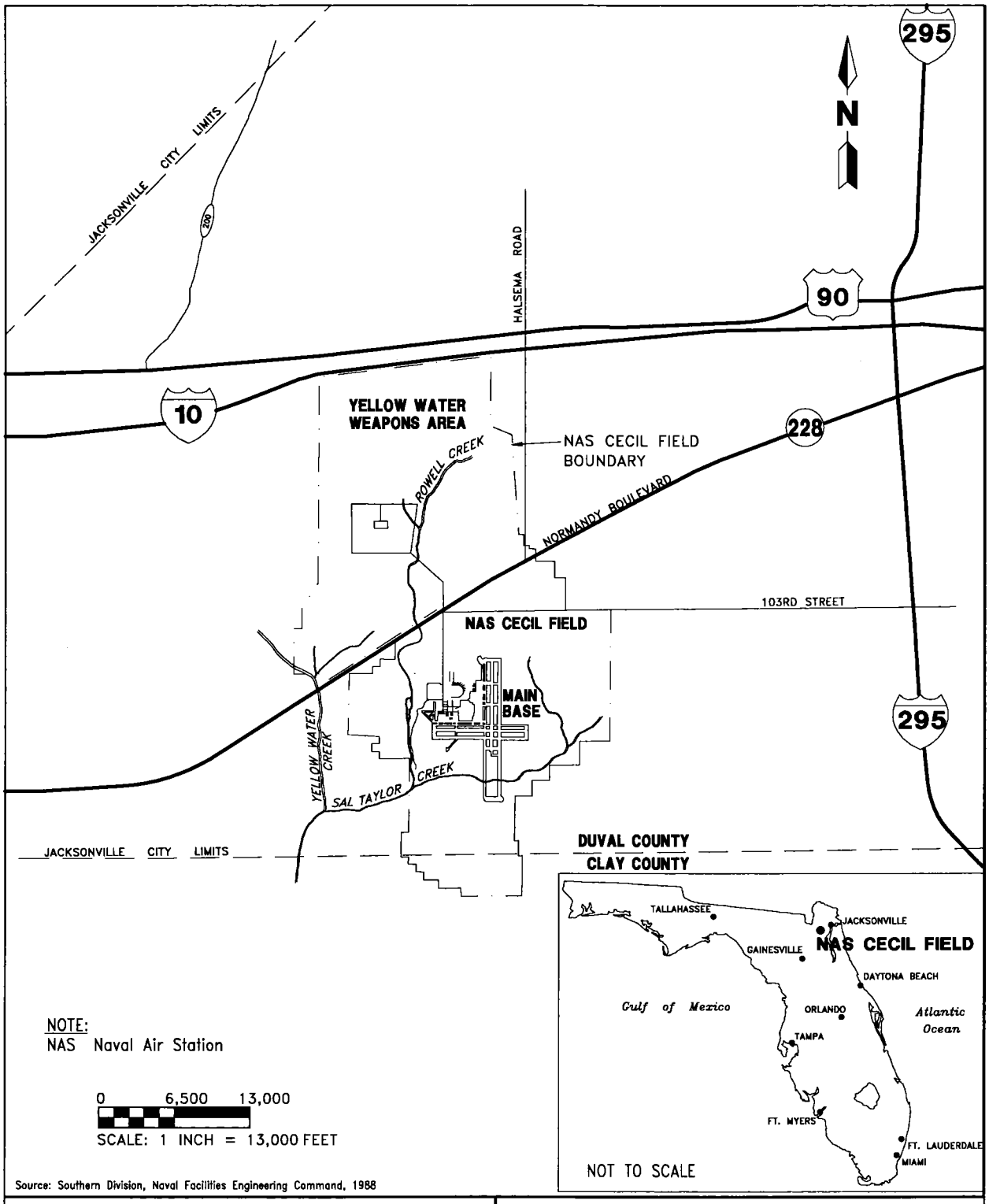

FIGURE 1-1
GENERAL LOCATION MAP

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

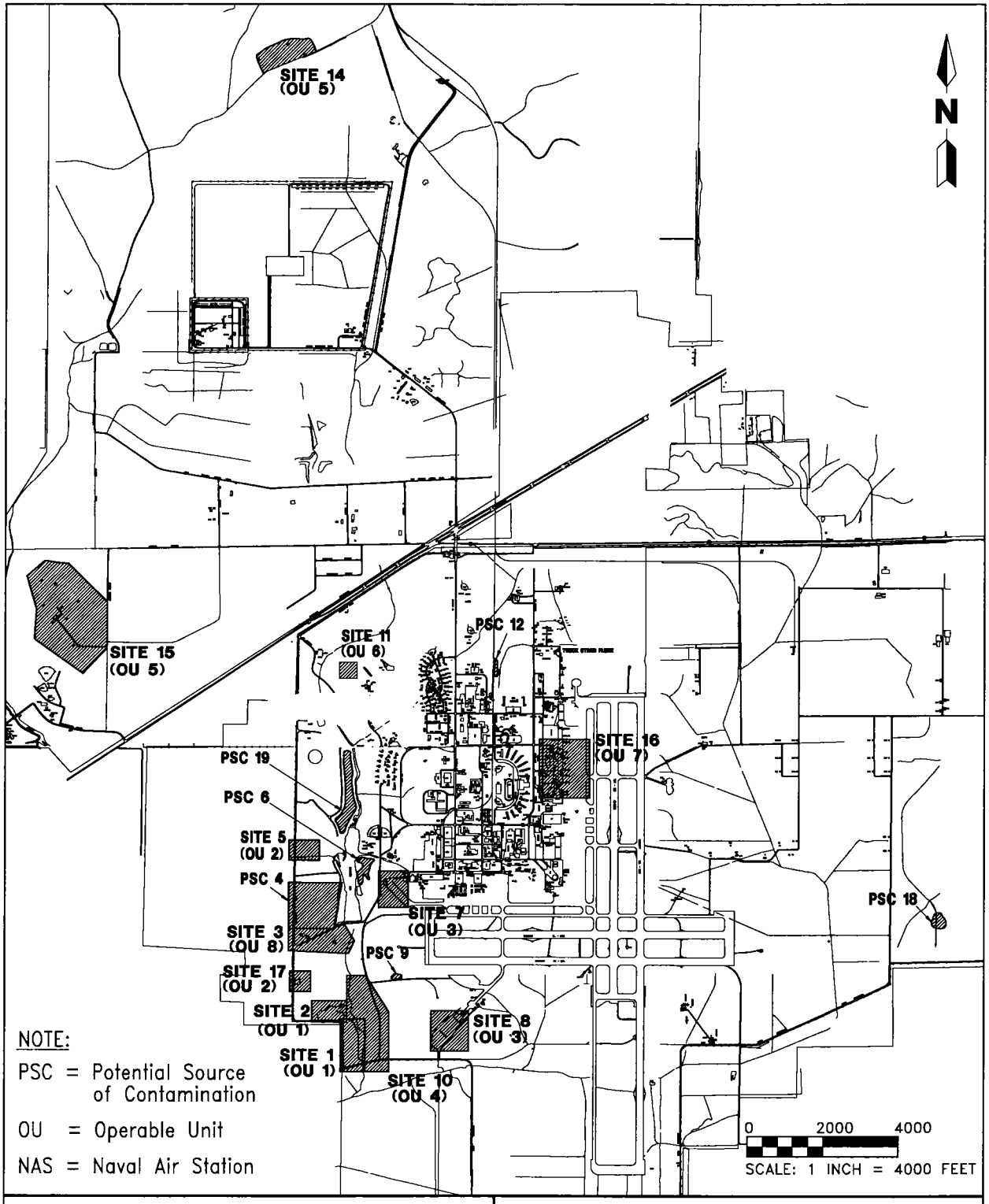

FIGURE 1-2
LOCATION OF OPERABLE UNITS AND POTENTIAL SOURCES OF CONTAMINATION AT NAS CECIL FIELD

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA

This report will address the following four primary objectives:

- description of the ecological setting of NAS Cecil Field,
- description of the methodology used to complete individual ecological risk assessments (ERAs) for each of the OUs,
- synopsis of the ERA results for each OU, and
- assessment of the total ecological risks represented by multiple OUs and PSCs at NAS Cecil Field.

The assessment of total risk is based on the results of the respective ERAs completed for each of the OUs as part of the remedial investigation (RI) and feasibility study (FS) process. Additional analyses of the total risk represented by the release of contamination from multiple OUs and PSCs are included in Chapter 8.0. The analysis of overall risk will pertain to the aquatic environments at NAS Cecil Field.

1.2 SCOPE. The BEAR is a "living" document that will be updated periodically as long as new ERAs or preliminary risk evaluation (PREs) are completed for sites at NAS Cecil Field. Based on the results of the ERA for each OU, portions of the BEAR will be updated and reissued.

The BEAR will be organized into the following sections:

- Chapter 1: Introduction
- Chapter 2: Ecological setting of aquatic and upland wildlife habitats; wetlands, including rare, endangered, and threatened species
- Chapter 3: Description of ERA methodology
- Chapter 4: Summary of the ecological chemicals of concern
- Chapter 5: Summary of biological sampling including toxicity testing, aquatic and terrestrial studies, wetland studies, and chemical analyses of plant and animal tissue
- Chapter 6: Summary of the results of the ERAs for each of the OUs
- Chapter 7: ERA for Lake Fretwell
- Chapter 8: Analysis of potential ecological risks in the NAS Cecil Field watersheds resulting from all sites, and summary of recommendations

CHAPTER 2.0

2.0 ECOLOGICAL SETTING

The ecological setting at each of the OUs and PSCs at NAS Cecil Field is described below. Aquatic habitats (Section 2.1), upland habitats (Section 2.2), and wetlands (Section 2.3) are described in separate subsections and for each of the OUs and PSCs in Section 2.4. Rare, endangered, and threatened species that may be present at NAS Cecil Field are described in Section 2.5.

2.1 AQUATIC HABITATS. Numerous creeks and streams ranging in width from 3 to 15 feet, with lengths totalling approximately 8 miles, are present at the NAS Cecil Field property, providing habitat for aquatic wildlife. Plate 1 shows the aquatic habitats and surface drainage features present at NAS Cecil Field. Streams at the facility include Yellow Water Creek, Sal Taylor Creek, and Rowell Creek, as well as smaller tributaries. Of these, the largest is Yellow Water Creek, which flows through the southwest corner of the Yellow Water Weapons Annex.

Several small ponds and four lakes are scattered throughout the base. The four lakes are Lake Newman, Lake Fretwell, Lake Wright, and Yellow Water (located in the personnel support area of the station). Lake Newman and Lake Fretwell are both man-made lakes that are part of the Rowell Creek drainage system. The largest of the lakes is Lake Fretwell, which is approximately 8 acres. It is stocked with bass for sport fishing and has been developed into a recreational complex.

Generally, the eastern and southern portions of the station drain to Sal Taylor Creek. The northern and western portions of the base drain to Lake Newman, Lake Fretwell, or Rowell Creek, which discharge to Sal Taylor Creek in the south-central portion of the facility. Sal Taylor Creek drains westward to Yellow Water Creek, which drains south to the St. Johns River via Black Creek.

A list of resident aquatic species at NAS Cecil Field is presented in Appendix A, Ecological Receptor Species at NAS Cecil Field. This list is based on those aquatic species collected from the aquatic habitats as well as species that are suspected to be resident but were not collected and identified. Appendix A also includes lists of mammals, birds, reptiles, amphibians, benthic macroinvertebrates, and plants associated with aquatic habitats.

2.2 UPLAND WILDLIFE HABITATS. Habitat provided for terrestrial wildlife species at each of the OUs and PSCs at NAS Cecil Field is described in Section 2.4. The term "upland" refers to land not considered to be a jurisdictional wetland by the State of Florida. In general, upland habitat is described for the facility based on a review of information gathered from biological sampling events (EA Engineering, Science, and Technology [EA], 1994a; 1994b) and previous reports (Camp, Dresser, and Mckee [CDM], 1994). The system for description and classification of upland habitats is based on the Florida Natural Areas Inventory (FNAI) and Department of Natural Resources Guide to Natural Communities of Florida (FNAI, 1990). The locations of upland habitats at NAS Cecil Field are shown on Plate 1.

2.3 WETLANDS. The locations of wetlands at NAS Cecil Field are shown on Plate 1. This map was generated based on information available from previous reports (Envirodyne Engineers, 1985), a previous wetland study (CDM, 1994), and National Wetlands Inventory (NWI) maps. Information on wetlands specific to OUs and PSCs is included as part of Section 2.4.

2.4 SITE-SPECIFIC INFORMATION. The ecological setting of each of the OUs and PSCs at NAS Cecil Field is summarized in this section. The vegetative cover, terrestrial and aquatic habitats, ecological receptors, and types and locations of wetlands are discussed for each OU and PSC.

Habitats present at NAS Cecil Field consist of both wetland and upland communities. Wetlands are identified according to soil type, hydrology, and plant life sustained in the area. Upland areas are drier than wetlands and are generally present at a higher elevation. Plate 1 shows the upland and wetland habitats present at NAS Cecil Field. Sections 5.3 and 5.4 contain more information on the upland and wetland communities present at the facility.

Wetlands are described according to both their U.S. Fish and Wildlife Services (USFWS) classification (Cowardin and others, 1979) and their FNAI counterpart. It is important to note that the FNAI classification system describes undisturbed areas. Because many of the OUs and PSCs have been altered due to past disposal practices and other human activities, the FNAI classifications used may not completely describe all vegetative cover types at each of the OUs and PSCs.

2.4.1 Operable Units Information is available on the ecological setting of all of the OUs identified at NAS Cecil Field.

Two extensive surveys to support ecological assessments at NAS Cecil Field were completed in 1993. An extensive wetlands survey was completed for OUs 1, 2, 7, and 8 (CDM, 1994). Wetlands were identified and delineated, and terrestrial habitats were mapped during this survey. The objectives and results of the wetlands survey are discussed in detail in Section 5.4 of this report. Habitat evaluations for OUs 3, 4, 5, and 6 and PSCs 4, 6, 9, 12, 18, and 19 were conducted by Harding Lawson Associates (HLA) (then ABB-ES) ecologists in September 1995. Table 2-1 lists all the types, indicator species, and approximate sizes of wetlands associated with OUs and PSCs at NAS Cecil Field. Plate 1 shows the habitat types, vegetative cover, and the types and extent of wetlands and watersheds across the facility. Site-specific observations made during this study are discussed in the following subsections, where appropriate.

Additionally, a comprehensive aquatic biological study was completed for NAS Cecil Field in 1993 (EA, 1994a). Biological sampling was conducted at stations within several watersheds at NAS Cecil Field, including Rowell Creek, Sal Taylor Creek, Yellow Water Creek, Lake Fretwell, and tributaries to these water bodies. Both reference locations and locations where OU and PSC activities may have impacted aquatic habitat were sampled. The objectives and results of the biological study are discussed in detail in Section 5.2 of this report. Plate 1 shows the locations of watersheds (i.e., aquatic habitats) where studies were conducted, and Plate 2 shows the sampling locations for surface water and sediment. Locations where samples were collected during this biological study are marked with sample identifiers including the characters "BIO." Site-specific

Table 2-1
Summary of Wetland Classes of Study Areas

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Study Area	Wetland Class	Indicator Species (common name)	Approximate Acreage
OU 1, Site 1	Palustrine scrub/shrub broad-leaved deciduous	Red maple, sweetgum, wax myrtle, royal fern, gallberry, and cinnamon fern.	1.5
	Palustrine forested broad-leaved deciduous	Laurel oak, water ash, red maple, and bald cypress.	3
	Palustrine emergent persistent	Arrowheads, rushes, sedges, and black willow.	1.5
OU 1, Site 2	Palustrine emergent persistent	Rushes, sedges, royal fern, cattails, and hatpins.	0.5
	Palustrine forested broad-leaved deciduous	Sweetgum, swampbay, red maple, red bay, slash pine, and cinnamon fern.	3.5
OU 2, Site 5	Palustrine forested broad-leaved deciduous	Water ash, red maple, bald cypress, aider, sweetbay, and cinnamon fern.	[1].3
	Palustrine emergent persistent	Arrowheads, rushes, sedges, water lily, and black willow.	1.8
OU 2, Site 17	Palustrine forested broad-leaved deciduous	Sweetgum, swampbay, red maple, red bay, slash pine, and cinnamon fern.	[1] 1.1
OU 3, Site 7[3]	NI	NI	NA
OU 3, Site 8[3]	Man-made drainage ditch	Red maple, laurel oak, willow, water oak, sweetgum, yellow-eyed grass, sedges, ferns	NA
OU 4, Site 10[3]	Palustrine forested broad-leaved deciduous	Sweetgum, Carolina cherry, southern bayberry, water oak, live oak, blueberry, red maple, false willow, greenbriar, goldenrod, royal fern pickerel-weed, and cattails.	NA
OU 5, Site 14[3]	Palustrine scrub-shrub marsh	Southern bayberry, water hemlock, sedges, St. John's-wort, grasses, foxtail clubmoss, hooded pitcher plant, bog buttons, asters, sundew, horned bladderwort, and purple bladder wort.	NA
OU 5, Site 15[3]	Forested swamp	Slash pine, cedar, red maple, water oak, black willow, bayberry, hollies, sweetgum, sedges, ferns, and water pennywort.	NA
OU 6, Site 11	NI	NI	NI
OU 7, Site 16	Palustrine forested broad-leaved deciduous	Red maple, laurel oak, water ash, bald cypress, sweetgum, slash pine, loblolly pine, sweetbay, cinnamon fern, and wax myrtle.	NA
	Palustrine forested needle-leaved evergreen	Pond pine in association with dense stands of broad-leaved evergreen and deciduous shrubs.	NA
	Palustrine forested broad-leaved evergreen	Sweet bay, red bay, and loblolly bay.	NA
	Palustrine emergent persistent	Cattails, bulrushes, saw grass, sedges, reed, manna grasses, slough grass, whitetop, dock, water willow, and smartweeds.	NA
	Palustrine scrub/shrub evergreen	Fettergush, young or stunted black spruce, pond pine, coastal sweetbells, gallberry, black titi.	NA
	Palustrine forested broad-leaved deciduous and needle-leaved evergreen	Red maple, pond pine, combination of typical vegetation of broad-leaved deciduous and needle-leaved evergreen.	NA

See notes at end of table.

Table 2-1 (Continued)
Summary of Wetland Classes of Study Areas

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Study Area	Wetland Class	Indicator Species (common name)	Approximate Acreage
OU 7, Site 16 (Continued)			
	Palustrine forested deciduous	Red maple, bald cypress, typical vegetation of broad-leaved deciduous in addition to pond cypress.	NA
OU 8, Site 3	Palustrine forested broad-leaved deciduous	Red maple, sweet gum, swamp bay, sweet bay, wax myrtle, loblolly bay, and cinnamon fern.	[2]6.2
	Palustrine scrub/shrub broad-leaved deciduous	Sweet bay, swamp bay, red bay, loblolly bay, wax myrtle, muscadine grape, gallberry, meadow beauty, and netted chain fern.	[2]6.2
	Palustrine emergent persistent	Black willow, myrtle oak, climbing hempweed, scarlet pimpernel, rushes, and dotted smartweed.	0.5
PSC 4	Palustrine scrub/shrub marsh	Southern bayberry, red maple, gallberry, titi, red bay, tupelo, oaks, sweetbay magnolia, tall gallberry holly, and myrtle-leaf holly.	NI
PSC 6[3]	Palustrine scrub/shrub swamp and emergent marsh	Sweet gum, red maple, water oak, tupelo, willow, elderberry, buttonbush, grasses, cattails, and rushes.	NI
PSC 9[3]	Man-made drainage ditch	Black willow, southern bayberry, yellow aster, grasses and sedges, round-leaved sundew, and spike rush.	NI
PSC 12[3]	NI	NI	NI
PSC 18[3]	Palustrine forested broad-leaved deciduous	Red maple, water oak, tupelo, ash, bayberry, St. John's-wort, blueberry, sweetgum, sedges, pickerelweed, greenbriar, sphagnum moss, and cinnamon fern.	NA
PSC 19[3]	Forested swamp, mixed deciduous , and needle-leaved evergreen	Red maple, southern bayberry, tupelo, sweetgum, ash, water oak, iron wood, buttonbush, swamp honeysuckle, cinnamon fern, sedges, royal fern, sphagnum moss, bluestem, water pennywort, and golden club	NA

Source: Camp, Dresser, and Mckee, 1994.

[1] Represents approximate site acreage where environmental sampling occurred. Adjacent wetland acreage is more extensive.
[2] Combined acreage for palustrine forested broad-leaved deciduous and palustrine scrub-shrub broad-leaved deciduous.
[3] Wetland class and indicator species information collected by Harding Lawson Associates (then ABB Environmental Services, Inc.) ecologists during habitat evaluations conducted in September 1995.

Notes: OU = operable unit.
NI = not identified; wetlands have not been delineated at this site or PSC.
NA = not applicable; wetlands were not directly located at the site or PSC.
PSC = potential source of contamination.

observations made during this study are discussed in the following subsections, where appropriate.

Ecological field investigations, including habitat mapping of OUs 3, 4, 5, and 6, were completed in September 1995. The goal of the field investigations was to gather qualitative information on the ecological setting of these areas. Currently, the results of these field investigations are the only data available about habitats and receptors at these OUs. The results of these investigations are summarized in Paragraphs 2.4.1.3 through 2.4.1.6.

2.4.1.1 **Operable Unit 1** OU 1 consists of two sites: Site 1, the Old Landfill; and Site 2, the Recent Landfill. The two sites are adjacent to one another. Figures 2-1 and 2-2 show the upland and wetland habitats present at Sites 1 and 2, respectively.

Terrestrial Habitats and Receptors. A cypress dome, dominated by mature bald cypress trees and associated mature hardwood species, is present in the wetlands area that covers the eastern portion of Site 1. The western portion of the site is an upland community consisting of a planted pine forest.

The upland plant community covering Site 2 consists primarily of grasses, a dense shrub and herb layer, and scattered slash pines (*Pinus elliotii*). The area north of Site 2 consists of a planted pine forest. An upland mixed forest borders Site 2 to the west. Wetlands were identified to the east of Site 2.

The vegetative community at Site 2 provides limited habitat for terrestrial wildlife. However, Site 1 and the wetland to the east of Site 2 have vegetative communities that are capable of supporting an abundance of wildlife (ABB-ES, 1994a). Numerous wildlife species representing all trophic levels have been observed in this area.

Potential terrestrial receptors at OU 1 include wildlife, plants, and invertebrates. Terrestrial wildlife that has been directly observed at OU 1 include both lower trophic-level organisms (e.g., insects, rodents, and armadillo [*Dasypus novemcinctus*]), and higher trophic-level predators such as barred owl (*Strix varia*), screech owl (*Otus asio*), sharp-shinned hawk (*Accipter striatus*), pygmy rattlesnake (*Sistrus miliarus barbouri*), water moccasin (*Agkistrodon pisciverous conanti*), and other snakes (ABB-ES, 1994a). Other terrestrial flora and fauna potentially residing at OU 1 are listed in Appendix A.

Aquatic Habitats and Receptors. Aquatic habitats at OU 1 were characterized as part of a facilitywide field survey completed in July 1993 (EA, 1994a). An earlier aquatic sampling event was completed in this area in 1991 (Environmental Consulting and Technology, Inc. [ECT], 1992). The results of the 1991 study were used to help design the 1993 sampling program and are briefly discussed below.

The 1991 sampling program consisted of quantitative collection of macroinvertebrates and qualitative collection of fish from six stations on Rowell Creek. Similar to the earlier study, the 1993 sampling program consisted of quantitative collection of macroinvertebrates and qualitative collection of fish at four locations and a reference station in the vicinity of OU 1. Results of both of these studies are discussed in detail in Section 5.2.

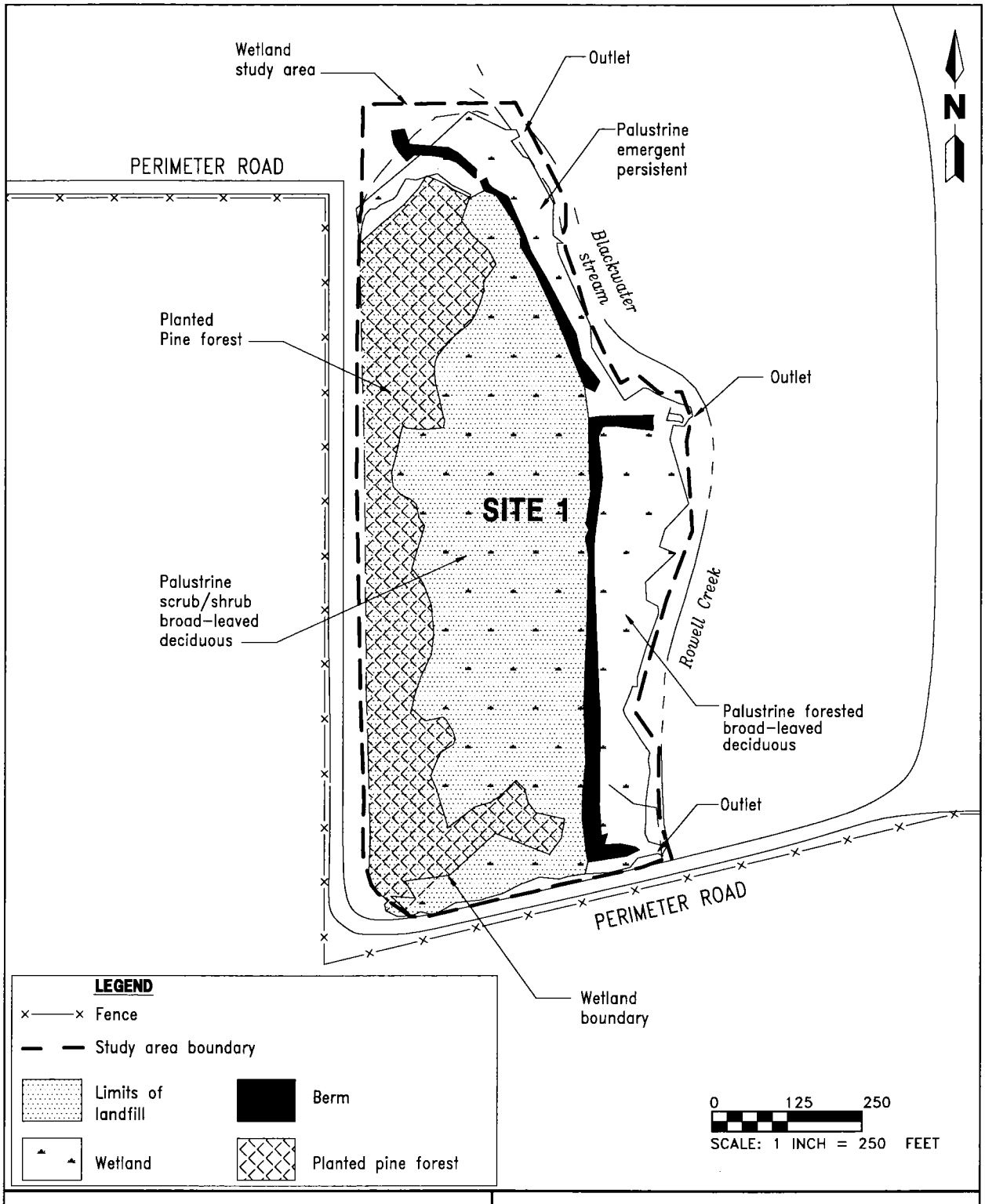

FIGURE 2-1
WETLAND AND UPLAND HABITATS PRESENT AT SITE 1

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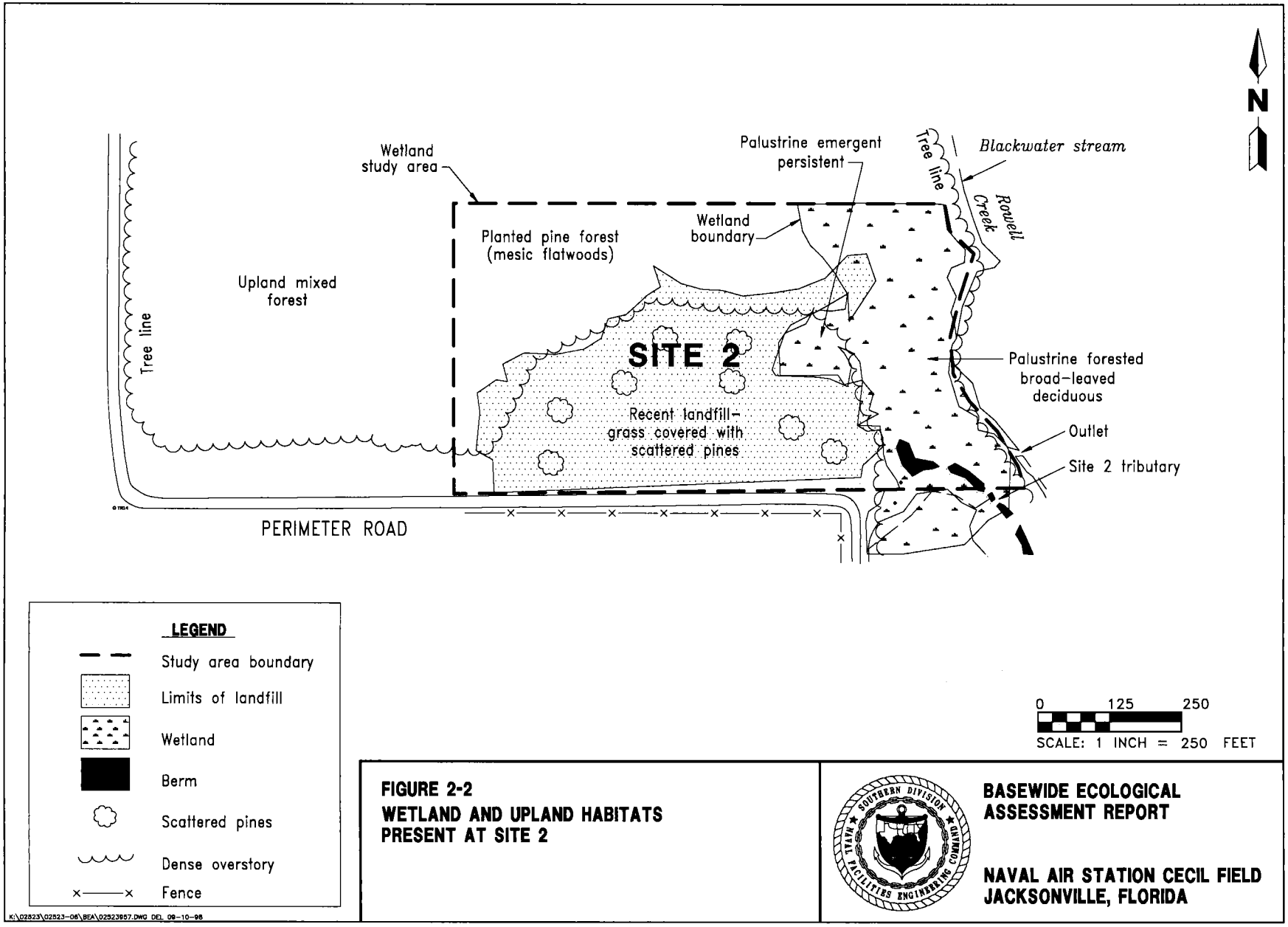

FIGURE 2-2
WETLAND AND UPLAND HABITATS PRESENT AT SITE 2

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A list of the benthic macroinvertebrates collected in the vicinity of OU 1 during the study is presented in Appendix A-7. Additionally, eight fish species from six families were identified in Rowell Creek adjacent to OU 1 in 1993. The fish collected were primarily juvenile or small species of fish.

Substrate at most of the sampling stations in the areas adjacent to OU 1 consisted of sand; two sampling stations located in the Site 2 tributary had leaf mat substrate. Water temperatures and pH were within normal ranges. The dissolved oxygen (DO) content varied from a low of 0.5 milligrams per liter (mg/ℓ) to 5.6 mg/ℓ. Water clarity ranged from clear to slightly tannic, with the exception of water from the Site 2 tributary, which was classified as turbid with an orange-rust color appearance and flocculent material. The water surface in this tributary has an iridescent appearance that breaks apart.

Potential aquatic receptors at OU 1 include invertebrates, plants, algae, amphibians, and fish. These receptors are present in Rowell Creek and in the Site 2 tributary. Other aquatic species identified at OU 1 during field sampling events are listed in Appendix A.

Wetlands. Three classes of wetlands were identified at OU 1. Of these, all three classes were palustrine (swamp, marsh, bog, fen; typically shoreward of lakes, river channels). They were found on the eastern portion of Site 1 (palustrine forested broad-leaved deciduous, palustrine emergent persistent, and palustrine scrub and shrub broad-leaved deciduous), and two classes were identified to the east of Site 2 (palustrine forested broad-leaved deciduous and palustrine emergent persistent). Table 2-1 lists the types, indicator species, and sizes of these wetlands, and Figures 2-1 and 2-2 show the location and types of wetlands identified at Sites 1 and 2, respectively (CDM, 1994). The results of the wetlands survey are discussed in more detail in Section 5.4.

2.4.1.2 Operable Unit 2 OU 2 consists of two sites: Site 5, the Oil Disposal Area Northwest; and Site 17, the Oil and Sludge Disposal Area Southwest. Site 5 is located approximately 3,000 feet north of Site 17. Figures 2-3 and 2-4 show the upland and wetland habitats present at Sites 5 and 17, respectively.

Terrestrial Habitats and Receptors. The plant communities at Sites 5 and 17 are similar, with disturbed upland cover types on the western portions of the sites and wetlands located on and to the east of the sites. The upland communities covering Site 5 include scrubby flatwoods, planted pines, and disturbed upland regions. Two types of wetlands are located to the east and south of the site. A drainage ditch, which bounds Site 5 on the south, carries surface water eastward toward Lake Fretwell, located approximately 1,000 feet from the site. An upland community consisting of a planted pine forest is located to the north and west of Site 5.

The western portion of Site 17 is an upland community. It is a grass-covered area with scattered young slash pines and a dense shrub and herb layer. A wetland area has been identified on the eastern portion of the site, and a planted pine forest surrounds the site.

The invertebrate biomass within the uplands at both Sites 5 and 17 probably serves as a forage base for a limited number of wildlife species, including amphibians, reptiles, birds, and mammals. Up to 20 or 30 species of reptiles and

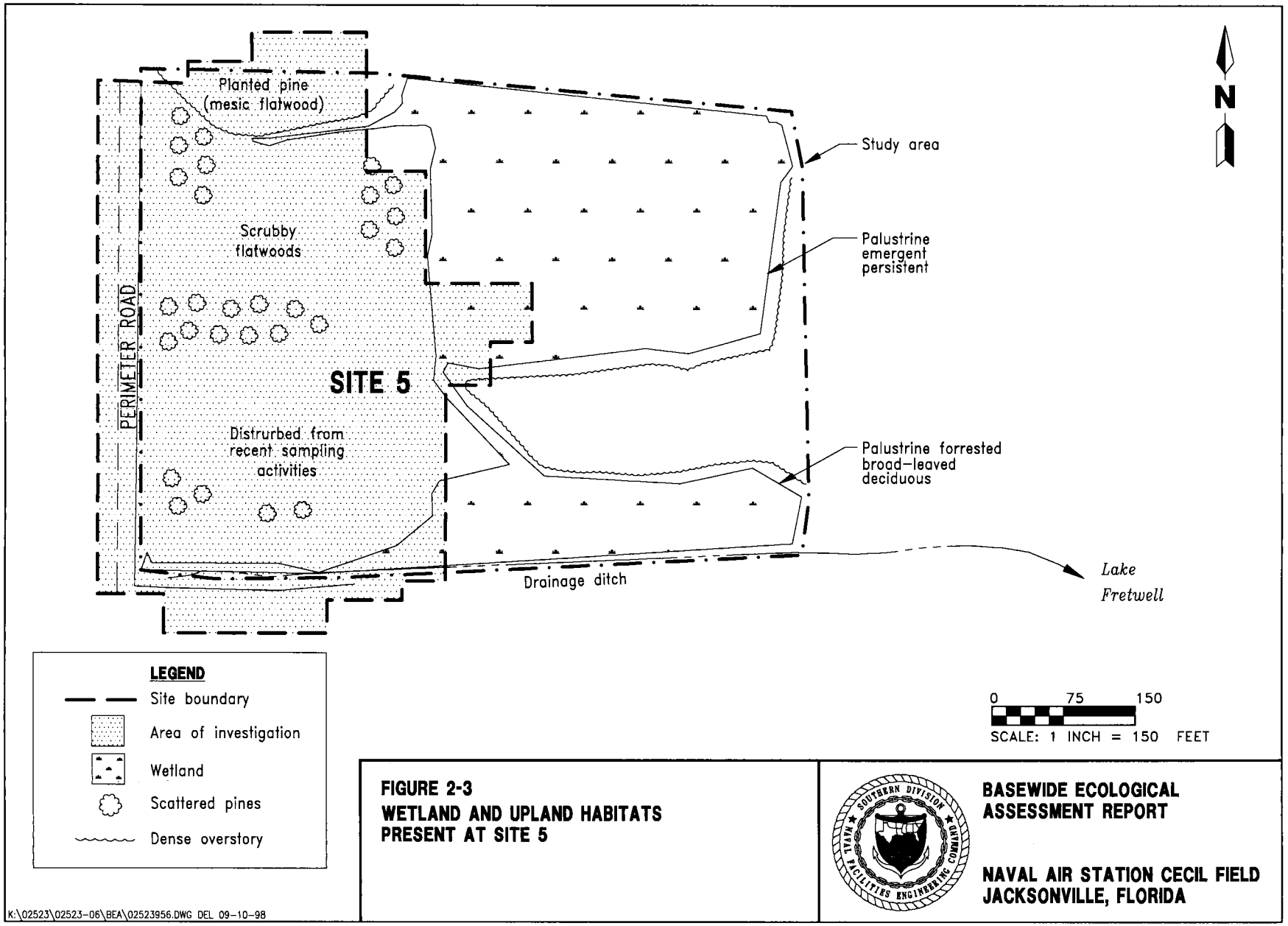

FIGURE 2-3
WETLAND AND UPLAND HABITATS PRESENT AT SITE 5

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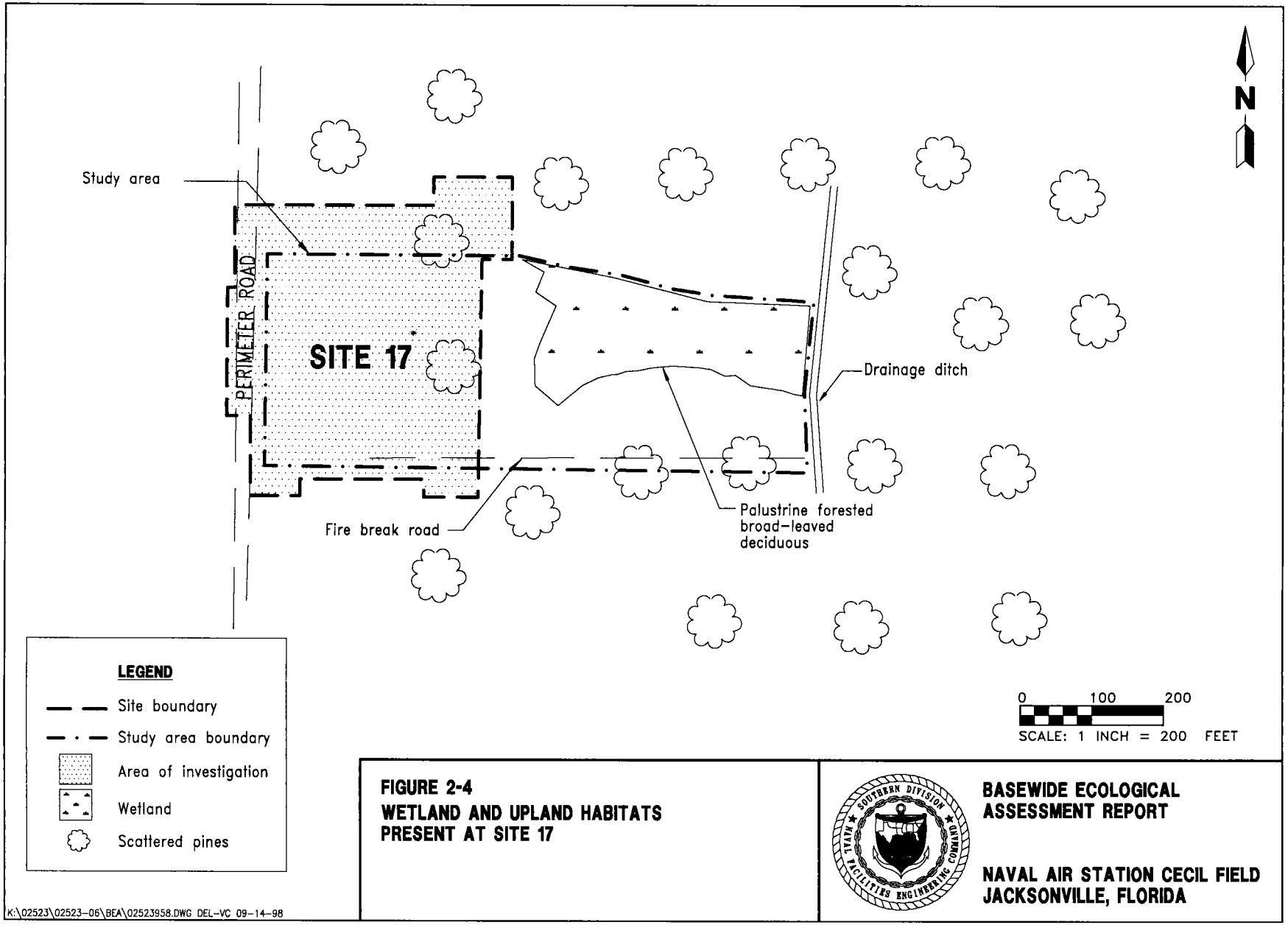

FIGURE 2-4
WETLAND AND UPLAND HABITATS PRESENT AT SITE 17

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amphibians can be supported in an upland habitat (Ashton and Ashton, 1988; 1989; 1991). Several small mammal trails were observed in the interior and around the perimeter of the uplands at Site 5. These trails may be from several types of species, including the eastern cottontail rabbit (*Sylvilagus floridanus*), the hispid cotton rat (*Sigmodon hispidus*), the cotton mouse (*Peromyscus gossypinus*), the armadillo, the red fox (*Vulpes vulpes*), the gray fox (*Urocyon cinereoargenteus*), and while-tailed deer (*Odocoileus virginianus*).

Sites 5 and 17 also provide habitat for avifauna. Birds that have been directly observed at OU 2 include: brown thrasher (*Toxostoma rufum*), bobwhite quail, mockingbird (*Mimus polyglottus*), common grackle (*Quiscalus quiscula*), fish crow (*Corvus ossigfragus*), killdeer (*Charadrius voviferus*), northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), mourning dove (*Zenaida macroura*), rufous-bellied woodpecker (*Centrus carolinus*), pine warbler (*Dendroica pinus*), ruby-crowned kinglet (*Regulus calendula*), solitary vireo (*Vireo solitarius*), and black and white warbler (*Mniotilta varia*).

Potential terrestrial receptors at OU 1 include wildlife, plants, and invertebrates. Other terrestrial flora and fauna potentially residing at OU 2 are listed in Appendix A.

Aquatic Habitats and Receptors. Aquatic habitats at the Site 5 drainage ditch were characterized as part of a facilitywide field survey completed in July 1993 (EA, 1994a). This survey also included sampling of aquatic macroinvertebrate communities in Rowell Creek and Lake Fretwell. Four sampling stations were located in the Site 5 drainage ditch. Aquatic sampling was not completed at Site 17 because there is no aquatic habitat in this area.

The goals and results of the 1993 study are discussed in Section 5.2. The sampling program consisted of quantitative collection of macroinvertebrates at four locations and a reference station. Fish were not collected in the Site 5 drainage ditch.

A list of the benthic macroinvertebrates collected in the vicinity of Site 5 during the study is shown in Appendix A-7. Substrate at most of the sampling stations consisted of 50 to 80 percent leaf pack; one sampling station had slightly more mud, muck, or silt than the other four locations. Water temperatures and pH were within normal ranges. The DO content varied from 0.4 mg/ℓ to 3.4 mg/ℓ, all below the Florida water quality standard of greater than or equal to 5 mg/ℓ. Water was clear at all stations evaluated.

Potential aquatic receptors at Site 5 include invertebrates, plants, algae, and amphibians. These receptors are present in the drainage ditch. Aquatic species identified at Site 5 are listed in Appendix A.

Wetlands. Two classes of wetlands were identified at OU 2. Of these, both wetland classes were found on and to the east of Site 5 (palustrine forested broad-leaved deciduous and palustrine emergent persistent, respectively), and one class was identified at Site 17 (palustrine forested broad-leaved deciduous). Table 2-1 lists the types, indicator species, and sizes of these wetlands. Figures 2-3 and 2-4 show the location and types of wetlands identified adjacent to Sites 5 and 17, respectively (CDM, 1994). The results of the wetlands survey are discussed in further detail in Section 5.4.

2.4.1.3 **Operable Unit 3** OU 3 consists of two sites: Site 7, the Old Fire-Fighting Training Area; and Site 8, the Firefighting Training Area/Boresite Range/Hazardous Waste Storage Area. Both sites are located near the flight line area. Habitat mapping of these sites was completed in 1995. Figures 2-5 and 2-6 provide an overview of the habitats at Site 7 and Site 8, respectively.

Terrestrial Habitats and Receptors. Ecological communities identified at Site 7 include mowed grass (4 to 6 inches in height) and disturbed uplands. Plant species observed at the site included grasses, yellow aster (*Aster* sp.), yellow fleabane, grasses (*Echinochloa* sp.), crabgrass (*Digitaria* or *Eleusine* sp.), bitterweed (*Helenium amarum*), blackberry (*Rubus* sp.), verbena, fleabane (*Erigeron* sp.), bullbriar greenbriar (*Smilax bona-nox*), buchnera (*Buchnera* sp.), ragweed (*Ambrosia* sp.), laramide, bracken fern (*Pteridium aquilinum*), winged sumac (*Rhus copallina*), dog fennel (*Eupatorium capillifolium*), cherry, and occasional live oak (*Quercus virginiana*), and slash pine.

Several ecological communities were found at Site 8, including mowed grass, disturbed upland, man-made drainage ditches, planted pine flatwoods, and a mixed pine and hardwood community. The site is surrounded by forested areas. Tree and shrub species observed at Site 8 include bay (*Magnolia* sp.), longleaf pine (*Pinus australis*), red cedar (*Juniperis virginiana*), live oak, loblolly pine (*Pinus taeda*), laurel oak, red maple, willow, black cherry, saw palmetto (*Serenoa repens*), water oak, southern bayberry (*Myrica cerifera*), sweetgum, and holly (*Myrica inodora*). Herbivorous and graminoid (grass, sedge, and rush) species found at Site 8 include crabgrass, yellow-eyed grass (*Xyris* sp.), fleabane, snapdragon, dog fennel, spanish needles (*Bidens pilosa*), panic grass (*Panicum vergatum*), sedges (*Carex* sp.), goldenrod (*Solidago fistulosa*), acacia (*Acacia* sp.), blackberry, cinnamon fern (*Osmunda cinnamomea*), bracken fern, bullbriar greenbriar, Virginia creeper (*Parthenocissus quinquefolia*), thistle (*Cirsium* sp.), verbena, tall grasses, yellow aster, agalinis (*Agalinis fasciculata*), bedstraw (*Galium* sp.), sumac, loblolly bay (*Gordona lasianthus*), and netted chain fern (*Woodwardia areolata*).

Potential receptor species at OU 3 include terrestrial plants, birds, mammals, and reptiles. Few signs of mammals were found at the site, though birds and reptiles were observed. Other terrestrial flora and fauna potentially residing at OU 3 are listed in Appendix A.

Aquatic Habitats and Receptors. A man-made drainage ditch was observed at Site 8. The ditch contained stagnant to slow-moving water, often with tannin staining. This ditch may provide minimum suitable habitat for aquatic macroinvertebrates.

Wetlands. Wetlands were not identified at OU 3, Site 7, and the only wetland identified at Site 8 is a man-made drainage ditch. Table 2-1 lists the types of indicator species present in this wetland.

2.4.1.4 **Operable Unit 4** OU 4 consists of Site 10, the Rubble Disposal Area. It extends due north from Perimeter Road along the eastern edge of Rowell Creek, south of Lake Fretwell. Habitat mapping at OU 4 was completed in 1995. Figure 2-7 provides an overview of the habitats present at Site 10.

Terrestrial Habitats and Receptors. The following communities were identified at OU 4, roughly from east to west: disturbed upland, mixed hardwood and pine

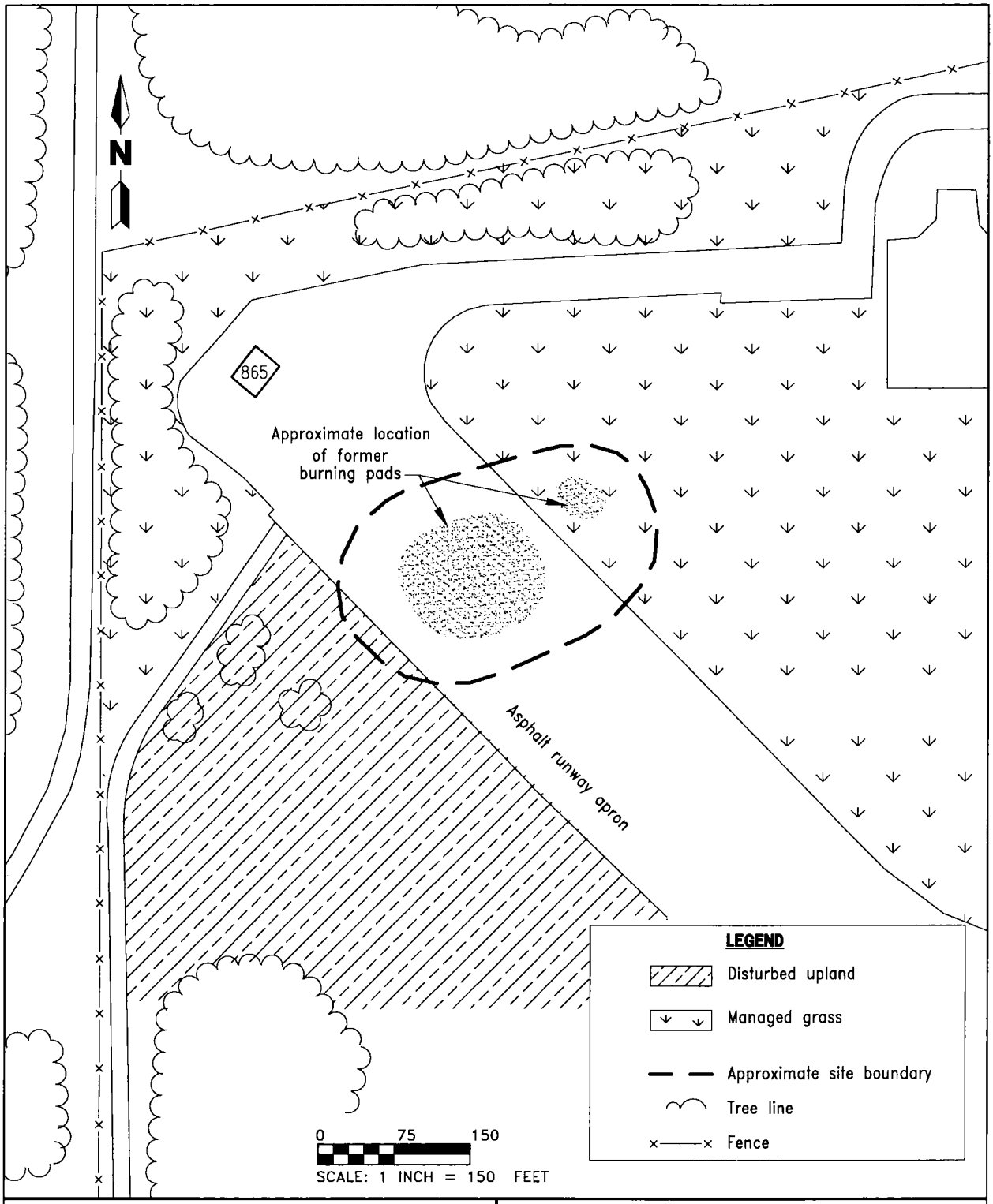

FIGURE 2-5
UPLAND HABITATS PRESENT AT SITE 7

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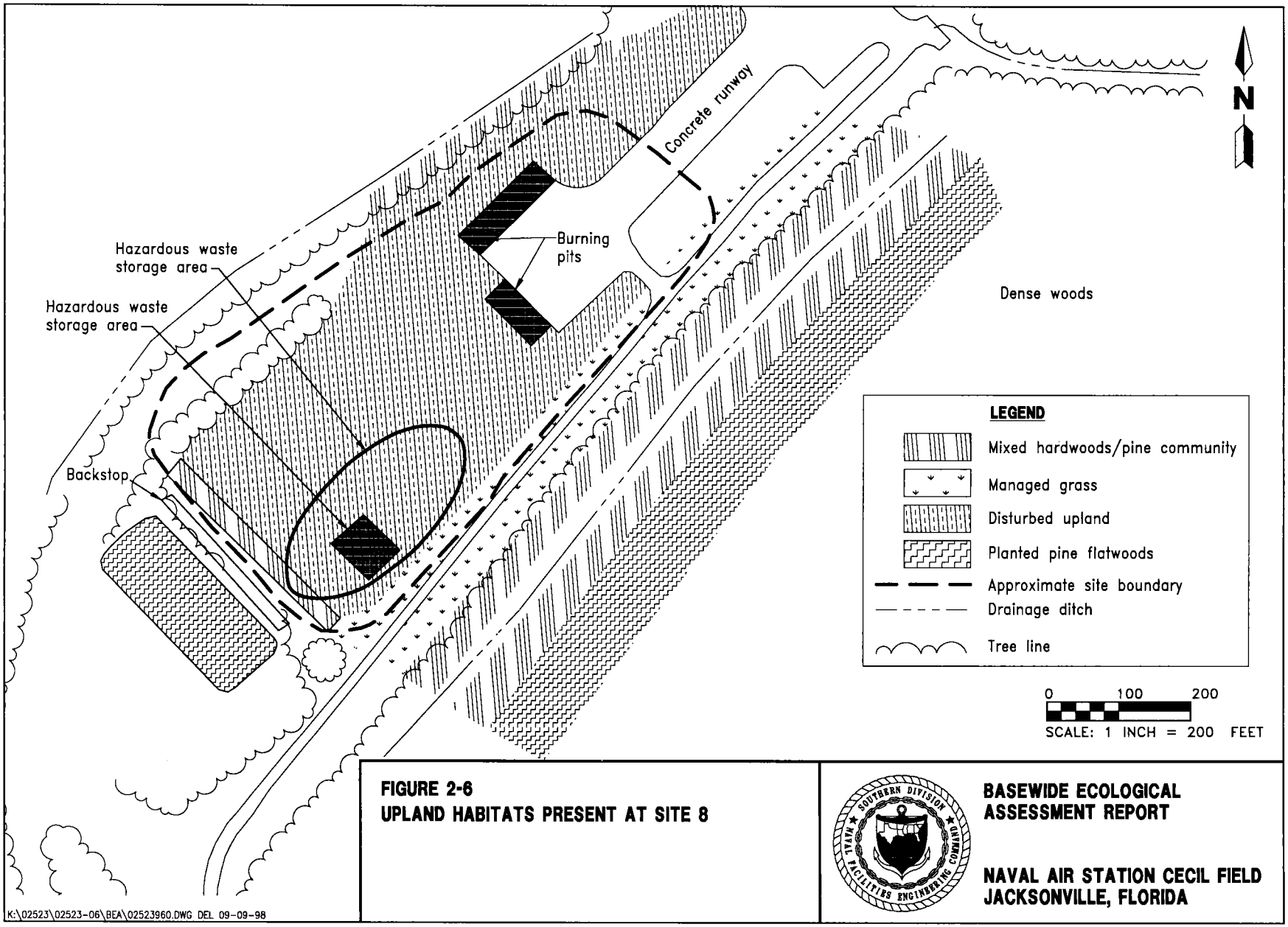

FIGURE 2-6
UPLAND HABITATS PRESENT AT SITE 8

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NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

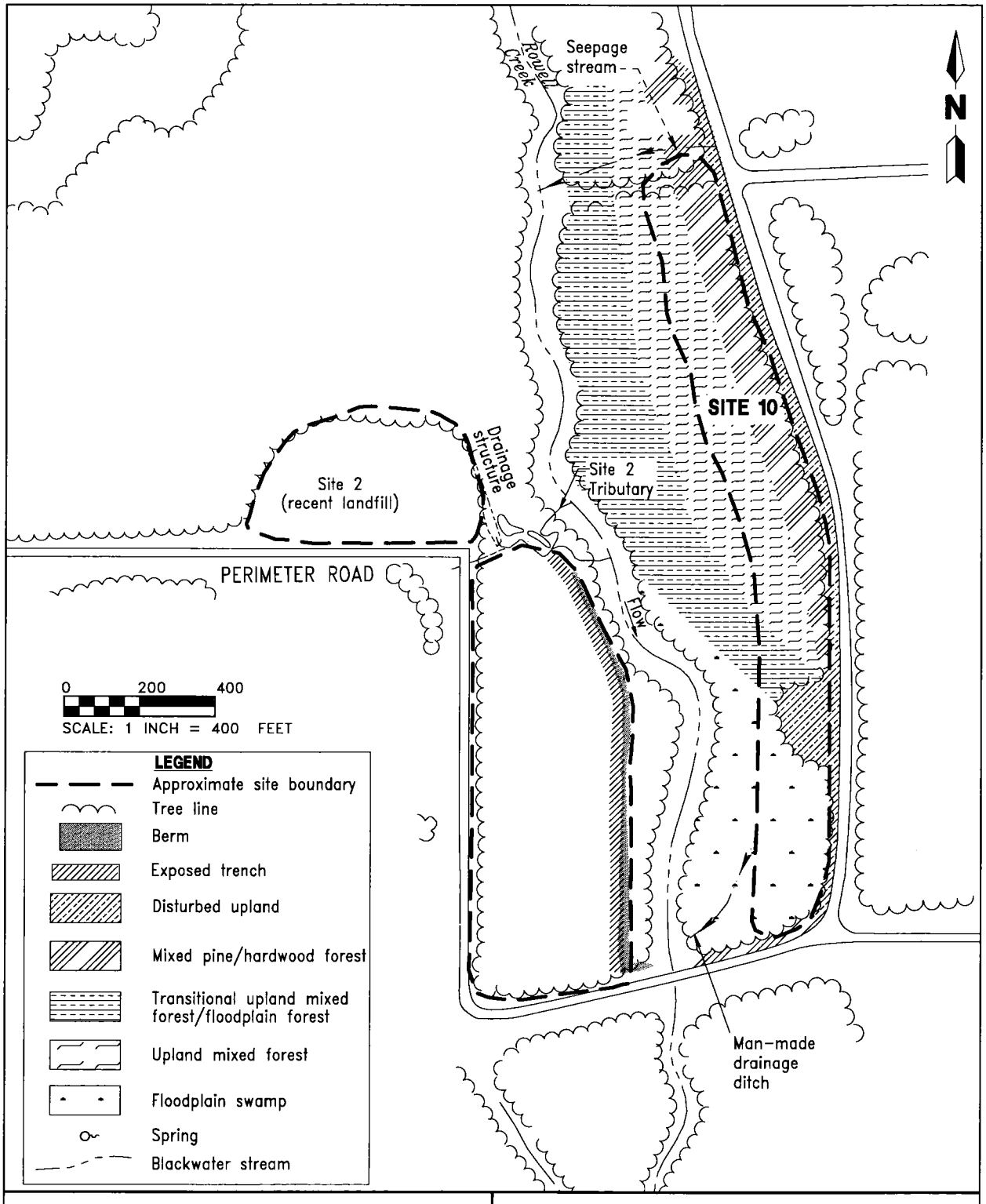

FIGURE 2-7
UPLAND HABITATS PRESENT AT SITE 10

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community, upland mixed forest (with a transitional hardwood and floodplain forest area grading down into the blackwater stream), floodplain swamp, and blackwater stream. Tree and shrub species found at Site 10 include sweetgum, Carolina cherry (*Pinus carolina*), southern bayberry, red cedar, water oak (and various other oak species), saw palmetto, bay, live oak, blueberry (*Vaccinium* sp.), cypress, sweetbay magnolia, red maple, and false willow. Herbaceous and graminoid plant species found at Site 10 include bullbriar greenbriar, bracken fern, wild poinsettia (*Poinsettia heterophylla*), dog fennel, yellow aster, dry grass, fleabane, coralberry (*Symphoricarpos orbiculatus*), sea myrtle (*Baccharis halmifolia*), grasses (*Endogronan* sp.), goldenrod, Virginia creeper, peppervine (*Ampelopsis arborea*), thistle, morning glory (*Ipomoea* sp.), muscadine grape (*Vitis rotundifolia*), evening primrose (*Oenothera* sp.), crabgrass, rudbeckia, trumpet creeper (*Campsis radicans*), holly, flat-topped white aster (*Aster umbellatus*), beauty berry (*Callicarpa americana*), panic grass, poison ivy (*Toxicodendron radicans*), blazing star (*Liatris tenufolia* and other species), climbing fern (*Ligodium* sp.), bamboo, grape fern (*Botrychium* sp.), sundew (*Drosera intermedia*), red aster, cattails (*Typha* sp.), climbing hempweed (*Mikania scandens*), clubmoss (*Lycopodium* sp.), meadow beauty (*Rhexhia virginica*), violet (*Viola* sp.), persimmon (*Diospyros virginiana*), cardinal flower (*Lobelia cardinalis*), maiden-hair fern (*Adiantum pedatum*), pokeweed, horsetail, cinnamon fern, royal fern (*Osmunda regalis*), pickerel weed (*Pontederia cordata*), buckwheat, wild poinsettia, and lobelia (*Lobelia* sp.).

Potential receptor species at OU 4 include terrestrial plants, birds, mammals, and reptiles. Few signs of mammals were found at the site, though birds and reptiles were observed. Other terrestrial flora and fauna potentially residing at OU 4 are listed in Appendix A.

Aquatic Habitats and Receptors. A seepage stream was found along the northern terminus of the site, and a man-made drainage ditch was found in the southern portion of the site. The ditch contained stagnant to slow-moving water, often with tannin staining. This ditch may provide minimum suitable habitat for aquatic macroinvertebrates.

Wetlands. One class of wetland was noted at OU 4. A palustrine forested broad-leaved deciduous forest was identified, associated with the seepage stream and man-made drainage ditches present at Site 10. Table 2-1 lists the type, and indicator species present.

2.4.1.5 Operable Unit 5 OU 5 consists of two sites: Site 14, the Blue 5 Ordnance Disposal Area; and Site 15, the Blue 10 Ordnance Disposal Area. They are both located in the Yellow Water Weapons Area portion of NAS Cecil Field. Habitat mapping at these sites was completed in 1995. Figures 2-8 and 2-9 show the habitats present at Sites 14 and 15, respectively.

Terrestrial Habitats and Receptors. Several ecological communities were observed at Site 14, including disturbed uplands, man-made drainage ditches, mesic (dry to moist) and wet planted pine flatwoods, wet meadows, scrub and shrub marshes with depression-emergent marsh characteristics, and carnivorous plants.

Tree and shrub species observed at Site 14 include myrtle-leaved holly (and other hollies), slash pine, southern bayberry, water hemlock (*Cicuta* sp.), and tall gallberry holly (*Ilex coriacea*). Herbaceous and graminoid plant species observed

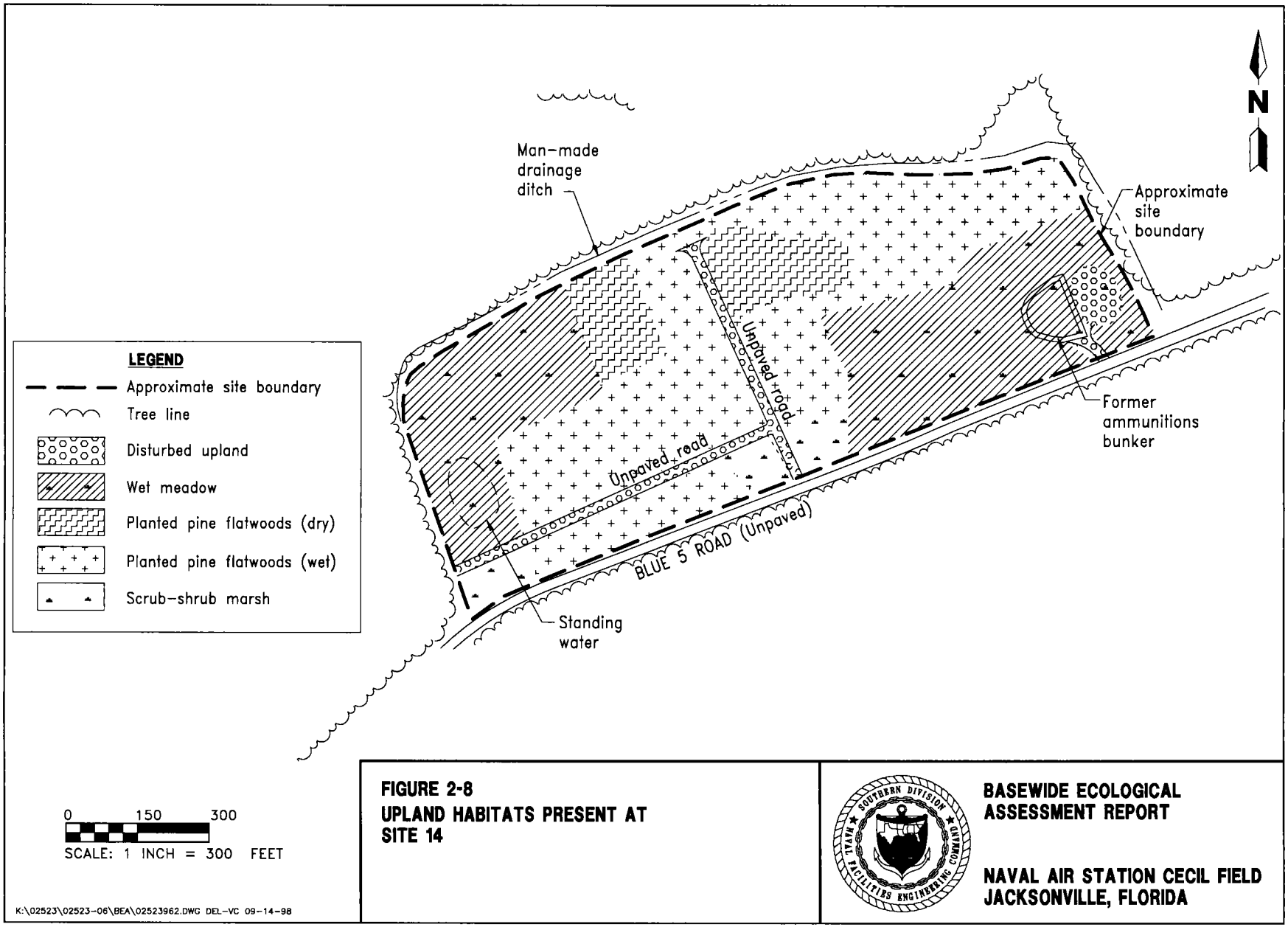

FIGURE 2-8
UPLAND HABITATS PRESENT AT SITE 14

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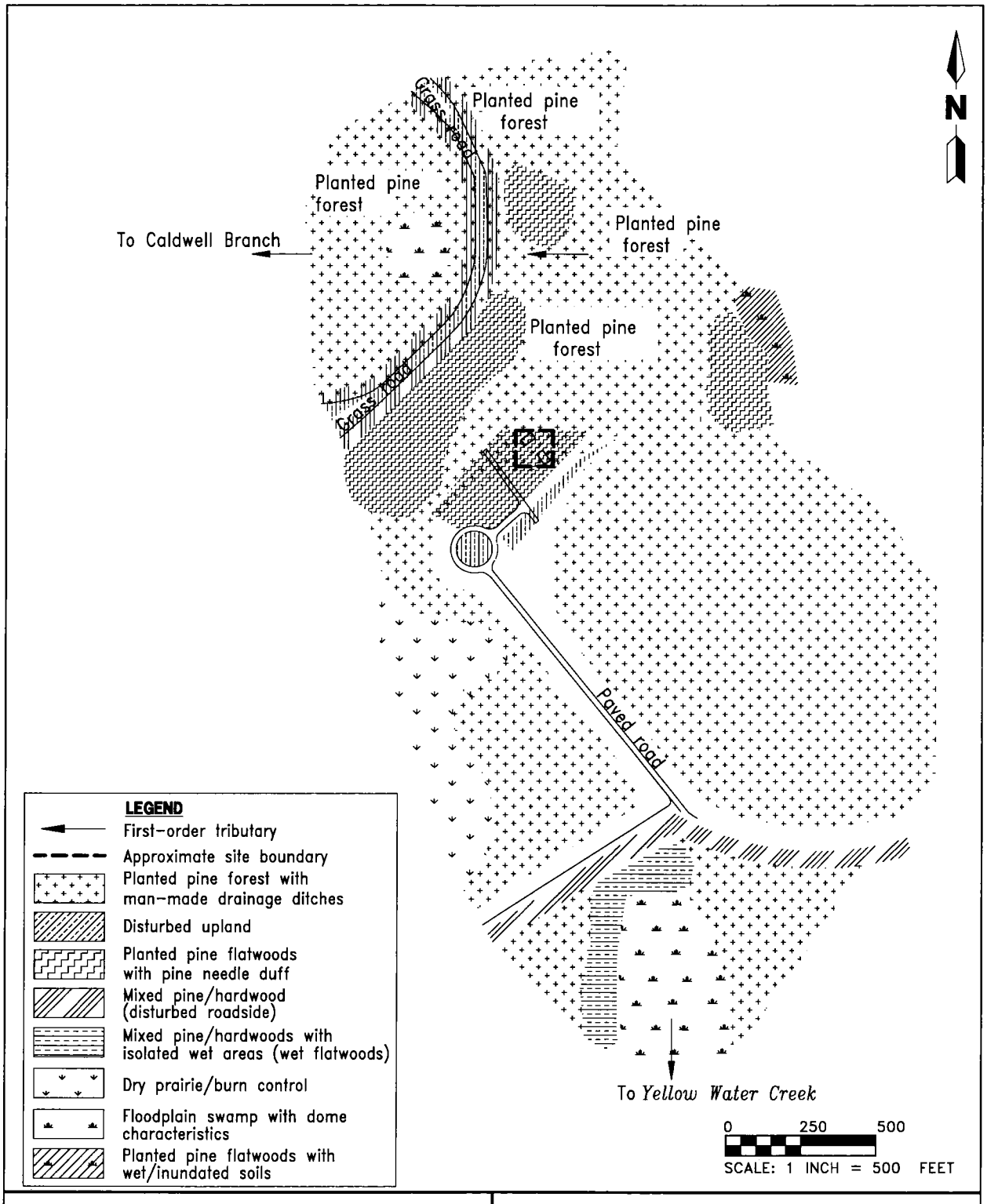

FIGURE 2-9
UPLAND HABITATS PRESENT AT SITE 15

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NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA

at Site 14 include twig rush (*Cladium* sp.), sedges (*Carex* sp. and *Cyperus* sp.), hatpins (*Eriocaulon* sp.), yellow-topped aster, blazing star, sand blackberry (*Rubus cuneifolius*), St. John's-wort (*Hypericum* sp.), grasses, yellow-eyed grass, common dodder (*Cuscuta* sp.), white bracted sedge (*Dichromena latifolia*), meadow beauties, rattlebox (*Sesbania* sp.), ragweed, acacia, dog fennel, redroot (*Lachnanthes caroliniana*), sedge (*Scirpus* sp.), foxtail clubmoss (*Lycopodium alopeuroides*), bugleweed (*Lycopus* sp.), seedbox (*Ludwigia alternifolia*), rabbit tobacco (*Gnaphalium obtusifolium*), twig rush, sea myrtle, muscadine grape, hatpins, agalinis, hooded pitcher plant (*Sarracenia minor*), bog buttons (*Lachnocaulon* sp.), asters, sundew, horned bladder wort (*Utricularia cornuta*), purple bladder wort (*Utricularia purpurea*), and tickseed (*Coreopsis gladiata*).

Several ecological communities were also observed at Site 15, including disturbed uplands, mesic and wet planted pine flatwoods (ranging from a dense, shrubby understory dominated by hollies to no understory dominated by pine needle duff), mesic and wet mixed pine and hardwoods, man-made drainage ditches, first-order (contributing streams) tributaries with tannin staining, pine flatwoods with dry prairie characteristics, and floodplain swamps with dome swamp characteristics. Most of the roadside canopy was a disturbed mixed pine and hardwood community.

The majority of the site, composed of pine flatwoods, was dominated by slash pines. Other tree and shrub species observed at Site 15 include sweetgum, southern bayberry, hollies, red maple, saw palmetto, live oak, water oak, occasional longleaf pine, black willow, gallberry (*Ilex glabra*), bald cypress (*Taxodium distichum*), laurel oak, turkey oak (*Quercus laevis*), scrub oak (*Quercus ilicifolia*), sweetbay magnolia, cedar, and titi (*Cyrilla racemiflora*). Herbaceous and graminoid species observed at Site 15 included bullbriar greenbriar, muscadine grape, graminoids, Virginia creeper, poison ivy, clubmoss, yellow-eyed grass, iris (*Iris* sp.), various ferns, blackberry, ragweed, fleabane, morning glory, thistle, cinnamon fern, sedges (*Carex* sp.), sphagnum moss (*Sphagnum* sp.), royal fern, netted chain fern, Spanish moss (*Tillandsia usneoides*), mullein (*Verbascum thapsus*), pitcher plants, dog fennel, water pennywort (*Hydrocotyle americana*), bracken fern, acacia, lichens, mimosa, yellow pea, verbena, blue sage (*Salvia azurea*), and beauty berry.

Potential receptor species at OU 5 include terrestrial plants, birds, mammals, and reptiles. Signs of wild boar (*Sus scrofa*) were evident at Site 14. Birds and reptiles were observed at both sites. Other terrestrial flora and fauna potentially residing at OU 5 are listed in Appendix A.

Aquatic Habitats and Receptors. Man-made drainage ditches were found at both Sites 14 and 15, and a first-order tributary was observed at Site 15. The ditches may provide minimum suitable habitat for aquatic macroinvertebrates. Though the tributary does not provide adequate habitat for most species of fish, it is possible that some aquatic macroinvertebrate, amphibian, and reptile species inhabit the tributary. The blackwater stream adjacent to Site 15 is a perennial, intermittent seasonal stream that may provide adequate habitat for a variety of aquatic and semiaquatic vertebrates and macroinvertebrates.

Wetlands. A wet meadow habitat was found at Site 14. This area was characterized as a disturbed wetland. A palustrine scrub-shrub marsh was also observed at Site 14. The floodplain swamps observed at Site 15 were in the vicinity of Yellow Water and Caldwell Creeks.

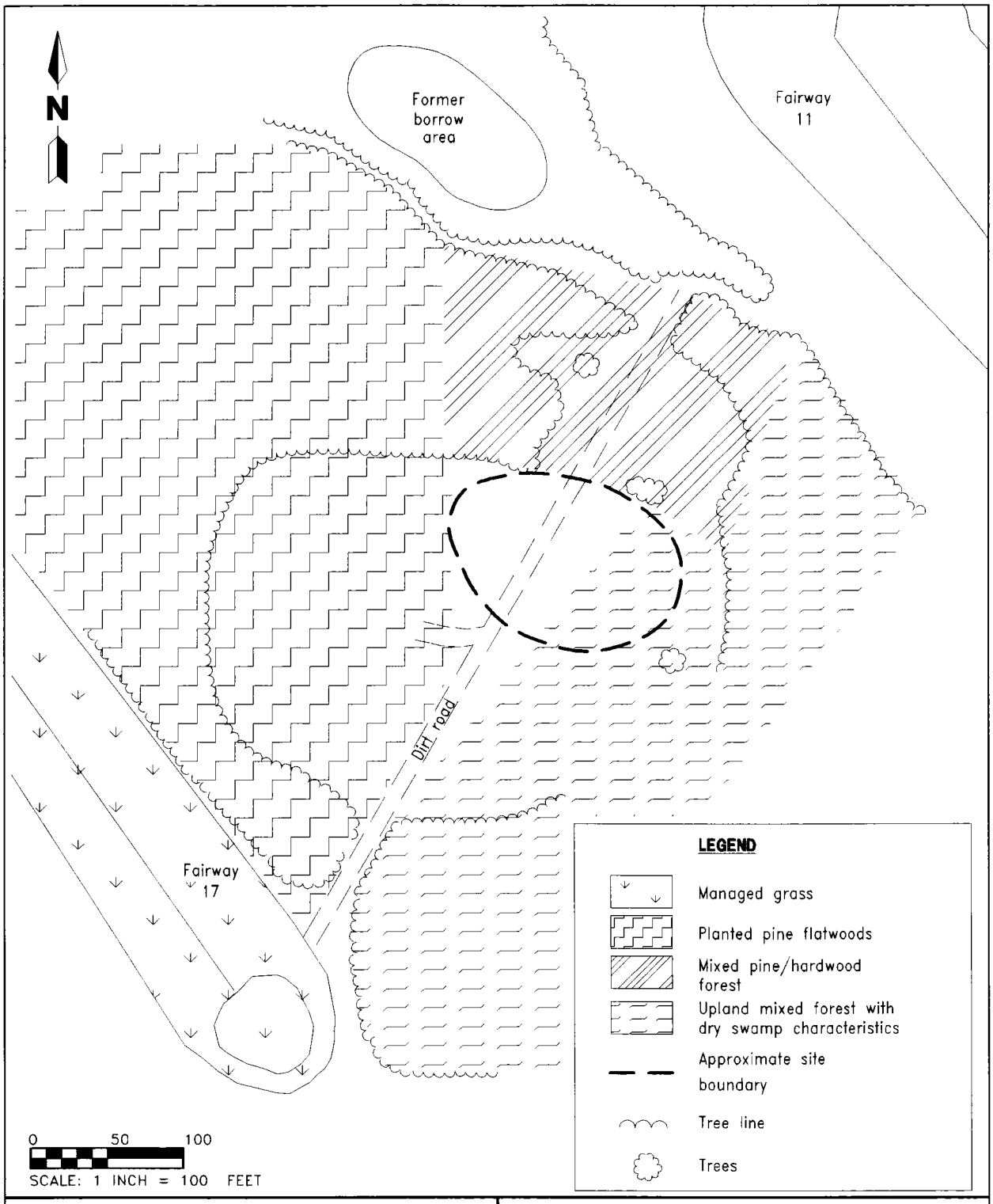

FIGURE 2-10
UPLAND HABITATS PRESENT AT SITE 11

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2.4.1.6 Operable Unit 6 OU 6 consists of Site 11, the Pesticide Disposal Area. It is located in the middle of NAS Cecil Field's golf course. Habitat mapping at this site was completed in 1995. Figure 2-10 provides an overview of the habitats at this site.

Terrestrial Habitats and Receptors. The ecological communities found at OU 6 include a mixed hardwood community (with dry swamp characteristics), a mixed pine and hardwood community, planted pine flatwoods, and mowed grass (the fairways). The mixed pine and hardwood and planted pine flatwoods communities have a fairly open understory with ground litter dominated by pine needle duff.

Tree and shrub species observed at Site 11 include sweetgum, saw palmetto, longleaf pine (*Pinus palustris*), live oak, cherry, water oak, red maple, bald cypress (dead trunks), fetterbush (*Lyonia lucida*), bay, southern bayberry, laurel leaf oak (*Quercus laurifolia*), and sweetbay magnolia. Herbaceous and graminoid species observed at Site 11 include cinnamon fern, goldenrod, greenbriar, muscadine grape, poison ivy, ferns, sedges, Virginia creeper, beauty berry, and blackberry.

Potential receptor species at OU 6 include terrestrial plants, birds, mammals, and reptiles. Few signs of mammals were found at the site, though birds and reptiles were observed. Other terrestrial flora and fauna potentially residing at OU 6 are listed in Appendix A.

Aquatic Habitats and Receptors. Aquatic habitat is not present at OU 6.

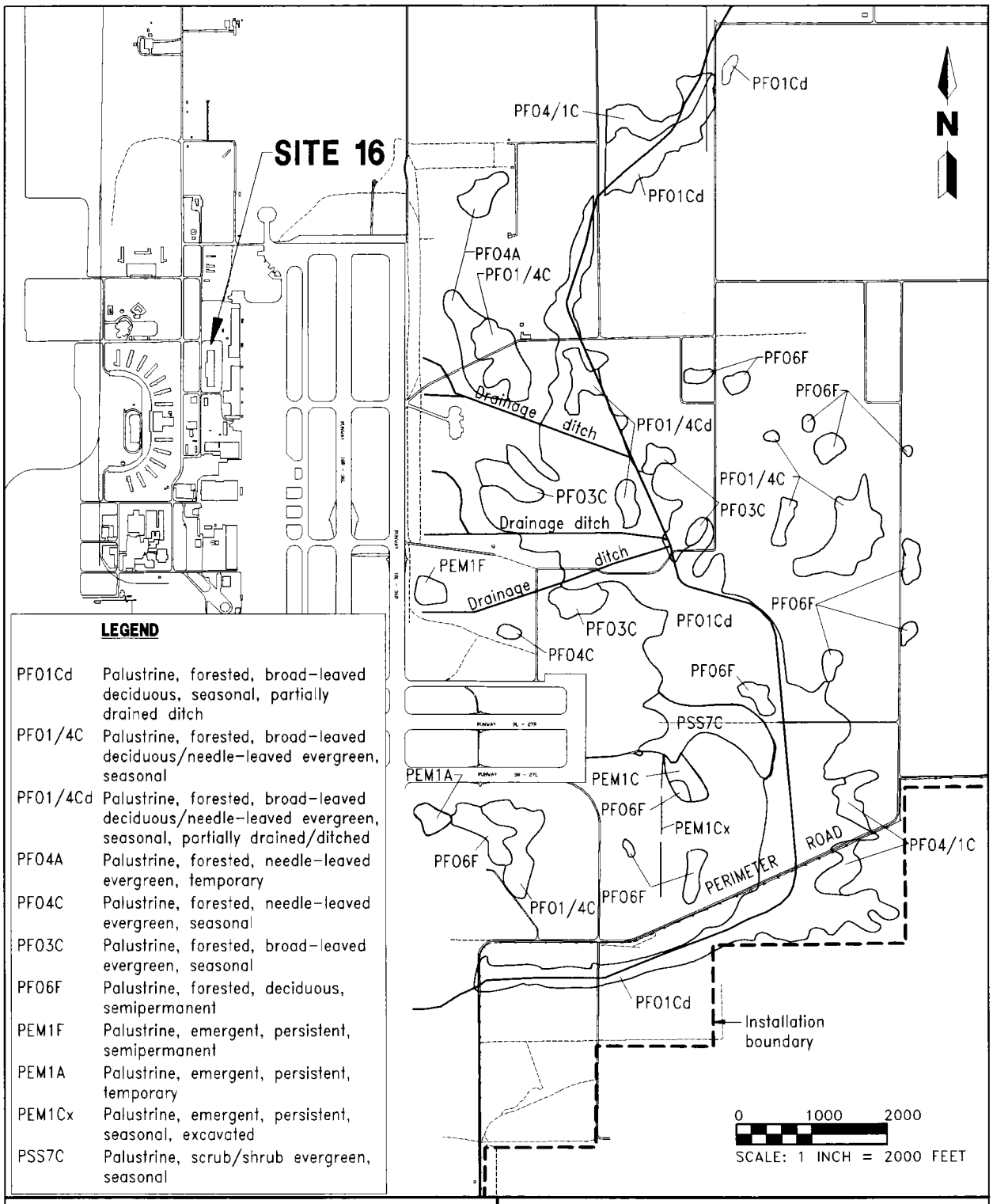
Wetlands. Wetlands were not identified at OU 6.

2.4.1.7 Operable Unit 7 OU 7 consists of Site 16, the AIMD seepage pit area, which is located in an industrial setting near NAS Cecil Field's flight line. Figure 2-11 provides an overview of the site showing the nearest terrestrial and wetland habitats.

Terrestrial Habitats and Receptors. OU 7 is vegetated with approximately 22,000 square feet of mowed grass. No surface soil staining or stressed vegetation, possibly resulting from past activity at the site, was visible during site visits in 1988, 1991, and 1993. The area adjacent to the site is relatively flat and is covered with asphalt and concrete. Because OU 7 is a small grassy area in an industrial setting, surrounded by paved roadways and parking lots, terrestrial receptors are not expected to reside at the site.

Aquatic Habitats and Receptors. OU 7 is located in an industrial area; there are no streams, creeks, or other natural water bodies in the immediate vicinity of the site. However, aquatic habitats located to the east of OU 7 were characterized as part of a facilitywide field survey completed in July 1993 (EA, 1994a). Three sampling stations were located in drainage ditches approximately 500 feet east of the runway. The ditches, which receive storm water drainage from both the runway areas and the developed areas west of the runway (including OU 7), carry discharge approximately 2,400 feet eastward to Sal Taylor Creek.

The goals and results of the 1993 aquatic study are discussed in Section 5.2. The sampling program consisted of quantitative collection of benthic macroinvertebrates (at the three locations and a reference station, all of which are located in Sal Taylor Creek), and qualitative collection of fish (at only one



LEGEND

PF01Cd	Palustrine, forested, broad-leaved deciduous, seasonal, partially drained ditch
PF01/4C	Palustrine, forested, broad-leaved deciduous/needle-leaved evergreen, seasonal
PF01/4Cd	Palustrine, forested, broad-leaved deciduous/needle-leaved evergreen, seasonal, partially drained/ditched
PF04A	Palustrine, forested, needle-leaved evergreen, temporary
PF04C	Palustrine, forested, needle-leaved evergreen, seasonal
PF03C	Palustrine, forested, broad-leaved evergreen, seasonal
PF06F	Palustrine, forested, deciduous, semipermanent
PEM1F	Palustrine, emergent, persistent, semipermanent
PEM1A	Palustrine, emergent, persistent, temporary
PEM1Cx	Palustrine, emergent, persistent, seasonal, excavated
PSS7C	Palustrine, scrub/shrub evergreen, seasonal

FIGURE 2-11
WETLANDS EAST OF SITE 16

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location and the reference station). The results of this study are discussed in detail in Section 5.2.

A list of the benthic macroinvertebrates collected in the vicinity of Site 16 during the study is shown in Appendix A-7. Two fish species, including the eastern mosquitofish (*Gambusia affinis*) and least killifish (*Heterandria formosa*), were collected from the two sampling stations in the vicinity of the site. The species collected were generally small, with low biomass.

Water temperatures and pH were within normal ranges. The DO content varied from 3.4 mg/ℓ to 4.9 mg/ℓ, all below the Florida water quality standard of greater than or equal to 5 mg/ℓ.

Water was clear at all stations evaluated. A viscous oily sheen was observed on the water surface at one station, and a petroleum sediment odor was evident at this and a second location (see Plate 2 for sampling stations). At least 50 percent aquatic vegetation was observed at the three sampling stations. Aquatic vegetation was not present at the reference station. A leaf pack and mud, muck, or silt substrate was noted only at the reference location.

There is no aquatic habitat in the immediate vicinity of OU 7. However, if contaminants from the site migrated via surface water runoff or groundwater discharge toward the drainage ditches, potential receptors would include invertebrates, plants, algae, and fish. Aquatic species identified in this area are listed in Appendix A.

Wetlands. Wetlands were not identified in the immediate area of OU 7. However, through a review of a national wetland inventory map (USFWS, 1983), seven classes of wetlands were identified approximately 5,000 feet east of the site (Table 2-1). Sal Taylor Creek flows through and directly influences these wetlands. Figure 2-11 shows the locations of these wetlands east of OU 7. The seven classes (Cowardin and others, 1979) identified east of OU 7 are

- palustrine forested broad-leaved deciduous,
- palustrine forested needle-leaved evergreen,
- palustrine forested broad-leaved evergreen,
- palustrine emergent persistent,
- palustrine scrub and shrub evergreen,
- combination palustrine forested broad-leaved deciduous and needle-leaved evergreen, and
- palustrine forested deciduous (unspecified).

2.4.1.8 Operable Unit 8 OU 8 consists of Site 3, the Oil and Sludge Disposal Area. Figure 2-12 shows the upland and wetland habitats present at Site 3.

Terrestrial Habitats and Receptors. An upland community consisting primarily of disturbed uplands with some characteristics of a dry prairie is located in the western portion of OU 8, both north and south of the Lake Fretwell service road.

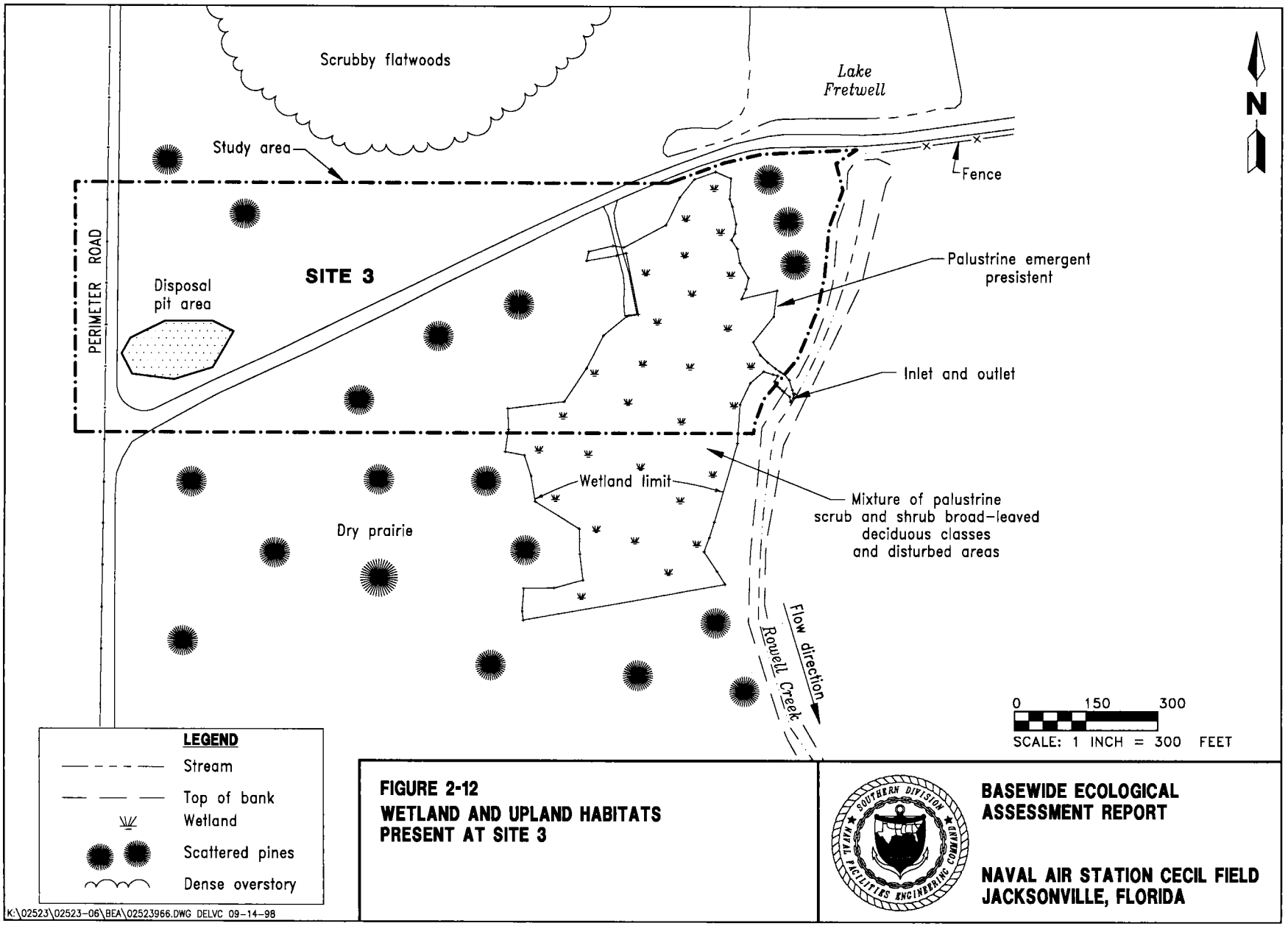

FIGURE 2-12
WETLAND AND UPLAND HABITATS PRESENT AT SITE 3

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The area consists of flat, sandy soil with dense ground cover and few to no trees. Vegetation identified in this area includes ragweed, goldenrod, dog fennel, bracken fern, sand blackberry, golden ragweed (*Senecio aureus*), and muscadine grape. Scattered wax myrtle (*Myrica cerifera*) and slash pine are also present.

A small scrubby flatwoods area is present to the north of OU 8. This area is flat and sandy with scattered pine trees, a sparse shrubby understory, and barren sand. Vegetation identified in this area includes longleaf pine, loblolly pine, saw palmetto, myrtle oak (*Quercus myrtifolia*), goldenrod, and sand blackberry.

Similar to OU 2, the invertebrate biomass within the uplands at OU 8 probably serves as a forage base for a limited number of wildlife species, including amphibians, reptiles, birds, and mammals. Up to 20 or 30 species of reptiles and amphibians can be supported in an upland habitat (Ashton and Ashton, 1988; 1989; 1991). The scrubby flatwoods to the north of Site 3 may provide habitat for a diverse array of avifauna, including insectivorous gleaners of pine needles and bark, flycatchers, a seed-eating assemblage, and nocturnal and diurnal aerial predators (Wolfe and others, 1988). The wetlands associated with OU 8 are expected to provide suitable habitat for a diverse congregation of wildlife species, which are potential receptors at the site. Invertebrates that inhabit the floor and arboreal canopy of the region are consumed by a number of amphibian, reptile, bird, and mammal species, which in turn provide food for many secondary and tertiary consumers.

Potential receptor species at OU 8 include terrestrial wildlife, plants, and invertebrates. Species that have been directly observed at OU 8 are listed in previous paragraphs. Other terrestrial flora and fauna potentially inhabiting OU 8 are listed in Appendix A.

Aquatic Habitats and Receptors. Aquatic habitats in Rowell Creek, which borders Site 3 to the east, were characterized as part of a facilitywide field survey completed in July 1993 (EA, 1994a). One sampling station was located in Rowell Creek downgradient of OU 8, approximately 1,200 feet east of where wastes were originally disposed of at the site (Plate 2). The goals and results of the 1993 study are discussed in Section 5.2. The sampling program consisted of quantitative collection of macroinvertebrates at this location; no fish were collected.

A list of the benthic macroinvertebrates collected in the vicinity of Site 3 during the study is shown in Appendix A-7. Substrate at the sampling station was mostly sand (80 percent); no leaf pack, mud, muck, or silt was observed. The water temperature at this station was 27.1 degrees Celsius (°C) and the pH was 6.7. The DO content was 5.2 mg/ℓ, slightly above the Florida standard of greater than or equal to 5 mg/ℓ (Florida Legislature, 1996). The surface water was clear, but a chlorine odor was evident in the surface water and sediment from the sampling station. The odor may be attributable to a sewage outfall located upstream of the sampling station. Treated effluent from NAS Cecil Field's domestic wastewater treatment plant (WWTP) is discharged to Rowell Creek via this outfall.

Potential aquatic receptors at OU 8 include invertebrates, plants, algae, and amphibians. These receptors are present in Rowell Creek. Potential aquatic receptor species identified at OU 8 are listed in Appendix A.

Wetlands. Three classes of wetlands have been identified at OU 8: palustrine forested broad-leaved deciduous, palustrine scrub-shrub broad-leaved deciduous, and palustrine emergent persistent. The types, indicator species, and approximate size of these wetlands are listed in Table 2-1. Figure 2-12 shows the location and types of wetlands identified at OU 8 (CDM, 1994). The results of the wetlands survey are discussed in more detail in Section 5.4.

2.4.2 Other Sites and PSCs Ecological field investigations of the following PSCs were completed in September 1995:

- PSC 4, Grease Pits;
- PSC 6, Lake Fretwell Rubble Disposal Area;
- PSC 9, Recent Grease Pits;
- PSC 12, Public Works Disposal Area;
- PSC 18, Ammunition Disposal Area; and
- PSC 19, Rowell Creek Rubble Disposal Area.

Ecological field investigations for the above-mentioned PSCs were completed concurrently with the investigations for OUs 3, 4, 5, and 6. The objectives of these investigations are described in Subsection 2.4.1. The following paragraphs present the results of the ecological investigations conducted at the remaining PSCs.

2.4.2.1 Potential Source of Contamination 4 PSC 4, the Grease Pit Area, extends from the Perimeter Road to the western edge of Lake Fretwell. Figure 2-13 provides an overview of the habitats identified at this PSC.

Terrestrial Habitats and Receptors. Many ecological communities were observed at PSC 4, including disturbed uplands, planted pine flatwoods, mixed pine and hardwoods, carnivorous plants (in a marshy unpaved road), scrub-shrub marsh, palustrine scrub-shrub transitional wetland, floodplain forest, and dry prairie.

The planted pinewood forest was dominated by slash pine; other tree and shrub species observed at PSC 4 include southern bayberry, red maple, gallberry, titi, red bay (*Persea borbonia*), tupelo, oaks, sweetbay magnolia, tall gallberry holly, scrub oak, myrtle-leaf holly (*Ilex myrifolia*), dwarf chinquapin oak (*Quercus prinoides*), Spanish oak (*Q. falcata*), and saw palmetto. Herbaceous and graminoid species observed at PSC 4 include agalinis, acacia, briars (*Smilax* sp.), hooded pitcher plants, round-leaved sundews (*Drosera* sp.), bog buttons, St. John's-wort, indigo (*Baptista* sp.), ragweed, buttonbush (*Cephalanthus occidentalis*), redroot, hatpins, rushes (*Juncus* sp.), sedges, seedbox, netted chain fern, cowbane (*Oxypolis* sp.), smartweed, royal fern, cinnamon fern, meadow beauty, goldenrod, water pennywort, grasses, blackberry, muscadine grape, persimmon, wiregrass (*Aristida stricta*), bracken fern, bullbriar greenbriar, dog fennel, blazing star, and winged sumac.

Potential receptors species at PSC 4 include terrestrial wildlife, plants, and invertebrates. Species that have been directly observed are listed in the previous paragraph. Other terrestrial flora and fauna potentially inhabiting PSC 4 are listed in Appendix A.

Aquatic Habitats and Receptors. Lake Fretwell, which is located along the eastern terminus of the PSC, would be classified as an impounded lake that may potentially receive runoff from PSC 4.

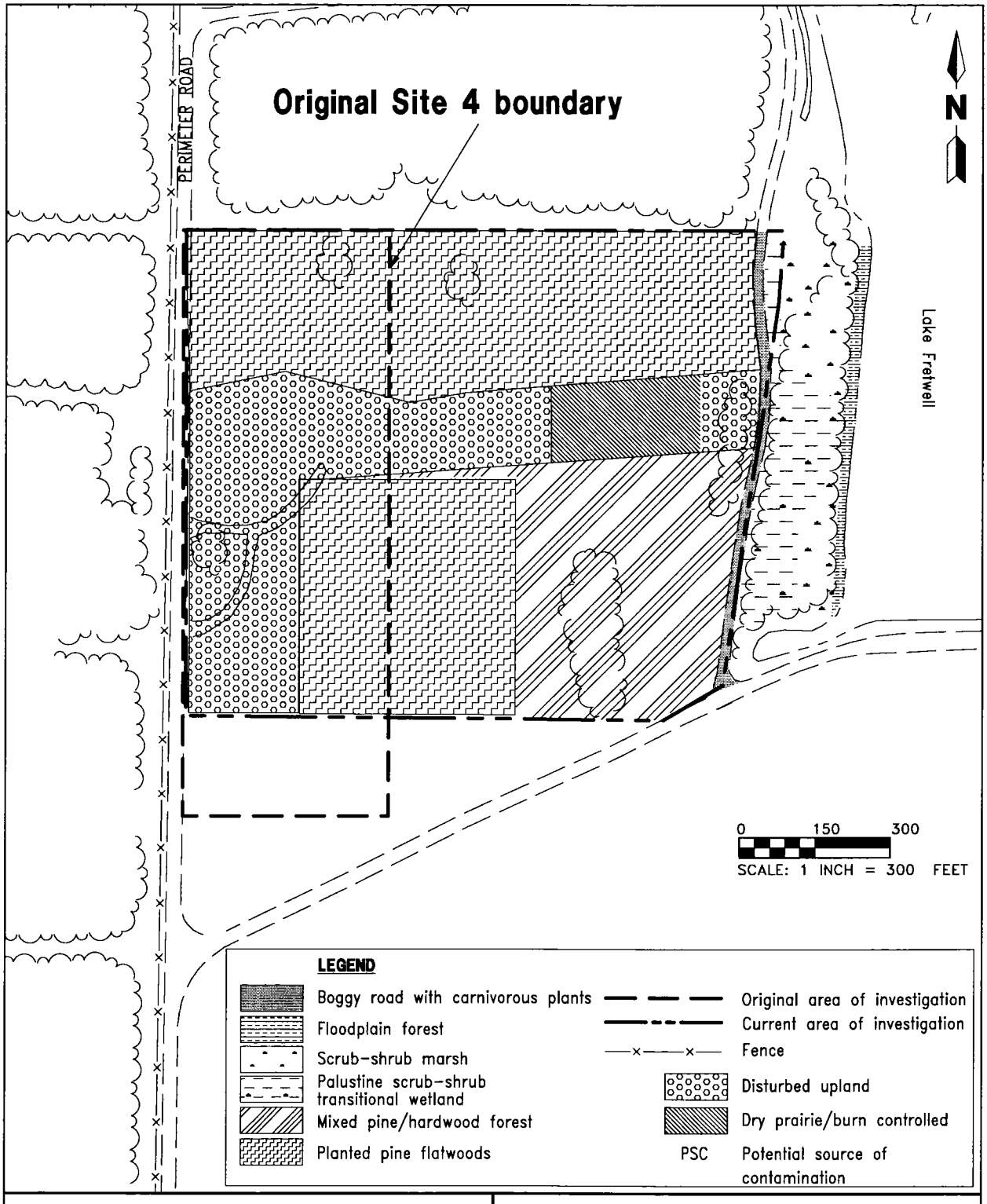

FIGURE 2-13
WETLAND AND UPLAND HABITATS PRESENT AT PSC 4

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Wetlands. A palustrine scrub-shrub marsh was observed at PSC 4. Table 2-1 lists the type and indicator species present.

2.4.2.2 **Potential Source of Contamination 6** PSC 6, the Lake Fretwell Rubble Disposal Area, is located along the eastern shore of Lake Fretwell, due south of the recreation area and southwest of the WWTP. Figure 2-14 provides an overview of the habitats identified at this PSC.

Terrestrial Habitats and Receptors. The following ecological communities were found at the site: mowed grass, disturbed uplands, planted pine flatwoods, depression-emergent marshes, and a degraded area with rubble.

Tree and shrub species observed at the site include slash pine (in the planted pine flatwoods), sweetgum, red maple, water oak, black cherry, tupelo, sweetbay magnolia, southern bayberry, willow, elderberry (*Sambucus canadensis*), and buttonbush. Some herbaceous and graminoid species observed at PSC 6 include great cane bamboo, muscadine grape, grasses, dog fennel, rattlebox, spanish needles, cattails, and rushes. Concrete debris present at PSC 6 may inhibit both plant growth and secondary or tertiary predation of small mammals.

Potential receptors species at PSC 6 include terrestrial wildlife, plants, and invertebrates. Species that have been directly observed are listed in the previous paragraph. Other terrestrial flora and fauna potentially inhabiting PSC 6 are listed in Appendix A.

Aquatic Habitats and Receptors. A depression-emergent marsh was identified at PSC 6.

Wetlands. Table 2-1 lists the wetland classes and indicator species identified in the palustrine scrub-shrub swamp and emergent marsh present at PSC 6.

2.4.2.3 **Potential Source of Contamination 9** PSC 9, the Recent Grease Pits Area, is located south of the flight line area and east of Site 10 along a service road. Figure 2-15 provides an overview of the habitats identified at this PSC.

Terrestrial Habitats and Receptors. A wooded area is located to the south of PSC 9 across the service road, and man-made drainage ditches run along the northern edge of PSC 9. The site itself is primarily an overgrown field or disturbed upland.

Shrubs encountered at PSC 9 include black willow and southern bayberry. Herbaceous and graminoid species observed at PSC 9 include blazing star, yellow aster, dog fennel, hempweed, thistle, seedbox, goldenrod, burrs, cattail, greenbriar, yellow-eyed grass, Spanish needles, fleabane, mimosa, mosses, poison ivy, burr-reeds, meadow beauty, agalinis, rattlebox, cowbane, white-eyed grass, acacia, grasses (*Echinochloa* sp.), water pennywort, sedges (including *Cyperus* sp.), narrow-leaved seedbox, round-leaved sundew, spike rush (*Eleocharis* sp.), and peas (*Cassia* sp.). Gastropod shells were also found at PSC 9.

Potential receptors species at PSC 9 include terrestrial wildlife, plants, and invertebrates. Species that have been directly observed are listed in the previous paragraph. Other terrestrial flora and fauna potentially inhabiting PSC 9 are listed in Appendix A.

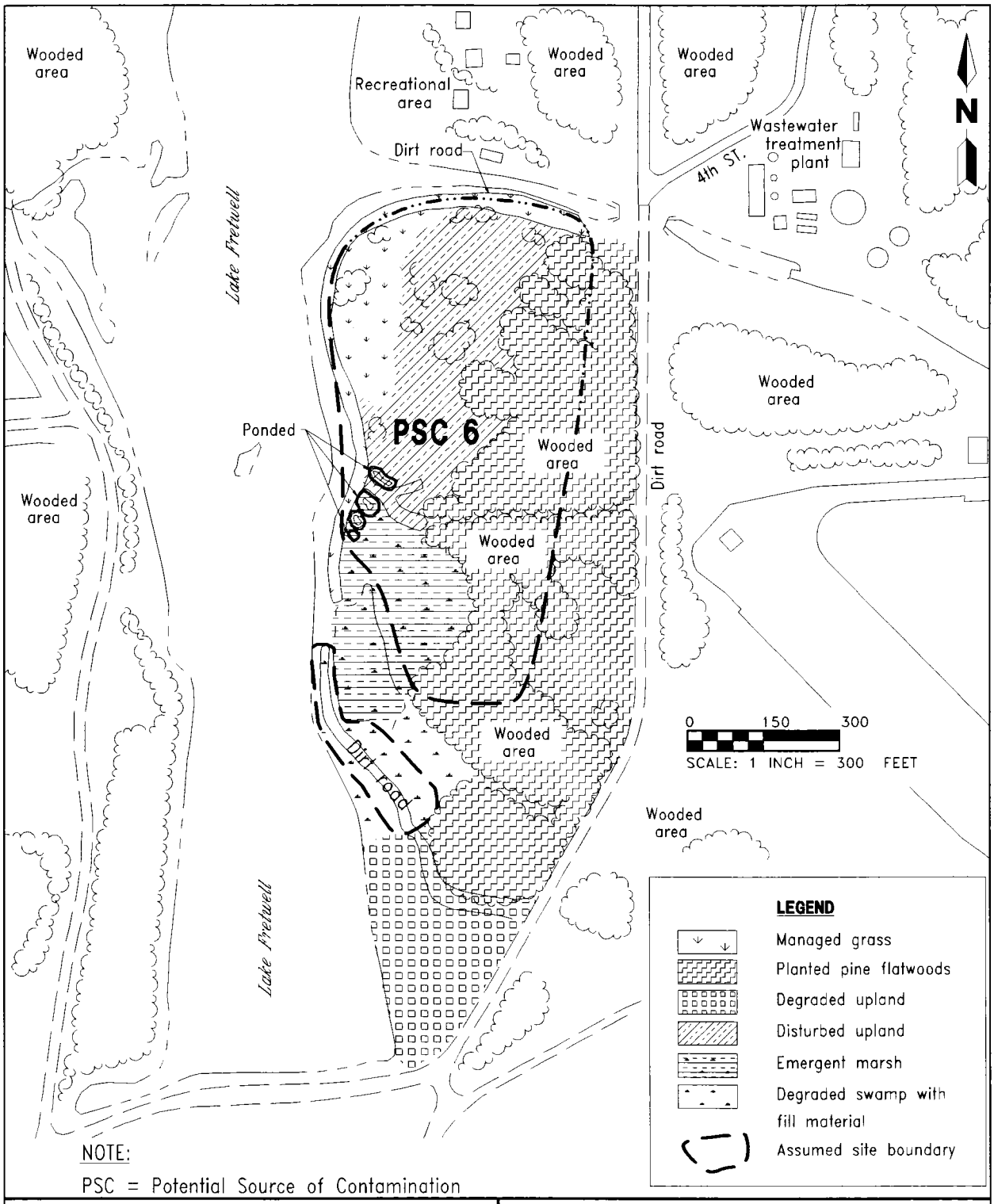

FIGURE 2-14
UPLAND HABITATS PRESENT AT PSC 6

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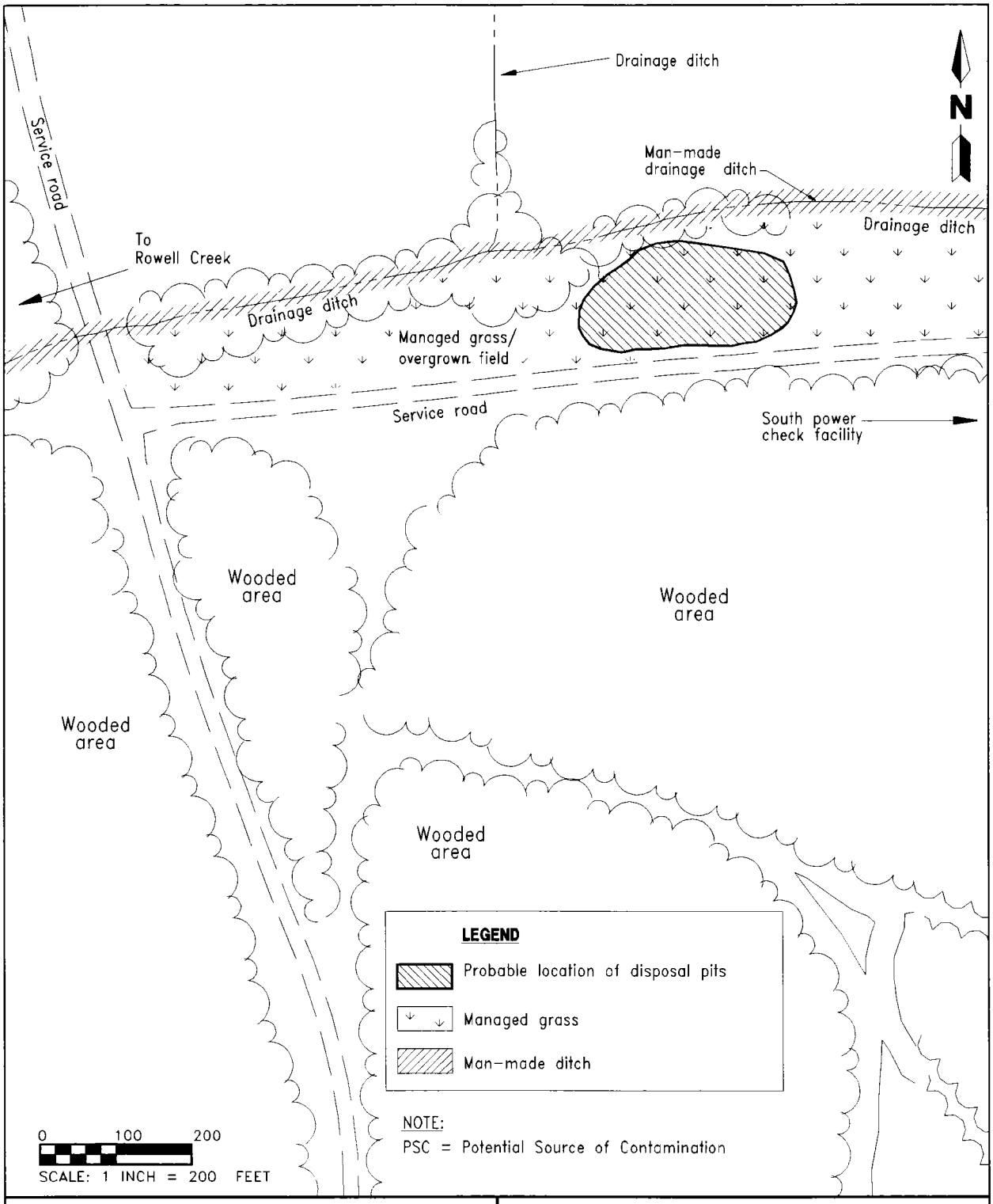

FIGURE 2-15
UPLAND HABITATS PRESENT AT PSC 9

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Aquatic Habitats and Receptors. A man-made drainage ditch was observed at PSC 9. This ditch may provide minimum suitable habitat for aquatic macroinvertebrates.

Wetlands. Table 2-1 lists the wetland type and indicator species associated with the man-made drainage ditch at PSC 9.

2.4.2.4 Potential Source of Contamination 12 PSC 12, the Public Works Rubble Disposal Area, is located near the base recycling area (behind the Public Works Department). Figure 2-16 provides an overview of the habitats identified at this PSC.

Terrestrial Habitats and Receptors. The majority of the site is used for storage and as a parking area. Electrical lines run overhead; therefore, the area is kept clear of large trees. The area covered by PSC 12 is best described as a disturbed upland community. Behind the site (to the east) are planted pine flatwoods; large piles of fill material and rubble have been deposited in the transition area between the disturbed uplands and the pine flatwoods.

Tree species observed at PSC 12 include longleaf pine, cabbage palm, saw palmetto, slash pines, water oak, gallberry, and live oak. Herbaceous and graminoid species observed at PSC 12 include grasses, fleabane, sedges, Spanish needles, ragweed, acacia, water pennywort, seedbox, Virginia creeper, sea myrtle, rattlebox, dog fennel, verbena, morning glory, goldenrod, muscadine grape, blackberry, and bracken fern.

Potential receptors species at PSC 12 include terrestrial wildlife, plants, and invertebrates. Species that have been directly observed are listed in the previous paragraph. Other terrestrial flora and fauna potentially inhabiting PSC 12 are listed in Appendix A.

Aquatic Habitats and Receptors. Aquatic habitats were not observed at PSC 12.

Wetlands. Wetlands were not identified at PSC 12.

2.4.2.5 Potential Source of Contamination 18 PSC 18, the Ammunition Disposal Area, is located in a forested area in the eastern and central portion of NAS Cecil Field. Figure 2-17 provides an overview of the habitats identified at this PSC.

Terrestrial Habitats and Receptors. The three ecological communities observed at PSC 18 include planted pine flatwoods, floodplain forest, and a floodplain swamp or braided blackwater stream. The habitat at PSC 18 is likely to be of high value to semiterrestrial and aquatic wildlife.

The closed arboreal canopy at the site is dominated by red maple and water oak, with occasional tupelo, ashes, and other oaks. The understory is open, and dominated by saw palmetto. Other shrub and herbaceous species observed at the site include southern bayberry, red bay, bryophytes, anolis, meadow beauty, lyonia, St. John's-wort, blueberry, sweetgum, bald cypress, inkberry, nannyberry (*Viburnum lentago*), winged sumac, netted chain fern, sedges, pickerelweed, muscadine grape, bullbriar greenbriar, panic grass, golden club (*Orontium aquaticum*), cross vine (*Bignonia* sp.), sphagnum moss, redberry greenbriar (*Smilax walteri*), and cinnamon fern.

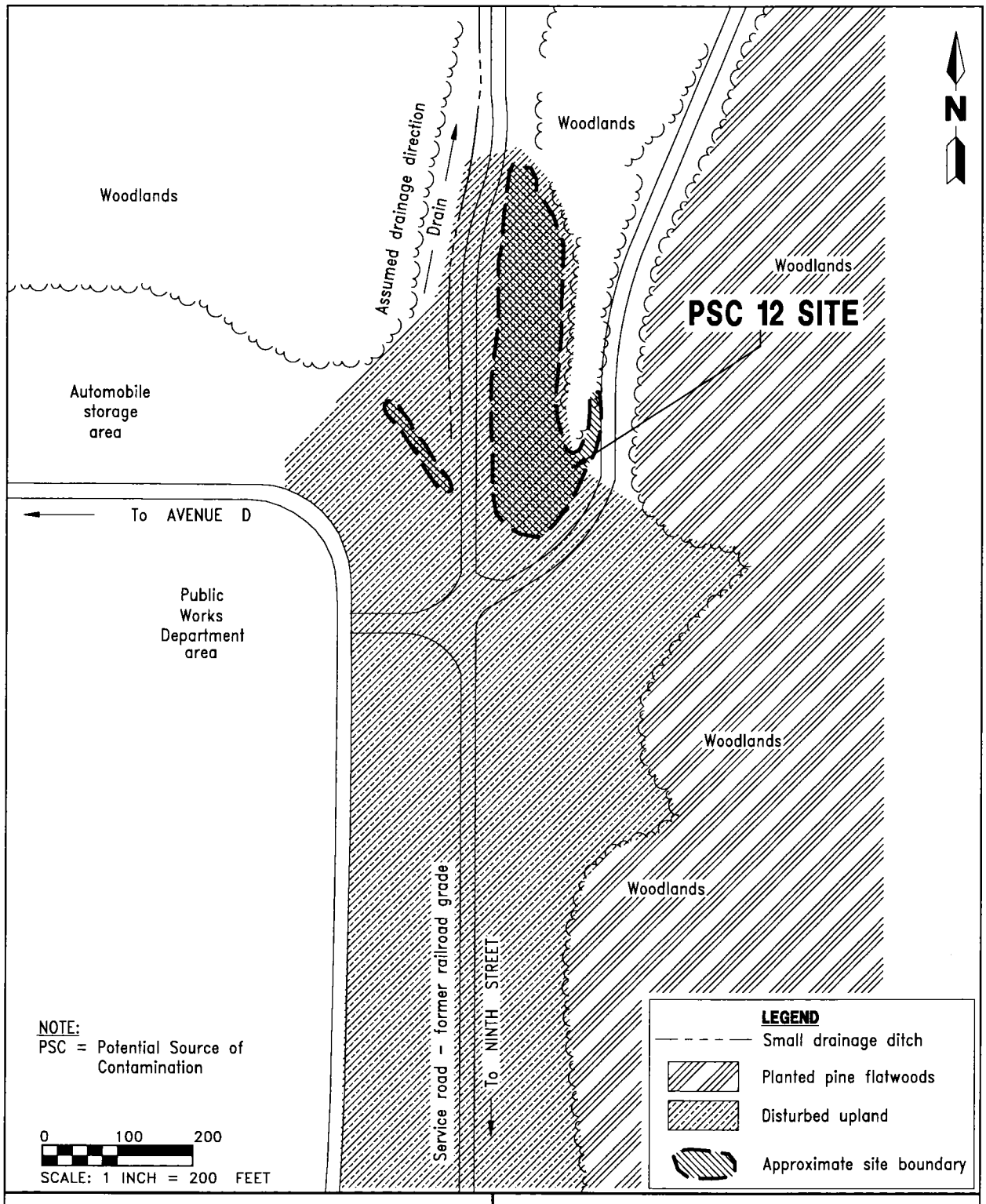

FIGURE 2-16
UPLAND HABITATS PRESENT AT PSC 12

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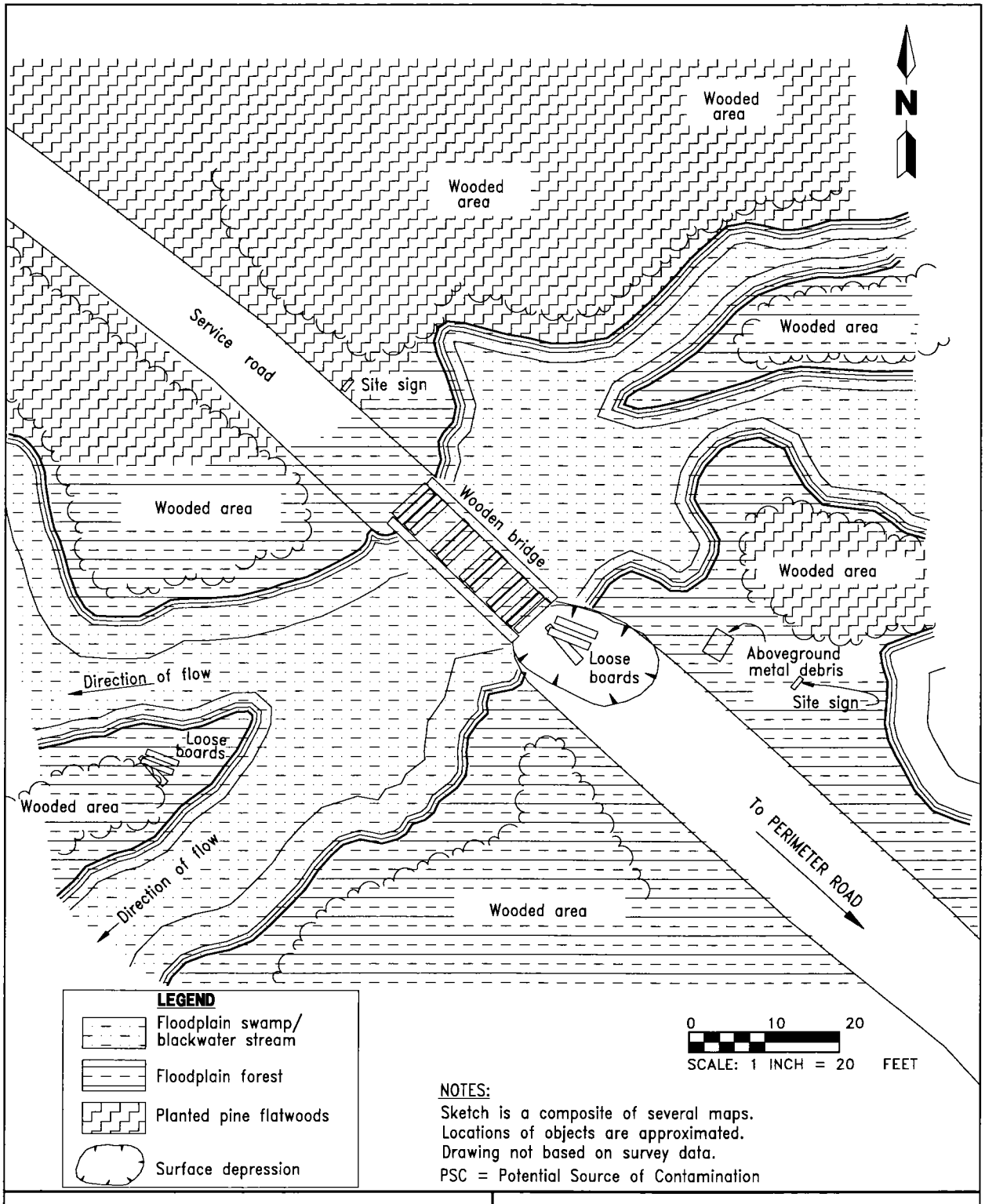

FIGURE 2-17
UPLAND HABITATS PRESENT AT PSC 18

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Potential receptors species at PSC 18 include terrestrial wildlife, plants, and invertebrates. Species that have been directly observed are listed in the previous paragraph. Other terrestrial flora and fauna potentially inhabiting PSC 18 are listed in Appendix A.

Aquatic Habitats and Receptors. The floodplain forest and floodplain swamp or braided blackwater stream habitats are likely of high value to aquatic wildlife.

Wetlands. Table 2-1 lists the wetland type and indicator species present in the wetlands associated with PSC 18.

2.4.2.6 Potential Source of Contamination 19 PSC 19, the Rowell Creek Rubble Disposal Area, is located due west of Rowell Creek and south of 6th Street. Figure 2-18 provides an overview of the habitats identified at this PSC.

Terrestrial Habitats and Receptors. Many ecological communities were identified at PSC 19, including (roughly from the west toward Rowell Creek) disturbed uplands, planted pine flatwoods, mixed pine and hardwoods, upland mixed forest, man-made drainage ditches, floodplain forest (some areas with some titi groves), floodplain swamp, and blackwater stream.

The dominant tree species observed at the site include red maple, slash pine, southern bayberry, black cherry, tupelo, and sweetgum. Other tree and shrub species included southern bayberry, holly, saw palmetto, sourwood (*Oxydendrum* sp.), red bay, sweetbay magnolia, red ash (*Fraxinus pennsylvanica*), ironwood (*Carpinus caroliniana*), hornbeam (*Ostrya* sp.), water oak, swamp honeysuckle (*Rhododendron viscosum*), buttonbush, tall gallberry holly, and titi. Herbaceous and graminoid species observed at PSC 19 include barberry (*Berberis* sp.), black comb fern (*Polypodium plumula*), bullbriar greenbriar, muscadine grape, poison ivy, bamboo, cinnamon fern, lady fern (*Athyrium filix-femina*), netted chain fern, sedges, royal fern, New York fern (*Thelypteris noveboracensis*), golden club, laurel greenbriar (*Smilax laurifolia*), lizard's tail (*Saururus cernuus*), bracken fern, Spanish needles, blackberry, yellow-eyed grass, sphagnum moss, sweetbells (*Leucothoe* sp.), yellow aster, dog fennel, bluestem, Virginia creeper, water pennywort, and morning glory.

Potential receptors species at PSC 19 include terrestrial wildlife, plants, and invertebrates. Species that have been directly observed are listed in the previous paragraph. Other terrestrial flora and fauna potentially inhabiting PSC 19 are listed in Appendix A.

Aquatic Habitats and Receptors. A man-made drainage ditch was observed at PSC 9. These ditches may provide minimum suitable habitat for aquatic macroinvertebrates. The floodplain forest, floodplain swamp, and blackwater stream habitats are likely of high value to aquatic wildlife.

Wetlands. Table 2-1 lists the wetland type and indicator species present in the wetlands at PSC 19.

2.5 RARE, ENDANGERED, AND THREATENED SPECIES. Certain species that are potentially present at NAS Cecil Field are protected by Federal and/or State laws. The Florida Administrative Code defines protected species as follows: (1) *Endangered species* are those that are so few or depleted in number or so

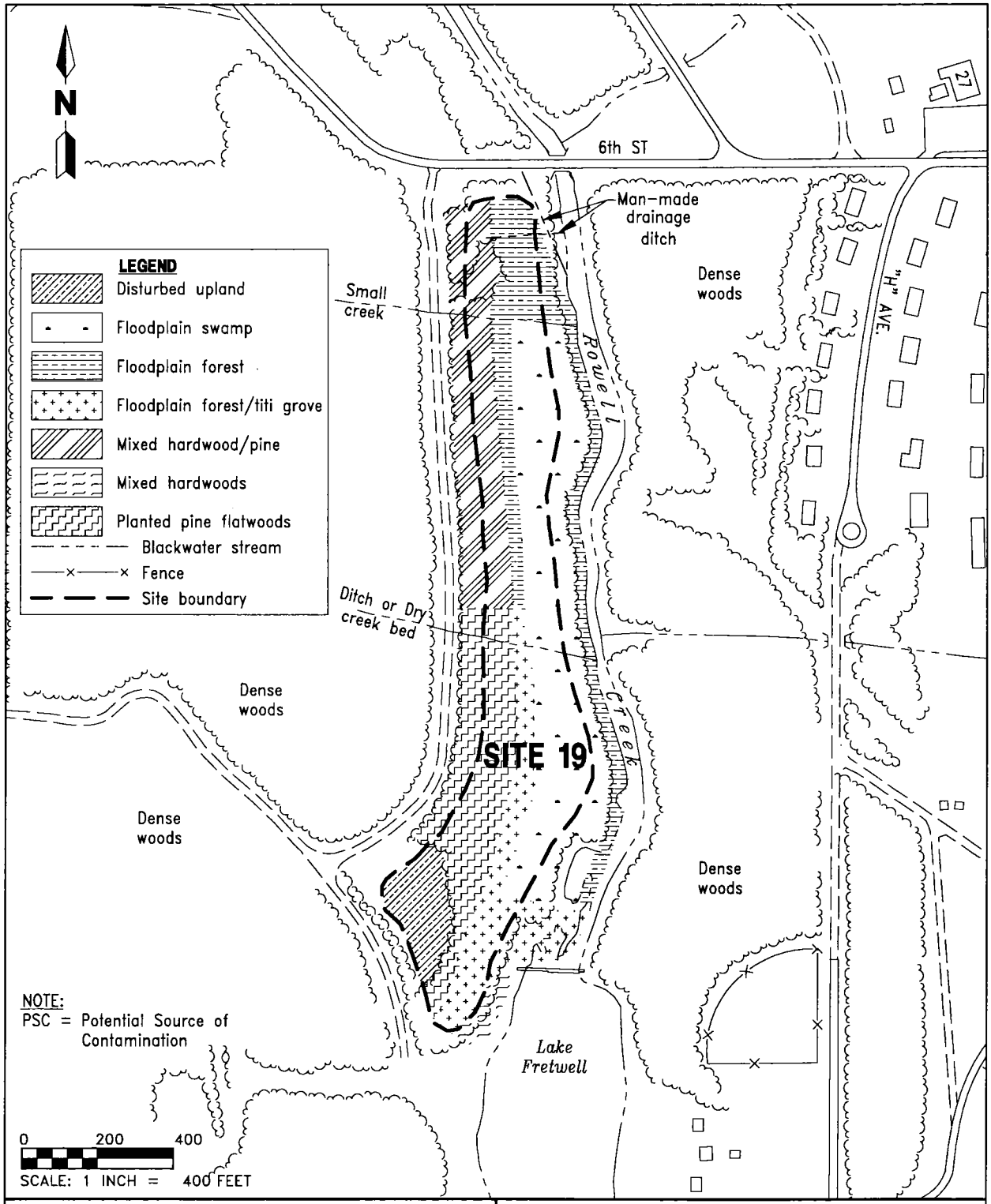

FIGURE 2-18
UPLAND HABITATS PRESENT AT PSC 19

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restricted in range or habitat as to be in imminent danger (or may attain such status in the immediate future) of extinction or extirpation; (2) Threatened species are those which are acutely vulnerable to environmental alteration or whose range or habitat is declining rapidly, thus leading to, or potentially leading to, rapid population decline; these species are likely to become endangered within the foreseeable future; (3) *Species of special concern* are those in need of special protection, recognition, or consideration because they are inherently vulnerable to habitat alteration, human disturbance, or human exploitation, which in turn may lead to their becoming threatened. The Florida Committee on Rare and Endangered Plants and Animals (FCREPA) also designates the category of rare to those species having a limited geographic distribution, special habitat requirements, or occurrence at the periphery of their range (Envirodyne Engineers, 1985). These status designations are applied to the species in the following sections.

Rare, endangered, and threatened species identified as potentially present at NAS Cecil Field are listed in Table 2-2. The list is based in part on a review of available information in the *Initial Assessment Study* (Envirodyne Engineers, 1985), a *Rare and Endangered Plant Survey Report* (Environmental Services and Permitting, Inc., 1990), *Technical Memorandum for Supplemental Sampling at OUs 1, 2, and 7* (ABB-ES, 1992), and the *Cecil Field Gopher Tortoise Survey and Management Plan* (CZR Incorporated [CZR], 1994). Supplemental information was provided through communication with officials at the Florida Game and Fresh Water Fish Commission (FGFWFC) (Wooding, 1994; Wood, 1995) and natural resource officers at NAS Cecil Field (Cochran, 1995) and Southern Division, Naval Facilities Engineering Command (Burst, 1995). In addition, the FNAI was also consulted when identifying rare, endangered, and threatened species potentially occurring at NAS Cecil Field (FNAI, 1997). The FNAI provides information on the status and distribution of natural communities and rare, threatened, or endangered plant or animal species.

2.5.1 **Fauna** Animal species protected under Federal or State statutes that are known or expected to occur at NAS Cecil Field are listed below.

The Florida gopher frog (*Rana capito*) is considered threatened by FCREPA (FNAI, 1994), is listed as a species of special concern by FGFWFC, and is currently under review by USFWS (Wood, 1994). It inhabits dry, well-drained soils of sandhill communities, pine flatwoods, and sand pine scrub. It commonly utilizes the burrow of the gopher tortoise (*Gopherus polyphemus*), which is a confirmed resident of NAS Cecil Field. The Florida gopher frog is a reported resident of Duval County (FNAI, 1994), and suitable habitat exists at NAS Cecil Field, especially at or near Sites 1, 2, 3, 4, and 5.

The American alligator (*Alligator mississippiensis*), reclassified from endangered to threatened status within the State of Florida and a State-listed species of special concern (Wood, 1994), is a confirmed resident of Lake Fretwell, which is located near Sites 3, 4, 5 and 6. Typical food of the alligator includes fish, birds, and reptiles. Nesting begins in late spring, with the female constructing a mound nest of vegetation near a body of water.

The eastern indigo snake (*Drymarchon corais couperi*) is listed as threatened by both the USFWS and FGFWFC (Wood, 1994). It is tolerant of a wide variety of habitats: pine flatwood, moist tropical hammocks, and, more typically, sandhill habitats (Moler, 1992). This snake is known to utilize the burrow of the gopher

Table 2-2
Rare, Endangered, and Threatened Flora and Fauna at or in the Vicinity of Naval Air Station Cecil Field

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Common Name	FGFWFC[1]	USFWS[2]	FDA[3]	FNAI	Comments
Florida gopher frog (*Rana capito*)	SSC	C2		S3	Possible resident at Naval Air Station (NAS) Cecil Field (Envirodyne Engineers, 1985).
American alligator (*Alligator mississippiensis*)	SSC	T(S/A)		S4	Confirmed resident in Lake Fretwell (Envirodyne Engineers, 1985).
Eastern indigo snake (*Drymarchon corais couperi*)	T	T		S3	Possible resident at NAS Cecil Field (Envirodyne Engineers, 1985). Its presence has not been confirmed (Cochran, 1995).
Florida pine snake (*Pituophis melanoleucus mugitus*)	SSC			S3	Identified by the FNAI as occurring in Duval County. Appropriate habitat exists within pine forests at NAS Cecil Field (Ashton and Ashton, 1988).
Gopher tortoise (*Gopherus polyphemus*)	SSC			S3	Confirmed resident at NAS Cecil Field; observed in association with Sites 2, 4, and 5; a possible resident at Site 1 (Envirodyne Engineers, 1985; ABB Environmental Services, Inc. (ABB-ES, 1994a); ABB-ES, 1994b). Also observed in several areas of NAS Cecil Field and the Yellow Water Weapons Annex by CZR, Incorporated (CZR, 1994).
Black creek crayfish (*Procambarus pictus*)	SSC			S2	Identified by the FNAI as occurring in Duval County. Appropriate habitat exists within Rowell, Sal Taylor, and Yellow Water Creek, and Lake Fretwell at NAS Cecil Field.
Wood stork (*Mycteria americana*)	E	E		S2	Confirmed migrant; observed feeding at Lake Fretwell (Cochran, 1995). Suitable habitat for feeding may be present in additional shallow water areas at NAS Cecil Field (Envirodyne Engineers, 1985).
Southeastern kestrel (*Falco sparverius paulus*)	T	C2			Either this, or the closely related subspecies, *F. sparverius*, has been observed in the Yellow Water Weapons Annex by HLA biologists and others (Cochran, 1995).
Red-cockaded woodpecker (*Picoides borealis*)	T	E		S2	Identified by the FNAI as occurring in Duval County. Appropriate habitat exists within pine forests at NAS Cecil Field.

See notes at end of table.

Table 2-2 (Continued)
Rare, Endangered, and Threatened Flora and Fauna at or in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Common Name	FGFWFC[1]	USFWS[2]	FDA[3]	FNAI	Comments
Florida burrowing owl (*Speotyto cunicularia floridana*)	SSC			S3	Identified by the FNAI as occurring in Duval County. Appropriate habitat exists at NAS Cecil Field.
Bald eagle (*Haliaeetus leucocephalus*)	T	T		S3	Confirmed migrant (Envirodyne Engineers, 1985).
Bachman's sparrow (*F. sparverius*Aimophila aestivalis)		C2		S3	Observed in Yellow Water Weapons Annex (CZR, 1994).
Loggerhead shrike (*Lanius lucovicianus*)		C2			Observed at Yellow Water Weapons Annex near the weapons compound by HLA biologist, and near runways at the facility (Cochran, 1995).
Sherman's fox squirrel (*Sciurus niger shermani*)	SSC			S2	Possible resident near Site 18 (HLA biologist), and confirmed at NAS Cecil Field (Cochran, 1995).
Florida black bear (*Ursus americanus floridanus*)	T	C2		S2	Evidence of black bears reported in outlying areas in 1982 (Envirodyne Engineers, 1985).
Florida mouse (*Podomys floridanus*)	SSC	C2			Known from Clay County, may range into habitats (sand pine scrub and longleaf pine-turkey oak communities) present at NAS Cecil. Not known to be a resident at NAS Cecil Field (Envirodyne Engineers, 1985; Cochran, 1995).
Hooded pitcher plant (*Sarracenia minor*)			T		Observed in wetlands associated with Sites 3 and 17 (HLA), and Sites 4 and 5 (Camp, Dresser, and McKee [CDM], 1994).
Spoon-leaved sundew (*Drosera intermedia*)			T	S3	Observed at one location at Yellow Water Weapons Annex in drainage ditch (Environmental Services & Permitting [ESP], 1990).
Cinnamon fern (*Osmunda cinnamomea*)			CE		Observed at Site 1 (HLA ecologist), 2, 3, 4, 5 and 17 (CDM, 1994 and the Yellow Water Weapons Annex (CZR, 1994).
Royal fern (*Osmunda regalis*)			CE		Observed at Site 1 (HLA ecologist), 2, 4, 5 and 17 (CDM, 1994) and the Yellow Water Weapons Annex (CZR, 1994).
Southern shield fern (*Thelypteris kunthii*)			T		Not observed at NAS Cecil Field, but appropriate habitat exists at Sites 11 and 18.
Comb fern (*Polypodium plumula*)			T		Not observed at NAS Cecil Field, but appropriate habitat exists within mesophytic (moderately moist) hardwood communities.

See notes at end of table.

Table 2-2 (Continued)
Rare, Endangered, and Threatened Flora and Fauna at or in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Common Name	FGFWFC[1]	USFWS[2]	FDA[3]	FNAI	Comments
Bartram's ixia (*Salpingostylis coelestina*)			E	S2	Confirmed by Navy personnel in the southwest quadrant of NAS Cecil Field (Burst, 1995; Cochran, 1995).
Variable-leaf crown beard (*Verbesina heterophylla*)					Observed at one location at NAS Cecil Field in sandhill habitat (ESP, 1990).
Netted chain fern (*Woodwardia areolata*)			T		Observed at Sites 3 and 5 (CDM, 1994), 1 and 17 (HLA ecologist).
Grass pink (*Calopogon tuberosus*)			T		Observed at Site 17 by HLA ecologist.
Ladies' tresses (*Spiranthes vernalis and polyantha*)	E		E	S1/S2	Confirmed at NAS Cecil Field (Cochran, 1995).
Rose pogonia (*Pogonia ophioglossoides*)			T		Confirmed at NAS Cecil Field (Cochran, 1995).
Foxtail clubmoss (*Lycopodium alopeuroides*)			T		Observed at Site 4 (CDM, 1994) and OU 2 (HLA ecologist).
Atlantic coast Florida lantana (*Lantana depressa vorfloridana*)	E			S2	Identified by the FNAI as occurring in Duval County. Appropriate habitat is within pine forests at NAS Cecil Field.
Southern red lily (*Lilium catesbaei*)	T			S3	Identified by the FNAI as occurring in Duval County. Appropriate habitats exist within pine forests at NAS Cecil Field.
Chaffseed (*Schwalbea americana*)	E	E		S1	Identified by the FNAI as occurring in Duval County. Appropriate habitats exist at NAS Cecil Field including pine forests and savannas and oak forests.
Wild azalea (*Rhododendron canescens*)			CE		Observed at NAS Cecil Field (CZR, 1994).
Swamp honeysuckle (*Rhododendron viscosum*)			T		Observed at NAS Cecil Field (CZR, 1994).
Dahoon holly (*Ilex cassine*)			CE		Observed at NAS Cecil Field (CZR, 1994).
American holly (*Ilex opaca*)			CE		Observed at NAS Cecil Field (CZR, 1994).
Dwarf palmetto (Sabal minor)			T		Observed in disturbed upland areas of OU 1 and OU 2 (HLA ecologists).

See notes at end of table.

Table 2-2 (Continued)
Rare, Endangered, and Threatened Flora and Fauna at or in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Florida Game and Fresh Water Fish Commission (FGFWFC) (list published in Sections 39-27.003-005, Florida Administrative Code) (Wood, 1994).
[2] U.S. Fish and Wildlife Service (USFWS) (list published in List of Endangered and Threatened Wildlife and Plants, 50 Code of Federal Regulations 17.11-12) (Wood, 1994).
[3] Florida Department of Agriculture (FDA) and Consumer Services (list is statutorily designated by the Preservation of Native Flora of Florida Act (581.185-187, Florida Statutes) (Wood, 1994).

Notes: FNAI = Florida Natural Areas Inventory.
SSC = species of special concern.
C2 = a candidate for Federal listing with some evidence of vulnerability, but for which not enough information exists to justify listing.
S3 = either very rare and local throughout its range (21 to 100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction or other factors.
T(S/A) = threatened due to similarity of appearance.
S4 = apparently secure in Florida (may be rare in parts of range).
T = threatened.
E = endangered.
S2 = imperiled in Florida because of rarity (6 to 20 occurrences or less than 3,000 individual(s) or because of vulnerability to extinction due to some natural or man-made factor.
CE = commercially exploited.
S1 = critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1,000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.

tortoise for shelter. It is a confirmed resident at NAS Cecil Field, and may be exposed to contaminants at or near Sites 1, 2, 3, 4, 5, and 17.

The Florida pine snake (*Pituophis melanoleucus mugitus*) is classified by the FGFWFC as a species of special concern. A species of special concern (SSC) is defined as a vulnerable population based on limited available habitat, and would likely be reclassified as threatened, based on loss or modification of its current available habitat. The Florida pine snake is also identified by the FNAI as being rare and local throughout its range, or vulnerable. The Florida pine snake, as its name implies, is commonly found in sandy long leaf pine forests that occur throughout NAS Cecil Field, and has been reported as a resident of Duval County by the FNAI (FNAI, 1997).

The red-cockaded woodpecker (*Picoides borealis*) is listed as endangered by the USFWS, threatened by the FGFWFC, and imperiled in Florida by the FNAI. This species is in danger of becoming extinct in all or parts of its range due to habitat loss. Currently this species is rare in the State of Florida; however, it is known to occur in Duval County (FNAI, 1997). This species requires an open pine woodland habitat, which is common throughout NAS Cecil Field. Although this species is not a known resident, it is possible that this species may occur in the pine forests at NAS Cecil Field.

The Florida burrowing owl (*Speotyto cunicularia floridana*) is listed as a SSC by the FGFWFC, and rare and local throughout its range, or vulnerable, by the FNAI (FNAI, 1997). Based on its preferred habitats (e.g., open grassland, prairies, and airfields), it is possible that this species may occur at NAS Cecil Field, although it has not been confirmed as a resident.

The black creek crayfish (*Procambarus pictus*) is identified by the FNAI as occurring in Duval County (FNAI, 1997). The water bodies at NAS Cecil Field, including Rowell Creek, Sal Taylor Creek, and Yellow Water Creek, and Lake Fretwell, would likely provide suitable habitat for this species. This species is listed as a SSC by the FGFWFC, and imperiled in Florida because of rarity or vulnerability, as classified by the FNAI.

The gopher tortoise (*Gopherus polyphemus*), a State SSC and a Federal SSC candidate species (Wood, 1994), is a confirmed resident at NAS Cecil Field. This tortoise constructs its burrows in dry, sandy soil afforded by sand pine, longleaf pine, and live oak hammock communities. It is omnivorous, although adults usually graze on grasses and herbs. The gopher tortoise is particularly important because its burrow provides refuge to a number of other species, such as the gopher frog and indigo snake (Moler, 1992). This reptile has been observed by HLA ecologists within 1,000 feet of Site 5. A number of gopher tortoise burrows were observed on the NAS property, some in association with Sites 1 and 4 (Envirodyne Engineers, 1985). A survey of gopher tortoises conducted at NAS Cecil Field (CZR, 1994) indicates that approximately 1,300 gopher tortoises inhabit NAS Cecil Field (density equals 0.43 gopher tortoises per acre), and approximately 12 inhabit the Yellow Water Weapons complex (density equals 0.05 gopher tortoises per acre). The biotic communities inhabited by the gopher tortoise included pine flatwoods, longleaf pine or turkey oak hills, shrub and brushland, and altered or ruderal (poor or waste) land. Additional information on the gopher tortoise survey is included in Subsection 5.3.3.

The wood stork (*Mycteria americana)* is known to breed in Florida and southeastern Georgia; it is a confirmed migrant at NAS Cecil Field, where it has been observed feeding at Lake Fretwell (Cochran, 1995). Drainage or alteration of feeding habitats have led to its listing as endangered by USFWS, FGFWFC (Wood, 1994), and FCREPA (Kale, 1978). Adults seek shallow freshwater marshes, flooded pastures, or ditches that may have sufficient concentrations of fish to accommodate their inefficient method of groping for food (Kale, 1978). Additional suitable habitat for feeding may be present at NAS Cecil Field in shallow water areas such as the wetlands on or near Sites 1, 2, 3, 4, 5, and 17.

The southeastern kestrel (*Falco sparverius paulus*) is considered threatened by both FGFWFC (Wood, 1994) and FCREPA (Kale, 1978, as cited in Envirodyne Engineers, 1985), and is under review by the USFWS. It occurs in open pine forests or clearings with available perches. Either this species or the unlisted eastern American kestrel, *F. sparverius sparverius*, occurs at NAS Cecil Field; a positive identification to subspecies has not been made at present (Cochran, 1995). Kestrels may feed in planted pine areas at or near Sites 1, 2, 3, 4, and 5, and have been observed in the Yellow Water Weapons area by HLA biologists.

The bald eagle (*Haliaeetus leucocephalus*) has been downgraded from endangered to threatened by the USFWS (Wood, 1994; 1995); it is also listed as threatened by FGFWFC (Wood, 1994). It was once considered widespread in Florida, but its numbers have diminished considerably since the 1940s. It is presently increasing in number within the state (Wood, 1995). The bald eagle is generally associated with lakes, rivers, and shallow coastal areas, particularly during nesting season, and has been reported in Duval County (FNAI, 1994). Since nesting occurs near the St. Johns River, the bald eagle may occasionally stray over NAS Cecil Field.

Bachman's sparrow (*Aimophila aestivalis*) is a candidate for Federal listing (C2), with some evidence of vulnerability, but for which not enough information exists to justify listing. It occurs in dry open pine or oak woods with scattered understory and in overgrown fields (Bull and Farrand, 1977). This species has been observed in the Yellow Water Weapons area (CZM, 1994).

Sherman's fox squirrel *(Sciurus niger shermani*) is listed as an SSC by FGFWFC and a candidate for listing by USFWS (Wood, 1994). Diminishing habitat of this species is the primary reason it is listed. Preferred habitats are those communities offered by sandhill association (longleaf pine and turkey oak) and ectonal (peripheral) situations in flatwoods. Typically, this squirrel depends upon pine seeds and acorns for food (Humphrey, 1992). Presence in Duval County of small, scattered populations of this species is confirmed (Wooding, 1990). A fox squirrel of this or the closely related and also protected subspecies, *S. sciurus avicennia,* was observed at NAS Cecil Field by an HLA biologist; it was seen in the pine woods along the eastern portion of Perimeter Road. Sherman's fox squirrel may range into appropriate habitat at other locations, including Sites 1, 2, 4, and 5.

The Florida black bear (*Ursus americanus floridanus*) is under consideration for listing by USFWS and considered threatened by both FGFWFC (Wood, 1994) and FCREPA. It is currently found only in large tracts of property that offer heavy vegetation as refuge (Humphrey, 1992). Evidence of black bears was reported in 1982 from the outlying portions of the property (Envirodyne Engineers, 1985).

The Florida mouse (*Podomys floridanus*) is limited in range to a patchy distribution in peninsular Florida, and has a very narrow habitat range within sand pine scrub and longleaf pine-turkey oak communities. It is listed by FGFWFC (Wood, 1994) and FCREPA (Humphrey, 1992) as threatened and is found in Clay County (Envirodyne Engineers, 1985). Although it is not listed in the inventory database for Duval County (FNAI, 1994), the Florida mouse may potentially range into appropriate habitats at NAS Cecil Field.

2.5.2 Flora None of the 44 endangered or 10 threatened plant species listed by USFWS and known to occur in Florida (Wood, 1994) are believed to occur at NAS Cecil Field (Envirodyne Engineers, 1985; CDM, 1994). Those plant species that are listed by the Florida Department of Agriculture (FDA) as threatened or commercially exploited and that were observed or may potentially occur at NAS Cecil Field are listed below.

The **hooded pitcher plant** was observed at several sites at NAS Cecil Field. HLA biologists and ecologists observed this plant in the wetland associated with Site 3 and in the eastern portion of Site 17. CDM (1994) observed the pitcher plant near Site 1 in the Rowell Creek floodplain, as well as at Sites 4 and 5. This species occurs in bogs, wet savannas, and open pinelands throughout central and northern Florida, and may be present in wetlands at additional sites at NAS Cecil Field.

The **spoon-leaved sundew** occurs in moist places associated with thin pinelands or open areas (Duncan and Foote, 1975). It was observed in the Yellow Water Weapons area (Environmental Services & Permitting, Inc. [ESP], 1990), and this or a related species was reported near Site 4. Additional sites at NAS Cecil Field offer appropriate habitat for this species.

The **cinnamon fern** has been observed at Site 1 and in the bottomland forest associated with Site 2, as well as at Sites 3, 4, 5, and 17 (CDM, 1994). It was also observed in the Yellow Water Weapons area by CZR (1994). It is commonly found in wet woods and swamps throughout Florida (Wunderlin, 1982). This fern is listed by the FDA because it is commercially exploited in Florida (Wood, 1994).

The **royal fern** is also commercially exploited in Florida (Wood, 1994). It occurs commonly in wetlands of Florida (Wunderlin, 1982) and has been observed at NAS Cecil Field at Sites 1 (ABB-ES, 1994a), 2 (in the emergent persistent wetland), 4, 5, and 17 (CDM, 1994).

The **southern shield fern** (*Thelypteris kunthii*) is listed by the FDA as threatened (Wood, 1994). It is commonly found in rocky woods and cypress swamps in Florida (Wunderlin, 1982) and may be present at NAS Cecil Field.

The **comb fern** is also listed as threatened by the FDA (Wood, 1994). Although it has not been observed at NAS Cecil Field, appropriate habitat is present. It is an epiphytic form frequently found in hammocks throughout Florida (Wunderlin, 1982).

Bartram's ixia (*Salpingostylis coelestina*) is unique in that it is exclusive to a small area in northeastern Florida. Its habitat is wet, grassy, flatwoods associated with slash or longleaf pines and wiregrass and wet prairie; it is a confirmed species in Duval County (FNAI, 1994). Due to its very limited range,

Bartram's ixia is listed by FDA as endangered (Wood, 1994) and by FCREPA as threatened (Ward, 1978, as cited in Envirodyne Engineers, 1985). This species was reported at NAS Cecil Field in the 1990 study (ESP, 1990), and its presence was later confirmed by Navy personnel (Burst, 1995; Cochran, 1995).

The **variable-leaf crown beard** (*Verbesina heterophylla*) is a terrestrial plant that occurs in sandhill and mesic flatwoods (FNAI, 1994). It was observed at one location at NAS Cecil Field in a sandhill habitat (ESP, 1990), but proximity to other study sites was not reported. Appropriate habitat exists at Sites 2, 3, 4, 5, and 17.

The **netted chain fern** was observed in wetlands at NAS Cecil Field at Sites 2, 3, and 5 (CDM, 1994) and at Sites 5 and 17 (by an HLA ecologist). It was also observed at the Yellow Water Weapons complex (CZR, 1994), and is commonly found in swamps and wet woods in Florida (Wunderlin, 1982). The netted chain fern is another commercially exploited species in Florida.

The **grass pink** (*Calopogon tuberosus*), a member of the orchid family and listed as threatened by FDA (Wood, 1994), was observed in the eastern part of Site 17 by HLA ecologists. This species occurs in moist soil of pine woodlands and marshes (Wunderlin, 1982), and could potentially occur in wetlands associated with additional sites at NAS Cecil Field.

Ladies' tresses (*Spiranthes* sp.), also members of the orchid family, include several species that are listed as threatened by FDA (Wood, 1994). Cochran (1995) indicated that a member of this genus has been confirmed at NAS Cecil Field (species name was not provided). This slender, grasslike genus is found in wet, grassy areas throughout Florida (Taylor, 1992).

The **rose pogonia** (*Pogonia ophioglossoides*) is listed as threatened by FDA (Wood, 1994) and is present at NAS Cecil Field (Cochran, 1995). Also a member of the orchid family, this fragrant, pink or rose-pink flowering plant is found in wet pine flatwoods and marshes in central and northern Florida (Taylor, 1992).

Foxtail clubmoss is listed as threatened by the FDA (Wood, 1994). It is a wetland species found in wet pinelands and along the edges of swamps. It has been observed at Site 4 (CDM, 1994) and OU 2 by HLA ecologists.

The **wild azalea** (*Rhododendron canescens*) is listed by FDA as a commercially exploited species (Wood, 1994). This member of the Ericaceae family is found in wet to well-drained woodlands and along streams of central and northern Florida (Taylor, 1992). It was observed at NAS Cecil Field by CZR (1994).

The **swamp honeysuckle** is listed by FDA as threatened (Wood, 1994). This species occurs in wet woods and swamps, and flowers from spring to early fall (Taylor, 1992). The honeysuckle has been observed at NAS Cecil Field (CZR, 1994).

The **dahoon holly** (*Ilex cassine*) is a commercially exploited species in Florida (Wood, 1994). It is found in flatwood depressions and along margins of swamps and ponds (Wunderlin, 1982), and has been observed at NAS Cecil Field (CZR, 1994).

The **American holly** (*Ilex opaca*) is also a commercially exploited species in Florida (Wood, 1994). This species is an occasional inhabitant of mesic woods (Wunderlin, 1982) and has been observed at NAS Cecil Field (CZR, 1994).

The **dwarf palmetto** (*Sabal minor*) is listed by the FDA as threatened (Wood, 1994). It occurs frequently in moist to wet woods (Wunderlin, 1982) and has been reported in disturbed upland areas of OU 1 and OU 2 at NAS Cecil Field.

The **Atlantic Coast Florida lantana** (*Lantana depressa varfloridana*) is identified by the FNAI as occurring in Duval County, and it is possible that this species may occur at NAS Cecil Field, as suitable pine forest habitat exists. This species is identified by the FGFWFC as endangered, and by the FNAI as imperiled in Florida due to rarity or vulnerability.

The **southern red lily** (*Lilium catesbaei*) is identified as threatened by the FGFWFC (i.e. vulnerable, based on habitat loss or declining numbers), and is designated by the FNAI as a species known to be vulnerable, based on localized occurrences or limited range (FNAI, 1997). Although this species has not been identified as occurring at NAS Cecil Field, it is possible that this species may be present at NAS Cecil Field, because habitats that may support this species do occur.

Chaffseed (*Schwalbea americana*) is identified by the USFWS and the FGFWFC as being endangered (i.e. in danger of being extirpated from all or part of its range). The FNAI identified this species as critically imperiled in the State of Florida. Although it has not been observed at NAS Cecil Field, habitat required by this species, including pine forests, oak forests, and savannas, are known to occur.

CHAPTER 3.0

3.0 ECOLOGICAL RISK ASSESSMENT METHODOLOGY

ERAs evaluate actual and potential adverse effects to ecological receptors associated with exposure to contamination from a hazardous waste site. The ERAs for each of the OUs at NAS Cecil Field were completed in accordance with current guidance materials for ERAs at Superfund sites, including the following:

- *Risk Assessment Guidance for Superfund Environmental Manual* (U.S. Environmental Protection Agency [USEPA], 1989a),
- *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference* (USEPA, 1989b),
- *Ecological Assessment of Superfund Sites: An Overview* (USEPA, 1991a),
- *Framework for Ecological Risk Assessment* (USEPA, 1992a),
- *Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997), and
- *Tri-Services Procedural Guidelines for Ecological Risk Assessments* (Wentsel *et al.*, 1996).

Recent risk assessment guidance documents, including the USEPA "Eco Update" bulletins written since 1991 and other publications (e.g., Maughan, 1993; Suter, 1993) were also consulted.

The assessment approach integrates both field and predictive methodologies to assess risks. The decisions regarding overall risk to ecological receptors are based on the weight-of-evidence from the results of all components of the assessment methodology (i.e., an approach that integrates results of physical, biological, toxicological, and modeling studies to draw risk-based conclusions). The weight-of-evidence components were designed to provide measures of risks for different ecological receptors, exposure pathways, and potential adverse effects. In general, risks tend to be biased high or overestimated as a result of protective or conservative assumptions used in analyses.

The following sections describe the five major components of an ERA, including ecological characterization, problem formulation, analysis, risk characterization, and uncertainty analyses.

3.1 ECOLOGICAL CHARACTERIZATION. In this section, the physical setting and different ecological habitats at each site are identified and described. This description serves as the basis for identifying ecological receptors to evaluate potential risks in the ERA. The ecological characterization may be based on a limited site reconnaissance, information obtained from existing reports and other literature, and correspondence with local, State, and Federal wildlife officials.

3.2 PROBLEM FORMULATION. Problem formulation is an important step of the ERA process, and consists of identification of receptors, identification of exposure pathways for those receptors, and the assessment and measurement endpoints selected for the ERAs.

3.2.1 Identification of Receptors Potential ecological receptors include both aquatic and terrestrial plants and animals. Aquatic receptors include invertebrates, plants, algae, amphibians, and fish. Terrestrial wildlife receptors include mammals, birds, reptiles, invertebrates, and amphibians. Aquatic and terrestrial species identified during the biological field investigations described in the ecological characterizations are used to identify aquatic and terrestrial receptors. Terrestrial and wetland flora and fauna and aquatic species potentially using NAS Cecil Field are identified in Appendix A.

3.2.2 Identification of Exposure Pathways Exposure pathways are identified for the ecological receptors potentially occurring at the site, which may include terrestrial and/or wetlands wildlife, terrestrial plants, terrestrial invertebrates, or aquatic receptors. The exposure pathway includes a source of contamination, potentially contaminated media (surface soil, food, groundwater, surface water, or sediment), and an exposure route. A conceptual model of the exposure pathways from source to ecological receptors is developed for each OU or group of sites within an OU.

Not all potential routes of exposure are presented in the contaminant pathway model. The model represents only those pathways that are evaluated in the ERA. This limitation is necessary to focus the risk evaluation on the pathways for which (1) contaminant exposures are the highest and most likely to occur and (2) there are adequate data pertaining to the receptors, contaminant exposures, and toxicity for completion of risk analyses.

Terrestrial and Wetland Wildlife. The exposure routes evaluated for wildlife represent those pathways that are believed to contribute the highest potential contaminant exposures. These exposures include ingestion of soil, sediment, surface water, and food items that are contaminated as a result of accumulation of constituents from site media.

The exposures related to dermal contact are considered in the evaluation of wildlife. However, there are limited data available in the literature to evaluate dermal exposures to wildlife receptors. In general, an assumption is made that fur, feathers, and chitinous exoskeleton limit the transfer of contamination across the dermis; therefore, exposures related to dermal contact are typically not evaluated as a part of the ERA. However, the need for an assessment of dermal exposures will be determined based on site-specific factors. The uncertainties associated with the limited evaluation of this potential exposure pathway will be discussed in the uncertainties section. Exposures related to inhalation are not evaluated as a part of the ERA, because this pathway is generally considered an insignificant route of exposure except in unusual circumstances, such as following a spill or release.

Potential food chain exposures for reptiles and amphibians exist at NAS Cecil Field, but are not evaluated due to a lack of available ingestion toxicity data relating food chain exposures to adverse responses for these receptors. Direct contact exposures for amphibians are evaluated on a site-specific basis. The uncertainties associated with the limited evaluation of these potential exposure pathways will be discussed in the uncertainty section.

Terrestrial Plants and Invertebrates. Terrestrial plants and soil invertebrates may be exposed to contamination in surface soil by direct contact, root uptake, and ingestion of the soil. Terrestrial plants may also be exposed to contamina-

tion in groundwater where the roots reach a zone of saturation. Because of difficulties estimating contaminant exposures for terrestrial plants from groundwater, the groundwater exposure pathway is generally not selected for evaluation.

Aquatic Receptors. Exposure pathways evaluated for aquatic receptors at NAS Cecil Field (including invertebrates, plants, amphibians, and fish) include direct contact with surface water, sediment, and groundwater (as it discharges to the surface water). Aquatic life may also be exposed to contamination in sediment as a result of ingestion of the sediment. This pathway is not chosen for evaluation because information on the amount of sediment ingested by aquatic organisms and associated toxicity is generally not available.

3.2.3 **Identification of Endpoints** Based on USEPA guidance (USEPA 1989a, 1992a, 1997), an important step in the problem formulation process is the identification of assessment and measurement endpoints, which must be completed before exposure, toxicity, or risk can be estimated. Endpoints are used in the ERA to define the ecological attributes to be protected or assessed (assessment endpoints) and to define measurable characteristics of those attributes that can be used to gauge the degree of impact that may occur (measurement endpoints). Assessment endpoints most often relate to attributes of biological populations or communities (e.g., abundance, productivity); individual-based assessment endpoints typically are relevant only if endangered species are present.

In general, assessment endpoints should have social relevance (i.e., be valued by society) and biological relevance (i.e., be measurable or predictable, and be susceptible to the hazard or stress being evaluated). When selecting assessment endpoints for an ERA, one must consider (1) the types of receptors likely to be found at the site (based on the available habitat) and (2) the chemical sensitivities of these receptors as they may be associated with past disposal practices at the site. Using this information, the assessment endpoint will be chosen to gauge the likelihood that population- or community-level effects may occur to those receptors most likely to experience adverse effects from exposure to site-related chemicals. For example, if pesticides have been detected in soil at a site where raptors are likely to forage, then an appropriate assessment endpoint would be reproductive effects (i.e., eggshell thinning) to raptors.

Measurement endpoints should be related to or predictive of the assessment endpoint, readily measurable, and appropriate to the exposure pathways, size, and temporal dynamics of the site. In many cases the assessment endpoint cannot be readily measured or observed; therefore, measurement endpoints are often used as surrogates for assessment endpoints. For example, it is difficult and time-consuming to measure changes to a population of receptors and even more difficult to attribute these changes to contaminant sources. It is possible to measure the effects that chemicals in site media may have on individual test organisms (i.e., in toxicity tests). When these data are available, the measured effects in toxicity tests will be used as a gauge of the assessment endpoint to extrapolate potential risks to populations of receptors. In the absence of site-specific toxicological data for site media, the measurement endpoints used to gauge the likelihood of population-level effects are toxicological benchmarks from the literature based on laboratory-measured effects.

Dose-response data for survival, growth, and reproductive effects to wildlife are generally available in the literature (i.e., they are easily measured in

laboratory tests) and have social and biological relevance when evaluating effects to populations of ecological receptors; therefore, these data are often used as measurement endpoints. In addition to data measuring these effects, dose-response data for abundance, biomass, emergence, hatchability, immobility, and population growth may be used as measurement endpoints in aquatic systems because they can be measured relatively easily in laboratory studies.

The endpoints selected for the ERAs are identified and listed at the beginning of the ERA process. Examples of endpoints used in ERAs for NAS Cecil Field are provided in Table 3-1.

Terrestrial and Wetland Wildlife. The assessment endpoint most often evaluated for terrestrial and semiaquatic wildlife is the survival and abundance of wildlife populations and communities within the habitats present at the NAS Cecil Field OUs. Because no long-term wildlife population data are available at NAS Cecil Field, a direct measurement of this assessment endpoint is not possible.

The literature-derived results of laboratory toxicity studies that relate the dose of a contaminant in an oral exposure with an adverse response to growth, reproduction, or survival of a test population (avian or mammalian species) are used as a measure of the assessment endpoint.

Terrestrial Plants and Invertebrates. The assessment endpoint most often evaluated for terrestrial plants and soil invertebrates is the survival, growth, and reproduction of terrestrial invertebrates and plant communities. This assessment endpoint is measured through toxicity testing of earthworms (*Eisenia foetida*) and lettuce seeds (*Lactuca sativa*) with surface soil samples from the hazardous waste sites. These laboratory toxicity tests provide a direct measure of the toxicity of the mixture of chemicals in soil to a terrestrial invertebrate and plant species. It is assumed that the responses of these test species are adequate indicators for other terrestrial invertebrates and plants occurring at NAS Cecil Field. In cases where toxicity testing of the surface soil was not completed, literature values on contaminant concentrations in surface soil that are associated with survival, growth, and reproduction of terrestrial invertebrates and plants are used as the measurement endpoint.

Aquatic Receptors. Where information on the benthic macroinvertebrate community is available, the assessment endpoint for aquatic receptors is the survival and maintenance of a well-balanced benthic macroinvertebrate community structure and function. This endpoint is measured based on the results of semiquantitative benthic macroinvertebrate sampling and toxicity testing of the sediment. Survival and abundance of fish, invertebrate, amphibian, and aquatic plant populations is a second assessment endpoint for aquatic life. The survival and maintenance of these is estimated based on literature-reported concentrations of a contaminant in water or sediment in a laboratory or field toxicity test that is associated with adverse effects on reproduction, growth, or survival of a test population. Toxicity testing of groundwater, surface water, or sediment may also be used as a measurement endpoint to evaluate the survival and maintenance of aquatic receptor populations at NAS Cecil Field.

3.3 ANALYSIS

In the analysis phase, ecological chemicals of potential concern (ECPCs) are selected in the hazard assessment, and potential ecological exposures and associated effects are characterized.

Table 3-1
Possible Endpoints for Ecological Assessment

Basewide Ecological Assessment Report
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Medium	Possible ECPCs	Receptor	Assessment Endpoint	Measurement Endpoint
Surface Water	Site-specific	Aquatic life (invertebrates, fish, plants, and amphibians).	Site-specific	Direct measurement of macroinvertebrate community structure and function. Effect concentrations in surface water ($\mu g/\ell$) associated with adverse effects to growth, reproduction, or survival of aquatic organisms. Direct measurement of growth or survival in surface water or groundwater toxicity tests
Sediment	Site-specific	Aquatic life (invertebrates, fish, plants, and amphibians).	Site-specific	Field sampling and measurement of macroinvertebrate community structure and function. Direct measurement of growth or survival in sediment toxicity tests. Effect concentrations in sediment (μg/kg or mg/kg) associated with adverse effects to growth, reproduction, or survival of aquatic organisms.
Surface Water, Sediment, and Surface Soil	Site-specific	Terrestrial and semiaquatic wildlife.	Site-specific	Oral contaminant exposure concentrations representing the dose of a chemical (mg/kg BW-day) associated with adverse effects to growth, reproduction, or survival of mammalian or avian laboratory test populations.
Surface Soil	Site-specific	Terrestrial invertebrates.	Site-specific	Growth and/or survival of earthworms exposed to surface soil samples in laboratory toxicity tests, or effect concentrations (mg/kg) from the literature related to adverse responses in test organisms.
Surface Soil	Site-specific	Terrestrial plants.	Site-specific	Germination of lettuce seeds exposed to surface soil samples in laboratory toxicity tests, or effect concentrations (mg/kg) from the literature related to adverse responses in test organisms.

See notes at end of table.

Table 3-1 (Continued)
Possible Endpoints for Ecological Assessment

Basewide Ecological Assessment Report
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Medium	Possible ECPCs	Receptor	Assessment Endpoint	Measurement Endpoint
Groundwater	Site-specific	Aquatic organisms (fish, invertebrates, plants, and amphibians).	Site-specific	Chemical concentrations in surface water ($\mu g/\ell$) associated with adverse effects to growth, reproduction, and survival of aquatic organisms.
		Wetland plants.		Chemical concentrations in solution ($\mu g/\ell$) associated with adverse effects on growth, reproduction, or survival of plants.

Notes: ECPCs = ecological chemicals of potential concern (associated with disposal practices at site).
$\mu g/\ell$ = micrograms per liter.
$\mu g/kg$ = micrograms per kilogram.
mg/kg = milligrams per kilogram.
mg/kg BW/day = milligram per kilogram of body weight per day.

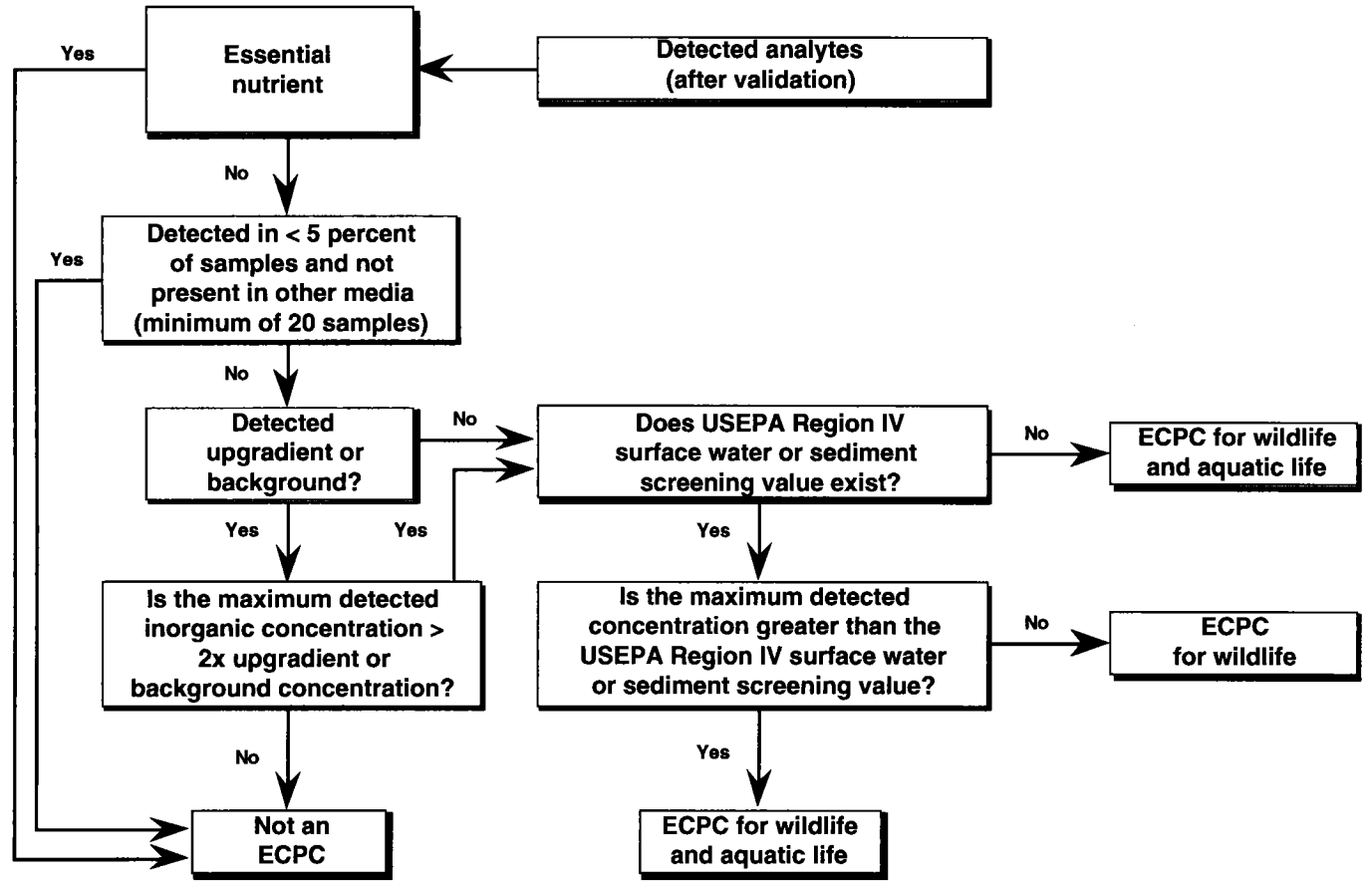
3.3.1 Selection of Ecological Chemicals of Potential Concern ECPCs represent the analytes detected in media (surface soil, surface water, sediment, or groundwater) that are considered in the ERA. The ECPCs are assumed to be associated with waste disposal practices at the sites and could present a risk for ecological receptors. The process for selection of ECPCs is depicted on Figure 3-1. Surface water and sediment ECPCs are selected separately for wildlife and aquatic receptors because available ECPC screening tools distinguish between these two groups of receptors.

Pursuant to USEPA (1989a; 1989b) national guidance, analytical data for each site at NAS Cecil Field are evaluated to determine their validity for use in the risk assessment. Analytes are not selected as ECPCs if the site concentrations are within 5 to 10 times the concentrations in associated trip blanks or method blanks. In addition, analytes in surface soil, surface water, sediment, and groundwater are not selected as ECPCs if the analyte was detected in 5 percent or fewer of the samples analyzed and were not selected as ECPCs in any other media. In accordance with USEPA Region IV guidance (USEPA, 1991b), if the maximum detected concentration of an inorganic analyte is less than two times the average inorganic concentration detected in upgradient (surface water, sediment, or groundwater) or background samples (surface soil), then the analyte is not selected as an ECPC.

ECPCs in surface soil may also be selected based on a comparison of detected concentrations with background concentrations in soil from Beyer (1990), the Dutch Soil Cleanup Criteria. Analytes detected in surface soil are not selected as ECPCs if the site concentration is below the value cited in Beyer (1990), as recommended by USEPA Region IV.

ECPCs for aquatic receptors for groundwater, surface water, and sediment are selected based on an additional step, in accordance with USEPA Region IV guidance (USEPA, 1991b; 1992b; 1995a). Analytes detected in the sediment are selected as ECPCs for aquatic life if the maximum detected concentration exceeds the sediment quality screening value, or is two times higher than the concentration in the upgradient reference station (inorganics only). The sediment quality screening value is based on the lowest value of either the Contract Laboratory Program (CLP) practical quantitation limit, the threshold effects level (TEL) from the Florida Sediment Quality Assessment guidelines (MacDonald, 1994), or the effects range-low (ER-L) sediment values (Long, 1993). Analytes in surface water and groundwater are retained as ECPCs for aquatic receptors if the maximum detected concentration exceeds the USEPA Region IV screening concentration (USEPA, 1992d) or exceeds the two times average concentration in the upgradient reference station (inorganics only). An analyte is also retained as an ECPC if a screening value is not available.

Calcium, magnesium, potassium, and sodium are excluded as ECPCs for all media because they are considered to be essential nutrients and are only toxic at extremely elevated concentrations. Evidence suggests that there is little potential for toxic effects to wildlife resulting from overexposure to these essential nutrients. The highly controlled physiological regulatory mechanisms of these inorganics suggest that there is little, if any, potential for bioaccumulation, and available toxicity data demonstrate that high dietary intake of these nutrients is well tolerated by wildlife (National Academy of Sciences, 1977; National Research Council [NRC], 1982). In addition, high concentrations



NOTES:
USEPA = U.S. Environmental Protection Agency
ECPC = ecological chemical of potential concern
> = greater than
< = less than
x = times

FIGURE 3-1
ECOLOGICAL CHEMICAL OF POTENTIAL CONCERN SELECTION PROCESS

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of calcium and magnesium (and manganese to some extent) are known to be associated with the detoxification of other metals in aquatic systems (USEPA, 1976).

All ECPCs selected for the ERA are summarized in tables that include the following:

- the frequency of detection,
- range of contract-required quantitation limits (CRQLs) and contract-required detection limits (CRDLs),
- range of detected concentrations,
- average detected concentration,
- average of all concentrations (only for analytes selected as ECPCs from 10 or more samples),
- 95th percentile upper confidence limit (UCL) (only for analytes selected as ECPCs from 10 or more samples),
- USEPA Region IV screening criteria (surface water and sediment only), and
- twice the average background or upgradient concentration for each of the inorganic analytes.

3.3.2 **Exposure Assessment** Exposure assessment is the process of estimating or measuring the amount of an ECPC in environmental media (surface soil, surface water, sediment, food items, or groundwater) to which an ecological receptor may be exposed via respective exposure routes. The following paragraphs discuss how contaminant exposures are, in general, estimated or measured for aquatic receptors, wildlife, terrestrial plants, and terrestrial soil invertebrates.

3.3.2.1 **Aquatic Receptors** Exposure concentrations for aquatic receptors are the amounts of the ECPCs measured in analytical samples of surface water, sediment, or groundwater at the respective sampling locations. Sediment samples collected for toxicity testing represent exposure of laboratory-grown test organisms to the actual mixture of contaminants in the system, thus presenting a means for measurement of bioavailability and adverse responses to sediment contamination.

3.3.2.2 **Terrestrial and Wetland Wildlife** Routes of contamination for wildlife for which exposure concentrations are measured or estimated are decided on a site-specific basis. Exposure routes usually include direct or indirect ingestion of soil, surface water, or sediment, and ingestion of contaminated food. Concentrations of the ECPCs measured in site media are used to estimate contaminant exposures for wildlife receptors. Typically, maximum and average concentrations are used to approximate worst-case and average contaminant exposures.

The actual amount of an ECPC taken in by a wildlife species as a result of indirect or direct ingestion of water, soil, or sediment is dependant on a number of factors. To consider these factors, certain species are selected as

representative wildlife species for evaluation in a food chain model. The representative wildlife species include mammalian and avian species representing the range of trophic levels and body sizes present at the site considering the available habitat. Table 3-2 summarizes how chemical exposure concentrations are determined for ECPCs in surface soil, sediment, and surface water for the representative wildlife species evaluated in the food-web model. A total potential dietary exposure (PDE) is estimated for each representative wildlife species for each ECPC in all media according to the equations in Table 3-2. The PDE is calculated based on the estimated concentrations of the ECPCs in food items that the species would consume; the amount of soil, surface water, or sediment that it would ingest; the relative amount of different food items in its diet; body weight; and food and water ingestion rate. If measurements of concentrations of contaminants in prey items have been collected, these values are used directly in food chain models in place of the estimated values.

Prey items for wildlife species in the food-web exposure models include invertebrates, plants, small mammals, and small birds. Concentrations of ECPCs in prey item tissue are estimated using bioaccumulation factors (BAFs). BAFs in invertebrates and plants are defined as the ratio of the ECPC concentration in plant or invertebrate tissue to the ECPC concentration in surface soil. The BAFs reported for avian and mammalian receptors are defined as the reported ratios of ECPC concentrations in the tissues of these receptors to the concentrations of ECPCs in their food items. BAFs are either back-calculated based on site-specific measurements or extrapolated from literature values or regression equations in the scientific literature. If literature values are not available, then BAFs may be estimated using best professional judgement.

Concentrations of ECPCs in aquatic prey items are estimated using bioconcentration factors (BCFs) for surface water and BAFs for sediment. BAFs and BCFs are defined as the ratio of the ECPC concentration in aquatic tissue to the ECPC concentration in the environmental media.

Based on the lack of scientific data for volatile organic compound (VOC) bioaccumulation and evidence provided in several reference materials (Suter, 1993; Maughan, 1993), an assumption is made that VOCs do not bioaccumulate in prey tissue.

The general approach used to select BAFs and BCFs for small mammals and birds, invertebrates, plants, and aquatic prey is presented in Table 3-3.

The site foraging frequency (SFF) allows for consideration of the frequency of feeding in the site area by estimating the acreage of the site relative to the receptor's feeding range and by considering the fraction of the year the receptor would be exposed to site-related chemicals. By definition, the SFF cannot exceed one.

For each representative wildlife species, the estimated percentage of soil in the overall diet is multiplied by the concentration of each ECPC in the soil and the food ingestion rate (kilogram [kg] per day) to determine the soil exposure concentration. Incidental soil ingestion associated with foraging activities is based on a study by Beyer *et al.* (1991), the USEPA *Wildlife Exposure Factors Handbook* (USEPA, 1993a), or is conservatively assumed to represent 5 percent of the total dietary intake.

Table 3-2
Model for Estimation of Chemical Exposures for Representative Wildlife Species

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Estimation of Contaminant Exposures Related to Surface Soil

Description:	Estimates the amount (dose) of a contaminant ingested and accumulated by a species via incidental ingestion of contaminated surface soil and ingestion of contaminated food items.
Soil Contaminant Concentration:	Maximum: The maximum detected concentration of the ecological chemicals of potential concern (ECPCs) when the number of samples is $\leq$ 9, and the lesser of the maximum detected concentration or the 95th percent upper confidence limit (UCL) when the number of samples is $\geq$ 10. Average: Average of all concentrations. If the average is greater than the maximum exposure point concentration (EPC), the maximum exposure point concentration was selected.
Concentration of a Contaminant in a Food Item (T_N):	$$\underset{\left(\frac{mg\ chem}{kg\ food}\right)}{Food\ Contaminant\ Concentration} = BAF\ X \underset{\left(\frac{mgchem}{kg\ food}\right)}{Soil\ Contaminant\ or\ Prey\ Item\ Concentration}$$ where BAF = bioaccumulation factor or mg/kg fresh weight tissue over mg/kg dry weight soil for invertebrates and plants, and mg/kg fresh weight tissue over mg/kg fresh weight food for small mammals and small birds.
Potential Dietary Exposure (PDE):	$$PDE = \frac{[P_1\ x\ T_1 + P_2\ x\ T_2 + \ldots + P_N\ x\ T_N + soil\ exposure]\ x\ IR_{Diet}\ x\ SFF\ x\ ED}{BW}$$ where PDE = potential dietary exposure (mg chem/kg BW-day), P_N = percent of diet composed of food item N, T_N = tissue concentration in food item N (mg chem/kg food), IR_{Diet} = food ingestion rate of receptor (kg food/day), BW = body weight (kgBW) of receptor, SFF = site foraging frequency (site area [acres] divided by home range [acres]), and ED = exposure duration (fraction of year species is expected to occur on site).
Soil Exposure:	$$\underset{(mg/kg)}{Soil\ Exposure} = (\%\ of\ Diet\ as\ Soil)\ X \underset{(mg/kg)}{Soil\ Contaminant\ Concentration}$$

See notes at end of table.

Table 3-2 (Continued)
Model for Estimation of Chemical Exposures for Representative Wildlife Species

Basewide Ecological Assessment Report
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Estimation of Contaminant Exposures Related to Surface Water and Sediment

Description: Estimates the amount of a contaminant ingested and accumulated by a species resulting from ingestion of surface water, incidental ingestion of sediment, and ingestion of contaminated aquatic food items.

Contaminant Concentration: Same as described above for soil.

Contaminant Concentration in Aquatic Prey Tissue (mg/kg):

$$\text{Aquatic Prey Contaminant Concentration } \left(\frac{\text{mg food}}{\text{kg food}}\right) = [BAF \times \text{Sediment Contaminant Concentration } \left(\frac{\text{mg chem}}{\text{kg food}}\right)] + [BCF \times \text{Surface Water Contaminant Concentration } \left(\frac{\text{mg chem}}{\ell \text{ water}}\right)]$$

where

BCF = bioconcentration factor (mg/kg of contaminant in food item per mg/ℓ of contaminant in water). Only BCFs greater than 300 were considered (USEPA, 1989a).

BAF = bioaccumulation factor (see note above).

Sediment Exposure:

$$\text{Sediment Contaminant Exposure } \left(\frac{\text{mg chem}}{\text{day}}\right) = \text{\% of Diet as Sediment} \times IR_{diet} \left(\frac{\text{kg food}}{\text{day}}\right) \times \text{Sediment Contaminant Concentration } \left(\frac{\text{mg chem}}{\text{kg food}}\right)$$

Surface Water Exposure:

$$\text{Surface Water Contaminant Exposure } \left(\frac{\text{mg chem}}{\text{day}}\right) = \text{Surface Water Contaminant Concentration } \left(\frac{\text{mg chem}}{\ell \text{ water}}\right) \times \text{Water Ingestion Rate } \left(\frac{\ell \text{ water}}{\text{day}}\right)$$

Aquatic Prey Exposure:

$$\text{Aquatic Prey Exposure } \left(\frac{\text{mg chem}}{\text{day}}\right) = \text{\% Diet as Aquatic Prey} \times IR_{diet} \left(\frac{\text{kg food}}{\text{day}}\right) \times \text{Aquatic Prey Contaminant Concentration } \left(\frac{\text{mg chem}}{\text{kg food}}\right)$$

where

IR_{diet} = food ingestion rate of receptor (kg of food/day).

Total Exposure Related to Surface Water and Sediment:

$$\text{Potential Dietary Exposure } \left(\frac{\text{mg chem}}{\text{kg BW-day}}\right) = \frac{\text{Aquatic Prey Exposure } \left(\frac{\text{mg chem}}{\text{day}}\right) + \text{Surface Water Exposure } \left(\frac{\text{mg chem}}{\text{day}}\right) + \text{Sediment Exposure } \left(\frac{\text{mg chem}}{\text{day}}\right)}{\text{kg BW}}$$

where BW = body weight (kg) of receptor.

See notes on following page.

Table 3-2 (Continued)
Model for Estimation of Chemical Exposures for Representative Wildlife Species

Basewide Ecological Assessment Report
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Notes: ≤ = less than or equal to.
≥ = greater than or equal to.
mg/kg = milligrams per kilogram.
mg/kg/BW-day = milligrams per kilogram body weight per day.
kg = kilogram.
% = percent.
mg/ℓ = milligrams per liter.
kg/day = kilograms per day.
ℓ/day = liters per day.
chem = chemical.
BW = body weight.

Table 3-3
Estimation of Bioaccumulation Factors

Basewide Ecological Assessment Report
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Prey Group	Nature of Approach	General Approach
Terrestrial Prey		
Plants		
Unit: mg/kg wet tissue per mg/kg dry soil	Literature values	When available, literature values were used to estimate plant BAFs. Evidence from the literature (Levine *et al.*, 1989) suggests that lead does not bioaccumulate in plant tissue; therefore, a BAF of zero is assigned (i.e., a zero does not imply that literature information is lacking).
	SAR	When literature values are not available, plant BAFs for semivolatile organic compounds (SVOCs) are calculated using a regression equation based on the uptake of organic chemicals into plant tissue from Travis and Arms (1988).[1]
	Extrapolation and empirical data	When literature values are not available, plant BAFs for inorganic compounds were obtained from Baes *et al.* (1984).[2]
	Assumption	Although evidence suggests that plants may transport organic analytes with log K_{ow}s < 5 (i.e., volatile organic compounds [VOCs]) from the roots into leafy portions (Briggs *et al.*, 1982; Briggs *et al.*, 1983), bioaccumulation data for VOCs is generally lacking in the scientific literature. In addition, evidence in the literature (Suter, 1993; Maughan, 1993) suggests that analytes with log K_{ow}s < 3.5 are not bioaccumulated into animal tissue. Therefore, it is assumed that transfer of VOCs from plant tissue to animal tissue does not occur.
Terrestrial Invertebrates		
Unit: mg/kg wet tissue per mg/kg dry soil	Site-specific data	Invertebrate BAFs for inorganics are calculated based on tissue concentrations of worms exposed to site soil.
	Literature values	When no site-specific values were available, literature values are used to estimate BAFs for invertebrates.
	Assumption	Earthworm data are used to represent all invertebrates.
	Empirical data and assumption	A single BAF for polynuclear aromatic hydrocarbons (PAHs) is calculated using data presented in Beyer (1990); dry weight is converted to wet weight assuming earthworms are 80 percent water.
	Assumption	Bioaccumulation data for VOCs are generally lacking in the scientific literature. In addition, evidence in the literature (Suter, 1993; Maughan, 1993) suggests that analytes with log K_{ow}s < 3.5 are not bioaccumulated into animal tissue. Therefore, it is assumed that soil invertebrates do not bioaccumulate VOCs.

See notes at end of table.

Table 3-3 (Continued)
Estimation of Bioaccumulation Factors

Basewide Ecological Assessment Report
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Prey Group	Nature of Approach	General Approach
Small Mammals		
Unit: mg/kg wet tissue per mg/kg wet food	Literature values	When available, literature values are used to estimate BAFs for small mammals.
	SAR	When literature values are not available for SVOCs, BAFs for small mammals are estimated using a regression equation based on the uptake of organic chemicals into beef tissue from Travis and Arms (1988) [3].
	Extrapolation and empirical data	When literature values are not available, BAFs for small mammals for inorganics are derived from ingestion-to-beef biotransfer factors (BTFs) presented in Baes *et al.* (1984) [4].
	Assumption	Bioaccumulation data for VOCs are generally lacking in the scientific literature. In addition, evidence in the literature (Suter, 1993; Maughan, 1993) suggests that analytes with log K_{ow}s < 3.5 are not bioaccumulated into animal tissue. Therefore, it is assumed that small mammals do not bioaccumulate VOCs.
Small Birds		
Unit: mg/kg wet tissue per mg/kg wet food	Literature values	When available, literature values are used to estimate BAFs for small birds.
	No information	BAFs are not obtained for SVOCs or for inorganic compounds because there is little bioaccumulation data available for birds. It is assumed that small birds do not accumulate VOCs.
Aquatic Prey		
Surface Water Unit: mg/kg tissue per mg/ℓ water	Empirical data	BCFs are obtained from AWQC documents or from the AQUIRE database. For data obtained from AQUIRE, species mean BCFs are calculated, and then averaged to derive a BCF for all aquatic organisms.
	Conservative assumption	Analytes with BCFs <300 are not considered in the surface water ingestion model.

See notes at end of table.

Table 3-3 (Continued)
Estimation of Bioaccumulation Factors

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Prey Group	Nature of Approach	General Approach
Aquatic Prey (Continued)		
Sediment Unit: mg/kg wet tissue per mg/kg wet sediment	Literature values	When available, literature values are used to estimate BAFs for macroinvertebrates.
	Assumption	Bioaccumulation data for VOCs are generally lacking in the scientific literature. Therefore, it is assumed that small mammals do not bioaccumulate VOCs. Little to no literature values exist for sediment to biota accumulation; only bioaccumulation of PCBs, the DDT_R family, and mercury are considered in the sediment ingestion model.

[1] Plant BAFs calculated using the following Travis and Arms (1988) regression: log BAF = 1.588 - 0.578 log K_{ow}.
[2] BAFs derived from Baes *et al.* (1984). Values are based on analysis of literature references, correlations with other chemical and physical parameters, or comparisons of observed and predicted elemental concentrations in vegetative and reproductive plant material and soil. Data are based on dry weight and were converted to a fresh weight basis assuming that plants are 80 percent water. This is generally consistent with the water content of berries (82 to 87 percent water) and leafy vegetables (87 to 95 percent water) presented in Suter (1993). Grains contain a much lower percentage of water (approximately 10 percent); therefore, this assumption likely underestimates exposure to graminivores.
[3] Small mammal BAFs calculated using the following Travis and Arms (1988) regression:
log BTF = log K_{ow} - 7.6 where BTF = biotransfer factor (mg/kg tissue divided by mg chemical ingested per day).
[4] BTFs were converted to a BAF (mg/kg tissue divided by mg/kg food) by multiplying by a food ingestion rate of 12 kilogram (dry weight) per day (average intake for lactating and nonlactating cattle's reported in Travis and Arms, 1988).

Notes: mg/kg = milligrams per kilogram.
BAF = bioaccumulation factor.
SAR = Structural Activity Relationship.
K_{ow} = octanol-water partition coefficient.
< = less than.
mg/ℓ = milligrams per liter.
BCF = bioconcentration factor.
AWQC = ambient water quality criteria.
AQUIRE = Aquatic Information Retrieval.
PCB = polychlorinated biphenyl.
DDT_R = 4,4'-dichlorodiphenyltrichloroethane and its daughter products.

3.3.3 **Ecological Effects Assessment** The ecological effects assessment describes the potential adverse effects to ecological receptors associated with the identified ECPCs and reflects the type of assessment endpoints selected. The general methods used for identifying and characterizing ecological effects for ECPCs in surface soil, surface water, sediment, and groundwater are described in the paragraphs below.

3.3.3.1 **Surface Soil** The measures of adverse ecological effects for terrestrial wildlife, terrestrial plants, and soil invertebrates are discussed separately.

Wildlife. Potential adverse ecological effects for wildlife are estimated for each ECPC based on available literature information. Reference toxicity values (RTVs) are determined for each ECPC for avian and mammalian receptors. The RTV relates the dose of a respective ECPC in an oral exposure with an adverse effect.

A lethal and sublethal RTV are identified for each ECPC and representative wildlife species selected. A lethal RTV represents the threshold for lethal effects and is based on an oral LD_{50} (oral dose lethal to 50 percent of a test population). The lethal RTV is one-fifth of the lowest reported LD_{50} for the most closely related test species. One-fifth of an oral LD_{50} value is considered to be protective of lethal effects for 99.9 percent of individuals in a test population (USEPA, 1986). An assumption is made that the value represented by one-fifth of an oral LD_{50} would be protective of 99.9 percent of the individuals within the terrestrial wildlife populations and represents a level of acceptable risk. A sublethal RTV is also identified that represents a threshold dose for sublethal effects. Sublethal effects are defined as those that impair or prevent reproduction or growth.

The RTVs are assumed to be a measure of the assessment endpoints for protection of the survival, growth, and reproduction of terrestrial wildlife populations. RTVs are derived separately for avian and mammalian species. If neither lethal nor sublethal toxicity information is available for an ECPC, it is not possible to identify RTVs, and risks associated with the predicted exposure for the respective ECPC are not quantitatively evaluated.

Plants and Invertebrates. The toxicity of ECPCs in surface soil to terrestrial plants and invertebrates may be measured by use of soil laboratory toxicity tests, or evaluated based on literature information. Soil toxicity testing is available for some sites and includes a 14-day survival toxicity test with earthworm tissue (*Eisenia foetida*) and a seed germination toxicity test with lettuce seed (*Lactuca sativa*) (Green *et al.*, 1989). Bioaccumulation of contaminants in earthworm tissue was determined for some sites by measuring the concentrations of contaminants in worm tissue following completion of the soil toxicity testing.

If site-specific toxicity data for earthworms or plants are not available, benchmarks from the literature were used to evaluate risk to plants and invertebrates. Terrestrial plant benchmarks were derived to be protective of the survival and reproductive fitness of plant species potentially occurring at NAS Cecil Field. In general, terrestrial phytotoxicity data are very limited. Phytotoxicity values for analytes in soil and solution were obtained from three primary sources: Hulzebos *et al.* (1993), Eno and Everett (1958), and Will and Suter (1995). Hulzebos *et al.* (1993) conducted soil and nutrient solution toxicity studies on lettuce (*Lactuca sativa*) for 76 organic priority pollutants.

Eno and Everett (1958) conducted soil toxicity studies on black valentine beans grown in soil containing 4,4'-dichlorodiphenyltrichloroethane (DDT). Will and Suter (1995) from the Oak Ridge National Laboratory (ORNL) developed plant toxicity screening values (benchmarks) for use in ERAs for toluene, 2,4-dinitrophenol, di-*n*-butylphthalate, polychlorinated biphenyls (PCBs), and metals. Using no observed effects concentrations and lowest observed effects concentrations obtained from the literature and experiments, the ORNL derived phytotoxicity benchmarks by the same methodology used by the National Oceanic and Atmospheric Administration (NOAA) for deriving the ER-L (Long and Morgan, 1990) sediment screening values.

Soil invertebrate benchmarks were derived to be protective of the survival and reproductive fitness of invertebrate species potentially occurring at NAS Cecil Field. For VOCs and semivolatile organic compounds (SVOCs), LC_{50} data for earthworm studies conducted in soil were obtained from Neuhauser *et al.* (1985 and 1986) for the following chemical classes: phenols, amines, aromatic VOCs, halogenated aliphatic VOCs, polynuclear aromatic hydrocarbons (PAHs), and phthalates. A single representative RTV was generated for each of the class of compounds. For pesticides and inorganics, reproductive effects were generally chosen as RTVs (when available) because these effects are generally more sensitive toxicity endpoints. When reproductive data were not available, appropriate mortality endpoints (e.g., one-fifth of the LC_{50} value) were chosen as RTVs. The resultant chemical concentration (selected as the RTV) is expected to be protective of 99.9 percent of the exposed population from lethal effects (USEPA, 1986). Pesticide, PCB, and inorganic analyte benchmarks were derived from a variety of primary sources of literature.

In the absence of toxicity testing, literature information is consulted to evaluate the toxicity of ECPCs in soil to invertebrates and plants. Concentrations of ECPCs in soil reported to be toxic to invertebrates and plants are compared with site concentrations to evaluate risks.

3.3.3.2 **Surface Water and Sediment** To evaluate food chain exposures to semi-aquatic wildlife exposed to surface water and sediment, lethal and sublethal RTVs are identified for each ECPC and each representative wildlife species as previously described.

Potential adverse effects on growth or survival for aquatic receptors are evaluated by the use of toxicity testing. When toxicity testing is unavailable, adverse effects associated with ECPCs in surface water and sediment are also evaluated by comparing the ECPC concentrations in surface water and sediment samples with available standards and reported toxicity benchmark values (TBVs).

Toxicity benchmarks for ECPCs in surface water include State of Florida Surface Water Quality Standards (Florida Legislature, 1996), Federal Ambient Water Quality Criteria (AWQC) (USEPA, 1991c), and effect concentrations obtained from searches of the USEPA Aquatic Information Retrieval (AQUIRE) database. Sediment toxicity benchmarks selected for comparison to detected sediment concentrations include NOAA ER-L and effects range-median (ER-M) sediment guidelines (Long *et al.*, 1993 and 1995), USEPA sediment quality guidelines (SQG) based on equilibrium partitioning (USEPA, 1988, 1993b, 1993c, 1993d, 1993e, and 1993f), Ontario Ministry of the Environment (OME) Lowest Effects Levels (LEL) (Persaud et al., 1996) and State of Florida SQGs (MacDonald, 1994).

3.3.3.3 **Groundwater** Potential adverse effects associated with ECPCs in groundwater may be measured in laboratory aquatic toxicity tests. The toxicity of groundwater to aquatic receptors has been evaluated through chronic toxicity testing with the water flea (*Ceriodaphnia dubia*) and fathead minnow (*Pimephales promelas*) for Site 3.

Adverse effects to aquatic receptors from exposure to groundwater ECPCs may also be measured using effects concentrations for surface water. Aquatic toxicity information for the ECPCs is obtained from searches of the USEPA AQUIRE database. Additional toxicity benchmarks include the State of Florida Surface Water Quality Standards (Florida Legislature, 1996) and USEPA AWQC (USEPA, 1991c). Groundwater is only evaluated where transport of contamination to a nearby surface water body is reasonably expected to occur; however, this evaluation is very conservative in that it does not consider attenuation in the aquifer or dilution upon discharge to surface water.

3.4 RISK CHARACTERIZATION. The following paragraphs describe how risks are characterized for ecological receptors. Potential adverse ecological effects are characterized separately for terrestrial and wetlands wildlife, terrestrial plants, and soil invertebrates resulting from exposure to ECPCs in surface soil. Risks are also characterized for aquatic receptors exposed to ECPCs in surface water, sediment, and groundwater.

3.4.1 Surface Soil Risks for the representative wildlife species associated with ingestion and bioaccumulation of ECPCs in surface soil and prey items are quantitatively evaluated using hazard quotients (HQs), which are calculated for each ECPC by dividing the estimated PDE concentration by the toxicological benchmark (RTV). Hazard indices (HIs) are determined for each receptor by summing the HQs for all ECPCs. When the estimated PDE is less than the RTV (i.e., the HQ is less than 1), it is assumed that chemical exposures would not be associated with adverse effects to receptors (i.e., inhibited growth, reproduction, and survival of the individual organism) and that no risks to wildlife populations are assumed. When the HQ or HI is greater than 1, an evaluation of the HQs comprising the HI is completed. The number of affected individuals in a population presumably increases with increasing HQ or HI values; therefore, the likelihood of population-level effects occurring is generally expected to increase with higher HQ or HI values.

Risks for terrestrial plants and soil invertebrates are characterized based on the responses of the test population observed in the toxicity testing. If adverse effects are observed in either of the toxicity tests, simple linear regressions are completed to determine if a correlation exists between the concentration of an analyte and the adverse response measured in the bioassay. Risks to terrestrial plants and invertebrates are also evaluated by comparing exposure point concentrations with the effects concentrations (or benchmarks) discussed in Subsection 3.3.3.1. A discussion of the weight-of-evidence is completed to characterize risk to these receptors.

3.4.2 Surface Water and Sediment Risks associated with exposures to ECPCs in surface water and sediment are characterized separately for aquatic receptors and wildlife.

Risks for aquatic receptors are characterized for each sampling location based on a weight-of-evidence evaluation of the following factors:

- presence or absence of analytes in surface water and sediment samples;
- concentrations of analytes measured in surface water and sediment samples;
- responses of test species in the sediment laboratory toxicity tests;
- measurements of the aquatic macroinvertebrate community structure and function;
- comparison of concentrations of ECPCs in filtered and unfiltered surface water to reported toxicity of the ECPC in laboratory tests (AQUIRE information), Federal AWQC (USEPA, 1991c), and State of Florida Surface Water Quality Standards (Florida Legislature, 1996);
- comparison of concentrations of ECPCs in sediment relative to NOAA ER-L and ER-M sediment guidelines (Long *et al.*, 1993 and 1995), USEPA SQGs and criteria based on equilibrium partitioning (USEPA, 1988a, 1993b, 1993c, 1993d, 1993e, and 1993f), Florida sediment screening guidelines (MacDonald, 1994), and OME LEL provincial SQGs (Persaud *et al.*, 1996); and
- physical and chemical factors in the aquatic environment (other than chemical contamination).

If there are negative test results in the toxicity testing, simple linear regressions are completed to determine if a correlation exists between the concentration of an analyte in sediment samples and the adverse response in the toxicity test.

Risks for the representative wildlife species associated with ingestion of surface water, potentially contaminated aquatic life, and sediment are quantitatively evaluated using the approach discussed in Subsection 3.4.1 for wildlife.

3.4.3 **Groundwater** Risks for aquatic life associated with exposures to ECPCs in filtered and unfiltered groundwater as it discharges to surface water are evaluated by comparing concentrations of the ECPCs in groundwater with the toxicity benchmarks for surface water listed in Paragraph 3.3.3.2. When exposure concentrations exceed the effects concentrations, criteria, or standards, the magnitude and likelihood of risks are discussed. If available, toxicity testing results of groundwater samples are used to characterize risks.

3.5 **UNCERTAINTY ANALYSES**. The objective of the uncertainty analysis is to discuss the assumptions of the ERA process that may influence the risk assessment results and conclusions. General uncertainties inherent in the risk assessment process are included in Table 3-4. In general, the ERA is biased to overestimate risks to receptors, thereby more likely identifying a need to manage risk than failing to identify a risk.

Table 3-4
Potential Sources of Uncertainty in Ecological Risk Assessment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Potential Source	Direction of Effect	Justification
Uncertainties Associated with ECPC Selection Process		
Degradation of chemicals not considered	Overestimate	Risk estimates are based on recent chemical concentrations. Concentrations will tend to decrease over time from degradation and the formation of daughter products.
No evaluation of TIC data	Underestimate	Risk was not calculated for potential exposure to these compounds.
Screening of sediment ECPCs	Underestimate	Several of the USEPA Region IV sediment screening values are based on laboratory CRQLs, not sediment toxicity data. Because some ECPCs may have been screened out of the risk assessment because their concentrations are less than the sediment screening value, this may result in an underestimate of risk.
Uncertainties Associated with Exposure Assessment		
Food chain assumed to occur at site	Unknown	Occurrence of the food chain used in the models at the sites is unknown.
Food chain model exposure parameter assumptions	Unknown	Some exposure parameters are from the literature and some are estimated. Efforts were made to select exposure parameters representative of a variety of species or feeding guilds, so that exposure estimates would be representative of more than a single species.
Uncertain occurrence of receptors at sites	Unknown	Actual occurrence at the sites by receptors considered in the food chain models is uncertain.
Assumption that receptor species will spend equal time at all habitats within home range	Unknown	Organisms will spend varying amounts of time in different habitats, thus affecting their overall exposures.
Extrapolation from test species to representative wildlife species	Unknown	Species differ with respect to absorption, metabolism, distribution, and excretion of chemicals. The magnitude and direction of the difference will vary with each chemical.
Consumption of contaminated prey	Unknown	Toxicity to prey receptors may result in sickness or mortality. Fewer prey items would be available for predators. Predators may stop foraging in areas with reduced prey populations, or may discriminate against or conversely select contaminated prey.
Limited evaluation of dermal or inhalation exposure pathways	Underestimate	The dermal and inhalation exposure pathways are generally considered insignificant due to protective fur, feathers, chitinous exoskeleton, and the low concentration of chemicals under natural atmospheric conditions. However, under certain conditions, these exposure pathways may occur.
Maximum exposure scenarios	Overestimate	It is unlikely any receptor would be exposed concurrently to maximum concentrations of all ECPCs.

See notes at end of table.

Table 3-4 (Continued)
Potential Sources of Uncertainty in Ecological Risk Assessment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Potential Source	Direction of Effect	Justification
Uncertainties Associated with Exposure Assessment (Continued)		
Missing BAF or RTV values	Underestimate	BAFs and RTVs were not available in the literature for many compounds and receptor classes (i.e., small birds); therefore, these gaps result in an underestimate of the total risk represented by the summary HI.
BAF estimation	Unknown	As many literature values were not available for some species and analytes, alternate BAFs were derived using other assumptions or regressions. There is additional uncertainty related to the averaging of log K_{ow} values for certain classes of semivolatile organic compounds prior to calculating BAFs using the Travis and Arms (1988) regression equations, resulting in an overestimate of risk for some compounds and an underestimate of risk for other compounds.
Continuous uptake and bioaccumulation of ECPCs by soil biota	Unknown	Tissue and organ responses to ECPC uptake were represented by a linear function, which is an oversimplification of a more complex system (i.e., trophic states and lipid concentrations may affect bioaccumulation).
Bioaccumulation of ECPCs in leafy portions of plants	Overestimate	Ryan and others (1988) state that compounds with log K_{ow} values >5 are unavailable to plants due to soil sorption. Compounds with log K_{ow} values >5 will be taken into the roots of plants, but are not easily transported into the leafy parts of plants (Briggs and others, 1982; 1983). The surface soil and ingestion exposure model overestimates ECPC exposure via plant ingestion to those receptors that only eat the leafy portions of plants.
Use of unfiltered surface water samples	Overestimate	Measurement of ECPC concentrations in unfiltered samples includes both dissolved and particulate fractions. The dissolved fraction is considered to be the biologically available component.
Relative uptake of inorganics by different plant species	Unknown	Estimated plant BAFs for certain inorganics were based on BAF data for leafy produce grown in sewage sludge. Variability in type of plant and substrate may make the chosen BAF values an overestimate or underestimate of actual uptake.
Uncertainties Associated with Effects		
Lack of ingestion toxicity information for reptile and amphibian species	Unknown	Information is not available on the toxicity of chemicals to reptilian or amphibian species resulting from dietary or oral exposures. Assuming the toxicities of analytes to mammals and birds are similar for reptiles and amphibians (and that the dietary exposures for reptiles and amphibians are the same as for the tertiary consumers evaluated), an assumption can be made that dietary exposures to reptiles and amphibians would result in similar risk levels that were predicted for predatory mammals and birds. However, actual risks to reptiles and amphibians are unknown.

See notes at end of table.

Table 3-4 (Continued)
Potential Sources of Uncertainty in Ecological Risk Assessment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Potential Source	Direction of Effect	Justification
Uncertainties Associated with Effects (Continued)		
Use of measurement endpoints	Overestimate	Although an attempt was made to have measurement endpoints reflect assessment endpoints, limited available ecotoxicological literature resulted in the selection of certain measurement endpoints that may overestimate assessment endpoints.
Lack of toxicity information for mammals or birds	Underestimate	Reference toxicity values for certain compounds and receptor groups were not available, thereby causing underestimation of the risk predicted by the summary HI.
Uncertainties Associated with Risk Characterization		
Risk evaluated for individual terrestrial receptors only	Overestimate	Effects on individual terrestrial organisms may occur with little population or community-level effects. However, as the number of affected individuals increases, the likelihood of population-level effects increases.
Effect of decreased prey item populations on predatory receptors	Unknown	Adverse population effects to prey items may reduce the foraging population for predatory receptors, but may not necessarily adversely impact the population of predatory species.
Multiple conservative assumptions	Overestimate	Cumulative impact of multiple conservative assumptions yields high risk to ecological receptors, and may result in risk at background concentrations or the prediction of risks when there is no potential for adverse effects.
Summation of effects (HIs)	Unknown	The assumption that effects are additive ignores potential synergistic or antagonistic effects. It assumes similarity in mechanism of action, which is not the case for many substances. Compounds may induce toxic effects in different organs or systems.

Notes: ECPC = ecological chemical of potential concern.
TIC = tentatively identified compound.
USEPA = U.S. Environmental Protection Agency.
CRQL = contract-required quantitation limit.
BAF = bioaccumulation factor.
RTV = reference toxicity value.
HI = hazard index.
K_{ow} = octanol-water partition coefficient.
> = greater than.

CHAPTER 4.0

4.0 SUMMARY OF ECOLOGICAL CHEMICALS OF CONCERN

Ecological chemicals of concern (ECCs) are the analytes associated with an ecological risk. The individual risk assessments for each OU identify the ECPCs for each of the media, based on the methodology described in Section 3.2. ECCs are then determined based on the results of the risk characterization, as described in Section 3.5. The ECCs identified for each of the OUs for surface soil, groundwater, surface water, and sediment are summarized in the following subsections. Additional information on the selection of ECPCs may be found in each of the site-specific baseline risk assessment (BRA) reports (ABB-ES, 1994a; ABB-ES, 1995a; ABB-ES, 1995b).

There are six PSCs identified at NAS Cecil Field. The contaminants detected in surface soil, surface water, sediment, and groundwater are summarized in the subsections below. All of the analytes detected in these media are discussed below because ECPCs have not been selected for the PSCs. Sampling locations for the various media are presented on Plate 4 in Appendix C.

4.1 SURFACE SOIL. Surface soil exposure pathways are identified for three groups of ecological receptors (terrestrial wildlife, terrestrial plants, and soil invertebrates). The exposure pathway includes a source of contamination (surface soil) and an exposure route. For wildlife, exposure routes evaluated include ingestion of soil, sediment, and food items that are contaminated as a result of accumulation of constituents from site media. Terrestrial plants and soil invertebrates may be exposed to contamination in surface soil by direct contact with and ingestion of the soil.

Table 4-1 summarizes the ECCs selected in surface soil for each OU and PSC. Discussions of the findings for each OU and PSC are provided below.

4.1.1 OU 1, Site 1 Surface soil samples collected and analyzed to evaluate potential risk to ecological receptors at Site 1 include CEF-1-SS1 through CEF-1-SS16 (Plate 4).

Thirty-one of the 35 analytes detected in surface soil exceeded background screening values and were selected as ECPCs for Site 1. Potential adverse effects to wildlife as a result of exposure to the ECPCs in surface soil at Site 1 were not identified via the food-web model. Further, the results of the toxicity testing in the earthworm (*Eisenia [E.] foetida*) and lettuce seeds (*Lactuca [L.] sativa*), measuring adverse effects on growth, reproduction, and survival, indicate that the contamination present in surface soil at Site 1 does not represent an unacceptable risk for terrestrial plants or soil invertebrates. Based on these data, no surface soil ECCs were identified for Site 1.

4.1.2 OU 1, Site 2 Plate 4 shows the locations of surface soil samples collected at Site 2. Surface soil samples collected and analyzed to evaluate potential risks to ecological receptors at Site 2 include CEF-2-SS1 through CEF-2-SS6, and CEF-2-SS10.

Twenty analytes were selected as ECPCs for surface soil at Site 2. Potential adverse effects to wildlife as a result of exposure to the ECPCs in surface soil at Site 2 were not identified through the food-web model. Toxicity tests in Site

Table 4-1
Summary of Ecological Contaminants of Concern for Surface Soil

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Chemical of Potential Concern	OU 1		OU 2		OU 3		OU 4	OU 5	
	Site 1	Site 2	Site 5	Site 17	Site 7	Site 8	Site 10	Site 14	Site 15
Aroclor-1260			X						
TRPH			X						
PAHs									X
Aluminum									X
Arsenic									X
Antimony									X
Lead									X

See notes at end of table.

Table 4-1 (Continued)
Summary of Ecological Contaminants of Concern for Surface Soil

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical of Potential Concern	OU 6[1]	OU 7	OU 8	PSCs					
	Site 11	Site 16	Site 3	4	6	9	12	18	19
Aroclor-1260									
TRPH									
PAHs									
Aluminum									
Arsenic									
Antimony									
Lead									

Sampling Locations:
OU 1, Site 1: CEF-1-SS1 through CEF-1SS16.
OU 1, Site 2: CEF-2-SS1 through CEF-2-SS8, and CEF-2-SS10.
OU 2, Site 5: CF5SS1 through CF5SS31.
OU 2, Site 17: CF17SS1 through CF17SS14.
OU 3, Site 7: CF7SS1 through CF7SS52.
OU 3, Site 8: CF8SS1 through CF8SS22, and CF8SS24 through CF8SS35.
OU 4, Site 10: CF10SS1 through CF10SS6.
OU 5, Site 14: CF14SS1 through CF14SS7.
OU 5, Site 15: CF15SS1 through CF15SS43, and CF15SS45 through CF15SS73.
OU 6, Site 11: CF11SS1 through CF11SS31.
OU 7, Site 16: Not applicable.
OU 8, Site 3: Disposal area - CF3-SS1 through CF3-SS10, and CF3-SS14 through CF3-SS23.
Helicopter crash site: CF3-SS11 through CF3-SS13, and CF3-SS24.
PSC 4: CF4SS1 through CF4SS5.
PSC 6: CF6SS1 through CF6SS10.
PSC 9: CF9SS1 through CF9SS6.
PSC 12: CF12SS1 through CF12SS8.
PSC 18: CF18SS1 through CF18SS5.
PSC 19: CF19SS1 through CF19SS5.

Notes: OU = operable unit.
X = denotes ecological contaminant of concern (i.e., analyte associated with ecological risk).
TRPH = total recoverable petroleum hydrocarbons.
PAH = polynuclear aromatic hydrocarbons.
PSC = potential source of contamination.

2 surface soil revealed no adverse effects to *E. foetida* or *L. sativa* growth, reproduction, and survival. Therefore, no surface soil ECCs were identified for Site 2.

4.1.3 OU 2, Site 5 Plate 4 depicts the locations of Site 5 surface soil samples. Surface soil samples collected and evaluated for potential risk to ecological receptors at Site 5 include CEF-2-SS1 through CEF 2-SS31.

ECPCs selected for Site 5 surface soil include 5 VOCs, 21 SVOCs (primarily PAHs, and phthalates), 6 pesticides, and Aroclor-1260. Eleven of the 19 detected inorganic analytes were retained as ECPCs. In addition, total recoverable petroleum hydrocarbon (TRPH) was measured in all 31 surface soil samples from Site 5 at concentrations ranging from 12 milligrams per kilogram (mg/kg) (CF5-SS-7) to 28,000 mg/kg (CF5-SS-4). Food-web model analysis identified no potential risks for wildlife exposed to Site 5 surface soil. However, further analyses of data suggest that elevated concentrations of TRPH and Aroclor-1260 at station CF5-SS-4 have the potential to impact the plant and invertebrate communities at Site 5. These two analytes are identified as ECCs for Site 5 surface soil (Table 4-1).

4.1.4 OU 2, Site 17 Plate 4 depicts the locations of Site 17 surface soil samples. Surface soil samples collected to evaluate potential risks to ecological receptors at Site 17 include CF17SS1 through CF17SS14.

All nine organic analytes detected in Site 17 surface soil were retained as ECPCs, including four VOCs, four SVOCs, and 4,4'-dichlorodiphenyldichloroethene (DDE). Three of the 11 inorganic analytes detected in Site 17 surface soil were retained as ECPCs. In addition, TRPH was detected in nine of the 14 surface soil samples from Site 17 at concentrations ranging from less than 10 mg/kg (the detection limit) to 210 mg/kg (CF17-SS-8).

Food-web model analysis suggests that no adverse effects to growth, reproduction, or survival are likely for terrestrial wildlife resulting from exposures to the ECPCs in surface soil at Site 17. Analyses of earthworm and lettuce seed toxicity test results did not reveal adverse effects related to Site 17 surface soil. A slight inhibition of lettuce seed germination at sampling stations CF17SS8 and CF17SS9 was not associated with concentrations of ECPCs in surface soil (as determined by regression analyses). It is possible that this effect is due to a nonmeasured physical, biological, or chemical factor (i.e., ECPC exposure is likely not responsible for the observed effect). No ECCs were identified for Site 17 surface soil.

4.1.5 OU 3, Site 7 Plate 4 shows the locations of surface soil samples collected at Site 7. Surface soil samples collected and analyzed to evaluate potential risks to ecological receptors at Site 7 include CF7SS1 through CF7SS52.

All of the organic analytes detected were selected as ECPCs for surface soil at Site 7, including one VOC, 26 SVOCs, 4 pesticides, and Aroclor-1260. Fourteen of the 21 inorganic analytes detected were retained as ECPCs. In addition, TRPH was retained as an ECPC.

Food-web model analysis identified potential sublethal effects for the cotton mouse, based on maximum and average exposure point concentrations of lead. Lead concentrations in surface soil may also adversely affect plants. However, the

risks predicted for small mammals and plants may be overestimated because they are due to an elevated detection of lead at sample location CF7SS12. Six confirmatory samples were collected in the vicinity of CF7SS12, and were analyzed for lead. The lead concentrations detected in confirmatory samples were three to four orders of magnitude below the lead concentration detected at CF7SS12. Therefore, it was concluded that plants and small mammals are not likely at risk from exposure to lead in Site 7 surface soil. Invertebrates exposed to surface soil at Site 7 are not likely to be at risk. No ECCs were identified for Site 7 surface soil.

4.1.6 OU 3, Site 8 Plate 4 shows the locations of surface soil samples collected at Site 8. Surface soil samples collected and analyzed to evaluate potential risks to ecological receptors at Site 8 include CF8SS1 through CF8SS22 and CF8SS24 through CF8SS35.

Samples CF8SS1 through CF8SS22 were analyzed for full target compound list (TCL) and target analyte list (TAL) and TRPH analyses, while samples CF8SS24 through CF8SS35 were analyzed for only TRPH. Three VOCs, six SVOCs, 4,4'- dichlorodiphenyldichloroethane (DDD), 4,4'-DDT, Aroclor-1260, and TRPH were selected as ECPCs for surface soil at Site 8. Seven of the 18 inorganic analytes detected were also retained as ECPCs.

Food-web model analysis suggests that no adverse effects to growth, reproduction, or survival are likely for terrestrial wildlife resulting from exposures to the ECPCs in surface soil at Site 8. Analyses of earthworm and lettuce seed toxicity test results did not reveal an association between adverse effects and concentrations of chemicals detected in Site 8 surface soil. There was a slight inhibition of lettuce seed germination and reduced earthworm growth for a few sample locations; however, these results were not associated with concentrations of ECPCs in surface soil (as determined by regression analyses). It is possible that these effects are due to a nonmeasured physical, biological, or chemical factor (i.e., ECPC exposure may not be responsible for the observed effect). No ECCs were identified for Site 8 surface soil.

4.1.7 OU 4, Site 10 Plate 4 shows the locations of surface soil samples collected at Site 10. Surface soil samples collected and analyzed to evaluate potential risks to ecological receptors at Site 10 include CF10SS1 through CF10SS6.

Samples CF10SS1 through CF10SS6 were analyzed for full TCL and TAL and TRPH analyses. One VOC, one SVOC, eight inorganics, and TRPH were selected as ECPCs for surface soil at Site 10. Risks to wildlife, plants, and invertebrates are unlikely; therefore, no ECCs were identified for Site 10 surface soil.

4.1.8 OU 5, Site 14 Plate 4 and Figure 4-7 show the locations of surface soil samples collected at Site 14. Surface soil samples collected and analyzed to evaluate potential risks to ecological receptors at Site 14 include CF14SS1 through CF14SS7.

All of the organic analytes detected were selected as ECPCs for surface soil at Site 14, including three phthalate esters, endosulfan II, and TRPH. Five of the 11 inorganic analytes detected were also retained as ECPCs.

Food-web model analysis suggests that no adverse effects to growth, reproduction, or survival are likely for terrestrial wildlife resulting from exposures to the ECPCs in surface soil at Site 14. Potential risks for plants and invertebrates were identified, as a result of detected concentrations of aluminum and copper. However, these risks are likely overestimated due to overly conservative benchmarks. No ECCs were identified for Site 14 surface soil.

4.1.9 OU 5, Site 15 Plate 4 shows the locations of surface soil samples collected at Site 15. Surface soil samples collected and analyzed to evaluate potential risks to ecological receptors at Site 15 include CF15SS1 through CF15SS43 and CF15SS45 through CF15SS73.

Nearly all of the organic analytes detected in surface soil were selected as ECPCs for Site 15, including all detected SVOCs and explosives, 4,4'-DDD, 4,4'-DDT, dieldrin, endosulfan II, and TRPH. Six analytes were detected in surface soil, but were not selected as ECPCs based on low frequency of detection. Fourteen of the 21 inorganic analytes detected in surface soil were also retained as ECPCs.

Food-web model analysis suggests that lethal and sublethal risks to small mammals and small birds may occur from exposure to lead and arsenic in Site 15 surface soil. Correlation analyses of earthworm and lettuce seed toxicity test results with site concentrations identified aluminum, lead, and PAHs, as primary risk contributors. Lead and PAHs, and possibly arsenic and antimony, were also identified as possible risk contributors based on invertebrate and plant benchmark comparisons. The ECCs identified for Site 15 surface soil are PAHs, aluminum, arsenic, antimony, and lead.

4.1.10 OU 6, Site 11 Plate 4 shows the locations of surface soil samples collected at Site 11. Surface soil samples collected and analyzed to evaluate potential risks to ecological receptors at Site 11 include CF11SS1 through CF11SS31.

All twenty-four organic analytes detected in Site 11 surface soil were retained as ECPCs, including three VOCs, eight SVOCs, and thirteen pesticides and PCBs. Thirteen of the eighteen inorganic analytes detected in Site 11 surface soil were retained as ECPCs.

Food-web analysis suggests that no adverse effects to growth, reproduction, or survival are likely for terrestrial wildlife resulting from exposures to the ECPCs in surface soil at Site 11. Risks to terrestrial invertebrates at Site 11 are negligible, based on a comparison of invertebrate toxicity benchmarks and ECPCs detected in soil. Phytotoxicity benchmarks were exceeded by aluminum, chromium, and vanadium concentrations, which suggests there is a potential risk to plants. However, it is unlikely that plants are adversely affected from exposure to these analytes as a result of past site activities, and stressed vegetation was not observed at the site. No ECCs were identified for Site 11 surface soil.

4.1.11 OU 7, Site 16 Surface soil was not evaluated as an exposure pathway for Site 16 because the small grassy area adjacent to the site is located in an industrial setting, surrounded by paved roads and parking lots. Terrestrial receptors are not expected to reside at the site.

4.1.12 OU 8, Site 3 Two surface soil data sets were evaluated in the OU 8 ERA (Plate 4). The first data set included the 20 samples (CF3-SS-1 through CF3-SS-10, and CF3-SS-14 through CF3-SS-23) collected from the grassy OU 8 disposal area. The second data set included four surface soil samples (CF3-SS-11 through CF3-SS-13 and CF3-SS-24) collected from the forested area in the vicinity of the helicopter crash site.

Four VOCs, 13 SVOCs, 5 pesticides, Aroclor-1254, and 9 of the inorganic analytes were retained as ECPCs to evaluate risks to ecological receptors from exposure to surface soil in the OU 8 disposal area. Three VOCs, 5 pesticides, and 1 of the 12 inorganic analytes detected in the four surface soil samples from the helicopter crash area were retained as ECPCs for evaluation in the OU 8 BRA (ABB-ES, 1995b).

The results of the food-web modeling suggest that wildlife receptors are not likely to be at risk from exposure to OU 8 surface soil.

Earthworm survival in toxicity tests was not adversely affected following exposure to OU 8 soil, suggesting that soil invertebrates are not at risk at Site 3. Reliability of results from lettuce seed germination is questionable based on the high variability between sample replicates and the relatively low germination observed in the reference soil location. Regression analyses indicate that reduced lettuce seed germination is poorly correlated with concentrations of the selected ECPCs in surface soil. It is likely that factors other than these chemicals are responsible for the reduced lettuce seed germination rates at CF3-SS-17 and CF3-SS-20. This suggests that plants may not be at risk from exposure to surface soil at the site (i.e., no lethal toxicity is associated with exposure to ECPCs in Site 3 surface soil). Therefore, no surface soil ECCs were identified for OU 8, Site 3 (Table 4-1).

4.1.13 PSC 4 Five surface soil samples (CF4SS1 through CF4SS5) were collected at PSC 4. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, metals, and TRPH. The only SVOC detected was bis(2-ethylhexyl)phthalate. Two pesticides, methoxychlor and endrin ketone, were also detected at several sample locations. Thirteen metals including aluminum, antimony, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, vanadium, and zinc were detected in surface soil at PSC 4. The essential nutrients calcium, magnesium, and potassium were also detected. TRPH was detected at all sample locations, with the maximum concentration of 45 mg/kg at CF4SS2. No VOCs were detected in PSC 4 surface soil.

Risks were evaluated for terrestrial receptors using a tiered approach. The first tier of screening involved comparing maximum surface soil concentrations with the Dutch Soil Cleanup numbers (for background) and the USEPA Region III Biological Technical Assistance Group (BTAG) screening values. Those analytes that exceeded this first tier of screening were further evaluated in Tier II by comparing maximum surface soil concentrations with conservative surface soil reference toxicity benchmarks for plants, invertebrates, and wildlife. The results of this second tier of evaluation indicated that site concentrations were less than all toxicity benchmarks, suggesting that ecological receptors are not at risk. Therefore, no ECCs were identified for analytes in PSC 4 surface soil.

4.1.14 PSC 6 Ten surface soil samples (CF6SS1 through CF6SS10) were collected at PSC 6. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs,

metals, and TRPH. Three VOCs (acetone, chloroform, and toluene), ten PAHs and three phthalate esters, eleven pesticides (including aldrin, alpha-chlordane, gamma-chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan sulfate, endrin ketone, heptachlor, heptachlor epoxide, and methoxychlor) seventeen metals (including aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, silver, thallium, vanadium, and zinc), cyanide, and TRPH were detected in surface soil at PSC 6. The essential nutrients calcium, magnesium, and potassium were also detected.

Risks were evaluated for terrestrial receptors using the tiered approach described in Subsection 4.1.13. The results of the second tier of evaluation indicated that all site concentrations were less than invertebrate and wildlife toxicity benchmarks, but that concentrations of chromium, vanadium, and zinc exceeded plant toxicity benchmarks. Given the low level of confidence assigned by the authors of the study (Will and Suter, 1995) to some of the plant toxicity benchmarks, and the low magnitude of exceedances, the evaluation concluded that terrestrial plants are not likely at risk. Therefore, no ECCs were identified for analytes in PSC 6 surface soil.

4.1.15 PSC 9 Six surface soil samples (CF9SS1 through CF9SS6) were collected at PSC 9. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, and metals. The only organic chemicals detected in surface soil were naphthalene and methoxychlor. Thirteen metals including aluminum, antimony, arsenic, barium, chromium, copper, iron, lead, manganese, nickel, thallium, vanadium, and zinc were also detected in surface soil at PSC 9. The essential nutrients calcium, magnesium, and potassium were also detected.

Risks were evaluated for terrestrial receptors using the tiered approach described in Subsection 4.1.13. The results of the second tier of evaluation indicated that all site concentrations were less than invertebrate and wildlife toxicity benchmarks, but that concentrations of aluminum and chromium exceeded plant toxicity benchmarks. Given the low level of confidence assigned by the authors of the study (Will and Suter, 1995) to the plant toxicity benchmarks, the evaluation concluded that terrestrial plants are not likely at risk. Therefore, no ECCs were identified for analytes in PSC 9 surface soil.

4.1.16 PSC 12 Eight surface soil samples (CF12SS1 through CF12SS8) were collected at PSC 12. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, and metals. Eight PAHs (including benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene), nine pesticides (including aldrin, alpha-chlordane, dieldrin, 4,4'-DDE, 4,4'-DDT, endrin, endrin ketone, endrin aldehyde, and methoxychlor) and Aroclor-1260 were detected in surface soil at PSC 12. Fourteen metals (including aluminum, antimony, arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, thallium, vanadium, zinc) and cyanide were detected in PSC 12 surface soil. The essential nutrients calcium, magnesium, and potassium were also detected. No VOCs were detected in surface soil at PSC 12.

Risks were evaluated for terrestrial receptors using the tiered approach described in Subsection 4.1.13. The results of the second tier of evaluation indicated that concentrations of all analytes detected in PSC 12 surface soil were less than toxicity benchmarks for ecological receptors, suggesting that terrestrial plants, invertebrates, and wildlife are not likely at risk. Therefore, no ECCs were identified for analytes in PSC 12 surface soil.

4.1.17 PSC 18 Five surface soil samples (CF18SS1 through CF18SS5) were collected at PSC 18. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, and metals. Acetone, bis(2-ethylhexyl)phthalate, endosulfan II, 4,4'-DDT, and twelve metals (including aluminum, arsenic, barium, beryllium, chromium, copper, iron, lead, manganese, nickel, vanadium, and zinc) were detected is surface soil at PSC 18. The essential nutrients calcium, magnesium, potassium, and sodium were also detected in surface soil.

Risks were evaluated for terrestrial receptors using the tiered approach described in Subsection 4.1.13. The results of the second tier of evaluation indicated that all site concentrations were less than wildlife toxicity benchmarks, but that concentrations of aluminum and vanadium exceeded plant toxicity benchmarks. Given the low level of confidence assigned by the authors of the study (Will and Suter, 1995) to the plant toxicity benchmarks, the evaluation concluded that terrestrial plants are not likely at risk. Therefore, no ECCs were identified for analytes in PSC 18 surface soil.

4.1.18 PSC 19 Five surface soil samples (CF19SS1 through CF19SS5) were collected at PSC 19. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, and metals. No VOCs or SVOCS were detected in surface soil at PSC 19. Eleven pesticides (including aldrin, alpha-chlordane, gamma-chlordane, dieldrin, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin, endrin ketone, heptachlor epoxide, and methoxychlor) were detected in soil (primarily at sample location CF19SS4). Fourteen metals (including aluminum, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, thallium, vanadium, and zinc) were detected in surface soil at PSC 19. The essential nutrients calcium and magnesium were also detected in surface soil.

Risks were evaluated for terrestrial receptors using the tiered approach described in Subsection 4.1.13. The results of the second tier of evaluation indicated that all site concentrations were less than plant and wildlife toxicity benchmarks, but that the maximum concentration of copper slightly exceeded the invertebrate toxicity benchmarks. Given the conservativeness of the invertebrate toxicity benchmark and the low magnitude of exceedances (i.e., less than a factor of two), the evaluation concluded that terrestrial invertebrates are not likely at risk. Therefore, no ECCs were identified for analytes in PSC 19 surface soil.

4.2 GROUNDWATER. Groundwater exposure pathways are identified for three groups of ecological receptors (terrestrial and wetland wildlife, terrestrial plants, and aquatic receptors). The exposure pathway includes a source of contamination, potentially contaminated media (groundwater discharging to the surface), and an exposure route. Potential exposures of terrestrial wildlife to groundwater may occur via ingestion of surface water that has received groundwater discharge. The indirect exposure of wildlife to groundwater was not evaluated because this route is not believed to contribute a high potential contaminant exposure.

Terrestrial plants may also be exposed to contamination in groundwater where roots reach a zone of saturation. This groundwater exposure pathway was not selected for evaluation because of difficulties estimating contaminant exposures for terrestrial plants from groundwater.

Exposure pathways evaluated for aquatic receptors (including invertebrates, plants, amphibians, algae, and fish) include direct contact with groundwater as

it discharges to surface water. This exposure pathway is the focus of groundwater exposure for NAS Cecil Field ecological receptors.

Table 4-2 summarizes the ECCs selected for each site. Discussion of the findings for each site is provided below.

4.2.1 OU 1, Sites 1 and 2 Plate 3-A presents the locations of monitoring wells for Sites 1 and 2. Due to the close proximity of Sites 1 and 2 and the fact that groundwater from both sites discharges to Rowell Creek, groundwater is evaluated for both sites (OU 1) as a single unit. Groundwater sampling stations evaluated for the presence of analytes associated with risk attributable to OU 1, Sites 1 and 2, include CF1MW1S, CF1MW4, CF1MW5S, CF1MW6S, CF1MW8I, CF1MW9S, CF1MW10S, CF1MW12I, CF1MW13S, CF1MW14I, CF1MW15S, CF1MW16I, CF1MW17I, CF1MW18S, CF2MW1S, CF2MW4S, CF2MWS, CF2MW6S, CF2MW7I, CF2MW8I, and CF2MW11S.

Eleven ECPCs were selected for unfiltered groundwater at OU 1 including one VOC, two SVOCs, and eight inorganics. Comparison of ECPCs with aquatic toxicity benchmark values indicates analytes present in the OU 1 groundwater are not likely to pose a risk to aquatic receptors. No ECCs were identified in the groundwater at Sites 1 and 2.

4.2.2 OU 2, Site 5 Data from 30 monitoring wells were used to evaluate groundwater potentially contributing to surface water contamination in the Site 5 drainage ditch and wetland (Table 4-2). Plate 3-A depicts the locations of these monitoring wells. The data set included primarily 1993 data, although analytical chemistry data from five 1991 monitoring well locations (CEF-5-3, CEF-5-4, CEF-5-5, CEF-5-6, and CEF-5-7S) were also evaluated. Wells screened at shallow, intermediate, and deep intervals were all included in the summary of groundwater data; groundwater from any of these three intervals could conceivably discharge to the Site 5 wetland or drainage ditch.

ECPCs identified in unfiltered, undiluted groundwater from Site 5 samples included 6 VOCs, 6 SVOCs, 1 pesticide (alpha-chlordane), and 14 inorganic analytes. Of the organic ECPCs in groundwater, only the concentrations of bis(2-ethylhexyl)phthalate and alpha-chlordane slightly exceeded available screening values and are considered ECCs for Site 5 groundwater (Table 4-2). However, alpha-chlordane was only detected in 1 of 30 groundwater monitoring wells at Site 5. Further, given the uncertainties associated with phthalates as laboratory contaminants and the low frequency of detection for alpha-chlordane, it is unlikely that future groundwater discharges of organic analytes are likely to pose substantial ecological risks from surface water exposure in the Site 5 wetland.

Of the 14 inorganic ECPCs in Site 5 groundwater, predicted average and maximum concentrations of eight analytes detected in unfiltered, undiluted groundwater were in excess of aquatic toxicity benchmarks and are identified as ECCs for Site 5 groundwater. When a dilution factor is applied, two of these ECCs are eliminated (copper and zinc). Concentrations of all eight analytes may be associated with suspended solids in groundwater and, therefore, not bioavailable at these levels. Further, the use of unfiltered, undiluted groundwater to evaluate potential risk to aquatic receptors via surface water exposure is an extremely conservative approach and may not be reflective of actual site conditions.

Table 4-2
Summary of Ecological Contaminants of Concern for Groundwater

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical of Potential Concern	OU 1		OU 2		OU 3		OU 4	OU 5	
	Site 1	Site 2	Site 5	Site [1]17	Site 7	Site 8	Site 10	Site 14	Site 15
VOCs/SVOCs									
1,2-Dichlorobenzene									
1,3-Dichlorobenzene									
1,4-Dichlorobenzene									
bis(2-Ethylhexyl)phthalate			X[2]			X[3,7]	X[3,7]		X[3,7]
Pesticides and PCBs									
Aroclor-1232									
Aroclor-1248									
alpha-Chlordane			X[4]						
4,4'-DDD						X[7]			
4,4'-DDT						X[7]			X[7]
Heptachlor									
Heptachlor epoxide									
Inorganic Analytes									
Aluminum			X[2]			X	X[7]	X	
Beryllium			X[2]						
Chromium			X[2]			X[7]			
Cobalt								X[7]	
Copper			X[2]				X[7]		
Cyanide						X[7]			
Iron			X[2]			X[7]	X[7]	X[8]	X[7]
Lead			X[2]						
Mercury			X[2]						
Silver									X[7]
Zinc			X[2]			X[7]			X[7]

See notes at end of table.

Table 4-2 (Continued)
Summary of Ecological Contaminants of Concern for Groundwater

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical of Potential Concern	OU 6	OU 7	OU 8	PSCs					
	Site 11	Site 16	Site 3	4	6	9[1]	12[1]	18	19
VOCs/SVOCs									
1,2-Dichlorobenzene			X[6]						
1,3-Dichlorobenzene			X[6]						
1,4-Dichlorobenzene			X[6]						
bis(2-Ethylhexyl)phthalate		X[3,5]	X[6]						
Pesticides and PCBs									
Aroclor-1232								X[2]	
Aroclor-1248			X[6]						
alpha-Chlordane									
4,4'-DDD									
4,4'-DDT									
Heptachlor				X[2,4]					
Heptachlor epoxide				X[2,4]					
Inorganic Analytes									
Aluminum		X[2]	X[6]					X[2]	
Beryllium									
Chromium			X[6]						
Cobalt									
Copper			X[6]	X[2,4]					
Cyanide				X[2,4]				X[2]	
Iron		X[5]	X[6]					X[2]	
Lead									
Mercury									
Silver									
Zinc		X[5]							

See notes at end of table.

Table 4-2 (Continued)
Summary of Ecological Contaminants of Concern for Groundwater

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Groundwater was not evaluated at this site or PSC.
[2] Analyte exceeded conservative surface water screening values in undiluted, unfiltered water only. This exposure scenario is believed unlikely for Naval Air Station Cecil Field ecological receptors because contaminants are bound to suspended solids and not likely to be bioavailable to aquatic receptors.
[3] Bis(2-ethylhexyl)phthalate exceeded screening values in undiluted, unfiltered water only. This analyte is a known laboratory contaminant,
and its actual association with the site is uncertain.
[4] This analyte was detected at a low frequency of detection.
[5] Concentrations of bis(2-ethylhexyl)phthalate, iron, and zinc originate in the intermediate aquifer and flow upward to the surficial aquifer; therefore, these analytes are not believed to be associated with contamination at Site 16.
[6] The site-specific dilution factor (as diluted groundwater discharges to Rowell Creek) is an order of magnitude higher than the measured dilution in the toxicity test required to reduce groundwater toxicity to test organisms; therefore, risks for aquatic receptors are not likely when diluted groundwater discharges to Rowell Creek.
[7] Risks identified based on a comparison of undiluted groundwater concentrations with conservative reference toxicity benchmarks, which likely overestimate risks for aquatic receptors.
[8] These analytes detected in groundwater were either not detected in surface water, or were not selected as ECPCs in surface water. This suggests that the exposure pathway from groundwater to aquatic organisms in surface water is incomplete.

Notes: OU = operable unit.
VOC = volatile organic compound.
SVOC = semivolatile organic compound.
X = analyte is associated with an ecological risk.
PCBs = polychlorinated biphenyls.
DDD = dichlorodiphenyldichloroethane.
DDT = dichlorodiphenyltrichloroethane.
PSC = potential source of contamination.

Sampling Stations:
OU 1, Sites 1 and 2: CF1MW1S, CF1MW4, CF1MW5S, CF1MW6S, CF1MW8I, CF1MW9S, CF1MW10S, CF1MW12I, CF1MW13S, CF1MW14I, CF1MW15S, CF1MW16I, CF1MW17I, CF1MW18S, CF2MW1S, CF2MW4S, CF2MW5S, CF2MW6S, CF2MW7I, CF2MW8I, CF2MW11S.
OU 2, Site 5: 1991 data: CEF-5-3, CEF-5-4, CEF-5-5, CEF-5-6, CEF-5-7. 1993 data: CF5MW3S, CF5MW4S, CF5MW5S, CF5MW6S, CF58S, CF59I, CF10S, CF511I, CF512D, CF5MW16S, CF5MW17I, CF5MW18D, CF5MW19S (including CF5MW19S-D), CF5MW20S, CF5MW21I, CF5MW22D, CF5MW23S, CF524S, CF525I, CF526D, CF527S, CF5MW28D (including CF5MW28D-D), CF5MW29S (including CF5MW29SD), and CF5MW30S.
OU 2, Site 17: Not applicable.
OU 3, Site 7: Not applicable.
OU 3, Site 8: CF8MW1 through CF8MW22.
OU 4, Site 10: CEF-10-25 through CEF-10-5S.
OU 5, Site 14: CF14MW1S through CF14MW3S.
OU 5, Site 15: CF15MW1S through CF15MW8S.
OU 6, Site 11: Not applicable.
OU 7, Site 16: 16MW10S, 16MW12I, 16MW17S, 16MW18D, 16MW19S, 16MW21S, 16MW22I, 16MW23D, 16MW24S, 16MW25D, 16MW27I, 16MW28D, 16MW32S, 16MW33D, 16MW38S, 16MW39I, 16MW40D, 16MW5S, 16MW7S, and 16MW9D.
OU 8, Site 3: CF3MW3S, CF3MW4S, CF3MW6S, CF3MW7D, CF3MW7S, CF3MW13S, MF3MW14I, MF3MW15D, MF3MW8S, MF3MW19D, CF3MW28S, CF3MW29D, CF3MW31S, and CF3MW32D.
PSC 4: CF4MW1 through CF4MW9.
PSC 6: CF6MW1 through CF6MW5.
PSC 9: CF9MW and CFRMW2.
PSC 12: CF12MW1 through CF12MW3.
PSC 18: CF18MW1 and CF18MW2.
PSC 19: CF19MW1 through CF19MW7.

4.2.3 OU 2, Site 17 Groundwater was not identified as an exposure pathway for Site 17 ecological receptors; therefore, it was not evaluated.

4.2.4 OU 3, Site 7. Groundwater was not identified as an exposure pathway for Site 7 ecological receptors; therefore, it was not evaluated.

4.2.5 OU 3, Site 8 Data from 22 monitoring wells were used to evaluate groundwater potentially contributing to surface water contamination in the drainage ditch in the southeastern part of Site 8. Plate 3-A depicts the locations of these monitoring wells. The data set included both filtered and unfiltered data from sample locations CF8MW1 through CF8MW22.

ECPCs identified in unfiltered groundwater from Site 8 included 3 VOCs, 2 SVOCs, 2 pesticides, 6 inorganic analytes (aluminum, barium, iron, manganese, selenium, and zinc), and TRPH. ECPCs identified in filtered groundwater (inorganics and cyanide only) included aluminum, barium, chromium, iron, manganese, and vanadium. Cyanide was also detected in the filtered samples.

Risks were evaluated for terrestrial plants and aquatic receptors by comparing exposure point concentrations with reference toxicity benchmarks. A comparison of the plant benchmarks suggests that aluminum may adversely affect terrestrial plants. A comparison of the aquatic toxicity benchmarks with groundwater ECPCs indicated that bis(2-ethylhexyl)phthalate, 4,4'-DDD, 4,4'-DDT, aluminum, chromium, cyanide, iron, and zinc detected in groundwater may present a risk to aquatic receptors at Site 8. However, it is unlikely that aquatic receptors would be exposed to undiluted groundwater; therefore, adverse effects are unlikely for most analytes. Aluminum was identified as a possible ECC in Site 8 groundwater.

4.2.6 OU 4 Site 10 Data from four monitoring wells (CEF-10-2S through CEF-10-5S) were used to evaluate ecological exposures to groundwater. ECPCs identified in filtered groundwater included one VOC (bis(2-ethylhexyl)phthalate), and three inorganic analytes (aluminum, iron, and manganese). ECPCs identified in unfiltered groundwater included six inorganic analytes (aluminum, barium, copper, iron, manganese, and vanadium).

Risks were evaluated for terrestrial plants and aquatic receptors by comparing ECPCs in filtered and unfiltered groundwater with reference toxicity benchmarks. Aluminum detected in unfiltered groundwater exceeded the terrestrial plant benchmarks; however, aluminum detected in filtered groundwater, which represents the bioavailable form, was below the plant benchmark. Undiluted concentrations of bis(2-ethylhexyl)phthalate, aluminum, copper, and iron slightly exceeded conservative reference toxicity benchmarks. Due to the conservative nature of this evaluation, none of the analytes detected in groundwater were determined to pose a risk to aquatic receptors. Therefore, no ECCs were identified for Site 10 groundwater.

4.2.7 OU 5 Site 14 Data from three monitoring wells were used to evaluate ecological exposures to groundwater, potentially contributing to surface water contamination in the drainage ditches, scrub-shrub swamp, and wet meadow at Site 14. The data set included both filtered and unfiltered data from sample locations CF14MW1S through CF14MW3S. Plate 3-B depicts the locations of these monitoring wells.

ECPCs identified in unfiltered groundwater from Site 14 included 1,3,5-trinitrobenzene, and 6 inorganic analytes (aluminum, beryllium, cobalt, iron, manganese, and thallium). ECPCs identified in filtered groundwater (inorganics only) included aluminum, beryllium, cobalt, iron, and manganese.

Risks were evaluated for terrestrial plants and aquatic receptors by comparing ECPCs in undiluted groundwater with reference toxicity benchmarks. The results of this evaluation suggest that concentrations of aluminum in filtered and unfiltered groundwater exceed the phytotoxicity benchmark. For aquatic invertebrates, aluminum, cobalt, and iron were the only analytes that exceeded their toxicity benchmarks. It is unlikely that the concentrations detected in groundwater would affect aquatic receptors because the analytes in groundwater that exceed surface water benchmarks are not detected in surface water (except aluminum). This would suggest that an incomplete exposure pathway exists between groundwater and aquatic organisms. Aluminum was identified as a possible ECC in Site 14 groundwater.

4.2.8 OU 5 Site 15 Data from eight monitoring wells were used to evaluate ecological exposure to groundwater, potentially contributing to surface water contamination in the ditches and bottomland swamps at Site 15. The data set included both filtered and unfiltered data, from sample locations CF15MW1S through CF15MW8S. Plate 3-B depicts the locations of these monitoring wells.

ECPCs identified in unfiltered groundwater from Site 15 included bis(2-ethylhexyl)phthalate, 3-nitrotoluene, cyclotrimethylenetrinitramine (RDX), 4,4'-DDD and 4,4'-DDT, iron, manganese, thallium, and zinc). ECPCs identified in filtered groundwater (inorganics only) included cobalt, iron, silver, thallium, and zinc.

Risks were evaluated for aquatic receptors by comparing ECPCs in undiluted groundwater with surface water reference toxicity benchmarks. The results of this evaluation indicated that concentrations of bis(2-ethylhexyl)phthalate, 4,4'-DDT, iron, and zinc in unfiltered groundwater exceed toxicity benchmarks. Iron, silver, and zinc were the only analytes detected in filtered groundwater that exceeded their respective toxicity benchmarks. However, the ERA concluded that due to the conservative nature of the evaluation (i.e., a comparison of undiluted groundwater concentrations with conservative reference toxicity benchmarks for surface water), risks to aquatic receptors are unlikely. Therefore, no ECCs were identified for Site 15 groundwater.

4.2.9 OU 6 Site 11 Groundwater was not identified as an exposure pathway for Site 11 ecological receptors; therefore; it was not evaluated.

4.2.10 OU 7, Site 16 Data from 21 monitoring wells (Plate 3-A) located within the identified plume (CEF-16-10S, CEF-16-12I, CEF-16-17S, CEF-16-18D, CEF-16-19S, CEF-16-20D, CEF-16-21S, CEF-16-22I, CEF-16-23D, CEF-16-24S, CEF-16-25D, CEF-16-27I, CEF-16-28D, CEF-16-32S, CEF-16-33D, CEF-16-38S, CEF-16-39I, CEF-16-40D, CEF-16-5S, CEF-16-7S, and CEF-16-9D) at OU 7 were used to evaluate groundwater potentially contributing to surface water contamination in the Site 16 drainage ditches and the adjacent wetlands. Reference analyte concentrations for groundwater were gathered from a cluster of four monitoring wells (CEF-16-13S, CEF-16-14D, CEF-16-15S, and CEF-16-16D) upgradient of Site 16. Wells screened in the shallow, intermediate, and deep intervals of the surficial aquifer were included in the summary of groundwater data, because groundwater from any of these three intervals could conceivably discharge to the Site 16 drainage ditches or wetlands.

Risks were evaluated for two potential pathways of future migration of Site 16 groundwater contamination to surface water. These two pathways include future discharge of groundwater contaminants to Sal Taylor Creek and to the nearby emergent wetlands. Exposure concentrations of groundwater ECPCs discharging to Sal Taylor Creek were predicted based on a dilution factor, while no dilution was applied to concentrations of groundwater ECPCs discharging to the wetlands. Fourteen ECPCs were identified in Site 16 groundwater samples. Five VOCs, one SVOC, and eight inorganics were selected as ECPCs.

Comparison of organic ECPCs to aquatic toxicity benchmarks suggested that these analytes are not likely to adversely affect aquatic receptors at Site 16. Of the eight inorganic ECPCs in Site 16 groundwater, predicted maximum concentrations of aluminum, iron, and zinc in the wetlands exceeded surface water toxicity benchmarks. However, concentrations of iron and zinc appear to originate in the intermediate aquifer and flow upward to the surficial aquifer; therefore, these detections are not believed to be associated with contamination from Site 16. In addition, aluminum as measured in unfiltered groundwater, does not represent the fraction of the metal that is dissolved and biologically available and toxic to aquatic organisms.

4.2.11 OU 8, Site 3 Data collected in 1994 from 14 monitoring wells were used to evaluate groundwater conditions potentially contributing to surface water contamination in Rowell Creek adjacent to OU 8. All wells screened at shallow, intermediate, and deep intervals from the upper aquifer were included in the summary of groundwater data; groundwater from any of these intervals could conceivably discharge to Rowell Creek. Sample locations include CF3-MW-3S, CF3-MW-4S, CF3-MW-6S, CF3-MW-7D, CF3-MW-7S, CF3-MW-13S, MF3-MW-14I, MF3-MW-15D, MF3-MW-18S, MF3-MW-19D, CF3-MW-28S, CF3-MW-29D, CF3-MW-31S, and CF3-MW-32D (Plate 3-A).

Twenty-five ECPCs were identified in OU 8 unfiltered undiluted groundwater. ECPCs included seven VOCs, nine SVOCs, Aroclor-1248, and eight inorganic analytes.

The maximum and average undiluted and unfiltered concentrations of 1,2-, 1,3-, and 1,4-dichlorobenzene (1,4-DCB); bis(2-ethylhexyl)phthalate; Aroclor-1248; aluminum; chromium; copper; and iron all exceed their respective aquatic toxicity benchmarks. These analytes were identified as groundwater ECCs for OU 8 (Table 4-2). Results of toxicity testing of samples from two monitoring wells (CF3-MW-17S and CF3-MW-28S) of the test species, the fathead minnow (*P. promelas)* and the water flea (*C. dubia*), showed reduced growth and mortality in the fathead minnow, and reduced survival and reproduction in the water flea. Up to a 20-fold dilution in the toxicity test was required to reduce OU 8 groundwater toxicity. Seven analytes (1,1-dichloroethane, DCB, aluminum, chromium, copper, iron, and lead) detected in groundwater exceeded aquatic toxicity benchmarks and may have contributed to the adverse effects observed to *C. dubia* and *P. promelas* in the toxicity tests. The range of reproductive, growth, and mortality effects concentrations for daphnids and fathead minnows from the USEPA AQUIRE database suggest that the three DCB isomers (1,2-, 1,3-, and 1,4-DCB) are likely to be primary groundwater risk contributors in the toxicity tests, although additive and synergistic effects from other toxicants are also possible. However, a 20-fold dilution reduced OU 8 groundwater toxicity in these tests. The anticipated site-specific dilution factor (133-fold) is an order of magnitude greater than the measured 20-fold laboratory dilution. Aquatic organisms are not likely to be at

risk from acute or chronic exposures to DCB in OU 8 groundwater when the diluted groundwater discharges to Rowell Creek.

4.2.12 PSC 4 Nine groundwater samples (CF4MW1 through CF4MW9) were collected at PSC 4. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, metals, and TRPH. One VOC (4-methyl-2-pentanone), and three SVOCs (4-methylphenol, naphthalene, and bis(2-ethylhexyl)phthalate) were detected in groundwater at PSC 4 at a low frequency (i.e. at only one or two sample locations). Heptachlor and heptachlor epoxide were the only pesticides detected in groundwater at PSC 4. Thirteen metals (including aluminum, antimony, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, vanadium, and zinc) and cyanide were also detected in groundwater at PSC 4, as well as the essential nutrients calcium, magnesium, potassium, and sodium. TRPH was analyzed for, and not detected in, groundwater at PSC 4.

Risks were evaluated for aquatic receptors using a tiered approach. The first tier of screening involved comparing maximum undiluted groundwater concentrations with Region III BTAG screening values for aquatic life. Those analytes that exceeded this first tier of screening were further evaluated in Tier II by comparing maximum undiluted groundwater concentrations with conservative surface water reference toxicity benchmarks. The results of this second tier of evaluation indicated that concentrations of heptachlor, heptachlor epoxide, copper, and cyanide in unfiltered groundwater exceeded toxicity benchmarks. However, the PRE concluded that these analytes are unlikely to cause risk to aquatic receptors given the low frequency of detection, and given the conservative nature of the evaluation (i.e., a comparison of undiluted maximum concentrations in groundwater with conservative surface water reference toxicity benchmarks). Therefore, no ECCs were identified for analytes in PSC 4 groundwater.

4.2.13 PSC 6 Five groundwater samples (CF6MW1 through CF6MW5) were collected to evaluate PSC 6. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, metals, and TRPH. No VOCs, pesticides, PCBs, or TRPH were detected in PSC 6 groundwater. The only SVOC detected in groundwater, bis(2-ethylhexyl)phthalate, was detected at sample location CF6MW5. Eleven metals (aluminum, barium, chromium, cobalt, copper, iron, manganese, mercury, nickel, vanadium, and zinc) were detected in groundwater at PSC 6. The essential nutrients calcium, magnesium, potassium, and sodium were also detected in groundwater at PSC 6.

Risks were evaluated for aquatic receptors using a tiered approach. The first tier of screening (which involved comparing undiluted detected concentrations with Region III BTAG screening values) suggested that ecological receptors were not at risk from exposure to PSC 6 groundwater; therefore, no second tier of evaluation was completed, and no analytes were identified as ECCs in PSC 6 groundwater.

4.2.14 PSC 9 Two groundwater samples (CF9MW1 and CF9MW2) were collected at PSC 9. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, metals, and TRPH. No SVOCs, pesticides, PCBs, or TRPH were detected in PSC 9 groundwater. One VOC (4-methyl-2-pentanone) was detected in groundwater. Seven metals (aluminum, barium, iron, manganese, mercury, vanadium, and zinc), and the essential nutrients calcium, magnesium, and sodium, were detected in groundwater at PSC 9.

Groundwater was not identified as an exposure pathway for PSC 9 ecological receptors; therefore, it was not evaluated.

4.2.15 PSC 12 Three groundwater samples (CF12MW1 through CF12MW3) were collected at PSC 12. The samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, metals and TRPH. Thirteen metals (aluminum, barium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, and zinc) and cyanide were detected in groundwater at PSC 12. The essential nutrients calcium, magnesium, potassium, and sodium were also detected. No VOCs, SVOCs, pesticides, PCBs, or TRPH were detected in groundwater at PSC 12.

Groundwater was not identified as an exposure pathway for PSC 12 ecological receptors; therefore, it was not evaluated.

4.2.16 PSC 18 Two groundwater samples (CF18MW1 and CF18MW2) were collected to evaluate PSC 18. The samples were analyzed for CLP VOCs, SVOCs, explosives, pesticides and PCBs, and metals. No VOCs, SVOCs, or explosives were detected in groundwater at PSC 12. One PCB (Aroclor-1260) was detected at sample location CF18MW1. Fifteen metals (aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, vanadium, and zinc), and the essential nutrients calcium, magnesium, potassium, and sodium, were also detected in PSC 18 groundwater.

Risks were evaluated for aquatic receptors using the tiered approach described in Subsection 4.2.12. The results of the second tier of evaluation indicated that concentrations of Aroclor-1232, aluminum, iron, and lead in unfiltered groundwater exceeded toxicity benchmarks for aquatic life. However, the PRE concluded that these analytes are unlikely to cause risk to aquatic receptors given the conservative nature of the evaluation (i.e., a comparison of undiluted maximum concentrations in groundwater with conservative surface water reference toxicity benchmarks). Therefore, no ECCs were identified for analytes in PSC 18 groundwater.

4.2.17 PSC 19 Seven groundwater samples (CF19MW1 through CF19MW7) were collected at PSC 19. The samples were analyzed for CLP VOCs, SVOCs, and metals. One VOC (methylene chloride) was detected at sample location CF19MW3. Bis(2-ethylhexyl)-phthalate was the only SVOC detected in groundwater. It was detected in sample CF19MW4, at an estimated concentration of 1 micrograms per kilogram (μg/kg). Eight metals (aluminum, barium, copper, iron, manganese, mercury, vanadium, and zinc), and the essential nutrients calcium, magnesium, potassium, and sodium, were also detected in PSC 19 groundwater.

Risks were evaluated for aquatic receptors using the tiered approach described in Subsection 4.2.12. The first tier of screening suggested that ecological receptors were not at risk from exposure to PSC 19 groundwater; therefore, no second tier of evaluation was completed, and no analytes were identified as ECCs in PSC 19 groundwater.

4.3 SURFACE WATER AND SEDIMENT. Surface water and sediment exposure pathways are identified for two groups of ecological receptors (terrestrial and wetland wildlife and aquatic receptors). The exposure pathway includes a source of contamination, potentially contaminated media (surface water and sediment), and an exposure route.

The exposure routes evaluated for terrestrial and wetland wildlife include ingestion of surface water and incidental ingestion of sediment. Potential

contaminant exposures for reptiles and amphibians exist, but are not evaluated due to lack of availability of data relating contaminant exposures to adverse responses for reptiles and amphibians.

Exposure routes evaluated for aquatic receptors include direct contact with surface water and sediment. Aquatic life may also be exposed to contamination in sediment as the result of ingestion of the sediment. This pathway was not chosen for evaluation because information on the amount of sediment ingested by aquatic organisms and associated toxicity is generally not available.

Table 4-3 summarizes the ECCs selected for each OU and PSC. Discussion of the findings for each of the OUs is provided below.

4.3.1 OU 1, Site 1 Plate 2 depicts the locations of OU 1 surface water and sediment samples. The following surface water and sediment sampling stations were evaluated for the presence of analytes associated with risk attributable to OU 1, Site 1: RC-SW/SD-6 through RC-SW/SD-8, RC-SW/SD-8A, RC-SW/SD-9, and RC-SW/SD-10.

Three analytes (acetone, aluminum, and barium) exceeded background values and were identified as surface water ECPCs for both aquatic receptors and terrestrial wildlife. Four analytes (acetone, aluminum, barium, and chromium) were selected as ECPCs for terrestrial wildlife only. Two analytes (acetone and methylene chloride) were selected as sediment ECPCs for both aquatic life and terrestrial wildlife. Three analytes (barium, cadmium, and nickel) were selected as ECPCs only for terrestrial wildlife.

Potential adverse effects to reproduction, growth, or survival were not identified for the representative wildlife species from exposure to the ECPCs in surface water at Site 1. A comparison of Site 1 ECPC surface water concentrations to benchmark toxicity values, along with results of field studies and the benthic macroinvertebrate study, supports the general conclusion that runoff from Site 1 does not represent a risk for aquatic receptors at Rowell Creek. No surface water ECCs were identified for OU 1, Site 1.

Results of the food-web model indicate that no potential adverse effects to reproduction, growth, or survival for the representative wildlife species are anticipated from exposure to the ECPCs in sediment at Site 1. The results of the field studies and sediment toxicity testing do not show impairment of the benthic macroinvertebrate community or toxicity of sediment at Rowell Creek sampling locations RC-Bio-8, RC-Bio-8A, RC-Bio-9, and RC-Bio-10 that are adjacent to Site 1 and downstream of Site 2. No sediment ECCs were identified for OU 1, Site 1.

4.3.2 OU 1, Site 2 Surface water and sediment sampling stations evaluated for the presence of analytes associated with risk attributable to Site 2 include 2-SW/SD-1 through 2-SW/SD3 (Plate 2).

Six of the analytes detected in Site 2 surface water were selected as ECPCs for both aquatic life and terrestrial wildlife (aluminum, barium, cyanide, iron, lead, and manganese). Three of the analytes were selected as ECPCs for terrestrial wildlife only (1,4-DCB, chlorobenzene, and nickel).

Results of the food-web model identified possible risks associated with iron in sediment for small mammals that may forage in the stream. Observed impairment of the benthic macroinvertebrate community at Site 2 was attributed to exposures to

Table 4-3
Summary of Ecological Contaminants of Concern for Surface Water and Sediment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical of Potential Concern	OU 1		OU 2		OU 3		OU 4	OU 5	
	Site 1	Site 2	Site 5	Site 17	Site 7[1]	Site 8	Site 10	Site 14	Site 15
VOCs/SVOCs									
PAHs									SD
Fluorene			SD						
2-Methylnaphthalene			SD						
Naphthalene			SD						
bis(2-Ethylhexyl)phthalate				SD[2,7]				SW[2]/SD[2,7]	
Pesticides and PCBs									
4,4'-DDD			SD						SD[8]
4,4'-DDE			SD						SD[8]
4,4'-DDT			SD						SD[8]
Aroclor-1254									
Aroclor-1260			SD			SD		SW[5]	SW[5]
Aldrin									
alpha-Chlordane									
gamma-Chlordane									
Endrin									
Endrin aldehyde									
Inorganic Analytes									
Aluminum		SW[3]/SD	SW[3]			SW		SW[5]	SW[5]
Cadmium									
Copper								SW[5]	SW[5]
Cyanide		SD				SW[5]		SW[5]	
Iron		SW[3]/D	SW[3]						SW[5]
Lead		SW[3]	SW[3]						SW/SD
Mercury		SD							
Nickel									
Selenium		SD							
Silver		SD							
Vanadium		SD							
Zinc				SD				SW[5,6]	
TRPH			SD			SD			

See notes at end of table.

Table 4-3 (Continued)
Summary of Ecological Contaminants of Concern for Surface Water and Sediment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Contaminant of Potential Concern	OU 6	OU 7	OU 8	PSCs					
	Site 11[1]	Site 16	Site 3	4[1]	6	9[1]	12[1]	18	19
VOCs/SVOCs									
PAHs					SD[7,9]				
Fluorene									
2-Methylnaphthalene									
Naphthalene									
bis(2-Ethylhexyl)phthalate					SD[3,9]				
Pesticides and PCBs									
4,4'-DDD					SD[7,8,10]				
4,4'-DDE					SD[8,10]				SD[6,8,10]
4,4'-DDT			SD[4]		SD[7,8,10]				SD[6,8,10]
Aroclor-1254			SD[4]						
Aroclor-1260					SD[7,10]				SD[6,7]
Aldrin									SD[6,8,10]
alpha-Chlordane				SD[8,10]					SD[6,8]
gamma-Chlordane				SD[8,10]					SD[6,8,10]
Endrin				SD[7,8,10]					
Endrin aldehyde				SD[8,10]					
Inorganic Analytes									
Aluminum			SW[3]						
Cadmium		SW[3]			SD[9]				
Copper		SW[3]			SD[9]				
Cyanide									
Iron		SW[3]							
Lead		SW[3]			SD[9]				
Mercury									
Nickel					SD[9]				
Selenium									
Silver			SW[3]						
Vanadium									
Zinc		SW[3]	SW[3]		SD[9]				
TRPH		SD							

See notes at end of table.

Table 4-3 (Continued)
Summary of Ecological Contaminants of Concern for Surface Water and Sediment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Surface water and sediment are not present at this site or PSC, or were not evaluated.
[2] Analyte is a known laboratory contaminant, and/or it is questionable whether or not the compound is site-related.
[3] Analyte was detected in unfiltered surface water; evaluation of unfiltered surface water may overestimate risk from this analyte.
[4] Aroclor-1254 and 4,4'-DDT were not detected in OU 8 groundwater, indicating that their presence is not due to OU 8, but rather another upgradient source.
[5] Toxicity benchmarks are protective of species that do not inhabit the warm waters at NAS Cecil Field. Therefore, this analyte is not likely to cause risk to the majority of aquatic receptors.
[6] The concentration of this analyte slightly exceeded conservative toxicity benchmarks and is therefore not considered to represent a significant risk for aquatic receptors.
[7] This analyte was detected at a low frequency; therefore, it is not likely associated with population-level effects for aquatic life.
[8] The presence of this analyte at the site is unrelated to past disposal practices; rather, it is likely present due to historical pesticide applications.
[9] Toxicity benchmark exceedances occurred at a sample location that is upgradient of the PSC; therefore, contamination is not believed to be PSC-related.
[10] The low number of toxicity benchmark exceedances suggests that population-level effects to aquatic organisms are unlikely.

Notes: OU = operable unit.
VOC = volatile organic compound.
SVOC = semivolatile organic compound.
SD = sediment.
PCBs = polychlorinated biphenyls.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
SW = surface water.
TRPH = Total recoverable petroleum hydrocarbon.
PSC = potential source of contamination.

Sampling locations
OU 1, Site 1: Surface water: RC-SW-6 through RC-SW-8, RC-SW-8A, RC-SW-9, and RC-SW-10; Sediment: RC-SD-6 through RC-SD-8, RC-SD-8A, RC-SD-9, and RC-SD-10.
OU 1, Site 2: Surface water: 2-SW-1 through 2-SW-3; Sediment: 2-SD-1 through 2-SD-3.
OU 2, Site 5: Drainage ditch surface water: 5-SW1 through 5-SW4; Drainage ditch sediment: 5-SD-1 through 5-SD-4; Wetland surface water: 5-SW-6 and 5-SW-7; Wetland sediment: 5-SD-6 and 5-SD-7.
OU 2, Site 17: Surface water: CF-17-SW1 and CF-17SW1D (duplicate); Sediment: CEF-17-SD1 (6/94), CEF-17-SD1D (6/94 duplicate), and CEF-17-SD1 (re-sample 2/95), CEF17-SD1D (2/95 duplicate) and CEF-17-SD2 (6/94).
OU 3, Site 7: Not applicable.
OU 3, Site 8: Surface water: CF8SW3, DF8SW4, CF8SW6, CR8SW7, and CF8SW8. Sediment: CF8SD3, CF8SD4, CF8SD6, CF8SD7, and CF8SD8.
OU 4, Site 10: Not applicable.
OU 5, Site 14: Surface water: CF14SW1 through CF14SW4. Sediment: CF14SD1 through CF14SD4.
OU 5, Site 15: Surface water: CF15SW1 through CF15SW7. Sediment: CF15SD1 through CF15SD7.
OU 6, Site 11: Not applicable.
OU 7, Site 16: Surface water: STC-SW-1, STC-SW-3, STC-SW-4; Sediment: STC-SD-1, STC-SD-3, STC-SD-4.
OU 8, Site 3: Surface water: CF3SW1, CF3SW1 (duplicate), RCSW3; Sediment: CF3SD1, CF3SD1 (duplicate), RCSD3.
PSC 4: Surface water: CF4SW1 through CF4SW6. Sediment: CF4SD1 through CF4SD6.
PSC 6: Surface water: CF6SW1, CF6SW4 through CF6SW6. Sediment: CF6SD1, and CF6SD4 through CF6SD6.
PSC 9: Not applicable.
PSC 12: Not applicable.
PSC 18: Surface water: CF18SW1 through CF18SW4. Sediment: CF18SD1 through CF18SD4.
PSC 19: Surface water: CF19SW1 through CF19SW3. Sediment: CF19SD1 through CF19SD3.

aluminum, lead, and iron in surface water, and aluminum, cyanide, mercury, selenium, silver, iron, and vanadium in sediment. These nine analytes were identified as ECCs for surface water and/or sediment (Table 4-3). The adverse biological responses may, however, be associated with an orange flocculent material that blankets the bottom substrate of the tributary and the water column. This material may be causing physical impairment of the benthic community and toxicity of the test organisms.

4.3.3 OU 2, Site 5 The following surface water and sediment sampling stations were evaluated for the presence of analytes associated with risk attributable to the Site 5 drainage ditch: 5-SWSD-1 through 5-SW/SD-4 (Plate 2). Those samples evaluated for the Site 5 wetland include 5-SW/SD-6 and 5-SW/SD-7 (Plate 2).

Six of the analytes in surface water were selected as ECPCs for both aquatic life and terrestrial wildlife (aluminum, barium, cyanide, iron, lead, and manganese). Three of the analytes were selected as ECPCs for terrestrial wildlife only (1,4-DCB, chlorobenzene, and nickel). Potential risks were not identified for wildlife exposed to Site 5 surface water in the drainage ditch or wetland. The benthic macroinvertebrate data revealed that one drainage ditch station (5-SW4) and the upstream reference station fell below the expected condition, given the quality of the habitat present. It could not be concluded that contamination in surface water from Site 5 was contributing to the decreased condition observed at the downstream sampling station. Aluminum, iron, and lead concentrations in surface water in the drainage ditch, wetland, and reference samples exceeded aquatic toxicity benchmark values and may be associated with the benthic community impact. However, since these analytes are present in reference samples as well as site samples, it cannot be concluded that effects are site-related. Further, the detected concentrations of inorganic analytes in unfiltered surface water may not be bioavailable to aquatic receptors due to the presence of suspended solids in unfiltered samples. However, these ECCs were conditionally identified for Site 5 surface water.

In Site 5 sediment, 22 of the 23 detected analytes exceeded background screening values and were selected as ECPCs. Fourteen analytes were selected as ECPCs for both aquatic and terrestrial wildlife. Eight analytes were selected as ECPCs for terrestrial wildlife only. Potential risks were not identified for wildlife exposed to Site 5 sediment in the drainage ditch or wetland. Evaluation of sediment toxicity testing data suggests that certain aquatic organisms are impacted by exposure to Aroclor-1260, DDT and its daughter products (DDT_r), and TRPH in Site 5 sediment. Fluorene, 2-methylnaphthalene, and naphthalene also exceed sediment toxicity benchmark values. These analytes were identified as ECCs for Site 5 sediment (Table 4-3).

4.3.4 OU 2, Site 17 Representative surface water samples could not be collected from the Site 17 wetland during June, 1994, sampling event. Surface water was evaluated for Site 17 based on results of a resampling effort in February 1995. Reanalyses of sediment samples for Site 17 were conducted, combining data from both sampling events. Surface water samples for Site 17 include CF-17-SW1 and its duplicate (CF-17-SW1D); sediment samples include CEF-17-SD1 and its duplicate (collected in June 1994), CEF-17-SD1 and its duplicate (resample 2/95), and CEF-17-SD2 (6/96) (see Plate 2).

No organic analytes were detected in the Site 17 surface water samples. None of the nine detected inorganic analytes were retained as ECPCs. No ECCs were identified for Site 17 surface water.

Two VOCs (2-butanone and toluene) and five SVOCs were detected and retained as sediment ECPCs for aquatic and wildlife receptors. One pesticide (4,4'-DDE), eight inorganic analytes and TRPH were also selected as sediment ECPCs. Risks to terrestrial and wetland wildlife were not identified through food-web model analyses. Detected concentrations of bis(2-ethylhexyl)phthalate and zinc in sediment exceeded available sediment screening values for protection of aquatic receptors; therefore, these analytes were identified as ECCs for Site 17 sediment (Table 4-3). Bis(2-ethylhexyl)phthalate is a known laboratory contaminant and was identified in only one sample; it is unlikely that this analyte is site-related.

4.3.5 OU 3, Site 7 Surface water and sediment were not present at Site 7; therefore, they were not evaluated.

4.3.6 OU 3, Site 8 Unfiltered and filtered surface water samples were collected from five locations within the drainage ditches present at Site 8. Two samples (CF8SW2 and CF8SW5) are located in the upgradient portions of the ditches and are believed to be unimpacted by site activities. Therefore, these samples were used to represent the upgradient conditions. Four of the surface water samples (CF8SW3, CF8SW4, CF8SW6 and CF8SW7) were summarized to evaluate contaminant exposure to wildlife and aquatic life while CF8SW8 was evaluated separately because it was collected at a later date to better characterize groundwater impacts to surface water in the downgradient portions of the Site 8 ditches. All surface water from Site 8 eventually drains into Sal Taylor Creek, located south of Site 8. All samples were analyzed for VOCs, SVOCs, pesticides and PCBs, and inorganics. Filtered surface water was analyzed for inorganics only (Plate 2). Sediment samples are colocated with surface water samples.

No VOCs, SVOCs, pesticides, or PCBs were detected in surface water collected at Site 8. Five analytes were identified as ECPCs in the unfiltered samples. Of the five, barium, cyanide, and vanadium were selected as ECPCs for both aquatic and wildlife receptors, whereas chromium was selected as an ECPC for wildlife and TRPH was selected as an ECPC for aquatic life. In the filtered samples, barium, beryllium, and vanadium were selected as ECPCs for both aquatic and wildlife receptors. Effects to aquatic life were also considered from exposure to alkalinity and chloride measured in Site 8 surface water.

In Site 8 sediment, six of the 19 detected analytes exceeded upgradient or Region IV screening values and were selected as ECPCs (including acetone, 2-butanone, di-*n*-butylphthalate, Aroclor-1260, zinc and TRPH). All six of the analytes were selected as ECPCs for aquatic and wildlife receptors (except for zinc, which was selected as a wildlife ECPC only).

Potential risks were not identified for wildlife exposed to Site 8 surface water and sediment. The results of the benthic macroinvertebrate study indicated a decreased biological condition at location CF8BIO2. However, the aquatic habitat available at this location is dissimilar to that of the reference location (Five Mile Creek), which may explain the decreased biological condition identified at CF8BIO2. It is likely that the ephemeral nature of the ditch is affecting the biological condition, not chemical contamination.

A comparison of the surface water ECPCs with aquatic benchmark values indicated that cyanide (in unfiltered surface water) was the only analyte detected in surface water at a concentration that exceeded its benchmark. However, it is unlikely that this analyte would pose a significant risk to the aquatic receptors present in the drainage ditches at Site 8, because the benchmark value for this analyte is based on highly sensitive cold water species of fish (salmonid species), which are not present at the site. Aluminum was detected at sample location CF8SW8 at concentrations that exceeded its aquatic benchmark, and which may represent some risks to aquatic receptors. Therefore, aluminum was identified as a possible ECC for Site 8 surface water.

Evaluation of sediment toxicity test results suggest that certain benthic invertebrates exposed to sediment at locations CF8SD3 and CF8SD4 may be adversely impacted. These impacts may be associated with concentrations of TRPH and Aroclor-1260 (based on correlation analysis). Adverse effects to benthic invertebrates were also observed at location CF8SD7; however, these effects could not be correlated with any chemical concentrations in sediment.

A comparison of aquatic benchmark values with sediment ECPCs indicated that Aroclor-1260 was the only analyte detected at a concentration that exceeded its aquatic benchmark. However, due to the conservative nature and applicability of the benchmark, it is unlikely that aquatic organisms are at risk. Aroclor-1260 and TRPH were identified as ECCs for Site 8 sediment. A qualitative evaluation of Site 8 surface water and sediment suggest that site concentrations are not adversely impacting downgradient surface water or sediment quality in Sal Taylor Creek.

4.3.7 OU 4, Site 10 Site 10 is located adjacent to Rowell Creek. The topography slopes down to the creek; therefore, all drainage occurs towards the creek. The surface water and sediment exposures to aquatic life associated with Site 10 were not evaluated because there is no existing transport mechanism between the contaminants potentially occurring in surface soil or groundwater at the site and surface water and sediment collected in the northern portion of Site 10. Furthermore, surface water and sediment impacts in Rowell Creek were evaluated in the OU 1 BRA, and it was determined that Site 10 is not attributable for adverse effects to aquatic life in this portion of the creek. Surface water and sediment data were not collected in the southern portion of the site, because the presence of water is an expression of groundwater, and data from adjacent monitoring wells were used as exposure point concentrations for aquatic life.

4.3.8 OU 5, Site 14 Site 14 is located at a groundwater divide in the Yellow Water Weapons Area; there are no surface water bodies in the immediate vicinity of Site 14 and the flat topography prevents any clear drainage pathway from occurring. Therefore, the samples were used to evaluate potential risks to wildlife that may forage at the site, and risks to the limited aquatic life that may utilize the ephemeral ditches. Unfiltered and filtered surface water and sediment samples were collected at four locations in the drainage ditch (CF14SW/SD1, CF14SW/SD2, CF14SW/SD3, and CF14SW/SD4, duplicate at CF14SW/SD3) bordering Site 14 (Plate 2). All samples were analyzed for VOCs, SVOCs, pesticides and PCBs, and inorganics. There are no upgradient surface water or sediment data available for Site 14; therefore, all ECPCs were selected based on a comparison with Region IV surface water or sediment screening values.

Acetone, bis(2-ethylhexyl)phthalate, and endrin were detected in Site 14 surface water samples. All three analytes were selected as ECPCs for aquatic and wildlife receptors. Nine out of fourteen inorganic analytes detected in unfiltered and filtered surface water were also selected as wildlife or aquatic ECPCs. The analytes detected in unfiltered and filtered surface water that were retained as ECPCs include aluminum, barium, copper, manganese, vanadium, and zinc. The ECPCs beryllium and nickel were only detected in unfiltered surface water, and the ECPCs antimony and cyanide were only detected in filtered surface water.

In Site 14 sediment, 21 of the 24 detected analytes exceeded background screening values and were selected as ECPCs. Fifteen analytes were selected as ECPCs for both aquatic and wildlife receptors. Five analytes were selected as ECPCs for wildlife receptors, and one analyte was selected as an ECPC for aquatic receptors. No lethal or sublethal risks to wildlife exposed to Site 14 surface water and sediment were identified through food-web model analysis.

Comparison of the ECPC concentrations detected in surface water samples with available toxicity benchmarks indicated that bis(2-ethylhexyl)phthalate, aluminum, copper, cyanide, and zinc exceeded the aquatic toxicity benchmarks. Analytes were not selected as surface water ECCs because they may either be known laboratory contaminants (e.g., bis(2-ethylhexyl)phthalate), exceed benchmarks based on sensitive species that do not occur at Site 14 (e.g., aluminum, copper, and cyanide), or were detected at low frequency and concentrations (e.g., zinc).

Comparison of the ECPC concentrations in sediment with benchmarks for aquatic life indicates that only one analyte, bis(2-ethylhexyl)phthalate, was detected at a maximum concentration that exceeded its aquatic toxicity benchmark. It is unlikely that population-level effects would occur from exposure to this analyte, because it was detected at an elevated concentration at only one sample location. Therefore, this analyte was not selected as an ECC.

4.3.9 OU 5, Site 15 Site 15 is located in a remote section of NAS Cecil Field, in the southwestern portion of the Yellow Water Weapons Storage Area. The site contains many habitats including disturbed uplands, mesic and wet mixed pine/hardwoods, slash pine flatwoods, and floodplain swamps. The primary mechanism of contaminant migration is surface water runoff to drainage ditches and tannin-stained tributaries, which surround the site. The Yellow Water Creek is the final receiving water body of surface water runoff from the ditches and tributaries.

Three unfiltered and filtered surface water samples (CF15SW1 through CF15SW3, duplicate at CF15SW3) were collected at Site 15 and analyzed for VOCs, SVOCs, pesticides and PCBs, explosive compounds, inorganic analytes, water quality parameters, and TRPH. Four additional unfiltered samples were collected (CF15SW4 through CF15SW7) and analyzed for lead only. All seven surface water samples were evaluated in the Site 15 ERA. Three sediment samples (CF15SD1 through CF15SD3) were collected and analyzed for full TCL and TAL analytes, TRPH, total organic carbon (TOC), and explosives to evaluate ecological risks at Site 15. Four additional sediment samples (CF15SD4 through CF15SD7) were collected and analyzed for PAHs and lead. All seven sediment samples were evaluated in the Site 15 ERA.

Four explosive compounds and TRPH were detected in surface water and selected as ECPCs for aquatic and wildlife receptors. Seven out of eleven inorganic analytes detected in unfiltered surface water were selected as ECPCs. Of these, aluminum,

barium, copper, lead and zinc were identified as ECPCs for both aquatic and wildlife receptors, while iron and arsenic were identified as aquatic and wildlife ECPCs, respectively. Five out of nine inorganic analytes detected in filtered surface water were selected as ECPCs. Aluminum, barium, and lead were identified as ECPCs for both aquatic and wildlife receptors, while iron and arsenic were identified as aquatic and wildlife ECPCs, respectively. The effects of chloride on aquatic life were also evaluated for Site 15 surface water.

In Site 15 sediment, all of the organic analytes detected (including 2-butanone, 12 PAHs, carbazole, di-*n*-butylphthalate, 4-nitrotoluene, 4 pesticides, and TRPH) were retained as ECPCs. Dieldrin was identified as an ECPC for wildlife receptors only, while the remaining organic analytes and TRPH were identified as ECPCs for aquatic and wildlife receptors. Six out of the nine detected inorganic analytes were selected as ECPCs. Aluminum, barium, lead, and vanadium were identified as ECPCs for aquatic and wildlife receptors, while the iron and chromium were identified as aquatic and wildlife ECPCs, respectively.

Risks to wildlife exposed to Site 15 surface water were not identified through food-web analysis. However, lethal risks to small mammals were predicted based on maximum exposure concentrations of lead in sediment. Although slight risks were predicted, it is unlikely that small mammals would be continually exposed to the maximum concentration at the site. Risks were not predicted in the average exposure scenario, which indicates that population-level effects are unlikely.

A comparison of ECPCs with available toxicity benchmarks for aquatic life indicated that lead in surface water and sediment, and PAHs in sediment, may cause adverse effects to aquatic organisms; therefore, these analytes were selected as ECCs for Site 15. Other analytes that exceeded benchmarks (including aluminum, copper, and iron in surface water; and 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT in sediment) were not considered to represent a significant risk to aquatic receptors.

4.3.10 OU 6, Site 11 Surface water and sediment were not present at Site 11; therefore, they were not evaluated.

4.3.11 OU 7, Site 16 Unfiltered surface water and sediment was sampled at three locations in the drainage ditches (STC-SW/SD-1, STC-SW/SD-3, and STC-SW/SD-4) and one reference location northeast of Site 16 in Sal Taylor Creek (STC-SW/SD-R1) (Plate 2).

Fifteen analytes were detected in the surface water samples. Of the 15 detected analytes, two VOCs and five inorganics were identified as ECPCs for both aquatic life and terrestrial wildlife. One VOC and one inorganic were selected as ECPCs for terrestrial wildlife only.

Risks to wildlife exposed to Site 16 surface water were not identified through food-web model analyses. Comparison of the concentrations of the ECPCs detected in surface water samples from the drainage ditches with available toxicity benchmarks indicated maximum concentrations of cadmium, copper, iron, lead, and zinc exceeded the aquatic toxicity benchmarks. The concentration of lead measured in water samples from the reference location in Sal Taylor Creek also exceeded available benchmarks. These inorganic analytes were identified as ECCs for Site 16 surface water (Table 4-3). However, it is believed that the presence of these metals in the surface water of the drainage ditches is not site-related. The

ditches receive storm water drainage from the runway area and much of the developed area west of the runways. Additionally, evaluation of unfiltered water may overestimate risk to receptors because it may not be representative of the bioavailability of inorganic analytes.

Twenty analytes were detected in the sediment samples. Three VOCs, 1 SVOC, and 10 inorganics were identified as ECPCs for both terrestrial wildlife and aquatic receptors. Three inorganics were selected as ECPCs for terrestrial wildlife only. TRPH was also detected in the Site 16 drainage ditch sediment and was identified as an ECPC.

No risks were identified through food-web model analyses for wildlife exposed to Site 16 sediment. There were no apparent trends in the status of the benthic macroinvertebrate community in the drainage ditches and reference station in Sal Taylor Creek as compared to the reference data. It could not be concluded from these data that contaminants in the sediment were contributing to the poor condition observed in the drainage ditches. However, based on the results of the laboratory sediment bioassays, impacts to the survival and reproduction of certain invertebrate receptors may be occurring in the drainage ditches. Associations between toxicity to invertebrate receptors may be attributable to elevated concentrations of TRPH in sediment at STC-SD-1 and STC-SD-3; therefore, TRPH is identified as an ECC at Site 16 (Table 4-3).

4.3.12 OU 8, Site 3 Surface water and sediment sampling stations are depicted on Plate 2. In June 1993, one unfiltered surface water sample (RC-SW-3) was collected in Rowell Creek approximately in the center of the OU 8 plume discharge location. Two additional unfiltered surface water samples were collected in November 1994 from Rowell Creek above and below RC-SW-3 (CF3-SW-1 and CF3-SW-2, respectively) (Figure 3-1). All three surface water samples were collected downgradient of the Navy WWTP. Surface water from sampling station CF3-SW-2 was collected to represent upgradient conditions unimpacted by the OU 8 groundwater plume, whereas surface water from CF3-SW-1 was collected to represent conditions within and downgradient from plume discharge.

Of the fourteen analytes detected in surface water from the upstream reference station, endosulfan I was the only analyte detected in the upstream sample that was not present in either of the downstream locations. Of the four analytes identified as ECPCs in the midplume location adjacent to OU 8 (station RC-SW-3), chloroform was selected as a wildlife ECPC only. In the downstream sample (CF3-SW-1), eight analytes were retained as ECPCs, five of which were selected only as wildlife ECPCs.

Results of the food-web modeling indicate no lethal or sublethal adverse effects to wildlife from exposure to surface water. Analysis of the benthic macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at RC-BIO-3 represent a poor environment for many types of aquatic organisms. Differences in habitat structure may be sufficient to explain the decreased biological condition; however, the NAS Cecil Field sewage treatment plant discharge impact could not be eliminated as a causative agent. Aluminum and zinc concentrations in surface water exceeded benchmark toxicity values and were identified as possible ECCs. However, these concentrations were measured in unfiltered water, which may overestimate actual exposures associated with inorganic analytes and subsequent risks to OU 8 aquatic receptors.

In June 1993, one sediment sample (RC-SD-3) was collected in Rowell Creek approximately in the center of the OU 8 plume discharge location. Two additional sediment samples were collected in November 1994 from Rowell Creek above and below RC-SD-3 (CF3-SD-2 and CF3-SD-1, respectively) (Plate 2). Sediment from sampling station CF3-SD-2 was collected to represent upgradient conditions unimpacted by the OU 8 groundwater plume, whereas sediment from CF3-SD-1 was collected to represent conditions within and downgradient from the plume.

At RC-SD-3, 2-butanone, 2 phthalate esters, Aroclor-1254, 4,4'-DDE, and 4 of the 10 detected inorganic analytes were identified as ECPCs. Four ECPCs (4,4'-DDE, copper, lead, and zinc) were selected only as wildlife ECPCs . In the downgradie-nt sample (CF3-SD-1), three analytes were identified as ECPCs: 2-butanone, 4,4'-DDT, and endrin ketone. None of the seven detected inorganic analytes were selected as ECPCs.

Results of the food-web modeling indicate no lethal or sublethal adverse effects to wildlife from exposure to sediment. Aroclor-1254 and 4,4'-DDT concentrations at RC-SD-3 exceeded sediment toxicity benchmarks for the protection of aquatic receptors; therefore, these two analytes were identified as ECCs. However, neither of these analytes were detected in OU 8 groundwater, indicating that the presence of Aroclor-1254 and 4,4'-DDT does not appear to be due to OU 8, but to another upgradient source. It is unlikely that aquatic receptors are currently at risk from exposure to the low levels of Aroclor-1254 or 4,4'-DDT detected in OU 8 sediment.

4.4.13 PSC 4 PSC 4 is located adjacent to the east side of Lake Fretwell; however, no surface water or sediment samples were collected at PSC 4. Impacts to aquatic organisms from PSC 4 are represented by chemical concentrations detected in groundwater.

4.3.14 PSC 6 PSC 6 is located adjacent to the west side of Lake Fretwell. The topography of PSC 4 is generally flat, with some low-lying wet areas. Six surface water and sediment samples (CF6SW/SD1 through CF6SW/SD6) were collected at PSC 6. The surface water and sediment samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, and inorganics.

1,2-dichloroethene and bis(2-ethylhexyl)phthalate were detected in surface water from sample location CF6SW3 and CF6SW5, respectively. Ten inorganic analytes (including aluminum, barium, copper, iron, lead, manganese, selenium, thallium, vanadium, and zinc) and the essential nutrients calcium, magnesium, potassium, and sodium were also detected in PSC 6 surface water.

Risks were evaluated for aquatic receptors using a tiered approach. The first tier of screening involved comparing maximum surface water concentrations with Florida surface water standards for freshwater and the Region III BTAG screening values for aquatic life in freshwater. Those analytes that exceeded this first tier of screening were further evaluated in Tier II by comparing maximum surface water concentrations with conservative surface water reference toxicity benchmarks. The results of this second tier of evaluation indicated that all concentrations of analytes detected in PSC 6 surface water are less than toxicity benchmarks. Therefore, no ECCs were identified for analytes in PSC 6 surface water.

Sediment was evaluated in a similar manner. A first tier of evaluation included comparing maximum detected sediment concentrations with Florida Department of

Environmental Protection (FDEP) soil cleanup goals, FDEP SQGs, and Region III BTAG criteria for flora and fauna. For those analytes that exceeded the Tier I screening criteria, a second tier of evaluation was performed, which involved comparing maximum detected sediment concentrations with conservative sediment quality criteria and guidelines for aquatic life. This second tier of evaluation identified several analytes that exceeded Tier II screening values, including bis(2-ethylhexyl)phthalate, 9 PAHs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin, endrin aldehyde, alpha and gamma chlordane, Aroclor-1260, cadmium, copper, lead, nickel, and zinc. However, the analytes that exceeded Tier II screening values were determined to be not likely associated with potential risks for aquatic organisms given the low frequency of detection (SVOCs and pesticides), collocation of maximum concentrations at one sample located 600 feet upgradient of the PSC (SVOCs and metals), and the low number of exceedances (pesticides). Furthermore, the presence of pesticides in sediment is likely associated with historical pesticide applications, rather than disposal practices at PSC 6. Therefore, no ECCs were identified in PSC 6 sediment.

Two VOCs (2-butanone and acetone) and thirteen SVOCs (including PAHs and phthalate esters), were detected in sediment at PSC 6. The VOCs and SVOCs were detected primarily in two sample locations, CF6SD3 and CF6SD5. Nine pesticides and one PCB were also detected in sediment from PSC 6. The highest concentrations of 4,4'-DDE, DDD, and DDT (180 µg/kg, 72 µg/kg, and 24 µg/kg, respectively) were detected at sample location CF6SD6. Aroclor-1260 was detected at one sample location (CF6SD2) at a concentration of 84 µg/kg. The remaining pesticides (including aldrin, endrin, endrin aldehyde, methoxychlor, alpha-chlordane and gamma-chlordane) were detected at relatively low concentrations and frequencies in sediment at PSC 6. Sixteen inorganic analytes (including aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, thallium, vanadium, and zinc), cyanide, and the essential nutrients calcium, magnesium, and potassium were also detected in PSC 6 sediment.

4.3.15 PSC 9 PSC 9 contains an ephemeral ditch that is dry most of the year. No surface water or sediment samples were collected at PSC 9. Therefore, these media were not evaluated.

4.3.16 PSC 12 PSC 12 is adjacent to a drainage ditch; however, no surface water or sediment samples were collected at PSC 12. Impacts to aquatic organisms from PSC 12 are represented by chemical concentrations detected in groundwater.

4.3.17 PSC 18 PSC 18 is located on Sal Taylor Creek (a blackwater stream), where ordinance was disposed of from a bridge. Surface water and sediment samples (CF18SW/SD1 through CF18SW/SD4) were collected at PSC 18. All surface water and sediment samples were analyzed for CLP VOCs, SVOCs, explosives, pesticides and PCBs, and inorganics. In addition, filtered surface water samples were collected and analyzed for inorganics only.

No VOCs, SVOCs, explosives, pesticides or PCBs were detected in surface water at PSC 18. Eight inorganic analytes (including aluminum, arsenic, barium, copper, iron, manganese, thallium, and zinc) were detected in unfiltered and filtered surface water at PSC 18. Cyanide and antimony were detected in unfiltered and filtered surface water, respectively. The essential nutrients calcium, magnesium, potassium, and sodium were also detected in both unfiltered and filtered surface water at PSC 18.

No VOCs were detected in sediment at PSC 18. Bis(2-ethylhexyl)phthalate was detected in the duplicate collected from sample location CF18SD3, and two pesticides (methoxychlor and endrin ketone) were detected at CF18SD4. Eleven inorganic analytes (including aluminum, barium, beryllium, chromium, copper, iron, lead, manganese, nickel, vanadium, and zinc), and the essential nutrients calcium, magnesium, potassium, and sodium were also detected in PSC 18 sediment.

Risks were evaluated for aquatic receptors using the tiered approach described in Subsection 4.3.14. The first tier of screening for surface water suggested that ecological receptors are not at risk from exposure to PSC 18 surface water; therefore, no second tier of evaluation was completed, and no analytes were identified as ECCs in PSC 18 surface water.

The maximum concentrations of two pesticides (methoxychlor and endrin ketone) in sediment exceeded Tier I screening values; therefore a second tier of evaluation was completed. The results of the second tier of evaluation indicated that concentrations of these analytes are not likely to cause risk to aquatic life. Therefore, no ECCs were identified for analytes in PSC 18 sediment.

4.3.18 PSC 19 PSC 19 is located adjacent to Rowell Creek north of Lake Fretwell. Site topography gradually slopes down towards Rowell Creek. In addition, a drainage ditch drains into Rowell Creek from the lower portion of PSC 19. Surface water and sediment samples (CF19SW/SD1 through CF19SW/SD3) were collected at PSC 19. All surface water and sediment samples were analyzed for CLP VOCs, SVOCs, pesticides and PCBs, and inorganics. In addition, filtered surface water samples were collected and analyzed for inorganics only.

No VOCs, SVOCs, pesticides, or PCBs were detected in surface water at PSC 19. Eight inorganic analytes (including aluminum, arsenic, barium, copper, iron, manganese, thallium, and zinc) were detected in unfiltered and filtered surface water at PSC 19. Lead, selenium, and vanadium were detected only in unfiltered surface water, and antimony was detected only in filtered surface water. The essential nutrients calcium, magnesium, potassium, and sodium were also detected in both unfiltered and filtered surface water at PSC 19.

No VOCs were detected in sediment at PSC 19. Benzo(a)fluoranthene was detected in sediment collected from sample location CF19SD2, but not in the duplicate collected at this location. Five pesticides (including aldrin, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, and gamma-chlordane), Aroclor-1254, twelve inorganic analytes (including aluminum, arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, vanadium, and zinc), and the essential nutrients calcium, magnesium, potassium, and sodium were also detected in PSC 19 sediment.
Risks were evaluated for aquatic receptors using the tiered approach described in Subsection 4.3.14. The first tier of screening for surface water suggested that ecological receptors are not at risk from exposure to PSC 19 surface water; therefore, no second tier of evaluation was completed, and no analytes were identified as ECCs in PSC 19 surface water.

Maximum concentrations of several pesticides and PCBs in PSC 19 sediment, including 4,4'-DDE, 4,4'-DDT, aldrin, alpha and gamma chlordane, and Aroclor-1260, exceeded both Tier I and Tier II toxicity benchmarks for aquatic life. However, the analytes that exceeded Tier II screening values were determined to be not likely associated with potential risks for aquatic organisms given the low frequency of detection (Aroclor-1260), the generally low magnitude of exceedance

(all pesticides and Aroclor-1260), and the low number of exceedances (aldrin, 4,4'-DDE, 4,4'-DDT, and gamma-chlordane). Therefore, no ECCs were identified for PSC 19 sediment. Furthermore, the presence of pesticides in sediment are likely associated with historical pesticide applications, rather than disposal practices at PSC 19. Therefore, no ECCs were identified in PSC 19 sediment.

CHAPTER 5.0

5.0 SUMMARY OF BIOLOGICAL SAMPLING

Several biological studies have been completed at NAS Cecil Field to support site-specific ERAs. The results of each of these studies are discussed in this chapter. Studies completed include toxicity testing (Section 5.1), aquatic studies (Section 5.2), terrestrial studies (Section 5.3), wetlands identification, mapping and delineation (Section 5.4) and laboratory analyses of plant and animal tissue (Section 5.5).

5.1 TOXICITY TESTING. Toxicity testing of surface soil, sediment, and groundwater has been completed as part of ERAs and contamination assessments for several sites at NAS Cecil Field. Table 5-1 lists the OUs and other areas where toxicity tests have been completed, along with the media tested, number of samples collected, test organisms used, and test types. Locations where samples of sediment, groundwater, and surface soil were collected for toxicity testing are shown on Plates 2, 3, and 4, respectively (sample identifiers contain the characters "TOX"). Samples were collected concurrently for chemical analysis and toxicity testing. The results of the chemical analyses for the media, then, can be used to establish contaminant exposure concentrations and provide the means for interpreting biological responses in the toxicity tests.

Methods used to perform surface soil toxicity testing for earthworms (*Eisenia foetida*) and lettuce seeds (*Lactuca sativa*) generally meet the standard procedures described in the protocol for short-term toxicity screening of hazardous waste site soil (Green and others, 1989). Methods used for sediment toxicity testing using the water flea (*Ceriodaphnia dubia*) are based on USEPA Method 1002.0. Methods used for sediment toxicity testing using the amphipod (*Hyalella [H.] azteca*) and midge larvae (*Chironomus [C.] tentans*) meet the standard procedures described in the American Society for Testing and Materials (ASTM) guidelines for conducting sediment toxicity tests with freshwater invertebrates (ASTM, 1991). Reports containing summaries of toxicity testing results are outlined in Appendix C; references include: Springborn Laboratories, 1994; Environmental Science and Engineering (ESE), 1995a; ESE, 1995b; and Inchcape Testing Services/Aquatec Laboratories, 1995a.

5.1.1 Operable Units The results of toxicity testing for each of the OUs at NAS Cecil Field are discussed below.

Numerical results from toxicity testing of surface soil at OUs 1, 2, 3, and 8 and OU 5 are summarized in Tables 5-2 and 5-3, respectively. Tables 5-4 and 5-5 present the numerical results of sediment toxicity testing from OUs 1, 2, and 7 and Lake Fretwell/Rowell Creek upstream of Lake Fretwell, respectively. The results of the sediment toxicity testing conducted for the North Fuel Farm area sites are presented in Table 5-6. The groundwater toxicity testing results are presented in Table 5-7. Summaries of the toxicity testing results for surface soil, sediment, and groundwater are presented in Tables 5-8, 5-9, and 5-10, respectively.

5.1.1.1 **Operable Unit 1** Surface soil and sediment toxicity testing was completed for both Sites 1 and 2 at OU 1 (Springborn Laboratories, 1994). Samples were collected in 1993. Numerical results of surface soil and sediment toxicity testing are shown in Tables 5-2 and 5-4, respectively. Analysis and

Table 5-1
Summary of Toxicity Tests Completed at Naval Air Station Cecil Field

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Operable Unit	Site	Medium	No. Samples	Test Organism	Test Type
OU 1	Site 1	Soil	15	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test
		Sediment	5	a) *Hyalella azteca* b) *Ceriodaphnia dubia*	a) 14-day survival test b) 7-day survival and reproduction test
	Site 2	Soil	10	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test
		Sediment	2	a) *Hyalella azteca* b) *Ceriodaphnia dubia*	a) 14-day survival test b) 7-day survival and reproduction test
OU 2	Site 5	Soil	15	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test
		Sediment	5	a) *Hyalella azteca* b) *Ceriodaphnia dubia*	a) 14-day survival test b) 7-day survival and reproduction test
	Site 17	Soil	7	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test
OU 3	Site 8	Soil	12	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test
		Sediment	5	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival test
OU 5	Site 15	Soil	6	a) *Eisenia foetida* b) *Lactuca sativa*	a) Whole and dilution-series 30-day survival and growth test b) 5-day germination test
OU 7	Site 16	Sediment	3	a) *Hyalella azteca* b) *Ceriodaphnia dubia*	a) 14-day survival test b) 7-day survival and reproduction test
OU 8	Site 3	Soil	9	a) *Eisenia foetida* b) *Lactuca sativa*	a) 28-day survival test b) 5-day germination test
		Groundwater	2	a) *Ceriodaphnia dubia* b) *Pimephales promelas*	a) Dilution-series chronic toxicity test b) Dilution-series chronic toxicity test
North Fuel Farm Area	Aviation Ordnance Dam Site	Sediment	4	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test
	North Containment Road Site	Sediment	2	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test

See notes at end of table.

Table 5-1 (Continued)
Summary of Toxicity Tests Completed at Naval Air Station Cecil Field

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Operable Unit	Site	Medium	No. Samples	Test Organism	Test Type
North Fuel Farm Area (Continued)	Aviation Ordnance Perimeter Road Site	Sediment	2	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test
	Gate 10 Dam Site	Sediment	4	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test
	Alpha Dam Site	Sediment	4	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test
	Possum Dam Site	Sediment	5	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test
	Gate 14 Dam Site	Sediment	4	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test
	Sal Taylor Creek (Reference)	Sediment	1	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test
Lake Fretwell	NA	Sediment	11	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival and growth test b) 14-day survival and growth test
Reference Locations[1]	NA	Sediment	4	a) *Hyalella azteca* b) *Ceriodaphnia dubia* c) *Chironomus tentans*	a) 14-day survival test b) 7-day survival and reproduction test c) 14-day survival test

[1] Reference samples were collected from Yellow Water Creek (YWC-SD/TOX-R1 and YWC-SD/TOX-20), Sal Taylor Creek (STC-SD/TOX-R1 and STC-SD/TOX-R-2), and Rowell Creek (RC-SD/TOX-R1) (Plate 2).

Notes: OU = operable unit.
NA = not applicable.

Table 5-2
Results of Surface Soil Toxicity Testing for Operable Units 1, 2, 3, and 8

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Operable Unit/Site Sample Location	Earthworm (*Eisenia foetida*)		Lettuce Seed (*Lactuca sativa*)
	Mortality (%)	Weight change (%)	Germination (%)
OU 1, Site 1			
BSS01 (Test 1)	2.5	-1.9	[1]8.3
BSS01 (Test 2)	7.5	-1.4	[1]0.0
1SS01	0	15	90
1SS02	[2]15	6.2	9.7
1SS03	2.5	3.3	93
1SS04	2.5	7.6	78
1SS05	0	2.3	91
1SS06	5	5.3	[1]83
1SS07	0	6.3	96
1SS08	0	9.8	98
1SS09	0	9.1	88
1SS10	7.5	-3.0	89
1SS11	2.5	2.5	89
1SS12	0	0.88	86
1SS13	0	3.2	99
1SS14	2.5	3.3	96
1SS15	2.5	6.8	91
OU 1, Site 2			
2SS01	2.5	-14	88
2SS02	2.5	-6.5	99
2SS03	2.5	-5.6	97
2SS04	10	13.5	[1]87
2SS05	0	2.6	97
2SS06	7.5	-1.2	97
2SS07	0	4.1	93
2SS08	0	-2.4	98
2SS09	17.5	5.8	96
2SS10	2.5	-4.6	95
OU 2, Site 5			
CF5SS2	0	-6.21	88
CF5SS4	[1]100	NA	[1]22
CF5SS6	0	1.98	92
CF5SS8	0	-6.77	89
CF5SS9	0	10.83	90
CF5SS13	0	-1.58	[3]79
CF5SS14	2.5	6.25	91

See notes at end of table.

Table 5-2 (Continued)
Results of Surface Soil Toxicity Testing for Operable Units 1, 2, 3, and 8

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Operable Unit/Site Sample Location	Earthworm (*Eisenia foetida*)		Lettuce Seed (*Lactuca sativa*)
	Mortality (%)	Weight change (%)	Germination (%)
OU 2, Site 5 (Continued)			
CF5SS15	0	-3.31	92
CF5SS19	0	-5.67	83
CF5SS20	0	0.57	94
CF5SS21	2.5	8.13	93
CF5SS23	0	-1.77	84
CF5SS24	0	3.46	92
CF5SS26	0	3.85	91
CF5SS31	0	11.05	83
OU 2, Site 17			
CF17SS3	0	11.67	87
CF17SS6	0	2.79	93
CF17SS8	2.5	30.9	[1]59
CF17SS9	0	0.77	[1]69
CF17SS10	0	5.96	94
CF17SS11	2.5	28.1	88
CF17SS12	0	-4.19	93
OU 3, Sites 7 and 8			
Control	0	[8]6.21	99
CF8SS4	0	[8]6.08	88
CF8SS5	0	[8]5.58	[1]29
CF8SS6	0	[8]5.64	[1]81
CF8SS7	0	[8]5.60	[1]85
CF8SS9	0	[8]5.93	98
CF8SS13	0	[1,8]5.34	96
CF8SS14	0	[8]5.93	[1]66
CF8SS16	0	[1,8]5.08	[1]45
CF8SS20	0	[1,8]5.43	94
CF8SS21	0	[1,8]5.34	96
CF8SS22	0	[1,8]5.73	99
CF8SS23	0	[1,8]4.87	100
OU 8, Site 3			
CEF3SS1[4]	0	NM	50
CEF3SS4	0.02	NM	65
CEF3SS9	0.02	NM	68
CEF3SS12	0	NM	78
CEF3SS15	0	NM	56

See notes on following page.

Table 5-2 (Continued)
Results of Surface Soil Toxicity Testing for Operable Units 1, 2, 3, and 8

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Operable Unit/Site Sample Location	Earthworm (*Eisenia foetida*)		Lettuce Seed (*Lactuca sativa*)
	Mortality (%)	Weight change (%)	Germination (%)
OU 8, Site 3 (Continued)			
CEF3SS17	0	NM	[5]22
CEF3SS20	0.02	NM	[6]19
CEF3SS22	0	NM	24
CEF3SS24	0	NM	93
Control[7]	0	NM	95

[1] Statistically different from the control sample.
[2] Statistically different from control. However, this difference is not considered to be biologically significant because several of the earthworms were missing from this test vessel at test termination and the observed mortality cannot be attributed to exposure to the soil sample. Missing earthworms were recovered alive in the waterbath.
[3] Statistically different from control. However, this difference is not considered to be biologically significant because the observed mortality is only slightly higher than control levels.
[4] Reference soil sample.
[5] Significantly different from the reference location ($p = 0.05$).
[6] Significantly different from the reference location ($p < 0.1$).
[7] Control was artificial soil: 10 percent peat, 20 percent Kaolinite clay, and 70 percent silica sand.
[8] Weight change is in grams, not percent.

Notes: Sample locations are shown on Plate 4.

% = percent.
OU = Operable Unit
NM = not measured.

Table 5-3
Results of Surface Soil Toxicity Testing for Operable Unit 5

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Sample Location	Earthworm (*Eisenia foetida*)			Lettuce Seed (*Lactuca sativa*)
	14-day Survival (%)	30-day Survival (%)	30-day Mean Growth (g)	Germination (%)
Control	100	100	0.25	94
CF15SS6	[1]33	[1]0	NC	95
CF15SS7	100	100	0.334	92
CF15SS18	100	100	0.270	98
CF15SS26	[1]20	[1]0	NC	97
CF15SS46	[1]17	[1]0	NC	93
CF15SS48	100	100	0.356	94
6.25% CF15SS15	87	30	0.071	89
12.5% CF15SS15	93	70	-0.053	93
25% CF15SS15	100	100	-0.031	96
50% CF15SS15	100	10	-0.293	97
100% CF15SS15	[1]17	[1]0	NC	98
6.25% CF15SS20	100	60	0.375	95
12.5% CF15SS20	100	17	0.188	98
25% CF15SS20	100	97	0.167	93
50% CF15SS20	100	97	0.258	88
100% CF15SS20	100	97	0.133	56

[1] Statistically different from control sample.

Notes: Sample locations are shown on Plate 4.

% = percent.
g = gram(s).
NC = not calculable.

Table 5-4
Results of Sediment Toxicity Testing for Operable Units 1, 2, and 7

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Operable Unit/Site	Water Flea (*Ceriodaphnia dubia*)		Amphipod (*Hyalella azteca*)
Sample Location	Survival (%)	Reproduction (offspring per adult)	Survival (%)
OU 1, Site 1			
RC-Tox-6	90	[1]14	98
RC-Tox-7	[1]30	[2]5	99
RC-Tox-8	100	27	99
RC-Tox-8A	100	22	98
RC-Tox-9	100	17	96
OU 1, Site 2			
2-Tox-2	[1]70	[1]11	[2]83
2-Tox-3	90	17	94
OU 2, Site 5			
5-Tox-1	80	[1]12	[1,2]24
5-Tox-2	100	17	100
5-Tox-3	80	[1]9	[1,2]36
5-Tox-4	[2]60	[1]8	[2]71
5-Tox-5	100	[1]11	90
OU 7, Site 16			
STC-Tox-1	90	15	[2]0
STC-Tox-3	[1]50	[1]7	[2]20
STC-Tox-R1	100	15	99

[1] Considered to be substantially different than reference or laboratory control (i.e., biologically significant).
[2] Statistically different as compared to the reference control.

Notes: Sample locations are shown on Plate 2.

% = percent.
OU = Operable Unit.

Table 5-5
Results of Sediment Toxicity Testing for Lake Fretwell, Rowell Creek Upstream of Lake Fretwell, and Operable Unit 3

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Sample Location	Amphipod (*Hyalella azteca*)			Midge larvae (*Chironomus tentans*)	
	Survival (%)	Growth (weight in mg/organism)	Growth (length in mm)	Survival (%)	Growth (weight in g/organism)
Control 1[1]	100	0.28	3.3	85	1.06
LF-SD/TOX-11	[3,4]0	NA	NA	82	1.74
LF-SD/TOX-12	[3,4]0	NA	NA	80	1.47
LF-SD/TOX-13	100	0.29	3.4	[3]65	1.72
LF-SD/TOX-14	[3]93	0.29	3.4	[3]62	1.91
LF-SD/TOX-15	100	0.39	3.6	[3]63	1.37
LF-SD/TOX-16	98	0.42	3.6	77	1.87
LF-SD/TOX-17	100	0.37	3.5	67	0.88
YWC-SD/TOX-20	[3]95	0.32	3.4	75	1.05
Control 2[2]	88	0.4	3.4	75	1.45
LF-SD/TOX-9	94	0.46	3.7	[3,4]42	1.5
LF-SD/TOX-10	99	0.47	3.7	87	1.47
RC-SD/TOX-18	98	0.41	3.5	[3,4]18	1.17
GC-SD/TOX-19	88	0.43	3.6	75	1.24
Control	95	1.99	95	0.21	3.4
CF8SD1 (Reference)	88	1.98	96	0.33	3.4
CF8SD2	98	2.69	100	0.25	3.2
CF8SD3	[5]48	[5]0.89	[5]54	0.31	3.3
CF8SD4	[5]48	[5]0.31	[5]10	[5]0.13	[5]2.8
CF8SD7	[5]33	[5]0.27	98	0.27	3.3

[1] Laboratory control for sediment samples LF-SD/TOX-11 through LF-SD/TOX-17 and YWC-SD/TOX-20.
[2] Laboratory control for sediment samples LF-SD/TOX-9, LF-SD/TOX-10, RC-SD/TOX-18, and GC-SD/TOX-19.
[3] Laboratory control for sediment samples CF8SD1 through CF8SD4 and CF8SD7.
[4] Significantly different from the laboratory control sediment.
[5] Statistically different from the reference sediment (CF8SD1).

Notes: Sample locations are shown on Figure 7-2.

% = percent.
mg = milligram.
mm = millimeter.
g = gram.

Table 5-6
Results of Sediment Toxicity Testing for the North Fuel Farm Area Sites

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Sample Location	Toxicity Testing Results			
	Amphipod (*Hyalella azteca*) Survival (%)	Amphipod (*Hyatella azteca*)	Midge Larvae (*Chironomus tentans*) Survival (%)	Midge Larvae (*Chironomus tentans*) Growth (mg)
Control[1]	93	NA	90	0.5
Control[1,5]	98	0.33	72	0.86
AVD-SD/TOX-4	83	NA	[2,3]8	[2,3]0.05
AVD-SD/TOX-4A[5]	99	0.33	80	0.82
AVD-SD/TOX-5	80	NA	[2]23	[2]0.21
AVD-SD/TOX-5A[5]	98	0.37	90	1.01
NCP-SD/TOX-4	[2]73	NA	[2]35	[2]0.14
NCP-SD/TOX-5	[2]63	NA	[2]48	[2]0.33
AVP-SD/TOX-4	98	NA	80	0.53
AVP-SD/TOX-5	100	NA	88	0.74
G10-SD/TOX-4	[2,3]0	NA	[2,3]0	[2,3]NA
G10-SD/TOX-4A[5]	96	0.31	85	0.79
G10-SD/TOX-5	[2,3]48	NA	93	0.45
G10-SD/TOX-5A[5]	100	0.32	83	1.04
ALP-SD/TOX-4	[2,3]53	NA	[2,3]10	[2,4]0.21
ALP-SD/TOX-4A[5]	96	0.36	70	1.05
ALP-SD/TOX-5	[2,3]0	NA	[2,3]0	[2,3]NA
ALP-SD/TOX-5A[5]	95	0.32	82	0.88
POS-SD/TOX-4	[2,3]0	NA	[2,3]0	[2,3]NA
POS-SD/TOX-4A[5]	[2]75	[2]0.23	[2]18	[2]0.45
POS-SD/TOX4B[6]	99	89	0.65	0.24
POS-SD/TOX-5	[2]43	NA	83	0.5
POS-SD/TOX-5A[5]	95	0.31	80	0.83
G14-SD/TOX-4	88	NA	48	[2]0.22
G14-SD/TOX-4A[5]	100	0.41	80	1.12
G14-SD/TOX-5	[2,3]35	NA	[2]60	[2,4]0.48

See notes at end of table.

Table 5-6 (Continued)
Results of Sediment Toxicity Testing for the North Fuel Farm Area Sites

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Sample Location	Toxicity Testing Results			
	Amphipod (*Hyalella azteca*) Survival (%)	Amphipod (*Hyatella azteca*)	Midge Larvae (*Chironomus tentans*) Survival (%)	Midge Larvae (*Chironomus tentans*) Growth (mg)
G14-SD/TOX-5A[5]	94	0.43	92	1.08
STC-SD/TOX-R2 (Reference location)	85	NA	30	0.25

[1] Laboratory control for all sediment sample locations in the North Fuel Farm Area Sites.
[2] Statistically significant difference as compared to the formulated sediment control.
[3] Statistically significant difference as compared to the reference sample (STC-SD/TOX-R2).
[4] A significant reduction in growth was assumed whenever a significant reduction in larval survival was observed.
[5] Sample location was resampled in December 1996.
[6] Sample location was resampled in December 1997.

Notes: % = percent.
mg = milligrams.
NA = not available.
AVD = Aviation Ordnance dam site.
NCP = North Containment Pond site
AVP = Aviation Ordnance Perimeter Road site.
G10 = Gate 10 site.
ALP = Alpha Dam site.
POS = Possum Dam site.
G14 = Gate 14 site.
STC = Sal Taylor Creek (reference).

Table 5-7
Results of Groundwater Toxicity Testing

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Sample Location Percent Sample	Water Flea (*Ceriodaphnia dubia*)		Fathead Minnow (*Pimephales promelas*)	
	Survival (%)	Reproduction (offspring per adult)	Survival (%)	Dry Weight (mg) per minnow
CEF3MW13S				
5	100	27.2	77	0.37
10	90	27.2	92	0.34
20	100	25.7	93	0.35
50	100	[1]22.1	95	0.29
100	100	26.2	78	[1]0.26
Control	100	30.9	93	0.33
[2]C-NOEC = 100	**[2]MATC = NC**	**[2]LOEC > 100**	**[2]C-NOEC=50 [2]MATC=71**	**[2]LOEC = 100**
CEF3MW28S				
5	100	[1]25.0	90	0.36
10	[1]60	14.4	90	0.38
20	[1]60	10.6	93	0.35
50	[1]40	4.2	88	0.36
100	90	[1]4.7	[1]12	0.36
Control	100	30.2	97	0.38
[2]C-NOEC <= 5	**[2]MATC = NC**	**[2]LOEC = 5**	**[2]C-NOEC=100 [2]MATC=71**	**[2]LOEC = 100**

[1] Statistically different relative to control ($p < 0.05$).
[2] All chronic no observed effect concentration (C-NOEC), maximum acceptable toxicant concentration (MATC), and lowest observed effects concentration (LOEC) values presented as a percent of the groundwater sample.

Notes: Sample locations are shown on Plate 3-A.

% = percent.
> = greater than.
< = less than.

Table 5-8
Summary of Toxicity Testing Results for Surface Soil

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site or PSC	Test Organism	Test Type	Test Result
OU 1	Site 1	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test	Soil was not toxic to either test organism.
	Site 2	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test	Soil was not toxic to either test organism.
OU 2	Site 5	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test	Soil was not toxic to either test organism at all sampling locations except for CF5SS4. At this location, there was 100 percent mortality of both earthworms (*E. foetida*) and lettuce seeds (*L. sativa*). Concentrations of TRPH and PCBs in soil were found to be positively correlated with lettuce seed toxicity. Therefore, TRPH and PCBs at surface soil sampling location CF5SS4 may be adversely affecting the terrestrial plant and invertebrate community in the area.
	Site 17	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test	Soil samples collected from Site 17 were not toxic to earthworms. Germination of lettuce seeds was slightly inhibited at CF17SS8 and CF17SS9. However, no correlation of ECPC concentrations and germination of lettuce seeds was observed. It is believed that a nonmeasured physical, biological, or chemical factor is responsible for the observed slight reduction in lettuce seed germination in soil samples, rather than contaminants present in the soil.
OU 3	Site 8	a) *Eisenia foetida* b) *Lactuca sativa*	a) 14-day survival test b) 5-day germination test	Soil samples collected from Site 8 did not cause mortality in earthworms. Growth of earthworms, however, was significantly reduced when exposed to soils from CF8SS13, CF8SS16, CF8SS20, CF8SS21, and CF8SS23. Linear regression analysis showed little correlation between the negative affects on earthworm growth and concentrations of ECPCs. Germination of lettuce seeds was significantly reduced from exposure to soil from CF8SS5, CF8SS6, CF8SS7, CF8SS14, and CF8SS16. Linear regression showed no correlation between percent seed germination and concentrations of analytes in surface soil.
OU 5	Site 15	a) *Eisenia foetida* b) *Lactuca sativa*	a) 30-day survival test b) 5-day germination test	Survival of earthworms was significantly lower than controls at sampling locations CF15SS6, CF15SS26, CF15SS46, and the 100 percent sample of CF15SS15. Growth of earthworms was also inhibited when exposed to soil from CF15SS15. Effects to earthworms may be related to concentrations of lead in soil. Germination of lettuce seeds was generally not affected by exposure to test soils, with the exception of the 100 percent sample of CF15SS20. Concentrations of PAHs may be related to the observed lowered germination rate in this sample.

See notes at end of table.

Table 5-8 (Continued)
Summary of Toxicity Testing Results for Surface Soil

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site or PSC	Test Organism	Test Type	Test Result
OU 8	Site 3	a) *Eisenia foetida* b) *Lactuca sativa*	a) 30-day survival test b) 5-day germination test	Soil samples were not toxic to earthworms. Statistically significant differences in lettuce seed germination rates were observed between soil samples from Site 3 and the control sample. The reliability of these results is suspect because duplicate samples did not show the same germination rates as their respective original samples, and because low germination was observed in the control sample. Linear regression analysis showed little correlation between seed germination rates and concentrations of analytes in surface soil.

Notes: PSC = potential source of contamination.
OU = operable unit.
TRPH = total recoverable petroleum hydrocarbons.
PCB = polychlorinated biphenyls.
ECPC = ecological chemical of potential concern
PAH = polynuclear aromatic hydrocarbons.

Table 5-9
Summary of Toxicity Testing Results for Sediment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site or PSC	Test Organism	Test Type	Test Result
OU 1	Site 1	a) *Hyalella azteca* b) *Ceriodaphnia dubia*	a) 14-day survival test b) 7-day survival and reproduction test	Sediment was not toxic to either test organism at four sampling locations. At one location, RC-Tox-7, percent survival and reproduction were reduced. At another location, RC-Tox-6, reproduction was reduced. These effects are believed to be related to discharge from Site 2.
	Site 2	a) *Hyalella azteca* b) *Ceriodaphnia dubia*	a) 14-day survival test b) 7-day survival and reproduction test	Both survival and reproduction were significantly decreased for the water flea (*C. dubia*) when exposed to sample 2-Tox-2 from the Site 2 tributary, as compared to a control sample. Survival of amphipods (*H. azteca*) was also significantly less than controls when exposed to this sample. Concentrations of iron in sediment were found to be positively correlated with mortality of amphipods during toxicity tests. The presence of other inorganics in the tributary could also be associated with sediment toxicity. Adverse physical conditions (i.e., orange flocculent material) present in the Site 2 tributary may be more responsible for sediment toxicity than the presence of metals in sediment.
OU 2	Site 5	a) *Hyalella azteca* b) *Ceriodaphnia dubia*	a) 14-day survival test b) 7-day survival and reproduction test	Sediment collected from three of the four stations in the Site 5 drainage ditch were toxic to one or both of the test organisms. Impacts to survival of certain invertebrate receptors may be occurring in the Site 5 drainage ditch. This suggests that the mixture of contaminants in the sediment may be toxic to aquatic life. Statistical analyses showed that TRPH, Aroclor-1260, and total DDT concentrations were positively correlated with sediment toxicity.
OU 3	Site 8	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival and growth test b) 14-day survival and growth test	Exposure to sediment collected from CF8SD3 and CF8SD4 caused a significant decrease in survival of the amphipod (*H. azteca*). Significant growth effects in the amphipod, as measured by changes in weight and length, were identified for sediment collected at sampling station CF8SD4. Linear regression revealed a positive correlation between TRPH in sediment and amphipod growth and survival. Exposure to sediments collected from three sample locations (CF8SD3, CF8SD4, and CF8SD7) caused a significant reduction in survival and growth for the midge (*C. tentans*). Linear regressions revealed no positive correlation between the concentration of detected ECPCs in sediment and adverse responses observed in the sediment toxicity tests.
OU 7	Site 16	a) *Hyalella azteca* b) *Ceriodaphnia dubia*	a) 14-day survival test b) 7-day survival and reproduction test	Sediment collected from STC-Tox-1 and STC-Tox-3 was toxic to one or both of the test organisms. Reproduction in the water flea was also reduced at sampling station STC-Tox-3. Toxicity may be attributable to elevated concentrations of TRPH in sediment; however, it is believed that TRPH is not related to disposal activities at Site 16.

See notes at end of table.

Table 5-9 (Continued)
Summary of Toxicity Testing Results for Sediment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site or PSC	Test Organism	Test Type	Test Result
North Fuel Farm Area	Aviation Ordnance Dam Site	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival and growth test b) 14-day survival and growth test	Sediment was collected from sampling station AVD-SD/TOX-4 and AVD-SD/TOX-5 in May 1995 and December 1996. Samples collected from both sample stations had no effect on amphipod (*Hyalella azteca*) survival or growth, for either sampling event. Sediment collected from both sampling stations, during the first sampling event (May 1995) had a significant effect on growth and survival of the midge (*Chironomus tentans*). However, sediment collected from the same sample locations in December 1996 had no effect on midge survival or growth. Simple linear regressions indicated no correlation between the lead and TRPH concentrations detected in sediment and adverse responses observed in the sediment toxicity test.
	North Containment Road Site	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test	Sediment was collected from sampling station NCP-SD/TOX-4 and NCP-SD/TOX-5 in May 1995. A statistically significant reduction in amphipod and midge survival, as compared to the laboratory control, was observed for both sampling stations. However, there was no significant reduction in survival when compared to the reference location. Midge growth was also significantly reduced at both sample locations, as compared to the laboratory control. However, when compared to the reference, there was no statistically significant effect on growth. Simple linear regressions do not indicate a correlation between lead and TRPH concentrations detected in sediment and toxicity test results.
	Aviation Ordnance Perimeter Road Site	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test	Sediment was collected from sampling location AVP-SD/TOX-4 and AVP-SD/TOX-5 in May 1995. The results of the toxicity testing indicated that exposure to sediment had no adverse effect on amphipod survival or midge survival and growth.
	Gate 10 Dam Site	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival and growth test b) 14-day survival and growth test	Sediment was collected from sampling stations G10-SD/TOX-4 and G10-SD/TOX-5 in May 1995 and December 1996. Samples collected from both locations in May 1995 caused statistically significant mortality in the amphipod when compared to the laboratory control and reference location. Toxicity test results from sample location G10-SD/TOX- 4 (collected in May 1995) revealed that midge survival and growth were significantly lower than the control and reference. Simple linear regressions indicated that no correlation exists between lead and TRPH concentrations and adverse responses observed in the sediment toxicity test for sample location G10-SD/TOX-4. The results of the toxicity tests for samples collected in December 1996 showed no adverse effect on amphipod or midge survival and growth.

See notes at end of table.

Table 5-9 (Continued)
Summary of Toxicity Testing Results for Sediment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site or PSC	Test Organism	Test Type	Test Result
North Fuel Farm Area (Continued)	Alpha Dam Site	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival and growth test b) 14-day survival and growth test	Sediment was collected from sampling stations AVP-SD/TOX-4 and AVP-SD/TOX-5 in May 1995 and December 1996. The results of the toxicity tests for sediment collected in May 1995 revealed a statistically significant reduced amphipod survival, and significantly reduced midge survival and growth, as compared to the laboratory control and reference, for both sampling stations. However, the sediment collected in December 1996 showed no adverse effects on survival or growth for either the amphipod or midge. The adverse effects observed for both species in the samples collected in May 1995 are attributable to TRPH detected in sediment, based on detected concentrations in sediment.
	Possum Dam Site	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival and growth test b) 14-day survival and growth test	Sediment was collected from sampling stations POS-SD/TOX-4 and POS-SD/TOX-5 in May 1995 and December 1996. Amphipod survival and midge survival and growth were statistically lower for sampling location POS-SD/TOX-4 (collected in May 1995) as compared to the laboratory control and reference. Similarly, survival and growth of the amphipod and survival of the midge were significantly lower in the samples collected in December 1996 from sampling location POS-SD/TOX-4. Sediment toxicity test results for POS-SD/TOX-5 in May 1995 revealed significant amphipod mortality as compared to the control, but not the reference; no adverse effects to midge survival and growth were observed. Sediment collected from POS-SD/TOX-5 in December 1996 showed no adverse effects to the amphipod or midge. It is likely that the toxic effects to the amphipod and midge are attributable to TRPH, based on the measured concentration in sediment.
	Gate 14 Dam Site	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival and growth test	Sediment was collected from sampling stations G14-SD/TOX-4 and G14-SD/TOX-5 in May 1995 and December 1996. Amphipod survival and midge survival and growth were not significantly lower for G14-SD/TOX-4 (collected in May 1995) as compared to the reference or laboratory control. Midge survival was significantly lower for G14-SD/TOX-5 (collected in May 1995) as compared to the control, but not to the reference; and amphipod survival was significantly lower as compared to the reference and control. However, the sediment collected from both locations in December 1996 had no adverse effects (i.e., significantly lower survival or growth) on the amphipod or midge. The toxic effects observed for both species in the samples collected in May 1995 is attributable to TRPH detected in sediment, based on detected concentrations in sediment.

See notes at end of table.

Table 5-9 (Continued)
Summary of Toxicity Testing Results for Sediment

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site or PSC	Test Organism	Test Type	Test Result
NA	Lake Fretwell and Rowell Creek Upstream of Lake Fretwell	a) *Hyalella azteca* b) *Chironomus tentans*	a) 14-day survival test b) 14-day survival test	Mortality of 100 percent was observed in the amphipod (*H. azteca*) at the Lake Fretwell sampling stations LF-SD/TOX-11 and LF-SD/TOX-12. Additionally, 58 percent mortality was observed in the midge larvae (*C. tentans*) test at sampling station LF-SD/TOX-9. Impacts to survival of certain invertebrate receptors may be occurring in the southern portion of Lake Fretwell. In Rowell Creek upstream of Lake Fretwell, sediment from RC-SD/TOX-18 was toxic to the midge larvae. Linear regressions revealed no positive association between the concentration of detected ECPCs in sediment and adverse responses observed in the sediment toxicity tests.

Notes: PSC = potential source of contamination.
OU = operable unit.
TRPH = total recoverable petroleum hydrocarbons.
DDT = dichlorodiphenyltrichloroethane.
NA = not applicable.
ECPC = ecological contaminant of potential concern.

Table 5-10
Summary of Toxicity Test Results for Groundwater

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site or PSC	Test Organism	Test Type	Test Result
OU 8	Site 3	a) *Ceriodaphnia dubia* b) *Pimephales promelas*	a) Dilution-series chronic test b) Dilution-series chronic test	Exposure to undiluted groundwater resulted in reduced growth and mortality in the fathead minnow, and reduced survival and reproduction in the water flea. Three dichlorobenzene isomers appear to be the primary risk contributors for groundwater at Site 3. When groundwater was diluted approximately 20-fold during testing, little toxicity was observed; this dilution is an order of magnitude less than the 133-fold dilution expected when groundwater discharges to Rowell Creek.

Notes: PSC = potential source of contamination.
OU = Operable Unit.

interpretation of the test results for surface soil and sediment bioassays are shown in Tables 5-8 and 5-9, respectively, and are discussed below.

Site 1 Surface Soil. Fifteen surface soil samples were collected for toxicity testing from Site 1 (1SS01 through 1SS15; Plate 4). The toxicity testing results of surface soil collected from Site 1 are tabulated in Table 5-2 and summarized in Table 5-8. Soil samples collected from Site 1 were not toxic to *E. foetida*. The earthworms exposed to the samples produced cocoons in several test chambers and generally gained more weight than the earthworms in the control sample, indicating good health. In general, soil collected from Site 1 was not toxic to *L. sativa*, with the exception of one of the background samples, BSS01. Although germination was statistically different in two samples (BSS01 and 1SS06) compared to the respective control samples, only sample (BSS01) substantially affected germination. The germination in the remaining samples exceeded 80 percent; therefore, it is believed that germination of *L. sativa* was not affected by exposure to surface soil from Site 1.

Site 1 Sediment. Five sediment samples were collected from Rowell Creek adjacent to Site 1 for toxicity testing (RC-Tox-6, RC-Tox-7, RC-Tox-8, RC-Tox-8A, and RC-Tox-9; Plate 2). The toxicity testing results of sediment collected from Site 1 are tabulated in Table 5-4 and summarized in Table 5-9. The elutriate samples from the sediment collected from Rowell Creek at Site 1 were not toxic to *C. dubia* except at location RC-Tox-6 (reproduction results) and location RC-Tox-7 (percent survival and reproduction). There is no widely accepted method to determine statistical significance of these test results. However, results of less than 80 percent survival and fewer than 15 offspring are generally considered to be significant (Springborn Laboratories, 1994). None of the sediment samples collected at Site 1 from Rowell Creek were toxic to *H. azteca*.

Site 2 Surface Soil. Ten surface soil samples were collected for toxicity testing from Site 2 (2SS01 through 2SS10; Plate 4). The toxicity testing results of surface soil collected from Site 2 are tabulated in Table 5-2 and summarized in Table 5-8. None of the soil samples collected from Site 2 were toxic to *E. foetida*. The earthworms exposed to the samples produced cocoons in several test chambers and generally gained more weight than the earthworms in the control sample, indicating good health. In general, soil collected from Site 2 was not toxic to *L. sativa*, with the exception of one of the background samples, BSS01. Although germination was statistically different in two samples (BSS01 and 2SS04) compared to the respective control samples, only sample (BSS01) substantially affected germination. The germination in the remaining samples exceeded 80 percent; therefore, it is believed that germination of *L. sativa* was not affected by exposure to surface soil from Site 2.

Site 2 Sediment. Two sediment samples were collected from the tributary adjacent to Site 2 for toxicity testing (2-Tox-2 and 2-Tox-3; Plate 2). The toxicity testing results of sediment collected from Site 2 are tabulated in Table 5-4 and summarized in Table 5-9. There is no widely accepted method to determine statistical significance of toxicity test results for *C. dubia*; however, results of less than 80 percent survival and fewer than 15 offspring are generally considered to be significant (Springborn Laboratories, 1994). Based on this method, the sediment sample at location 2-Tox-2 adversely affected both survival and reproduction of *C. dubia*, as compared to both the reference and the laboratory control. Also, survival of *H. azteca* was significantly less than controls in sediment sample 2-Tox-2.

5.1.1.2 **Operable Unit 2** Both surface soil and sediment samples were collected for toxicity testing at Site 5. Only surface soil samples were collected for toxicity testing at Site 17; there is no water body directly associated with Site 17 from which sediment could be collected. Soil and sediment samples were collected in 1993 (Springborn Laboratories, 1994). Numerical results of surface soil and sediment toxicity testing are shown in Tables 5-2 and 5-4, respectively. Analysis and interpretation of the test results for surface soil and sediment from OU 2 are shown in Tables 5-8 and 5-9, respectively.

Site 5 Surface Soil. Fifteen surface soil samples were collected for toxicity testing from Site 5 (CF5SS2, CF5SS4, CF5SS6, CF5SS8, CF5SS9, CF5SS13, CF5SS14, CF5SS15, CF5SS19, CF5SS20, CF5SS21, CF5SS23, CF5SS24, CF5SS26, CF5SS31; Plate 4). The toxicity testing results of surface soil collected from Site 2 are tabulated in Table 5-2 and summarized in Table 5-8. With the exception of sample CF5SS4, soil samples were not toxic to *E. foetida*. At CF5SS4, 100 percent mortality was observed in the earthworm. *E. foetida* exposed to all other Site 5 soil samples produced cocoons in several test chambers and generally gained more weight than those in the control soil, indicating good health.

In general, the soil collected from Site 5 did not inhibit germination of *L. sativa*, with the exception of sample CF5SS4, where germination was statistically different from the control sample at 22 percent. In addition, germination of *L. sativa* following exposure to one background soil sample (BSS01) was statistically different compared to its respective control sample. Despite the statistical significance for this sample, its germination rate was relatively high (79 percent), and all remaining Site 5 soil samples exhibited over 79 percent germination. It is concluded, then, that germination of *L. sativa* was not adversely affected by exposure to surface soil samples at Site 5, with the exception of CF5SS4.

Site 5 Sediment. Five sediment samples were collected from a drainage ditch at Site 5 for toxicity testing (5-Tox-1 through 5-Tox-5; Plate 2). The toxicity testing results of sediment collected from Site 5 are tabulated in Table 5-4 and summarized in Table 5-9. Mortality of *H. azteca* in three samples (5-Tox-1, 5-Tox-3, and 5-Tox-4) was statistically significant as compared to controls, with values of 76 percent, 64 percent, and 29 percent, respectively. The results for the *C. dubia* tests are difficult to compare statistically to the control results. In general, test results are considered to be significant if there is less than 80 percent survival and fewer than 15 offspring per adult (Springborn Laboratories, 1994). Using this interpretation of the results, mortality was significant in *C. dubia* for station 5-Tox-4, at 40 percent. A reduced number of offspring compared to the upstream reference sample (12) was observed at stations 5-Tox-3 and 5-Tox-4 at 9 and 8, respectively. Reproduction was also suppressed in the upstream reference at 12 versus the threshold of 15.

Site 17 Surface Soil. Seven surface soil samples were collected for toxicity testing from Site 17 (CF17SS3, CF17SS6, CF17SS8, CF17SS9, CF17SS10, CF17SS11, CF17SS12; Plate 4) for sampling locations. The toxicity testing results of surface soil collected from Site 17 are tabulated in Table 5-2 and summarized in Table 5-8. The soil samples collected from Site 17 were not toxic to *E. foetida*. The earthworms exposed to the soil produced cocoons in several test chambers and generally gained more weight than those in the control soil, indicating good health. The soil samples collected also did not adversely affect germination of

L. sativa, except at one of the background sampling locations (BSS01) and at locations CF17SS8 and CF17SS9 (at 59 percent and 69 percent, respectively).

5.1.1.3 Operable Unit 3 Surface soil and sediment toxicity tests at OU 3, Site 8 were completed in 1995 (ESE, 1995c). Toxicity tests were not completed for Site 7. Numerical results of surface soil and sediment toxicity testing are presented in Tables 5-2 and 5-5, respectively. Analysis and interpretation of the test results for surface soil and sediment from OU 3 are presented in Tables 5-8 and 5-9, respectively.

Site 8 Surface Soil. Twelve surface soil samples were collected from Site 8 for whole-soil toxicity testing (CF8SS4, CF8SS5, CF8SS6, CF8SS7, CF8SS9, CF8SS13, CF8SS14, CF8SS16, CF8SS20, CF8SS21, CF8SS22, and CF8SS23). A surface soil reference sample was not collected at Site 8. The toxicity test results for surface soil collected from Site 8 are presented in Table 5-2 and summarized in Table 5-8.

For the whole-soil tests, survival of *E. foetida* was not significantly reduced as compared to the control in any of the samples collected from Site 8; *E. foetida* experienced 100 percent survival when exposed to soil at all the sample locations. However, the mean growth *of E. foetida* was significantly lower at five sample locations (CF8SS13, CF8SS16, CF8SS20, CF8SS21, and CF8SS23) as compared to the control. Germination of *L. sativa* was significantly lower in the test soil as compared to the control at five sample locations (CF8SS5, CF8SS6, CF8SS7, CF8SS14, and CF8SS16).

Site 8 Sediment. Five sediment samples were collected from Site 8 for bulk-sediment toxicity testing (CF8SD1, CF8SD2, CF8SD3, CF8SD4, and CF8SD7). CF8SD1 was treated as the sediment reference sample location; however, this location may be unsuitable as a reference sample because it was collected from a separate drainage system than the other Site 8 sediment toxicity samples. Furthermore, CF8SD1 may be impacted by contaminants unique to that sample location. The toxicity test results for the sediment collected Site 8 are presented in Table 5-5 and summarized in Table 5-9. Survival and mean growth *of C. tentans* were significantly reduced at three sample locations (CF8SD3, CF8SD4, and CF8SD7) as compared to the reference. Survival of *H. azteca* was significantly reduced in two samples (CF8SD3 and CF8SD4) as compared to the reference; growth of *H. azteca*, as measured by weight and length, was significantly lower at sample location CF8SD4 as compared to the reference.

5.1.1.4 Operable Unit 4 Toxicity testing has not been completed for media at OU 4.

5.1.1.5 Operable Unit 5 Surface soil toxicity tests at OU 5, Site 15 were completed in 1995 (ESE, 1995a). Toxicity tests were not completed for Site 14. Numerical results for these tests are tabulated in Table 5-3.

Site 15 Surface Soil. Six surface soil samples were collected from Site 15 for whole-soil toxicity testing, including a reference sample (CF15SS6, CF15SS7, CF15SS18, CF15SS26, CF15SS46, and reference sample CF15SS48; Plate 4). Two samples were also collected for definitive (dilution-series) toxicity testing from locations CF15SS15 and CF15SS20. The toxicity testing results of surface soil collected from Site 15 are tabulated in Table 5-3 and summarized in Table 5-8.

For the whole-soil tests, survival of *E. foetida* was significantly different from controls and the reference sample at locations CF15SS6, CF15SS26, and CF15SS46. At the end of the 30-day test period, *E. foetida* exposed to soil at these locations experienced 100 percent mortality. For the dilution-series tests with CF15SS15, some earthworm mortalities were observed in the lowest two concentrations of soil (6.25 percent and 12.5 percent) that were not duplicated during replicate testing; therefore, these results are not considered to be significant. For the 100 percent sample of CF15SS15, 100 percent mortality of *E. foetida* was observed after 30 days of exposure. There was weight loss in the *E. foetida* exposed to all concentrations of the dilution-series test for this sample. The 30-day LC_{50} for this sample was determined to be 30.7 percent of the soil. For the dilution-series tests with CF15SS20, no LC_{50} could be calculated because *E. foetida* survival for the 100 percent sample was 97 percent, and all organisms exposed gained weight during the testing period.

With the exception of the 100 percent sample of CF15SS20, there were no significant differences in germination of *L. sativa* between test soils and the control or reference soils. At this one location, germination of *L. sativa* was 56 percent.

5.1.1.6 Operable Unit 6 Toxicity testing has not been completed for media at OU 6.

5.1.1.7 Operable Unit 7 Sediment samples were collected in the drainage ditches east of Sal Taylor Creek and downgradient of OU 7, Site 16, for toxicity testing (Springborn Laboratories, 1994). Samples were collected in 1993. Numerical results of sediment toxicity tests are tabulated in Table 5-4 and summarized in Table 5-9.

Site 16 Sediment. Two sediment samples were collected from the drainage ditches east of Sal Taylor Creek, located downgradient of Site 16, for toxicity testing (STC-Tox-1 and STC-Tox-3; Plate 2). The reference location STC-Tox-R1 was collected in Sal Taylor Creek upstream of Site 16. The toxicity testing results of sediment collected downgradient of Site 16 are tabulated in Table 5-4 and summarized in Table 5-9. Significant mortality of *H. azteca* (100 percent and 80 percent) was observed at stations STC-Tox-1 and STC-Tox-3, respectively. The results for the *C. dubia* tests are difficult to compare statistically to the control results. Ten replicates of the sediment elutriate are exposed to one *C. dubia* per replicate; therefore, percent survival is reported as a pass or fail result (i.e., either 0 or 100 percent survival). In general, test results are considered to be significant if there is less than 80 percent survival and fewer than 15 offspring per adult (Springborn Laboratories, 1994). Using this interpretation of the results, mortality was significant in *C. dubia* for station STC-Tox-3 (50 percent); a reduced number of offspring (seven as compared to 15) was also observed at this station.

5.1.1.8 Operable Unit 8 Surface soil and groundwater samples were collected for toxicity testing from OU 8, Site 3 (Inchcape Testing Services/Aquatec Laboratories, 1995a). Samples were collected in 1994. Numerical results of surface soil and groundwater toxicity tests are shown in Tables 5-2 and 5-7, respectively. Analysis and interpretation of the test results for surface soil and groundwater are shown in Tables 5-8 and 5-10, respectively.

Site 3 Surface Soil. Nine surface soil samples were collected for toxicity testing from Site 3 (CEF3SS1, CEF3SS4, CEF3SS9, CEF3SS12, CEF3SS15, CEF3SS17, CEF3SS20, CEF3SS22, and CEF3SS24; Plate 4). The toxicity testing results of surface soil collected from Site 3 are tabulated in Table 5-2 and summarized in Table 5-8. Soil collected from Site 3 was not toxic to *E. foetida*. Survival was similar to that in the control and reference soil samples, ranging from 98 to 100 percent for the 28-day exposure. Germination of *L. sativa* was 95 percent in the control soil sample, but only 50 percent in the reference soil sample CEF3SS1. Seed germination in samples CEF3SS17 and CEF3SS20 was significantly different from the reference soil sample. Interpretation of the germination test results is difficult for two reasons. First, the germination seen in the reference soil sample is relatively low, making comparisons to it somewhat questionable. Second, there was a high degree of variability in three replicate tests completed as part of the study. Sample CEF3SS22 showed low germination (24 percent) that was not statistically significant, probably because of high replicate variability.

Site 3 Groundwater. Groundwater samples were collected from two monitoring wells at Site 3 and submitted for toxicity testing (CEF3MW13S and CEF3MW28S; Plate 3). The toxicity testing results of groundwater collected from Site 3 are tabulated in Table 5-7 and summarized in Table 5-10. Chronic toxicity was observed in *P. promelas* exposed to groundwater from both CEF3MW13S and CEF3MW28S. The chronic no observed effect concentration (C-NOEC) in both samples was 50 percent, and the maximum acceptable toxicant concentration (MATC) in both samples was 71 percent. Chronic toxicity was not reported for *C. dubia* at CEF3MW13S. A statistically significant adverse reproductive response was noted in the 50 percent groundwater sample from this location; however, the 100 percent groundwater sample showed no adverse response, thus the 50 percent response is considered an anomaly. Chronic toxicity was observed in both test species at CEF3MW28S, with *C. dubia* exhibiting a higher degree of sensitivity than P. *promelas*. The C-NOEC for C. dubia was less than 5 percent of the groundwater sample from this location, and the lowest observed effect concentration (LOEC) was 5 percent. Some uncertainty is associated with the *C. dubia* test results—while no significant mortality was observed in the 100 percent undiluted groundwater sample, 60 percent mortality was observed in the 50 percent dilution sample. Overall, up to a 20-fold dilution (5 percent sample) was necessary to remove adverse effects in one or both of the test organisms.

5.1.2 Other Sites and PSCs Toxicity testing of sediment was completed for Lake Fretwell and Rowell Creek upstream of Lake Fretwell in 1995 (ESE, 1995b). The toxicity testing results of sediment collected from Lake Fretwell and Rowell Creek upstream of the lake are tabulated in Table 5-5 and summarized in Table 5-9. Sediment toxicity testing was also completed for the North Fuel Farm Area, which included seven sites. The results of the toxicity tests are presented in Table 5-6 and summarized in Table 5-9. Toxicity tests were not conducted at any of the PSCs at NAS Cecil Field.

5.1.2.1 Lake Fretwell Sediment Eight sediment samples from Lake Fretwell (LF-SD/Tox-9 through LF-SD/Tox-16), three samples from Rowell Creek upstream of Lake Fretwell (LF-SD/Tox-17, RC-SD/Tox-18, and GC-SD/Tox-19), and one sample from a reference location in Yellow Water Creek (YWC-SD/Tox-20) were submitted for 14-day survival toxicity tests using amphipods (*H. azteca*) and midge larvae (*C. tentans*). Plate 2 shows these sampling locations. The toxicity testing results of sediment collected from these areas are tabulated in Table 5-5 and summarized in Table 5-9.

Survival of *H. azteca* in the reference (YWC-SD/TOX-20), was significantly different ($p \leq 0.05$) from the laboratory control sediment. Survival of *H. azteca* in samples from stations LF-SD/TOX-11 and LF-SD/TOX-12 was significantly different from the reference sediment sample. Growth, reported as weight and length, of *H. azteca* in the sediment from all sample stations was not significantly different from the laboratory control and reference sample. Growth of *H. azteca* in sediment from stations LF-SD/TOX-11 and LF-SD/TOX-12 could not be determined due to 100 percent mortality.

Survival of *C. tentans* exposed to sediment from stations LF-SD/TOX-9, LF-SD/TOX-13, LF-SD/TOX-14, LF-SD/TOX-15, and RC-SD/TOX-18 was significantly different from the laboratory control sediment sample. Survival of *C. tentans* exposed to sediment from stations LF-SD/TOX-9 and RC-SD/TOX-18 was significantly different from the reference sediment sample. Growth of *C. tentans* exposed to the sediment samples was not significantly different from the control or reference sediment samples. Complete information on the sediment toxicity testing from Lake Fretwell and Rowell Creek upstream of Lake Fretwell is presented in Appendix D-5.

5.1.2.2 **North Fuel Farm Area** The North Fuel Farm Area consist of seven sites, including the Aviation Ordnance (AVORD) Dam, North Containment Pond, AVORD Perimeter Road, Gate 10 Dam, Alpha Dam, Possum Dam, and Gate 14 Dam. In May 1995, two sediment samples were collected for toxicity testing from each of the sites. Five of the sites, including the AVORD Dam, Gate 10 Dam, Alpha Dam, Possum Dam, and Gate 14 Dam were resampled in December 1996, and submitted for sediment toxicity testing. The samples collected in May 1995 were submitted for 14-day toxicity testing of the amphipod (*Hyalella azteca*) survival and midge (*Chironomus tentans*) survival and growth. The samples collected in December 1996 were submitted for 14-day toxicity testing of amphipod and midge survival and growth. The toxicity testing results are presented in Table 5-6 and summarized in Table 5-9. The results of the toxicity testing for each of the sites associated with the North Fuel Farm Area are discussed below.

AVORD Dam Site. Two sampling locations in Sal Taylor Creek (AVD-SD/TOX-4 and AVD-SD/TOX-5) were identified for toxicity testing, one upstream and one downstream of the AVORD Road Bridge. Sediment samples were collected from these locations in May 1995 and again in December 1996. No adverse effects to amphipod survival were identified for either of the samples collected in May 1995. However, survival and growth of the midge exposed to sediment from both sampling locations were significantly reduced as compared to the control. Survival and growth of the midge exposed to sediment from sampling location AVD-SD/TOX-5 was significantly reduced as compared to the control sample only. Toxicity tests conducted samples collected in December 1996 had no adverse effect on amphipod or midge survival or growth.

North Containment Pond Site. Two sediment samples were collected in May 1995 for toxicity testing. Sample NCP-SD/TOX-4 was collected from the containment pond, and sample NCP-SD/TOX-5 was collected from Sal Taylor Creek, downstream of the containment pond. Amphipod survival and midge survival and growth were significantly reduced as compared to the control. However, there were no significant differences for either of the test species when compared to the reference location. These sample locations were not resampled in December 1996.

AVORD Perimeter Road Site. Two sediment samples were collected in May 1995 for toxicity testing. Sample AVP-SD/TOX-4 and AVP-SD/TOX-5 were collected from the

tributary to Sal Taylor Creek west of the AVORD Perimeter Road site. No adverse effects (i.e. reduced survival and growth) to amphipods or midges were observed in sediment toxicity tests conducted using samples collected at either of these locations. These sample locations were not resampled in December 1996.

Gate 10 Dam Site. Two sampling locations (G10-SD/TOX-4 and G10-SD/TOX-5) were identified in Sal Taylor Creek, north and south of the Perimeter Road. Sediment samples were collected from these locations in May 1995 and again in December 1996. Amphipod mortality was significantly reduced as compared to the control and reference for both sample locations. Midge mortality and growth were significantly reduced as compared to the control and reference for sample G10-SD/TOX-4. No adverse effects (i.e. mortality or reduced growth) to the amphipod or midge were identified for samples collected in December 1996.

Alpha Dam Site. Two sampling locations (ALP-SD/TOX-4 and ALP-SD/TOX-5) were identified in Sal Taylor Creek, west of the runway. Sediment samples were collected from these location in May 1995 and again in December 1996. Amphipod survival was significantly reduced as compared to the control and reference for both sample locations. Midge survival and growth were also significantly reduced as compared to the control and reference for both sample locations. However, no adverse effects (i.e. mortality or reduced growth) to the amphipod or midge were observed for samples collected in December 1996.

Possum Dam Site. Two sampling locations (POS-SD/TOX-4 and POS-SD/TOX-5) were identified in Sal Taylor Creek west of the Perimeter Road. Sediment samples were collected from these locations in May 1995, in December 1996, and again in December 1997 (sample location POS-SD/TOX-4 only). Toxicity tests results for POS-SD/TOX-4 identified significantly reduced amphipod survival and midge survival and growth. The results of the toxicity test conducted with sediment from POS-SD/TOX-4 (collected in December 1996) had similar results. Amphipod survival and growth and midge survival were significantly reduced as compared to the control. Sediment from location POS-SD/TOX-5 (collected in May 1995) caused a significant reduction in survival of the amphipod, as compared to the control, but not the reference. Sediment from location POS-SD/TOX-5 had no adverse effect on midge survival or growth. In addition samples collected from POS-SD/TOX-5, in December 1996, had no adverse effect on either of the test species. No adverse effects (i.e., mortality or reduced growth) to the amphipod or midge were observed for sample POS-SD/TOX 4 collected in December 1997.

Gate 14 Dam Site. Two sampling locations (G14-SD/TOX-4 and G14-SD/TOX-5) were identified in Sal Taylor Creek west of the Gate 14 Dam Road. Sediment samples were collected from these locations in May 1995 and again in December 1996. Survival of the amphipod and midge in sample G14-SD/TOX-4 (collected in May 1995) was not significantly different from control or reference. Sediment samples collected during the first sampling event from location G14-SD/TOX-5 had significantly reduced midge survival as compared to the control, but not the reference, and a significant reduction in amphipod survival as compared to the laboratory control and reference. However, no adverse effects (i.e. mortality or reduced growth) to the amphipod or midge were identified for samples collected in December 1996.

5.2 AQUATIC STUDIES. Aquatic studies conducted at NAS Cecil Field include examination and sampling of aquatic resources and habitats. Aquatic resources

include fish, invertebrates, and aquatic plants. The timing and scope of the aquatic studies completed at NAS Cecil Field are reported in Appendix C.

A semiquantitative macroinvertebrate survey was conducted at NAS Cecil Field in June and July 1993 (EA, 1994a). An earlier aquatic sampling event was completed in 1991 (ECT, 1992). The 1991 sampling event included sampling of aquatic macroinvertebrate and fish communities at six locations in Rowell Creek. This 1991 study was completed to identify ecological receptors in Rowell Creek and to characterize the status of macroinvertebrate populations. The results of this study were used, in part, to design the aquatic sampling program that was completed in 1993.

The 1993 sampling event included sampling of aquatic macroinvertebrate communities at locations throughout Rowell Creek and Lake Fretwell. Macroinvertebrate sampling at NAS Cecil Field was completed during a low-flow period, which is considered to be a period of high stress (FDEP, 1992). Detailed discussions of the field and laboratory methodology for collection and analyses of the macroinvertebrate data are provided in appendices of the BRAs for each OU. The sampling plan generally included

- collection of parameters describing aquatic habitat,
- collection of macroinvertebrates by use of dip-net sweeps,
- collection of macroinvertebrates by use of Hester-Dendy artificial substrates, and
- collection of macroinvertebrates by use of three replicate petite ponar dredge samples.

At each station location sampled, an aquatic habitat parameter characterization was performed. Physical/chemical parameters included surrounding land use, local watershed information, canopy cover, width, depth, velocity, sediment/substrate characteristics, weather conditions, and water quality measurements (including temperature, DO, pH and conductivity). Metrics used in the characterization of the benthic macroinvertebrate study are presented in Table 5-11.

At stations that were wadable, benthic macroinvertebrates were collected by use of a D-frame dip net. Qualitative samples were collected by conducting net sweeps from multiple habitats at each station. Net sweeps were distributed in the different habitat types (i.e., snags, leaf packs, aquatic vegetation, undercut banks, etc.).

Hester-Dendy artificial substrates were used in addition to dip-net sampling in wadable habitats. Three replicate Hester-Dendy samplers were placed at each station approximately 4 weeks prior to collection of the dip-net samples. The metrics used to describe the structure and function of the benthic macroinvertebrate community as sampled by Hester-Dendy samplers are described in Table 5-11.

At all stations, three replicate samples were collected with a petite ponar grab sampler to investigate the macroinvertebrate community associated with sediment. The metrics used to describe the structure and function of the benthic macroin

Table 5-11
Benthic Macroinvertebrate Community Metrics

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Jacksonville, Florida

Metric	Description
Total taxa (number of invertebrate taxa)	Defines species richness. Richness generally increases with increasing water quality, habitat diversity, and/or habitat suitability (U.S. Environmental Protection Agency [USEPA], 1990).
Number of individuals per square meter	Classifies invertebrate density (USEPA, 1990)
Dominant taxon	Measures redundancy. A high level of redundancy (i.e., dominance of the fauna by a single taxon) is equated with the dominance of a pollution tolerant organism and a lowered diversity (Plafkin and others, 1989).
Percent dominant taxon	Calculated as the ratio of the taxonomic group with the most individuals (dominant) to the total number of organisms. Percent dominance should remain low to reflect a healthy biotic condition (Plafkin and others, 1989).
Florida index	Commonly used index for Florida streams that focuses on the tolerance of specific populations indigenous to the state. This index does not use the entire macroinvertebrate assemblage, and is heavily weighted to the arthropods (e.g., insects with horny segmented external covering and jointed limbs). The Florida index increases in value as the condition of the water quality increases (Florida Department of Environmental Regulation [FDER], currently known as Florida Department of Environmental Protection, 1990).
Shannon-Weaver index	Measures indices of community structure and function. The Shannon-Weaver value may range from 0 to 3.3 log N, where N = the total number of individuals. This index is often insensitive to subtle changes in community structure unless the environment has been grossly modified; however, it is often used to calculate other indices (USEPA, 1990).
Percent diptera	Increases in the presence of stress (USEPA, 1990).
Percent chironomid	Represents pollution tolerant benthic taxa (USEPA, 1990).
Percent ephemeroptera-plecoptera-trichoptera (EPT)	Consists of the most pollution sensitive benthic taxa. Good biotic condition is reflected in communities having a fairly even distribution among EPT and chironomids (USEPA, 1990).
Percent collector-filtered	Reflects the riffle/run community food base and provides insight into the nature of potential disturbance factors. Predominance of a feeding type may indicate an unbalanced community responding to an overabundance of a particular food source. Filtering collectors are sensitive to toxicants bound to fine particulate organic material and may decrease in abundance when exposed to sources of such bound toxicants (USEPA, 1990).
Percent shredders	Shredders are sensitive to riparian (bank to bank) zone impacts and are particularly good indicators of toxic effects when the toxicants are readily adsorbed to course particulate organic matter (USEPA, 1990).
Percent calcium dependent	Measures the number of crustacean and mollusc individuals. These taxa are calcium-dependent and are generally most diverse in alkaline-fed streams. Stress such as habitat degradation or chemical contamination may eliminate certain taxa represented in this metric (FDER, 1990).
Hisenhoff biotic index (HBI)	Developed to summarize overall pollution tolerance of the benthic arthropod community. Similar in concept to the Florida index, but incorporates abundance and a slightly different weighing factor for tolerance. Tolerance values are assigned ranging from 0 to 10 (10 signifying the most tolerant). The 0-10 scale was modified to include nonarthropod species. The HBI index decreases in value with increasing water resource integrity. Although it may be applicable for other types of pollutants, use of the HBI in detecting nonorganic pollution effects has not been thoroughly evaluated (FDER, 1990; USEPA, 1990).

vertebrate community as sampled by the ponar dredge are also presented in Table 5-11. The taxa identified from the ponar samples are indicative of the infaunal (within, as opposed to on top, of benthic deposits) benthic community with some epifaunal components represented. Station-to-station differences in the benthic macroinvertebrate community may be due to variations in substrate composition and/or man-induced alterations on the population. Because no State of Florida regional reference exists for this gear type, all comparisons were made to the reference stations for each site and PSC.

To minimize disturbance to samples and habitat before each sample type was collected, the order of collection was Hester-Dendy, ponar, and dip net, working upstream from the previous sample collection, where possible.

Fish were collected by use of either a 10- or 25-foot seine net at each station sampled. The sampling was qualitative in approach, as dictated by habitat restrictions.

Aquatic habitat quality and biological condition scores were calculated for the sampling stations based on data collected from the above field-survey efforts. The sampling and analyses of the benthic communities and aquatic habitat assessment generally follow USEPA rapid bioassessment protocols (RBP), a cumulative metric technique developed by USEPA (1989c), modified by Barbour and others (1992) and further adapted by FDEP (FDEP, 1992). This process involves the use of a series of metrics or community attributes, each of which is designed to evaluate a component of benthic community structure or function (Table 5-11). The State of Florida regional reference station (Five Mile Creek) was used as a standard of comparison.

The biological and habitat scores obtained by the above methods were divided by the reference score for a percent comparability value. Regression analyses were performed and the stations were plotted. Sampling station locations (which are denoted by the "-Bio-" qualifier) are presented on Plate 2. The figures that present the relationship between habitat quality and biological condition are presented in the OU-specific discussions.

Sampling station plots that fall within the 95 percent confidence interval lines indicate a predictable condition of the biological community in response to habitat quality. This relationship can be expected only in the absence of poor water quality; that is, poor water quality would prevent the biological community from reaching its potential even though appropriate habitat conditions exist. Sites that fall in the lower right-hand area indicate the depression of biological conditions in habitats that have the capacity to support a healthy community. This is usually an indication of toxic conditions resulting from poor water quality. Artificial (and usually temporary) elevation of biological condition because of organic enrichment would put sites in the upper left-hand area of these graphs.

Study results are summarized in the following sections according to OUs and other PSCs. Findings from additional sampling efforts at stations not considered as part of an OU are presented in Subsection 5.2.2.

5.2.1 Operable Units Aquatic studies have been completed at OUs 1, 2, 7 and 8. Results of these studies serve as measurement endpoints for assessing the survival and maintenance of aquatic communities and populations within the surface water

and sediment at specific study sites. Findings from these studies are summarized below.

5.2.1.1 **Operable Unit 1** The initial aquatic sampling event of OU 1 was completed in 1991 (ECT, 1992). The 1991 sampling event included sampling of aquatic macroinvertebrate and fish communities at six locations in Rowell Creek. One sampling station was located in Rowell Creek adjacent to Site 1 and one station was located downstream of OU 1. Results of this sampling event were used for planning the 1993 sampling event. Aquatic habitats at Sites 1 and 2 were characterized as part of a field survey completed in July 1993 (EA, 1994a). Six aquatic sampling stations were located in Rowell Creek adjacent to Site 1 and downstream of Site 2 (RC-Bio-6, RC-Bio-7, RC-Bio-8A, RC-Bio-8, RC-Bio-9, and RC-Bio-10). Two sampling stations were located in the Site 2 tributary (2-Bio-2 and 2-Bio-3). Two reference locations in Rowell Creek (RC-Bio-4 and RC-Bio-5) were selected for comparative analysis. The OU 1 biological sampling stations are presented on Plate 2.

The 1993 aquatic sampling effort was focused on collection of information on the status of macroinvertebrate community structure and function that would be directly comparable to the results of chemical analyses of surface water and sediment and sediment toxicity testing, and included quantitative collection of macroinvertebrates and qualitative collection of fish. The study area for Sites 1 and 2 consisted of Rowell Creek adjacent to Site 1 and a tributary at Site 2. Appendix C summarizes the objectives of the study. Sampling methods and a description of the metrics used for this study are presented in Section 5.2 and Table 5-11, respectively.

A summary of the water quality measurements and surface water results for total hardness, nitrate and nitrite, total nitrogen, and total phosphorus are summarized in Table 5-12. With the exception of 2-Bio-1, water depth was 1 meter or less at all stations. Water temperatures ranged from 23.0 to 26.1 degrees Celsius (°C) and pH ranged from 6.2 to 7.2, both of which are within normal ranges. The DO values ranged from a very low value of 0.5 mg/ℓ at 2-Bio-1 to a high of 5.6 mg/ℓ at RC-Bio-4. Conductivity was highest at RC-Bio-9 (402 micromhos per centimeter [μmhos/cm]). Compared to the locations upstream of Sites 1 and 2, including RC-Bio-4 and RC-Bio-5 (269 and 279 μmhos/cm, respectively), conductivity was generally higher at the Rowell Creek locations adjacent to Site 1 (261 to 402 μmhos/cm) and lower at Site 2 (184 to 206 μmhos/cm). All measurements of conductivity fall within the normal range according to State of Florida surface water quality standards (Florida Legislature, 1996).

Water clarity is classified as clear at all stations except RC-Bio-4, RC-Bio-5, 2-Bio-2, and 2-Bio-3. Stations RC-Bio-4 and RC-Bio-5 have a water clarity that is classified as slightly tannic. Both locations at Site 2 are turbid and have an orange-rust-colored appearance. The water column contains an orange-rust-colored flocculent material. The material could represent precipitated metals including aluminum and iron, as well as microbial mass. The surface water at Site 2 also has an iridescent appearance that breaks apart. Periphyton occurs at most stations, but was absent at stations 2-Bio-2 and 2-Bio-3.

Table 5-13 contains the results of the habitat assessment scores for each of the sampling stations at OU 1, including the State of Florida regional reference, Five Mile Creek. Habitat quality at one of the reference stations, RC-Bio-5 (score of 64), is comparable to the downstream Rowell Creek stations (RC-Bio-6 to RC-Bio-10,

Table 5-12
Summary of OU 1 Surface Water Quality Measurements

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Depth (m)[1]	Temperature (°C)[1]	pH[1]	DO (mg/ℓ)[1]	Conductivity (μmhos/cm)[1]	Secchi (m)[1]	Total Hardness (mg/ℓ as $CaCO_3$)[2]	Nitrate plus Nitrite (mg/ℓ)[2]	Total Nitrogen (mg/ℓ)[2]	Total Phosphorus (mg/ℓ)[2]
RC-Bio/SW-4	0.5	25.6	6.2	5.6	269	0.75	85.3	3.28	4.11	0.80
RC-Bio/SW-5	0.4	25.5	6.4	3.8	279	0.4	85.2	4.12	5.19	0.84
RC-Bio/SW-6	0.3	26.1	7.1	3.7	385	0.3	97.3	6.23	7.34	0.65
RC-Bio/SW-7	0.3	25.7	7.0	3.3	376	0.3	96.1	5.42	6.81	0.66
RC-Bio/SW-8	0.3	24.8	7.2	3.6	394	0.3	98.4	5.87	7.11	0.62
RC-Bio/SW-8A	0.2	25.1	7.0	3.1	386	0.2	97.0	5.43	6.68	0.63
RC-Bio/SW-9	1.0	24.7	7.2	4.1	402	1.0	101	6.13	7.4	0.65
RC-Bio/SW-10	0.2	25.3	6.6	4.0	261	0.0	91	0.4	1.39	0.76
2-Bio/SW-1	>1.0	23.0	6.4	0.4	217	0.3	50.3	0.11	0.48	0.01
2-Bio/SW-2	0.5	24.3	6.6	3.2	184	0.5	54.4	0.03	0.82	0.08
2-Bio/SW-3	0.3	25.8	6.6	3.6	206	0.3	55.8	0.37	0.91	0.01

[1] From Appendix P, OU 1 Baseline Risk Assessment (BRA) (ABB-ES, 1994a). Measured in the field by EA Engineering, Science, and Technology, Inc.
[2] From Appendix A, OU 1 BRA (ABB-ES, 1994a). Measured in the laboratory.

Notes: m = meter.
°C = degrees Celsius.
DO = dissolved oxygen.
mg/ℓ = milligrams per liter.
μmhos/cm = micromhos per centimeter (a measure of electrical conductivity).
$CaCO_3$ = calcium carbonate.
> = greater than.

Table 5-13
Habitat Assessment Scores, Operable Unit 1

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Bottom Substrate	Water Velocity	Artificial Channel	Bank Stability	Riparian Zone Vegetation	Flow Adjustment	Total Score	Percent Comparison to Reference
RC-Bio-4	18	6	14	5	6	--	49	68.0
RC-Bio-5	23	15	14	5	7	--	64	88.9
RC-Bio-6	14	18	13	5	8	--	58	80.6
RC-Bio-7	14	18	13	8	8	--	61	84.7
RC-Bio-8	20	16	14	6	7	--	63	87.5
RC-Bio-8A	17	16	13	7	8	--	61	84.7
RC-Bio-9	20	15	14	5	8	--	62	86.1
RC-Bio-10	20	20	14	4	5	--	63	87.5
2-Bio-2	15	2	12	7	9	--	45	62.5
2-Bio-3	16	2	12	9	9	--	48	66.7
Five Mile Creek [1]	24	8	15	10	10	5	72	100

[1] Five Mile Creek is the Florida regional reference station considered in this study. Sampling methods and habitat scoring procedures are discussed in Section 5.2.

Note: -- = not measured.

ranging from 58 to 63). Habitat quality is lowest at the stations at Site 2, including 2-Bio-2 with a score of 45, and 2-Bio-3 with a score of 48.

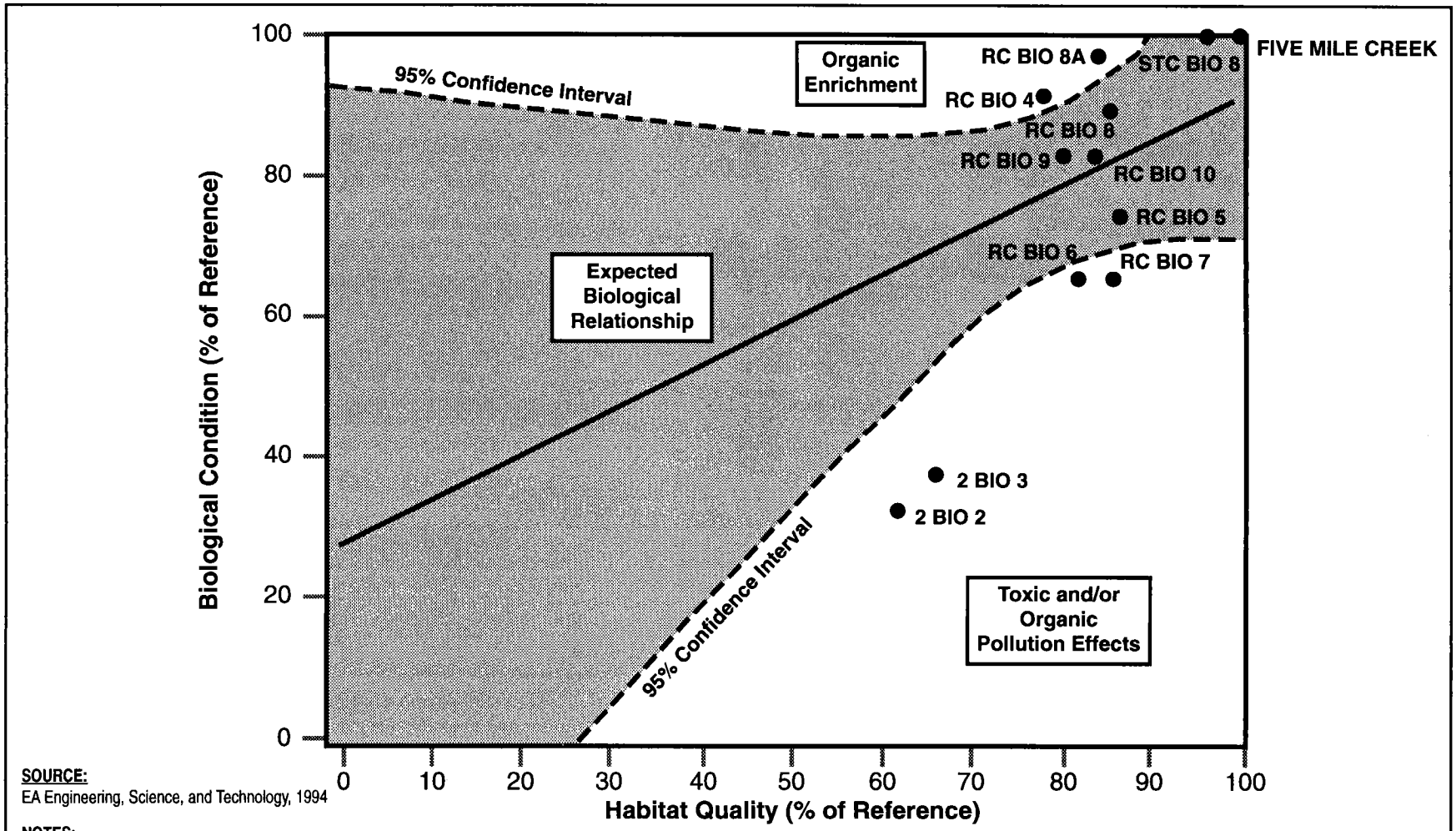
A taxonomic list of the benthic macroinvertebrates collected at OU 1 is presented in Appendix A-7. Identified taxa were collected from the OU 1 sampling stations using a combination of dip-net and ponar samplers. Hester-Dendy samplers were utilized in the Rowell Creek stations.

OU 1 Dip Net Sampling Results. The metrics used to describe the structure and function of the benthic macroinvertebrate community as sampled by dip net are described in Table 5-11. A list of metrics is presented in the OU 1 BRA (ABB-ES, 1994a). Total metric scores ranged from lows of 10 at 2-Bio-2 and 12 at 2-Bio-3 to a high of 32 at RC-Bio-8.

The relationship between habitat quality and biological condition at OU 1 sampling stations is shown on Figure 5-1. RC-Bio-5, RC-Bio-6, RC-Bio-8, RC-Bio-9, and RC-Bio-10 lie within the predictable condition of the biological community in response to habitat quality. Stations RCGC-Bio-R1, RC-Bio-8A, and RC-Bio-4 exhibited a higher benthic quality than might be expected, which is perhaps representative of nutrient enrichment that would artificially sustain a more diverse fauna than dictated by habitat quality. Stations RC-Bio-R1 and RC-Bio-7 fell just below the 95 percent confidence line. Both of these stations had fairly high habitat quality, but appear to be slightly impaired. Stations 2-Bio-2 and 2-Bio-3, when compared to the reference, fall just below the line. These stations could be classified as moderately impaired.

OU 1 Hester-Dendy Substrate Sampler Results. The metrics used to describe the structure and function of the benthic macroinvertebrate community as sampled by the Hester-Dendy substrate sampler are described in Table 5-11. A list of metrics for the Hester-Dendy substrate samplers is presented in the OU 1 BRA (ABB-ES, 1994a). Hester-Dendy substrate sampler results are only available for the sampling stations in Rowell Creek and are not available for the Site 2 tributary. The Site 2 tributary sampling stations could not be sampled because the orange-rust-colored flocculent material would have engulfed the samplers and prevented colonization. The total number of taxa from stations that could be sampled was lowest at RC-Bio-7 (24). The highest number of taxa was at RC-Bio-5 (41), followed by RC-Bio-9 (39) and RC-Bio-10 (36). The number of individuals was lowest at Five Mile Creek (326 per squared meter [m^2]). Compared to the other reference station, RC-Bio-5 (4,881/m^2), all other stations had lower abundance. The Florida index was lowest at RC-Bio-7 (8). Five Mile Creek (15) scored higher than RC-Bio-6 (9), RC-Bio-8A (10), RC-Bio-8 (13), and RC-Bio-10 (14). Only two Rowell Creek stations, RC-Bio-9 (22) and RC-Bio-5 (16), ranked higher than the regional reference. Differences in levels of taxonomic identification could be responsible for the lower scores at the OU 1 and reference locations. Overall scores, with the exception of the reference stations, were good to very good as classified by the Florida index.

The Shannon-Weaver index values were lowest at RC-Bio-10 (3.274) and highest at Five Mile Creek (4.612) and RC-Bio-6 (3.904). The values at the other stations were fairly high and varied only slightly, ranging from 3.291 at RC-Bio-9 to 3.677 at RC-Bio-7.



SOURCE:
EA Engineering, Science, and Technology, 1994

NOTES:
RC = Rowell Creek
BIO = Aquatic biological sampling station
STC = Sal Taylor Creek
% = percent

KEY:
- - - - = Expected relationship
——— = Estimated relationship

FIGURE 5-1
RELATIONSHIP BETWEEN HABITAT QUALITY AND BIOLOGICAL CONDITION, OPERABLE UNIT (OU) 1

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

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The percent of ephemeroptera-plecoptera-trichoptera (EPT), which consists of the most pollution sensitive benthic taxa (i.e., insect orders *Ephemeroptera* [mayflies], *Plecoptera* [stoneflies], and *Trichoptera* [caddisflies]), was low at RC-Bio-7 (0.0 percent), and Five Mile Creek (5.6 percent). The percent of EPT was lower than the other reference location, RC-Bio-5 (26.8), at the remaining stations, with the exception of RC-Bio-8 (38.9).

The Hilsenhoff Biotic index rates the community on a scale of 1 (high quality) to 10 (low quality). All stations (5.6 to 6.8) had comparable scores to Five Mile Creek (6.4).

Comparing the Rowell Creek Hester-Dendy results to Five Mile Creek, general trends indicate that RC-Bio-7 had metric values that were lower, whereas RC-Bio-9 and RC-Bio-10 had similar or higher values than Five Mile Creek. No conclusive trends existed among metrics for the other stations. The stations in the Site 2 tributary were not sampled.

OU 1 Ponar Sampling Results. The metrics used to describe the structure and function of the benthic macroinvertebrate community as sampled by the ponar dredge are described in Table 5-10. A list of metrics for the ponar dredge gear type is presented in the OU 1 BRA (ABB-ES, 1994a). Total taxa was lowest at 2-Bio-2 (6) and 2-Bio-3 (9) and highest at RC-Bio-8A (33). The upstream reference locations had total taxa of 31 and 21 at RC-Bio-4 and RC-Bio-5, respectively.

The number of individuals was lowest at 2-Bio-3 (287/m^2) and RC-Bio-10 (903/m^2) and highest at RC-Bio-5 (7,826/m^2). Abundance was not very high at the other reference location RC-Bio-4 (2,766/m^2), with three other stations, RC-Bio-8 (1,247/m^2), 2-Bio-2 (1,849/m^2), and RC-Bio-7 (2,136/m^2) having lower numbers and the remaining stations having higher abundance.

The Florida index was low at 2-Bio-2 (1), RC-Bio-5(1), 2-Bio-3 (2), and RC-Bio-7 (2). All other stations were higher than the RC-Bio-5 reference but had low overall scores (range of 4 to 6).

The Shannon-Weaver index was low at 2-Bio-2 (1.574) compared to RC-Bio-4 (3.702) and RC-Bio-5 (2.284). The indices for all other stations were within the values for the reference locations.

The percent of EPT individuals, which comprise the most sensitive taxa, was low at all stations. This is not uncommon when the ponar is used to sample the community. These taxa are more common on cobble and gravel substrate in riffle habitat or on woody debris. The highest value was RC-Bio-10 (3.2 percent), followed by RC-Bio-8A (2.4 percent). All other stations comprised 1 percent or fewer EPT individuals in the community.

The Hilsenhoff biotic index had little variability between stations ranging from 6.9 at RC-Bio-10 to 8.9 at RC-Bio-7. On a scale of 1 to 10, with low values indicative of good community quality, the stations at NAS Cecil Field are all classified as being below average, based on the infaunal benthic community.

OU 1 Fish Sampling Results. Eight fish species from six families were collected from OU 1 and upstream of OU 1, including the coastal shiner, *Notropis petersonis*, tadpole madtom, *Noturus gyrinus*, eastern mosquitofish, *Gambusia holbrooki*, the brook silverside, *Labidesthes sicculus*, redbreast sunfish, *Lepomis auritus*, the

bluegill, *Lepomis macrochirus*, largemouth bass, *Micropterus salmoides*, and the blackbanded darter, *Percina nigrofasciata*. Abundance of each species at each collecting station ranged from three to seven. The length and weight ranges for all fish collected are listed in Appendix P of the OU 1 BRA (ABB-ES, 1994a). The fish collected were primarily juvenile or small species of fish (some adults) with consequently low biomass at most stations. Observations indicated the occurrence of black spot on some specimens of golden shiner from RC-Bio-R1; this is a resting life stage of a fluke found on the skin and fins of fish and is common in many water bodies (EA, 1994a).

Summary of Aquatic Studies Results for OU 1. In summary, 2-Bio-2 and 2-Bio-3 exhibited notable differences in water quality and habitat. The surface water column at these sampling stations contained an orange-rust-colored flocculent material that also coated the bottom substrate. Bottom substrate composition was predominantly leaf mats compared to sand at the other locations. The presence of the material contributed to an overall lower habitat quality as compared to the regional reference and other Rowell Creek stations. It is difficult to discern from the ponar data whether or not the lower metric values at Site 2 are due to habitat differences, external influences, or a combination of the two. However, comparison of the impairment with the distribution of analytes detected in surface water yielded the observations below.

- Impairment of the benthic community was observed at locations with both high (510 micrograms per liter [$\mu g/\ell$]) and low (36.8 $\mu g/\ell$) concentrations of aluminum in surface water.

- Impairment was also observed in the presence and absence of lead and cyanide in surface water.

- The benthic community metrics were not correlated with the concentrations of iron, aluminum, manganese, or barium or any ECPCs in surface water. Linear regressions were not possible for lead or cyanide because these were detected in only one sample.

The benthic community impairment may be a result of clogging of gills, physical impairment of movement and foraging of aquatic receptors, or the prevention of light penetration and growth of algal food. A correlation was found between iron concentrations in sediment and responses in the bioassay.

5.2.1.2 Operable Unit 2 Aquatic habitats at the Site 5 drainage ditch were characterized as part of the semiquantitative macroinvertebrate survey completed in June and July 1993 (EA, 1994a; EA, 1994b). Sampling stations for Site 5 included 5-Bio-2 through 5-Bio-4, located in the drainage ditch adjacent to and downstream of Site 5, and the upstream reference station, 5-Bio-5 (Plate 2). Results were also compared to the Florida regional reference station, Five Mile Creek. Because aquatic habitat is not located at Site 17, aquatic sampling was not conducted.

The 1993 aquatic sampling effort focused on collection of information regarding the status of macroinvertebrate community structure and function in the Site 5 drainage ditch. Appendix C summarizes the objectives and scope of the study. Sampling methods and a description of the metrics used to characterize the benthic macroinvertebrate community are presented in Section 5.2 and Table 5-11, respectively.

A summary of the physical and chemical characterization scores for each sampling station at OU 2 is included in Appendix I of the OU 2 BRA (ABB-ES, 1995a). Most stations had fairly similar characteristics. All stations were located in forested areas with relatively poor aquatic habitat quality.

The Site 5 surface water quality measurements and values for total hardness, nitrate plus nitrite, total nitrogen, and total phosphorus are summarized in Table 5-14. Water depth was 0.5 meter or less at all stations, and no flow or stream velocity was observed. Water temperatures ranged from 23.6 to 26.1 °C, and pH ranged from 5.6 to 6.9. The DO values were all less than the Florida water quality standard of greater than or equal to 5 mg/ℓ (Florida Legislature, 1996), ranging from a low value of 0.4 mg/ℓ to a high of 3.4 mg/ℓ. The lowest DO concentrations were found at 5-Bio-4 and 5-Bio-5 (the upgradient reference station). Conductivity was highest at 5-Bio-4 (177 μmhos/cm) and was lowest at the upstream reference location (91 μmhos/cm). All measurements of conductivity fall within the normal range according to State of Florida Surface Water Quality Standards (Florida Legislature, 1996).

Water clarity was clear at all stations evaluated and aquatic vegetation was observed only at station 5-Bio-2, with 10 percent aquatic vegetation. Leaf pack was a major component of the substrate at all sampling stations in the Site 5 drainage ditch, ranging from 50 to 80 percent. Station 5-Bio-2 also contained slightly more mud, muck, or silt than other evaluated stations. Periphyton were rarely found at any of the Site 5 drainage ditch stations.

Table 5-15 presents habitat assessment scores for Site 5, which were derived from this study. Habitat quality at all Site 5 drainage ditch stations is generally poor, due primarily to the lack of flow in the channel, poor bottom substrate, and lack of aquatic macrophytic vegetation. The one upgradient reference station, 5-Bio-5, scored 28 in the habitat assessment scoring. Although this is less than half of the regional reference station (Five Mile Creek, total score of 72), the reference station habitat quality is comparable to the downstream Site 5 drainage ditch stations (5-Bio-2, 5-Bio-3, and 5-Bio-4), which had habitat quality scores ranging from 28 to 37.

A taxonomic list of the benthic macroinvertebrates collected is presented in Appendix A-7. Identified taxa were collected from the drainage ditch stations using a combination of dip-net and ponar samplers. Fish were not collected from OU 2 sampling stations.

OU 2 Dip Net Sampling Results. Methods used in the sampling effort are described above, and metrics used to characterize the benthic macroinvertebrate community are presented in Table 5-11. A list of metrics is also included in the OU 2 BRA (ABB-ES, 1995a). Examination and interpretation of the metric scores do not show any trends in the data or a pattern of degradation with distance downstream from Site 5. Most of the metric values are similar to those calculated for the upstream reference (5-Bio-5) or the Five Mile Creek reference. Taxa richness is similar across all of the Site 5 stations and is lowest at the upstream location (5-Bio-5). The metric scores for the Hilsenhoff biotic index and Chironomid taxa were similar across the stations and were also similar to those values calculated for the Five Mile Creek regional reference. There is a lower proportion of shredders at locations 5-Bio-5 and 5-Bio-2 than the stations further downstream (5-Bio-3 and 5-Bio-4).

Table 5-14
Summary of Operable Unit 2, Site 5, Surface Water Quality Measurements

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Depth (m)[1]	Temperature (°C)[1]	pH[1]	DO (mg/ℓ)[1]	Conductivity (μmhos/cm)[1]	Secchi (m)[1]	Total Hardness (mg/ℓ as $CaCO_3$)[2]	Total Kjeldahl Nitrogen (mg/ℓ)[2]	Nitrate plus Nitrite (mg/ℓ)[2]	Total Nitrogen (mg/ℓ)[2]	Total Phosphorus (mg/ℓ)[2]
5-SW-1[3]	NA	NA	NA	NA	NA	NA	19.2	1.69	0.04	1.73	0.16
5-BIO/SW-2	0.3	26.1	5.6	3.4	99	0.30	17.8	1.86	0.69	2.55	0.17
5-BIO/SW-3	0.2	24.5	6.8	1.0	120	0.20	9.8	1.25	0.03	1.28	0.12
5-BIO/SW-4	0.2	23.6	6.9	0.4	177	0.20	25.8	1.56	ND	1.56	0.23
5-BIO/SW-5	0.5	24.1	6.0	0.8	91	0.50	8.5	0.88	0.02	0.90	0.08
5-SW-6[3]	NA	NA	NA	NA	NA	NA	45.2	1.67	0.14	1.81	0.07
5-SW-7[3]	NA	NA	NA	NA	NA	NA	61.2	2.87	0.33	3.12	0.09
Five Mile Creek[4]	1	23	4.4	5.8	62	0.3	NA	NA	NA	NA	NA

[1] From Appendix I, OU 2 Baseline Risk Assessment (BRA) (ABB Environmental Services, Inc. [ABB-ES], 1995a). Measured in the field by EA Engineering, Science, and Technology, Inc.
[2] From Appendix A, OU 2 BRA (ABB-ES, 1995a). Measured in the laboratory.
[3] Although no macroinvertebrate data were collected at these wetland stations, water quality parameters are included in this table for regional perspective.
[4] Five Mile Creek is the Florida regional reference station considered in this study.

Notes: m = meter.
°C = degrees Celsius.
DO = dissolved oxygen.
mg/ℓ = milligrams per liter.
μmhos/cm = micromhos per centimeter (a measure of electrical conductivity).
$CaCO_3$ = calcium carbonate.
NA = not available.
ND = no data.

Table 5-15
Habitat Assessment Scores, Operable Unit 2, Site 5

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Bottom Substrate	Water Velocity	Artificial Channel	Bank Stability	Riparian Zone Vegetation	Flow Adjustment	Total Score	Percent Comparison to Five Mile Creek
5-BIO-2	5	0	12	8	5	--	30	41.7
5-BIO-3	7	0	12	5	4	--	28	38.9
5-BIO-4	15	2	12	3	5	--	37	51.4
5-BIO-5	5	0	12	8	3	--	28	38.9
Five Mile Creek[1]	24	8	15	10	10	5	72	100

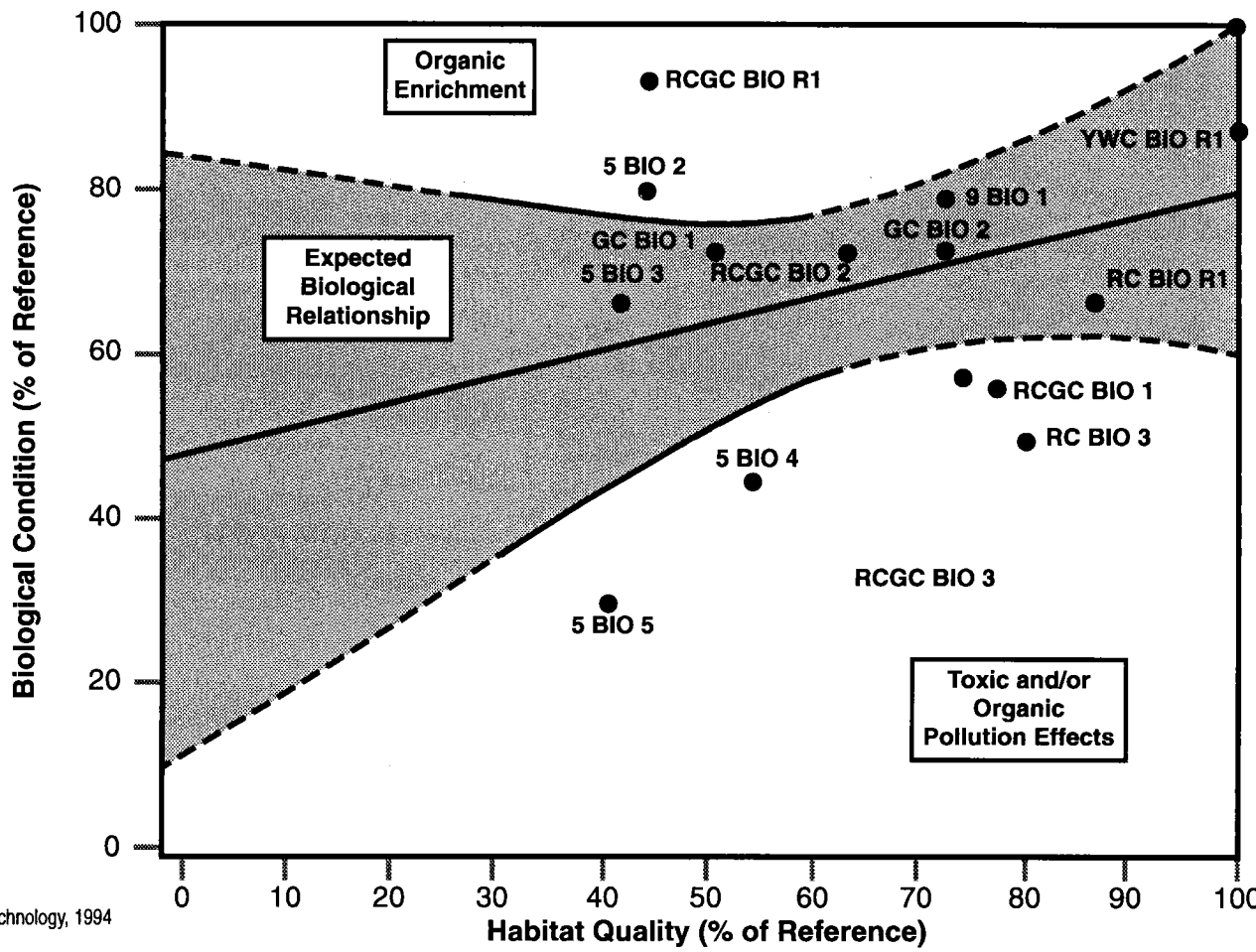
[1] Five Mile Creek is the Florida regional reference station considered in this study.

Note: -- = not measured.

The metric values were assigned bioassessment ranking scores, and total metric scores were calculated for each station. Total scores ranged from lows of 8 at 5-Bio-5 (the upgradient reference station) and 14 at 5-Bio-4 to a high of 22 at 5-Bio-2. The low DO levels at 5-Bio-5 may help explain the low total metric score. These scores were compared to the reference locations. The State of Florida regional reference, Five Mile Creek, was selected and used for all station comparisons. An upstream station (5-Bio-5) was used as an upstream reference. The regional reference station, Five Mile Creek, has better habitat quality than the Site 5 sampling stations. Direct comparisons of data from this regional reference with the Site 5 stations should be made carefully in consideration of this factor. It was not possible to find a regional reference station with similar habitat quality. Comparisons with the regional reference were made for the purpose of putting the Site 5 results in perspective with results for other streams in Florida. However, emphasis is placed on comparisons between the Site 5 stations and the upstream reference in order to draw conclusions concerning potential impacts relative to Site 5. The relationship between habitat quality and biological condition among all stations at Site 5 is illustrated as a line graph on Figure 5-2. The only Site 5 drainage ditch station that falls within the predictable condition of the biological community in consideration of habitat quality is station 5-Bio-3.

Station 5-Bio-2 exhibited a higher condition of the benthic community than would be expected based on the quality of the habitat present. Stations 5-Bio-4 and 5-Bio-5 fell just below the lower 95 percent confidence interval. The macroinvertebrate community appears to be below the condition expected for the quality of the habitat present.

OU 2 Ponar Sampling Results. Methods used in this sampling effort are described above, and descriptions of metrics are presented in Table 5-11. A complete list



SOURCE:
EA Engineering, Science, and Technology, 1994

NOTES:
YWC = Yellow Water Creek
RC = Rowell Creek
BIO = Aquatic biological sampling station
GC = Golf course
% = percent

KEY:
= Expected relationship
= Estimated relationship

FIGURE 5-2
RELATIONSHIP BETWEEN HABITAT QUALITY AND BIOLOGICAL CONDITION, OPERABLE UNITS (OUs) 2 AND 6

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

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of metrics is included in the OU 2 BRA (ABB-ES, 1995a). Because no State of Florida regional reference exists for this gear type, all comparisons were made to the upstream reference station, 5-Bio-5.

Total taxa were low at 5-Bio-5 (5), 5-Bio-4 (10), and 5-Bio-2 (13). The greatest number of total taxa from the Site 5 drainage ditch were found at 5-Bio-3, with 25 taxa represented. Density was lowest at 5-Bio-5 (143/m^2). Density was low at station 5-Bio-2 with 702/m^2, whereas stations 5-Bio-3 and 5-Bio-4 had 1,691/m^2 and 1,247/m^2, respectively. The Florida index was lowest at 5-Bio-5 (2) and 5-Bio-4 (2). The other two stations (5-Bio-2 and 5-Bio-3) were somewhat higher, at 3 and 5, respectively. Diversity, as measured by the Shannon-Weaver index, was lowest at 5-Bio-5 (2.246) and 5-Bio-4 (1.973). Density for stations 5-Bio-2 and 5-Bio-3 was slightly higher, at 2.807 and 3.116, respectively.

The Hilsenhoff biotic index had little variability between stations ranging from a low of 7.3 at 5-Bio-5 (the upgradient reference station) to 9.4 at 5-Bio-4. Chironomids dominated the benthic community at 5-Bio-2 (75.5 percent) compared to the other Site 5 stations, which ranged from 20.0 percent to 43.2 percent. Percent Chironomid taxa decreased with distance downstream of Site 5 and was lowest at the upstream station (5-Bio-5). Percent dominant taxon at stations 5-Bio-2 and 5-Bio-3 were similar and comparable to the upstream reference. The metric value was higher at station 5-Bio-4, at 60.9 percent.

Summary of Aquatic Studies Results for OU 2. A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions throughout this OU 2 drainage ditch, including the upstream reference station, represent a poor environment for many types of aquatic organisms. The generally poor habitat quality observed at the upstream reference station limits the interpretation of the benthic results. Taxa identified within the Site 5 drainage ditch indicate a stressed environment. Comparison of the metrics between the Site 5 sampling stations indicates no clear trends in data with the exception of percent Chironomid taxa. Percent Chironomid taxa decreases with distance downstream of Site 5 and is lowest at the upstream station (5-Bio-5). A benthic community dominated by Chironomid taxa is characteristic of a stressed benthic community. Based on the metrics calculated for the dip-net samples, the benthic communities at stations 5-Bio-04 and 5-Bio-5 are below their respective expected condition relative to the quality of habitat present. Station 5-Bio-03 is within the expected condition given that the habitat quality and the condition of the benthic community at station 5-Bio-02 is above the expected condition.

It could not be concluded that contamination in surface water or sediment from Site 5 was contributing to the decreased condition observed at the downstream sampling station. The only trend in community structure was a decrease in the percent of the taxa as Chironomids decrease with distance downstream of the site.

5.2.1.3 Operable Unit 3 Aquatic habitats near Site 8 were characterized as part of the facilitywide field survey completed in June and July 1993 (EA, 1994a; EA, 1994b), and focused on the status of macroinvertebrate community structure and function and fish species at Site 8. Appendix C summarizes the objectives and scope of this study. Sampling methods and a description of the metrics used for this study are presented above in Section 5.2 and Table 5-11, respectively. Site 7 at OU 3 does not include aquatic habitats. Sampling stations for Site 8 included 8-Bio-1 (Plate 2), located in a tributary adjacent to and northwest of

Site 8, and 8-Bio-2, located downstream of 8-Bio-1. Both stations were located in forested areas. Petroleum sediment odor was present at 8-Bio-2 and sediment had a moderately oily texture. Sand was the major substrate type (60 percent), with detritus constituting most of the remainder (35 percent). Surface water had odor, and no oily sheen was noted. Habitat quality was generally low at 8-Bio-2.

The Site 8 surface water quality measurements are presented in Table 5-16. Water depth was 0.2 meter at both stations, and no flow or stream velocity was observed. Water temperatures ranged from 26 to 26.6 °C and pH ranged from 6.3 to 6.4. The DO values were all less than the Florida water quality standard of greater than or equal to 5 mg/ℓ (Florida Legislature, 1996), ranging from a 2.8 mg/ℓ (at 8-Bio-2) to 5.3 mg/ℓ (at 8-Bio-1). Conductivity was 7.6 μmhos/cm at 8-Bio-8, and 6.7 μmhos/cm at 8-Bio-2. All measurements of conductivity fall within the normal range according to State of Florida Surface Water Quality Standards (Florida Legislature, 1996).

Water clarity was turbid at 8-Bio-1, but clear at 8-Bio-2. No aquatic vegetation was observed at 8-Bio-2, but aquatic macropohytes were common at 8-Bio-1. Table 5-17 presents habitat assessment scores for Site 8. Habitat quality at the Site 8 sampling stations is generally poor, due primarily to the lack of flow in the channel, poor bottom substrate, and lack of aquatic vegetation. The habitat assessment score for 8-Bio-2 was higher overall (34) than for 8-Bio-1 (29). Neither of the Site 8 habitat assessment scores were greater than half that of the regional reference station (Five Mile Creek, total score of 72).

A taxonomic list of the benthic macroinvertebrates collected is presented in Appendix A-7. Identified taxa were collected from the stations using a combination of dip-net and ponar samplers. Although fish are commonly observed at the Site 8 stations, none were collected at the Site 8 stations. Fish collected in Rowell Creek during the 1993 sampling event are listed in Appendix A-2.

OU 3 Dip Net Sampling Results. Methods used in the sampling effort are described above and metrics applied to analysis are presented in Section 5.2 and Table 5-11, respectively. A complete description of metrics for the dip-net gear type is included in the EA's report (EA, 1994b). The overall trend for Site 8 stations is low, as compared to the two reference stations, with 8-Bio-2 showing the most difference. Taxa richness is less at the Site 8 stations than the State regional reference station (Five Mile Creek); 8-Bio-2 showed the lowest taxa richness (8). The metric scores for the Hilsenhoff biotic index and Chironomid taxa were similar across the stations and were also similar to those values calculated for the Five Mile Creek regional reference. There is a higher proportion of shredders at locations 8-Bio-1 and 8-Bio-2 than at either of the reference stations. No filtered-collectors were identified for either of these stations.

The metric values were assigned bioassessment ranking scores and total metric scores were calculated for each station. Total scores ranged from lows of 12 and 18 at 8-Bio-1 and 8-Bio-2, respectively, to 28 at Five Mile Creek. The low DO levels provide an explanation for the low total metric score at the Site 8 stations. Direct comparisons of data from the regional reference with the Site 8 stations should be made carefully in consideration of this factor. It was not possible to find a regional reference station with similar habitat quality. Comparisons with the regional reference were made for the purpose of putting the Site 8 results in perspective with results for other streams in Florida.

Table 5-16
Summary of Operable Unit 3, Site 8, Surface Water Quality Measurements

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Depth (m)[1]	Temperature (°C)[1]	pH[1]	DO (mg/ℓ)[1]	Conductivity (μmhos/cm)[1]	Secchi (m)[1]	Total Hardness (mg/ℓ as $CaCO_3$)[2]	Nitrate plus Nitrite (mg/ℓ)[2]	Total Nitrogen (mg/ℓ)[2]	Total Phosphorus (mg/ℓ)[2]
8-Bio-1	0.2	26.6	6.3	5.3	67	0.20	NA	NA	NA	NA
8-Bio-2	0.2	26.0	6.4	7.8	76	0.20	NA	NA	NA	NA

[1] From EA Engineering, Science, and Technology Addendum, Inc., Addendum (EA, 1994b). Measured in the field.
[2] Measured in the laboratory.

Notes: m = meter.
°C = degrees Celsius.
DO = dissolved oxygen.
mg/ℓ = milligrams per liter.
μmhos/cm = micromhos per centimeter (a measure of electrical conductivity).
$CaCO_3$ = calcium carbonate.
NA = not available; will be provided when fieldwork is completed.

Table 5-17
Habitat Assessment Scores, Operable Unit 3, Site 8

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Bottom Substrate	Water Velocity	Artificial Channel	Bank Stability	Riparian Zone Vegetation	Flow Adjustment	Total Score	Percent Comparison to Reference
8-Bio-1	3	1	13	9	4	--	29	43.3
8-Bio-2	5	1	13	9	6	--	34	50.7
Five Mile Creek[1]	24	8	15	10	10	5	72	100

[1] Five Mile Creek is the Florida regional reference station considered in this study.

Note: -- = not measured.

The relationship between habitat quality and biological condition among Site 8 stations is illustrated as a line graph on Figure 5-3. Station 8-Bio-1 falls within the predictable condition of the biological community in consideration of habitat quality, while 8-Bio-2 fell just below the lower 95 percent confidence interval, indicating a slight depression of biological condition.

OU 3 Ponar Sampling Results. Methods used in this sampling effort are described in Section 5.2, and descriptions of metrics are presented in Table 5-11. A complete description of metrics is included in EA's report (EA, 1994b). No State of Florida regional reference exists for this gear type.

Total taxa were lower at 8-Bio-2 (number of samples [n] = 8) compared to 8-Bio-1 (n = 13). Density was comparable at both Site 8 stations (about 400/m^2]. The Florida index was 3 at 8-Bio-1 and 1 at 8-Bio-2. Diversity, as measured by the Shannon-Weaver index, was lower at 8-Bio-2 (2.394) compared to 8-Bio-1 (3.386).

The Hilsenhoff biotic index had little variability between stations, ranging from a low of 7.0 at 8-Bio-1 to the 8-Bio-2 value of 9.1. Chironomids and Diptera dominated the benthic communities at the two Site 8 sampling stations (between 37 and 47 percent for each group at each station).

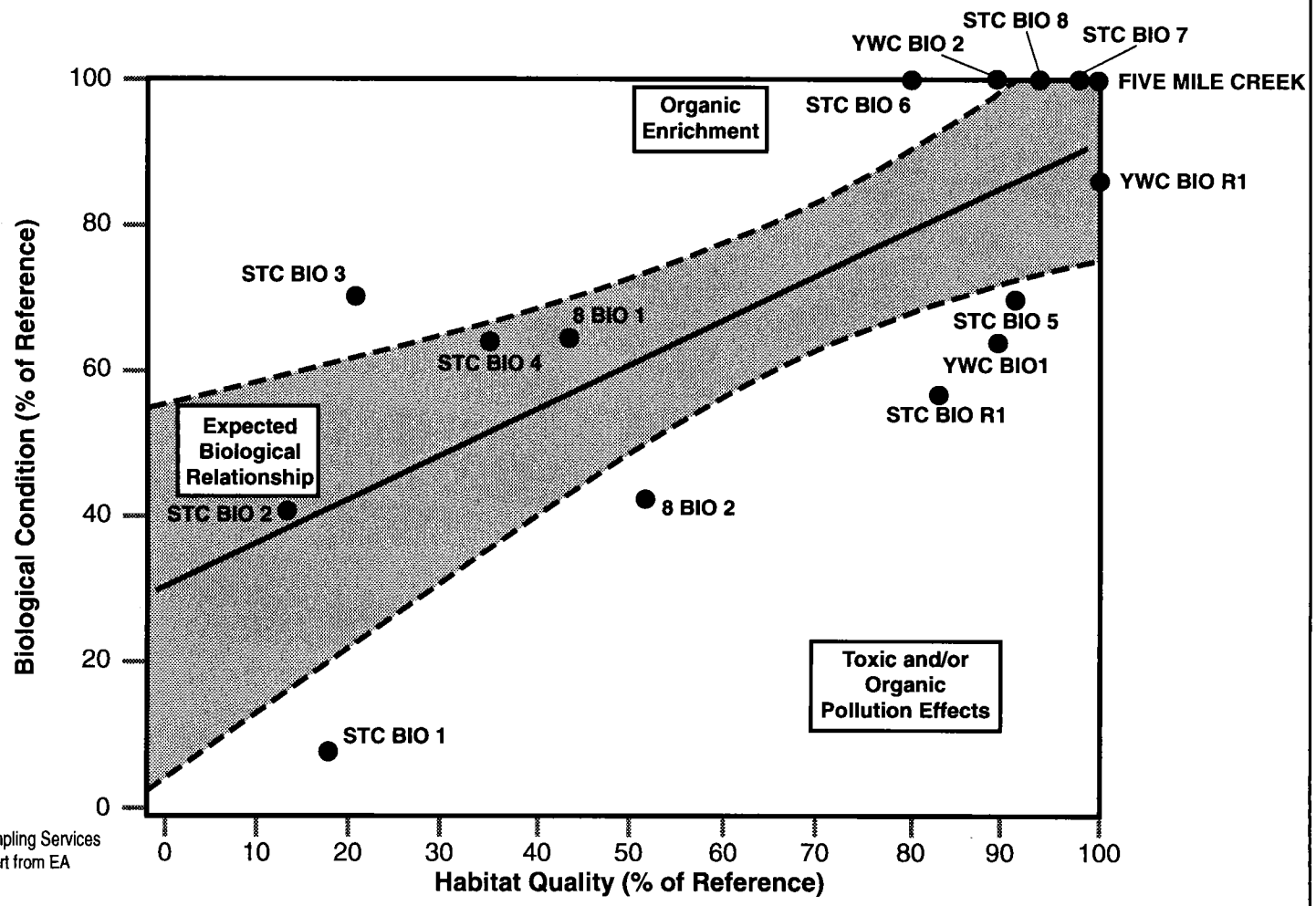
Summary of Aquatic Studies Results for OU 3. A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at the downstream station represent a poor environment for many types of aquatic organisms. Comparison of the metrics between the Site 8 sampling stations indicates no clear trends in data, although there are some indicators of increased stress at 8-Bio-2. The petroleum sediment odor at 8-Bio-2 may be a factor influencing the community at this location.

5.2.1.4 Operable Unit 4 Biological sampling was not completed at OU 4, Site 10. Samples collected in Rowell Creek east of Site 10 were analyzed as part of the benthic macroinvertebrate study conducted by EA (1994a) for OU 1.

5.2.1.5 Operable Unit 5 Due to the lack of aquatic habitat, biological sampling was not completed at OU 5, Sites 14 and 15.

5.2.1.6 Operable Unit 6 Aquatic habitats near Site 11 were characterized as part of the facilitywide field survey completed in June and July 1993 (EA, 1994a), which focused on the status of the macroinvertebrate community structure and function and fish species at Site 11. Appendix C summarizes the objectives and scope of this study. Sampling methods and a description of the metrics used for this study are presented above in Section 5.2 and Table 5-11, respectively. Sampling stations for Site 11 include GC-Bio-1, located in a tributary draining the Golf Course and downstream of the pesticide tank rinse area, and GC-Bio-2, located downstream of GC-Bio-1 (Plate 2). The riparian zone of GC-Bio-2 was predominantly forested, as was the upstream reference station for Site 11 (RCGC-Bio-R1). Sand was the major substrate type. Surface water had no odor, and no oily sheen was noted.

The Site 11 surface water quality measurements are summarized in Table 5-18. Water depth was similar at Site 11 stations (0.2 meters at station GC-Bio-1, and 0.5 meters at station GC-Bio-1). Minimal velocity was observed at all Site 11 stations. Water temperatures ranged from 25.1 to 27.5 °C and pH was similar at both stations. The DO value for GC-Bio-1 (4.2 mg/ℓ) was less than the Florida



SOURCE:
Addendum to Aquatic Biological Sampling Services Conducted at NAS Cecil Field, Report from EA Engineering, June 1994.

NOTES:
YWC = Yellow Water Creek
BIO = Aquatic biological sampling station
STC = Sal Taylor Creek
% = percent

KEY:
- - - - = Expected relationship
——— = Estimated relationship

FIGURE 5-3
RELATIONSHIP BETWEEN HABITAT QUALITY AND BIOLOGICAL CONDITION, OPERABLE UNITS (OUs) 3 AND 7

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA

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Table 5-18
Summary of Operable Unit 6, Site 11, Surface Water Quality Measurements

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Depth (m)[1]	Temperature (°C)[1]	pH[1]	DO (mg/ℓ)[1]	Conductivity (μmhos/cm)[1]	Secchi (m)[1]	Total Hardness (mg/ℓ as $CaCO_3$)[2]	Nitrate plus Nitrite (mg/ℓ)[2]	Total Nitrogen (mg/ℓ)[2]	Total Phosphorus (mg/ℓ)[2]
GC-Bio-1	0.2	25.1	6.4	4.2	144	0.20	NA	NA	NA	NA
GC-Bio-2	0.5	27.5	7.0	5.6	186	0.90	NA	NA	NA	NA

[1] From EA Engineering, Science, and Technology Addendum, Inc., Addendum (EA, 1994b). Measured in the field.
[2] Measured in the laboratory.

Notes: Surface water quality measurements are not available for the reference station RCGC-Bio-R1.

m = meter.
°C = degrees Celsius.
DO = dissolved oxygen.
mg/ℓ = milligrams per liter.
μmhos/cm = micromhos per centimeter (a measure of electrical conductivity).
$CaCO_3$ = calcium carbonate.
NA = not available; will be provided when fieldwork is completed.

water quality standard of greater than or equal to 5 mg/ℓ (Florida Legislature, 1996), while that of GC-Bio-2 slightly exceeded the standard value. Conductivity was 144 μmhos/cm at GC-Bio-1, and 186 μmhos/cm at GC-Bio-2. All measurements of conductivity fall within the normal range according to State of Florida Surface Water Quality Standards (Florida Legislature, 1996).

Water clarity was clear at both Site 11 stations. No aquatic vegetation was observed at GC-Bio-2, but aquatic macropohytes and periphyton were abundant at GC-Bio-1.

Table 5-19 presents habitat assessment scores derived for Site 11. Habitat quality at the Site 11 sampling stations is generally poor; habitat assessment scores were lower for both locations as compared to the regional reference station (Five Mile Creek, total score of 72). However, aquatic vegetation was common at station GC-Bio-1. Habitat assessment scores were not provided in the study for RCGC-Bio-R1.

Table 5-19
Habitat Assessment Scores, Operable Unit 6, Site 11

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Bottom Substrate	Water Velocity	Artificial Channel	Bank Stability	Riparian Zone Vegetation	Flow Adjustment	Total Score	Percent Comparison to Five Mile Creek [1]
GC-Bio-1	16	5	3	9	2	--	35	52.2
GC-Bio-2	20	3	12	6	8	--	49	73.1
Five Mile Creek	24	8	15	10	10	5	72	100

[1] Five Mile Creek is the Florida regional reference station considered in this study. Methods for sampling and habitat scoring procedures are discussed in Section 5.2.

Notes: Habitat scores for the reference station RCGC-Bio-R1 are not available.

-- = not measured.

A taxonomic list of the benthic macroinvertebrates collected is presented in Appendix A-7. Identified taxa were collected from the stations using a combination of dip-net and ponar samplers. No fish were observed at GC-Bio 1. One species of fish was collected at GC-Bio-2; twenty-three brook silverside (*Labidesthes sicculus*) were netted, ranging in length from 36 to 56 millimeters, and all weighing less than 0.5 gram. Additional fish species observed at Cecil Field sampling stations are listed in Appendix A-2.

OU 6 Dip-Net Sampling Results. Methods used in the sampling effort are described in Section 5.2, and metrics applied to analysis are presented in Table 5-11. A complete discussion of the metrics for the dip-net gear type are presented in the EA report (EA, 1994b). The overall trend for OU 6 stations is similar, as compared to the two reference stations. Taxa richness is slightly higher (32) at the State regional reference station (Five Mile Creek), and the other three stations had similar values (24 for both of GC-Bio-1 and GC-Bio-2, and 21 for RCGC-Bio-R1). The metric scores for the Hilsenhoff biotic index, EPT index, and Chironomid taxa were similar across the all four stations. Percent dominant taxa

were higher at the two Site 11 stations and RCGC-Bio-R1, as compared to Five Mile Creek values. Similar values were found for the proportion of shredders at the two Site 11 stations and RCGC-Bio-R1, while Five Mile Creek had a higher value. Percent filtered-collector values for RCGC-Bio-R1 exceeded those for the stations at OU 6.

The metric values were assigned bioassessment ranking scores and total metric scores were calculated for each station. Total scores were equal for both GC-Bio-1 and GC-Bio-2 (20), and were less than the scores of 26 at RCGC-Bio-R1 and 28 at Five Mile Creek. Although scores were slightly higher for Five Mile Creek, direct comparisons of data from the regional reference with the Site 11 stations should be made carefully in consideration of lower DO values at Site 11. It was not possible to find a regional reference station with similar habitat quality. Comparisons with the regional reference were made for the purpose of putting the Site 11 results in perspective with results for other streams in Florida.

The relationship between habitat quality and biological condition among Site 11 stations is illustrated as a line graph on Figure 5-2. Stations GC-Bio-1 and BC-Bio-2 both fall within the predictable conditions of the biological community in consideration of habitat quality, while RCGC-Bio-R1 exceeded the 95 percent confidence interval, closely approximating the condition at Five Mile Creek. The two reference stations are believed to be organically enriched, and not comparable in this regard to most NAS Cecil Field stations.

OU 6 Ponar Sampling Results. Methods used in this sampling effort are described in Section 5.2, and descriptions of metrics are presented in Table 5-11. A complete discussion of the metrics for the ponar dredge gear type are presented in the EA report (EA, 1994b). Because no State of Florida regional reference exists for this gear type, all comparisons were made to the upstream reference station, RCGC-Bio-R1.

Total taxa were similar at both Site 11 stations (26 at GC-Bio-1, 34 at GC-Bio-1). RCGC-Bio-R1 showed a total taxa value of 42, higher than any other station sampled in the watershed at NAS Cecil Field, suggestive of increased water quality or suitability. Density was lowest at GC-Bio-2 (1663/m^2) and increased to 6,034/m^2 at GC-Bio-1. Density at RCGC-Bio-R1 was unusually higher than any other station sampled in the NAS Cecil Field watershed, with a density of 11,624/m^2. The Florida index was highest at RCGC-Bio-R1 (12) of all stations sampled at NAS Cecil Field, as compared to 5 at GC-Bio-1 and 6 at GC-Bio-2. Diversity as measured by the Shannon-Weaver index, was highest at GC-Bio-1 (4.151); GC-Bio-2 (3.696) was comparable to RCGC-Bio-R1 (3.627).

The Hilsenhoff biotic index had little variability between stations ranging from a low of 6.8 at GC-Bio-2 to 7.3 at GC-Bio-1 and 7.4 at RCGC-Bio-R1. These data reflect little or no difference in pollution tolerance of the benthic arthropod community at the three sampling stations. Chironomids and dipterids dominated the benthic communities at the two Site 11 sampling stations (39 to 55 percent each) and were lower than RCGC-Bio-R1 (between 62 and 68 percent).

OU 6 Hester-Dendy Sampling Results. Methods used for this sampling technique are presented above in Section 5.2, and the metrics are described in Table 5-11. A complete description of the metrics for this gear type is provided in the EA report (EA, 1994b). The total number of taxa was similar at both Site 11 stations (21 at GC-Bio-1 and 15 at GC-Bio-2), RCGC-Bio-R1 showed 23, and Five Mile Creek

showed comparatively higher species richness (30). Percent of the chironomid and dipterid species were similar at both Site 11 stations, but less than both of the reference stations. Percent pollution-sensitive species was high (percent EPT is 12.5) at GC-Bio-1, as compared to 1.4 percent EPT at RCGC-Bio-R1. Calcium dependent species were dominant at GC-Bio-1 (74.3 percent as compared to 10.2 percent at RCGC-Bio-R1), indicative of higher alkalinity at the upstream Site 11 station.

The Florida index was lower at both Site 11 stations (4 at GC-Bio-1; 3 at GC-Bio-2) and the reference station, RCGC-Bio-R1 (6) than that at Five Mile Creek (15). The Hilsenhoff biotic index values and Shannon-Weaver index obtained in Hester-Dendy samples were similar for all stations at OU 6, including the reference stations.

No trends were identified for OU 6 sampling stations by Hester-Dendy sampling efforts. The artificial substrate sampling showed little overall differences among Site 11 stations and RCGC-Bio-R1.

Summary of Aquatic Studies Results for OU 6. A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at Site 11 stations (GC-Bio-1 and GC-Bio-2) are acceptable. These stations do not appear to be adversely impacted by surface water runoff from the golf course. Station RCGC-Bio-R1 was not representative of most stations sampled at NAS Cecil Field due to low habitat quality and dense growth of aquatic macrophytes. The unusually high scores for some of the metrics evaluated for this reference station may be due to these unique habitat characteristics.

5.2.1.7 Operable Unit 7 Aquatic habitats near Site 16 were characterized as part of the facilitywide field survey completed in June and July 1993 (EA, 1994a). The study focused on the status of macroinvertebrate community structure and function and fish species in Sal Taylor Creek east of Site 16. Appendix C summarizes the objectives and scope of this study. Methods and a description of the metrics used for this study are presented above in Section 5.2 and Table 5-11, respectively.

Three sampling stations in the drainage ditches and one reference station in Sal Taylor Creek (STC-SW/SD/Bio/Tox-R1) were sampled (Plate 2). Two of the sampling stations (STC-SW/SD/Bio/Tox-1 and STC-SW/SD/Bio/Tox-3) were located in the two ditches east of Site 16 and west of Sal Taylor Creek. The two ditches are adjacent to storm sewers 1 and 2, located approximately 500 feet east of the runway. The drainage ditches extend 500 to 600 feet in length before they merge into one ditch where the third sampling station (STC-SW/SD/Bio-4) was located. The ditches receive storm water drainage from the runway area and much of the developed area west of the runways (including OU 7). The ditches carry the storm water approximately 2,400 feet to Sal Taylor Creek.

A summary of the physical and chemical characterization scores for each station sampled is included in Appendix P of the OU 7 BRA. All stations had fairly similar characteristics. However, due to differences in habitat, the reference location in Sal Taylor Creek (STC-Bio-R1) may not be suitable for comparison with drainage ditch parameters. All stations were located in open canopy areas except for the reference location, which was heavily shaded.

The surface water quality measurements for the Sal Taylor Creek and drainage ditch locations including total hardness, nitrate and nitrite, total nitrogen, and total

phosphorus are summarized in Table 5-20. Water depth was 1.0 meter or less at all stations, water temperatures ranged from 24.3 to 26.5 °C, and pH ranged from 5.8 to 6.3. The DO values were less than the State of Florida surface water quality standard of greater than or equal to 5 mg/ℓ (Florida Legislature, 1996) at the four Site 16 sampling locations (including the reference station), ranging from a low value of 3.4 mg/ℓ (STC-SW/Bio-4) to a high of 4.9 mg/ℓ (STC-SW/Bio-3). DO measurements at the storm sewer discharge locations (STC-SW/Bio-1 and STC-SW/Bio-3) were higher than the other two sampling stations.

Conductivity was highest at STC-SW/Bio-R1 (169 μmhos/cm) and lowest at STC-SW/-Bio-1 (92 μmhos/cm). All measurements of conductivity fall within the normal range according to State of Florida surface water quality standards (Florida Legislature, 1996).

Water was clear at all stations. A viscous oily sheen was observed on the water surface at one station (STC-SW/Bio-1). Petroleum sediment odor was evident at two stations (STC-SD/Bio-1 and STC-SD/Bio-3). Fifty percent aquatic vegetation was observed at two stations (STC-SW/Bio-1 and STC-SW/Bio-4) and 75 percent aquatic vegetation was observed at one station (STC-SW/Bio-3). Aquatic vegetation was not observed at the reference location (STC-SW/Bio-R1). Leaf pack and mud, muck, or silt were observed as substrate components only at the reference station (STC-SW/Bio-R1).

Habitat assessment scores for Site 16 are presented in Table 5-21. Habitat quality at all Site 16 stations is generally poor. The upgradient reference station, STC-Bio-R1, scored 56 in the habitat assessment. Although this is less than the regional reference station at Five Mile Creek (total score of 72), the reference station (STC-Bio-R1) habitat quality is considerably higher than the Site 16 drainage ditch sampling stations (STC-Bio-1, STC-Bio-3, and STC-Bio-4), which had habitat quality scores ranging from 11 to 23. Although the habitats of the Sal Taylor Creek reference station (STC-Bio-R1) and Five Mile Creek regional reference station are comparable, the habitat assessment scores show that both the Sal Taylor Creek reference station and the Five Mile Creek regional reference location are vastly different from the drainage ditch stations and may not be suitable as reference locations for purposes of comparison. In addition, the drainage ditches are artificial, man-made channels, and the reference locations and the drainage ditch sampling locations are substantially different with regard to bottom substrate, water velocity, and vegetation.

A taxonomic list of the benthic macroinvertebrates collected is presented in Appendix A-7. Identified taxa were collected from the drainage ditch and reference station using a combination of dip-net, Hester-Dendy, and ponar samplers.

OU 7 Fish Sampling Results. Fish were collected with a 10-foot seine net at sampling station STC-Bio-4 in the deepest section of the drainage ditch and at the reference location STC-Bio-R1. A total of two fish species were collected from the Site 16 fish sampling stations (STC-Bio-4 and STC-Bio-R1). Two eastern mosquitofish (*Gambusia affinis*) were collected at the reference location (STC-Bio-R1). Thirty-six eastern mosquitofish and four least killifish (*Heterandria formosa*) were collected at STC-Bio-4. As indicated by the length and weight data (Appendix P, OU 7 BRA), the fish collected were small species of fish with

Table 5-20
Surface Water Quality Measurements Summary for Operable Unit 7, Site 16

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Depth (m)[1]	Temperature (°C)[1]	Stream Velocity (m/s)	pH[1]	DO (mg/ℓ)[1]	Conductivity (μmhos/cm)[1]	Secchi (m)[1]	Total Hardness (mg/ℓ as $CaCO_3$)[2]	Total Kjeldahl Nitrogen (mg/ℓ)[2]	Nitrate/ Nitrite (mg/ℓ)[2]	Total Nitrogen (mg/ℓ)[2]	Total Phosphorous (mg/ℓ)[2]
STC-Bio/SW-1	0.5	25.7	0.0	5.8	4.3	92	1.0	21.2	1.62	0	1.62	0.06
STC-Bio/SW-3	0.3	26.5	<0.5	6.2	4.9	146	0.3	40.5	NA	NA	NA	NA
STC-Bio/SW-4	1.0	24.3	<0.5	5.9	3.4	125	1.0	37.9	NA	NA	NA	NA
STC-Bio/SW-R1	0.2	25.1	<0.5	6.3	3.7	169	0.2	87.9	1.09		1.09	0.09
Five Mile Creek[3]	1	23	0.1	4.4	5.8	62	0.3	NA	NA	NA	NA	NA

[1] From Appendix P, Operable Unit 7 Baseline Risk Assessment (BRA) (ABB Environmental Services, Inc. [ABB-ES], 1996b). BRA measured in the field by EA Engineering, Science, and Technology, Inc. (EA, 1994b).
[2] From Appendix A, Operable Unit 7 BRA (ABB-ES, 1995b). Measured in the laboratory. Total Kjeldahl nitrogen, nitrate plus nitrite, total nitrogen, and total phosphorous were not measured for STC-Bio/SW-3, STC-Bio-SW-4, and the Five Mile Creek regional reference.
[3] Five Mile Creek is the Florida regional reference station considered in this study.

Notes: m = meter.
°C = degrees Celsius.
m/s = meter per second.
DO = dissolved oxygen.
mg/ℓ = milligrams per liter.
μmhos/cm = micromhos per centimeter (a measure of electrical conductivity).
$CaCO_3$ = calcium carbonate.
< = less than.
NA = not available.

Table 5-21
Habitat Assessment Scores, Operable Unit 7

Basewide Risk Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Bottom Substrate	Water Velocity	Artificial Channel	Bank Stability	Riparian Zone Vegetation	Flow Adjustment	Total Score	Percent Comparison to Five Mile Creek [1]
STC-Bio-1	5	0	2	2	2	NA	11	16
STC-Bio-3	5	3	2	2	2	NA	14	21
STC-Bio-4	5	5	3	8	2	NA	23	34
STC-Bio-R1	18	10	14	8	6	NA	56	84
Five Mile Creek	24	8	15	10	10	5	72	100

[1] Five Mile Creek is the Florida regional reference station considered in this study. Methods for sampling and habitat scoring procedures are discussed in Section 5.2.

Note: NA = not applicable.

consequently low biomass. The most notable abnormality was the presence of eroded caudal fins on three specimens (out of 36 specimens) of eastern mosquitofish collected at sampling station STC-Bio-4. No physical abnormalities or deformities were observed on the fish collected from STC-Bio-R1.

OU 7 Dip Net Sampling Results. Methods used in the sampling effort are described in Section 5.2, and metrics applied to the analysis are presented in Table 5-11. A complete description of the metrics for the dip net gear type used in this study is presented in the EA report (EA, 1994b). Examination and interpretation of the metric scores do not show any trends in the data or a pattern of degradation with increased distance from Site 16. Most of the metric values are similar to those calculated for the reference location (STC-Bio-R1), but are quite different from the Five Mile Creek reference. With the exception of STC-Bio-1, which had the lowest score of 7, total taxa or taxa richness is similar across the Site 16 stations, with scores ranging from 14 (STC-Bio-R1) to 20 (STC-Bio-4). Total taxa at the Five Mile Creek station was 32. Invertebrate density at the Site 16 sampling stations varied widely, ranging from $14/m^2$ (STC-Bio-R1) to $420/m^2$ (STC-Bio-1). Density at the Five Mile Creek station was $824/m^2$. Percentage dominant taxon was higher at all Site 16 sampling stations as compared to the Five Mile Creek station. STC-Bio-1 was highest with a score of 64 and STC-Bio-4 was lowest with a score of 20. Percent dominant taxon at the Five Mile Creek station was 11.

The Florida index metric scores were similar for all four Site 16 sampling stations ranging from 2 at STC-Bio-1 to 6 at STC-Bio-3, but were all lower than the Five Mile Creek station, which had a score of 12. Diversity, as measured by the Shannon-Weaver index, was also similar for all Site 16 sampling stations ranging from 1.626 at STC-Bio-1 to 3.282 at STC-Bio-4. The Shannon-Weaver index at the Five Mile Creek station (4.5) was higher than all Site 16 sampling stations.

Percent diptera ranged from a low of 2 at STC-Bio-1 to a high of 87 at STC-Bio-4. The score at the Five Mile Creek station fell within this range at 21. Percent

chironomid metric scores were similar to percent diptera scores, ranging from 2 at STC-Bio-1 to 86 at STC-Bio-4. The score at the Five Mile Creek station was 20. The percentage of EPT was negligible at all four Site 16 sampling stations compared to 10 percent EPT at Five Mile Creek.

With the exception of station STC-Bio-3 (1 percent), filter-collectors were not identified at any of the Site 16 stations. The percentage of filter-collectors at the Five Mile Creek station (10) was considerably higher. Shredders did not occur at sampling station STC-Bio-1; the highest percentage of shredders occurred at STC-Bio-3, with a score of 37. The Five Mile Creek and Sal Taylor Creek reference stations fell within that range at 16 and 17, respectively. Percent calcium dependent scores, which were zero at STC-Bio-1 and 2 at STC-Bio-3 and STC-Bio-4, were lower than the Florida regional reference (18). STC-Bio-R1, however, had a higher score of 26.

The Hilsenhoff biotic index rates the community on a scale of 1 (low pollution tolerance; high quality) to 10 (high pollution tolerance; low quality). STC-Bio-1 had the lowest quality score at 9.9. The metric scores for the Hilsenhoff biotic index were similar across the other stations (6.2 to 7.7) and were also similar to the Five Mile Creek regional reference (6.9).

The metric values were assigned bioassessment ranking scores, and total metric scores were calculated for each station. Total scores ranged from a low of 2 at STC-Bio-1 to a high of 20 at STC-Bio-3. These scores were compared to both reference locations including the State of Florida regional reference, Five Mile Creek, and the reference station (STC-Bio-R1). The regional reference station, Five Mile Creek, has substantially better habitat quality than the Site 16 sampling stations. Comparisons between the reference stations and the drainage ditches were conducted; however, due to differences in habitat and habitat quality, the results of the comparisons are inconclusive. However, the regional reference data are useful to compare the Site 16 results with results for other streams in Florida.

The relationship between habitat quality and biological condition among all stations at OU 7 is illustrated as a line graph on Figure 5-3. The only Site 16 sampling station that falls within the predictable condition of the biological community in consideration of habitat quality is station STC-Bio-4. Station STC-Bio-3 exhibited a higher condition of the benthic community than would be expected, based on the quality of the habitat present. Station STC-Bio-R1 fell just below the lower 95 percent confidence interval indicating that the community is slightly impaired. Station STC-Bio-1 fell well below the lower 95 percent confidence interval, indicating that the community is impaired. The macroinvertebrate community at STC-Bio-1 appears to be below the condition expected for the quality of the habitat present. However, it is important to note that those results were plotted against the regional reference for a percent comparability value. Had the data been normalized against the Sal Taylor Creek reference station, it is possible that none of the drainage ditch locations would fall below the 95 percent confidence interval.

OU 7 Hester-Dendy Sampling Results. Hester-Dendy samplers were used at stations STC-Bio-1 and STC-Bio-4. Hester-Dendy data were not available for station STC-Bio-R1 because the sampler was exposed as a result of receding water levels. Given that the Hester-Dendy samplers were exposed due to low-flow conditions and

shallow water depth and that no standard of comparison exists, evaluation of the Hester-Dendy data was not conducted.

OU 7 Ponar Sampling Results. Methods used for this analysis are presented in Section 5.2, and descriptions of metrics are presented in Table 5-11. A complete description of metrics used in the study is provided in the EA report (EA, 1994b). ponar dredge samples were taken at all Site 16 sampling stations (STC-Bio-1, STC-Bio-3, and STC-Bio-4). Because no State of Florida regional reference exists for this type of sampling equipment, all comparisons were made to reference station STC-Bio-R1.

Total taxa was lowest at STC-Bio-1 with a score of 4. The remaining two ponar dredge sampling stations had similar scores (10 and 17), but were still lower than the reference (STC-Bio-R1), which had a score of 24. Density was lowest at STC-Bio-1 at 143/m^2. Density was similar at stations STC-Bio-4 and STC-Bio-3 with readings of 530 and 731/m^2, respectively. The reference station had the highest density with a reading of 2,610/m^2. Percent dominant taxon for the Site 16 ponar dredge sampling stations ranged from 28 at STC-Bio-3 to 70 at STC-Bio-1. Percent dominant taxon for the reference station (STC-Bio-R1) fell within that range at 40.

The Florida index was low for all Site 16 ponar dredge sampling stations, with scores ranging from 1 at STC-Bio-1 to 2 at STC-Bio-3 and STC-Bio-4. The reference station did not score much higher with a Florida index of 5. The Shannon-Weaver index was lowest at STC-Bio-1 with a score of 1.357. The remaining two stations had similar scores of 2.645 at STC-Bio-4 to 3.453 at STC-Bio-3. The Shannon-Weaver index at the reference station (STC-Bio-R1) fell within that range with a score of 3.003.

Percent diptera ranged from 10 at STC-Bio-1 to 87 at STC-Bio-4. The reference station (STC-Bio-R1) scored well below this range at 4, indicative of a low stress environment. Chironomids dominated the benthic community at STC-Bio-4 (81 percent) whereas the other Site 16 stations had scores of 10 percent at STC-Bio-1 and 39 percent at STC-Bio-3. Percent chironomid at the reference station (STC-Bio-R1) was low at 4. Percent EPT was zero at all Site 16 ponar dredge sampling stations. At the reference station (STC-Bio-R1), percent EPT was low at 1. The variability in distribution among EPT and chironomids at the drainage ditch sampling locations is indicative of poor biotic conditions.

Filter-collectors were not present at the Site 16 ponar dredge stations except for STC-Bio-3, which had a percentage of 8. The percentage of filter-collectors at the reference station (STC-Bio-R1) was comparable to STC-Bio-3 at 7. Percent shredders at all Site 16 sampling stations was low, ranging from 2 at STC-Bio-3 to 11 at STC-Bio-4. The reference station (STC-Bio-R1) fell below that range at 1. Percent calcium dependent scores were also low, ranging from zero at STC-Bio-1 and STC-Bio-4 to 14 at STC-Bio-3. The percent calcium dependent score at the reference station (STC-Bio-R1) was comparable to the highest score at 12.

The Hilsenhoff biotic index was similar at all Site 16 ponar dredge sampling stations, ranging from 8.3 at STC-Bio-4 to 10 at STC-Bio-1 indicating a very pollutant-tolerant community. The reference station (STC-Bio-R1) fell within that range with a score of 8.9, also indicative of a pollutant-tolerant community.

Summary of Aquatic Studies Results for OU 7. A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions throughout the drainage ditches east of Site 16 and the runways and the reference station represent a poor environment for many types of aquatic organisms. Furthermore, as was also the case with Site 5, OU 2, the highly variable conditions associated with ephemeral streams such as the drainage ditches are not representative of aquatic habitat for which available bioassessment protocols were designed to evaluate; only certain types of aquatic taxa are well adapted to exploit these habitats. Comparisons of the metrics between the Site 16 sampling stations indicate no clear trends in data. In addition, the absence of a reference location that is similar in habitat to the man-made drainage ditches limits the interpretation of the benthic results. Based on the metrics calculated for the dip-net samples, the benthic communities at stations STC-Bio-1 and STC-Bio-R1 are below their respective expected conditions relative to the quality of habitat present. It is believed that STC-Bio-1 received drainage from OU 7 when it was operating and may be receiving contaminated groundwater that is infiltrating the storm sewers. Station STC-Bio-4 is within the expected condition given the habitat quality, and the condition of the benthic community at station STC-Bio-3 is above what is expected.

It could not be concluded that contamination in surface water or sediment from Site 16 was contributing to the poorer condition observed at Site 16 drainage ditches. Factors possibly influencing the benthic community at STC-Bio-1 include petroleum sediment odor and an oily sheen noted on the surface water.

5.2.1.8 Operable Unit 8 The semiquantitative macroinvertebrate survey conducted at NAS Cecil Field in June and July 1993 (EA, 1994a; EA, 1994b), included sampling of aquatic macroinvertebrate communities at locations throughout Rowell Creek and Lake Fretwell. Methods and a description of the metrics used for this study are presented in Section 5.2 and Table 5-11, respectively. One sampling location from this sampling event was in Rowell Creek, downgradient from Site 3 (Plate 2). This Rowell Creek station (station RC-Bio-3) is located approximately 1,200 feet east of the disposal area within the area of groundwater plume discharge from Site 3. The plume enters Rowell Creek downstream from the Lake Fretwell dam. Between RC-Bio-3 and Lake Fretwell is a sewage outfall associated with the NAS Cecil Field Navy WWTP. The presence of this sewage outfall adds some uncertainty to the evaluation of the macroinvertebrate community at Site 3. Any observed impacts on the macroinvertebrate community at RC-Bio-3 may be attributable to either the sewage treatment plant outfall or the Site 3 groundwater plume.

The surface water quality measurements and measurements of total hardness, nitrate plus nitrite, total nitrogen, and total phosphorus at RC-Bio-3 are summarized in Table 5-22. Water quality data are also provided in Table 5-22 for sampling stations CF3SW1 (located downgradient from RC-Bio-3) and CF3SW2 (located between the sewage treatment outfall and upgradient of RC-Bio-3; Plate 2). Although no macroinvertebrate data were collected at these Rowell Creek stations, water quality parameters were reviewed for regional perspective. Water depth at RC-Bio-3 was 0.2 meter from the riparian zone to instream, and low stream velocity (0.2 cubic feet per second) was observed. Water temperature taken at or near the bottom was 27.1 °C and pH was 6.7. The DO value of 5.2 mg/ℓ was slightly above the Florida water quality standard of greater than or equal to 5 mg/ℓ (Florida Legislature, 1996). Conductivity was 437 μmhos/cm, which is within the normal range according to State of Florida Surface Water Quality Standards (Florida Legislature, 1996).

Table 5-22
Summary of Operable Unit 8, Site 3, Surface Water Quality Measurements

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Station	Depth (m)[1]	Temperature (°C)[1]	pH[1]	DO (mg/ℓ)[1]	Conductivity (μmhos/cm)[1]	Secchi (m)[1]	Total Hardness (mg/ℓ as $CaCO_3$)[2]	Total Kjeldahl Nitrogen (mg/ℓ)[2]	Nitrate plus Nitrite (mg/ℓ)[2]	Total Nitrogen (mg/ℓ)[2]	Total Phosphorus (mg/ℓ)[2]
CF3SW1 [3,4]	NA	21	6.3	2.7	121	NA	97	NA	NA	NA	0.4
RC-Bio/SW3	0.2	27.1	6.7	5.2	437	0.20	[5]106	NA	[6]5.55	NA	1.30[7]
CF3SW2 [3]	0.2	24.5	6.8	1.0	120	0.20	110	NA	NA	2	NA
Five Mile Creek [7]	1	23	4.4	5.8	62	0.3	NA	NA	NA	NA	0.5

[1] From Appendix R, Operable Unit (OU) 8 Basewide Risk Assessment (BRA) (ABB Environmental Services, Inc. [ABB-ES], 1995b). Measured in the field by EA Engineering, Science, and Technology, Inc. (EA, 1994b)
[2] From Appendix D, OU 8 BRA (ABB-ES, 1995b) Measured in the laboratory.
[3] Although no macroinvertebrate data were collected at these wetland stations, water quality parameters are included in this table for regional perspective.
[4] Values for this station represent an average of duplicate samples collected simultaneously.
[5] Value is for sample collected June 26, 1993.
[6] Value represents an average of samples collected June 26, 1993, and August 18, 1993.
[7] Five Mile Creek is the Florida regional reference station considered in this study.

Notes: m = meter.
°C = degrees Celsius.
DO = dissolved oxygen.
mg/ℓ = milligrams per liter.
μmhos/cm = micromhos per centimeter (a measure of electrical conductivity).
$CaCO_3$ = calcium carbonate.
NA = not available.

Water clarity was good; however, an odor of chlorine was prominent in the RC-Bio-3 surface water and sediment. Five percent aquatic vegetation and 10 percent woody debris were observed at RC-Bio-3. Sand was a major (80 percent) component of the substrate. No leaf pack, mud, muck, or silt were apparent in the substrate. Periphyton, fish, or aquatic macrophytes were not found at this station.

Aquatic habitat quality scores were calculated for the Site 3 sampling stations based on data collected during the field survey. The results of the habitat quality scoring, including the State of Florida regional reference, Five Mile Creek, are summarized in Table 5-23. Habitat quality at the station is generally poor, due at least in part to poor bottom substrate and lack of aquatic macrophytic vegetation. The score (54) represented 80.6 percent of the regional reference station (Five Mile Creek, total score of 72).

Table 5-23
Habitat Assessment Scores, Operable Unit 8, Site 3

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Station	Bottom Substrate	Water Velocity	Artificial Channel	Bank Stability	Riparian Zone Vegetation	Flow Adjustment	Total Score	Percent Comparison to Five Mile Creek
RC-BIO-3	12	20	12	7	3	--	54	80.6
Five Mile Creek[1]	24	8	15	10	10	5	72	100

[1] Five Mile Creek is the Florida regional reference station considered in this study.

Note: -- = not measured.

A taxonomic list of the benthic macroinvertebrates at NAS Cecil Field is presented in Appendix A-7. Identified taxa were collected using dip nets, a ponar dredge, and Hester-Dendy artificial substrates.

OU 8 Dip-Net Sampling Results. Methods used to describe the structure and function of the benthic macroinvertebrate community as sampled by the ponar dredge are described in Section 5.2 and summarized in Table 5-11. A complete description of metrics for the dip-net gear type used in this study is provided in the EA report (EA, 1994b). Examination and interpretation of the metric scores show considerable differences between RC-Bio-3 and the Five Mile Creek reference station. Taxa richness, Florida index, and EPT index are markedly decreased at RC-Bio-3, but percent dominant taxon and percent shredders are greatly increased at RC-Bio-3. Station RC-Bio-3 scored approximately 50 percent of the regional reference station (Five Mile Creek). The low DO levels and generally poorer habitat quality at RC-Bio-3 may help explain the low total metric score relative to Five Mile Creek. It is unclear whether or not either the residential sewage treatment plant outfall, the poor habitat quality, or the groundwater plume from Site 3 is responsible for the lower metrics observed in dip-net samples from RC-Bio-3.

OU 8 Hester-Dendy Sampling Results. Methods used for this sampling technique are presented in Section 5.2, and the metrics are described in Table 5-11. A complete description of metrics used in this study for this gear type is provided in the

EA report (EA, 1994b). The Hester-Dendy substrate sampler results generally support those obtained from dip-net samples. The total number of taxa was decreased at RC Bio 3 and consisted primarily (97 percent) of the dominant chironomid species, *Polypedilum illinoense*, a pollution-tolerant taxon. None of the most pollution-sensitive species were detected (as reflected in a 0 percent EPT value).

The Florida index was only slightly lower at RC-Bio-3 (12) than that at Five Mile Creek (15), a less dramatic difference than that found in dip-net samples. The Hilsenhoff biotic index values obtained in Hester-Dendy samples were similar for RC-Bio-3 (6.0) and the regional reference station (6.4). Because this index may be insensitive to the presence of nonorganic pollutants such as those containing chlorine, the effect of sewage outfall versus contributions from Site 3 effluent cannot be delineated. Percent diptera was 99.5, as also was percent chironomid, as compared to 60.5 percent for both metrics at Five Mile Creek. The percent EPT and percent filtered-collectors was 0.0 percent, and 98.6 percent shredders were noted.

The relatively large decrease in the Shannon-Weaver index at RC-Bio-3 (0.279), as compared to the regional reference station value (4.612), suggests that the Rowell Creek environment has been modified. However, these data warrant careful consideration, given habitat quality differences between Rowell Creek and Five Mile Creek.

The artificial substrate sampling indicates a poorly developed benthic macroinvertebrate community. However, due to lack of adequate reference data, the source of this impact is not defined. The decreased condition of the benthic macroinvertebrate community may be due to the residential sewage treatment plant outfall or to the influence of the Site 3 groundwater plume, or to the generally poor habitat quality of RC-Bio-3.

OU 8 Ponar Sampling Results. Metrics used to describe the structure and function of the benthic macroinvertebrate community at RC-Bio-3 as sampled by the ponar dredge are described in Table 5-11. A complete description of metrics used in this study is provided in the EA report (EA, 1994b). The dominant taxon (42 percent) was a chironomid species, *Polypedilum illinoense*, a pollution-tolerant taxon. None of the most pollution-sensitive species were detected (as reflected in a 0 percent EPT value). Density of macroinvertebrates was high at RC-Bio-3 ($10,736/m^2$).

Summary of Aquatic Studies Results for OU 8. A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at RC-Bio-3 represent a poor environment for many types of aquatic organisms. Data from dip-net, ponar, and Hester-Dendy studies support this conclusion. Adequate reference data were not available, limiting interpretation of the benthic results. Aquatic habitat conditions at Site 3 are dissimilar from that of the regional reference station. Five Mile Creek is deeper, cooler, more acidic, more oxygenated, and has a lower conductivity than RC-Bio-3. These differences in habitat structure may be sufficient to explain the decreased biological condition at RC-Bio-3. However, the residential sewage treatment plant discharge or the Site 3 groundwater plume may also contribute to the differences in community structure at this sampling location.

5.2.2 Other Sites and PSCs Aquatic studies conducted by EA, (1994 a and b) included additional locations that were not evaluated in association with OUs. These sampling stations (as shown on Plate 2) include RCGC-Bio-1 (located downstream of the drainage from surface deposits of 5-gallon containers), RCGC-Bio-2 (downstream of drainage from Fairway 7 drum site), RCGC-Bio-3 (the previous Bio-2 location), RC-Bio-1 and RC-Bio-2 (adjacent to Site 19), LF-Bio-1 (located at the northern point of Lake Fretwell), RC-Bio-3 (adjacent to Site 3, located below the Lake Fretwell dam and the sewage treatment outfall), LF-Bio-2 (at the Lake Fretwell inlet from the Site 5 tributary), LF-Bio-3 (middle of the lake), LF-Bio-4 (near the lake shore, adjacent to Site 3 and PSC 4), LF-Bio-5 (located behind the Lake Fretwell dam to the west), LF-Bio-6 (behind the Lake Fretwell dam to the east), LF-Bio-7 (located at the lake inlet from the west and at the southern point near Site 3), LF-Bio-8 (located north of LF-Bio-6 in Lake Fretwell), 6-Bio-1 (located in the pond on PSC 6), STC-Bio-2 (located in Sal Taylor Creek in the ditch downstream of Site 16, STC-Bio-5 (located upstream of tributary from Site 8), STC-Bio-6 (Sal Taylor Creek, downstream of the tributary from Site 8), STC-Bio-7 (downstream of STC-6), STC-Bio-8 (downstream of confluence with Rowell Creek), 9-Bio-1 (in the tributary downstream of PSC 9), YWC-Bio-1 (in Yellow Water Creek downstream of Site 15, 200 feet upstream of the road near the housing area), and YWC-Bio-2 (200 feet upstream of Normandy Boulevard).

Reference stations utilized for the NAS Cecil Field watershed include RCGC-Bio-R1 (the reference station for location on the golf course), RC-Bio-R1 (Rowell Creek upstream of Normandy Boulevard), STC-Bio-R1 (Sal Taylor Creek in the munitions area upstream of ditches draining Site 16), and YWC-Bio-R1 (Yellow Water Creek upstream of Site 15). The reference station locations are also depicted on Plate 2.

Sampling methods of the aquatic studies are discussed in Section 5.2, and metrics used to evaluate the structure and function of communities within these sampling locations are presented in Table 5-11. Results of these studies are summarized below.

Surface water quality measurements for the additional sites and PSCs and reference stations are presented in Table 5-24. All the additional sampling locations except STC-Bio-2, LF-Bio-1, LF-Bio-2, LF-Bio-5, and LF-Bio-7 are in areas that are 50 percent or more forested. Moderate sediment oils were present only at STC-Bio-2, and a slight amount was detected at 6-Bio-1. Sediment odors were normal at all stations except 9-Bio-1, RCGC-Bio-1, and RCGC-Bio-3, where evidence of anaerobic gases was present, and STC-Bio-2, where petroleum odor was detected. Most stations had substrates composed of at least 50 percent sand; exceptions were 9-Bio-1 and RCGC-Bio-1 (40 percent each), RCGC-Bio-1, RCGC-Bio-2, STC-Bio-R1 and YWC-Bio-2 (45 percent each), STC-Bio-2 (15 percent), STC-Bio-5, LF-Bio-1, LF-Bio-4, LF-Bio-6, LF-Bio-7 and 6-Bio-1 (0 percent each), YWC-Bio-R1 (25 percent) and LF-Bio-2 and LF-Bio-3 (10 percent each).

Surface water was clear at all stations except STC-Bio-5, which was turbid. Sampling stations associated with the golf course, Lake Fretwell, and Yellow Water Creek, along with RC-Bio-2, RC-Bio-3, STC-Bio-5, STC-Bio-R1 and 6-Bio-1, showed a tannic coloration. Water odor was normal at all these sampling stations. Water surface oils were present as a sheen only at STC-Bio-2. Periphyton and aquatic macrophytes were rare or absent at all these stations.

Table 5-24
Summary of Surface Water Quality Measurements for Additional Sites, Potential Sources of Contamination, and Reference Stations

Basewide Ecological Assessment Report
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Jacksonville, Florida

Station	Depth (m)[1]	Temperature (°C)[1]	pH[1]	DO (mg/ℓ)[1]	Conductivity (μmhos/cm)[1]	Secchi (m)[1]
RCGC-Bio-1	0.2	21.8	5.4	0.9	17.3	1.00
RCGC-Bio-2	1.0	23.4	6.2	1.4	168	1.00
RCGC-Bio-3	0.4	23.2	6.6	2.3	195	0.40
RC-Bio-1	0.5	28.0	7.3	5.7	187	1.50
RC-Bio-2	0.5	27.9	7.8	5.9	187	1.70
RC-Bio-3	0.2	27.1	6.7	5.2	437	0.1
LF-Bio-1	0.2	31.9	7.9	7.6	178	1.30
LF-Bio-2	0.2	31.4	7.7	7.7	179	1.00
LF-Bio-3	0.2	30.1	7.2	6.5	177	1.20
LF-Bio-4	0.2	28.9	6.9	5.6	178	1.50
LF-Bio-5	0.2	29.0	7.6	5.9	180	1.70
LF-Bio-6	0.2	27.8	8.1	5.6	181	1.30
LF-Bio-7	0.2	27.3	6.8	4.0	183	22.20
LF-Bio-8	0.2	30.7	7.4	6.9	169	1.40
6-Bio-1	NA	NA	NA	NA	NA	0.5
STC-Bio-2	0.3	26.5	6.2	7.4	148	0.30
STC-Bio-5	0.2	24.0	6.5	5.0	79	1.2
STC-Bio-6	0.2	25.6	6.7	6.8	143	0.20
STC-Bio-7	0.2	25.6	6.7	6.8	143	0.20
STC-Bio-8	NA	NA	NA	NA	NA	NA
9-Bio-1	0.2	22.4	5.8	4.3	62	0.20
YWC-Bio-1	0.2	25.2	6.4	4.4	99	0.20
YWC-Bio-2	0.2	24.4	6.5	4.4	114	1.00
RCGC-Bio-R1	NA	NA	NA	NA	NA	NA
RC-Bio-R1	NA	NA	NA	NA	NA	NA
STC-Bio-R1	0.2	25.1	6.3	3.7	169	0.20
YWC-Bio-R1	0.2	23.9	6.5	4.1	105	0.20

[1] Measured in the field.

Notes: m = meter.
°C = degrees Celsius.
DO = dissolved oxygen.
mg/ℓ = milligrams per liter.
μmhos/cm = micromhos per centimeter (a measure of electrical conductivity).
NA = not applicable.

Table 5-25 presents habitat assessment scores derived for the additional sites, PSCs, and reference stations. The highest habitat quality score was noted at the reference station, YWC-Bio-R1 (75), also exceeding the regional reference station, Five Mile Creek (67). STC-Bio-5 and STC-Bio-7 had moderately high scores (63 and 66, respectively). The lowest score was noted at STC-Bio-2 (13).

Although the habitat assessment procedure is designed for stream habitat, information that was applicable to the lake stations was tabulated and scores were assigned (Table 5-25). These scores were only comparable to each other and showed some variability. The scores for Lake Fretwell ranged from 26 at LF-Bio-1 to 46 at LF-Bio-7. At the pond station, 6-Bio-1, the score was 52.

A taxonomic list of the benthic macroinvertebrates collected is presented in Appendix A-7. Identified taxa were collected from the stations using a combination of dip-net, ponar, and Hester-Dendy samplers. Fish species observed at NAS Cecil Field sampling stations are listed in Appendix A-2.

Dip-Net Sampling Results for Additional Sites, PSCs, and Reference Stations. Methods used in the sampling effort are described in Section 5.2, and metrics applied to analysis are presented in Table 5-11. Complete descriptions of metrics for the dip net gear type are presented in the EA reports (EA, 1994a; EA, 1994b). Total scores for these stations ranged from a low of 12 at STC-Bio-2 to 40 at STC-Bio-8. Most stations scored slightly less than the Five Mile Creek score of 28. Other reference station scores were 18 for RC-Bio-R1, 26 for RCGC-Bio-R1, 16 for STC-Bio-R1, and 24 for YWC-Bio-R1.

The relationship between habitat quality and biological condition is illustrated for some of the additional stations on Figures 5-2 and 5-3. Methods used in deriving this relationship are described in Section 5.2. On Figure 5-2, the following stations lie within the predictable conditions of the community: 9-Bio-1, RCGC-Bio-3, and RC-Bio-R1. Station RCGC-Bio-R1 exhibited a higher benthic quality than might have been expected. This may be representative of nutrient enrichment, which will artificially sustain a more diverse fauna in a given habitat quality than expected. Stations RCGC-Bio 1 and RCGC-Bio-2 fell below the 95 percent confidence line and could be classified as slightly impaired.

The above situations represent areas where organic pollution or toxicants could be adversely affecting the biological conditions, regardless of the quality of the habitat. However, the very low DO present at these two stations may possibly be adversely influencing the communities.

On Figure 5-3, the following stations lie within the predictable conditions of the community: STC-Bio-2, STC-Bio-7, STC-Bio-8, and YWC-Bio-R1. Stations STC-Bio-6 and YWC-Bio-2 showed a higher than expected benthic quality. Stations STC-Bio-R1, STC-Bio-5, and YWC-Bio-1 were moderately impaired.

Ponar Sampling Results for Additional PSCs and Reference Stations. Methods used in the sampling effort are described in Section 5.2, and metrics applied to analysis are presented in Table 5-11. Complete descriptions of metrics used in these studies are presented in the EA reports (EA, 1994a; EA, 1994b). Since no State of Florida regional reference data exist for this gear type, all stream station data comparisons were made to the reference stations RC-Bio-R1, RCGC-Bio-R1, STC-Bio-R1, and YWC-Bio-R1. Since no lake reference stations were established

Table 5-25
Habitat Assessment Scores for Additional Sites, Potential Sources of Contamination, and Reference Stations

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Naval Air Station Cecil Field
Jacksonville, Florida

Station	Bottom Substrate	Water Velocity	Artificial Channel	Bank Stability	Riparian Zone Vegetation	Flow Adjustment	Total Score	Percent Comparison to Five Mile Creek[1]
RCGC-Bio-1	23	3	14	5	7	NA	52	77.6
RCGC-Bio-2	23	3	14	3		NA	50	74.6
RCGC-Bio-3	20	3	14	2	4	NA	43	64.2
RC-Bio-1	20	6	14	7	7	NA	54	80.6
RC-Bio-2	20	6	14	8	7	NA	55	82.1
RC-Bio-3	12	20	12	7	3	NA	54	80.6
LF-Bio-1	4	0	14	6	2	NA	26	--
LF-Bio-2	10	0	14	9	2	NA	35	--
LF-Bio-3	10	0	14	9	4	NA	37	--
LF-Bio-4	10	0	14	9	4	NA	37	--
LF-Bio-5	7	0	14	9	0	NA	30	--
LF-Bio-6	7	0	14	9	0	NA	30	--
LF-Bio-7	18	0	14	8	6	NA	46	--
LF-Bio-8	10	0	14	9	5	NA	28	--
6-Bio-1	24	0	1.4	9	5	NA	52	--
STC-Bio-2	5	2	2	2	2	NA	13	19.4
STC-Bio-5	18	18	14	5	8	NA	63	94
STC-Bio-6	12	16	13	7	6	NA	54	80.6
STC-Bio-7	21	21	13	6	5	NA	66	98.5
STC-Bio-8	NA	NA	NA	NA	NA	NA	NA	NA
9-Bio-1	16	7	13	5	8	NA	49	73.1
YWC-Bio-1	24	7	14	9	8	NA	62	92.5
YWC-Bio-2	25	10	14	6	5	NA	60	89.6
RCGC-Bio-R1	NA	NA	NA	NA	NA	NA	NA	NA
RC-Bio-R1	NA	NA	NA	NA	NA	NA	NA	NA
STC-Bio-R1	18	10	14	8	6	NA	56	83.6
YWC-Bio-R1	24	22	14	8	7	NA	75	100
Five Mile Creek	24	8	15	10	10	5	67	100

[1] Five Mile Creek is the Florida regional reference station considered in this study. Methods for sampling and habitat scoring procedures are reported in Section 5.2.

Notes: NA = not available. -- = comparison not appropriate for Lake Fretwell.

as part of this study, the only suitable stations for comparisons were RC-Bio-1 and RC-Bio-2, located just upstream from Lake Fretwell.

The total number of taxa was lowest at LF-Bio-6 (8 taxa), followed by LF-Bio-5 (10). Other stations with a number of taxa that was lower than the reference stations were 9-Bio-1 (17 taxa), STC-Bio-2 (19), LF-Bio-1, LF-Bio-3, LF-Bio-4 (20), and LF-Bio-8 (22). The remaining stations ranged from 23 to 46 taxa each, comparing favorably with reference stations.

The number of individuals was lowest at 6-Bio-1 (831/m^2), compared to 2,480/m^2 and 11,624/m^2 for RC-Bio-R1 and RCGC-Bio-R1, respectively. Density at most other stations was appreciably higher than RC-Bio-R1, but tended to have lower abundance compared to RCGC-Bio-R1 and YWC-Bio-R1 (6,479/m^2).

The Florida index was lowest at YWC-Bio-1 (1). All stations were lower than RCGC-Bio-1 (12), and most were also lower than YWC-Bio-R1 (6); only YWC-Bio-2 (9) and STC-Bio-8 (8) exceeded the latter.

The Shannon-Weaver index was lowest at LF-Bio-4 (1.332). Index values at all other stations were comparable to the reference stations (RC-Bio-R1 (2,844), RCGC-Bio-R1 (3.627), STC-Bio-R1 (3.003), and YWC Rio-R1 (3.531).

The percent EPT individuals was low at all stations as expected because of the substrate type. These taxa are more common on cobble or gravel substrate than on sand or mud. Most stations had 0 percent EPT and the highest percentages were at RC-Bio-R1 (9.8 percent) and LF-Bio-2 (5.5 percent).

The Hilsenhoff Biotic index values were high at most stations, ranging from 6.3 at YWC-Bio-R1 to 9.7 at LF-Bio-4. On a scale of 1-10, with the low values indicative of good quality community, the stations at NAS Cecil Field are all classified as below average, based on the infaunal benthic community.

The trends in metric values indicate that LF-Bio-6 and STC-Bio-4 ranked lower for many of the key metrics compared to the reference stations and other stations studied. Station LF-Bio-6, the deepest station sampled in Lake Fretwell, had very low DO at the bottom, which may have contributed to its low metric values. STC-Bio-4 ranked low in the Hester-Dendy and ponar samples. The stream stations RC-Bio-R1, STC-Bio-R1, and YWC-Bio-R1 were suitable reference stations with high habitat assessment scores and moderate to high metric values. Station RCGC-Bio-R1 was not representative of most stations sampled, due to low habitat quality and dense growth of aquatic macrophytes, which was not typical of most stations. However, RCGC-Bio-R1 did score unusually high on many metrics, which may have been due to the unique habitat characteristics discussed above.

Hester-Dendy Sampling Results for Additional Sites, PSCs and Reference Stations. Because some samplers were totally exposed or were not set at some stations, Hester-Dendy sampler data are not available at the following stations: RC-Bio-1 and 2, STC-Bio-R1, and LF-Bio-1 through LF-Bio-8.

The total number of taxa was lowest at STC-Bio-2 (7 taxa), which is much lower than all the others in the comparison. The other stations ranged from 22 taxa (RC-Bio-R1) to 41 (STC-Bio-8). STC-Bio-R1 (36) and Five Mile Creek (30) were next highest.

The number of individuals was lowest at STC-Bio-2 (313/m^2) and at Five Mile Creek (326/m^2). The remaining stations had similar or higher numbers of individuals. The highest number was observed at RC-Bio-3 (26,686/m^2).

The Florida index values were lowest at STC-Bio-1 and 2 (both were 0), followed by RC-Bio-R1 (3). Compared to Five Mile Creek (15), values at all other stations were lower. The next highest value was measured at STC-Bio-8 (14), followed by YWC-Bio-1 (12).

The Shannon-Weaver index values were lowest at STC-Bio-2 (1.419). All other stations had comparable values, ranging from 2.484 at YWC-Bio-1 to 4.612 at Five Mile Creek.

The percent of EPT individuals, which consists of the most pollution-sensitive benthic taxa, was 0.0 at STC-Bio-2 and STC-Bio-4. Percentages at the reference stations, Five Mile Creek (5.6 percent), RC-Bio-R1 (0.8 percent), and RCGC-Bio-R1 (1.4 percent), were also low. The percent of EPT was highest at STC-Bio-8 (34.1 percent), followed by YWC-Bio-R1 (17.5 percent).

The Hilsenhoff biotic index scores ranged from a good quality score of 4.7 at STC-Bio-8 to a low score of 8.7 at RC-Bio-R1. Many of the stations had scores higher than Five Mile Creek (6.4), including reference stations RC-Bio-R1 (8.7) and RCGC-Bio-R1 (7.4).

The trends in the metric values indicate that STC-Bio-2 and 4 consistently ranked lower than the reference stations and all other stations. The reference stations at Five Mile Creek and YWC-Bio-R1 were among the higher ranking stations and were more suitable as reference stations than RC-Bio-R1 or RCGC-Bio-R1, which had similar metric values to the potentially influenced stations.

Summary of Aquatic Studies Results for the Additional Sites, PSCs, and Reference Stations. A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at stations STC-Bio-R1, STC-Bio-5, and YWC-Bio-1 are moderately impaired. All other stations lie within or above the predictable condition. Station-to-station differences may be due to differences in substrate composition and/or where they exist, in addition to or instead of man-induced alteration of the population. The very low DO present at RCGC-Bio-1 and RCGC-Bio-2 may possibly be adversely impacting these communities.

5.2.3 Other Studies No additional aquatic studies have been completed to date.

5.3 TERRESTRIAL STUDIES. Terrestrial studies include examination or sampling of terrestrial wildlife or habitat at NAS Cecil Field. Terrestrial wildlife includes mammals, birds, reptiles, amphibians, terrestrial invertebrates, and plants. The objectives and scope of terrestrial studies are reported in Appendix C, and ecological receptor species observed or expected to occur at NAS Cecil Field are listed in Appendix A. Study results for each OU and PSC are summarized in the following subsections. Any terrestrial studies not completed for a specific OU are summarized in Subsection 5.3.3. A facilitywide survey of the gopher tortoise (*Gopherus polyphemus*), listed as a species of special concern by the FGFWFC, was conducted by CZR (1994); a summary is presented in Subsection 5.3.3.

5.3.1 Operable Units Terrestrial studies have been completed at OUs 1, 2, 3, 4, 5, 6, 7, and 8. These studies consist of mapping plant cover types, based upon FNAI (1990) classification of natural communities, and direct observations and field signs of terrestrial wildlife. The selection of appropriate representative wildlife species for risk assessments is based upon the species known or expected to occur at each OU, as determined by these field studies.

A summary of upland habitats observed at the OUs and PSCs is presented in Table 5-25, including identification of habitat types found at each OU and PSC. Plate 1 shows the location and extent of upland habitats associated with OUs and PSCs at NAS Cecil Field. Further descriptions of terrestrial communities are provided in the paragraphs below for each OU and PSC.

5.3.1.1 Operable Unit 1 Mapping of vegetative communities was completed for Sites 1 and 2 (CDM, 1994); the objectives and timing of this field effort are described in Appendix C. A description of upland habitats at OU 1 is presented in Table 5-26, and the locations at Sites 1 and 2 are depicted on Figures 2-1 and 2-2, respectively.

OU 1 habitats most closely resemble mesic flatwood and upland mixed forest communities (FNAI, 1990). The western border of Site 1 is an upland community consisting of a planted pine forest. Typical vegetation identified in this area includes slash pine (*Pinus elliotti*), longleaf pine (*Pinus palustris*), loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), sand blackberry (*Rubus cuneifolius*), blackberry (*Rubus* sp.), and muscadine grape (*Vitis rotundifolia*).

At Site 2, an upland mixed forest with a well-developed, closed-canopy forest of upland hardwoods, dominated by water oak (*Quercus nigra*), myrtle oak (*Q. myrtifolia*), and sweetgum borders the northwestern corner. The trees in this area appear to be older than NAS Cecil Field (50 years), indicating no prior disturbance with the exception of a few monitoring well installations.

Bordering the northern edge of Site 2 is a planted pine forest. Although this is a disturbed area with drainage ditches and a few roads, characteristics of the mesic flatwood FNAI classification are evident. The area is relatively flat with poorly drained soil. Vegetation includes longleaf pine, slash pine, loblolly pine, saw palmetto (*Serenoa repens*), bog buttons (*Lachnocaulon anceps*), and gallberry (*Ilex glabra*). The vegetative community of Site 2 provides limited habitat for terrestrial wildlife, in contrast to Site 1. Ecological diversity at Site 1, based upon direct observation of individuals and signs of lower trophic level organisms, includes insects, rodents, and armadillo (*Dasypus novemcinctus*), as well as higher trophic level predators, including sharp-shinned hawk (*Accipiter striatus*), pygmy rattlesnake (*Sistrurus miliarus barbouri*), and other snakes.

5.3.1.2 Operable Unit 2 Mapping of vegetative communities was completed for Sites 5 and 17 (CDM, 1994 and HLA ecologists); the scope and objectives of this field effort are described in Appendix C. A description of upland habitats at OU 2 is presented in Table 5-26, and the locations at Sites 5 and 17 are depicted on Figures 2-3 and 2-4, respectively.

Terrestrial parts of Site 5 include scrubby flatwoods, planted pine (mesic flatwoods), and disturbed upland regions (Plate 1). These uplands are dominated

Table 5-26
Description of Upland Habitats

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Classification	Description	Representative Vegetation (common name)	Location
Mesic flatwood (includes planted pines)	Open canopy forest of widely spaced pine trees and a dense ground cover of herbs and shrubs; relatively flat; moderately to poorly drained terrain.	Slash pine, longleaf pine, loblolly pine, red maple, sweetgum, sand blackberry, blackberry, muscadine grape, saw palmetto, bog buttons, and gallberry.	OU 1, Sites 1 and 2 OU 2, Site 5 OU 3, Site 8 OU 4, Site 10 OU 5, Site 15 OU 6, Site 11 PSC 4 PSC 19
Upland mixed forest	Well developed, closed canopy forest and upland.	Water oak, myrtle oak, and sweetgum.	OU 1, Sites 1 and 2 OU 4, Site 10 OU 6, Site 11
Scrubby flatwood	Open canopy of widely scattered pine trees, with a sparse shrub understory; relatively flat, areas of open sand, with some characteristics of mesic flatwood.	Slash pine, longleaf pine, loblolly pine, muscadine grape, saw palmetto, wax myrtle, blackberry, goldenrod.	OU 2, Site 5
Disturbed areas	Open, dry areas dominated by forbes, many of which are colonizing areas disturbed by investigative activities.	Water oak, myrtle oak, and sweetgum.	OU 2, Sites 5 and 17 OU 3, Site 7 and 8 OU 4, Site 10 OU 5, Sites 14 and 15 PSC 4 PSC 6 PSC 9 PSC 12 PSC 19
Dry prairie	Flat, sandy soil with little to no trees and dense ground cover.	Ragweed, goldenrod, dog fennel, bracken fern, wax myrtle, sand blackberry, golden ragweed and muscadine grape.	OU 8, Site 3 OU 5, Site 15 PSC 4
Maintained fields	Grassy areas that are maintained by mowing.	Grasses, mixed herbaceous vegetation.	OU 7, Site 16 OU 3, Sites 7 and 8 OU 5, Site 11 PSC 6

Sources: Camp, Dresser, and Mckee, 1994; ABB Environmental Services, Inc., 1995i.

Notes: OU = Operable Unit.
PSC = Potential Source of Contamination.

by various pine species, including longleaf pine, slash pine, and loblolly pine. Occasional water oak and red maple are found in the southern and eastern parts of the site. The shrubby understory at Site 5 varies from sparse to dense and includes shrubs such as saw palmetto, wax myrtle (*Myrica cerifera*), Carolina cherry (*Prunus caroliniana*), and fetterbush (*Lyonia* sp.). Dense vines cover much of the shrub layer; plants in this layer include catbriar (*Smilax bona-nox*), muscadine grape, bramble (*Rubus* sp.), and Virginia creeper (*Parthenocissus virginiana*). Open areas in the drier parts of the site are dominated by forbes, many of which are colonizing areas disturbed by investigative activities at the site. Herbaceous vegetation observed at Site 5 includes bracken fern (*Pteridium aquilinum*), cinnamon fern (*Osmunda cinnamomea*), sand blackberry, dog fennel (*Eupatorium capitatum*), St. John's-wort (*Hypericum* sp.), fleabane (*Erigeron* sp.), evening primrose (*Oenothera* sp.), broom sedge (*Andropogon virginiana*), rush (*Juncus marginatus*), and grasses, including a *Paspalum* species.

At Site 17, the western part is upland, with palustrine forested broad-leaved deciduous wetland occurring to the east of the site (Plate 1). The vegetative community covering Site 17 (the former disposal area) consists of upland plant communities. A grass-covered area with scattered young slash pine trees and a dense shrub and herb layer covers this region. Woody vegetation in the Site 17 uplands includes slash pine loblolly pine, myrtle oak, red maple muscadine grape, bay, and blackberry. This plant community is disturbed and does not fall within any FNAI natural community type. Herbaceous species observed in the disturbed Site 17 uplands include plantain, Virginia creeper, rushes, and dog fennel.

Bordering Site 17 is a planted pine forest. Although this is a disturbed area with drainage ditches and fire roads, characteristics of the mesic flatwood FNAI classification are evident. The area is relatively flat with poorly drained soil. Vegetation includes longleaf pine, slash pine, loblolly pine, saw palmetto, bog buttons, and gallberry.

It is likely that the invertebrate biomass at the uplands at both OU 2 sites serves as a forage base for a limited number of wildlife species, including amphibians, reptiles, birds, and mammals. Upland habitats likely support several reptile and amphibian species, including 20 to 30 species of reptiles and amphibians (Ashton and Ashton, 1988; 1989; 1991). Species of mole salamander (*Ambystoma* spp.) spend at least part of the year in pine woodlands, and a number of other salamanders, frogs (including members of the genera *Hyla*, *Rana*, and *Pseudacris*), and toads (*Bufo* spp.) may also occur in this habitat. Several lizard species and colubrid snakes may also be found in disturbed pine forest communities (Ashton and Ashton, 1988).

Several small mammal trails were observed in the interior and around the perimeter of Site 5 uplands. Some of these trails may be the work of the eastern cottontail rabbit (*Sylvilagus floridanus*). Other mammals that may occur in this habitat include the hispid cotton rat (*Sigmodon hispidus*) and cotton mouse (*Peromyscus gossypinus*), as well as the armadillo (*Dasypus novemcinctus*). Predatory mammals such as the red fox (*Vulpes vulpes*) and gray fox (*Urocyon cinereoargenteus*) may feed on small mammals at these sites, and white-tailed deer (*Odocoileus virginianus*) may forage in these areas.

Depending upon the vegetative association, southeastern pine forests provide habitat for a diverse array of avifauna, including insectivorous gleaners of pine needles and bark, flycatchers, a seed-eating assemblage, and nocturnal and diurnal

aerial predators (Wolfe and others, 1988). Birds of prey such as the black vulture (*Coragyps atratus*), turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), and red-shouldered hawk (*B. lineatus*) search for prey items in the more open regions, and granivorous birds such as the mourning dove (*Zenaida macroura*) and northern bob-white (*Colinus virginianus*) are likely to occur in the upland communities at Sites 5 and 17.

Birds observed at the two sites include the brown thrasher (*Toxostoma rufum*), bobwhite quail, mockingbird (*Mimus polyglottus*), common grackle (*Quiscalus quiscula*), fish crow (*Corvus ossifragus*), killdeer (*Charadrius voviferus*), northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), mourning dove, rufous-sided towhee (*Pipilo erythrophthalmus*), common flicker (*Colaptes auratus*), red-bellied woodpecker (*Centurus carolinus*), pine warbler (*Dendroica pinus*), ruby-crowned kinglet (*Regulus calendula*), solitary vireo (*Vireo solitarius*), and black and white warbler (*Mniotilta varia*).

5.3.1.3 **Operable Unit** 3 OU 3 consists of Sites 7 and 8. Site-specific descriptions are provided below. A description of upland habitats at OU 3 is provided in Table 5-26, and the locations of Sites 7 and 8 are depicted on Figures 2-5 and 2-6, respectively.

Site 7, the Old Firefighting Training Area, is located near the flight line area. The only ecological communities observed at Site 7 were mowed grass (to a height of 4 to 6 inches) and disturbed uplands. These latter areas are best characterized as degraded old fields, overgrown fields, and weedy parking lots/storage. Plant species observed at the site include grasses, yellow aster, yellow fleabane, grasses, crabgrass (*Digitaria or Eleusine* sp.), bitterweed (*Helenium amarum*), blackberry, verbena, fleabane, bullbriar greenbriar, buchnera (*Buchnera* sp.), ragweed (*Ambrosia artemisiifolia*), laramide, bracken fern, winged sumac (*Rhus copallina*), dog fennel, cherry, and occasional live oak and slash pine.

In mowed grass areas, there may be a limited assemblage of terrestrial invertebrates and birds found in these managed grassy areas; however, the occurrence of ecological receptors foraging in these areas is expected to be minimal. The limited cover present in mowed and disturbed uplands, and the proximity of these sites to roads, generally precludes their use by large predatory animals; however, small rodents or birds may be found foraging at the site. Appendix A contains a list of species that may occur at mowed grass and disturbed upland areas.

Site 8, the Firefighter Training Area, Boresite Test Range, and Hazardous Waste Storage Area, is located south of the flight line area near the Perimeter Road. Several ecological communities were found at Site 8, including mowed grass, disturbed upland, planted pine flatwoods, and a mixed pine and hardwood community. The site is surrounded by forested areas.

Disturbed upland areas are dominated by graminoids and other herbaceous plants, with a sparse shrubby understory, and no arboreal canopy. These areas are best characterized as degraded old fields, overgrown fields, weedy parking lots/storage areas, and unpaved roads.

The FNAI (1990) habitat classifications were designed to characterize pristine areas and, due to active management of these flatwoods, do not correspond well with this cover type. However, particular features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which

grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay (thus retaining soil moisture).

The mixed pine and hardwood community at Site 8 is a transitional community composed of the same plant species found in the planted pine and upland mixed forest communities. The mixed pine and hardwood communities were scattered in and bordering the stand of planted pines (e.g., along roadsides), and were primarily dry.

Tree and shrub species observed at Site 8 include bay, longleaf pine, red cedar (*Juniperus virginiana*), live oak, loblolly pine, laurel oak, red maple, willow (*Salix* sp.), black cherry (*Prunus serotina*), saw palmetto, water oak, southern bayberry (*Myrica cerifera*), sweetgum, and holly (*Myrica inodora*). Herbivorous and graminoid species found at Site 8 include crabgrass, yellow-eyed grass, fleabane, snapdragon, dog fennel, Spanish needles (*Bidens pilosa*), panic grass (*Panicum vergatum*), sedges, goldenrod (*Solidago* sp.), acacia (*Acacia* sp.), sedges, blackberry, cinnamon fern, bracken fern, bullbriar greenbriar, Virginia creeper, thistle (*Cirsium* sp.), verbena, tall grasses, yellow aster, agalinis (*Agalinis fasciculata*), bedstraw (*Galium* sp.), sumac, loblolly bay (*Gordonia lasianthus*), and netted chain fern (*Woodwardia areolata*).

In mowed grass areas, there may be a limited assemblage of terrestrial invertebrates and birds found in these managed grassy areas; however, the occurrence of ecological receptors foraging in these areas is expected to be minimal. The limited cover present in mowed and disturbed uplands, and the proximity of these sites to roads, generally precludes their use by large predatory animals; however, small rodents or birds may be found foraging at the site. Appendix A contains a list of species that may occur within ecological communities identified at Site 8.

5.3.1.4 **Operable Unit 4** OU 4 consists of Site 10, the Rubble Disposal Area, shown on Figure 2-7. It extends due north from the Perimeter Road along the eastern edge of Rowell Creek (south of Lake Fretwell). The following upland communities were identified at Site 10, roughly from east to west: disturbed upland, mixed hardwood/pine community, and upland mixed forest. A description of upland habitats at OU 4 is provided in Table 5-26.

Disturbed upland areas are dominated by graminoids and other herbaceous plants, with a sparse shrubby understory, and no arboreal canopy. These areas are best characterized as degraded old fields, overgrown fields, weedy parking lots/storage areas, and unpaved roads.

The mixed pine and hardwood community at Site 10 is a transitional community composed of the same plant species found in upland mixed forest communities. The mixed pine and hardwood forests bordered the upland mixed forest. The upland mixed forest observed at Site 10 is a well developed community characterized as having a closed arboreal canopy and sandy-clay soils with organic or sometimes calcareous components. The rolling topography usually contributes to water runoff; however, the soils and leaf litter conserve soil moisture (FNAI, 1990). This community was likely preceded by an upland pine community.

Tree and shrub species found at Site 10 include sweetgum, Carolina cherry, southern bayberry, gallberry (*Ilex glabra*) and other hollies, red cedar, water

oak, Spanish oak, live oak, saw palmetto, bay, blueberry, dahoon holly, cypress, sweetbay magnolia, red maple, and false willow. Herbaceous and graminoid plant species found at Site 10 include bullbriar greenbriar, bracken fern, wild poinsettia (*Poinsettia heterophylla*), dog fennel, yellow aster, dry grass, fleabane, coralberry (*Symphoricarpos orbiculatus*), sea myrtle (*Baccharis halmifolia*), grasses, goldenrod, Virginia creeper, peppervine (*Ampelopsis arborea*), thistle, morning glory (*Ipomoea* sp.), muscadine grape, evening primrose (*Oenothera* sp.), crabgrass, rudbeckia, trumpet creeper (*Campsis radicans*), holly, flat-topped white aster, beauty berry (*Callicarpa americana*), panic grass, persimmon (*Diospyros virginiana*), meadow beauty (*Rhexia virginica*), grass, poison ivy (*Toxicodendron radicans*), blazing star (*Liatris tenuifolia* and other species), climbing fern (*Ligodium* sp.), bamboo, grape fern (*Botrychium* sp.), red aster, climbing hempweed (*Mikania scandens*), clubmoss (*Lycopodium* sp.), meadow beauty (*Rhexia virginica*), violet (*Viola* sp.), yellow-eyed grass, rushes, peas (*Cassia* sp.), vervain, maiden-hair fern (*Adiantum pedatum*), pokeweed, cinnamon fern, royal fern (*Osmunda regalis*), pickerelweed (*Pontederia cordata*), buckwheat, wild poinsettia, and lobelia.

5.3.1.5 Operable Unit 5 OU 5 consists of Sites 14 and 15. Site-specific descriptions are provided below. The locations of Sites 14 and 15 are depicted on Figures 2-8 and 2-9, respectively. A description of upland habitats at OU 5 is provided in Table 5-26.

Site 14, the Blue 5 Ordnance Disposal Area, is located in the Yellow Water Weapons Area. The terrestrial community identified at this site is disturbed upland. Disturbed upland areas are dominated by graminoids and other herbaceous plants, with a sparse shrubby understory, and no arboreal canopy. These areas are best described as degraded old fields, overgrown fields, weedy parking lots/storage areas, and unpaved roads. The limited cover and proximity of these sites to roads generally precludes their use by large predatory animals; however, small rodents or birds may be found foraging at the site.

Tree and shrub species observed at Site 14 include myrtle-leafed holly (and other hollies, slash pine, southern bayberry, water hemlock (*Cicuta* sp.), and tall gallberry holly (*Ilex glabra*). Herbaceous and graminoid plant species observed at Site 14 include twig rush, sedges, hatpins, yellow-topped aster, blazing star, sand blackberry, St. John's-wort, grasses, yellow-eyed grass, common dodder (*Cuscuta* sp.), white bracted sedge (*Dichromena latifolia*), meadow beauties, rattlebox (*Sesbania* sp.), ragweed (*Ambrosia artemisiifolia*), acacia, dog fennel, redroot, foxtail clubmoss (*Lycopodium alopecuroides*), bugleweed (*Lycopus* sp.), seedbox (*Ludwigia alternifolia*), rabbit tobacco (*Gnaphalium obtusifolium*), twig rush, sea myrtle, muscadine grape, hatpins, agalinis, hooded pitcher plant (*Saracenia minor*), bog buttons, asters, sundew (*Drosera* sp.), horned bladder wort (*Utricularia cornuta*), purple bladder wort (*U. purpurea*), and tickseed (*Coreopsis gladiata*).

Site 15, the Blue 10 Ordnance Disposal Area, is located in the western portion of the Yellow Water Weapons Compound. Upland ecological communities observed at Site 15 include disturbed uplands, mesic planted pine flatwoods (ranging from a dense, shrubby understory to no understory dominated by pine needle duff), mesic mixed pine and hardwoods, and pine flatwoods with dry prairie characteristics. Most of the roadside canopy is a disturbed mixed pine and hardwood community. Dry prairie habitats occur in flat, moderately to poorly drained terrain and are controlled by periodic burns, thus limiting pine introduction into the community.

Some features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay (thus retaining soil moisture).

The majority of the site, composed of planted pine flatwoods, was dominated by slash pines. Other tree and shrub species observed at Site 15 include sweetgum, southern bayberry, hollies, red maple, saw palmetto, bay, live oak, water oak, occasional longleaf pine, gallberry, laurel oak, turkey oak, scrub oak, sweetbay magnolia, and cedar. Herbaceous and graminoid species observed at Site 15 included bullbriar greenbriar, muscadine grape, graminoids, Virginia creeper, poison ivy, white sabatia (*Sabatia brevifolia*), bamboo, yellow star grass, morning glory, beauty berry, ragweed, yellow-eyed grass, various ferns, blackberry, mullein (*Verbascum thapsus*), blue curls (*Trichostema dichotomum*), ragweed, fleabane, morning glory, thistle, cinnamon fern, sedges, sphagnum moss (*Sphagnum* sp.), royal fern, netted chain fern, Spanish moss, dog fennel, bracken fern, acacia, lichens, mimosa, yellow pea, verbena, blue sage (*Salvia azurea*), and beauty berry.

5.3.1.6 Operable Unit 6 OU 6, which consists of Site 11, the Pesticide Disposal Area, is located in the middle of the NAS Cecil Field Golf Course (between fairways 17 and 11). Figure 2-10 shows the habitats present at Site 11. The ecological communities found at this site include a mixed hardwood community (with dry swamp characteristics), a mixed pine and hardwood community, planted pine flatwoods, and mowed grass (the fairways). The mixed pine and hardwood and planted pine flatwoods communities have a fairly open understory with ground litter dominated by pine needle duff. A description of upland habitats at OU 6 is presented in Table 5-26.

Some features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay (thus retaining soil moisture).

The mixed pine and hardwood community, a transitional community, is composed of the same plant species found in the planted pine and upland mixed forest communities. The mixed pine and hardwood forests were scattered in or bordering the stands of planted pine plantations (e.g., along roadsides), and were primarily dry.

In the maintained areas (roadsides and fairways), there may be a limited assemblage of terrestrial invertebrates and birds found in these managed grassy areas; however, the occurrence of ecological receptors foraging in these areas is expected to be minimal.

Tree and shrub species observed at Site 11 include sweetgum, saw palmetto, longleaf pine, live oak, cherry, water oak, red maple, baldcypress (*Taxodium distichum*) (dead trunks), fetterbush, bay, southern bayberry, laurel leaf oak, and sweetbay magnolia. Herbaceous and graminoid species observed at Site 11 include cinnamon fern, goldenrod, greenbriar, muscadine grape, poison ivy, ferns, sedges, Virginia creeper, beauty berry, and blackberry.

5.3.1.7 Operable Unit 7 OU 7 consists of Site 16, the AIMD Seepage Pit and adjacent area. Figure 2-11 shows the location of Site 16. Site 16 is vegetated with approximately 22,000 square feet of mowed grass. Surface soil staining and stressed vegetation from waste activities were not visible during site visits in 1988, 1991, and 1993. The general area adjacent to Site 16 is relatively flat and is covered with asphalt and concrete. Because Site 16 is a small area of mowed grass surrounded by paved roadways and parking and storage lots in an industrialized area, terrestrial receptors are not expected to reside at this site. In the mowed grass areas, there may be a limited assemblage of terrestrial invertebrates and birds found in these managed grassy areas; however, the occurrence of ecological receptors foraging in these areas is expected to be minimal.

5.3.1.8 Operable Unit 8 Terrestrial areas of Site 3 consist of scrubby flatwoods and disturbed, grassy uplands (Figure 2-12). A description of these habitats is presented in Table 5-26. An upland community consisting primarily of disturbed uplands with some characteristics of a dry prairie occurs in the western part of Site 3, both to the north and south of the Lake Fretwell service road. The Site 3 disposal areas are located in this part of the site. This area consists of flat, sandy soil with dense ground cover, and little to no trees. Typical vegetation identified here includes ragweed, goldenrod, dog fennel, bracken fern, sand blackberry, golden ragweed, and muscadine grape. Scattered wax myrtle and slash pine are also present.

A small part of the northern end of the study area most closely resembles the FNAI (1990) scrubby flatwoods cover type. The area is flat and sandy with scattered pine trees, a sparse shrubby understory, and barren sand. Typical vegetation identified in this area includes longleaf pine, loblolly pine, saw palmetto, myrtle oak, goldenrod, and sand blackberry.

It is likely that the invertebrate biomass at the Site 3 uplands serves as a forage base for a limited number of wildlife species, including amphibians, reptiles, birds, and mammals. Upland habitats likely support several reptilian and amphibian species, including 20 to 30 species of reptiles and amphibians (Ashton and Ashton, 1988; 1989; 1991). Species of mole salamander spend at least part of the year in pine woodlands (such as the scrubby flatwoods at Site 3), and a number of other salamanders, frogs, and toads may also occur in this habitat. Several lizard species and colubrid snakes may also be found in disturbed pine forest communities (Ashton and Ashton, 1988).

Depending upon the vegetative association, southeastern pine forests provide habitat for a diverse array of avifauna, including insectivorous gleaners of pine needles and bark, flycatchers, a seed-eating assemblage, and nocturnal and diurnal aerial predators (Wolfe and others, 1988). The scrubby flatwoods along the northern boundary of Site 3 are expected to host such an assemblage, and the edge of this wooded area allows for additional diversity of species. Birds of prey such as the black vulture, turkey vulture, red-tailed hawk, and red-shouldered hawk search for prey items in the more open regions, and granivorous birds such as the mourning dove and northern bobwhite are likely to occur in this upland community.

Mammals that may occur in scrubby flatwoods include the rabbit, the hispid cotton rat, and the cotton mouse, as well as the armadillo. Predatory mammals such as the red fox and gray fox may feed on small mammals at these sites, and white-tailed deer may forage here.

Disturbed grassy uplands typically host reptiles such as the box turtle (*Terrapene carolina*), six-lined racerunner (*Cnemidophorus sexlineatus*), black racer (*Coluber constrictor*), and coachwhip (*Masticophus flagellum*). Birds likely to forage here include the turkey vulture, bobwhite, and meadowlark. The least shrew (*Cryptotis parva*), cotton rat, harvest mouse (*Reithrodontomys humulis*), spotted skunk (*Spilogale putorius*), and bobcat (*Lynx rufus*) are among mammals typically found in this habitat (FNAI, 1990).

5.3.2 Other Sites and PSCs Upland habitats have also been characterized for additional PSCs that are not associated with OUs. Descriptions of these are presented below.

5.3.2.1 PSC 4 PSC 4, the Historical Grease Pits shown on Figure 2-13, extends from the Perimeter Road to the western edge of Lake Fretwell. Upland communities identified by HLA biologists include disturbed uplands, planted pine flatwoods and mixed pine and hardwoods and dry prairies. A description of these habitats is provided in Table 5-26.

Disturbed upland areas are dominated by graminoids and other herbaceous plants, with a sparse shrubby understory, and no arboreal canopy. These areas are best characterized as degraded old fields, overgrown fields, weedy parking lots/storage areas, and unpaved roads. The limited cover and proximity of these sites to roads generally precludes their use by large predatory animals; however, small rodents or birds may be found foraging at the site.

Some features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay (thus retaining soil moisture).

The mixed pine and hardwood community, a transitional community, is composed of the same plant species found in the planted pine. The mixed pine and hardwood forests were found scattered in or bordering stands of planted pines (e.g., along roadsides).

Dry prairie habitats occur in flat, moderately to poorly drained terrain and are controlled by periodic burns, thus limiting pine introduction into the community.

The planted pine flatwoods are dominated by slash pine; other tree and shrub species observed at PSC 4 include southern bayberry, red maple, gallberry, redbay, oaks, sweetbay magnolia, scrub oak, myrtle-leaf holly, dwarf chinquapin oak (*Quercus prinoides*), Spanish oak, and saw palmetto. Herbaceous and graminoid species observed at PSC 4 include agalinis, acacia, greenbriars, indigo (*Baptista* sp.), ragweed, buttonbush, redroot, rushes, seedbox, netted chain fern, cowbane, royal fern, cinnamon fern, meadow beauty, goldenrod, grasses, blackberry, muscadine grape, persimmon, wiregrass, bracken fern, bullbriar greenbriar, dog fennel, blazing star, and winged sumac.

5.3.2.2 PSC 6 PSC 6, the Lake Fretwell Rubble Disposal Area shown on Figure 2-14, is located along the eastern shore of Lake Fretwell, due south of the recreation area, and southwest of the WWTP. The following upland ecological communities, as described in Table 5-26, were found at the site: mowed grass,

disturbed upland, planted pine flatwoods. The degraded area with concrete rubble has very little exposed ground.

Disturbed upland areas or overgrown fields are dominated by graminoids and other herbaceous plants, with a sparse shrubby understory, and no arboreal canopy. The limited cover and proximity of these sites to roads generally precludes their use by large predatory animals; however, small rodents or birds may be found foraging at the site.

Some features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay (thus retaining soil moisture).

Tree and shrub species observed at the site during the September 1995 field visit by HLA biologists include slash pine (in the planted pine flatwoods), sweetgum, red maple, water oak, black cherry, sweetbay magnolia, southern bayberry, elderberry, and buttonbush. Herbaceous and graminoid species observed at PSC 6 include great cane bamboo, muscadine grape, grasses, dog fennel, rattlebox, and Spanish needles.

In the mowed grass areas, there may be a limited assemblage of terrestrial invertebrates and birds found in these managed grassy areas; however, the occurrence of ecological receptors foraging in these areas is expected to be minimal. Appendix A contains a list of receptors potentially occurring in disturbed upland, planted pine flatwoods, and maintained grass areas.

5.3.2.3 **PSC 9** PSC 9, the Recent Grease Pits shown on Figure 2-15, is located south of the flight line area and east of PSC 10 along a service road. A wooded area is south of PSC 9 across the service road. The site itself is primarily an overgrown field, or disturbed upland (Table 5-26).

Disturbed upland areas are dominated by graminoids and other herbaceous plants, with a sparse shrubby understory, and no arboreal canopy. These areas are characterized as degraded old fields, overgrown fields, weedy parking lots/storage areas, and unpaved roads. The limited cover and proximity of these sites to roads generally precludes their use by large predatory animals; however, small rodents or birds may be found foraging at the site.

Shrubs encountered at PSC 9 include black willow and southern bayberry. Herbaceous and graminoid species observed at PSC 9 include blazing star, yellow aster, dog fennel, hempweed, thistle, seedbox, goldenrod, greenbriar, yellow-eyed grass, Spanish needles, fleabane, mimosa, mosses, poison ivy, burr-reeds, meadow beauty, agalinis, rattlebox, cowbane, white-eyed grass, acacia, grasses, sedges, narrow-leaved seedbox, round-leaved sundew, and peas. Gastropod shells were also found by HLA biologists at PSC 9.

5.3.2.4 **PSC 12** PSC 12, the Public Works Rubble Disposal Area shown on Figure 2-16, is located near the base recycling area behind the Public Works Department. The majority of the site is used for storage and as a parking area; electrical lines run overhead; therefore, the area is kept clear of large trees. Disturbed upland community describes the area covered by PSC 12 (Table 5-26). Behind the site (to the east) are planted pine flatwoods; large piles of fill material and

rubble have been deposited in the transition area between the disturbed uplands and the pine flatwoods.

Disturbed upland areas are dominated by graminoids and other herbaceous plants, with a sparse shrubby understory, and no arboreal canopy. These areas are characterized as degraded old fields, overgrown fields, weedy parking lots/storage areas, and unpaved roads. The limited cover and proximity of these sites to roads generally precludes their use by large predatory animals; however, small rodents or birds may be found foraging at the site.

Some features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay, which retains soil moisture.

Tree species observed at PSC 12 include longleaf pine, cabbage palm, saw palmetto, slash pines, water oak, gallberry, and live oak. Herbaceous and graminoid species observed at PSC 12 include grasses, fleabane, sedges, Spanish needles, ragweed, acacia, seedbox, Virginia creeper, sea myrtle, rattlebox, dog fennel, verbena, morning glory, goldenrod, muscadine grape, blackberry, and bracken fern.

5.3.2.5 PSC 18 PSC 18, the Ammunition Disposal Area shown on Figure 2-17, is located in a forested area in the eastern and central portion of NAS Cecil Field. The upland community observed at PSC 18 is planted pine flatwoods (Table 5-26).

Some features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay, which retains soil moisture.

The closed arboreal canopy at the site is dominated by red maple and water oak, with occasional tupelo, ashes, and other oaks. The understory was open, and dominated by saw palmetto. Other shrub and herbaceous species observed at the site include southern bayberry, redbay, bryophytes, anolis, meadow beauty, lyonia, St. John's-wort, blueberry, sweetgum, inkberry, nannyberry (*Viburnum lentago*), winged sumac, netted chain fern, muscadine grape, bullbriar greenbriar, panic grass, golden club (*Orontium aquaticum*), cross vine (*Bignonia* sp.), redberry greenbriar, and cinnamon fern.

5.3.2.6 PSC 19 PSC 19, the Rowell Creek Rubble Disposal Area shown on Figure 2-18, is located due west of Rowell Creek and south of 6th Street. Upland communities identified by HLA biologists during the September 1995 field visit include (roughly from the west towards Rowell Creek) disturbed uplands, planted pine flatwoods, mixed pine and hardwoods, and upland mixed forest (Table 5-26).

Disturbed upland areas are dominated by graminoids and other herbaceous plants, with a sparse shrubby understory, and no arboreal canopy. Degraded old fields, overgrown fields, weedy parking lots/storage areas, and unpaved roads characterize this type of area. The limited cover and proximity of these sites to roads generally precludes their use by large predatory animals; however, small rodents or birds may be found foraging at the site.

Some features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay (thus retaining soil moisture).

The mixed pine and hardwood community, a transitional community, is composed of the same plant species found in the planted pine and upland mixed forest communities. The mixed pine and hardwood forests were scattered in and bordering stands of planted pine plantations (e.g., along roadsides).

Upland mixed forests are well-developed communities characterized as having a closed arboreal canopy and sandy-clay soils with organic or sometimes calcareous components. The rolling topography usually contributes to water runoff; however, the soils and leaf litter conserve soil moisture (FNAI, 1990). This community was likely preceded by an upland pine community.

The dominant tree species observed at the site include red maple, slash pine, southern bayberry, black cherry, and sweetgum. Other tree and shrub species included holly, saw palmetto, sourwood, redbay, sweetbay magnolia, red ash (*Fraxinus pennsylvanica*), ironwood (*Carpinus caroliniana*), and hornbeam (*Ostrya* sp.). Herbaceous and graminoid species observed at PSC 19 include barberry, black comb fern, bullbriar greenbriar, muscadine grape, poison ivy, bamboo, cinnamon fern, lady fern (*Athyrium filix-femina*), netted chain fern, sedges, royal fern, New York fern (*Thelypteris noveboracensis*), golden club, laurel greenbriar, lizard's tail, bracken fern, Spanish needles, blackberry, yellow-eyed grass, sweetbells (*Leucothoe* sp.), yellow aster, dog fennel, bluestem (*Andropogon viscosum*), Virginia creeper, and morning glory.

5.3.3 Other Studies A facilitywide survey of the gopher tortoise (*Gopherus polyphemus*), which is listed as a species of special concern by the FGFWFC, was conducted (CZR, 1994) to identify suitable habitat, estimate population numbers, develop management guidelines, determine potential mitigation sites, and determine the existence of other endangered, threatened, or special concern species within the survey areas. The estimated number of gopher tortoises at NAS Cecil Field (90 percent confidence limit) totaled 1319, plus or minus 167, with an estimated additional 12 ± 25 animals scattered throughout the Yellow Water Complex (see Section 2.5 and Table 2-2). Total estimated habitat acreage was 3,075 at NAS Cecil Field, and an additional 245 acres in the Yellow Water Weapons area. Suitable habitat for the gopher tortoise includes the pine flatwoods, longleaf pine/turkey oak hills, shrub and brushland, and altered and ruderal land. No other protected species were observed at NAS Cecil Field or the Yellow Water Complex during this study (CZR, 1994).

5.4 WETLAND STUDIES. Wetland studies include examination and sampling of wetlands at NAS Cecil Field. The objectives and scope of wetland studies are reported in Appendix C. Appendix A-1 includes a list of wetland plant species observed at NAS Cecil Field. Study results are summarized in the following subsection according to OU and PSC. A description of wetland habitats at the OUs and PSCs is presented in Table 5-27. Wetland habitats identified at OUs and PSCs that were not comparable to the classifications systems of Cowardin and others (1979) or FNAI (1990) are presented in site-specific text descriptions. Wetland

Table 5-27
Wetland Classification System Characteristics

Basewide Ecological Assessment
Naval Air Station Cecil Field
Jacksonville, Florida

USFWS Classification[1]	Corresponding FNAI Classification[2]	Description	Representative Vegetation (common name)	Location
Palustrine forested broad-leaved deciduous	Floodplain swamp	Occurs on flooded soil along stream channels.	Red maple, laurel oak, water ash, and bald cypress.	OU 1, Site 1 and 2 OU 2, Site 5 OU 5, Site 15 PSC 4 PSC 18 PSC 19
Palustrine forested broad-leaved deciduous	Bottomland forest	Closed canopy forest occurring on low-lying flatlands that border streams with distinct banks.	Red maple, sweetgum, slash pine, loblolly pine, sweetbay, cinnamon fern, and wax myrtle.	
Palustrine forested broad-leaved deciduous	Hydric hammock	Well-developed hardwood and cabbage palm forest with variable understory; low, flat, wet sandy areas.	Cabbage palm, diamond-leaf oak, red cedar, red maple, swamp bay, sweetbay, water oak.	OU 2, Site 17 PSC 4
Palustrine scrub/shrub broad-leaved deciduous	Wet flatwoods	Relatively open canopy; flat, poorly drained terrain.	Loblolly pine, slash pine, longleaf pine, sweetbay, sedges, wax myrtle, and gallberry.	OU 1, Site 1
Palustrine scrub/shrub broad-leaved deciduous	Seepage slope	Usually saturated but rarely inundated.	Loblolly pine, slash pine, longleaf pine, titi, wax myrtle, and gallberry.	
Palustrine emergent persistent	Floodplain marsh	Usually flooded with flowing water.	Arrowheads, bog buttons, rushes, sedges, dotted smartweed, black willow, sweetbay, royal fern, hat pins, and cattails.	OU 1, Site 1 and 2 OU 2, Site 5 PSC 6
Riverine	Seepage stream	Perennial or intermittent seasonal water courses originating from shallow groundwaters that have percolated through deep, sandy, upland soils.	Few aquatic flora; filamentous green algae, tape grass, and pondweed.	OU 4, Site 10
No comparable classification	Wet prairie (wet meadow)	Treeless with sparse to dense ground cover on low, relatively flat, poorly drained terrain.	Southern bayberry, hollies, herbaceous species, and graminoids.	OU 5, Site 14

Source: Camp, Dresser, and Mckee, 1994.

[1] Cowardin and others, 1979.
[2] Florida Natural Areas Inventory (FNAI), 1990.

Notes: USFWS = U.S. Fish and Wildlife Service.
OU = Operable Unit.
PSC = Potential Source of Contamination.

studies not yet completed for a specific OU or PSC are summarized in Subsection 5.4.3.

5.4.1 Operable Units Wetland assessments have been conducted at OUs 1, 2, 7 and 8 (Table 5-27). Wetlands were delineated according to current State of Florida (Florida Department of Environmental Regulation [FDER], 1990) and Federal guidelines (Environmental Laboratory, 1987). Based on a review of regulations and discussions with the FDEP representatives, it was determined that the U.S. Army Corps of Engineers delineation technique would satisfy the State of Florida guidelines. Wetland communities were described according to their USFWS classification (Cowardin and others, 1979) and FNAI counterpart. It should be noted, however, that the FNAI wetland classification system describes undisturbed vegetative communities. In addition, there is considerable overlap between communities identified according to the FNAI. Wetlands were also evaluated for their value and ability to perform certain wetland functions (CDM, 1994). The functional assessment was completed using a computer model called the Wetland Evaluation Technique (WET) to identify and evaluate remedial alternatives for each OU. The results of the WET analyses are presented in the wetlands assessment (CDM, 1994).

Wetlands were also characterized at OUs 3, 4, 5, and 6 by HLA ecologists and were described according to the USFWS classification (Cowardin and others, 1979) and FNAI (1990), where possible. These are summarized in Table 5-26 and locations are depicted on Plate 1. Descriptions are provided below for each OU.

5.4.1.1 Operable Unit 1 Table 5-27 presents the USFWS and corresponding FNAI wetland classifications at OU 1, Sites 1 and 2 (respectively) along with a description of the wetland characteristics and observed vegetation. Plate 1 and Figures 2-1 and 2-2 depict the locations of wetlands at Sites 1 and 2, respectively. The wetland and upland habitats at both Sites 1 and 2 have been significantly altered in the past due to a variety of man-made disturbances, including construction, modifications, or grading.

Approximately three-fourths of Site 1 is classified as wetland. The remaining one-fourth of the study area consists of planted pines along the western edge. A cypress dome with mature bald cypress trees and associated mature hardwood species exists at Site 1. The area adjacent to Rowell Creek on the eastern side of the berm (palustrine forested broad-leaved deciduous [Cowardin and others, 1979] or floodplain swamp [FNAI, 1990], is prone to intermittent flooding by Rowell Creek. Wetlands on the western side of the berm (palustrine scrub and shrub broad-leaved deciduous [Cowardin and others, 1979] or wet flatwoods and seepage slope [FNAI, 1990]), contain soil of heterogeneous moisture, and are located on the former landfill. Runoff from this area migrates downslope eastward toward Rowell Creek. The northern part of this system (palustrine emergent persistent wetland [Cowardin and others, 1979]) is fed from a nearby artesian groundwater spring located to the northeast of Site 2. This area remains saturated due to the presence of groundwater discharge and surface runoff. Characteristic flora of this area include arrowheads (*Sagittaria latifolia*), sedges, and black willow.

To the east of Site 2, wetlands fall within two USFWS classes including palustrine forested broad-leaved deciduous and palustrine emergent persistent (Cowardin and others, 1979). The palustrine forested area corresponds to two FNAI wetland classes including the floodplain swamp and bottomland forest. The bottomland

forest borders Rowell Creek where the banks are distinct, such that water rarely overflows the stream channel to inundate the forest. The water table is usually high in these areas. Floodplain swamp areas are also located along Rowell Creek in low-lying areas where floodwater collects.

The palustrine emergent persistent area is inundated by water from a groundwater seep. The seep drains overland approximately 80 feet and is diverted into a man-made channel where it empties into an emergent persistent wetland area prior to entering Rowell Creek. This area is inundated throughout much of the year.
OU 1 wetlands support an abundance of wildlife. Ecological diversity in these areas was confirmed through the observation and signs of numerous wildlife species, including the barred owl (*Strix varia*), screech owl (*Otus asio*), sharp-shinned hawk (*Accipiter velox*), pygmy rattlesnake, water moccasin (*Agkistrodon piscivorus conanti*), and other snakes.

5.4.1.2 Operable Unit 2 Table 5-27 presents the USFWS and corresponding FNAI wetland classifications at OU 2, Sites 5 and 17 (respectively) along with a description of the wetland characteristics and observed vegetation. Plate 1 and Figures 2-3 and 2-4 depict the locations of wetlands at Sites 5 and 17, respectively.

The wetland identified at Site 5 falls under two USFWS classes: palustrine forested broad-leaved deciduous and palustrine emergent persistent (Cowardin and others, 1979). The palustrine forested wetland to the east of the site is associated with the Rowell Creek and Lake Fretwell floodplain. This area is classified as palustrine forested broad-leaved deciduous (Cowardin and others, 1979) or floodplain swamp (FNAI, 1990). This section of Site 5 is prone to intermittent flooding by Rowell Creek. The dominant tree in this region is red maple, with occasional sweet bay and bald cypress. The shrub understory is open and includes alder (*Alnus serrulata*), titi (*Cyrilla racemiflora*), wax myrtle, gallberry, fetterbush, and swamp bay. Herbaceous species noted in this region include cinnamon fern, royal fern, netted chain fern, and poison ivy.

A small region of persistent, palustrine, emergent vegetation occurs between upland parts of Site 5 and the Rowell Creek and Lake Fretwell floodplain swamp. This community is located in the northeastern region of the study area. This open region includes royal fern, fragrant water lily (*Nymphea odorata*), bog buttons, spatterdock (*Nuphar luteum*), and St. John's-wort. This open area is surrounded by the Site 5 uplands to the west, forested floodplain to the east and north, and the Site 5 drainage ditch to the south.

The drainage ditch leading from Site 5 to Lake Fretwell is characterized by flooded soil along parts of the drainage ditch channel. The approximately 12- to 15-foot-wide drainage ditch is relatively linear, with banks sloping from 2:1 to 3:1. Parts of the drainage ditch channel are dominated by lizard's tail, rushes, and sedges. The banks of the drainage ditch are densely vegetated with shrubby cover, including alder, elderberry, false willow, wax myrtle, and black willow.

At Site 17, the wetland identified to the east (Plate 1 and Figure 2-4) falls within two USFWS cover classes (palustrine forested broad-leaved deciduous and palustrine emergent persistent) (Cowardin and others, 1979). This forested area includes a well-developed hardwood community, with a dense shrubby and herbaceous understory. Dominant woody vegetation in this region includes red maple, swamp bay, sweet bay, sweet gum, gallberry, and wax myrtle. Herbaceous and lianoid

species noted in this wetland region include sphagnum moss, royal fern, colic root, cinnamon fern, yellow jessamine (*Gelsemium sempervirens*), poison ivy, green briar, and Virginia creeper. Several stands of hooded pitcher plant and a species of grass pink (*Calopogon tuberosus*) were also observed in this wetland. These species are both designated as threatened species according to the FGFWFC (1994).

The Rowell Creek floodplain and its associated wetlands are expected to provide suitable habitat for a diverse assemblage of wildlife species. A rich diversity of invertebrates inhabits the floor and arboreal canopy of floodplain forests in the region. These invertebrates are consumed by a number of amphibian, reptile, bird, and mammal species, which in turn provide food for many secondary and tertiary consumers.

Signs of raccoon (*Procyon lotor*) and white-tailed deer were encountered in the floodplain swamp, which likely provides habitat for a number of insectivorous, herbivorous, and carnivorous mammals, as well as a diverse assemblage of reptiles and amphibians. Reptiles typically occurring in such floodplains included the water moccasin, as well as several snake and turtle species. Amphibian species likely occurring in such areas include oak toads (*Bufo quercicus*) and southern leopard frog (*Rana sphenocephala*). Various species of mole salamander, treefrog (*Hyla* spp.), and grass frog (*Pseudacris* spp.) may also occur in wetland habitats at either site.

Birds commonly observed at palustrine forests include the swamp sparrow, Carolina wren (*Thryothorus ludovicianus*), northern cardinal, and common yellowthroat (*Geothlypis trichas*). Open water regions in the floodplain may provide habitat for mallards (*Anas platyrhynchos*), wood ducks (*Aix sponsa*), and a number of wading birds including great blue herons (*Ardea herodias*). Beavers, raccoons, otters (*Lutra canadensis*), and opossums (*Didelphis virginiana*) are also known to occur in forested wetlands at NAS Cecil Field. The short-tailed shrew, an insectivorous small mammal, is known to occur in wetland forests in Florida (O'Neil and Mettee, 1982).

5.4.1.3 **Operable Unit 3** Site 7 does not include wetland habitats. Site 8 includes some man-made ditches (Plate 1 and Figure 2-6) of 2 to 5 feet in width, with undeveloped banks (i.e., the banks are gently sloping), shallow and grass-lined, and containing stagnant to slow-moving water (often with tannin staining). It is possible that these ditches provide minimal suitable habitat for aquatic macroinvertebrates.

5.4.1.4 **Operable Unit 4** The eastern portion of OU 4, Site 10 consists of wetlands including a transitional hardwood/floodplain forest area grading down into the floodplain swamp and blackwater stream (Table 5-27). A seepage stream was found along the northern terminus of the site, and a man-made drainage ditch was found in the southern portion of the site (Plate 1 and Figure 2-7).

Typically, floodplain forest communities are dominated by hardwoods and occur on the dry soils of the upper reaches of a floodplain (i.e., on levees, impoundments, river terraces); floodplain forests are usually inundated for a portion of the growing season (FNAI, 1990).

Seepage streams are described by the FNAI (1990) as clear, narrow, and shallow perennial or intermittent seasonal streams fed primarily by shallow groundwater that percolates through sandy soils. The surrounding forest habitat typically is

dominated by hardwoods which block most of the sunlight (resulting in a lack of aquatic flora). The stream observed at Site 10 was sandy-bottomed, channelized, clear, and had a flow velocity of approximately 1 ft/sec. The banks of the stream were approximately 12 feet across (from the tops of the slopes), unvegetated, and were overhanging providing good habitat for semiaquatic mammals and reptiles.

Plants observed in the wetlands at the site include sundew, cattails, rushes, water pennywort (*Hydrocotyle americana*), cardinal flower (*Lobelia cardinalis*), and horsetails.

5.4.1.5 Operable Unit 5 Site 14, the Blue 5 Ordnance Disposal Area shown on Plate 1 and Figure 2-8, is located in the Yellow Water Weapons Area. Wetland communities found at this site include man-made drainage ditches, wet planted pine flatwoods, wet meadow, and scrub-shrub marsh with depression/emergent marsh characteristics (Table 5-27).

The wet meadow area was characterized as a disturbed wetland with occasional slash pines, poorly drained soils, overgrown bushes, and weedy edges. The dominant shrubs observed in the wet meadows at Site 14 include various southern bayberry and hollies. Hooded pitcher plant, diodia (*Diodia virginiana*), bog buttons, asters, rabbit tobacco, dog fennel, purple bladder wort, tickseed, Maryland meadow beauty, climbing hempweed, sundew, agalinis, blazing star, bugleweed, horned bladder wort, grasses, sedges, asters, seedbox, yellow-top, foxtail clubmoss, and ragweed were found in the wetland at Site 14. Some features of the planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest (which grades into upland mixed forest), mesic flatwoods, and wet flatwoods. The pine flatwoods are characterized by rolling hills composed of sandy soils with variable amounts of clay (thus retaining soil moisture).

The scrub-shrub marsh is characterized by poorly drained, saturated soils and was dominated by sedges, rushes, and hydrophytes with scattered shrubs and saplings. Various plant species observed in the shrub and sapling layers include sourwood, titi, red maple, fetterbush, redbay, tupelo, and slash pine. Herbaceous plant species observed in this community include hatpins, seedbox, netted chain fern, cowbane, knotweed, St. John's-wort, and royal fern.

Site 15, the Blue 10 Ordnance Disposal Area shown on Plate 1 and Figure 2-9, is located in the western portion of the Yellow Water Weapons Compound. Wetland communities observed at the site include wet planted pine flatwoods with a dense, shrubby understory dominated by hollies, wet mixed pine and hardwoods, man-made drainage ditches, first-order tributaries with tannin staining, and floodplain swamps with dome swamp characteristics (Table 5-27).

Some features of the wet planted pine flatwoods exhibit similar characteristics defined by the FNAI as upland pine forest. The wet pine flatwoods are characterized by rolling lowland composed of sandy soils with variable amounts of clay (thus retaining soil moisture).

The wet mixed pine and hardwood community, a transitional community, is composed of the same plant species found in the planted pine and upland mixed forest communities (previously mentioned). This transitional community borders the stands of planted pine plantations (e.g., along roadsides), and was, at this site, a wet area.

The man-made drainage ditches are best described as 2 to 5 feet in width, with undeveloped banks (i.e., the banks are gently sloping), shallow and grass-lined, and containing stagnant to slow-moving water (often with tannin staining). It is possible that these ditches provide minimal suitable habitat for aquatic macroinvertebrates.

First order tributaries to the Yellow Water Creek and Caldwell Creek were encountered at Site 15 (Plate 1 and Figure 2-9). These tributaries are approximately 10 feet wide, with gently sloping banks, tannin-stained water, and low-flow velocity (less than 1 foot per second [ft/sec]). Although these ditches do not provide adequate habitat for most species of fish, it is possible that some aquatic macroinvertebrate, amphibian, and reptile species may inhabit these ditches.

Floodplain swamps are typically found along stream channels and low spots within stream or river floodplains. The soils are often a variable mix of sands, alluvial material, and organic material. Floodplain swamps are characterized by buttressed, hydrophytic trees (e.g., cypress) with a sparse understory and ground cover (FNAI, 1990).

The floodplain swamps observed at Site 15 are in the vicinity of blackwater creeks (Yellow Water Creek and Caldwell Creek); however, there is no obvious topographical transition into a creek floodplain. Instead, the swamps appear to be depressional, inundated areas surrounded by mesic pine uplands. These depression swamps have vegetation consistent with both a floodplain swamp community and a dome swamp community (FNAI, 1990). Therefore, the swamps at Site 15 may best be characterized as floodplain swamps with some dome swamp characteristics.

Tree and shrub species observed at Site 15 include sweetgum, southern bayberry, hollies, red maple, saw palmetto, bay, live oak, water oak, occasional longleaf pine, black willow, gallberry, baldcypress, laurel oak, turkey oak, scrub oak, sweetbay magnolia, cedar, and titi. Herbaceous and graminoid species include graminoids, reindeer moss, marsh pink, clubmoss, iris, various ferns, sedges, sphagnum moss, royal fern, netted chain fern, Spanish moss, pitcher plants, and water pennywort.

5.4.1.6 Operable Unit 6 OU 6, which consists of Site 11, does not include wetland habitats.

5.4.1.7 Operable Unit 7 Although wetlands were not identified in the immediate area of Site 16 (CDM, 1994), wetlands are located to the east of Site 16, as shown on Plate 1 and Figure 2-11. Sal Taylor Creek, which is located approximately 5,000 feet east of OU 7, flows through and directly influences these wetlands. According to the USFWS national wetland inventory map, the wetlands east of Site 16 fall under the following seven general USFWS classes (Cowardin and others, 1979): palustrine forested broad-leaved deciduous, palustrine forested needle-leaved evergreen, palustrine forested broad-leaved evergreen, palustrine emergent persistent, palustrine scrub and shrub evergreen, combination palustrine forested broad-leaved deciduous and needle-leaved evergreen, and palustrine forested deciduous (unspecified). The distribution of these wetland classes at Site 16 are depicted on Plate 1. Table 5-27 presents the USFWS wetland classifications for the wetlands east of Site 16, a brief description of the wetland characteristics, a list of the dominant plant species expected in each wetland cover type, and a summary list of representative vegetation expected in each wetland cover type.

5.4.1.8 Operable Unit 8 Table 5-27 contains the USFWS and corresponding FNAI wetland classifications for the OU 8 study area, along with a brief description of the wetland characteristics, and a summary list of representative vegetation in each wetland cover type. The locations of each wetland type are presented on Plate 1 and Figure 2-12.

Site 3 wetlands are best described as a mixture of palustrine forested and scrub-shrub broad-leaved deciduous classes, with some palustrine emergent persistent mixed in the northerly part of the wetland. The mixed forested and scrub-shrub communities most clearly resemble the FNAI classifications of bottomland forest, wet prairie, and baygall.

The bottomland forest is characterized by a low-lying, closed canopy hardwood forest. Dominant trees are red maple, sweetgum, and various pines. The shrubby understory includes wax myrtle and loblolly bay. Herbaceous vegetation in this habitat includes cinnamon ferns and netted chain fern. Communities in the wet prairie part of Site 3 consist of sparse, dense ground cover of grasses and herbs. Dominant species include hatpins, panic grass, St. John's-wort, and meadow beauty, with some scattered wax myrtle. The baygall community, also a part of this area, is typically found in flat areas or on slopes where high lowland water tables help maintain soil moisture. Typical plants in this community include sweetbay, swamp bay, red bay, loblolly bay, gallberry, muscadine grape, netted chain fern, and cinnamon fern.

The palustrine emergent persistent area, which is mixed into the northeastern part of the wetlands at Site 3, most closely approximates the FNAI floodplain marsh classification. It is dominated by emergent grasses, herbs, and shrubs. Typical species include sedges, bulrush, climbing hempweed, scarlet pimpernel (*Anagallis arvensis*), and dotted smartweed (*Polygonum punctatum*), along with scattered black willow and myrtle oak.

The Rowell Creek floodplain and its associated wetlands are expected to provide suitable habitat for a diverse assemblage of wildlife species. A rich diversity of invertebrates inhabits the floor and arboreal canopy of floodplain forests in the region. These invertebrates are consumed by a number of amphibian, reptile, bird, and mammal species, which in turn provide food for many secondary and tertiary consumers.

The floodplain swamp likely provides habitat for a number of insectivorous, herbivorous, and carnivorous mammals, as well as a diverse assemblage of reptiles and amphibians. Reptiles typically occurring in such floodplains include the water moccasin as well as several snake and turtle species. Amphibian species likely to occur in such areas include oak toads and southern leopard frogs. Various species of mole salamander, treefrog, and grass frogs may also occur in wetland habitats at Site 3.

Birds commonly observed in palustrine forests include the swamp sparrow, Carolina wren, northern cardinal, and common yellowthroat. Beavers, raccoons, otters, and opossums are also known to occur in forested wetlands at NAS Cecil Field. The short-tailed shrew, an insectivorous small mammal, is known to occur in wetland forests in Florida (O'Neil and Mettee, 1982).

5.4.2 Other Sites and PSCs Wetlands were also characterized at PSCs that are not considered a part of OUs. These characterizations were completed by HLA

ecologists and descriptions were based upon the USFWS classification (Cowardin and others, 1979) and FNAI (1990), where possible. Findings are summarized in Table 5-27 and locations of the wetlands are depicted on Plate 1. Descriptions are provided below for each PSC.

5.4.2.1 PSC 4 PSC 4, the Historical Grease Pits shown on Plate 1 and Figure 2-13, extends from the Perimeter Road to the western edge of Lake Fretwell. Wetland communities identified by HLA ecologists include a marshy unpaved road containing carnivorous plants, scrub-shrub marsh, palustrine scrub-shrub transitional wetland, and floodplain forest. Lake Fretwell, along the eastern terminus of the site, would classify as an impounded lake that may potentially receive runoff from PSC 4. Table 5-27 presents the USFWS wetland classifications for the wetlands east of PSC 4, a brief description of the wetland characteristics, a list of the dominant plant species expected in each wetland cover type, and a summary list of representative vegetation expected in each wetland cover type.

The scrub-shrub marsh is characterized by poorly drained, saturated soils and at PSC 4 was dominated by sedges, rushes, and hydrophytes with scattered shrubs and saplings. Various plant species observed in the shrub and sapling layers included sourwood, titi, red maple, fetterbush, redbay, tupelo, and slash pine. Herbaceous plant species observed in this community included hatpins, seedbox, netted chain fern, cowbane, knotweed, St. John's-wort, and royal fern.

The palustrine scrub-shrub transitional wetland is characterized by a sapling and thick scrub-shrub layer of sweetflag (*Acorus* sp.) with moist to wet, poorly drained soils and no arboreal canopy. Saplings and shrubs observed in this community include titi, southern bayberry, sweet-bay magnolia, red bay, holly, slash pine, red maple, and oaks. Herbaceous species observed include redroot, royal fern, cinnamon fern, netted chain fern, St. John's-wort, sedges, meadow beauty, goldenrod, and water pennywort.

Typically, floodplain forest communities are dominated by hardwoods and occur on the dry soils of the upper reaches of a floodplain (i.e., on levees, impoundments, river terraces); floodplain forests are usually inundated for a portion of the growing season (FNAI, 1990).

Tree and shrub species observed at PSC 4 wetlands include southern bayberry, gallberry, titi, redbay, tupelo, oaks, sweetbay magnolia, and myrtle-leaf holly. Herbaceous and graminoid species observed at PSC 4 include sweetflag, hooded pitcher plants, round-leaved sundews, bog buttons, St. John's-wort, buttonbush, redroot, hatpins, rushes, sedges, netted chain fern, smartweed, royal fern, cinnamon fern, water pennywort, and grasses.

5.4.2.2 PSC 6 PSC 6, the Lake Fretwell Rubble Disposal Area shown on Plate 1 and Figure 2-14, is located along the eastern shore of Lake Fretwell, due south of the recreation area, and southwest of the WWTP. The wetland community found at the site is a depression/emergent marsh (Table 5-27).

The depression/emergent marsh is composed primarily of hydrophytic emergent vegetation. The dominant species observed at the PSC 6 marsh were cattails; other herbaceous and graminoid species observed included rushes, St. John's-wort, yellow-eyed grass, common dodder, twig rush, sedges, and white bracted sedge. Sporadic shrubs and saplings observed in and around the perimeter of the marsh

include elderberry, buttonbush, slash pines, water oak, tupelo, sweetbay magnolia, southern bayberry, and willow.

5.4.2.3 **PSC 9** PSC 9, the Recent Grease Pits shown on Plate 1 and Figure 2-15, is located south of the flight line area and east of PSC 10 along a service road. Man-made drainage ditches run along the northern edge of PSC 9. Cattails, water pennywort, sedges, round-leaved sundew, and spike rush were observed.

5.4.2.4 **PSC 12** PSC 12, the Public Works Rubble Disposal Area shown on Plate 1 and Figure 2-16, is located near the base recycling area behind the Public Works Department. Wetland communities are not present at PSC 12.

5.4.2.5 **PSC 18** PSC 18, the Ammunition Disposal Area shown on Plate 1 and Figure 2-17, is located in a forested area in the eastern and central portion of NAS Cecil Field. The wetland communities observed at PSC 18 include floodplain forest and a floodplain swamp and braided blackwater stream (Table 5-27). The habitat at PSC 18 is likely to be of high value to semiterrestrial and aquatic wildlife.

Typically, floodplain forest communities are dominated by hardwoods and occur on the dry soils of the upper reaches of a floodplain (i.e., on levees, impoundments, river terraces); floodplain forests are usually inundated for a portion of the growing season (FNAI, 1990).

A floodplain swamp community is typically found along stream channels and low spots within stream or river floodplains. The soils are often a variable mix of sands, alluvial material, and organic material. Floodplain swamps are characterized by buttressed, hydrophytic trees (e.g., cypress) with a sparse understory and ground cover (FNAI, 1990).

The canopy at PSC 18 is dominated by water oak, with occasional tupelo, ashes, and other oaks. The understory is open. Other shrub and herbaceous species observed at the site include southern bayberry, redbay, bryophytes, anolis, meadow beauty, lyonia, St. John's-wort, baldcypress, inkberry, nannyberry, winged sumac, netted chain fern, sedges, pickerelweed, sphagnum moss, and cinnamon fern.

5.4.2.6 **PSC 19** PSC 19, the Rowell Creek Rubble Disposal Area shown on Plate 1 and Figure 2-18, is located due west of Rowell Creek and south of 6th Street. Wetland communities identified by HLA ecologists during the September 1995 field visit include (roughly from the west towards Rowell Creek) man-made drainage ditches, and floodplain forest (some areas with some titi groves, floodplain swamp, and blackwater stream [Table 5-27]).

Typically, floodplain forest communities are dominated by hardwoods and occur on the dry soils of the upper reaches of a floodplain (i.e., on levees, impoundments, river terraces); floodplain forests are usually inundated for a portion of the growing season (FNAI, 1990).

A floodplain swamp community is typically found along stream channels and low spots within stream or river floodplains. The soils are often a variable mix of sands, alluvial material, and organic material. Floodplain swamps are characterized by buttressed, hydrophytic trees (e.g., cypress) with a sparse understory and ground cover (FNAI, 1990).

The dominant tree species observed at the site include red maple, slash pine, southern bayberry, black cherry, tupelo, and sweetgum. Other tree and shrub species included southern bayberry, holly, sourwood, redbay, sweetbay magnolia, hornbeam, water oak, swamp honeysuckle, buttonbush, and titi. Herbaceous and graminoid species observed at PSC 19 include lady fern, netted chain fern, sedges, royal fern, New York fern, sphagnum moss, and water pennywort.

5.4.3 Other Studies No additional studies have been completed to date.

5.5 CHEMICAL ANALYSES OF PLANT OR ANIMAL TISSUE. Analyses of plant and animal tissue have been performed to provide site-specific information necessary for OU- or PSC-specific ERAs. Currently, plant tissue from NAS Cecil Field has not been analyzed for chemical content.

Two types of animal tissue studies have been completed: earthworm analysis and fish tissue analysis. Earthworms were analyzed as part of surface soil toxicity testing, and fish tissue was analyzed as part of a fish sampling program at Lake Fretwell and Rowell Creek. The results of each of these studies are discussed separately. The following subsections provide summaries of the chemical analyses of earthworm and/or fish tissue for each site. Summary tables of the contaminants of concern in earthworm and/or fish tissue are provided for each site.

5.5.1 Earthworm Tissue Analyses As part of surface soil toxicity testing, tissue from earthworms (*Eisenia foetida*) has been analyzed at OUs 2 and 8. A summary of these studies is presented below.

5.5.1.1 **Analyses for OU 2** *E. foetida* exposed to surface soil from OU 2 during toxicity tests were subsequently analyzed for content of pesticides, PCBs, and inorganic analytes. Site-specific BAFs for these chemicals were derived based upon known soil content of these chemicals. The derived BAFs were utilized in food-web models to estimate exposure of terrestrial wildlife to specific analytes in terrestrial invertebrates. Table 5-28 presents a summary of earthworm BAF values for surface soil ECPCs at OU 2. Tissue data are not available for TRPH.

5.5.1.2 **Analyses for OU 8** Tissue studies similar to those conducted for OU 2 with earthworms were completed for OU 8. For the purpose of estimating BAFs, *E. foetida* exposed to OU 8 surface soil during toxicity tests were analyzed for inorganic analyte content. The lack of organic analytes in the surface soil samples selected for the bioaccumulation study, coupled with limited sample size and resultant high detection limits, precluded analyses of organics in earthworm tissue.

The site-specific BAF values derived from these studies are presented in Appendix T of the OU 8 BRA (ABB-ES, 1995b), and are summarized in Table 5-29. The BAFs were utilized in food-web models to estimate exposure of terrestrial wildlife to concentrations of surface soil ECPCs in terrestrial invertebrates.

5.5.2 Fish Tissue Analyses A fish sampling program was completed at NAS Cecil Field in April 1995 (Inchcape/Aquatec, 1995b; Quanterra, 1995). The locations of fish samples collected from Lake Fretwell and Rowell Creek upstream of Lake Fretwell are depicted on Figure 5-4. Analyses of contaminant concentrations in fish tissue were conducted to reduce uncertainty in the exposure estimation and

Table 5-28
Summary of Earthworm Bioaccumulation Factors for Operable Unit 2[1]

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Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	SITE 5						SITE 17		
	CF5SS13 BAF	CF5SS15 BAF	CF5SS19 BAF	CF5SS20 BAF	CF5SS26 BAF	Site 5 BAF[2]	CF17SS8 BAF	CF17SS10 BAF	Site 17 BAF[2]
Organics									
4,4'-DDD	NC	NC	NC	NC	3.03	3.03	NC	NC	NC
4,4'-DDE	NC	42.6	28.7	3.63	0.925	19.0	NC	NC	NC
4,4'-DDT	NC	NC	NC	NC	1.23	1.23	NC	NC	NC
Aroclor-1260	3.32	NC	NC	3.30	NC	3.31	NC	NC	NC
Inorganic Analytes									
Barium	0.125	0.0873	0.118	0.215	0.131	0.135	NC	NC	NC
Beryllium	NC	NC	NC	0.148	0.040	0.0941	NC	NC	NC
Cadmium	1.28	1.24	0.444	NC	2.0	1.24	NC	NC	NC
Cobalt	1.57	0.385	0.300	0.296	0.200	0.550	NC	NC	NC
Copper	0.600	0.840	0.800	0.339	0.840	0.684	NC	NC	NC
Lead	0.101	0.085	0.127	0.0658	0.103	0.0965	0.266	0.0919	0.179
Manganese	1.53	0.114	0.179	0.155	0.141	0.424	0.176	0.188	0.182
Nickel	NC	0.0335	NC	0.325	NC	0.179	NC	NC	NC
Zinc	10.4	0.313	2.20	0.287	0.733	2.78	NC	NC	NC

[1] BAFs are presented for only the analytes selected as ecological chemicals of potential concern in surface soil samples from OU 2. Analytes detected in earthworms that were not detected in surface soil are assumed to be nonsite-related.
[2] Site-specific BAFs are equal to the arithmetic average of all sample location-specific BAFs.

Notes: BAF = bioaccumulation factor.
DDD = dichlorodiphenyldichloroethane.
NC = BAF was not calculated for this chemical at this location.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.

Table 5-29
Summary of Earthworm Bioaccumulation Factors for Operable Unit 8[1]

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Sample Location BAFs			Site 3 BAF[2]
	CF3SS9 BAF	CF3SS17 BAF	CF3SS24 BAF	
Inorganic Analytes				
Barium	0.0361	0.102	0.0988	0.0790
Cadmium	0.357	2.97	NC	1.66
Copper	0.119	0.209	0.396	0.241
Lead	0.0189	0.0385	0.0254	0.0276
Manganese	0.213	0.263	0.290	0.255
Mercury	0.113	NC	NC	0.113
Silver	0.133	0.758	NC	0.446
Zinc	0.521	0.806	9.73	3.69

[1] BAFs are presented for only the analytes selected as ecological chemicals of potential concern in surface soil samples from OU 8. Analytes detected in earthworms that were not detected in surface soil are assumed to be nonsite-related.
[2] Site-specific BAFs are equal to the arithmetic average of all sample location-specific BAFs.

Notes: BAF = bioaccumulation factor.
NC = BAF was not calculated for this chemical at this location.

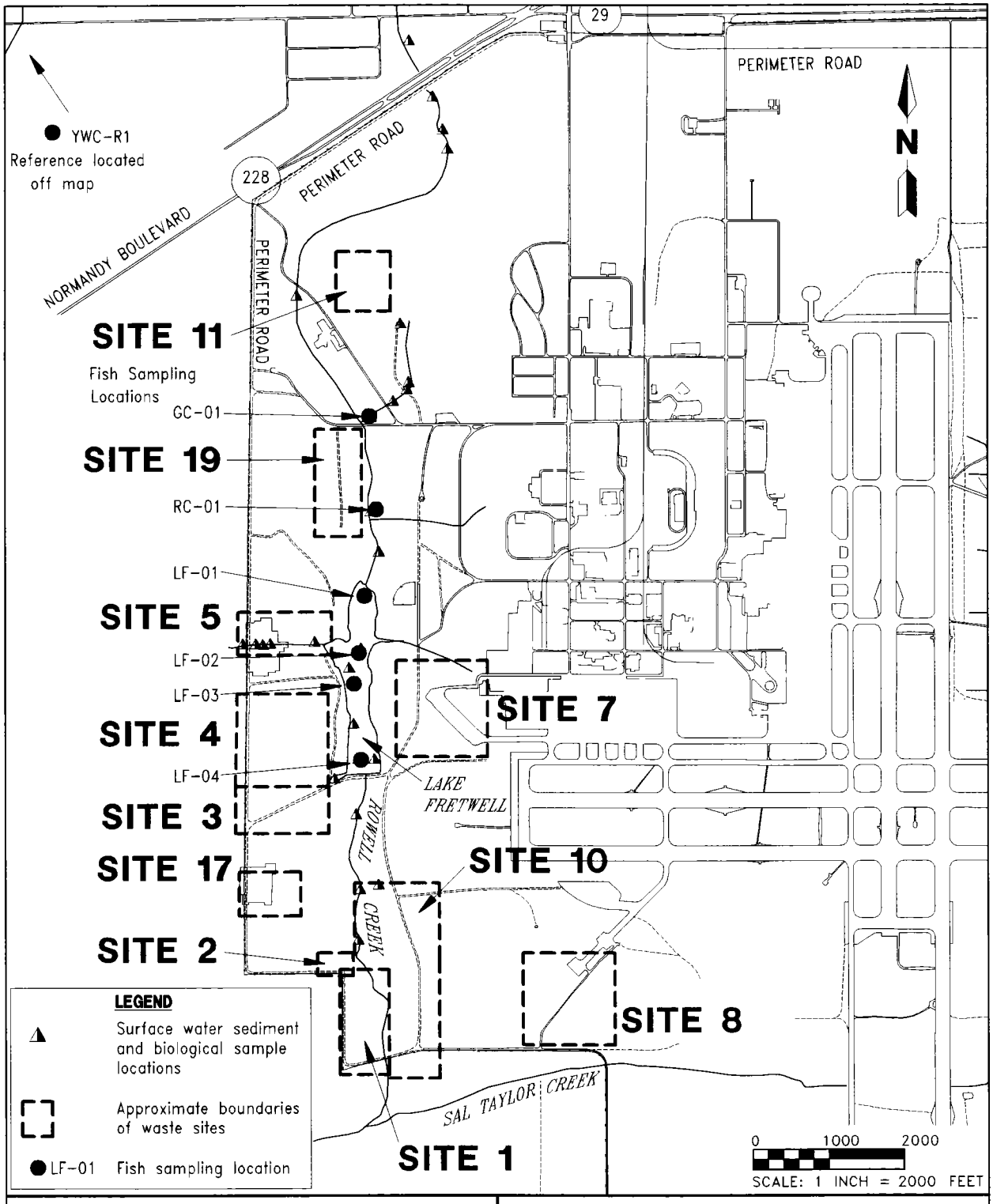

FIGURE 5-4
LOCATIONS OF FISH SAMPLES FROM LAKE FRETWELL AND ROWELL CREEK UPSTREAM OF LAKE FRETWELL

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risk characterization process for human and ecological receptors. The objectives of the fish sampling program were as follows:

- to collect whole fish and fish fillet tissue samples from Lake Fretwell, upper Rowell Creek, and a reference area;
- to analyze tissue samples for metals, pesticides, and PCBs; and
- based on analytical results, to determine the extent of contamination in fish tissue above background conditions in order to provide a basis for determining if contaminants in fish tissue pose a risk to human health and the environment.

For the purposes of the ERA, data from whole fish tissue samples are used to measure the extent of contamination to which ecological receptors (including fish, reptiles, birds, and mammals) may be exposed. Whole body samples for each of the three feeding guilds selected (primary and secondary consumer, omnivorous bottom feeder, and tertiary consumer) were collected. The target species for each of the trophic levels/feeding guilds are listed below.

- Golden shiner (*Notemingonus crysoleucas*). This species is used to represent a primary/secondary consumer that feeds on planktonic crustaceans, algae, and aquatic insects. Golden shiners are typically found in relatively clear weedy lakes and ponds, and may serve as an important prey item for the larger consumers in Lake Fretwell.
- Lake chubsucker (*Erimyzon sucetta*). This species is used to represent an omnivorous bottom feeder.
- Largemouth bass (*Micropterus salmoides*). This species is chosen to represent a tertiary consumer of recreational importance in Lake Fretwell. Largemouth bass live in weedy lakes, where they feed on invertebrates, frogs, and other fish.

Fish sampling and analysis was performed according to the technical approach described in the Fish Sampling Plan (ABB-ES, 1995c). Fish sampling locations are shown on Figure 5-1. Whole fish were collected from two locations in Rowell Creek upstream of Lake Fretwell (GC01 and RC01), one reference station in Yellow Water Creek (YWC-R1), and four locations in Lake Fretwell (LF01 to LF04). Duplicate samples were collected at locations LF01 and LF03. Samples collected at each of the sampling locations, including duplicates, were evaluated as independent samples.

The results of fish sampling and chemical analyses for the golden shiner, the lake chubsucker, and the largemouth bass are presented in Tables 5-30, 5-31, and 5-32, respectively. For the golden shiner, six pesticides, Aroclor-1260, and 14 inorganics were detected at one or more sampling locations; for the lake chubsucker, nine pesticides, Aroclor-1260, and 14 inorganics were detected; and for the largemouth bass, five pesticides, Aroclor-1260, and 13 inorganics were detected.

The chemicals 4,4'-DDE and Aroclor-1260 were the most widely distributed organic contaminants in fish in the sampling area. Both chemicals were detected in golden shiner tissue at four sampling locations; in lake chubsucker tissue, 4,4'-DDE was

Table 5-30
Results of Chemical Analyses of Golden Shiner Whole Fish

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Chemical	Lake Fretwell				Rowell Creek Upstream of Lake Fretwell		Reference Location
	LF01	LF02	LF03	LF04	RC01	GC01	YWCR1
Organics (µg/kg)							
4,4'-DDD	ND	ND	ND	ND	ND	NA	NA
4,4'-DDE	ND	12	1.3 J	1.3 J	2.5 J	NA	NA
4,4'-DDT	ND	ND	ND	ND	ND	NA	NA
Aroclor-1260	ND	550	49 J	52 J	56 J	NA	NA
Dieldrin	13	ND	ND	ND	ND	NA	NA
Endosulfan I	7.3	ND	ND	ND	ND	NA	NA
Endosulfan II	ND	ND	ND	ND	ND	NA	NA
Heptachlor	ND	ND	ND	ND	ND	NA	NA
Methoxychlor	ND	38 J	ND	ND	ND	NA	NA
alpha-Chlordane	ND	ND	.83 J	ND	1.3 J	NA	NA
gamma-Chlordane	ND	2.5 J	ND	ND	ND	NA	NA
Inorganic Analytes (mg/kg)							
Aluminum	269	240	129	270	ND	NA	NA
Arsenic	ND	ND	ND	ND	ND	NA	NA
Barium	13.1	14.9	18.8	28.3	26.9	NA	NA
Calcium	15,600 J	32,200 J	17,500 J	50,700 J	50,700 J	NA	NA
Chromium	1.9	ND	ND	ND	ND	NA	NA
Copper	20.7	23.1	17.1	20.5	10.5	NA	NA
Iron	286	283	409 J	341	93.9 J	NA	NA
Lead	ND	ND	2.9	ND	ND	NA	NA
Magnesium	1,120	1,140	1,080	2,150	1,630	NA	NA
Manganese	ND	ND	14.4	15.9	8.2	NA	NA
Mercury	.41 J	ND	ND	ND	.5 J	NA	NA
Nickel	ND	ND	ND	ND	ND	NA	NA

See notes at end of table.

Table 5-30 (Continued)
Results of Chemical Analyses of Golden Shiner Whole Fish

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
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Chemical	Lake Fretwell				Rowell Creek Upstream of Lake Fretwell		Reference Location
	LF01	LF02	LF03	LF04	RC01	GC01	YWCR1
Inorganic Analytes (mg/kg) (Continued)							
Potassium	11,600	10,000	12,000 J	17,300	11,900 J	NA	NA
Selenium	3.4	ND	ND	ND	ND	NA	NA
Sodium	4,330 J	4,560 J	4,710 J	2,060 J	4,430 J	NA	NA
Zinc	113 J	143 J	122 J	164 J	190 J	NA	NA
% Lipids	0.37	0.43	0.20	0.13	0.20	NA	NA

Notes: µg/kg = micrograms per kilogram.
DDD = dichlorodiphenyldichloroethane.
ND = not detected.
NA = no data are available at this location for this species.
DDE = dichlorodiphenyldichloroethene.
J = Estimated value.
DDT = dichlorodiphenyltrichloroethane.
mg/kg = milligrams per kilogram.
% = percent.

Table 5-31
Results of Chemical Analyses of Lake Chubsucker Whole Fish

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Lake Fretwell						Rowell Creek Upstream of Lake Fretwell		Reference Location
	LF01	LF01DUP	LF02	LF03	LF03DUP	LF04	RC01	GC01	YWCR1
Organics (µg/kg)									
4,4'-DDD	4.8 J	ND	ND	ND	ND	ND	ND	5.4 J	ND
4,4'-DDE	ND	2 J	5.1 J	4.2 J	2.6 J	2.9 J	3.4 J	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND	ND	17.00 J
Aroclor-1260	ND	ND	240	ND	160	87 J	73 J	ND	ND
Dieldrin	ND	1.1 J	ND	ND	ND	ND	1.7 J	ND	2.1 J
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	.89 J
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND	2 J
Methoxychlor	ND	ND	ND	ND	45 J	3.6 J	ND	ND	33 J
alpha-Chlordane	2.3 J	.89 J	ND	2.2 J	1.4 J	ND	2.1 J	ND	ND
gamma-Chlordane	ND	.53 J	.69 J	ND	ND	ND	.94 J	.90 J	ND
Inorganic Analytes (mg/kg)									
Aluminum	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	2.9	2.7 J	ND	2.8 J	ND	3.3 J	ND	ND	ND
Barium	23.5	11.1	4.5	13.5 J	9.3 J	8.9	11.3	16.9	22.2
Calcium	95,500 J	47,000 J	14,200 J	64,100 J	44,900 J	36,600 J	64,600 J	69,400 J	45,700 J
Chromium	2	ND	ND	1.70	2.3	3.5	1.9	ND	ND
Copper	ND	5.5	ND	3.3	3.6	ND	2.8	ND	3.4
Iron	241	193 J	ND	132 J	217 J	301	161 J	401	250 J
Lead	ND	2.5	ND	ND	ND	ND	ND	ND	1.7 J
Magnesium	3,040	1,660	1,090	2,150 J	1,950	1,610	1,730	2,180	1,680
Manganese	21.9	10.9	ND	17.8	17.4	12.7	11.7	12.3	16.7
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	.66 J
Nickel	ND	ND	ND	ND	ND	3.3	ND	ND	ND

See notes at end of table.

Table 5-31 (Continued)
Results of Chemical Analyses of Lake Chubsucker Whole Fish

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Lake Fretwell						Rowell Creek Upstream of Lake Fretwell		Reference Location
	LF01	LF01DUP	LF02	LF03	LF03DUP	LF04	RC01	GC01	YWCR1
Inorganic Analytes (mg/kg) (Continued)									
Potassium	13,900	12,000 J	10,900	10,600 J	12,800 J	12,800	10,800 J	11,800	11,500 J
Selenium	4.2	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	5,190 J	4,520 J	4,260 J	4,560 J	5,140 J	4,130 J	4,470 J	5,150 J	4,550 J
Zinc	143 J	98.4 J	81.1 J	121 J	116 J	95.8 J	94 J	103 J	116 J
% Lipids	0.27	0.10	0.20	0.37	0.17	0.23	0.33	0.43	0.57

Notes: µg/kg = micrograms per kilogram.
DDD = dichlorodiphenyldichloroethane.
J = estimated value.
ND = not detected.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
mg/kg = milligrams per kilogram.
% = percent.

Table 5-32
Results of Chemical Analyses of Largemouth Bass Whole Fish

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Lake Fretwell				Rowell Creek Upstream of Lake Fretwell		Reference Location
	LF01	LF02	LF03	LF04	RC01	GC01	YWCR1
Organics (µg/kg)							
4,4'-DDD	24	ND	ND	ND	ND	37	NA
4,4'-DDE	24	11 J	6.3 J	4.4 J	11 J	30	NA
4,4'-DDT	ND	ND	ND	ND	ND	ND	NA
Aroclor-1260	640	530	220	150	250	ND	NA
Dieldrin	ND	ND	ND	ND	ND	ND	NA
Endosulfan I	ND	ND	ND	ND	ND	11	NA
Endosulfan II	ND	ND	ND	ND	ND	ND	NA
Heptachlor	ND	ND	ND	ND	ND	ND	NA
Methoxychlor	ND	ND	ND	ND	ND	ND	NA
alpha-Chlordane	15	ND	ND	ND	3.4 J	ND	NA
gamma-Chlordane	4.2 J	ND	ND	ND	.39 J	3 J	NA
Inorganic Analytes (mg/kg)							
Aluminum	ND	ND	ND	ND	ND	ND	NA
Arsenic	3 J	ND	ND	2.7 J	ND	2.1 J	NA
Barium	2.8	2.9	1.6	2.3	1	1.1	NA
Calcium	61,600 J	29,800 J	16,200 J	33,100 J	13,300 J	13,100 J	NA
Chromium	1.4	ND	ND	2.3 J	ND	ND	NA
Copper	ND	ND	7.9	ND	2.8	ND	NA
Iron	76.1	158	94.2 J	86.5	48.4 J	62.5	NA
Lead	ND	ND	ND	ND	ND	ND	NA
Magnesium	1,690	1,490	1,070	1,330	999	778	NA
Manganese	ND	11.1	1.6	ND	ND	ND	NA
Mercury	1.3 J	1.2 J	1.1 J	1.3 J	1.3 J	1.5 J	NA
Nickel	ND	ND	ND	ND	ND	ND	NA

Table 5-32 (Continued)
Results of Chemical Analyses of Largemouth Bass Whole Fish

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Lake Fretwell				Rowell Creek Upstream of Lake Fretwell		Reference Location
	LF01	LF02	LF03	LF04	RC01	GC01	YWCR1
Inorganic Analytes (mg/kg) (Continued)							
Potassium	8,290	13,200	10,700 J	10,700	10,300 J	8,460	NA
Selenium	3	4 J	3.4 J	ND	ND	2.7 J	NA
Sodium	4,720 J	5,140 J	4,280 J	4,350 J	4,000 J	3,230 J	NA
Zinc	57.2 J	95.5 J	59.3 J	60.2 J	41.8 J	36.2 J	NA
% Lipids	1.9	0.27	0.23	0.10	0.50	2.60	NA

Notes: µg/kg = micrograms per kilogram.
DDD = dichlorodiphenyldichloroethane.
ND = not detected.
NA = no data are available at this location for this species.
DDE = dichlorodiphenyldichloroethene.
J = estimated value.
DDT = dichlorodiphenyltrichloroethane.
mg/kg = milligrams per kilogram.
% = percent.

detected at six locations and Aroclor-1260 at four locations; and in largemouth bass tissue, 4,4'-DDE was detected at six locations and Aroclor-1260 at five locations. Concentrations of 4,4'-DDE in the different species collected included the following: golden shiner tissue–1.3 to 12 μg/kg; lake chubsucker tissue–2 to 5.1 μg/kg; and largemouth bass tissue–4.4 to 24 μg/kg. Concentrations of Aroclor-1260 in the different species collected included the following: golden shiner tissue–49 to 550 μg/kg; lake chubsucker tissue–73 to 240 to μg/kg; and largemouth bass tissue–140 to 640 μg/kg. Overall, concentrations of 4,4'-DDE and Aroclor-1260 were highest in the largemouth bass.

Other pesticides detected in fish include 4,4'-DDD, dieldrin, endosulfan I, methoxychlor, alpha-chlordane, and gamma-chlordane. The largest of these detections was a result of 45 μg/kg of methoxychlor at location LF03DUP in the lake chubsucker. Most of the other detections are less than 10 μg/kg. Lake chubsucker tissue had more detections of pesticides than the other fish species; however, this may be the result of duplicate sampling for this species (all samples were evaluated separately).

Five pesticides were detected in lake chubsucker tissue collected from the upstream reference station, indicating that detections of pesticides may not be site-related, but rather the result of widespread pesticide application at and around NAS Cecil Field.

Several inorganics were detected in all three test species at every sampling location, including essential nutrients such as calcium, magnesium, potassium, and sodium. Other less common inorganics were also detected. Aluminum, chromium, lead, mercury, and selenium were detected in golden shiner tissue; lead, nickel, and selenium were detected in lake chubsucker tissue; and chromium, copper, and manganese were detected in largemouth bass tissue. Although most of these inorganics were detected at low levels at only one or two sampling locations for each species, aluminum and chromium were more abundant. Aluminum was detected in golden shiner tissue at four sampling locations, and chromium was detected in lake chubsucker tissue at five sampling locations.

Lipid-normalized analytical results for hydrophobic organic analytes and mercury detected in the golden shiner, the lake chubsucker, and the largemouth bass are presented in Tables 5-33, 5-34, and 5-35, respectively. The fish tissue data were lipid normalized to evaluate differences between trophic levels or differences between the lake and stream environment that are not explicable in terms of the lipid content of these animals. Lipid normalization is performed by dividing the concentration of a chemical detected in a fish by the percent lipid content of the fish. This adjustment is done because it is assumed that lipophilic compounds accumulate in fish in proportion to tissue lipid content; therefore, contaminant concentrations should vary directly with fish lipid content assuming equivalent exposures. Pesticides and Aroclor-1260 are known to be lipophilic. However, inorganic compounds generally are not lipophilic, and conclusions about lipid-normalized fish tissue concentrations for inorganics may be inaccurate (Hebert and Keenleyside, 1995). Therefore, discussions about lipid-normalized data are limited to results of detections of pesticides and Aroclor-1260.

The lipid content of the three different species of fish tissue sampled at NAS Cecil Field was as follows: golden shiner tissue–0.13 to 0.43 percent; lake chubsucker tissue–0.10 to 0.43 percent; and for largemouth bass tissue–0.10 to 2.60 percent. All the species are of similar low lipid content, with the

Table 5-33
Results of Chemical Analyses of Golden Shiner Whole Fish
Adjusted for Percent Lipids

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Lake Fretwell				Rowell Creek Upstream of Lake Fretwell		Reference Location
	LF01	LF02	LF03	LF04	RC01	GC01	YWCR1
Organics (µg/kg)							
4,4'-DDE	ND	2,791	650	1,000	1,250	NA	NA
Aroclor-1260	ND	127,907	24,500	40,000	28,000	NA	NA
Dieldrin	3,514	ND	ND	ND	ND	NA	NA
Endosulfan I	1,973	ND	ND	ND	ND	NA	NA
Methoxychlor	ND	8,837	ND	ND	ND	NA	NA
alpha-Chlordane	ND	ND	415	ND	650	NA	NA
gamma-Chlordane	ND	581	ND	ND	ND	NA	NA
Inorganic Analytes (mg/kg)							
Mercury	111	ND	ND	ND	250	NA	NA

Notes: µg/kg = micrograms per kilogram.
DDE = dichlorodiphenyldichloroethene.
ND = not detected.
NA = no data are available at this location for this species.
mg/kg = milligrams per kilogram.

Table 5-34
Results of Chemical Analyses of Lake Chubsucker Whole Fish Adjusted for Percent Lipids

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Lake Fretwell						Rowell Creek Upstream of Lake Fretwell		Reference Station
	LF01	LF01DUP	LF02	LF03	LF03DUP	LF04	RC01	GC01	YWCR1
Organics (µg/kg)									
4,4'-DDD	1,778	ND	ND	ND	ND	ND	ND	1,256	ND
4,4'-DDE	ND	2,000	2,550	1,135	1,530	1,261	1,030	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND	ND	2,982
Aroclor-1260	ND	ND	120,000	ND	94,118	37,826	22,121	ND	ND
Dieldrin	ND	1,100	ND	ND	ND	ND	515	ND	368
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	156
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND	351
Methoxychlor	ND	ND	ND	ND	26,471	1,565	ND	ND	5,789
alpha-Chlordane	852	890	ND	595	824	ND	636	ND	ND
gamma-Chlordane	ND	530	345	ND	ND	ND	285	209	ND
Inorganic Analytes (mg/kg)									
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	116

Notes: µg/kg = micrograms per kilogram.
DDD = dichlorodiphenyldichloroethane.
ND = not detected.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
mg/kg = milligrams per kilogram.

Table 5-35
Results of Chemical Analyses of Largemouth Bass Whole Fish Adjusted for Percent Lipids

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Lake Fretwell				Rowell Creek Upstream of Lake Fretwell		Reference Location
	LF01	LF02	LF03	LF04	RC01	GC01	YWCR1
Organics (µg/kg)							
4,4'-DDD	1,263	ND	ND	ND	ND	1,423	NA
4,4'-DDE	1,263	4,074	2,739	4,400	2,200	1,154	NA
Aroclor-1260	33,684	196,296	95,652	150,000	50,000	ND	NA
Endosulfan I	ND	ND	ND	ND	ND	423	NA
alpha-Chlordane	789	ND	ND	ND	680	ND	NA
gamma-Chlordane	221	ND	ND	ND	78	115	NA
Inorganic Analytes (mg/kg)							
Mercury	68	444	478	1,300	260	58	NA

Notes: µg/kg = micrograms per kilogram.
DDD = dichlorodiphenyldichloroethane.
ND = not detected.
NA = not applicable.
DDE = dichlorodiphenyldichloroethene.
mg/kg = milligrams per kilogram.

largemouth bass having a slightly higher lipid content overall. When adjusted for tissue lipid content, the concentrations of pesticides and Aroclor-1260 in the fish rise by several orders of magnitude. The lipid-normalized concentrations for pesticides and PCBs among the species are generally within the same orders of magnitude, as they were for the unadjusted data. Overall, evaluation of the lipid-adjusted organic data does not lead to any discernable trend for any particular chemical or species, other than those already discussed for the non-adjusted data.

Based on these results, it appears that fish in Lake Fretwell and Rowell Creek are bioaccumulating 4,4'-DDE, Aroclor-1260, and some metals. Golden shiner tissue appears to be bioaccumulating aluminum relative to other species, where aluminum was not detected. Similarly, lake chubsucker tissue appears to be bioaccumulating chromium more readily than other species. Largemouth bass tissue generally had a higher lipid content than the other two test species. In addition, tissue from largemouth bass collected at sampling station LF-01 contained the highest detected concentrations of 4,4'-DDD, 4,4'-DDE, Aroclor-1260, and alpha- and gamma-chlordane. Detected concentrations of mercury (ranging from 1.1 to 1.5 mg/kg) were also highest in whole fish tissue from largemouth bass.

Some of the OUs and PSCs at NAS Cecil Field may be responsible for the presence of these chemicals in this watershed system; however, due to the close proximity of several sources, it is difficult to ascertain point sources of contaminants to this area. It is believed that the former widespread use of pesticides at NAS Cecil Field contributes to the presence of pesticides, including 4,4'-DDE, in the Rowell Creek watershed. Also, a once-common method to suppress dust on dirt roads (such as those found in several areas at NAS Cecil Field) was to spray them with waste oils. Transformer oil, a common waste oil, once contained PCBs to act as a dielectric. Though this practice for dust suppression was discontinued several years ago (probably in the 1960s or 1970s) at NAS Cecil Field, oils contaminated with PCBs could be a source of Aroclor-1260 to the Lake Fretwell watershed.

5.5.3 Fish Tissue Analyses (Human Health Evaluation of Lake Fretwell) A fish sampling program was conducted at Lake Fretwell, NAS Cecil Field in January 1997 to evaluate the potential human health risks resulting from consumption of game fish. The results of the 1997 fish sampling were not used to further evaluate potential ecological risks at the Lake Fretwell because the DQOs for the 1997 fish sampling event are not compatible with the DQOs of the previous fish sampling event performed for evaluating ecological risks.

Fish fillet samples were used to measure the level of contamination to which humans consuming fish may be exposed. A total of 47 fish from three trophic (omnivorous, benthic/foraging, and piscivorous) levels was collected from Lake Fretwell and submitted chemical analysis. The target species for each trophic level included the largest (i.e. oldest) panfish (*Lepomis sp.*), catfish (*Ictalurus sp.*), and bass (*Micropterus sp.*). The oldest fish were targeted because these fish are more likely to have bioaccumulated contaminants in their tissue. Fish were collected using trot lines, gill nets, sweep nets, and electroshock techniques. In addition, the lake was drained to ensure that these collection methods were successful. Whole fish were sent to the laboratory where they were subsequently filleted for analysis. Fish fillets were analyzed for pesticides, PCBs, and mercury. A complete summary of the fish collected during this event is provide in Table 5-36.

Table 5-36
Fish Sampled from Lake Fretwell

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Sample ID	Species	Common Name	Trophic Level	No. of Fish/ Sample	Length (mm)	Weight (g)	Sampling Technique[1]	Where Collected	Collect Date[2]
LF-RE-01	*Lepomis microlophus*	Redear sunfish	Omnivorous	1	202	164	Electroshock	East	1/14/97
LF-RE-02	*Lepomis microlophus*	Redear sunfish	Omnivorous	1	219	198	Electroshock	East	1/14/97
LF-RE-03	*Lepomis microlophus*	Redear sunfish	Omnivorous	1	220	188	Electroshock	East	1/14/97
LF-RE-04	*Lepomis microlophus*	Redear sunfish	Omnivorous	1	209	163	Gill net	At dam	1/16/97
LF-BG-01	*Lepomis macrochirus*	Bluegill	Omnivorous	1	215	204	Nets	North	1/14/97
LF-BG-02	*Lepomis macrochirus*	Bluegill	Omnivorous	1	213	180	Nets	North	1/14/97
LF-BG-03	*Lepomis macrochirus*	Bluegill	Omnivorous	1	214	220		South	1/14/97
LF-BG-04	*Lepomis macrochirus*	Bluegill	Omnivorous	1	202	147	Rod and reel	North	1/14/97
LF-BG-05	*Lepomis macrochirus*	Bluegill	Omnivorous	1	223	200	Rod and reel	North	1/14/97
LF-BG-06	*Lepomis macrochirus*	Bluegill	Omnivorous	2	172	85	Electroshock	East	1/14/97
					200	140	Rod and reel	North	
LF-BG-07	*Lepomis macrochirus*	Bluegill	Omnivorous	2	193	135	Rod and reel	North	1/14/97
					180	114	Rod and reel	North	
LF-BG-08	*Lepomis macrochirus*	Bluegill	Omnivorous	2	180	94		North	1/14/97
					190	138		North	
LF-BG-09	*Lepomis macrochirus*	Bluegill	Omnivorous	1	198	150	Gill net	At dam	1/16/97
LF-BG-10	*Lepomis macrochirus*	Bluegill	Omnivorous	1	195	137	Gill net	At dam	1/16/97
LF-BG-11	*Lepomis macrochirus*	Bluegill	Omnivorous	1	210	165	Gill net	At dam	1/16/97
LF-BG-12	*Lepomis macrochirus*	Bluegill	Omnivorous	1	192	136	Gill net	At dam	1/16/97
LF-YB-01	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	269	286	Nets or trot line	North	1/14/97
LF-YB-02	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	262	270	Nets or trot line	North	1/14/97
LF-YB-03	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	297	300	Nets or trot line	South	1/14/97
[3]LF-YB-04	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	310	530	Nets or trot line	South	1/14/97
LF-YB-05	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	289	385	Nets or trot line	South	1/14/97

See notes at end of table.

Table 5-36 (Continued)
Fish Sampled from Lake Fretwell

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Sample ID	Species	Common Name	Trophic Level	No. of Fish/ Sample	Length (mm)	Weight (g)	Sampling Technique[1]	Where Collected	Collect Date[2]
LF-YB-06	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	272	325	Nets or trot line	South	1/14/97
LF-YB-07	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	288	340	Nets or trot line	South	1/14/97
LF-YB-08	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	246	188	Nets or trot line	South	1/14/97
LF-YB-09	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	269	270	Nets or trot line	South	1/15/97
LF-YB-10	*Ictalurus natalis*	Yellow bullhead	Benthic/Foraging	1	271	305	Nets or trot line	South	1/15/97
[3]LF-CC-01	*Ictalurus punctatus*	Channel catfish	Benthic/Foraging	1	430	560	Nets or trot line	South	1/14/97
LF-CC-02	*Icalurus punctatus*	Channel catfish	Benthic/Foraging	1	439	620	Trot line	South	1/14/97
LF-CC-03	*Icalurus punctatus*	Channel catfish	Benthic/Foraging	1	21 (inches)	1,300	Gill net	At dam	1/16/97
LF-CC-04	*Icalurus punctatus*	Channel catfish	Benthic/Foraging	1	23 (inches)	2,000	Gill net	At dam	1/16/97
LF-CC-05	*Icalurus punctatus*	Channel catfish	Benthic/Foraging	1	418	605	Gill net	At dam	1/16/97
LF-LMB-01	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	314	400	Electroshock	Northeast	1/13/97
LF-LMB-02	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	300	340	Electroshock	Northeast	1/13/97
LF-LMB-03	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	282	274	Electroshock		1/14/97
[4]LF-LMB-04	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	22 (inches)	2,800	Trot line	North	1/14/97
LF-LMB-05	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	303	400	Electroshock	East	1/14/97
LF-LMB-06	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	289	320	Electroshock	East	1/14/97
LF-LMB-07	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	455	1,800	Electroshock	East	1/14/97
LF-LMB-08	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	358	675	Electroshock	East	1/14/97
[3]LF-LMB-09	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	20 (inches)	1,800	Rod and reel	Southeast	1/15/97
LF-LMB-10	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	436	1,400	Rod and reel	South	1/15/97
LF-LMB-11	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	460	330	Rod and reel	south	1/15/97

See notes at end of table.

Table 5-36 (Continued)
Fish Sampled from Lake Fretwell

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Sample ID	Species	Common Name	Trophic Level	No. of Fish/ Sample	Length (mm)	Weight (g)	Sampling Technique[1]	Where Collected	Collect Date[2]
LF-LMB-12	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	288	300	Rod and reel	South	1/15/97
LF-LMB-13	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	21 (inches)	2,500	Gill net	At dam	1/16/97
LF-LMB-14	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	442	1,400	Gill net	At dam	1/16/97
LF-LMB-15	*Micropterus salmoides*	Largemouth bass	Piscivorous	1	455	1,500	Gill net	At dam	1/16/97
LF-LMB-16	*Micropterus salmoides*	Largemouth bass	Piscivorous	1			Gill net	At dam	1/16/97

[1] Sampling technique was difficult to track for each individual sample. In general
- electroshocking collected at species except for channel catfish and yellow bullhead.
- fyke nets collected only sunfish.
- hoop nets collected sunfish and yellow bullheads.
- trot lines collected yellow bullheads and channel catfish (almost exclusively). One largemouth bass was caught by trot line.
- gill net (used as a seine) collected all species.
- rod and reel caught sunfish and largemouth bass.

[2] All fish caught on 1/16/97 were collected via gill net from the partially-drained lake bottom.
[3] Designed in the field as a duplicate sample (for lab analysis).

Notes: ID = identification.
mm = millimeters.
g = grams.

Summary statistics for all the fish collected during the January 1997 sampling event are presented in Table 5-37. The summary statistics are provided by species in Tables 5-38, 5-39, and 5-40, for bass, catfish, and panfish, respectively. Included in these tables are analytes detected, frequency of detection, reporting limits, range and mean of detected concentrations, 95 percent UCL, and exposure point concentration.

Analytes detected in the bass included Aroclor-1260, 10 pesticides, and mercury. Aldrin and 4,4'-DDE were the most frequently detected pesticides in bass (both 10/16), and mercury was detected in 15 of the 16 samples collected. Of all these fish sampled, the maximum detected concentrations of aldrin, endrin ketone, methoxychlor, alpha-hexachlorocyclohexane (HCH), gamma-HCH, and mercury were measured in bass. Analytes detected in catfish included Aroclor-1260, 8 pesticides, and mercury. Aroclor-1260, 4,4'-DDE, and mercury were detected at the highest frequency in catfish (11/15, 13/15, and 14/15, respectively). Of all the fish sampled, the maximum concentrations of endosulfan I, endrin, alpha-chlordane, and gamma-chlordane were measured in catfish. Analytes detected in panfish included Aroclor-1260, 8 pesticides, and mercury. 4,4'-DDE and mercury were the most frequently detected analytes in panfish (12/16 and 15/16, respectively). Of all the fish sampled, the maximum concentrations of Aroclor-1260, 4,4'-DDE, dieldrin, endosulfan sulfate, and heptachlor epoxide were measured in panfish.

A qualitative review of these new data support the results and conclusions of the previous fish sampling conducted at Lake Fretwell, which suggests that 4,4'-DDE, Aroclor-1260, and mercury are bioaccumulating in fish tissue. These analytes were generally detected at higher concentrations than other analytes in fish fillets.

Table 5-37
Chemicals Detected in Lake Fretwell Fish Tissue, All Fish Combined

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Reporting Limit Range	Range of Detected Concentration[2]	Mean of Detected Concentrations[3]	95% UCL[4]	Exposure Point Concentration[5]
Polychlorinated Biphenyls (mg/kg)						
Aroclor-1260	19/47	33 to 34	8.5 to 100	31.6	25	25
Pesticides (mg/kg)						
Aldrin	12/47	1.6 to 2	0.12 to 0.55	0.28	0.88	0.55
4,4'-DDE	35/47	3 to 3.35	0.17* to 4.3	0.8	1.3	1.3
Dieldrin	7/47	3 to 3.4	0.1 to 0.96	0.35	2	0.96
Endosulfan I	8/47	1.6 to 2	0.17 to 1.2	0.47	0.88	0.88
Endosulfan sulfate	1/47	3 to 3.4	0.57 to 0.57	0.57	1.7	0.57
Endrin	10/47	3 to 3.4	0.14 to 1.4	0.72	1.8	1.4
Endrin ketone	1/47	3 to 3.4	0.14 to 0.14	0.14	1.9	0.14
Heptachlor epoxide	7/47	1.6 to 2	0.21 to 0.7	0.44	0.86	0.7
Methoxychlor	3/47	16 to 17	0.76 to 3.1	1.8	9.5	3.1
alpha-HCH	1/47	1.6 to 2	0.26 to 0.26	0.26	0.88	0.26
alpha-Chlordane	13/47	1.6 to 2	0.067 to 0.79	0.22	0.96	0.79
gamma-HCH (Lindane)	1/47	1.6 to 2	0.39 to 0.39	0.39	0.87	0.39
gamma-Chlordane	6/47	1.6 to 2	0.13 to 0.6*	0.26	0.92	0.6
Inorganic Analytes (mg/kg)						
Mercury	44/47	0.1 to 0.1	0.06 to 0.85	0.29	0.36	0.36

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for the nondetected concentration.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] 95% upper confidence limit (UCL) of the arithmetic mean is calculated using all samples. One-half the contract-required quantitation limit/contract-required detection limit is used as a surrogate for sample results reported as nondetected concentration.
[5] Exposure point concentration is the lower concentration of either the 95% UCL or maximum detected concentration. The UCL is not calculated when there are less than 10 total samples.

Notes: % = percent.
mg/kg = milligrams per kilogram.
DDE = dichlorodiphenyldichloroethene.
* = average of a sample and its duplicate.
HCH = hexachlorocyclohexane.

Table 5-38
Chemicals Detected in Lake Fretwell Fish Tissue, Bass Only

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Reporting Limit Range	Range of Detected Concentration[2]	Mean of Detected Concentrations[3]	95% UCL[4]	Exposure Point Concentration[5]
Polychlorinated Biphenyls (mg/kg)						
Aroclor-1260	2/16	33 to 33.5	15.3* to 34	24.6	18.9	18.9
Pesticides (mg/kg)						
Aldrin	10/16	1.7 to 2	0.13 to 0.55	0.31	0.77	0.55
4,4'-DDE	10/16	3 to 3.35	0.26 to 1	0.5	1.5	1
Dieldrin	2/16	3 to 3.35	0.21 to 0.24	0.22	2.4	0.24
Endrin	1/16	3 to 3.35	0.62 to 0.62	0.62	1.8	0.62
Endrin ketone	1/16	3 to 3.35	0.14 to 0.14	0.14	2.4	0.14
Heptachlor epoxide	1/16	1.6 to 2	0.25 to 0.25	0.25	0.94	0.25
Methoxychlor	1/16	16 to 17	3.1 to 3.1	3.1	9.1	3.1
alpha-HCH	1/16	1.6 to 2	0.26 to 0.26	0.26	0.94	0.26
alpha-Chlordane	2/16	1.6 to 2	0.067 to 0.12	0.09	1.4	0.12
gamma-HCH (Lindane)	1/16	1.6 to 2	0.39 to 0.39	0.39	0.89	0.39
Inorganic Analytes (mg/kg)						
Mercury	15/16	0.1 to 0.1	0.28 to 0.85	0.55	0.84	0.84

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for the nondetected concentration.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] 95% upper confidence limit (UCL) of the arithmetic mean is calculated using all samples. One-half the contract-required quantitation limit/contract-required detection limit is used as a surrogate for sample results reported as nondetected concentration.
[5] Exposure point concentration is the lower concentration of either the 95% UCL or maximum detected concentration. The UCL is not calculated when there are less than 10 total samples.

Notes: % = percent.
mg/kg = milligrams per kilogram.
* = average of a sample and its duplicate.
DDE = dichlorodiphenyldichloroethene.
HCH = hexachlorocyclohexane.

Table 5-39
Chemicals Detected in Lake Fretwell Fish Tissue, Catfish Only

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Reporting Limit Range	Range of Detected Concentration[2]	Mean of Detected Concentrations[3]	95% UCL[4]	Exposure Point Concentration[5]
Polychlorinated Biphenyls (mg/kg)						
Aroclor-1260	11/15	33 to 34	8.5 to 63*	30.7	18.9	18.9
Pesticides (mg/kg)						
4,4'-DDE	13/15	3 to 3.3	0.17* to 3.2	0.96	1.9	1.9
Dieldrin	3/15	3 to 3.4	0.1 to 0.44	0.27	2.9	0.44
Endosulfan I	3/15	1.6 to 2	0.29 to 1.2	0.63	0.97	0.97
Endrin	8/15	3 to 3.4	0.25 to 1.4	0.8	2	1.4
Heptachlor epoxide	2/15	1.6 to 2	0.21 to 0.3	0.26	1	0.3
Methoxychlor	2/15	16 to 17	0.76 to 1.5	1.1	13.6	1.5
alpha-Chlordane	7/15	1.6 to 2	0.15 to 0.79	0.3	0.96	0.79
gamma-Chlordane	6/15	1.6 to 2	0.13 to 0.6*	0.26	1.1	0.6
Inorganic Analytes (mg/kg)						
Mercury	14/15	0.1 to 0.1	0.06 to 0.35*	0.18	0.84	0.84

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for the nondetected concentration.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] 95% upper confidence limit (UCL) of the arithmetic mean is calculated using all samples. One-half the contract-required quantitation limit/contract-required detection limit is used as a surrogate for sample results reported as nondetected concentration.
[5] Exposure point concentration is the lower concentration of either the 95% UCL or maximum detected concentration. The UCL is not calculated when there are less than 10 total samples.

Notes: % = percent.
mg/kg = milligrams per kilogram.
* = average of a sample and its duplicate.
DDE = dichlorodiphenyldichloroethene.

Table 5-40
Chemicals Detected in Lake Fretwell Fish Tissue, Panfish Only

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Reporting Limit Range	Range of Detected Concentration[2]	Mean of Detected Concentrations[3]	95% UCL[4]	Exposure Point Concentration[5]
Polychlorinated Biphenyls (mg/kg)						
Aroclor-1260	6/16	33 to 33	18 to 100	35.5	28.8	28.8
Pesticides (mg/kg)						
Aldrin	2/16	1.7 to 2	0.12 to 0.14	0.13	1.8	1.8
4,4'-DDE	12/16	3 to 3.3	0.29 to 4.3	0.89	1.2	0.14
Dieldrin	2/16	3 to 3.3	0.25 to 0.96	0.61	2.1	0.96
Endosulfan I	5/16	1.7 to 2	0.17 to 0.69	0.38	0.97	0.69
Endosulfan sulfate	1/16	3 to 3.3	0.57 to 0.57	0.57	1.8	0.57
Endrin	1/16	3 to 3.3	0.14 to 0.14	0.14	2.4	0.14
Heptachlor epoxide	4/16	1.7 to 2	0.42 to 0.7	0.57	0.87	0.7
alpha-Chlordane	4/16	1.7 to 2	0.084 to 0.28	0.15	1.4	0.28
Inorganic Analytes (mg/kg)						
Mercury	15/16	0.1 to 0.1	0.06 to 0.26	0.12	0.15	0.15

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for the nondetected concentration.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] 95% upper confidence limit (UCL) of the arithmetic mean is calculated using all samples. One-half the contract-required quantitation limit/contract-required detection limit is used as a surrogate for sample results reported as nondetected concentration.
[5] Exposure point concentration is the lower concentration of either the 95% UCL or maximum detected concentration. The UCL is not calculated when there are less than 10 total samples.

Notes: % = percent.
mg/kg = milligrams per kilogram.
* = average of a sample and its duplicate.
DDE = dichlorodiphenyldichloroethene.

CHAPTER 6.0

6.0 ECOLOGICAL RISK ASSESSMENT RESULTS

The results and conclusions of each of the ERAs for the OUs and PSCs at NAS Cecil Field are summarized in this chapter. The results are presented in the order of each OU and PSC.

6.1 OPERABLE UNITS. The ERAs for OUs 1, 2, 3, 4, 5, 6, 7, and 8 have been completed. A summary of the ERA results for OUs at NAS Cecil Field is presented in Table 6-1.

6.1.1 Operable Unit 1 The ERA for OU 1 was completed in December 1994 (ABB-ES, 1994a). Results and conclusions of the ERA are discussed for OU 1 by site and by medium of concern.

6.1.1.1 Surface Soil at Site 1 A total of 34 analytes was detected in surface soil at Site 1. Of these, 31 were retained as ECPCs, including one VOC, 14 SVOCs, five pesticides, three PCB congeners, and eight inorganics. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 1 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Six representative wildlife species were selected for Site 1. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on surface soil toxicity testing completed for OU 1. The selection of species and models used to predict exposure are discussed in detail in Chapter 3.0; results of toxicity testing are discussed in detail in Section 5.1.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated using the food web model for each representative species were all less than 1, indicating no potential adverse effects to wildlife resulting from exposure to ECPCs in surface soil at Site 1.

Risks to Terrestrial Plants and Soil Invertebrates. Soil samples collected for toxicity tests at Site 1 were not toxic to either earthworms or lettuce seeds. Based on the results of these tests, which measure growth, reproduction, and survival of test organisms, it is assumed that the contamination present in surface soil at Site 1 does not present an unacceptable risk to terrestrial plants or soil invertebrates.

6.1.1.2 Surface Water at Site 1 Surface water samples collected adjacent to Site 1 are downgradient of groundwater discharge from Site 2. A total of eight analytes was detected in these surface water samples at Site 1. Of these analytes, three were retained as ECPCs, including one VOC and two inorganics. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 1 surface water include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in surface water were characterized based on both field measurements of the structure and function of the benthic macroinvertebrate

Table 6-1
Summary of Ecological Risk Assessment Results for Operable Units

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site	Date ERA Completed	Media			
			Surface Soil	Surface Water	Sediment	Groundwater
OU 1	Site 1	December 1994	No risk.	No risk.	Adverse biological conditions were measured at sampling stations RC-Bio-6 and RC-Bio-7, downstream of the confluence between the Site 2 tributary and Rowell Creek. Conditions observed may be attributable to the Site 2 tributary.	No risk.
OU 1	Site 2	December 1994	No risk.	No risk.	Adverse biological conditions were measured within the Site 2 tributary. Toxicity tests showed adverse effects to survival and reproduction of test species at stations 2-Tox-2 and 2-Tox-3; effects are believed to be related to iron concentrations in sediment. An orange-red flocculent material is present in the tributary, and it is believed that its presence may be responsible for the adverse conditions observed. Iron concentrations in sediment may reflect the amount of flocculent material present.	No risk.
OU 2	Site 5	May 1995	No risk to terrestrial wildlife. Toxicity tests showed 100% mortality of test species for sample CF5-Tox-4; effects are believed to be related to concentrations of TRPH and PCBs in soil. Therefore, these chemicals may be adversely affecting terrestrial plants and soil invertebrates in the area of this sample.	No risk.	Toxicity tests showed adverse effects to survival of test species for three samples in the drainage ditch: 5-Tox-1, 5-Tox-3, and 5-Tox-4. Effects appear to be related to concentrations of TRPH, Aroclor-1260, and total DDT. Therefore, these contaminants may be adversely affecting aquatic life in the drainage ditch.	No risk.
OU 2	Site 17	May 1995	No risk to terrestrial wildlife or soil invertebrates. Toxicity tests showed that lettuce seed germination was inhibited at sampling locations CF-17-SS8 and CF-17-SS9, but no correlation between effects and contaminant concentrations was observed. Therefore, it is believed that exposure to soil poses little risk to terrestrial plants.	No risk.	No risk.	NM

See notes at end of table.

Table 6-1 (Continued)
Summary of Ecological Risk Assessment Results for Operable Units

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site	Date ERA Completed	Media			
			Surface Soil	Surface Water	Sediment	Groundwater
OU 3	Site 7	August 1997	No risk to terrestrial wildlife. Plant and invertebrate toxicity benchmarks for some inorganic analytes were exceeded. However, the toxicity benchmarks are conservative, exceedances are of relatively low magnitude, and no stressed vegetation was observed at the site. Therefore, it is unlikely that these receptors would be adversely impacted.	NM	NM	NM
OU 3	Site 8	August 1997	No risk to terrestrial wildlife. Toxicity tests showed a reduction in earthworm growth at five sample locations. Toxicity tests showed that lettuce seed germination was inhibited at five sample locations, but no correlation between effects and contaminant concentrations was observed. Therefore, these chemicals or other stressors may be adversely effecting invertebrates and plants in the areas sampled.	No risk to semiaquatic wildlife. Field measurement of benthic community structure and function indicated reduced habitat quality at CF8-BIO2; however, it is not likely due to contamination but the ephemeral nature of the ditch. No risks were predicted for aquatic receptors, based on benchmark comparisons.	No risk to terrestrial wildlife. Toxicity tests showed adverse effects to survival and growth to certain invertebrate receptors. However, no correlation exists between contaminants of concern and toxicological effects, except for TRPH concentrations and midge survival and growth.	No risk to invertebrates and plants. Risk to aquatic receptors was predicted, based on toxicity benchmark exceedances. However, the benchmarks are conservative and the exceedances were of relatively low magnitude, and groundwater is likely to be diluted when discharging to surface water. Therefore, it is unlikely that aquatic receptors would be at risk from exposure to groundwater.
OU 4	Site 10	November 1996	No risk to terrestrial wildlife or soil invertebrates. Phytotoxicity benchmarks were exceeded for three inorganic analytes. However, it is unlikely that plants would be at risk based on the conservative nature of benchmarks, relatively low exceedances, and background concentrations. No stressed vegetation was observed.	NM	NM	Risks to terrestrial plants and aquatic receptors from exposure to inorganics in groundwater are predicted. However, risks are based on a conservative phytotoxicity benchmarks; therefore, they would not be representative of actual conditions at the site.

See notes at end of table.

Table 6-1 (Continued)
Summary of Ecological Risk Assessment Results for Operable Units

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site	Date ERA Completed	Media			
			Surface Soil	Surface Water	Sediment	Groundwater
OU 5	Site 14	October 1997	No risk to terrestrial wildlife. Phytotoxicity benchmarks were exceeded by four inorganic analytes; however, due to sporadic detections and conservative benchmarks, any risk to plants would be unlikely. No stressed vegetation was observed. Risks to terrestrial invertebrates are predicted, but unlikely, because risks are based on an elevated detection from one sample location.	No risk to semiaquatic wildlife. Risk to aquatic receptors was predicted based on one organic and several inorganic analytes. However, these analytes are not likely site-related contaminants, the toxicity benchmarks are conservative, and aquatic habitat at the site is limited.	No risk to semiaquatic wildlife. Risk to aquatic receptors was predicted based on a maximum detected concentration of one organic analyte. It is unlikely that population-level risks exist based on this one exceedance.	Although there were some exceedances of plant and invertebrate toxicity benchmarks, risks to these receptors are unlikely based on the conservative nature of benchmarks, and absence of groundwater contaminants in surface water.
OU 5	Site 15	October 1997	Risks to terrestrial wildlife were predicted for small mammals and small birds based on exposure to lead. Toxicity tests indicated that earthworm survival and growth and lettuce seed germination were significantly reduced after exposure to surface soil. Plant and invertebrate toxicity benchmarks were exceeded for PAHs and several inorganic analytes.	No risk to semiaquatic wildlife. Risks were predicted for aquatic receptors, based on elevated concentrations of lead.	No risk to semiaquatic wildlife. Risks were predicted for aquatic receptors, based on elevated concentrations of PAHs, pesticides, and lead.	Risks to aquatic receptors are unlikely, although toxicity benchmarks were exceeded for several analytes. Risks are greatly overestimated based on limited bioavailability of analytes and use of conservative toxicity benchmarks.
OU 6	Site 11	August 1997	No risk to terrestrial wildlife or soil invertebrates. Three inorganic analytes were detected at concentrations that exceeded phytotoxicity benchmarks. However, risks to plants are unlikely because these benchmarks are conservative, and exceedances are minimal.	NM	NM	NM

See notes at end of table.

Table 6-1 (Continued)
Summary of Ecological Risk Assessment Results for Operable Units

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Operable Unit	Site	Date ERA Completed	Media			
			Surface Soil	Surface Water	Sediment	Groundwater
OU 7	Site 16	January 1996	NM	No risk.	Toxicity tests showed adverse effects to survival and reproduction of test species. Effects may be related to TRPH in sediment samples, but TRPH is not believed to be site-related.	No risk.
OU 8	Site 3	September 1997	No risk to terrestrial wildlife or soil invertebrates. Toxicity tests showed that lettuce seed germination rates were lower in soil samples CEF3SS17 and CEF3SS20 than in control samples. However, test results could not be replicated and low germination rates were observed in the control sample. Terrestrial plants are not believed to be at risk from exposure to soil.	No risk.	No risk.	Toxicity tests showed that exposure to undiluted, unfiltered groundwater from wells CF3-MW-13S and CF3-MW-28S resulted in adverse effects to growth, mortality, survival, and reproduction of test species. Three dichlorobenzene isomers appear to be the primary risk contributors. However, when groundwater is diluted, which naturally occurs at the site, little toxicity was observed. Therefore, it is believed that groundwater discharging to Rowell Creek poses little risk to aquatic receptors.

Notes: ERA = ecological risk assessment.
OU = operable unit.
% = percent.
TRPH = total recoverable petroleum hydrocarbons.
PCB = polychlorinated biphenyl.
DDT = dichlorodiphenyltrichloroethene.
NM = not a medium of concern.
PAH = polynuclear aromatic hydrocarbon.

communities and on comparison of exposure concentrations of ECPCs in surface water samples with representative toxicity benchmarks or standards. Results of biological sampling are discussed in detail in Section 5.2. For terrestrial wildlife, four representative wildlife species were selected for Site 1. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. The lowest reported adverse effects concentrations for acetone and barium, which are two analytes retained as ECPCs, are orders of magnitude higher than their measured concentrations in Site 1 surface water samples. Based on this observation, it is assumed that neither of these analytes contributes to risks for aquatic receptors at Site 1.

Concentrations of aluminum in surface water ranged from 91.5 to 601 $\mu g/\ell$; these exceed the Federal chronic AWQC value of 87 $\mu g/\ell$ for aluminum. However, the ERA for OU 1 concluded that aluminum in surface water is not contributing to risk to receptors in the area and is not attributable to runoff from Site 1. The highest concentration of aluminum measured in surface water at Site 1 is less than concentrations reported to cause lethal or sublethal effects to fish, invertebrates, aquatic plants, and algae. Also, biological sampling results indicate that the benthic macroinvertebrate community is not impaired at six of the surface water sampling locations near Site 1, and no link could be established between concentrations of aluminum in surface water and the measured impairment at two stations. Finally, statistical comparison of the surface water concentrations upstream and downstream of Site 1 does not show a significant increase in aluminum downstream; therefore, its presence is not likely to be related to Site 1.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all less than 1, indicating no potential adverse effects to wildlife resulting from exposure to ECPCs in surface water at Site 1.

6.1.1.3 Sediment at Site 1 Sediment samples collected adjacent to Site 1 are downgradient of groundwater discharge from Site 2. Sediment samples were collected from the same location as surface water samples. A total of 13 analytes was detected in sediment samples at Site 1. Of these, three were retained as ECPCs for both aquatic and terrestrial receptors, including acetone, barium, and methylene chloride. Two chemicals were retained as ECPCs for aquatic receptors only (cadmium and nickel). The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 1 sediment include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in sediment were characterized based on results of both sediment toxicity tests and quantitative benthic macroinvertebrate sampling. Results of biological sampling are discussed in detail in Chapter 5.0. For terrestrial wildlife, four representative wildlife species were selected for Site 1. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. Overall, the results of the field studies and sediment toxicity tests indicate that there is no impairment of the

macroinvertebrate community, or toxicity of sediment samples to water fleas or amphipods, for four of the six sampling locations adjacent to Site 1. This evidence suggests that any contamination released from Site 1 is not resulting in unacceptable risks at these locations.

Adverse biological conditions were measured at two locations in Rowell Creek, RC-Bio-6 and RC-Bio-7, immediately downstream of the Site 2 tributary. Comparison of the biological responses at these two locations with the distribution of analytes in sediment yielded the observations below.

- There was no statistical difference between concentrations of barium measured at locations where adverse biological responses were observed versus locations where a healthy macroinvertebrate community was observed.

- Two ECPCs for sediment, acetone and methylene chloride, could not be linked to observations of adverse biological responses.

- Cadmium and nickel were detected in only one sediment sample immediately downstream of the Site 2 tributary and were also detected in the Site 2 tributary. Concentrations of these analytes were below their respective USEPA Region IV sediment screening values.

Based on these observations, there appears to be no obvious chemical or visual contamination of sediment that can be associated with the adverse biological responses at the two locations. There are, however, indications that the discharge of the tributary at Site 2 could be associated with the adverse responses seen at Site 1. This discharge was noted during the field investigation at OU 1; it was observed as a trail of orange flocculent material draining into Rowell Creek at two defined points of entry. The presence of the flocculent material, which is discussed further in this section, is believed to be due to aluminum, iron, other metal-precipitated hydroxides, salts, and microbial growth.

If the discharge of the Site 2 tributary is adversely influencing the macroinvertebrate community at Site 1, the reach of the stream at risk is limited to a stretch approximately 700 feet long (measured from the southernmost confluence of the Site 2 tributary with Rowell Creek to the next downstream sampling location). No impairment of the macroinvertebrate community was observed beyond this point.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all less than 1, indicating no potential adverse effects to wildlife resulting from exposure to ECPCs in sediment at Site 1.

6.1.1.4 Groundwater at Sites 1 and 2 Due to the close proximity of Sites 1 and 2 and the fact that the groundwater from both sites discharges to Rowell Creek, groundwater is evaluated for OU 1 as a whole.

Surficial groundwater from Sites 1 and 2 flows toward Rowell Creek and is discharged to the wetlands associated with the sites. Therefore, aquatic receptors may be exposed to contaminated groundwater. Nine analytes detected in filtered groundwater samples were retained as ECPCs, including one VOC, two SVOCs, and six inorganics.

Predicted exposure concentrations of ECPCs for aquatic receptors were estimated based on the dilution of groundwater as it enters Rowell Creek. A dilution factor of 0.03 for groundwater contaminants entering Rowell Creek was calculated as part of a modelling effort.

Using the estimating approach described in the preceding paragraph, the predicted average and maximum concentrations of all the ECPCs except vanadium and aluminum fall either below their State or Federal water quality standards, or below the lowest reported concentrations associated with an adverse effect to fish, invertebrates, mollusks, or algae reported in the USEPA AQUIRE database. Thus, most of the ECPCs are not considered to pose a risk for aquatic receptors. It was not possible to evaluate the risks associated with vanadium in surface water because no toxicity information is available on vanadium in water, and there are no Federal or State standards for this analyte.

The predicted average and maximum concentrations of aluminum are both greater than the Federal chronic AWQC of 87 $\mu g/\ell$. Aluminum in Rowell Creek is discussed in greater detail in Paragraph 6.1.1.2. The predicted average concentration of 179 $\mu g/\ell$ falls below the reported range of toxicity for aluminum. Overall, the weight of evidence suggests that discharge of groundwater from Sites 1 and 2 is not contributing to aluminum contamination in Rowell Creek in the vicinity of OU 1.

6.1.1.5 Surface Soil at Site 2 A total of 27 analytes was detected in surface soil samples collected from Site 2. Of these, 20 were retained as ECPCs, including 11 SVOCs, 3 pesticides, 1 PCB congener, and 5 inorganics. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 2 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Six representative wildlife species were selected for Site 2. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on surface soil toxicity testing completed for OU 1. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0; results of toxicity testing are discussed in detail in Section 5.1.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated using the food-web model for each representative species were all less than 1, indicating no potential adverse effects to wildlife resulting from exposure to ECPCs in surface soil at Site 2.

Risks to Terrestrial Plants and Soil Invertebrates. Soil samples collected for toxicity tests at Site 2 were not toxic to either earthworms or lettuce seeds. Based on the results of these tests, which measure growth, reproduction, and survival of test organisms, it is assumed that the contamination present in surface soil at Site 2 does not present an unacceptable risk to terrestrial plants or soil invertebrates.

6.1.1.6 Surface Water at Site 2 Surface water samples were collected from both the Site 2 drainage structure and the Site 2 tributary to Rowell Creek. A total of 10 analytes was detected in these surface water samples. Of these, six inorganics were retained as ECPCs for both aquatic receptors and terrestrial wildlife, and two VOCs were retained as ECPCs for terrestrial wildlife only. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 2 surface water include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in surface water were characterized based on both field measurements of the structure and function of the benthic macroinvertebrate communities, and on comparison of exposure concentrations of ECPCs in surface water samples with representative toxicity benchmarks or standards. Results of biological sampling are discussed in detail in Chapter 5.0. For terrestrial wildlife, four representative wildlife species were selected for Site 2. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. The selection of species and models used to predict exposure is discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. Concentrations of aluminum, barium, cyanide, lead, and manganese fell below those reported from laboratory toxicity testing to be associated with either lethal or sublethal effects to fish, invertebrates, plants, or algae; therefore, risks are not expected to be associated with exposure to these chemicals.

Iron concentrations detected in the Site 2 tributary are within those concentrations reported to be lethal to fish and to have sublethal effects to both fish and aquatic invertebrates. Therefore, exposure to iron present in the Site 2 tributary could cause mortality in fish, invertebrates, or algae.

The results of biological studies indicate that the benthic macroinvertebrate community is impaired in the area of the Site 2 tributary. However, impairment of the benthic community could not be statistically associated with the detection of any of the ECPCs in surface water, including iron, in the Site 2 tributary. The risks for benthic macroinvertebrates are discussed further in Paragraph 6.1.1.7 along with the ERA results for sediment.

Risks to Terrestrial Wildlife. Risks to terrestrial wildlife due to exposure to ECPCs in surface water are discussed in the next section as part of the ERA results for exposure to sediment.

6.1.1.7 Sediment at Site 2 Sediment samples were collected at the same locations as surface water samples from both the Site 2 drainage structure and the Site 2 tributary to Rowell Creek. A total of 22 analytes was detected in these sediment samples. Of these, 13 were retained as ECPCs for both aquatic receptors and terrestrial wildlife (including four VOCs, one SVOC, and eight inorganics), and eight analytes were retained as ECPCs for terrestrial wildlife only (including three SVOCs and five inorganics). The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 2 sediment include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in sediment were characterized based on results of both sediment toxicity tests and quantitative benthic macroinvertebrate sampling. Results of biological sampling are discussed in detail in Chapter 5.0. For terrestrial wildlife, four representative wildlife species were selected for Site 2. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. Results of both field studies and sediment toxicity tests indicate impairment of the benthic macroinvertebrate community and toxicity of sediment at sampling locations within the Site 2 tributary.

Both survival and reproduction were significantly decreased for water fleas when exposed to sample 2-Tox-2 from the Site 2 tributary, as compared to a control sample (see Plate 2 for sampling locations). Survival of amphipods was also significantly less than controls when exposed to this sample. The two stations 2-Tox-2 and 2-Tox-3 in the tributary are classified as moderately impaired, representing a situation where organic pollution or toxicants could be adversely affecting the biological conditions regardless of habitat quality, which was fairly low at Site 2.

The following conclusions were reached regarding risks to aquatic receptors attributable to exposure to ECPCs in sediments:

- None of the four VOCs retained as ECPCs for sediment was found to be correlated with the impairment of the macroinvertebrate community at Site 2.

- The only metal with which a biological response (e.g., toxicity test results or benthic community metrics) could be positively correlated was iron concentrations in sediment versus mortality of amphipods. As iron concentrations increased, the toxicity of sediment from Site 2 increased. Iron concentrations in the sediment and surface water samples could reflect the amount of iron oxide (orange flocculent material) in the respective samples.

- The presence of several inorganics in the tributary may be associated with the impairment of the benthic community and the observed toxicity of the sediment.

- The adverse physical conditions associated with the flocculent material in the Site 2 tributary may be more responsible for benthic community impairment and sediment toxicity than the presence of metals in sediment. This material clogs fish gills and can physically impair the movement and foraging of aquatic receptors. The blanketing effect of the material prevents light penetration and growth of biomass (algae) for receptors, and covers the available spaces in the bottom substrate where macroinvertebrates live.

Risks to Terrestrial Wildlife. The results of calculations of HQs and HIs show that the HIs for one of the representative species, the eastern cottontail, are above the target of 1 for exposures based on the average detected concentrations of ECPCs (HI of 1.8) and the maximum detected concentrations of ECPCs (HI of 4.3). The primary contributors to the HIs are the HQs for iron. If exposures of iron associated with sediment ingestion are dropped from the lethal HI calculation, the HIs for both average and maximum exposure fall well below 1.

If exposures related to ingestion of sediments are removed from the calculations of lethal and sublethal HIs, the HIs all fall below 1. This indicates that exposure to ECPCs in sediment is the primary contributor to predicted risks, with iron being the primary risk driver. ECPCs in surface water are not an important

contributor to risks to terrestrial wildlife; therefore, risks were not predicted for wildlife ingesting surface water at Site 2.

6.1.2 Operable Unit 2 The ERA for OU 2 was completed in May 1995 (ABB-ES, 1995a). Results and conclusions of the ERA are discussed for OU 2 by site and by medium of concern.

One surface water sample and two sediment samples were collected from the wetland area of Site 17 in June 1994 (see Plate 2 for sampling locations). The data from the surface water sample were found to be questionable by the data validator, so resampling of surface water and sediment at one location was completed in February 1995 to reduce the uncertainties associated with evaluation of these media. Thus, the ERA was based on data from one surface water sample and three sediment samples.

In addition, groundwater at Site 17 was not a medium of concern for the ERA because it is not believed to discharge to the surface at this site.

6.1.2.1 Surface Soil at Site 5 A total of 53 analytes was detected in surface soil samples collected from Site 5. Of these, 44 were retained as ECPCs, including 5 VOCs, 21 SVOCs, 6 pesticides, 1 PCB congener, and 11 inorganics. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 5 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Six representative wildlife species were selected for Site 5. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on surface soil toxicity testing completed for OU 2. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0; results of toxicity testing are discussed in detail in Chapter 5.0.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species are all below 1, indicating no potential adverse effects to reproduction, growth, or survival for species exposed to ECPCs in surface soil at Site 5.

Risks to Terrestrial Plants and Soil Invertebrates. Except at one sampling location, surface soil collected for toxicity testing was not toxic to either earthworms or lettuce seeds. At one location, CF5-Tox-4, there was 100 percent mortality of both earthworms and lettuce seeds (see Plate 4 for sampling locations). Linear regression showed that concentrations of TRPH and PCBs in this sample were positively correlated with lettuce seed toxicity; as concentrations rose, soil was more toxic to the seeds. These results indicate that TRPH and PCBs at CF5-Tox-4 may be adversely affecting the terrestrial plant and invertebrate community in the area.

6.1.2.2 Surface Water at Site 5 There are two surface water systems present at Site 5. Surface water is present within a drainage ditch adjacent to the site, and a wetlands area also contains surface water. Evaluation of risks was performed separately for these two areas.

A total of 14 analytes was detected in surface water within the Site 5 drainage ditch. Of these, eight were retained as ECPCs for both aquatic receptors and

terrestrial wildlife (including two VOCs and six inorganics), and two were retained as ECPCs for terrestrial wildlife only (including one VOC and one inorganic). Nine inorganics were detected in surface water at the Site 5 wetland. Of these, only manganese was retained as an ECPC for both aquatic receptors and terrestrial wildlife. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 5 surface water include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in surface water were characterized based on both field measurements of the structure and function of the benthic macroinvertebrate communities and on comparison of exposure concentrations of ECPCs in surface water samples with representative toxicity benchmarks or standards. The results of biological sampling are discussed in detail in Section 5.2. For terrestrial wildlife, four representative wildlife species were selected for Site 5. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. Concentrations of aluminum in both of the surface water systems at Site 5 exceeded surface water criteria and guidelines; however, aluminum in an upstream sample collected near Site 5 also exceeded criteria. Concentrations of iron and lead in both the drainage ditch and the upstream sample exceeded surface water criteria.

No trends are apparent in the status of the benthic macroinvertebrate community in the Site 5 drainage ditch adjacent to and downstream of Site 5. It could not be concluded that contamination in surface water from Site 5 was contributing to the decreased condition observed at the downstream sampling station. Risks to aquatic receptors are discussed more fully with the sediment results in Paragraph 6.1.2.3.

Risks to Terrestrial Wildlife. For both surface water systems at Site 5, the lethal and sublethal HIs and HQs calculated for each representative species were all below 1, indicating no potential adverse effects to reproduction, growth, or survival for species exposed to ECPCs in surface water at Site 5.

6.1.2.3 Sediment at Site 5 ECPCs for sediment were selected separately for the drainage ditch area and the wetland area of Site 5. The ECPC selection process is discussed in Chapter 3.0.

A total of 27 analytes was detected in sediment samples from the Site 5 drainage ditch. Of these, 22 were retained as ECPCs for both aquatic receptors and terrestrial wildlife (including 6 VOCs, 5 SVOCs, 3 pesticides, 1 PCB congener, and 7 inorganics), and 3 were retained as ECPCs for terrestrial wildlife only (including 1 SVOC and 2 inorganics).

A total of 16 analytes was detected in sediment samples from the Site 5 wetland. Of these, 10 were retained as ECPCs for both aquatic receptors and terrestrial wildlife (including 1 VOC and 9 inorganics), and 3 were retained as ECPCs for terrestrial wildlife only (all inorganics).

Receptors that may potentially be exposed to Site 5 sediment include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in sediment were characterized based on results of both sediment

toxicity tests and quantitative benthic macroinvertebrate sampling. Results of biological sampling are discussed in detail in Section 5.2. For terrestrial wildlife, four representative wildlife species were selected for Site 5. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. As discussed earlier for Site 5 surface water, there are no apparent trends in the status of the macroinvertebrate community in the Site 5 drainage ditch. It could not be concluded that sediment contamination was contributing to the decreased condition observed in the downstream sampling stations. A review of the habitat quality suggests that conditions at the drainage ditch are poor for many types of aquatic organisms, especially those not adaptable to the variable conditions associated with ephemeral streams such as this ditch.

Sediment collected from 5-Tox-4 was toxic to water fleas, and sediment collected from locations 5-Tox-1, 5-Tox-3, and 5-Tox-4 was toxic to amphipods. Based on the results of these laboratory sediment bioassays, impacts to survival of certain invertebrate receptors may be occurring in the Site 5 drainage ditch. This suggests that the mixture of contaminants in the sediment may also be toxic to aquatic life.

To determine which contaminants measured in the drainage ditch sediment may be causative agents for the observed toxicity, linear regressions were completed for selected analytes. This comparison yielded the following results:

- Because VOCs are generally only toxic to aquatic receptors at elevated concentrations, it is unlikely that VOCs are substantially responsible for test impacts because they were detected at low concentrations in the drainage ditch.

- PAHs detected in sediment are suspected to be laboratory contaminants and not site-related; it is unlikely that they are responsible for the observed sediment toxicity.

- Based on statistical analyses, review of sediment screening values, and distribution of the analytes within the Site 5 drainage ditch, it is unlikely that inorganics are substantial contributors to observed sediment toxicity.

- Although total DDT concentrations (DDT_R, the sum of concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT) were positively correlated with sediment toxicity, it is unlikely that DDT_R is the primary contributor to observed laboratory mortality at the Site 5 drainage ditch locations. Concentrations of DDT_R were within the range of contamination tolerated by a majority of evaluated freshwater organisms in the Great Lakes (Persaud and others, 1992).

- Statistical analyses showed that both TRPH and Aroclor-1260 concentrations were positively correlated with sediment toxicity. This suggests that, in addition to DDT_R, TRPH and Aroclor-1260 may be contributing to observed mortality in test organisms in the laboratory toxicity tests.

TRPH is known to adversely affect aquatic organisms (Alexander, 1982; Mahaney, 1994; McGrath and Alexander, 1979).

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all below 1, indicating no potential adverse effects to reproduction, growth, or survival for species exposed to ECPCs in sediment at Site 5 in either the drainage ditch or the wetlands area.

6.1.2.4 Groundwater at Site 5 Data from 30 monitoring wells sampled at Site 5 were used to evaluate groundwater conditions potentially contributing to surface water contamination in the Site 5 drainage ditch and wetland areas.

Detections of analytes in unfiltered groundwater were used to select ECPCs. This is a very conservative approach because unfiltered groundwater data represent concentrations in both the dissolved and the particulate fractions of groundwater. Particulates in the groundwater are not bioavailable to aquatic receptors and are not likely to be discharged to surface water. A total of 44 analytes was detected in unfiltered groundwater samples. Of these, 37 were retained as ECPCs for aquatic receptors, including 8 VOCs, 9 SVOCs, 3 pesticides, and 17 inorganics. The ECPC selection process is discussed in Chapter 3.0.

Predicted exposure concentrations of ECPCs for aquatic receptors were estimated based on the dilution of groundwater as it enters the Site 5 drainage ditch and wetland area. A dilution factor of 0.062 for unfiltered groundwater contaminants was calculated as part of a modelling effort. Discharge of undiluted groundwater was also evaluated, representing a very conservative approach toward estimating risks due to groundwater exposure.

Risks to Aquatic Receptors. Comparison of the average and maximum exposure concentrations of ECPCs with available criteria and toxicity benchmarks indicated that no risks to aquatic receptors would result from exposure to ECPCs in diluted groundwater. Although risks for aquatic receptors would theoretically be increased with exposure to eight inorganic ECPCs at concentrations detected in undiluted, unfiltered groundwater, this exposure scenario is deemed highly unlikely. Furthermore, any analytes present in unfiltered groundwater in the particulate fraction would not be bioavailable to aquatic receptors, and thus would not represent an exposure risk.

6.1.2.5 Surface Soil at Site 17 A total of 20 analytes was detected in surface soil from Site 17. Of these, 12 were retained as ECPCs, including 4 VOCs, 4 SVOCs, 1 pesticide, and 3 inorganics. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 17 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Six representative wildlife species were selected for Site 17. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on surface soil toxicity testing completed for OU 2. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0; results of toxicity testing are discussed in detail in Section 5.1.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all below 1, indicating no potential adverse

effects to reproduction, growth, or survival for species exposed to ECPCs in surface soil at Site 5.

Risks to Terrestrial Plants and Soil Invertebrates. Soil samples collected from Site 17 were not toxic to earthworms. Two soil samples, CS-17-SS8 and CS-17-SS9, were toxic to lettuce seeds, but the background sample BSS01 was also toxic to them (see Plate 4 for sampling locations). Germination of lettuce seeds was also slightly inhibited at these two surface soil sampling stations. However, no correlation of ECPC concentrations in surface soil and germination of lettuce seeds was observed. Both of these samples with lower germination of lettuce seeds contained few contaminants. It is possible that a nonmeasured physical, biological, or chemical factor is responsible for the observed slight reduction in lettuce seed germination. Overall, it is believed that contamination present in Site 17 surface soil does not present an unacceptable risk for terrestrial plants or soil invertebrates.

6.1.2.6 Surface Water at Site 17 A total of nine inorganics was detected in the surface water sample collected at Site 17. None were retained as ECPCs, and no risk to either aquatic receptors or terrestrial wildlife due to exposure to contaminants in Site 17 surface water is expected.

6.1.2.7 Sediment at Site 17 Three sediment samples were collected from the wetlands downgradient of Site 17. A total of 24 analytes was detected in sediment samples. Of these, 14 were retained as ECPCs for both aquatic receptors and terrestrial wildlife, including 2 VOCs, 5 SVOCs, and 7 inorganics. Six analytes were retained as ECPCs for terrestrial wildlife only, including one pesticide and five inorganics, and one inorganic was retained as an ECPC for aquatic receptors only. The ECPC selection process is discussed in Chapter 3.0.

Contaminant exposures via direct contact with sediment were evaluated by comparing exposure concentrations with available SQGs. No sediment toxicity tests were completed for samples collected at Site 17. Although the use of guidelines to estimate risks involves some uncertainty, this approach provides a conservative screening tool in the absence of site-specific toxicity test data. For terrestrial wildlife, five representative wildlife species were selected for Site 5. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. Based on a comparison of exposure concentrations of ECPCs to SQGs, risks are not anticipated for aquatic receptors in the Site 17 wetland. Concentrations of zinc and bis(2-ethylhexyl)phthalate slightly exceeded benchmarks but were below reported effects concentrations reported for aquatic receptors. For the 11 ECPCs in which sediment screening values were not available, aluminum, barium, and selenium exceeded reported effects levels. The effects level for aluminum is based on effects to larval trout, which are known to be among the most sensitive ecological receptors. Also, the magnitude of exceedances for barium and selenium is low, suggesting that adverse effects due to exposures to these chemicals is minimal or unlikely.

Overall, risks are not anticipated for aquatic receptors associated with exposure to ECPCs in wetland sediment at Site 17.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all below 1, indicating no potential adverse effects to reproduction, growth, or survival for species exposed to ECPCs in sediment in the wetlands at Site 17.

6.1.3 Operable Unit 3 The ERA for OU 3 was completed in August 1997 (ABB-ES, 1997a). Results and conclusions of the ERA are discussed for OU 3 by site and by medium of concern.

6.1.3.1 Surface Soil at Site 7 A total of 54 analytes was detected in surface soil samples collected from Site 7. Of these, 47 were retained as ECPCs, including 1 VOC, 26 SVOCs, 4 pesticides, 1 PCB congener, 14 inorganics, and TRPH. The ECPC selection process is discussed in Chapter 3.

Receptors that may potentially be exposed to Site 7 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Three representative wildlife species were selected for Site 7. A model was used to estimate contaminant exposures and risks for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on comparisons of surface soil concentrations with plant and invertebrate toxicity benchmarks. The selection of species and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Terrestrial Wildlife. The lethal HIs and HQs calculated for each representative species are all below 1, indicating that potential lethal effects are unlikely for species exposed to ECPCs in surface soil at Site 7. The sublethal HIs and HQs calculated for representative species were all below 1, except for the small mammal HI which slightly exceeded 1. The primary risk contributor for the small mammal is lead, largely influenced by a maximum concentration of 17,800 mg/kg, which was not confirmed in subsequent sampling efforts at that location. Although these results suggest that a potential for effects on small mammal reproduction and growth may exist, risks are likely overestimated by including the maximum concentration in the evaluation.

Risks to Terrestrial Plants and Soil Invertebrates. Based on the comparison of soil concentrations with plant toxicity benchmarks, antimony, chromium, lead, and zinc were identified as potential risk contributors. However, maximum and average exposure point concentrations for antimony, chromium, and zinc only slightly exceed benchmarks. Furthermore it is unlikely that plants are at risk from exposure to these analytes. Considering the conservative nature of the antimony, chromium, and lead benchmarks, and an average zinc concentration that is below the benchmark, as discussed for terrestrial wildlife, risks to plants from exposure to lead in soil are likely overestimated. It should also be noted that no stressed vegetation was observed at Site 7 surface soil sampling locations while conducting the habitat characterization at this site. Lead was the only analyte detected at concentrations that exceeded the invertebrate toxicity benchmark. However, the magnitude of this exceedance was low, which would suggest that invertebrates at Site 7 would not be adversely impacted by exposure to lead.

6.1.3.2 Surface Soil at Site 8 A total of 39 analytes was detected in surface soil samples collected from Site 8. Of these, 20 were retained as ECPCs, including 3 VOCs, 6 SVOCs, 1 PCB, 2 pesticides, 7 inorganics, and TRPH. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 8 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Six representative wildlife receptors were selected to evaluate wildlife exposures to surface soil at Site 8. A model was used to predict contaminant exposure for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on surface soil toxicity testing completed for Site 8. Species selection and models used to predict exposure and risks to wildlife are discussed in detail in Chapter 3.0; results of toxicity testing are discussed in detail in Chapter 5.0.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species are all below 1, indicating that potential adverse effects on reproduction, growth, or survival for species exposed to ECPCs in surface soil at Site 8 are unlikely.

Risks to Terrestrial Plants and Soil Invertebrates. Soil samples collected for toxicity tests at Site 8 had no direct effect on earthworm survival over the 30-day exposure period. Earthworm growth (as measured by decreased weight gain) was significantly lower at five locations (CF8SS13, CF8SS16, CF8SS20, CF8SS21, and CF8SS23) as compared to the control. Lettuce seed germination was also significantly lower than the control at five locations (CF8SS5, CF8SS6, CF8SS7, CF8SS14, and CF8SS16). Linear regressions showed no correlation between contaminants most likely to cause toxicity (i.e. were ECPCs, and detected in the majority of samples) and observed toxic effects. It is possible that the combination of contaminants present in soil and other physical stressors may have caused the adverse effects to earthworms and lettuce seeds.

6.1.3.3 Surface Water at Site 8. A total of 10 inorganic analytes and TRPH was detected in unfiltered surface water, and a total of 9 inorganic analytes were detected in filtered surface water. Of these, 5 analytes were selected as ECPCs for unfiltered surface water and 3 were selected as ECPCs for filtered surface water. No VOCs, SVOCs, pesticides or PCBs were detected in Site 8 surface water. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 8 surface water include terrestrial wildlife receptors and aquatic receptors. Risks to terrestrial wildlife were evaluated based on five representative wildlife species selected for Site 8. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0. Risks to aquatic receptors are characterized based on field measurement of the structure and function of the benthic macroinvertebrate communities and on comparison of exposure concentrations with aquatic toxicity benchmarks. The results of the biological sampling are discussed in detail in Section 5.2.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species are all below 1, indicating that potential adverse effects on the reproduction, growth, or survival of species exposed to ECPCs in surface water at Site 8 are unlikely.

Risk to Aquatic Receptors. The results of the biological study suggest that there is reduced habitat quality at sample location CF8BIO2, as compared to the regional reference station; reduced habitat quality is based primarily on the physical

habitat conditions. The habitat at this location represents a poor environment for aquatic organisms because of the ephemeral nature of the man-made ditch.

A comparison of Site 8 exposure point concentrations with aquatic toxicity benchmarks indicates that cyanide was the only analyte detected in surface water at concentrations that exceeded its aquatic toxicity benchmark. However, adverse effects to aquatic receptors are unlikely, because the cyanide benchmark is based on highly sensitive receptors (salmonids), which do not occur in warm water systems. In addition, cyanide was detected in unfiltered surface water only, which would suggest that this analyte is bound to sediment and not bioavailable.

6.1.3.4 Sediment at Site 8 A total of 18 analytes was detected in sediment samples collected at Site 8. Of these, 6 were retained as ECPCs, including 2 VOCs, 1 SVOC, 1 PCB, zinc, and TRPH. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 8 sediment include terrestrial wildlife receptors and aquatic receptors. Risks to terrestrial wildlife were evaluated based on five representative wildlife species selected for Site 8. A model was used to predict contaminant exposures and risks for each representative species selected, based on its position in the food chain. The selection of species and models used to estimate exposure and risk are discussed in detail in Chapter 3.0. Risks for aquatic receptors are characterized based on field measurement of the structure and function of the benthic macroinvertebrate communities, sediment toxicity studies, and comparison of exposure concentrations with aquatic toxicity benchmarks. The results of the toxicity testing and biological sampling are discussed in detail in Sections 5.1 and 5.2, respectively.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species are all below 1, indicating that potential adverse effects on the reproduction, growth, or survival for species exposed to ECPCs in sediment at Site 8 are unlikely.

Risks to Aquatic Receptors. As discussed for surface water, results of the macroinvertebrate community study indicated that sample location CF8BIO2 showed reduced habitat quality, as compared to the regional reference location. Data from dip-net and ponar studies support this conclusion, with low overall biotic indices and a high percentage of pollution-tolerant species. The ephemeral nature of the man-made ditch may explain the reduced habitat at this location.

Toxicity tests conducted with Site 8 sediment identified statistically significant differences in midge and amphipod survival and growth, as compared to the reference. Based on the results of these laboratory sediment bioassays, impacts to survival and growth of certain invertebrate receptors may be occurring in the Site 8 drainage ditch. In order to determine which contaminants detected in sediment may be causative agents for the observed toxicity, linear regressions were completed for selected analytes.

The results of the regressions suggest that there is no correlation between midge survival and growth and TRPH concentrations in sediment. However, regressions conducted for the amphipod indicate that a positive correlation exists between TRPH concentrations in sediment and amphipod survival and growth.

6.1.3.5 Groundwater at Site 8. Data from 22 monitoring wells sampled at Site 8 were used to evaluate groundwater conditions potentially contributing to surface water contamination in the Site 8 drainage ditch and Sal Taylor Creek.

ECPCs were identified for unfiltered and filtered groundwater collected at Site 8. Filtered groundwater samples were collected because the turbidity of the unfiltered samples was measured at greater than 5 nephelometric turbidity units (NTUs). Also, the concentrations detected in filtered groundwater are more representative of the bioavailable inorganic contaminants that may be discharging to the drainage ditch. A total of 38 analytes was detected in unfiltered groundwater samples. Of these, 3 VOCs, 2 SVOCs, 2 pesticides, 6 inorganics, and TRPH were selected as ECPCs for unfiltered groundwater. A total of 13 inorganic analytes and cyanide was detected in filtered groundwater, of these 7 were identified as ECPCs. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to groundwater at Site 8 included terrestrial plants and aquatic receptors. Terrestrial plants may be exposed to groundwater at Site 8 because groundwater is at or near the ground surface in southeastern portion of the site. Aquatic receptors may be exposed to groundwater discharging to the drainage ditch at Site 8. Risks to terrestrial plants and aquatic receptors were evaluated by comparing exposure point concentrations with phytotoxicity benchmarks and surface water toxicity benchmarks, respectively.

Risks to Soil Invertebrates and Terrestrial Plants. A comparison of maximum and average exposure point concentrations of ECPCs in the earthworm with toxicity benchmarks indicated that aluminum was the only analyte detected in filtered and unfiltered groundwater that exceeded the plant phytotoxicity benchmark. Risks to terrestrial plants from exposure to aluminum are most likely over estimated because plants would be exposed to diluted concentration of chemicals in groundwater in the drainage ditch.

Risks to Aquatic Receptors. Comparison of the average and maximum exposure point concentrations of ECPCs in groundwater with available criteria and toxicity benchmarks indicated that 1 phthalate ester, 2 pesticides, 4 inorganics, and cyanide exceeded aquatic benchmarks. Most inorganic analytes, bis(2-ethylhexyl)-phthalate, and cyanide, only slightly exceeded the most conservative benchmarks, and would most likely not pose a risk to aquatic receptors. The available pesticide toxicity benchmarks are highly conservative because they are based on residues in fish for the protection of wildlife, not the protection of aquatic organisms; therefore, it is unlikely that aquatic receptors would be at risk from exposure to pesticides detected in groundwater. Concentrations of aluminum in Site 8 groundwater may pose a risk to aquatic organisms in the Site 8 ditch.

6.1.4 Operable Unit 4 The ERA for OU 4 was completed in November 1996 (ABB-ES, 1996a). Results and conclusions of the ERA are discussed for OU 4 by site and by medium of concern.

6.1.4.1 Surface Soil at Site 10 A total of 16 analytes was detected in surface soil samples collected from Site 10. Of these, 11 were selected as ECPCs, including 1 VOC, 1 SVOC, 8 inorganics, and TRPH. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 10 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Five

representative wildlife species were selected to evaluate potential risks from exposure to Site 10 surface soil. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on comparison of ECPC concentrations with plant and invertebrate toxicity benchmarks. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all less than 1, indicating no potential for adverse effects to wildlife resulting from exposure to ECPCs in surface soil at Site 10.

Risks to Terrestrial Plants and Soil Invertebrates. Based on the comparison of average and maximum exposure point concentrations with phytotoxicity benchmarks, several analytes (including aluminum, chromium, and vanadium) were identified as potential risk contributors. Exceedance of the phytotoxicity benchmark suggest that plants may be affected by concentrations detected in surface soil. However, due to the conservative nature of the selected phytotoxicity benchmarks and the sporadic detection of chromium and vanadium, and considering background concentrations of these analytes at NAS Cecil Field, it is unlikely that plant populations would be adversely affected from exposure to aluminum, chromium, and zinc at Site 10. A comparison of ECPCs with invertebrate toxicity benchmarks indicated that invertebrates from Site 10 are not at risk because none of the analytes detected in surface soil exceeded invertebrate toxicity benchmarks.

6.1.4.2 **Groundwater at Site 10** Data from four monitoring wells sampled at Site 10 were used to evaluate groundwater conditions potentially contributing to surface water contamination in Rowell Creek and wetlands at Site 10.

Detections of analytes in unfiltered and filtered groundwater were used to select ECPCs. The use of unfiltered data is a very conservative approach because unfiltered groundwater data represent concentrations in both the dissolved and the total fractions of groundwater. Contaminants sorbed to particulates in the groundwater are not bioavailable to aquatic receptors and are not likely to have discharged to surface water. Furthermore, assuming that aquatic organisms are exposed to the full concentration of chemicals in groundwater likely overestimates risk, as groundwater would be diluted upon discharge to surface water. A total of 12 analytes was detected in unfiltered groundwater. Of these, 1 phthalate ester and 3 inorganic analytes were selected as ECPCs. In addition, 12 inorganic analytes were detected in filtered groundwater, and 6 were selected as ECPCs. The ECPC selection process is discussed in Chapter 3.0.

Risk to Terrestrial Plants. Risks for terrestrial plants were evaluated by comparing phytotoxicity benchmarks with maximum and average exposure point concentrations of ECPCs. Aluminum was the only analyte detected in filtered and unfiltered groundwater that exceeded the plant phytotoxicity benchmark. However, based on the background concentration of aluminum in groundwater, the relatively small exceedance of the toxicity benchmark, and that no stressed vegetation was observed along Rowell Creek during the habitat characterization, it is unlikely that plants are being impacted by aluminum concentrations in groundwater.

Risk to Aquatic Receptors. A comparison of the average and maximum PECs in groundwater with several aquatic toxicity benchmarks was conducted to evaluate

risks to aquatic receptors. The following analytes were detected at concentrations that exceeded aquatic toxicity benchmarks: bis(2-ethylhexyl)phthalate, aluminum, and iron (in unfiltered groundwater) and aluminum, copper, and iron (in filtered groundwater). Based on the conservative nature of the bis(2-ethylhexyl)-phthalate, aluminum, and iron toxicity benchmarks, it is unlikely that these analytes would pose a risk to populations of aquatic receptors at Site 10. There is uncertainty associated with the actual presence of copper in groundwater because it was detected in filtered groundwater, but not unfiltered groundwater. Furthermore, copper only slightly exceeded toxicity benchmarks. Therefore, it is unlikely that copper would be a risk to aquatic receptors at Site 10.

6.1.5 Operable Unit 5 The ERA for OU 5 was completed in October 1997 (ABB-ES, 1997b). Results and conclusions of the ERA are discussed for OU 5 by site and by medium of concern.

6.1.5.1 Surface Soil at Site 14 A total of 16 analytes was detected in surface soil from Site 14. Of these, 10 were identified as ECPCs, including 3 SVOCs, 1 pesticide, 5 inorganics, and TRPH. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 14 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Five representative wildlife species were selected to evaluate potential risk to wildlife receptors for Site 14. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on comparison of ECPC concentrations with plant and invertebrate toxicity benchmarks. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative wildlife species were all less than 1, except the for omnivorous small mammals. The lethal and sublethal HIs, based on maximum exposure point concentrations, slightly exceeded one for this trophic level. The primary risk contributor was vanadium; however, with respect to the assessment endpoints and the historic site activities, this analyte was not identified as a primary risk contributor and would not likely cause risks to small mammal populations at Site 14.

Risks to Terrestrial Plants and Soil Invertebrates. Based on the comparison of maximum and average exposure point concentrations with phytotoxicity benchmarks, several analytes (including aluminum, chromium, copper and vanadium) were identified as potential risk contributors. Due to the conservative nature of the selected phytotoxicity benchmarks, the sporadic detections of aluminum and copper, and considering background concentrations of these analytes in soil at NAS Cecil Field, it is not likely that plant populations would be adversely affected from exposure to these analytes in soil at Site 14. In addition, no observations of stressed vegetation were evident at Site 14.

A comparison of ECPCs with invertebrate toxicity benchmarks identified that maximum concentrations of copper slightly exceeded its toxicity benchmark. It is unlikely that this exceedance would have population-level significance, based on the fact that the elevated detection was from a single sample location.

6.1.5.2 Surface Water at Site 14 A total of 16 analytes was detected in unfiltered surface water, and a total of 13 analytes was detected in filtered surface water. Of these, 1 VOC, 1 phthalate ester, 1 pesticide, and 8 inorganics were identified as ECPCs in unfiltered surface water. A total of 8 inorganic analytes was selected as ECPCs in filtered surface water. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to surface water at Site 14 include terrestrial wildlife receptors and aquatic receptors. Four representative wildlife species were selected to evaluate potential risks to wildlife receptors exposed to surface water at Site 14. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0. Risks to aquatic receptors are characterized based on a comparison of exposure concentrations with aquatic toxicity benchmarks.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all below 1, indicating that no potential adverse effects on the reproduction, growth, or survival of terrestrial wildlife exposed to ECPCs in surface water at Site 14 are likely.

Risks to Aquatic Receptors. Comparison of the average and maximum exposure point concentrations of ECPCs in surface water with available criteria and toxicity benchmarks indicate that bis(2-ethylhexyl)phthalate, aluminum, copper, cyanide, and zinc exceeded aquatic benchmarks. A review of the toxicity data for bis(2-ethylhexyl)phthalate suggest that some invertebrates and amphibians may be at risk from exposure to this contaminant. However, this analyte is a known laboratory contaminant and is not typically associated with the disposal activities (ordnance disposal and detonation) conducted at Site 14. Similarly, cyanide was detected in one filtered sample and in no other media, and like bis(2-ethylhexyl)phthalate it is not typically associated with the disposal activities conducted at the Site 14. The aquatic toxicity benchmark for aluminum and copper are slightly conservative because they are based on cold water species of fish, which would not be found in the aquatic habitat at Site 14. Zinc was detected at concentrations that may cause adverse effects to freshwater invertebrates. However, it is likely that the limited aquatic habitat at Site 14 would abrogate any predicted risks to aquatic species based on conservative toxicity benchmark exceedances. Furthermore, the majority of aquatic organisms can tolerate site concentrations of these analytes.

6.1.5.3 Sediment at Site 14 A total of 24 analytes was detected in sediment at Site 14. Of these 2 VOCs, 10 SVOCs, 8 inorganics, and TRPH were identified as ECPCs in sediment. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to sediment at Site 14 include terrestrial wildlife receptors and aquatic receptors. Four representative wildlife species were selected to evaluate sediment risks at Site 14. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to estimate exposure and risk are discussed in detail in Chapter 3.0. Risks to aquatic receptors are characterized based on a comparison of exposure concentrations with aquatic toxicity benchmarks.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all below 1, indicating that no potential

adverse effects on the reproduction, growth, or survival of terrestrial wildlife exposed to ECPCs in sediment at Site 14 are likely.

Risks to Aquatic Receptors. Bis(2-ethylhexyl)phthalate was the only analyte detected in sediment at concentrations that exceeded toxicity benchmarks. The benchmark exceedance is based on the maximum detected concentration. It is unlikely that the entire population of aquatic receptors at Site 14 would be continually exposed to the maximum concentration; therefore, population-level risks are unlikely to occur.

6.1.5.4 Groundwater at Site 14 A total of 17 analytes was detected in unfiltered groundwater. Of these, 1 explosive and 6 inorganic analytes were identified as ECPCs. In addition, one filtered groundwater sample was collected and analyzed for inorganics. A total of 5 analytes was identified as ECPCs. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may be exposed to groundwater at Site 14 include terrestrial plants and aquatic receptors. Risks to terrestrial plants and aquatic receptors were characterized by comparing ECPC exposure point concentrations with plant and aquatic toxicity benchmarks.

Risks to Terrestrial Plants. The average and maximum exposure point concentrations of aluminum in unfiltered and filtered groundwater exceeded its phytotoxicity benchmark. However, aluminum was detected in surface water at much lower concentrations, which would indicate that aluminum concentrations in groundwater are not adversely impacting surface water (i.e., they are not discharging to the surface). Furthermore, no stressed vegetation was observed at the site while conducting the habitat characterization. The exposure point concentrations of all other analytes were less than plant RTVs, indicating that adverse effects to plants from exposure to these analytes are not likely to occur.

Risks to Aquatic Receptors. Comparison of the average and maximum exposure point concentrations of ECPCs with available criteria and toxicity benchmarks shows that aluminum, cobalt, and iron in unfiltered groundwater and aluminum in filtered groundwater exceed toxicity benchmarks. Cobalt and iron only slightly exceed the most conservative benchmarks, and were not detected in surface water. Therefore, it is unlikely that these analytes would be of concern for aquatic receptors. Although aluminum was detected at concentrations above the aquatic benchmark, it is unlikely that aquatic receptors would be at risk because the benchmark is based on a value that is protective of cold water species of fish that do not inhabit Site 14.

6.1.5.5 Surface Soil at Site 15 A total of 56 analytes was detected in surface soil at Site 15. Of these, 43 were selected as ECPCs, including 21 SVOCs, 3 explosive compounds, 4 pesticides, 14 inorganics, and TRPH. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 15 surface soil included terrestrial wildlife, terrestrial plants, and soil invertebrates. Five representative wildlife species were selected to evaluate potential risks to wildlife from exposure to surface soil at Site 15. A model was used to estimate contaminant exposures and risks for each representative species selected based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0. Risks to terrestrial plant and

soil invertebrate receptors are characterized based on surface soil toxicity testing completed for Site 15, and a comparison of exposure concentrations with plant and invertebrate toxicity benchmarks.

Risks to Terrestrial Wildlife. Lethal and sublethal HIs and HQs were calculated for maximum and average exposure concentrations using the food-web model. Lethal and sublethal effects were estimated for three trophic levels (small mammal, omnivorous small bird, and insectivorous small bird) for both maximum and average exposures. The estimated risks for small birds were low (i.e., HIs only slightly exceeded 1) suggesting that population-level impacts would be minimal. The primary risk contributor identified for small mammals is lead. No risks were predicted for predatory mammals and birds at Site 15.

Risks to Terrestrial Plants and Soil Invertebrates. Results of the surface soil toxicity tests indicated that earthworm survival and growth and lettuce seed germination were significantly reduced after exposure to Site 15 surface soil. Linear regressions were used to determine if any correlations exist between soil concentrations of suspected contaminants of concern and observed effects in earthworm and lettuce seed toxicity testing; however, no strong correlations between individual contaminant concentrations and biological effects were identified. A multiple linear regression indicated that lead and aluminum may be associated with decreased earthworm survival. It is likely that the combination of contaminant concentrations and other physical stressors (i.e., possibly TOC) may have caused the adverse toxicological effects.

The ECPCs in surface soil were compared to a toxicity benchmarks to evaluate risks to terrestrial plants and soil invertebrates. The results of this comparison indicated that maximum and average exposure point concentrations of PAHs and several inorganics (including aluminum, antimony, arsenic, chromium, lead, and vanadium) exceed plant and invertebrate benchmarks. None of these analytes, however, were correlated with observed effects in toxicity tests, except aluminum and lead. It is possible that this conservative benchmark comparison may overestimate potential risks to terrestrial plants and soil invertebrates; conversely, a combination of these analytes may have contributed to adverse effects in toxicity tests.

6.1.5.6 Surface Water at Site 15 A total of 15 analytes was detected in unfiltered surface water and a total of 9 analytes was detected from filtered surface water collected from Site 15. Of analytes detected in unfiltered surface water, 12 were retained as ECPCs including 4 explosive compounds, 7 inorganics, and TRPH. A total of 5 inorganic analytes was retained as ECPCs in filtered surface water. The ECPC selection process is described in Chapter 3.0.

Receptors that may potentially be exposed to surface water at Site 15 include semiaquatic wildlife receptors. Wildlife species were selected to evaluate potential risks to wildlife receptors from exposure to surface water at Site 15. A model was used to estimate contaminant exposures and risks for each representative species selected, based on its position in the food chain. Species selection and models used to estimate exposure are discussed in detail in Chapter 3.0. Risks to aquatic receptors are characterized based on a comparison of exposure concentrations with aquatic toxicity benchmarks.

Risks to Semiaquatic Wildlife. The lethal and sublethal HIs and HQs were calculated based on maximum and average exposure point concentrations using the

food web model for each representative wildlife species. No lethal effects are anticipated for wildlife, because HIs are all less than 1. A low probability for sublethal effects (i.e., effects on growth or reproduction) was estimated for small mammals based on a maximum exposures to lead. However, it is unlikely that organisms would be continuously exposed to maximum concentrations; risks based on average concentrations are less than 1. Therefore, population-level effects are unlikely.

Risks to Aquatic Receptors. The maximum and average exposure point concentrations for the ECPCs in unfiltered and filtered surface soil were compared to toxicity benchmarks. The results of this comparison identified concentrations of aluminum, copper, iron, and lead in unfiltered and filtered surface water to be in exceedance of toxicity benchmarks. However, based on the conservative nature of the surface water benchmarks, consistency with groundwater concentrations of aluminum, copper, and iron, and a lack of association with site activities, it is unlikely that aquatic receptors would be at risk from exposure to aluminum, copper, and iron in Site 15 surface water. It is possible that elevated concentrations of lead in surface water may be associated with past site activities, and that aquatic organisms may be at risk.

6.1.5.7 Sediment at Site 15 A total of 31 analytes was detected in sediment samples collected from Site 15. Of these, 27 were retained as ECPCs including 1 VOC, 14 SVOCs, 1 explosive compound, 4 pesticides, 6 inorganics, and TRPH. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 15 sediment include semiaquatic wildlife and aquatic receptors. Three representative wildlife species were selected to evaluate risks for wildlife from exposure to sediment at Site 15. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0. Risks to aquatic receptors are characterized based on a comparison of exposure concentrations with aquatic toxicity benchmarks.

Risks to Semiaquatic Wildlife. The lethal and sublethal HIs and HQs were calculated based on maximum and average exposure point concentrations using the food-web model for each representative wildlife species. No lethal effects are anticipated for wildlife because HIs are all less than 1. A low probability for sublethal effects (i.e., effects on growth or reproduction) was estimated for small mammals based on a maximum exposures to lead. However, it is unlikely that organisms would be continuously exposed to maximum concentrations; risks based on average concentrations are less than 1. Therefore, population-level effects are unlikely.

Risks to Aquatic Receptors. The maximum and average exposure point concentrations of all PAHs, pesticides, and lead were compared to and exceeded toxicity benchmarks. Based on the slight PAH and pesticide exceedance, it is unlikely that adverse effects to aquatic receptors would occur. Furthermore, PAH benchmarks that do not consider site-specific factors (i.e., adjusting for TOC) likely overestimate risk, and pesticides are not related to the disposal history for Site 15.

6.1.5.8 Groundwater at Site 15 A total of 26 analytes was detected in filtered and unfiltered groundwater samples collected from Site 15. Of these, 9 were

identified as ECPCs including 1 SVOC, 2 explosive compounds, 2 pesticides, and 4 inorganic analytes.

Filtered groundwater samples were also collected and analyzed for inorganics. A total of 14 analytes was detected and 9 were selected as ECPCs. The ECPC selection process is discussed in Chapter 3.0. Receptors that may potentially be exposed to groundwater at Site 15 include aquatic receptors in the ditches and bottomland swamps.

Risks to Aquatic Receptors. A comparison of the average and maximum exposure point concentrations with aquatic toxicity benchmarks was conducted to evaluate potential risks to aquatic receptors. The following analytes were detected at concentrations that exceeded aquatic toxicity benchmarks: bis(2-ethylhexyl)phthalate, 4,4'-DDT, iron, silver (in unfiltered groundwater) and zinc. However, risks to aquatic organisms are expected to be minimal, or unlikely altogether, for the following reason: bis(2-ethylhexyl)phthalate and zinc were not detected in surface water at Site 15; therefore, it is reasonable to assume that these analytes are not discharging to surface water at detectable concentrations. It is more likely that aquatic organisms would be exposed to diluted concentrations, at which toxic effects are less likely. The benchmarks for 4,4'-DDT are overly conservative because they are based on residues in fish for the protection of wildlife. Therefore, adverse effects to aquatic organisms from exposure to 4,4'-DDT in groundwater is unlikely to occur. Silver and iron concentrations exceed conservative benchmarks, which are protective of species of fish that do not inhabit Site 15. A more applicable benchmark for iron, based on duckweed growth, is orders of magnitude above the maximum detected concentration of iron. Therefore, it is unlikely that these analytes would be a risk to aquatic receptors at Site 15. Furthermore, silver was only detected in one filtered sample (it was not detected in unfiltered groundwater at all), which raises uncertainty about its presence in groundwater.

6.1.6 Operable Unit 6 The ERA for OU 6, Site 11, was completed in August 1997 (ABB-ES, 1997c). Results and conclusions of the ERA conducted for surface soil are discussed below.

6.1.6.1 Surface Soil at Site 11 A total of 42 analytes was detected in surface soil collected at Site 11. Of these, 37 were identified as ECPCs, including 3 VOCs, 8 SVOCs, 13 pesticides, and 13 inorganics.

Receptors that may potentially be exposed to Site 11 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Three representative wildlife species were selected to evaluate potential risks to wildlife from exposure to soil at Site 11. A model was used to estimate contaminant exposures and risks for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on a comparison of exposure point concentrations with phytotoxicity benchmarks and invertebrate toxicity benchmarks, respectively.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all less than 1, indicating that no potential adverse effects to wildlife resulting from exposure to ECPCs in surface soil at Site 11 are likely.

Risks to Terrestrial Plants and Soil Invertebrates. The maximum and average concentrations of aluminum, chromium, and vanadium exceeded plant RTVs. However, these analytes are not associated with disposal practices at Site 11; rather, their presence in soil is most likely due to the clayey nature of the soil. Furthermore, the toxicity benchmarks for these analytes are likely overly conservative. The benchmarks were obtained from Will and Suter (1994); however, the confidence level in these benchmarks are "low" because they were derived from limited toxicity data. In addition, the concentration of chromium and vanadium detected in surface soil only slightly exceeded toxicity benchmarks. The maximum and average concentrations of all ECPCs in surface soil were below invertebrate toxicity benchmarks. These results suggest that plants and soil invertebrates would not likely be adversely affected from exposure to surface soil at Site 11.

6.1.7 Operable Unit 7 The ERA for OU 7 was completed in January 1996 (ABB-ES, 1996b). Results and conclusions of the ERA will be discussed for OU 7, Site 16, by medium of concern. Surface soil is not a medium of concern at Site 16 because the area is covered with pavement and mowed grass, and it is unlikely that the site serves as a habitat for terrestrial wildlife.

6.1.7.1 Surface Water at Site 16 Surface water was collected from three locations in the drainage ditches near Site 16, and at one reference location. A total of 15 analytes was detected in surface water samples. Of these, seven were retained as ECPCs for both aquatic receptors and terrestrial wildlife (including two VOCs and five inorganics), and two were retained as ECPCs for terrestrial wildlife only (including one VOC and one inorganic compound). The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to surface water near Site 16 include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in surface water were characterized based on both field measurements of the structure and function of the benthic macroinvertebrate communities and on comparison of exposure concentrations of ECPCs in surface water samples with representative toxicity benchmarks or standards. Results of biological sampling are discussed in detail in Chapter 5.0. For terrestrial wildlife, four representative wildlife species were selected for Site 16. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. There are no apparent trends in the status of the benthic macroinvertebrate community in the Site 16 drainage ditches. Conditions at two sampling stations, STC-Bio-1 and the reference station STC-Bio-R1, were poorer than expected given the habitat quality (see Plate 2 for sampling locations); however, it could not be concluded that contamination in surface water from Site 16 was contributing to this condition.

Maximum concentrations of cadmium, copper, iron, lead, and zinc exceeded aquatic toxicity benchmarks. However, it is believed that the presence of these metals is not site-related because the drainage ditches near Site 16 receive storm water drainage from the runway area and much of the developed area west of the runways.

The risk characterization for aquatic receptors for both surface water and sediment contamination is summarized in Paragraph 6.1.7.2.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all below 1, indicating no potential adverse effects to reproduction, growth, or survival for species exposed to ECPCs in surface water in the drainage ditches at Site 16.

6.1.7.2 Sediment at Site 16 Sediment samples were collected from the same locations as surface water samples. A total of 20 analytes was detected in sediment samples. Of these, 14 were retained as ECPCs for both aquatic receptors and terrestrial wildlife (including 3 VOCs, 1 SVOC, and 10 inorganics), and 3 were retained as ECPCs for terrestrial wildlife only (3 inorganics). The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 16 sediment include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in sediment were characterized based on results of both sediment toxicity tests and quantitative benthic macroinvertebrate sampling. Results of biological sampling are discussed in detail in Section 5.2. For terrestrial wildlife, four representative wildlife species were selected for Site 16. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. There are no apparent trends in the status of the benthic macroinvertebrate community in the Site 16 drainage ditches. Conditions at two sampling stations, including the reference station, were poorer than expected given the habitat quality; however, it could not be concluded that contamination in sediment from Site 16 was contributing to this condition. A review of the habitat quality suggests that conditions at the drainage ditch are poor for many types of aquatic organisms, especially those not adaptable to the variable conditions associated with ephemeral streams, such as this ditch. Factors possibly influencing the benthic community at one location include a petroleum sediment odor and an oily sheen on the surface water noted in the area.

Sediment collected from locations STC-Tox-1 and STC-Tox-3 was toxic to amphipods; sediment collected from location STC-Tox-3 was toxic to water fleas (see Plate 2 for sampling locations). Reproduction in the water flea was also reduced during tests with sediment sample STC-Tox-3. Based on these results, impacts to the survival and reproduction of certain invertebrate receptors may be occurring at these locations in the drainage ditches.

Toxicity may be attributable to elevated concentrations of TRPH in sediment at locations STC-Tox-1 and STC-Tox-3. Elevated concentrations of TRPH are known to adversely affect aquatic organisms (Alexander, 1982; Mahaney, 1994). It is believed, however, that the presence of TRPH in sediment is not site-related because the ditches receive storm water drainage from the runway area and much of the developed area west of the runways.

Overall, risks may be present to certain macroinvertebrate receptors at two of the three drainage ditch sampling stations. For station STC-Tox-1, risks are based on mortality of amphipods in sediment toxicity testing; for station STC-Tox-3, risks are based on the toxicity of sediments to both amphipods and the water flea. These risks may be associated with the presence of TRPH in sediment, which is not believed to be site-related. Finally, analysis of the benthic community metrics

relative to contaminant concentrations in surface water and sediment are inconclusive.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated for each representative species were all below 1, indicating no potential adverse effects to reproduction, growth, or survival for species exposed to ECPCs in sediment in the drainage ditches at Site 16.

6.1.7.3 Groundwater at Site 16 Data from 21 monitoring wells sampled at Site 16 were used to evaluate groundwater conditions potentially contributing to surface water contamination in the Site 16 drainage ditches and the adjacent wetlands.

Detections of analytes in unfiltered groundwater were used to select ECPCs. This is a very conservative approach because unfiltered groundwater data represent concentrations in both the dissolved and the particulate fractions of groundwater. Particulates in the groundwater are not bioavailable to aquatic receptors and are not likely to be discharged to surface water. A total of 33 analytes was detected in unfiltered groundwater samples. Of these, 14 were retained as ECPCs for aquatic receptors, including 5 VOCs, 1 SVOC, and 8 inorganics. The ECPC selection process is discussed in Chapter 3.0.

Risks were evaluated for two potential pathways of future migration of groundwater contamination to surface water. These two paths include discharge of groundwater contaminants to Sal Taylor Creek and to the nearby emergent wetlands. Exposure concentrations of groundwater discharging to Sal Taylor Creek were predicted based on a dilution factor of 900; no dilution was applied to concentrations of groundwater ECPCs discharging to the wetlands. Maximum and average exposure concentrations were compared to aquatic toxicity benchmarks and available surface water quality standards.

Risks to Aquatic Receptors. Risks to aquatic receptors from exposure to groundwater in Sal Taylor Creek surface water are not expected, based on a dilution factor of 900 as groundwater enters the creek. The exposure concentrations of all groundwater ECPCs in Sal Taylor Creek are less than their respective lowest aquatic toxicity benchmarks.

Of the ECPCs in Site 16 groundwater, predicted maximum concentrations in the wetlands of four analytes (bis(2-ethylhexyl)phthalate, aluminum, iron, and zinc) exceed surface water toxicity benchmarks. It is possible, but unlikely, that aquatic receptors would encounter this worst-case condition in the wetlands. Concentrations of bis(2-ethylhexyl)phthalate, iron, and zinc appear to originate in the intermediate aquifer at Site 16 (which was found to be free of site-related contaminants) and flow upward to the surficial aquifer; therefore, it is believed that these detections are not associated with contamination from Site 16. In addition, the toxicity of aluminum is pH-dependent; the pH of surface water is typically higher than that of groundwater. When aluminum in groundwater is discharged to surface water, the higher pH causes aluminum to move from the dissolved phase to the particulate phase, which decreases its bioavailability to aquatic receptors. Measured concentrations of aluminum encompass both the dissolved and particulate phases, which overestimate the concentrations to which receptors would be exposed.

6.1.8 Operable Unit 8 The final ERA for OU 8 was completed in September 1997 (ABB-ES, 1997d). Results and conclusions of the ERA will be discussed for OU 8, Site 3, by medium of concern.

6.1.8.1 Surface Soil at Site 3 ECPCs were selected separately for two areas at Site 3: the grassy area near the disposal pit and the forested area near the helicopter crash site. The ECPC selection process is discussed in Chapter 3.0.

A total of 47 analytes was detected in surface soil near the disposal pit area at Site 3. Of these, 32 were retained as ECPCs, including 4 VOCs, 13 SVOCs, 5 pesticides, 1 PCB congener, and 9 inorganics. TRPH was detected in four soil samples in this area. A total of 20 analytes was detected in surface soil near the helicopter crash site at Site 3. Of these, 9 were retained as ECPCs, including 3 VOCs, 5 pesticides, and 1 inorganic. TRPH was detected in three soil samples in this area.

Receptors that may potentially be exposed to Site 3 surface soil include terrestrial wildlife, terrestrial plants, and soil invertebrates. Five representative wildlife species were selected for the disposal area at Site 3, and six representative wildlife species were selected for the helicopter crash site at Site 3. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Risks to terrestrial plants and soil invertebrates were assessed based on surface soil toxicity testing completed for OU 8. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0; results of toxicity testing are discussed in detail in Section 5.1.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated using the food-web model for each representative species at both the disposal area and the helicopter crash site were all less than 1, indicating no potential adverse effects to wildlife resulting from exposure to ECPCs in surface soil at Site 3.

Risks to Terrestrial Plants and Invertebrates. Soil samples collected for toxicity tests at Site 3 were not toxic to earthworms. Based on the results of this test, which measure growth, reproduction, and survival of test organisms, it is assumed that the contamination present in surface soil at Site 3 does not present an unacceptable risk to soil invertebrates.

Statistically significant differences in lettuce seed germination rates were observed between surface soil samples CEF3SS17 and CEF3SS20 and the control sample (see Plate 4 for sampling locations). The reliability of these results, however, is suspect because duplicate samples did not show the same germination rates as their respective original samples, and because low germination was observed in the control sample. Linear regression analysis showed little correlation between seed germination rates and concentrations of analytes in soil. Overall, it is believed that terrestrial plants are probably not at risk from exposure to surface soil at Site 3.

6.1.8.2 Surface Water at Site 3 ECPCs were selected separately for two surface water samples collected in Rowell Creek adjacent to Site 3. One sample, CF3-SW-2, was collected to represent upgradient conditions not impacted by the groundwater plume at Site 3, and the second sample, CF3-SW-1, was collected to represent conditions within and downgradient of plume discharge (see Plate 2 for sampling

locations). Both samples were collected downgradient of an outfall from NAS Cecil Field's WWTP and are likely impacted by this treated effluent.

A total of 10 analytes was detected in the upgradient surface water sample CF3-SW-2. Of these, three were retained as ECPCs for both aquatic receptors and terrestrial wildlife (including one VOC and two inorganics) and one VOC was retained as an ECPC for terrestrial wildlife only. A total of 16 analytes was detected in the downgradient surface water sample CF3-SW-1. Of these, three were retained as ECPCs for both aquatic receptors and terrestrial wildlife (including two VOCs and one inorganic) and five were retained as ECPCs for terrestrial wildlife only (including two VOCs and three inorganics). The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 3 surface water include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in surface water were characterized based on both field measurements of the structure and function of the benthic macroinvertebrate communities and on comparison of exposure concentrations of ECPCs in surface water samples with representative toxicity benchmarks or standards. Results of biological sampling are discussed in detail in Section 5.2. For terrestrial wildlife, five representative wildlife species were selected for Site 3. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. A review of the habitat quality parameter data collected during testing suggests that habitat conditions at Rowell Creek near Site 3 represent a poor environment for many types of aquatic organisms. Differences in habitat structure between the Rowell Creek area and the reference station may explain the decreased biological condition observed in samples collected adjacent to Site 3. The NAS Cecil Field WWTP may also contribute to differences in the community structure in this area.

Surface water concentrations of two analytes, aluminum and silver, exceed aquatic benchmark values. However, the cold-water species that is the most sensitive to exposure to these two chemicals does not occur in Rowell Creek, a warm-water system. Furthermore, the evaluation of unfiltered surface water may overestimate the risk associated with exposure to inorganics, which may be sorbed to particulates and would therefore be less bioavailable than the dissolved fraction. It is unlikely that the levels of aluminum or silver in surface water pose a risk to aquatic receptors at Site 3.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated using the food-web model for each representative species at both sampling locations at Rowell Creek were all less than 1, indicating no potential adverse effects to wildlife resulting from exposure to ECPCs in surface water at Site 3.

6.1.8.3 Sediment at Site 3 Sediment samples were collected from the same locations as surface water samples at Site 3. Similar to surface water, ECPCs were selected separately for the two sediment samples collected in Rowell Creek.

A total of 15 analytes was detected in the upgradient sediment sample CF3-SD-2. Of these, five were retained as ECPCs for both aquatic and terrestrial receptors (including one VOC, two SVOCs, and one PCB congener) and four were retained as

ECPCs for terrestrial wildlife only (including one pesticide and three inorganic). A total of 10 analytes was detected in the downgradient sediment sample CF3-SD-1. Of these, two were retained as ECPCs for both aquatic and terrestrial receptors (including one VOC and one pesticide), and one pesticide was retained as an ECPC for terrestrial wildlife only. The ECPC selection process is discussed in Chapter 3.0.

Receptors that may potentially be exposed to Site 3 sediment include aquatic receptors and terrestrial wildlife. Risks for aquatic receptors resulting from exposure to ECPCs in sediment were characterized based on results of quantitative benthic macroinvertebrate sampling. Results of biological sampling are discussed in detail in Chapter 5.0. For terrestrial wildlife, four representative wildlife species were selected for Site 3. A model was used to predict contaminant exposures for each representative species selected, based on its position in the food chain. Species selection and models used to predict exposure are discussed in detail in Chapter 3.0.

Risks to Aquatic Receptors. Sediment concentrations of two analytes, Aroclor-1254 and 4,4'-DDT, exceeded sediment RTVs. Neither of these compounds were detected in groundwater at Site 3, indicating that their presence does not appear to be site-related. Both analytes were detected at low levels, and both are less than their respective draft USEPA SQGs. It is unlikely that aquatic receptors are currently at risk from exposure to the low levels of these two analytes in sediment in the Site 3 area.

Risks to Terrestrial Wildlife. The lethal and sublethal HIs and HQs calculated using the food-web model for each representative species at both sampling locations at Rowell Creek were all less than 1, indicating no potential adverse effects to wildlife resulting from exposure to ECPCs in sediment at Site 3.

6.1.8.4 Groundwater at Site 3 Surficial groundwater from Site 3 flows toward and discharges to Rowell Creek. Therefore, aquatic receptors may be exposed to contaminated groundwater. Data from 14 monitoring wells sampled at Site 3 were used to evaluate groundwater conditions potentially contributing to surface water contamination in Rowell Creek adjacent to the site.

Results of groundwater modelling at Site 3 indicated that contaminants would be diluted by a factor of 133 when entering Rowell Creek. However, detections of analytes in unfiltered, filtered, and diluted unfiltered groundwater were used to select ECPCs. Using unfiltered concentrations to determine ECPCs is a very conservative approach because the data represent concentrations in both the dissolved and the particulate fractions of groundwater. Particulates in the groundwater are not bioavailable to aquatic receptors and are not likely to be discharged to Rowell Creek. The ECPC selection process is discussed in Chapter 3.0.

A total of 40 analytes was detected in undiluted, unfiltered groundwater samples. Of these, 25 were retained as ECPCs for aquatic receptors, including 7 VOCs, 9 SVOCs, 1 PCB congener, and 8 inorganics. Selection of ECPCs for undiluted, filtered groundwater was performed for inorganics only. Of the 12 inorganics detected in filtered groundwater, six were retained as ECPCs.

Assuming that groundwater is diluted 133-fold when entering Rowell Creek, 14 of the 25 ECPCs selected for undiluted groundwater are eliminated. The 11 remaining ECPCs for diluted groundwater are composed of 4 VOCs, 5 SVOCs, and 2 inorganics.

Concentrations of ECPCs in groundwater were compared to toxicity benchmarks and promulgated State and Federal standards. Additionally, the toxicity of groundwater at Site 3 was evaluated through dilution-series chronic toxicity testing with the water flea and the fathead minnow using two groundwater samples collected from monitoring wells CF3-MW-13S and CF3-MW-28S (see Plate 3 for sample locations).

Risks to Aquatic Receptors. Concentrations of nine analytes in undiluted, unfiltered groundwater samples exceeded aquatic RTVs. However, these data likely overestimate adverse effects to receptors. Comparison of diluted groundwater with RTVs provides a more realistic estimate of the potential for adverse effects to receptors. Only two analytes, 1,2-DCB and aluminum, exceed RTVs if groundwater is assumed to be diluted.

Filtration of groundwater significantly reduced the concentration of aluminum in groundwater samples. Therefore, it is unlikely that future discharges of aluminum will pose a risk to aquatic receptors in Rowell Creek.

Exposure to both undiluted groundwater samples from Site 3 resulted in reduced growth and mortality in the fathead minnow, and reduced survival and reproduction in the water flea. In general, the water flea was more sensitive to Site 3 groundwater than the fathead minnow. Up to a 20-fold dilution was required to reduce the toxicity of groundwater to the test species.

Although several groundwater risk contributors were identified, three DCB isomers appear to be the primary risk contributors for Site 3. When groundwater was diluted approximately 20-fold, little toxicity was observed. This dilution is an order of magnitude less than the 133-fold dilution expected when groundwater discharges to Rowell Creek. Analyses of the toxicity testing data, then, support the contention that diluted groundwater discharging to Rowell Creek poses little risk to aquatic receptors in the vicinity of Site 3.

6.2 OTHER SITES AND PSCs

Sampling of potentially contaminated media was conducted to confirm and characterize other PSCs where disposal has occurred at NAS Cecil Field. The results of these sampling efforts are discussed in the following sections.

6.2.1 PSC 4, Grease Pits and PSC 9, Recent Grease Pit

In order to characterize contamination and to evaluate potential ecological risks at PSC 4 and PSC 9, surface soil, subsurface soil, and groundwater were sampled in February 1997 and May 1997, respectively. All of the samples collected were analyzed for VOCs, SVOCs, pesticides and PCBs, inorganics, and TRPH. The results of the chemical analyses are presented in Chapter 4.0. The chemical concentrations detected in these media were screened against the USEPA Region III BTAG screening levels (USEPA, 1995b), and the Dutch Soil Cleanup Criteria (Beyer, 1990), to determine the need for an ecological PRE. Based on the results of the comparison it was determined that these sites required no further action (NFA).

6.2.2 PSC 6, Lake Fretwell Rubble Disposal Pile Surface soil, subsurface soil, surface water, sediment, and groundwater samples were collected in order to characterize the contamination and to evaluate potential ecological risks at PSC 6. Samples were collected in two sampling events February 1997 and July 1997. The samples were analyzed for VOCs , SVOCs, pesticides and PCBs, and inorganics. The results of the chemical analyses are presented in Chapter 4.0. The chemical concentrations detected in these media were screened against the BTAG screening levels (USEPA, 1995b),and the Dutch Soil Cleanup Criteria (Beyer, 1990), to determine the need for an ecological PRE. Based on the results of the comparison, it was determined that a PRE would be conducted for the PSC. It was also recommended that additional sediment samples be collected in order to thoroughly characterize this medium. The PRE concluded that there was no risk associated with exposure to surface soil, surface water, sediment, or groundwater.

6.2.3 PSC 12, Public Works Disposal Area Surface soil, subsurface soil, and groundwater samples were collected in order to characterize the contamination and to evaluate potential ecological risks at PSC 12. Samples were collected in February 1997. The samples were analyzed for VOCs , SVOCs, pesticides and PCBs, and inorganics. The results of the chemical analyses are presented in Chapter 4.0. The chemical concentrations detected in these media were screened against BTAG screening levels (USEPA, 1995b), and the Dutch Soil Cleanup Criteria (Beyer, 1990) to determine the need for an ecological PRE. Based on the results of the comparison, it was determined that a PRE would not be conducted for the PSC. No risks were identified for exposure to surface soil and surface water. Sediment and groundwater were not media of concern.

6.2.4 PSC 18, Ammunition Disposal Area Surface soil, subsurface soil, surface water, sediment, and groundwater samples were collected in order to characterize the contamination and to evaluate potential ecological risks at PSC 18. Samples were collected in two sampling events February 1997 and December 1997. The samples were analyzed for VOCs , SVOCs, explosives, pesticides and PCBs, and inorganics. The results of the chemical analyses are presented in Chapter 4.0. The chemical concentrations detected in these media were screened against the BTAG Screening Levels (USEPA, 1995b), and the Dutch Soil Cleanup Criteria (Beyer, 1990) to determine the need for an ecological PRE. Based on the results of the comparison, a PRE was conducted for the PSC. The PRE concluded there was no risk associated with surface soil, surface water, sediment, or groundwater exposures.

6.2.5 PSC 19, Rowell Creek Rubble Disposal Area Surface soil, subsurface soil, surface water, sediment, and groundwater samples were collected in order to characterize the contamination and to evaluate potential ecological risks at PSC 19. Samples were collected in February 1997. The samples were analyzed for VOCs , SVOCs, pesticides and PCBs, and inorganics. The results of the chemical analyses are presented in Chapter 4.0. The chemical concentrations detected in these media were screened against the BTAG screening levels (USEPA, 1995b),and the Dutch Soil Cleanup Criteria (Beyer, 1990) to determine the need for an ecological PRE. Based on the results of the comparison a PRE was conducted for the PSC. No risks were found in the ERA to be associated with exposure to surface soil, surface water, sediment, or groundwater.

CHAPTER 7.0

7.0 ECOLOGICAL RISK ASSESSMENT FOR LAKE FRETWELL

The information below describes the results of the ERA for Lake Fretwell and Rowell Creek upstream of Lake Fretwell. The ERA was completed according to the methodology described in Chapter 3.0. The ERA includes problem formulation (Section 7.1), selection of ECPCs (Section 7.2), exposure assessment (Section 7.3), ecological effects assessment (Section 7.4), risk characterization (Section 7.5), and uncertainty analyses (Section 7.6).

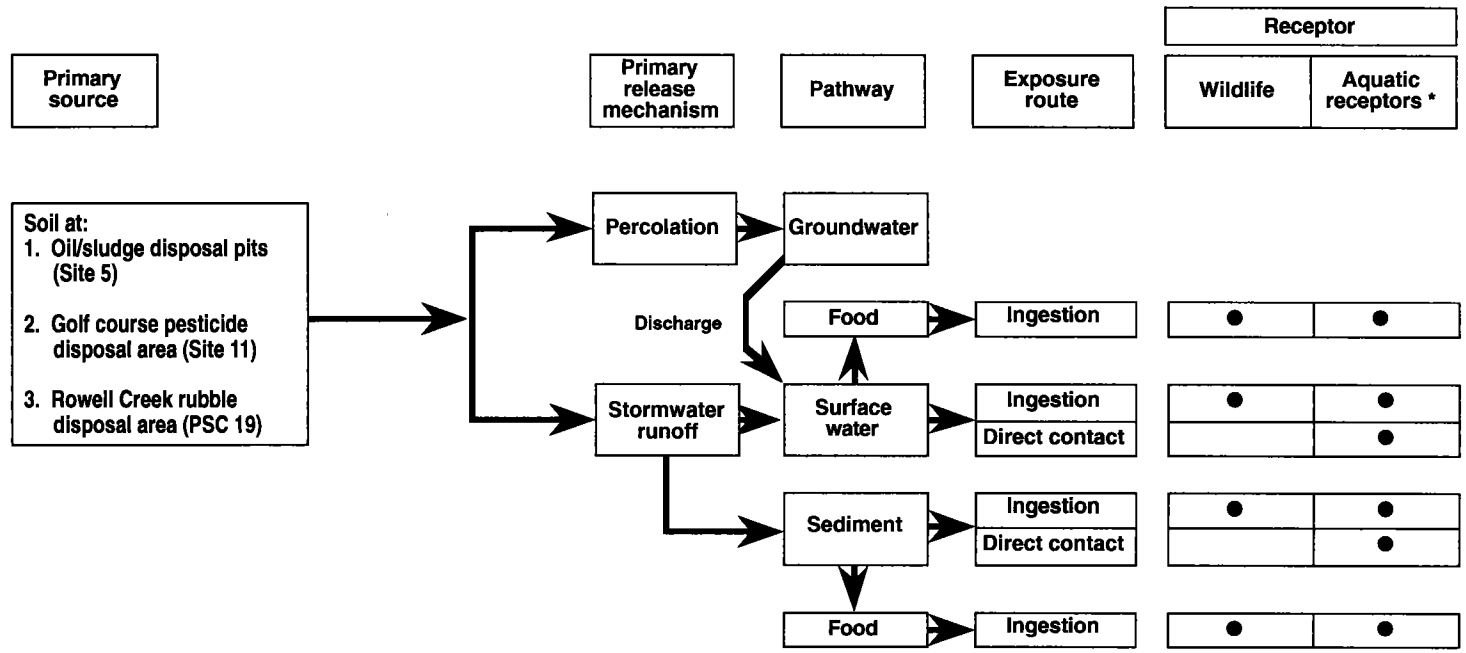
7.1 PROBLEM FORMULATION. Problem formulation is the initial step of the ERA process. In this section, the ecological receptors and exposure pathways are identified. In addition, the assessment and measurement endpoints used to evaluate and measure risks to ecological receptors are also selected.

7.1.1 Identification of Receptors Terrestrial and aquatic flora and fauna potentially occurring at NAS Cecil Field are presented in Appendix A. Terrestrial wildlife and aquatic receptors are expected to be found in the aquatic and riparian (stream bank) habitats associated with Lake Fretwell and Rowell Creek. Wildlife receptors, including omnivorous small mammals, opportunistic mammals, and piscivorous avian species, would likely use the wetland and aquatic habitats present at the site for forage and shelter. Aquatic receptors present at the site and adjacent shallow wetlands would include invertebrates, fish, mollusks, amphibians, algae, and aquatic plants.

7.1.2 Exposure Pathways Exposure pathways for ecological receptors evaluated in the assessment are summarized in the Site Conceptual Model (Figure 7-1). Although Lake Fretwell is not designated as an OU at NAS Cecil Field, the lake is surrounded by several OUs and sources of potential contamination. Site 11, the Golf Course Pesticide Area, is located to the north of Lake Fretwell; contaminants from Site 11 and the golf course may be transported to Lake Fretwell via Rowell Creek. PSC 19, the Rowell Creek Rubble Disposal Area, is also located to the west of Rowell Creek, just north of Lake Fretwell. An extensive palustrine freshwater wetland system associated with Lake Fretwell is located immediately to the east of Site 5, the Oil/Sludge Disposal Pits. A drainage ditch south of Site 5 carries surface water in an easterly direction, through the freshwater wetland, towards Lake Fretwell. Other sites that may contribute to contamination in Lake Fretwell via surficial run off, drainage ditch discharge, or groundwater discharge include the unnamed wash rack west of Building 860, PSC 6 (along the southeastern Shore of Lake Fretwell), the Yellow Water Weapons Area, the fight line apron, and area of interest (AOI) 33. An ERA for Lake Fretwell is being completed as part of the BEAR to evaluate potential risks for Lake Fretwell ecological receptors exposed to contaminants from these various sources.

The pathways include exposures to contamination in surface water and sediment. The identified pathways are associated with two areas: Lake Fretwell and Rowell Creek upstream of Lake Fretwell. The surface water and sediment data from both Rowell Creek and Lake Fretwell represent contamination potentially received from both the discharge of groundwater, overland transport from the sites, and drainage ditch discharge.

Potential exposures to groundwater contamination are not evaluated as part of the ERA for Lake Fretwell and Rowell Creek upstream of Lake Fretwell. It is believed



NOTES:
PSC = Potential source of contamination
* Aquatic receptors = Invertebrates, plants, amphibians, and fish

FIGURE 7-1
CONTAMINANT PATHWAY MODEL FOR ECOLOGICAL RECEPTORS, LAKE FRETWELL AND ROWELL CREEK UPSTREAM OF LAKE FRETWELL

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that the surface water samples from Lake Fretwell provide an accurate representation of the contribution of groundwater contamination from the surrounding upgradient sites. In addition, exposure from groundwater at Site 5 to aquatic and wetland receptors was evaluated as part of the BRA for OU 2 (ABB-ES, 1995a).

7.1.3 Evaluation of Potential Ecological Effects A preliminary review of the analytes detected in surface water and sediment was conducted to focus the ERA for Lake Fretwell. The following sections identify the types of contaminants that are most likely to pose risks to ecological receptors at the site.

All of the analytes detected in surface water and sediment media were reviewed and screened for toxicological benchmarks, known toxicological properties, background concentrations, and bioaccumulation potential. The frequency of detection and types of media in which an analyte was detected were also considered. This review identified a subset of probable risk drivers, which are presented in the following subsections.

Surface Water. Several VOCs that are often associated with laboratory contamination were detected in surface water from Rowell Creek and Lake Fretwell. These VOCs were detected at a low frequency and concentration; therefore, they are not anticipated to present a risk for aquatic receptors or semiaquatic wildlife.

Many inorganic analytes were also detected in surface water from Rowell Creek and Lake Fretwell. In general, the essential nutrients (calcium, magnesium, sodium, and potassium) and aluminum, barium, and iron were detected at a high frequency (i.e., in most or all of the samples). Of these, aluminum was detected at concentrations that are often associated with mortality in salmonid fish. However, these fish are coldwater species that do not inhabit the water bodies at NAS Cecil Field. Other metals (including beryllium, cadmium, copper, lead, manganese, mercury, nickel, vanadium, and zinc) were detected in some of the surface water samples. Most of these metals were detected at fairly low concentrations that are generally not associated with toxic effects for either aquatic receptors or semiaquatic wildlife. Mercury, however, may cause adverse reproductive effects in piscivorous mammals or birds that ingest fish that have bioaccumulated mercury in their tissue.

Sediment. Sediment samples from Rowell Creek and Lake Fretwell were analyzed for SVOCs, pesticides, PCBs, and metals. Di-*n*-butylphthalate was detection at relatively high concentrations and at a high frequency of detection in sediment; however, toxic effects to aquatic receptors from exposure to di-*n*-butylphthalate are unknown because sediment toxicity data are not readily available for this compound.

Several pesticides and the PCB, Aroclor-1260 were detected at low to moderate frequencies in sediment (i.e., in up to one-half the samples). Pesticides, which can bioaccumulate via the food chain and cause eggshell thinning for birds, were generally detected at low concentrations (i.e., less than 3 µg/kg). Aroclor-1260 was detected in nearly half the sediment samples at a maximum concentration of 14 µg/kg; this analyte also has potential for bioaccumulating via the food chain and is most often associated with adverse reproductive effects in minks (and possibly other mammals).

Many inorganic analytes were also detected in Rowell Creek and Lake Fretwell sediment, including the essential nutrients and several heavy metals. Arsenic,

cadmium, cobalt, and zinc were detected in only a few samples and at low concentrations. Other metals (including aluminum, barium, chromium, copper, lead, manganese, nickel, and vanadium) were detected in most or all of the sediment samples at fairly low concentrations. The exceptions may be copper (32.7 mg/kg) and lead (75.8 mg/kg), which may be associated with lethal effects for aquatic life, or lethal and adverse reproductive effects for semiaquatic wildlife receptors.

7.1.4 Identification of Endpoints The assessment and measurement endpoints and ECPCs selected for the Lake Fretwell ERA are listed in Table 7-1. Assessment endpoints represent the ecological component to be protected, whereas the measurement endpoints approximate or provide a measure of the achievement of the assessment endpoint. The specific assessment endpoints for the receptor groups most likely to be at risk at Lake Fretwell are discussed below.

Wildlife Receptors. Wildlife receptors could be exposed to contamination in surface water and sediment via direct (e.g., direct contact and incidental ingestion) and indirect (e.g. ingestion of contaminated prey items) exposure pathways. As discussed in Subsection 7.1.3, the contaminates of greatest concern in these media for wildlife include PCBs, mercury, and possibly pesticides, lead, and copper. Reproductive effects are the primary adverse effects associated with wildlife exposure to PCBs, copper, and mercury. Therefore, the assessment endpoints selected for wildlife receptors at Lake Fretwell are the survival and maintenance of mammal and bird subpopulations. The measurement endpoints selected for this assessment endpoint are based on oral contaminant doses measuring adverse effects on the survival and reproduction of mammalian or avian laboratory test organisms.

Aquatic Receptors. Aquatic organisms could be exposed to contamination in surface water and sediment via direct contact. As discussed in Subsection 7.1.3, the contaminants of greatest concern in surface water are aluminum and mercury. The contaminants of greatest concern in sediment are PCBs, pesticides, and metals. The assessment endpoint selected for surface water and sediment is survival and maintenance of fish, invertebrates, and amphibian subpopulations. The measurement endpoints selected to evaluate the assessment endpoint are effects concentrations in surface water and sediment associated with adverse effects to growth, reproduction, and survival of aquatic organisms. Other measurement endpoints used to gauge the assessment endpoints are measures of macroinvertebrate community structure and function as compared to a reference location.

7.1.5 Fate and Transport This subsection discusses the possible pathways for contaminants at Cecil Field to migrate to Lake Fretwell. The primary mechanisms for contaminant transport are surface water runoff, drainage ditch conveyance, and groundwater migration following precipitation infiltration.

Overland transport of contaminants at Cecil Field is less likely due to the relatively flat and vegetated topography; however, the extensive drainage ditch system could be a major mechanism for contaminant migration into Lake Fretwell. Storm water and surface water runoff ultimately end up in Lake Fretwell because many drainage ditches flow to either Rowell Creek (which discharges to Lake Fretwell) or Lake Fretwell itself. Surface water runoff can result in contaminant migration via physical transport of contaminated soils (i.e., soil erosion). During the period of active disposal at Site 5 in the early 1970s, heavy precipitation could have carried contaminants (e.g., PCBs) in the soil from Site 5

Table 7-1
Endpoints for Ecological Assessment

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Medium	Possible ECPCs	Receptor	Assessment Endpoint	Measurement Endpoint
Sediment and Surface Water	PCBs, copper, and mercury	Wildlife	Survival and maintenance of wildlife receptor subpopulations from exposure to PCBs and metals.	Oral contaminant doses (mg/kg BW-day) based on measured adverse effects on survival (e.g., LD_{50} studies, LOAELS, and NOAELs) of mammalian or avian laboratory test populations.
			Survival and maintenance of wildlife receptor populations from exposure to aluminum, lead, and mercury.	Oral contaminant doses (mg/kg BW-day) based on measured adverse effects on reproduction (e.g., LD_{50} studies, LOAELS, and NOAELs) of mammalian or avian laboratory test populations.
Surface Water	Aluminum, lead, and mercury	Aquatic organisms	Survival and maintenance of aquatic receptor populations from exposure to aluminum, lead, and mercury.	Contaminant concentrations in surface water ($\mu g/\ell$) associated with adverse effects to growth, reproduction, and survival of aquatic organisms.
Sediment	PCBs, pesticides, and metals	Aquatic organisms	Macroinvertebrate community structure and function.	Measurement of the macroinvertebrate community structure and function at the site and comparison it to a reference location.
		Aquatic organisms	Survival and maintenance of aquatic receptor populations from exposure to PCBs, pesticides, and metals.	Contaminant concentrations in sediment (μg/kg and mg/kg) associated with adverse effects to growth, reproduction, and survival of aquatic organisms.
		Aquatic organisms	Survival and maintenance of invertebrate populations from exposure to PCBs, pesticides, and metals.	Direct measurement of survival and growth of the midge (*Chironomus tentans*) and amphipod (*Hyalella azteca*) in laboratory toxicity tests.

Notes: ECPC = ecological chemical of potential concern.
PCB = polychlorinated biphenyl.
mg/kg/BW/day = milligram per kilogram of body weight per day.
LD_{50} = lethal dose to 50 percent of a test population.
LOAEL = lowest observed adverse effect concentration.
NOAEL = no observed adverse effect concentration.
$\mu g/\ell$ = micrograms per liter.
μg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.

to the Site 5 drainage ditch via surface water runoff. In addition, it is possible that the Site 5 disposal pits could have overflowed into the drainage ditch during major storm events.

Rainwater from UNF 6, the unnamed wash rack west of Building 860, has been diverted into the storm water drainage system in the past rather than to the oil/water separator associated with the 864 Lift Station. It is likely that contaminants (e.g., solvents and jet fuels) associated with washing aircraft were discharged into the drainage system that ultimately leads to Lake Fretwell during these times of diversion. It is also possible that contaminants from PSC 6, PSC 19, the Yellow Water Weapons Area, the flight line apron, AOI 33, and the golf course (e.g., pesticides from AOI 21, 22, and general application) may have reached Lake Fretwell via drainage ditches.

Contaminants may also have reached Lake Fretwell via precipitation infiltration and groundwater migration. Groundwater flow direction at Site 5 is primarily to the southeast. The Site 5 drainage ditch acts as the primary point of groundwater discharge. Groundwater transport is also the likeliest route of contaminant transport from Site 11, the pesticide disposal area. The groundwater flow direction at Site 11 is towards Rowell Creek. Historic pesticide use on the golf course may also be a contributing factor to surficial aquifer contamination, which ultimately discharges into Rowell Creek. Other possible sources of contaminant migration through precipitation infiltration and groundwater migration include metals from the sludge drying beds at the WWTP, and contaminants at PSC 6, PSC 19, and AOI 22.

7.1.6 Contaminant Modes of Toxicities This section discusses the specific toxicological effects and modes of toxicity of the contaminants most likely to be of concern in Lake Fretwell. These contaminants of concern include PCBs, mercury, lead, and copper.

PCBs are acutely toxic to newly hatched fish, and are readily bioaccumulated by aquatic organisms (USEPA, 1980). PCBs also bind to sediment particles and are highly lipophilic. Acute exposures to small mammals produced mild liver damage and some mortality. Chronic exposures typically generate serious health effects, including liver, stomach, and thyroid gland injuries, anemia, skin irritation, and reproductive effects. These effects have also been noted in offspring of adults exposed to PCBs.

Mercury is typically found in three states in the natural environment elemental (Hg^0), inorganic (Hg^{-2}), and methylated (CH_3Hg^+). In an aquatic environment elemental and inorganic mercury are typically converted to methylmercury by aerobic and anaerobic bacteria. Methylmercury, which is a neurotoxin, is readily accumulated by aquatic organisms from water and food items. The highest concentrations are typically measured in predatory fish. Omnivorous fish typically have intermediate detected tissue concentrations and planktivorous fish typically have the lowest detected concentrations. Methylmercury is also known to adversely affect developing neural tissue in mammals and birds (Watras, C.J., and H.W. Huckabee, 1994).

Lead is a ubiquitous environmental metal. Like mercury, lead is found in the environment most often in its inorganic state; however, it is known to form organic complexes. Chronic exposure to lead is likely to cause reproductive and developmental effects in small mammals. Avian species exposed to lead are likely

to have hematological effects such as anemia, blood changes, and kidney pathology. Acute exposures to lead result in mortality to both avian and mammalian species. Lead toxicity in the aquatic environment is highly dependent on water hardness. The toxicity of lead increases as water hardness decreases.

Chronic exposure to copper is likely to produce toxicological effects to the liver and kidney of mammals. Other toxicological effects noted in mammals include reproductive effects, such as reduced litter size. In the aquatic environment, copper ions form complexes with inorganic and organic constituents, which are typically less toxic than free cupric ions (USEPA, 1984). The alkalinity and pH of water greatly influences the state of copper in water; therefore, its toxicity. Toxicological effects to aquatic receptors include adverse reproductive effects and mortality for both chronic and acute exposures.

7.2 SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN. Analytes were determined to be ECPCs according to the process described in Subsection 3.3.1 and illustrated on Figure 3-1. The results of the selection of ECPCs in surface water and sediment are described in the following sections. ECPCs for aquatic life and terrestrial wildlife were selected separately for both surface water and sediment.

In July of 1993, eight surface water and sediment samples were collected in Lake Fretwell (LF-SW/SD-1 through LF-SW/SD-8; Plate 2) and three surface water and sediment samples were collected in Rowell Creek upstream of Lake Fretwell (RC-SW/SD-1, RC-SW/SD-2, and GC-SW/SD-2). The eight surface water samples from Lake Fretwell and the three samples from Rowell Creek were included in the surface water summaries. Based on detection of PCBs in the 1993 Lake Fretwell sediment data (Appendix B), sediment was resampled for chemical analyses and toxicity testing and fish tissue was collected in April of 1995. As shown on Figure 7-2, eight sediment samples were collected in Lake Fretwell (LF-SD-9 through LF-SD-16 with a duplicate at LF-SD-9), and three sediment samples were collected in Rowell Creek upstream of Lake Fretwell (LF-SD-17, RC-SD-18, and GC-SD-19) during the April 1995 sampling effort. The 1995 sediment data were summarized to represent the most current exposure conditions in Lake Fretwell and Rowell Creek upstream of Lake Fretwell. The 1993 sediment data are presented in Appendix B. The historical sediment data were qualitatively compared to the 1995 sediment data set. Based on this comparison, detected concentrations of pesticides, PCBs, and inorganics are considerably lower in the 1995 sediment data set. In addition, a number of analytes detected in the 1993 data set (benzo(b)fluoranthene, chrysene, pyrene, 4,4'-DDD, 4,4'-DDT, Aroclor-1254, and mercury) were not detected in sediment collected in 1995. Analytes detected in the 1995 sediment samples that were not detected in 1993 include endosulfan II, endrin aldehyde, gamma-chlordane, and arsenic.

7.2.1 Surface Water In 1993, surface water was sampled from Lake Fretwell and Rowell Creek upstream of Lake Fretwell. Tables 7-2 and 7-3 provide a summary of the analytical results, screening values, and exposure point concentrations for Lake Fretwell and Rowell Creek upstream of Lake Fretwell, respectively. The summary tables include the USEPA Region IV Freshwater Quality Chronic Screening Values (USEPA, 1995a), which were used to screen ECPCs for aquatic receptors. For the analytes selected as ECPCs, maximum and average exposure point concentrations are provided. Calcium, iron, magnesium, potassium, and sodium are excluded from the screening process because they are naturally occurring elements.

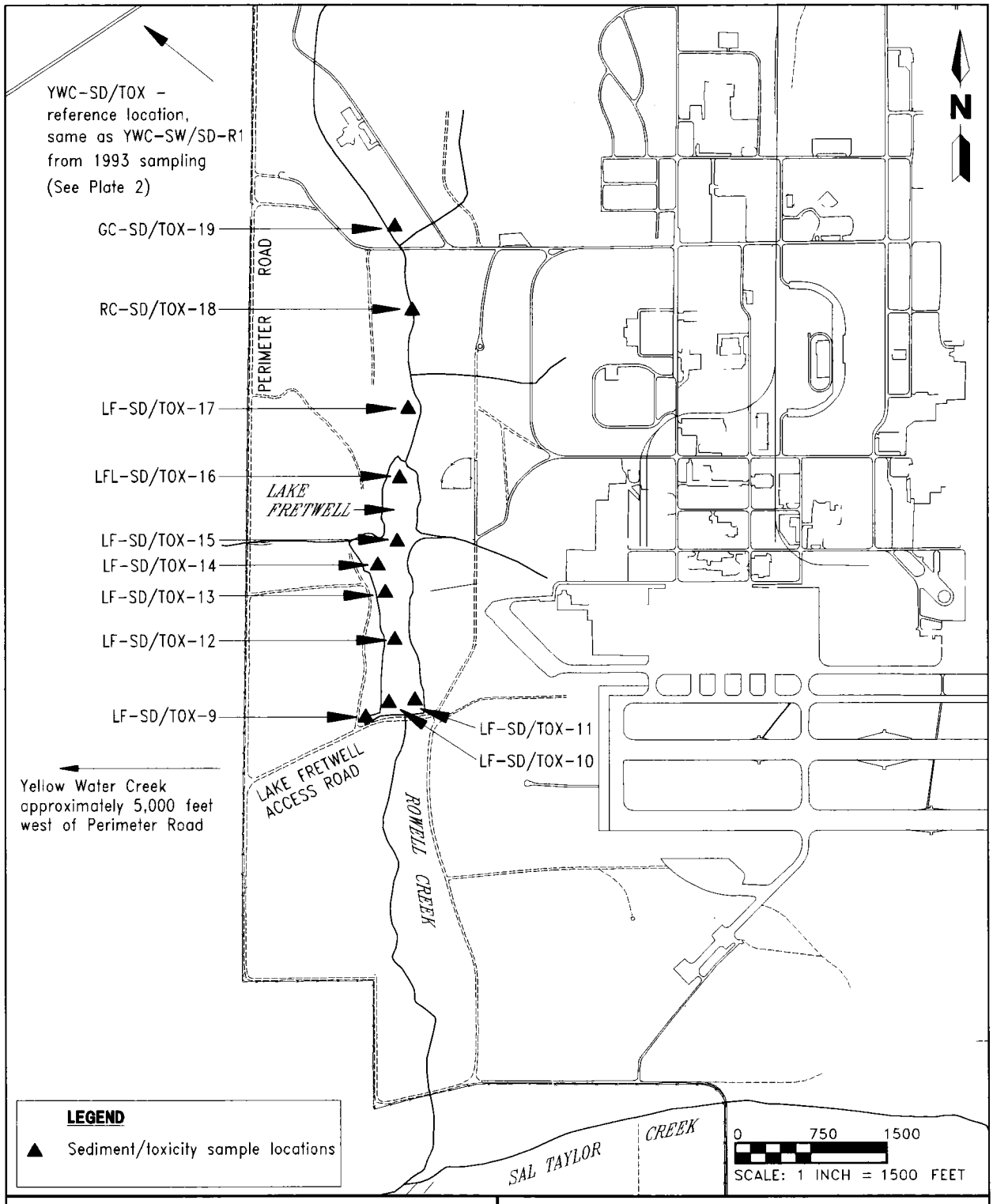

FIGURE 7-2
LOCATIONS OF SEDIMENT AND TOXICOLOGICAL SAMPLING STATIONS AT LAKE FRETWELL AND ROWELL CREEK UPSTREAM OF LAKE FRETWELL

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Table 7-2
Selection of Ecological Chemicals of Potential Concern, Surface Water Associated with Lake Fretwell

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Analyte	Frequency of Detection[1]	Range of Detected Concentrations[2]	Mean of Detected Concentrations[3]	Screening Reference Concentration[4]	Region IV Water Quality Screening Values[5]	Analyte ECPC? (Yes/No)[6]	Wildlife Exposure Concentrations[14]			
							95% UCL[7]	Arithmetic Mean[8]	Exposure Point Concentrations	
									Maximum[9]	Average[10]
Volatile Organic Compounds (µg/ℓ)										
Acetone	1/8	7	7	NA	NA	A/W	6	5	7	7
Chloroform	1/8	[2]3.5	3.5	NA	289	W[12]	5.2	4.8	3.5	3.5
Inorganic Analytes (µg/ℓ)										
Aluminum	8/8	84.4 to 751	181	619	87	A/W	369	181	751	181
Barium	8/8	[2]19.8 to 29.6	23.6	59.9	NA	No[11]				
Beryllium	3/8	0.23 to 0.29	0.26	ND	0.53	W[12]	11.8	1.7	0.29	0.26
Calcium	8/8	[2]12,400 to 14,200	13,700	16,980	NA	No[11]				
Copper	6/8	1.7 to [2]7.1	3.5	7.0	6.05	A/W	13.5	5.8	7.1	3.5
Iron	8/8	790 to 1,270	950	4,940	1,000	No[11]				
Lead	2/8	7.7 to 7.8	7.8	6.2	1.17	A/W	18.7	6.8	7.8	7.8
Magnesium	8/8	[2]2,610 to 2,920	2,810	4,127	NA	No[11,13]				
Manganese	4/8	7.6 to 19.1	14.5	24.8	NA	No[11]				
Mercury	5/8	0.08 to 0.5	0.3	ND	0.012	A/W	0.5	0.21	0.5	0.3
Nickel	1/8	13	13	ND	81.2	W[12]	21	19	13	13
Potassium	6/8	[2]485 to 961	746	1,251	NA	No[11,13]				
Sodium	8/8	6,490 to 7,570	6,880	12,520	NA	No[11,13]				
Zinc	3/8	9.5 to 30.3	21.4	ND	54.5	W[12]	21.5	14.3	30.3	21.4

See notes at end of table.

Table 7-2 (Continued)
Selection of Ecological Chemicals of Potential Concern, Surface Water Associated with Lake Fretwell

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[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The following samples were analyzed: LF-SW-1 through LF-SW-8 (with a duplicate at LF-SW-8D).
[2] The average of the detected concentration in a sample and its duplicate. For nondetect values, one-half of the contract-required quantitation limit (CRQL) or contract-required detection limit is used as a surrogate.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.
[4] The screening reference concentration is equal to two times the average background concentration for inorganics and is equal to the average background concentration for organics. Background sample locations include RCGC-SW-R1, RC-SW-R1, and YWC-SW-R1.
[5] U.S. Environmental Protection Agency (USEPA) Region IV, Waste Management Division, *Freshwater Water Quality Chronic Screening Values for Hazardous Waste Sites* (USEPA, 1995a). Values for copper, lead, nickel, and zinc based upon equations using the average hardness for surface water samples from Lake Fretwell of 45.6 $\mu g/\ell$ of $CaCO_3$.
[6] Ecological chemical of potential concern (ECPC) selection process is depicted on Figure 3-1. "A" indicates an ECPC for aquatic receptors. "W" indicates an ECPC for terrestrial receptors.
[7] The 95 percent upper confidence limit (UCL) is calculated on the log-transformed average of all concentrations using the formula provided in the USEPA Region IV supplemental guidance (1991b).
[8] The arithmetic mean of all concentrations assigns a value of one-half of the CRQL for organics and method detection limit for inorganics to all nondetects.
[9] The maximum exposure concentration is equal to the maximum detected concentration.
[10] The average exposure concentration is equal to the mean of detected concentrations.
[11] The maximum detected concentration is less than two times the average background concentration for inorganics.
[12] The maximum analyte concentration is below the USEPA Region IV water quality screening value; therefore, the analyte was not considered an ECPC for aquatic receptors.
[13] Analyte is an essential nutrient and is not present at toxic levels.
[14] Aquatic receptor exposure concentrations are location-specific and are equal to the respective concentrations measured in surface water and sediment samples.

Notes: % = percent.
$\mu g/\ell$ = micrograms per liter.
NA = not available.
ND = not detected in background samples.

Table 7-3
Selection of Ecological Chemicals of Potential Concern, Surface Water Associated with Rowell Creek Upstream of Lake Fretwell

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Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Detected Concentrations[2]	Mean of Detected Concentrations[3]	Screening Reference Concentration[4]	Region IV Water Quality Screening Values[5]	Analyte ECPC? (Yes/No)[6]	Wildlife Exposure Concentrations[14]			
							95% UCL[7]	Arithmetic Mean[8]	Exposure Point Concentrations	
									Maximum[9]	Average[10]
Volatile Organic Compounds (µg/ℓ)										
Acetone	1/3	12	12	NA	NA	A/W	NC	7	12	12
Methylene chloride	1/3	1	1	NA	1,930	W[12]	NC	0.4	1	1
Inorganic Analytes (µg/ℓ)										
Aluminum	2/3	86.9 to 107	97	619	87	No[11]				
Barium	3/3	23.4 to 25.7	24.7	59.9	NA	No[11]				
Cadmium	1/3	0.26	0.26	ND	0.83	W[12]	NC	1.8	0.26	0.26
Calcium	3/3	13,900 to 14,700	14,300	16,980	NA	No[13]				
Iron	3/3	702 to 996	958	4,940	1,000	No[11,12]				
Lead	1/3	3.4	3.4	6.2	1.93	No[11]				
Magnesium	3/3	2,810 to 2,990	2,910	4,127	NA	No[13]				
Manganese	1/3	7.8	7.8	24.8	NA	No[11]				
Potassium	1/3	866	866	1,251	NA	No[13]				
Sodium	3/3	6,680 to 7,240	6,980	12,520	NA	No[13]				
Vanadium	1/3	3	3	ND	NA	A/W	NC	18	3	3

See notes at end of table.

Table 7-3 (Continued)
Selection of Ecological Chemicals of Potential Concern,
Surface Water Associated with Rowell Creek Upstream of Lake Fretwell

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[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The following samples were analyzed: RC-SW-1, RC-SW-2, and GC-SW-2.
[2] Values where one-half of the contract-required quantitation limit (CRQL) or contract-required detection limit is used as a surrogate.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.
[4] The screening reference concentration is equal to two times the average background concentration for inorganics and is equal to the average background concentration for organics. Background sample locations include RCGC-SW-R1, RC-SW-R1, and YWC-SW-R1.
[5] U.S. Environmental Protection Agency (USEPA) Region IV, Waste Management Division, *Freshwater Water Quality Chronic Screening Values for Hazardous Waste Sites* (USEPA, 1995a). Values for cadmium and lead based upon equations using the average hardness for surface water samples from Rowell Creek of 67.7 $\mu g/\ell$ of $CaCO_3$.
[6] Ecological chemical of potential concern (ECPC) selection process is depicted on Figure 3-1. "A" indicates an ECPC for aquatic receptors. "W" indicates an ECPC for terrestrial receptors.
[7] The 95 percent upper confidence limit (UCL) is calculated on the log-transformed average of all concentrations using the formula provided in the USEPA Region IV supplemental guidance (1991b).
[8] The arithmetic mean of all concentrations assigns a value of one-half of the for organics and method detection limit for inorganics to all nondetects.
[9] The maximum exposure concentration is equal to the maximum detected concentration.
[10] The average exposure concentration is equal to the mean of detected concentrations.
[11] The maximum detected concentration is less than two times the average background concentration for inorganics.
[12] The maximum analyte concentration is below the USEPA Region IV water quality screening value; therefore, the analyte was not considered as an ECPC for aquatic receptors.
[13] Analyte is an essential nutrient and is not present at toxic levels.
[14] Aquatic receptor exposure concentrations are location-specific and are equal to the respective concentrations measured in surface water and sediment samples.

Notes: % = percent.
$\mu g/\ell$ = micrograms per liter.
NA = not available.
NC = not calculated.
ND = not detected in background samples.

7.2.1.1 **Lake Fretwell** Surface water was collected from eight locations (LF-SW-1 through LF-SW-8 with a duplicate at LF-SW-8D) in Lake Fretwell (Plate 2). Of the 16 analytes detected in surface water, 1 VOC (acetone), and 4 inorganics (aluminum, copper, lead, and mercury) were selected as ECPCs for both terrestrial wildlife and aquatic receptors. One VOC (chloroform) and three inorganics (beryllium, nickel, and zinc) were selected as ECPCs for terrestrial wildlife only.

7.2.1.2 **Rowell Creek Upstream of Lake Fretwell** Surface water was collected from three locations (RC-SW-1, RC-SW-2, and GC-SW-2) in Rowell Creek upstream of Lake Fretwell (Plate 2). Of the 13 analytes detected in surface water, 1 VOC (acetone) and 1 inorganic (vanadium) were selected as ECPCs for both terrestrial wildlife and aquatic receptors. One volatile (methylene chloride) and one inorganic (cadmium) were selected as ECPCs for terrestrial wildlife only.

7.2.2 Sediment Sediment was sampled from Lake Fretwell and Rowell Creek upstream of Lake Fretwell. Tables 7-4 and 7-5 provide a summary of the analytical results, the USEPA Region IV Sediment Screening Values (USEPA, 1995a), and exposure point concentrations for Lake Fretwell and Rowell Creek upstream of Lake Fretwell, respectively.

7.2.2.1 **Lake Fretwell** Sediment was sampled from eight locations (LF-SD-9 through LF-SD-16 with a duplicate at LF-SD-9D; Figure 7-2) in Lake Fretwell. Table 7-4 provides a summary of the analyses of the sediment samples. Nine of 25 analytes detected in sediment samples were selected as ECPCs for both aquatic life and terrestrial wildlife. The selected analytes include one SVOC (di-*n*-butylphthalate), three pesticides (endosulfan II, endrin aldehyde, and alpha-chlordane), and five inorganics (arsenic, cadmium, lead, manganese, and zinc). Three pesticides/PCBs (4,4'-DDE, Aroclor-1260, and gamma-chlordane) and one inorganic (nickel) were selected as ECPCs for terrestrial wildlife only.

7.1.2.2 **Rowell Creek Upstream of Lake Fretwell** Sediment was sampled from three locations (LF-SD-17, RC-SD-18, and GC-SD-19 with a duplicate at LF-SD-17D; Figure 7-2) in Rowell Creek upstream of Lake Fretwell. Table 7-4 provides a summary of the analyses of the sediment samples. One of 19 analytes detected in sediment samples was selected as an ECPC for both aquatic life and terrestrial wildlife.

The selected analyte is di-*n*-butylphthalate. Four pesticides and PCBs (4,4'-DDE, Aroclor-1260, dieldrin, and alpha-chlordane) were selected as ECPCs for terrestrial wildlife only. No organic analytes were retained as ECPCs for either aquatic receptors or terrestrial wildlife.

7.2 EXPOSURE ASSESSMENT. Exposure assessment is the process of estimating or measuring the amount of an ECPC to which an ecological receptor may be exposed. The following subsections discuss how contaminant exposures were estimated or measured for aquatic receptors and terrestrial wildlife at Lake Fretwell and Rowell Creek upstream of Lake Fretwell. The site conceptual model (Figure 7-1) provides a summary of potential exposure pathways that exist at Lake Fretwell for each group of receptors.

7.2.1 Surface Water Exposure concentrations for ECPCs in surface water are determined for both aquatic receptors and terrestrial wildlife. Exposure pathways for aquatic receptors and terrestrial wildlife were identified in the contaminant

Table 7-4
Selection of Ecological Chemicals of Potential Concern, Sediment Associated with Lake Fretwell

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Analyte	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[3]	Screening Reference Concentration[4]	Region IV Sediment Quality Screening Values[5]	Analyte ECPC? (Yes/No)[6]	Wildlife Exposure Concentrations[16]			
							95% UCL[7]	Arithmetic Mean[8]	Exposure Point Concentrations	
									Maximum[9]	Average[10]
Semivolatile Organic Compounds (µg/kg)										
Di-*n*-butylphthalate	8/8	[2]17.04 to 380	113	NA	NA	A/W	372	113	380	113
Pesticides and PCBs (µg/kg)										
4,4'-DDE	3/8	0.27 to 0.87	0.49	ND	3.3	W[12]	7.6	1.8	0.87	0.49
Aroclor-1260	3/7[11]	3 to 14	7	ND	33	W[12]	508	34	14	7
Endosulfan II	1/8	0.12	[2]0.12	ND	NA	A/W	35.5	3.3	0.12	0.12
Endrin aldehyde	1/8	0.31	0.31	ND	NA	A/W	12.4	3.2	0.31	0.31
alpha-Chlordane	3/8	[2]0.19 to 2.4	0.94	ND	1.7	A/W	10.5	1.6	2.4	0.9
gamma-Chlordane	1/8	0.13	0.13	ND	1.7	W[12]	7.2	1.6	0.13	0.13
Inorganic Analytes (mg/kg)										
Aluminum	8/8	912 to 10,700	2,900	15,980	NA	No[13]				
Arsenic	1/8	7.7	7.7	ND	7.24	A/W	10.5	9.7	7.7	7.7
Barium	8/8	4.6 to 101	20	195.2	NA	No[13]				
Cadmium	2/8	0.46 to 1.4	0.9	ND	1.0	A/W	0.8	0.6	1.4	0.93
Calcium	8/8	523 to 8,300	2,630	5,860	NA	No				
Chromium	8/8	2.9 to [2]18.9	7.6	14.6	52.3	W[12]	15.8	7.6	18.9	7.6
Cobalt	1/8	0.8	0.8	3.4	NA	No[13]				
Copper	8/8	1.4 to 32.7	7.4	50.4	18.7	No[13]				
Cyanide	4/4[15]	0.18 to 0.71	0.34	1.66	NA	No[13]				
Iron	8/8	415 to 4,110	1,160	6,280	NA	No[13,14]				
Lead	8/8	3.4 to 75.8	16.6	47	30.2	A/W	49.9	16.6	75.8	16.6
Magnesium	8/8	55.8 to 2,980	540	1,160	NA	No[14]				

See notes at end of table.

Table 7-4 (Continued)
Selection of Ecological Chemicals of Potential Concern, Sediment Associated with Lake Fretwell

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Analyte	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[3]	Screening Reference Concentration[4]	Region IV Sediment Quality Screening Values[5]	Analyte ECPC? (Yes/No)[6]	Wildlife Exposure Concentrations[16]			
							95% UCL[7]	Arithmetic Mean[8]	Exposure Point Concentrations	
									Maximum[9]	Average[10]
Manganese	8/8	3.1 to 19.7	8.5	17.4	NA	A/W	15.3	8.5	19.7	8.5
Nickel	8/8	1.5 to [2]10	4.1	6.4	15.9	W[12]	9	4	10	4
Potassium	6/8	18.5 to 110	42	135	NA	No[13,14]				
Sodium	8/8	196 to 1,060	330	1,154	NA	No[13,14]				
Vanadium	8/8	1.6 to 17.6	5	29.8	NA	No[13]				
Zinc	1/8	132	132	ND	124	A/W	147	18	132	132

[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The following samples were analyzed: LF-SD-9 through LF-SD-16

[2] The average of the detected concentration in a sample and its duplicate. For nondetect values, one-half of the contract-required quantitation limit (CRQL) or contract-require detection limit is used as a surrogate.

[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.

[4] The screening reference concentration is equal to two times the average background concentration for inorganics and is equal to the average background concentration for organics. The background sample location is YWC-SD-20.

[5] U.S. Environmental Protection Agency (USEPA) Region IV Waste Management Division, *Sediment Screening Values for Hazardous Waste Sites* (USEPA, 1995a).

[6] Ecological chemical of potential concern (ECPC) selection process is depicted on Figure 3-1. "A" indicates an ECPC for aquatic receptors. "W" indicates an ECPC for terrestrial receptors.

[7] The 95 percent upper confidence limit (UCL) is calculated on the log-transformed average of all concentrations using the formula provided in the USEPA Region IV supplemental guidance (1991).

[8] The arithmetic mean of all concentrations assigns a value of one-half of the CRQL for organics and method detection limit for inorganics to all nondetects.

Table continued on next page.

Table 7-4 (Continued)
Selection of Ecological Chemicals of Potential Concern, Sediment Associated with Lake Fretwell

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[9] The maximum exposure concentration is equal to the maximum detected concentration.
[10] The average exposure concentration is equal to the mean of detected concentration.
[11] The validated analytical data for Aroclor-1260 were rejected at sampling station LF-SD-10.
[12] The maximum analyte concentration is below the sediment quality screening value; therefore, the analyte was not considered an ECPC for aquatic receptors.
[13] The maximum detected concentration is less than two times the average background concentration for inorganics.
[14] Analyte is an essential nutrient and is not present at toxic levels.
[15] The validated analytical data for cyanide was rejected at sampling stations LF-SD-10, LF-SD-11, LF-SD-13, and LF-SD-14.
[16] Aquatic receptor exposure concentrations are location-specific and are equal to the respective concentrations measured in surface water and sediment samples.

Notes: % = percent.
µg/kg = micrograms per kilogram.
NA = not available.
UCL = upper confidence limit.
PCB = polychlorinated biphenyl.
DDE = dichlorodiphenyldichloroethene.
ND = not detected in the background samples.
mg/kg = milligram per kilogram.

Table 7-5
Selection of Ecological Chemicals of Potential Concern, Sediment Associated with Rowell Creek Upstream of Lake Fretwell

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Analyte	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[3]	Screening Reference Concentration[4]	Region IV Sediment Quality Screening Values[5]	Analyte ECPC? (Yes/No)[6]	Wildlife Exposure Concentrations[16]			
							95% UCL[7]	Arithmetic Mean[8]	Exposure Point Concentrations	
									Maximum[9]	Average[10]
Semivolatile Organic Compounds (µg/kg)										
Di-*n*-butylphthalate	3/3	94 to [2]185	153	NA	NA	A/W	NC	153	185	153
Pesticides and PCBs (µg/kg)										
4,4'-DDE	1/2[11]	[2]0.195	0.2	ND	3.3	W[12]	NC	1.3	0.2	0.2
Aroclor-1260	1/2[11]	6.6	6.6	ND	33	W[12]	NC	16.2	6.6	6.6
Dieldrin	1/2[11]	[2]1.53	1.5	ND	3.3	W[12]	NC	0.87	1.5	1.5
alpha-Chlordane	2/2[11]	[2]0.19 to 0.19	0.19	ND	1.7	W[12]	NC	0.19	0.19	0.19
Inorganic Analytes (mg/kg)										
Aluminum	3/3	1,720 to [2]2,820	2,290	15,980	NA	No[13]				
Barium	3/3	9.4 to 14.5	12.3	195.2	NA	No[13]				
Calcium	3/3	[2]930.5 to 1,360	1,090	5,860	NA	No[13,14]				
Chromium	3/3	2.6 to [2]5.45	4.4	14.6	52.3	No[12,13]				
Copper	3/3	3.7 to [2]5.5	4.7	50.4	18.7	No[12,13]				
Cyanide	2/2[15]	0.4 to [2]0.41	0.4	1.66	NA	No[13]				
Iron	3/3	631 to 986	795	6,280	NA	No[13]				
Lead	3/3	8.5 to 17	13	47	30.2	No[12,13]				
Magnesium	3/3	76.4 to [2]124.35	97.3	1,160	NA	No[13,14]				
Manganese	3/3	3.6 to [2]5.95	4.7	17.4	NA	No[13]				
Nickel	3/3	1.5 to [2]2.5	1.8	6.4	15.9	No[12,13]				
Potassium	1/3	[2]36	36	135	NA	No[13,14]				
Sodium	3/3	[2]260 to 266	264	1,154	NA	No[13,14]				
Vanadium	3/3	3 to [2]5.4	4	29.8	NA	No[13]				

See notes at end of table.

Table 7-5 (Continued)
Selection of Ecological Chemicals of Potential Concern, Sediment Associated with Rowell Creek Upstream of Lake Fretwell

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[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The following samples were analyzed: LF-SD-17, RC-SD-18 and GC-SD-19.
[2] The average of the detected concentration in a sample and its duplicate. For nondetect values, one-half of the contract-required quantitation limit (CRQL) or contract-required detection limit is used as a surrogate.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.
[4] The screening reference concentration is equal to two times the average background concentration for inorganics and is equal to the average background concentration for organics. The background sample location is YWC-SD-20.
[5] U.S. Environmental Protection Agency (USEPA) Region IV, Waste Management Division, *Sediment Screening Values for Hazardous Waste Sites* (USEPA, 1995a).
[6] Ecological chemical of potential concern (ECPC) selection process is depicted on Figure 3-1. "A" indicates an ECPC for aquatic receptors. "W" indicates an ECPC for terrestrial receptors.
[7] The 95 percent upper confidence limit (UCL) is calculated on the log-transformed average of all concentrations using the formula provided in the USEPA Region IV supplemental guidance (1991).
[8] The arithmetic mean of all concentrations assigns a value of one-half of the CRQL for organics and method detection limit for inorganics to all nondetects.
[9] The maximum exposure concentration is equal to the maximum detected concentration.
[10] The average exposure concentration is equal to the mean of detected concentrations.
[11] The validated analytical data were rejected at sampling station GC-SD-19.
[12] The maximum analyte concentration is below the sediment quality screening value; therefore, the analyte was not considered an ECPC for aquatic receptors.
[13] The maximum detected concentration is less than two times the average background concentration for inorganics.
[14] Analyte is an essential nutrient and is not present at toxic levels.
[15] The validated data for cyanide were rejected at sampling station GC-SD-19.
[16] Aquatic receptor exposure concentrations are location-specific and are equal to the respective concentrations measured in surface water and sediment samples.

Notes: % = percent.
µg/kg = micrograms per kilogram.
NA = not available.
NC = not calculated.
PCB = polychlorinated biphenyl.
DDE = dichlorodiphenyldichloroethene.
ND = not detected in the background samples.
mg/kg = milligrams per kilogram.

pathway model on Figure 7-1. Exposures for terrestrial wildlife to ECPCs in surface water and sediment are evaluated concurrently.

7.2.1.1 **Terrestrial Wildlife** Four species were selected as representative wildlife species for the purpose of evaluating risks associated with exposures to surface water and sediment contamination in Lake Fretwell and Rowell Creek upstream of Lake Fretwell. Life history information used to estimate exposures for each of the representative wildlife species is summarized in Table 7-6. The four representative wildlife species used for exposure modeling are described below.

- Florida water rat (*Neofiber alleni*). This small mammalian omnivore may be exposed to contamination in surface water and sediment as a result of direct ingestion and ingestion of aquatic prey. Aquatic prey (plants and invertebrates) may become contaminated as a result of accumulation of contaminants from the surface water and sediment. The Florida water rat was selected to represent mammalian species that would receive higher doses as a result of their small body size.

- Raccoon (*Procyon lotor*). This species represents an opportunistic omnivorous species that may be exposed to contamination in surface water and sediment both as a result of direct ingestion and ingestion of aquatic prey. Aquatic prey includes plants, invertebrates and fish.

- Kingfisher (*Ceryle alcyon*). This species represents a piscivorous avian species that may be exposed to contamination in surface water both as a result of direct ingestion and ingestion of aquatic prey.

- Great blue heron (*Ardea herodias*). This species represents a higher trophic level avian receptor that may be exposed to surface water and sediment contamination from Lake Fretwell. Great blue herons feed primarily on aquatic prey items including fish, frogs, and invertebrates. The great blue heron has been observed at Lake Fretwell and was selected to represent the wading bird guild (group) of ecological receptors (i.e., other herons and egrets).

Contaminant exposures for each of the representative wildlife species related to the surface water and sediment ECPCs are estimated based on the equations in Table 3-2. Exposures evaluated for the representative wildlife species include ingestion of surface water and sediment and ingestion of aquatic life (which may bioconcentrate ECPCs in the surface water or accumulate ECPCs from sediment). Maximum and average exposure concentrations are equal to the respective maximum and mean of the detected concentrations.

PDEs for each of the representative wildlife species for each of the surface water and sediment ECPCs are estimated using a model discussed in Paragraph 3.3.2.2. In the model, exposure doses for each ECPC for each representative wildlife species are calculated based on the exposure concentrations in surface water (and sediment) and life history factors for the species. The equations are provided in Table 3-2. Piscivorous exposures are estimated using the maximum analyte concentration detected in any fish species from the corresponding lake or stream sampling stations. In addition, the site-derived fish tissue data were used to estimate exposures to all aquatic prey, including benthic macroinvertebrates. The model for the Lake Fretwell ERA uses the maximum site-specific measurements of

Table 7-6
Exposure Parameters for Representative Wildlife Species

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Representative Wildlife Species	Body Weight (kg)	Reported Diet	Soil and Sediment Ingestion (% of diet)	Assumed Diet for Exposure Assessment (% of diet)	Food Ingestion Rate (kg/day)	Water Intake Rate (ℓ/day)	Home Range (acres)
Florida water rat (*Neofiber alleni*)	0.33 [a]	Primarily aquatic plants and crayfish [b].	<2% sed. [c]	90% Aquatic plants, 8% Aquatic organisms	0.027 [d]	0.037 [e]	0.42 [f]
Raccoon (Procyon lotor)	3.99 [g]	Mostly fleshy fruits, nuts acorns, corn; also frogs, crayfish, and insects [b].	7% sed. [c]	93% Aquatic organisms	0.214 [d]	0.344 [e]	385 [h]
Kingfisher (*Ceryle alcyon*)	0.15 [i]	Mostly small fish; some crayfish, frogs, crabs, snakes, and insects [i].	7% sed. [c]	93% Aquatic organisms	0.014 [j]	0.0165 [k]	35 [l]
Great blue heron (*Ardea herodias*)	2.23 [b]	Mostly fish; some amphibians, crustaceans, and birds [b].	<2% sed. [c]	>98% Aquatic organisms	0.401 [m]	0.101 [k]	1.5 [n]

References:
[a] Burt and Grossenheider, 1980.
[b] Wildlife Exposure Factors Handbook, (U.S. Environmental Protection Agency [USEPA] 1993a).
[c] Sediment ingestion assumed to be 7% for the raccoon and the heron and 2% for the Florida water rat and heron.
[d] Calculated using the mammal equation based on body weight (Wt.) in kg. Food ingestion (kg/day) = $0.0687 \times Wt^{0.822}$ (USEPA, 1993a).
[e] Calculated using the mammal equation based on body (Wt.) in kg. Water ingestion (l/day) = $0.099 \times Wt^{0.90}$ (USEPA, 1993a).
[f] Value for the muskrat was used for the Florida water rat (USEPA, 1993a).
[g] Median of mean weights for male and female raccoons in Alabama (USEPA, 1993a).
[h] Average of adult male and female raccoons from May to December (USEPA, 1993a).
[i] Terres, 1991.
[j] Calculated using the bird equation based on body weight (Wt.) in kg. Food ingestion (kg/day) = $0.0582 \times Wt^{0.651}$ (USEPA, 1993a).
[k] Calculated using the bird equation based on body weight (Wt.) in kg. Water ingestion (ℓ/day) = $0.059 \times Wt^{0.67}$ (USEPA, 1993a).
[l] Sayler and Lagler, 1949.
[m] As reported estimating from Kushlan's (1978) allometric equation for wading birds, assuming a body weight of 2,230 g (USEPA, 1993a).
[n] Size of heron feeding territory in summer (USEPA, 1993a).

Notes: kg = kilograms.
% = percent.
kg/day = kilograms per day.
ℓ/day = liters per day.
< = lesser than.
g = grams.

pesticide, PCB, and inorganic concentrations in whole fish in place of estimates based on BCFs. The fish data were collected to provide accurate measurements of exposure and to reduce uncertainty in the exposure and risk assessments. The collection and analyses of fish tissue is described in Section 5.5.

The contaminant exposures calculated for each of the representative wildlife species for each of the ECPCs in surface water and sediment are presented in Appendices D-1 and D-2 (for Lake Fretwell and Rowell Creek upstream of Lake Fretwell, respectively).

7.2.1.2 **Aquatic Receptors** Contaminant exposures related to direct contact with surface water are evaluated for aquatic receptors in Lake Fretwell and Rowell Creek upstream of Lake Fretwell. Exposures are evaluated for each of the geographic sampling locations in Lake Fretwell and Rowell Creek with the exposure concentrations assumed to be equal to the amount of an analyte detected in the surface water sample from the respective location. The concentrations of ECPCs detected in surface water from Lake Fretwell and Rowell Creek upstream of Lake Fretwell are provided in Tables 7-2 and 7-3, respectively.

7.2.2 **Sediment** Both aquatic receptors and wildlife may be exposed to ECPCs in sediment. Exposure pathways for ECPCs in sediment are depicted on Figure 7-1.

7.2.2.1 **Terrestrial Wildlife** Routes of exposure to contaminated sediment evaluated for each of the representative wildlife species include indirect ingestion of sediment (during foraging activities) and ingestion of contaminated food (aquatic organisms that have accumulated contamination from the surface water and sediment). Site-specific measurements of whole fish were used to measure the contaminant concentrations in aquatic prey. The collection and analysis of fish tissue is described in Section 5.5. Contaminant exposures for each of the representative wildlife species for each of the ECPCs are calculated based on the equations in Table 3-2. The exposure concentrations calculated are reported in Appendices D-1 and D-2 (for Lake Fretwell and Rowell Creek upstream of Lake Fretwell, respectively).

7.2.2.2 **Aquatic Receptors** Contaminant exposures via direct contact were evaluated by the use of sediment toxicity tests. Exposures are evaluated for each of the sampling stations in Lake Fretwell and Rowell Creek upstream of Lake Fretwell with the exposure concentrations assumed to be equal to the amount of an analyte detected in the sediment sample from the respective location.

7.3 **ECOLOGICAL EFFECTS ASSESSMENT**. The ecological effects assessment describes the potential adverse effects associated with the identified ECPCs to ecological receptors.

7.3.1 **Surface Water and Sediment** Potential or adverse ecological effects for ECPCs in surface water and sediment are described in the paragraphs below.

7.3.1.1 **Terrestrial Receptors** The ecological effects assessment for ECPCs in surface water and sediment includes identification of RTVs for avian and mammalian receptors. The RTV relates the dose of a respective ECPC in an oral exposure with an adverse effect. For each ECPC identified and each representative wildlife species selected, lethal and sublethal RTVs are identified. A lethal RTV represents the threshold for lethal effects and is based on oral LD_{50} values (oral

dose lethal to 50 percent of a test population). The lethal RTV is one-fifth of the lowest reported LD_{50} for the closest related test species. One-fifth of an oral LD_{50} is considered to be protective of lethal effects for 99.9 percent of individuals in a test population (USEPA, 1986). An assumption is made that the value represented by one-fifth of an oral LD_{50} would be protective of 99.9 percent of the individuals within the terrestrial wildlife populations at Lake Fretwell and Rowell Creek upstream of Lake Fretwell, and represents a level of acceptable risk. A sublethal RTV is also identified that represents a threshold dose for effects that impair or prevent reproduction, growth, or survival.

Toxicity data for avian species are limited; in cases where toxicity information is unavailable, RTVs are not identified and risks associated with the predicted exposure for the respective ECPC are not evaluated. The absence of specific data for a taxonomic group does not imply that there is no anticipated toxicological effect associated with contaminant exposure by these receptors.

The RTVs derived for each of the representative wildlife species for each of the ECPCs in surface water and sediment at Lake Fretwell and Rowell Creek upstream of Lake Fretwell are summarized in Appendix D-3. The dose-response information used to derive RTVs is included as Appendix D-4.

7.3.1.2 **Aquatic Receptors** The results of the quantitative sampling and analyses of the benthic macroinvertebrate community at Lake Fretwell (LF-Bio-1 through LF-Bio-8) and Rowell Creek upstream of Lake Fretwell (RC-Bio-1, RC-Bio-2, and GC-Bio-2) are provided in Subsection 5.2.2. The biological sampling locations are depicted on Plate 2. Although the habitat assessment procedure (described in Section 5.2) is designed for stream habitat, information that was applicable to the Lake Fretwell sampling stations was tabulated and scores were assigned (Table 5-24). Due to the lack of a suitable reference station for the Lake Fretwell sampling stations, the Lake Fretwell habitat assessment scores were only comparable to each other. The scores for Lake Fretwell ranged from 26 at LF-Bio-1 to 46 at LF-Bio-7. Habitat assessment scores for sampling stations in Rowell Creek upstream of Lake Fretwell were consistent ranging from 49 at GC-Bio-2 to 55 at RC-Bio-2. For the Rowell Creek sampling stations, the habitat scores were divided by the Five Mile Creek reference station score for a percent comparability value (Table 5-24). These values ranged from 73.1 percent at station GC-Bio-2 to 82.1 percent at RC-Bio-2.

Metrics used to characterize the benthic macroinvertebrate community are described in Table 5-10 and discussed for Lake Fretwell and the upstream stations in Rowell Creek in Subsection 5.2.2. The trends in metric values indicate that station LF-Bio-6 ranked lower for many of the key metrics as compared to the other Lake Fretwell sampling stations. Station LF-Bio-6, the deepest station sampled in Lake Fretwell, had very low DO at the bottom, which may have contributed to its low metric values. A review of the macroinvertebrate habitat quality parameter data at the other Lake Fretwell and Rowell Creek sampling stations suggests that these stations lie within normal conditions.

Table 7-7 summarizes the results (percent survival and growth) from the 14-day toxicity tests with the amphipod, *H. azteca*, and the midge larvae, *C. tentans*. After 14 days of exposure, survival of *H. azteca* in the reference (YWC-SD/TOX-20), was significantly different (p less than or equal to 0.05) from the laboratory control sediment; however, this significance is the result of no mortality in the laboratory control. Survival of *H. azteca* in samples from stations LF-SD/TOX-11

Table 7-7
Results of Sediment Toxicity Testing

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Sample Location	Amphipod (*Hyalella azteca*)			Midge larvae (*Chironomus tentans*)	
	Survival (%)	Growth (weight in mg/organism)	Growth (length in mm)	Survival (%)	Growth (weight in g/organism)
Control 1[1]	100	0.28	3.3	85	1.06
LF-SD/TOX-11	[3,4,5]0	NA	NA	82	1.74
LF-SD/TOX-12	[3,4,5]0	NA	NA	80	1.47
LF-SD/TOX-13	100	0.29	3.4	[3,5]65	1.72
LF-SD/TOX-14	[3]93	0.29	3.4	[3,5]6	1.91
LF-SD/TOX-15	100	0.39	3.6	[3,5]63	1.37
LF-SD/TOX-16	98	0.42	3.6	77	1.87
LF-SD/TOX-17	100	0.37	3.5	67	0.88
YWC-SD/TOX-20	[3]95	0.32	3.4	75	1.05
Control 2[2]	88	0.4	3.4	75	1.45
LF-SD/TOX-9	94	0.46	3.7	[3,4,5]42	1.5
LF-SD/TOX-10	99	0.47	3.7	87	1.47
RC-SD/TOX-18	98	0.41	3.5	[3,4,5]18	1.17
GC-SD/TOX-19	88	0.43	3.6	75	1.24

[1] Laboratory control for sediment samples LF-SD/TOX-11 through LF-SD/TOX-17 and YWC-SD/TOX-20.
[2] Laboratory control for sediment samples LF-SD/TOX-9, LF-SD/TOX-10, RC-SD/TOX-18, and GC-SD/TOX-19.
[3] Significantly different from the laboratory control sediment.
[4] Significantly different from the reference sediment (YWC-SD/TOX-20).
[5] Considered to be substantially different from the reference or control sediment (i.e., biologically significant).

Notes: % = percent
mg = milligram
mm = millimeter
g = gram
NA = not available.

and LF-SD/TOX-12 were significantly different from the reference sediment. Growth, reported as weight and length, of *H. azteca* in the sediment from all sample stations was not significantly different from the laboratory control and reference sample. Growth of *H. azteca* in sediment from stations LF-SD/TOX-11 and LF-SD/TOX-12 could not be determined due to 100 percent mortality. Survival of *C. tentans* exposed to sediment from stations LF-SD/TOX-9, LF-SD/TOX-13, LF-SD/TOX-14, LF-SD/TOX-15, and RC-SD/TOX-18 were significantly different from the laboratory control sediment. Survival of *C. tentans* exposed to sediment from stations LF-SD/TOX-9 and RC-SD/TOX-18 were significantly different from the reference sediment. Growth of *C. tentans* exposed to the sediment samples was not significantly different from the control or reference sediments. Complete information on the sediment toxicity testing from Lake Fretwell and Rowell Creek upstream of Lake Fretwell is presented in Appendix D-5.

Ecological effects associated with surface water ECPCs are also estimated based on aquatic toxicity benchmarks. Aquatic toxicity benchmarks include the Florida Surface Water Quality Standards for Class III freshwater (Florida Legislature, 1995b) and aquatic toxicity information from the USEPA AQUIRE database (Appendix D-6). Information from the AQUIRE database on the aquatic toxicity of surface water ECPCs to freshwater life is summarized in Table 7-8.

The toxicity of ECPCs in sediment to aquatic receptors is also estimated by comparing maximum and average exposure concentrations of ECPCs in sediment to available sediment toxicity benchmarks. Sediment toxicity benchmarks are the concentrations reported in the literature as a "safe" no-effect concentration, a "threshold" concentration above which adverse effects are observed, and various adverse effects concentrations. Benchmarks are available from *Approach to the Assessment of Sediment Quality in Florida Coastal Waters* (SQAG) (MacDonald and others, 1994) and the updated NOAA database (Long and others, 1995). These benchmarks are listed as part of the risk characterization for sediment in Lake Fretwell and in Rowell Creek upstream of Lake Fretwell, respectively.

7.4 RISK CHARACTERIZATION. Risks are characterized for contamination in surface water and sediment of Lake Fretwell and Rowell Creek upstream of Lake Fretwell for both terrestrial wildlife and aquatic receptors. Risks are characterized based upon the methodology provided in Chapter 3.0. The methodology represents an integrated approach using both field and theoretical methods to provide a measure of actual or potential risks.

7.4.1 Surface Water Potential risks associated with ECPCs in the surface water of Lake Fretwell and Rowell Creek upstream of Lake Fretwell are characterized for both wildlife and aquatic receptors. Risks for terrestrial wildlife are characterized by comparing PDE concentrations for surface water ECPCs with a respective RTV (estimated threshold for toxicity). Risks for aquatic life are characterized based on field measurements and comparison of exposure concentrations of the ECPCs in surface water samples with respective toxicity benchmark values or standards.

7.4.1.1 Terrestrial Wildlife Risks for representative wildlife species associated with ingestion of surface water, potentially contaminated aquatic life, and sediment are quantitatively evaluated using HQs, which are calculated for each ECPC for lethal and sublethal effects by dividing the estimated contaminant exposure concentration by the lethal and sublethal RTV. Lethal and sublethal HIs

Table 7-8
Toxicity of Surface Water Ecological Chemicals of Potential Concern to Aquatic Receptors

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Analyte[1]	Fish[2]		Invertebrates[2]		Mollusks[2]		Amphibians[2]		Algae and Aquatic Plants[2]
	Lethal	Sublethal	Lethal	Sublethal	Lethal	Sublethal	Lethal	Sublethal	Sublethal
Volatile Organic Compounds ($\mu g/\ell$)									
Acetone	$30/1.0 \times 10^5$ - 1.5×10^7	--	$62/1 \times 10^4$ - 1.5×10^7	$14/1.1 \times 10^6$ - 6.9×10^6	$7/7 \times 10^6$ - 4.8×10^7	--	$2/2 \times 10^7$ - 2.4×10^7	--	$9/5.3 \times 10^5$ - 1×10^7
Inorganic Analytes ($\mu g/\ell$)									
Aluminum[3]	$6/3.28 \times 10^3$ - 3.5×10^4	--	$7/7.4 \times 10^2$ - 3.82×10^4	--	$2/3.06 \times 10^4$ - 5.55×10^4	--	--	--	--
Mercury	$32/1.5 \times 10^2$ - 1×10^5	--	50/4.7 - 3.2×10^4	--	$2/5 \times 10^3$ - 1×10^4	3/500 - 5.9×10^3	--	--	$5/1.2 \times 10^3$ - 1.2×10^4
Vanadium	4/128 - 6×10^3	--	--	--	--	--	--	--	--

[1] With the exception of aluminum, copper, and lead, toxicity information for surface water ecological contaminant of potential concerns was retrieved from the U.S. Environmental Protection Agency (USEPA) Aquatic Information Retrieval System. All aquatic toxicity information is included as Appendix D-6. Aquatic toxicity data for aluminum, copper, and lead were gathered from corresponding ambient water quality criteria documents (USEPA, 1991c).
[2] Number of studies/range of concentrations.
[3] Information for aluminum is from USEPA, 1988.

Notes: $\mu g/\ell$ = micrograms per liter.
-- = not measured.

are determined for each representative wildlife species by summing the HQs for all ECPCs.

Lake Fretwell. The lethal and sublethal HIs and HQs calculated for each of the representative wildlife species from exposure to Lake Fretwell surface water and sediment ECPCs are provided in Appendix D-1. A summary of the HIs for representative wildlife species in Lake Fretwell is presented in Table 7-9.

Table 7-9
Summary of Hazard Indices for Representative Wildlife Species Exposed to Ecological Chemicals of Potential Concern in Surface Water and Sediment from Lake Fretwell

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Receptors[1]	Maximum Exposure/ Lethal RTVs	Average Exposure/ Lethal RTVs	Maximum Exposure/ Sublethal RTVs	Average Exposure/ Sublethal RTVs
Florida water rat	0.019	0.016	0.11	0.073
Raccoon	0.74	0.73	5.3	5.2
Kingfisher	1.0	1.0	2.1	2.0
Great blue heron	2.1	2.1	4.0	3.9

[1] A model of the potential exposures to surface water and sediment at Lake Fretwell for terrestrial wildlife is presented in Appendix D-1.

Note: RTV = reference toxicity value.

A low probability for lethal effects is predicted for the kingfisher and great blue heron suggesting that population-level effects for piscivorous birds are unlikely. The HIs for the kingfisher (1.0) and the great blue Heron (2.1) are equal or slightly above 1 for the exposures based on both the maximum and average detected concentrations of ECPCs. The primary contributor to the lethal HI for the avian representative wildlife species is copper exposures associated with the ingestion of contaminated fish. These risk estimates are not likely associated with adverse effects for terrestrial wildlife populations. If copper exposures associated with ingestion of contaminated fish are removed from the food-web model, the lethal HIs for the kingfisher and great blue heron are reduced to 0.078 and 0.15, respectively. Copper was not a significant ECPC for any of the OUs or PSCs draining into Lake Fretwell. Lethal risks are not predicted for terrestrial wildlife ingesting surface water and sediment because ingestion of surface water and sediment ECPCs is not an important contributor to the HI for avian receptors.

Sublethal effects (adverse effects to growth and reproduction) are predicted for the raccoon, kingfisher, and great blue heron. The HIs for the raccoon (5.3), kingfisher (2.1), and great blue heron (3.9) exceed 1 for exposures based on the maximum detected concentrations of ECPCs. The HIs for these representative wildlife species also exceed one for exposures based on the average detected concentration of ECPCs. The primary contributor to the sublethal HI for the raccoon is Aroclor-1260 which is associated with ingestion of contaminated fish. For the two avian representative wildlife species, sublethal risks are associated with ingestion of mercury in fish. If mercury exposures associated with ingestion of contaminated fish are removed from the food-web model, the sublethal HIs for the kingfisher and great blue heron are reduced to 0.25 and 0.34, respectively. Because ingestion of surface water and sediment ECPCs are not important

contributors to the HI for any of the representative wildlife species, risks are not predicted for terrestrial wildlife exposed through ingestion of surface water or sediment in Lake Fretwell.

Aroclor-1260, copper, and mercury were detected in fish tissue collected from Lake Fretwell. Aroclor-1260, copper, and mercury were detected in largemouth bass at maximum concentrations of 640 μg/kg, and 7.9 mg/kg, and 1.3 mg/kg, respectively. The magnitude of these HIs suggest that population level effects are not likely. Sublethal effects to the representative wildlife species assume ingestion of the maximum concentration of analytes detected in fish tissue from Lake Fretwell. Section 5.5 provides further information on the collection and analysis of fish tissue in Lake Fretwell.

Although surface water samples from Lake Fretwell were collected approximately 2 years earlier (June 1993) than collection of fish tissue (April 1995), aluminum, copper, and mercury were detected in the 1993 surface water samples (Table 7-2). Aroclor-1260 was detected in sediment from Lake Fretwell (which was collected at the same time as the fish tissue) at concentrations ranging from 3 to 14 μg/kg. It is assumed that aquatic life in Lake Fretwell may bioconcentrate ECPCs in surface water (copper and mercury) or accumulate ECPCs from sediment (Aroclor-1260).

Rowell Creek Upstream of Lake Fretwell. The lethal and sublethal HIs and HQs calculated for each of the representative wildlife species from exposure to surface water and sediment ECPCs in Rowell Creek upstream of Lake Fretwell are provided in Appendix D-2. A summary of the HIs for representative wildlife species in Rowell Creek upstream of Lake Fretwell is presented in Table 7-10. Lethal effects are not expected for the representative wildlife species at Rowell Creek resulting from exposure to ECPCs in the surface water or sediment because the lethal HIs and HQs are all less than 1.

Table 7-10
Summary of Hazard Indices for Representative Wildlife Species Exposed to Ecological Chemicals of Potential Concern in Surface Water and Sediment from Rowell Creek Upstream of Lake Fretwell

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Receptors[1]	Maximum and Average Exposure/Lethal RTVs[2]	Maximum and Average Exposure/Sublethal RTVs
Florida water rat	2.3×10^{-5}	0.01
Raccoon	2.2×10^{-4}	1.7
Kingfisher	1.5×10^{-3}	0.038
Great blue heron	2.8×10^{-3}	0.033

[1] A model of the potential exposures to surface water and sediment at Rowell Creek upstream of Lake Fretwell for terrestrial wildlife is presented in Appendix D-2.
[2] Maximum and average concentrations of ECPCs were identified for surface water (Table 7-2).

Note: RTV = reference toxicity value.

A low probability for sublethal effects are predicted for the raccoon, suggesting that population-level effects for omnivorous mammals are unlikely. The HI for the raccoon is above 1 for exposures based on the maximum and average detected

concentrations of the ECPCs (HI of 1.7). The primary contributor to the sublethal HI for the raccoon is Aroclor-1260. The HQ for Aroclor-1260 is 1.67. If Aroclor-1260 exposures associated with ingestion of contaminated fish are removed from the calculation, the sublethal HI for the raccoon falls below 1 at 0.0034. This indicates that exposures to Aroclor-1260 in contaminated fish tissue are the primary contributor to predicted risks for the raccoon. Because ingestion of the surface water and sediment are not important contributors to the HI, risks are not predicted for terrestrial wildlife ingesting surface water or sediment in Rowell Creek upstream of Lake Fretwell.

Aroclor-1260 was detected in both largemouth bass and golden shiner whole fish tissue at concentrations of 0.25 μg/kg and 0.056 μg/kg, respectively. Sublethal effects to the raccoon assume ingestion of the maximum concentration of Aroclor-1260 detected in fish tissue from Rowell Creek upstream of Lake Fretwell. Section 5.5 provides further information on the collection and analysis of fish tissue in Rowell Creek upstream of Lake Fretwell.

Aroclor-1260 was detected in sediment from Rowell Creek upstream of Lake Fretwell at a concentration of 6.6 μg/kg. It is assumed that aquatic life in Rowell Creek upstream of Lake Fretwell may accumulate Aroclor-1260 from sediment.

7.4.1.2 **Aquatic Receptors** Risks for aquatic receptors resulting from exposure to the ECPCs in surface water are characterized based on field measurements of the structure and function of the benthic macroinvertebrate communities. Risks are also characterized based upon comparison of the exposure concentrations of the ECPCs in surface water samples with respective aquatic toxicity benchmarks or standards. Tables 7-11 and 7-12 present the concentrations of the ECPCs detected in respective surface water samples from Lake Fretwell and Rowell Creek upstream of Lake Fretwell. The risk characterization for aquatic receptors for both surface water and sediment contamination in Lake Fretwell and upstream of Lake Fretwell is summarized in Table 7-13. The 1993 surface water and biological samples and 1995 sediment and toxicological samples were collected from the same locations. Corresponding data from the 1993 and 1995 sampling stations are provided in Table 7-13 as part of the risk characterization for aquatic receptors.

There are no apparent trends in the status of the benthic macroinvertebrate community in Lake Fretwell and Rowell Creek upstream of Lake Fretwell. Due to the lack of a suitable reference location for the Lake Fretwell sampling stations, the Lake Fretwell habitat assessment scores are comparable only to each other. The macroinvertebrate habitat quality parameter data at the Lake Fretwell and Rowell Creek sampling stations suggest that these stations lie within normal conditions.

Lake Fretwell. Table 7-11 provides a comparison of the concentrations of the ECPCs detected in surface water samples from Lake Fretwell with available toxicity benchmarks. Concentrations of aluminum, lead, and mercury exceed the aquatic toxicity benchmarks. The concentrations of aluminum and lead measured in the water samples from the reference locations also exceed available benchmarks.

The AWQC value of 87 $\mu g/\ell$ for aluminum may not be appropriate as a screening value because it is based on the protection of brook trout and striped bass. Neither of these sensitive species are present in Lake Fretwell. The final chronic AWQC value of 748 $\mu g/\ell$ is a more appropriate screening value for aluminum because this value does not consider the brook trout or striped bass toxicity data. Based on

Table 7-11
Comparison of Concentrations of Ecological Chemicals of Potential Concern in Surface Water of Lake Fretwell with Aquatic Toxicity Benchmarks

Basewide Ecological Assessment Report
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Analyte	Range of Detected Reference Concentrations[1]	LFSW1	LFSW2	LFSW3	LFSW4	LFSW5	LFSW6	LFSW7	LFSW8	LFSW8D
Volatile Organic Compounds (µg/ℓ)										
Acetone	10	ND	ND	ND	ND	ND	ND	7 J	ND	ND
Inorganic Analytes (µg/ℓ)										
Aluminum	287 to 332	84.9	112	84.4	93.4	87.2	751	94	84.1	192
Copper	1.9 to 5.1	ND	ND	2.5 J	2.5 J	1.7 J	3.9 J	3.4 J	1.7 J	ND
Lead	3.1	ND	ND	ND	ND	ND	7.8	7.7	ND	ND
Mercury	ND	ND	ND	0.08 J	0.14 J	0.5	0.33	0.34	ND	ND

Analyte	AWQC[2]	Florida Surface Water Quality Standard (µg/ℓ)[3]	Lowest Reported Adverse Effect Concentration (µg/ℓ)[4]
Volatile Organic Compounds (µg/ℓ)			
Acetone	NA	NA	10,000
Inorganic Analytes (µg/ℓ)			
Aluminum	87	NA	740
Copper	12	6.05	NS
Lead	3.2	1.17	NS
Mercury	0.012	0.012	4.7

[1] The reference locations include RCGC-SW-R1, RC-SW-R1, and YWC-SW-R1.
[2] Federal Ambient Water Quality Criteria (U.S. Environmental Protection Agency [USEPA], 1991c).
[3] Chapter 62-302, Florida Administrative Code (Florida Legislature, 1997), Surface Water Quality Standards for Class III Freshwater.
[4] From Table 7-7.

Notes: LFSW = Lake Fretwell surface water. AWQC = ambient water quality criteria (guidance established under the Clean Water Act).
µg/ℓ = micrograms per liter. NA = not available.
ND = not detected. NS = not searched.
J = estimated value.The value indicated by an asterisk is the average of a sample and its duplicate.

Table 7-12
Comparison of Concentrations of Ecological Chemicals of Potential Concern in Surface Water of Rowell Creek Upstream of Lake Fretwell with Aquatic Toxicity Benchmarks

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Reference Concentrations[1]	RC-SW-1	RC-SW-2	GC-SW-2	AWQC[2]	Florida Surface Water Quality Standard ($\mu g/\ell$)[3]	Lowest Reported Adverse Effect Concentration ($\mu g/\ell$)[4]
Volatile Organic Compounds ($\mu g/\ell$)							
Acetone	10	12	ND	ND	NA	NA	10,000
Inorganic Analytes ($\mu g/\ell$)							
Vanadium	ND	3 J	ND	ND	NA	NA	128

[1] The reference locations include RCGC-SW-R1, RC-SW-R1, and YWC-SW-R1.
[2] Federal Ambient Water Quality Criteria (U.S. Environmental Protection Agency [USEPA], 1991c).
[3] Chapter 62-302, Florida Administrative Code (Florida Legislature, 1997), Surface Water Quality Standards for Class III Freshwater.
[4] From Table 7-7.

Notes: AWQC = Ambient Water Quality Criteria (guidance established under the Clean Water Act).
$\mu g/\ell$ = micrograms per liter.
ND = not detected.
NA = not available.
J = estimated value.

Table 7-13
Aquatic Receptor Risk Characterization

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Naval Air Station Cecil Field
Jacksonville, Florida

Sampling Locations		Biological Parameters		Contaminants Associated with Risk		Interpretation of Weight-of-Evidence
1993 Surface Water/Biological Sampling Station[1]	1995 Sediment/ Toxicological Sampling Station[2]	Sediment Laboratory Toxicity Testing	Benthic Community Composition	Surface Water[3]	Sediment[4]	
LF-SW/BIO-1	LF-SD/TOX-16	No toxicity	Inconclusive	--	--	No significant risks estimated.
LF-SW/BIO-2	LF-SD/TOX-15	37 percent midge larvae mortality[5]	Inconclusive	--	alpha-Chlordane (TEL)	No significant risks estimated.
LF-SW/BIO-3	LF-SD/TOX-13	35 percent midge larvae mortality[5]	Inconclusive	--	--	No significant risks estimated.
LF-SW/BIO-4	LF-SD/TOX-12	100 percent amphipod mortality[5,6]	Inconclusive	--	--	Risks for aquatic receptors are possible due to sediment toxicity of amphipods.
LF-SW/BIO-5	LF-SD/TOX-11	100 percent amphipod mortality[5,6]	Inconclusive	--	--	Risks for aquatic receptors are possible due to sediment toxicity of amphipods.
LF-SW/BIO-6	LF-SD/TOX-10	No toxicity	Inconclusive	Al and Pb	--	No significant risks estimated.
LF-SW/BIO-7	LF-SD/TOX-9	58 percent midge larvae mortality[5,6]	Inconclusive	Pb	--	Risks for aquatic receptors are possible due to sediment toxicity of midge larvae.
LF-SW/BIO-8	LF-SD/TOX-14	7 percent amphipod mortality[5] and 38 percent midge larvae mortality[5]	Inconclusive	--	As (TEL), Cd (TEL, ER-L), Pb (TEL, ER-L), and Zn (TEL)	Risks for aquatic receptors are possible due to elevated concentrations of Ar, Cd, Pb, and Zn in sediment
RC-SW/BIO-2	LF-SD/TOX-17	No toxicity	Normal condition	--	--	No significant risks estimated.
RC-SW/BIO-1	RC-SD/TOX-18	82 percent midge larvae mortality[5,6]	Normal condition	--	--	Risks for aquatic receptors are possible due to sediment toxicity of midge larvae.
GC-SW/BIO-2	GC-SD/TOX-19	No toxicity	Normal condition	--	--	No significant risks estimated.

See notes at end of table.

Table 7-13 (Continued)
Aquatic Receptor Risk Characterization

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Naval Air Station Cecil Field
Jacksonville, Florida

[1] 1993 surface water and biological sampling stations are depicted on Plate 2.
[2] 1995 sediment and toxicological sampling stations are depicted on Figure 7-2.
[3] ECPCs in surface water that exceeded the screening reference concentration and also exceeded benchmarks. Benchmarks for surface water ECPCs are listed in Tables 7-10 and 7-11.
[4] ECPCs in sediment that exceeded at least one benchmark. Benchmarks for sediment ECPCs are listed in Tables 7-13 and 7-14.
[5] Results are statistically significant as compared to the laboratory control.
[6] Results are statistically and biologically significant as compared to the reference location YWC-SD/TOX-20.

Notes: -- = not measured.
TEL = threshold effects level from Florida SQAG.
Al = aluminum.
Pb = lead.
As = arsenic.
Cd = cadmium.
ER-L = effects range-low concentration.
Zn = zinc.
ECPC = ecological chemical of potential concern.
SQAG = Sediment Quality Assessment Guidelines.

the screening value of 748 $\mu g/\ell$, detected concentrations of aluminum in Lake Fretwell surface water are not likely to present a risk to aquatic receptors.

Detected concentrations of lead and mercury in surface water exceed available benchmarks at sampling stations LF-SW-6 and LF-SW-7. In addition, concentrations of mercury also exceed screening benchmarks at sampling stations LF-SW-3, LF-SW-4, and LF-SW-5. It should be noted, however, that the AWQC value for mercury (0.012 $\mu g/\ell$) is based on a tissue residue level established for the FDA action level; therefore, the value is overly protective of toxicological effects to aquatic life. All detected concentrations of mercury in the surface water of Lake Fretwell are well below the lowest adverse effect concentration reported in the AQUIRE at 4.7 $\mu g/\ell$. Lead was detected in fish tissue collected from Lake Fretwell at a concentration of 2.5 mg/kg in lake chubsucker tissue and 2.9 mg/kg in golden shiner tissue. The presence of lead in surface water of Lake Fretwell may cause a risk to aquatic receptors.

Rowell Creek Upstream of Lake Fretwell. Table 7-12 provides a comparison of the concentrations of the ECPCs detected in surface water samples from Rowell Creek upstream of Lake Fretwell with available toxicity benchmarks. Detected concentrations of acetone and vanadium are well below their respective aquatic toxicity benchmarks; therefore, risks associated with exposure to surface water in Rowell Creek upstream of Lake Fretwell are not predicted for aquatic receptors.

7.4.2 **Sediment** Potential risks are characterized for contamination in sediment in Lake Fretwell and in Rowell Creek upstream of Lake Fretwell for both terrestrial wildlife and aquatic receptors. The risk characterization methodology is described in Section 3.5.

7.4.2.1 **Terrestrial Wildlife** The lethal and sublethal HIs and HQs calculated for each of the representative wildlife species for exposures related to both surface water and sediment ECPCs have been discussed in the previous section (paragraph 7.4.1.1).

7.4.2.2 **Aquatic Receptors** Risks for aquatic receptors associated with ECPCs in sediment at Lake Fretwell and Rowell Creek upstream of Lake Fretwell are characterized for each sampling station based on the approach outlined in Section 3.5. The sediment samples for toxicity testing and chemical analyses were gathered from a split sample of sediment. These samples were collected in April of 1995. Sampling of the macroinvertebrate community and collection of surface water samples for chemical analyses were completed at roughly the same locations in the summer of 1993. Although the results of the benthic macroinvertebrate sampling are not directly comparable with the chemical and toxicity testing analyses (due to variation in the time and location of sample collection), they are discussed in Subsection 5.2.2 and Paragraph 7.3.1.2. The 1993 benthic macroinvertebrate habitat quality parameter data at the Lake Fretwell and Rowell Creek sampling stations suggests that these stations lie within normal conditions. s Concurrent sampling of the sediment for chemical analyses and toxicity testing allows for comparison of adverse responses in aquatic receptors with measured concentrations of analytes in the sediment samples.

Lake Fretwell. Risks for aquatic receptors in Lake Fretwell associated with ECPCs in sediment are characterized for each sampling station (LF-SD/Tox-9 through LF-SD/TOX-16). Table 7-14 presents the distribution of ECPCs detected in sediment from Lake Fretwell. Nine analytes detected in sediment samples from Lake Fretwell

Table 7-14
Comparison of Lake Fretwell Sediment with Toxicity Benchmarks

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Analyte	LF-SD-9	LF-SD-10	LF-SD-11	LF-SD-12	LF-SD-13	LF-SD-14	LF-SD-15	LF-SD-16
Semivolatile Organic Compounds (µg/kg)								
Di-n-butylphthalate	34 J	60 J	140 J	110 J	83 J	380 J	38 J	73 J
Pesticides and PCBs (µg/kg)								
Endosulfan II	0.23 J	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	ND	ND	ND	ND	ND	ND	0.31 J	ND
alpha-Chlordane	0.38 J	ND	0.22 J	ND	ND	ND	2.4 J	ND
Inorganic Analytes (mg/kg)								
Arsenic	ND	ND	ND	ND	ND	7.7	ND	ND
Cadmium	ND	ND	ND	ND	ND	1.4	0.46	ND
Lead	6.3	3.4	14.8	4.7	6.4	75.8	11.4	10
Manganese	8.3	4.8	7	13.1	3.1	19.7	5.8	5
Zinc	ND	ND	ND	ND	ND	132	ND	ND

Analyte	Reference Concentrations[1]	NOAA ER-L/ER-M[2]	State of Florida TEL/PEL[3]
Semivolatile Organic Compounds (µg/kg)			
Di-*n*-butylphthalate	110 J	NA/NA	NA/NA
Pesticides and PCBs (µg/kg)			
Endosulfan II	ND	NA/NA	NA/NA
Endrin aldehyde	ND	NA/NA	NA/NA
alpha-Chlordane	ND	NA/NA	2.26/4.79
Inorganic Analytes (mg/kg)			
Arsenic	ND	8.2/70	7.24/41.6
Cadmium	ND	1.2/9.6	0.676/4.21
Lead	23.5	46.7/218	30.2/112
Manganese	8.7	NA/NA	NA/NA
Zinc	ND	150/410	124/271

See notes at end of table.

Table 7-14 (Continued)
Comparison of Lake Fretwell Sediment with Toxicity Benchmarks

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[1] The reference location is YWC-SD-20 (Plate 2).
[2] National Oceanic and Atmospheric Administration ER-L and ER-M sediment values (Long and others, 1995). ER-L (10th percentile) represents a lower threshold value above which adverse effects on sensitive life stages and/or species have been documented. ER-M (50th percentile) represents a second threshold value above which adverse effects on most species are frequently or always observed.
[3] Florida Department of Environmental Protection Sediment Quality Assessment Guidelines (MacDonald and others, 1994). PEL defines the lower limit of the range of contaminant concentrations associated with adverse biological effects. TEL defines the upper limit of the range of contaminant concentrations not considered to represent significant hazards to aquatic organisms.

Notes: µg/kg = micrograms per kilogram.
J = estimated value.
PCB = polychlorinated biphenyl.
ND = not detected.
mg/kg = milligrams per kilogram.
NOAA = National Oceanic and Atmospheric Administration
ER-L = effects range-low.
ER-M = effects range-medium.
TEL = threshold effect level.
PEL = probable effect level.
NA = not available.

were selected as ECPCs for aquatic life. These ECPCs included one SVOC three pesticides, and five inorganics. The ER-L and ER-M sediment values (Long and others, 1995) and the State of Florida Sediment Quality Assessment Guidelines (MacDonald, 1994) are provided as a point of reference. An evaluation of the weight-of-evidence from the toxicological and chemical data is summarized in Table 7-12 and discussed below.

Sediment collected from three of the eight sampling stations in Lake Fretwell was toxic to one of the test organisms in the laboratory bioassays, as compared to the reference sediment sample collected upstream. Mortality of 100 percent was observed in the amphipod test at sampling stations LF-SD/TOX-11 and LF-SD/TOX-12, which are located at the southeastern and southwestern portions of the lake, respectively. In addition, 58 percent mortality was observed in the midge larvae test at sampling station LF-SD/TOX-9, which is located in the southwestern edge of Lake Fretwell. Based on the results of the laboratory sediment bioassays, impacts to survival of certain invertebrate receptors may be occurring in the southern portion of Lake Fretwell.

To determine which contaminants measured in the Lake Fretwell sediment may be possible causative agents for the observed toxicity, simple linear regressions were completed for selected analytes. The regressions compared the observed responses in the bioassays (amphipod and midge larvae mortality) to the concentrations of di-*n*-butylphthalate, alpha-chlordane, lead, and manganese in sediment (Appendix D-7). There were several contaminants detected at only one or two stations for which regressions were not possible. The linear regressions reveal no positive association between the concentration of detected ECPCs in sediment and adverse responses observed in the sediment toxicity tests. This suggests that toxicological effects may be associated with simultaneous exposures to multiple contaminants or conditions not related to the OUs or PSCs.

A comparison of sediment guidelines with site chemical data (Table 7-13) reveals that alpha-chlordane, arsenic, cadmium, lead, and zinc exceed available sediment guidelines. Sediment toxicity benchmarks are not available for di-*n*-butylphthalate, endosulfan II, and endrin aldehyde.

Detected concentrations of di-*n*-butylphthalate in sediment from Lake Fretwell are not associated with the observed mortality in the sediment toxicity tests. Although di-*n*-butylphthalate was detected at all eight sampling stations at concentrations ranging from 34 to 380 µg/kg, this analyte is likely to be a laboratory contaminant rather than a site-related contaminant.

Alpha-chlordane was detected in three of the eight sediment sampling locations at concentrations ranging from 0.22 µg/kg to 2.4 µg/kg. Detected concentrations of alpha-chlordane at sampling station LF-SD/TOX-15 (2.4 µg/kg) exceeded the State of Florida TEL. Within this range of concentrations (i.e., between the lower limit TEL and upper limit permissible exposure limit [PEL]), adverse biological effects are possible; however, it is difficult to predict the occurrence, nature, and/or severity of these effects. The results of the sediment toxicity testing from sampling station LF-SD/TOX-15 show 35 percent mortality in the midge larvae as compared to the laboratory control. However, this result is not statistically significant when compared to the reference sediment from NAS Cecil Field.

Although several inorganics are elevated above upgradient concentrations, based on the results of the correlation analysis (Appendix D-7), none of these analytes

appear to be a substantial contributor to the observed mortality in the sediment laboratory bioassays. Low correlation coefficients (i.e., R^2 less than 0.1) were observed for all inorganics when regressed against amphipod and midge larvae mortality. Concentrations of these inorganics were all highest at sampling station LF-SD/TOX-14. Detected concentrations of arsenic, cadmium, lead, and zinc at LF-SD/TOX-14 exceed their respective Florida TEL (but not the PEL) values, and concentrations of cadmium and lead also exceed their respective NOAA ER-L (but not ER-M values) at this sampling station. Sediment quality screening values are not available for manganese. The results of the sediment toxicity testing from sampling station LF-SD/TOX-14 show 7 percent mortality in the amphipod test and 38 percent mortality in the midge larvae test as compared to the laboratory control. These results, however, are not statistically significant when compared to the reference sediment from NAS Cecil Field.

Based on the weight-of-evidence for each of the sampling locations (toxicity testing results, benthic community, and chemical analyses), the statements below concerning risks for aquatic life associated with sediment contamination in Lake Fretwell can be made.

- Risks may be present to certain macroinvertebrate receptors at four of the eight sampling stations (LF-SD/TOX-7, LF-SD/TOX-9, LF-SD/TOX-11, and LF-SD/TOX-12). For stations LF-SD/TOX-11 and LF-SD/TOX-12, risks are based on mortality of amphipods in sediment toxicity testing. At sampling station LF-SD/TOX-9, risks are based on mortality of midge larvae in sediment toxicity testing. At sampling station LF-SD/TOX-7, detected concentrations of arsenic, cadmium, lead, and zinc exceeded threshold, but not probable, effects benchmarks and observed toxicity in both test organisms was statistically significant as compared to the laboratory control.

- Based on the results of simple linear regressions (Appendix D-7), the observed mortality in the sediment toxicity tests is not associated with concentrations of individual ECPCs in bulk sediment from Lake Fretwell. Although not evaluated, it is possible that the toxicological results are correlated with exposure to multiple ECPCs and other factors that influence the bioavailability of sediment toxicants.

- Analysis of the benthic community metrics relative to contaminant concentrations in surface water are inconclusive.

Rowell Creek Upstream of Lake Fretwell. Risks for aquatic receptors in Rowell Creek upstream of Lake Fretwell associated with ECPCs in sediment are characterized for each sampling station (LF-SD/Tox-17, RC-SD/TOX-18, and GC-SD/TOX-19). Table 7-15 presents the distribution of ECPCs detected in sediment from Lake Fretwell. Only one analyte (di-*n*-butylphthalate) detected in sediment samples from Rowell Creek upstream of Lake Fretwell was selected as an ECPC for aquatic life. An evaluation of the weight-of-evidence from the toxicological and chemical data is summarized in Table 7-15 and discussed below.

Sediment collected from one of the three sampling stations in Rowell Creek upstream of Lake Fretwell was toxic to the midge larvae in the laboratory bioassays as compared to the reference sediment sample collected upstream in Yellow Water Creek. Mortality of 82 percent was observed in the midge larvae at sampling station RC-SD/TOX-18. Based on the results of the laboratory sediment

Table 7-15
Comparison of Rowell Creek (Upstream of Lake Fretwell) Sediment with Toxicity Benchmarks

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Analyte	Reference Concentration[1]	LF-SD-17	LF-SD-17D	RC-SD-18	GC-SD-19	NOAA ER-L/ER-M[2]	State of Florida TEL/PEL[3]
Semivolatile Organic Compounds (µg/kg)							
Di-*n*-butylphthalate	110 J	200 J	170 J	94 J	180 J	NA/NA	NA/NA

[1] The reference location is YWC-SD-20 (Figure 7-1).
[2] National Oceanic and Atmospheric Administration ER-L and ER-M sediment values (Long and others, 1995). ER-L (10th percentile) represents a lower threshold value above which adverse effects on sensitive life stages and/or species have been documented. ER-M (50th percentile) represents a second threshold value above which adverse effects on most species are frequently or always observed.
[3] Florida Department of Environmental Protection Sediment Quality Assessment Guidelines (MacDonald and others, 1994). PEL defines the lower limit of the range of contaminant concentrations associated with adverse biological effects. TEL defines the upper limit of the range of contaminant concentrations not considered to represent significant hazards to aquatic organisms.

Notes: This table shows ecological chemicals of potential concern for aquatic receptors from Table 7-4.

NOAA = National Oceanic and Atmospheric Administration.
ER-L = effects range-low.
ER-M = effects range-medium.
TEL = threshold effect level.
PEL = probable effect level.
µg/kg = micrograms per kilogram.
J = estimated value.
NA = not available.

bioassays, impacts to survival of certain invertebrate receptors may be occurring in portions of Rowell Creek upstream of Lake Fretwell. Linear regressions reveal no positive association between the concentrations of detected ECPCs in sediment and adverse responses observed in the sediment conditions toxicity tests. This suggests that the mixture of contamination from the OUs and PSCs and other sediment conditions may be toxic to aquatic life at sampling station RC-SD/TOX-18.

Table 7-14 provides a comparison of the ECPC concentrations with sediment benchmarks. Based on this evaluation, risks are not anticipated for aquatic exposures to ECPCs in sediment in Rowell Creek upstream of Lake Fretwell. Benchmarks do not exist for di-*n*-butylphthalate; however, this analyte is likely the result of laboratory contamination.

In summary, the results of the sediment toxicity testing indicate that aquatic receptors may be at risk at sampling station RC-SD/TOX-18. Observed toxicity may be due to a mixture of contamination in the sediment or other physical disturbances at sampling station RC-SD/TOX-18.

7.5 UNCERTAINTY ANALYSES. A number of uncertainties and assumptions are inherent in the ecological risk assessment process. Table 3-3 summarizes general ERA uncertainties. Specific uncertainties associated with the evaluation of risks associated with contamination at Lake Fretwell and Rowell Creek upstream of Lake Fretwell are described below.

- Due to the presence of several PSCs surrounding Lake Fretwell and Rowell Creek upstream of Lake Fretwell, it is difficult to attribute predicted risks to a particular site or PSC.

- The surface water and biological samples were collected in June 1993, while the sediment and toxicological samples and fish tissue were collected in April 1995. Although the 1993 surface water and 1995 sediment sampling stations are located in roughly the same vicinity, collection of the samples on different dates increases uncertainty in the data comparison.

- An assumption has been made that organisms evaluated in the laboratory bioassays are representative of organisms in Lake Fretwell and Rowell Creek.

- The lack of information concerning the toxicity of surface water and sediment ECPCs to avian species may result in an underestimation of risks.

- The lack of aquatic toxicity benchmarks for some of the surface water and sediment ECPCs may result in an underestimation of risks for aquatic life.

- The food-web model for representative wildlife species assumes ingestion of the maximum concentration of detected analytes in whole fish tissue collected form golden shiner, lake chubsucker, or largemouth bass. PDEs related to ingestion of contaminated aquatic life may be overestimated, depending on the feeding habits of the representative wildlife species.

- The simple linear regression model does not account for the influence of bioavailability (e.g., TOC, sediment grain size) or the potential toxicity of sediment to aquatic life.

- The site-derived fish tissue data were used to estimate exposures to all aquatic prey including benthic macroinvertebrates. Depending on the feeding habits of the representative wildlife species and/or concentrations of ECPCs present in aquatic prey other than fish, this assumption may either overestimate or underestimate potential risks associated with ingestion of contaminated aquatic prey.

- Lake Fretwell is periodically drained, which could have two effects. Draining the lake may physically mobilize sediment, which would displace contaminants associated with lake sediment, causing them to be deposited downgradient in Lake Fretwell or Rowell Creek. Draining the lake may also change or alter the bioavailability of metals, based on a change in the oxidation state. Metals may be oxidized and reduced when the water level is lowered and raised.

- The FDEP, which manages the STORET database, was contacted to provide regional background concentrations for potential risk contributors identified in this ERA (FDEP, 1997). The FDEP conducted a search of the database on chemical data for selected ECPCs: for all lakes in the State of Florida north of 26 degrees latitude, copper, mercury, lead, and Aroclor-1260 in surface water, and Aroclor-1260 in sediment. The database search provided a number of concentrations for copper and lead (number of detects was 100 and 75, respectively). The average detected concentrations of copper and lead in surface water were 8.05 $\mu g/\ell$ and 3.23 $\mu g/\ell$, respectively. The maximum detected concentrations of copper and lead in Lake Fretwell surface water are 7.1 $\mu g/\ell$ and 7.8 $\mu g/\ell$, respectively. These concentrations are generally consistent with average regional background levels. Mercury was detected in surface water in only one lake at a concentration of 0.1 $\mu g/\ell$, and Aroclor-1260 was not detected. The maximum detected concentration of mercury in Lake Fretwell was 0.5 $\mu g/\ell$. As discussed in Paragraph 7.4.1.2, the AWQC for mercury is based on residues in fish for human consumption; the maximum detected concentration of mercury in surface water is lower than effects concentrations for aquatic life. Aroclor-1260 was not detected in sediment; however, the method detection limits ranged between 12 and 60 $\mu g/kg$. The average detected concentration of Aroclor-1260 in Lake Fretwell sediment, 7 $\mu g/kg$, is most likely comparable to concentrations detected in lakes throughout northern Florida.

CHAPTER 8.0

8.0 ANALYSES OF OVERALL ECOLOGICAL RISKS

The analyses of overall ecological risks are discussed for the aquatic environments at NAS Cecil Field. Examination of total risks for terrestrial wildlife associated with contamination in surface soil is discussed for each of the OUs in Chapter 6.0. The ERA completed for each OU at NAS Cecil Field includes examination of worst-case exposure conditions where species are assumed to be resident and exposed over a lifetime to contamination in the area of the particular OU or site. Risks for wildlife species exposed to contamination in surface soil from a variety of sites would be expected to result in lower contaminant exposures than the worst-case scenario. Examination of the surface soil ECCs in Chapter 4.0 (Table 4-1) shows that persistent and potentially bioaccumulative contaminants are not identified across several sites that are located in close proximity (i.e., close enough for a species to forage in both areas); therefore, a risk evaluation for multiple exposures is not completed. ECCs in surface soil were identified for Site 5 and Site 15, which are approximately 7,000 feet apart.

The watersheds at NAS Cecil Field may receive contamination from more than one site or from nonsite-related sources, such as runoff and overland flow. If so, it becomes important to assess risks associated with multiple exposures. Risks for the watersheds and a discussion of recommendations for further action will be discussed in the following subsections. The assessment of overall ecological risks is based on the ERA results reported in Chapters 6.0 and 7.0, the extent of contamination of the watersheds reported in Chapter 4.0, and the status of the aquatic communities reported in Chapter 5.0. The goals of the risk analyses include

- identification of contamination in watersheds that has migrated from sites,
- assessment of risks associated with particular contaminants with the intent of identifying the necessity for source controls, and
- identification of any areas within the watershed that are at risk as a result of contamination present in the surface water or sediment regardless of the contaminant source.

Potential ecological risks and recommendations for further action will be discussed for Rowell Creek, Lake Fretwell, and tributaries to Rowell Creek in Section 8.1, Sal Taylor Creek in Section 8.2, and Yellow Water Creek in Section 8.3. Table 8-1 summarizes potential ecological risks and recommendations for each of the watersheds.

8.1 ROWELL CREEK. Ecological risks and recommendations for further action for Rowell Creek are subdivided into four segments including Rowell Creek upstream of Lake Fretwell (Subsection 8.1.1), Lake Fretwell (Subsection 8.1.2), Rowell Creek downstream of Lake Fretwell (Subsection 8.1.3), and tributaries to Rowell Creek (Subsection 8.1.4).

Table 8-1
Summary of Watershed Ecological Risks

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Watershed	Potential Source(s) of Contamination	Ecological Risks
ROWELL CREEK		
1. Rowell Creek Upstream of Lake Fretwell		
Rowell Creek North of 6th Street.	None	None
Golf Course Tributary	Golf Course	ERA not undertaken for golf course tributary; however, potential risks associated with exposures to PCBs and pesticides in sediment may exist for terrestrial wildlife and aquatic receptors.
Rowell Creek East of PSC 19	Site 11 and PSC 19	Sublethal effects associated with ingestion of Aroclor-1260 in fish tissue are predicted for piscivorous mammals. Risks for certain aquatic macroinvertebrate receptors at RC-18 are based on mortality observed in sediment toxicity tests.
2. Lake Fretwell		
Site 5 Drainage Ditch and Wetlands Area	Site 5	Risks for certain aquatic macroinvertebrate receptors at SD/TOX-5-1, SD/TOX-5-3, and SD/TOX-5-4 associated with Aroclor-1260, DDT_R, or TRPH in sediment.
Lake Fretwell	Site 11, PSC 19, PSC 6, and Site 5	Sublethal effects for all representative wildlife species associated with ingestion of PCBs and metals in fish tissue. Risks for certain aquatic macroinvertebrates at SD/TOX-LF-7, SD/TOX-LF-9, SD/TOX-LF-11, and SD/TOX-LF-12 based on mortality observed in sediment toxicity tests.
3. Rowell Creek Downstream of Lake Fretwell		
Northernmost section	Site 3 and wastewater treatment plant	No risks predicted.
Southernmost section	Site 3, wastewater treatment plant, Site 1, Site 2, and PSC 10	Risks for certain aquatic macroinvertebrates based on sediment toxicity and impairment of benthic community at SD/TOX-RC-6 and SD/TOX-RC-7. Responses may be associated with discharge of tributary draining from Site 2 to Rowell Creek.
4. Tributaries to Rowell Creek		
Site 2 Tributary	Site 2	Lethal risks for small mammals associated with ingestion of iron in sediment. Risks for certain aquatic macroinvertebrates based on sediment toxicity and impairment of benthic community. Adverse responses associated with metals in surface water and sediment and orange-red flocculent material present in Site 2 tributary.

See notes at end of table.

Table 8-1 (Continued)
Summary of Watershed Ecological Risks

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Watershed	Potential Source(s) of Contamination	Ecological Risks
SAL TAYLOR CREEK		
1. Upstream and East of Flight Line	Site 16, North Fuel Farm (1991 JP-5 fuel spill), and flight line	Risks for certain aquatic macroinvertebrates at STC-1 and STC-3 based on mortality observed in sediment toxicity tests. Risks may be associated with TRPH in sediment; however the presence of TRPH is not related to Site 16. Risks for aquatic receptors in wetlands associated with exposures to bis(2-ethylhexyl)phthalate, aluminum, iron, and zinc in groundwater.
2. Downstream of Site 8 Tributary	Site 8, Site 16, and North Fuel Farm (1991 JP-5 fuel spill)	No risks predicted.
3. Site 8 Tributary	Site 8	Risks for certain aquatic macroinvertebrates may occur from exposure to aluminum in groundwater, and Aroclor-1260 and TRPH in sediment, based on the toxicity benchmark evaluation for surface water, sediment, and groundwater, and on the sediment toxicity testing results. Risks may also occur for terrestrial plants due to elevated concentrations of aluminum in groundwater.
YELLOW WATER CREEK	Site 15	Lethal risks for small mammals associated with ingestion of lead in sediment. Potential risks to terrestrial plants and invertebrates based on results of toxicity tests. Invertebrate effects may be associated with aluminum and lead in soil. Plant effects are not correlated with any one chemical in linear regressions. Potential risks for certain aquatic macroinvertebrates from exposure to lead in surface water and sediment, and possibly PAHs in sediment.

Notes: NAS = Naval Air Station.
ERA = ecological risk assessment.
PCB = polychlorinated biphenyl.
PSC = Potential Source of Contamination.
DDT_r = dichlorodiphenyltrichloroethane (and its daughter products).
TRPH = total recoverable petroleum hydrocarbons.

8.1.1 Rowell Creek Upstream of Lake Fretwell Rowell Creek upstream of Lake Fretwell is further subdivided into three segments including Rowell Creek north of 6th Street (Paragraph 8.1.1.1), the golf course tributary (Paragraph 8.1.1.2), and Rowell Creek east of PSC 19 (Paragraph 8.1.1.3). Sites potentially contributing to contamination in the surface water and sediment of Rowell Creek upstream of Lake Fretwell include Site 11, the Golf Course Pesticide Disposal Area, and PSC 19, the Rowell Creek Rubble Disposal Area (Figure 1-2). The locations of the surface water and sediment samples collected in Rowell Creek upstream of Lake Fretwell are depicted on Plate 2.

8.1.1.1 Rowell Creek North of 6th Street Surface water and sediment samples were collected in Rowell Creek south of Normandy Boulevard and north of 6th Street at sampling stations RCGC-SW/SD/Bio-R1, RCGC-SW/SD/Bio-1, RCGC-SW/SD/Bio-2, and RCGC-SW/SD/Bio-3 (from north to south, respectively). An additional reference location (denoted by the "R1" qualifier) was collected at station RC-SW/SD/BIO-R1 in Rowell Creek north of Normandy Boulevard. The aforementioned sampling stations are located upstream of any known hazardous waste sites or PSCs at NAS Cecil Field; therefore, the results of the chemical and biological sampling are not included in any of the ERAs completed to date. Appendix B contains a list of analytes detected in the surface water and sediment samples, and Subsection 5.2.2 discusses the results of benthic macroinvertebrate studies conducted at these sampling stations. The relationship between habitat quality and biological condition among the sampling stations is illustrated as a line graph (on Figures 5-1, 5-2, and 5-3). Stations RCGC-Bio-3 and RC-Bio-R1 are within the predictable condition of the biological community in response to habitat quality. Station RCGC-Bio-R1 exhibited a higher benthic quality than might have been expected. This may be representative of a situation indicative of nutrient enrichment, which will artificially sustain a more diverse fauna than dictated by habitat quality. Stations RCGC-Bio-1 and RCGC-Bio-2 could be classified as slightly impaired. Factors possibly influencing the communities at the impaired stations include very low DO that was observed at RCGC-Bio-1 and RCGC-Bio-2.

8.1.1.2 Golf Course Tributary Five surface water and sediment samples were collected downstream of Site 11, the Golf Course Pesticide Disposal Area, in the golf course tributary (GC-SW/SD-5, GC-SW/SD-4, GC-SW/SD-3, GC-SW/SD/Bio-1, GC-SW/SD/Bio-2; from north to south, respectively). The ERA for OU 6, Site 11, has been completed; however, the golf course tributary was not believed to be impacted directly by Site 11 because there is no apparent migration pathway. Therefore, no ERA was undertaken for the golf course tributary. In 1995, an Interim Record of Decision and interim remedial action (IRA) were initiated at Site 11 which included excavation and disposal of pesticide containers and soil contaminated by pesticides. The objective of the IRA was to control sources of contamination to groundwater.

A cursory review of the surface water and sediment data from the golf course tributary (Appendix B) reveals detections of pesticides (including DDE and chlordane) and PCBs (including Aroclor-1254 and Aroclor-1260) in sediment well above the Region IV Sediment Screening Values (USEPA, 1995a). Chlordane was also detected in surface water at concentrations two orders of magnitude greater than the Region IV Surface Water Screening Values (USEPA, 1995a).

Biological sampling was completed for two of the five golf course tributary sampling locations (GC-Bio-1 and GC-Bio-2) in 1993. The habitat assessment scores for Site 11 sampling stations are listed in Table 5-18 and depicted on Figure 5-2.

A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at stations GC-Bio-1 and GC-Bio-2 are acceptable. Biological samples were not collected at stations GC-3, -4, and -5, which are located further north and in closer proximity to Site 11.

Based on the available information for the golf course tributary, it appears that concentrations of pesticides and PCBs in the sediment may pose a risk for both terrestrial wildlife and aquatic receptors. Although the benthic macroinvertebrate community at two of the five sampling stations is within the predictable condition in response to habitat quality, data for the sampling stations closest to Site 11 are not available. In addition, toxicity testing of sediment was not completed.

8.1.1.3 Rowell Creek East of PSC 19 Two surface water and sediment samples were collected in Rowell Creek east of PSC 19 (RC-SW/SD/Bio-1 and RC-SW/SD-Bio-2; from north to south, respectively; Plate 2) in 1993. In 1995, sediment in Rowell Creek east of PSC 19 was resampled for chemical analyses and toxicity testing at two locations (RC-SD/Tox-18 and LF-SD/Tox-17; north to south in roughly the same location as RC-SD/Bio-1 and RC-SD/Bio-2, respectively; Figure 7-2). Surface water was not recollected in 1995. These two sampling locations are evaluated as part of the Lake Fretwell ERA in Chapter 7.0. PSCs include Site 11 to the north and PSC 19 to the east.

Potential risks associated with ECPCs in the surface water and sediment of the two Rowell Creek sampling locations are characterized for both terrestrial wildlife and aquatic receptors in Section 7.4. Sublethal effects associated with ingestion of Aroclor-1260 in fish tissue are predicted for the raccoon. Aroclor-1260 was detected in largemouth bass and golden shiner whole fish tissue collected from Rowell Creek upstream of Lake Fretwell. Due to the presence of elevated concentrations of PCBs in the sediment of the golf course tributary, it is anticipated that the source of detected concentrations of Aroclor-1260 in both fish tissue and the sediment of Rowell Creek is the Golf Course Pesticide Disposal Area at Site 11. PSC 19, the Rowell Creek Rubble Disposal Area, is assumed to be free of contamination (ABB-ES, 1995c); therefore, it is unlikely that this area is contributing to contamination in Rowell Creek.

Sediment collected from station RC-SD/Tox-18 was toxic (82 percent mortality) to the midge larvae in toxicity tests; therefore, impacts to the survival of certain invertebrate receptors may be occurring in this portion of Rowell Creek upstream of Lake Fretwell. Linear regressions revealed no association between the concentration of detected ECPCs in sediment and adverse response observed in the sediment toxicity tests, suggesting that the observed toxicity may be due to a mixture of contamination in the sediment or other physical disturbances at station RC-SD/Tox-18. Risks to aquatic receptors associated with exposures to ECPCs in surface water were not identified.

8.1.2 Lake Fretwell Lake Fretwell is surrounded by several sources of potential contamination. Site 11, the Golf Course Pesticide Area, is located to the north of Lake Fretwell; contaminants from the golf course may be transported to Lake Fretwell via Rowell Creek. Site 19, the Rowell Creek Rubble Disposal Area, is also located to the west of Rowell Creek, just north of Lake Fretwell. PSC 6, the Lake Fretwell Rubble Disposal Area, borders Lake Fretwell to the east. A palustrine freshwater wetland system associated with Lake Fretwell is located immediately to the east of Site 5, the Oil/Sludge Disposal Pits. A drainage ditch

south of Site 5 carries surface water in an easterly direction, through the freshwater wetland, towards Lake Fretwell. Sites potentially contributing to contamination in the surface water and sediment of Lake Fretwell include Site 11, the Golf Course Pesticide Disposal Area; PSC 19, the Rowell Creek Rubble Disposal Area; PSC 6, the Lake Fretwell Rubble Disposal Area; and Site 5, the Oil Disposal Area (Figure 1-2). The aquatic habitat of Lake Fretwell is subdivided into the Site 5 drainage ditch and wetlands area (Paragraph 8.1.2.1) and Lake Fretwell (Paragraph 8.1.2.2). The locations of the surface water and sediment samples collected in the Site 5 drainage ditch and wetlands area and Lake Fretwell are depicted on Plate 2.

8.1.2.1 Site 5 Drainage Ditch and Wetlands Area Surface water and sediment were evaluated in the Site 5 drainage ditch (5-SW/SD/Bio/Tox-1, 5-SW/SD/Bio/Tox-2, 5-SW/SD/Bio/Tox-4; from west to east, respectively), the wetlands area adjacent to Site 5 (5-SW/SD-6 and 5-SW/SD-7), and an upstream location (5-SW/SD/Bio/Tox-5) west of both Site 5 and Perimeter Road as part of the ERA for OU 2 (Plate 2).

Analyses of the benthic macroinvertebrate sampling results indicate impairment of the benthic community at the Site 5 drainage ditch both upstream and downstream of Site 5. However, evaluation of the sediment toxicity testing data suggests that certain organisms are impacted by exposure to sediment. Further, the evaluation suggests that the responses are associated with contamination emanating from Site 5. Elevated concentrations of Aroclor-1260, DDT_R, or TRPH are possibly associated with adverse responses.

Risks were not identified for terrestrial and wetland wildlife resulting from exposures to ECPCs in surface water and sediment at the Site 5 wetland and drainage ditch.

Potential risks for aquatic receptors were evaluated for exposures to ECPCs in groundwater. The concentration of ECPCs in groundwater as they are discharged to the Site 5 wetland were estimated based on a dilution model. The risk characterization did not identify any risks for aquatic receptors associated with ECPCs in diluted groundwater. Although risks for aquatic receptors would theoretically be increased with exposure to inorganic analytes at concentrations detected in undiluted, unfiltered groundwater, such an actual exposure is deemed unlikely.

In summary, contamination in the Site 5 drainage ditch sediment may pose a risk to certain macroinvertebrate receptors. Sediment contamination at sampling stations 5-SD-1, 5-SD-3, and 5-SD-4 appears to have the potential to impact the aquatic invertebrate communities at Site 5. Site 5 sediment contaminants could potentially migrate to Lake Fretwell (for example, as a result of possible resuspension and transport of contaminated sediment during storms). Sediment from these three stations is characterized by elevated concentrations of TRPH and Aroclor-1260. In addition, low levels of DDT_R were detected at these sampling stations.

8.1.2.2 Lake Fretwell As described in Subsection 8.1.2, several PSCs exist for Lake Fretwell, the most notable of which include Site 11, the Golf Course Pesticide Disposal Area and Site 5, the Oil Disposal Area. The ERA for Lake Fretwell is presented in Chapter 7.0.

In July 1993, eight surface water and sediment samples were collected in Lake Fretwell (LF-SW/SD/Bio-1 through LF-SW/SD/Bio-8; Plate 2). Based on detections

of pesticides and PCBs in the 1993 Lake Fretwell sediment (Appendix B), it was resampled for chemical analyses and toxicity testing and fish tissue was collected in April of 1995. Eight sediment samples were recollected in Lake Fretwell (LF-SD-9 through LF-SD-16; Figure 7-2) during the April 1995 sampling effort.

Based on these data, sublethal risks were identified for each of the representative wildlife species (Florida water rat, raccoon, kingfisher, and great blue heron) based on ingestion of contaminated fish tissue. The primary contributors to sublethal effects for the representative wildlife species are as follows: aluminum and mercury for the Florida water rat; Aroclor-1260 and mercury for the raccoon; and copper and mercury for the kingfisher and great blue heron. Due to the presence of multiple sites and PSCs surrounding Lake Fretwell, it is difficult to determine the source of these contaminants. It is suspected, however, that the source(s) of Aroclor-1260 may be from either Site 11 or Site 5, where the PCB was found at elevated concentrations in the sediment.

Based on the weight-of-evidence for each of the sampling stations in Lake Fretwell, risks may be present to certain macroinvertebrate receptors at four of the eight sampling locations including LF-SD/Tox-7, LF-SD/Tox-9, LF-SD-Tox-11, and LF-SD/Tox-12. Risks to aquatic receptors are based on the results of the sediment toxicity testing. It is possible that toxicological effects may be associated with simultaneous exposures to multiple contaminants in sediment and other factors that influence the bioavailability of sediment toxicants.

8.1.3 Rowell Creek Downstream of Lake Fretwell The stretch of Rowell Creek downstream of Lake Fretwell extends approximately 3,500 feet before converging with Sal Taylor Creek to the south. The length of Rowell Creek in the first 1,000 feet directly downstream of Lake Fretwell may receive contamination from Site 3, the Oil and Sludge Disposal Pit. In addition, this portion of Rowell Creek also receives discharge from an upgradient sewage treatment plant. Ecological risks occurring in the northernmost section of Rowell Creek downstream of Lake Fretwell are discussed in Paragraph 8.1.3.1. The remaining 2,500 feet of Rowell Creek north of the confluence of Rowell Creek and Sal Taylor Creek is discussed in Paragraph 8.1.3.2. This portion of Rowell Creek may receive potential contamination from the upstream site (Site 3) and the WWTP as well as from OU 1 (Sites 1 and 2) to the west and PSC 10 to the east of Rowell Creek.

8.1.3.1 Northernmost Portion of Rowell Creek Downstream of Lake Fretwell Sources of potential contamination to the first 1,000 feet of Rowell Creek directly downstream of Lake Fretwell include Site 3 to the east, discharge from the sewage treatment plant located upstream to the east, and possibly resuspension of sediment from Lake Fretwell during flooding. In April 1993, surface water and sediment were collected from one location (RC-SW/SD/Bio-3) in Rowell Creek, approximately in the center of the Site 3 groundwater plume discharge location. In November 1994, two additional samples were collected north and south of RC-SW/SD/Bio-3 (CF3-SW/SD-1 and CF3-SW/SD-2, respectively). All three samples were collected downgradient of the Navy-owned WWTP outfall. The locations of the surface water and sediment sampling stations are shown on Plate 2.

Risks were not identified for terrestrial and wetland wildlife resulting from exposures to ECPCs in surface water and sediment in the first 1,000 feet of Rowell Creek directly downstream of Lake Fretwell.

A review of the habitat quality parameter data collected during testing suggests that habitat conditions at Rowell Creek near Site 3 represent a poor environment for many types of aquatic organisms. Differences in habitat structure between the Rowell Creek area and reference station may explain the decreased biological condition observed in samples collected adjacent to Site 3. The NAS Cecil Field domestic WWTP may also contribute to differences in the community structure in this area.

Risks to aquatic receptors were not identified for exposure to surface water and sediment in this portion of Rowell Creek. Although Aroclor-1254 and 4,4'-DDT were detected in sediment in the vicinity of Site 3, they were present at low levels, and were not found in Site 3 groundwater. This indicates that transport of these contaminants from Site 3 is not occurring.

Undiluted, unfiltered groundwater at Site 3 may result in risk to aquatic benthic organisms. Although several groundwater risk contributors were identified, three DCB isomers (1,2-DCB, 1,3-DCB, and 1,4-DCB) were found to be the primary risk contributors from Site 3 groundwater. However, when a dilution factor was applied to estimate only the hydraulic dilution of groundwater (ignoring other natural attenuation processes such as biodegradation) prior to discharge to Rowell Creek, estimated concentrations of chemicals in groundwater were below available aquatic toxicity benchmarks and criteria. Toxicity testing of groundwater with the water flea and fathead minnow supports the contention that diluted groundwater discharging to Rowell Creek poses little risk to aquatic receptors.

8.1.3.2 Southernmost Portion of Rowell Creek Downstream of Lake Fretwell The remaining 2,500 feet of Rowell Creek north of the confluence of Rowell Creek and Sal Taylor Creek is discussed below. This portion of Rowell Creek may receive potential contamination from Site 3 and the upstream WWTP as well as from OU 1 (Sites 1 and 2) to the west and PSC 10 to the east of Rowell Creek.

In 1993, two surface water and sediment samples were collected upstream of OU 1 (RC-SW/SD/Bio-4 and RC-SW/SD/Bio-5) and six samples were collected in Rowell Creek adjacent to OU 1 (RC-SW/SD/Bio/Tox-6, RC-SW/SD/Bio/Tox-7, RC-SW/SD/Bio/Tox-8, RC-SW/SD/Bio/Tox-8A, RC-SW/SD/Bio/Tox-9, and RC-SW/SD/Bio/Tox-10). The locations of the sampling stations are depicted on Plate 2.

Risks were not identified for terrestrial and wetland wildlife resulting from exposures to ECPCs in surface water and sediment in the stretch of Rowell Creek approximately 2,500 feet north of the confluence of Rowell Creek and Sal Taylor Creek.

Sediment toxicity testing and the analyses of the benthic macroinvertebrate sampling results indicate sediment toxicity and impairment of the benthic community at two of the six sampling locations in Rowell Creek (RC-SW/SD/Bio/Tox-6 and RC-SW/SD-Bio/Tox-7). Comparison of the adverse responses with the measurement of ECPCs in surface water and sediment did not reveal any contaminant(s) that could be associated with the responses. There are indications that the responses may be associated with the discharge of the tributary draining Site 2 into Rowell Creek. The two stations with impairment are located immediately downstream of the confluences of the drainage from Site 2. If the tributary is adversely influencing Rowell Creek, the extent of effects is minimal and is being confined to a maximum reach of stream of approximately 700 feet.

Risks for aquatic receptors associated with ECPCs in groundwater from Sites 1 and 2 were not identified.

8.1.4 Tributaries to Rowell Creek A summary of ecological risks and recommendations for further action is discussed for the Site 2 tributary in Paragraph 8.1.4.1.

8.1.4.1 Site 2 Tributary The Site 2 tributary flows into Rowell Creek from the west just north of sampling station RC-SW/SD/Bio/Tox-6 (Plate 2). Two surface water and sediment samples were collected from the Site 2 tributary (2-SW/SD-Bio-Tox-2 and 2-SW/SD/Bio/Tox-3) and one sample was collected in the Site 2 drainage structure (2-SW/SD/Bio/Tox-1). The locations of the Site 2 sampling locations are depicted on Plate 2.

Lethal effects were identified for small mammals that may forage in the Site 2 tributary. Risks were associated with ingestion of iron in sediment.

Impairment of the benthic macroinvertebrate community and sediment toxicity were observed in the Site 2 tributary. Toxicity of the sediment to one of the two test species was positively correlated (greater than 0.95) to the amount of iron measured in sediment. Exposures of iron for small mammals resulting from incidental ingestion of sediment could potentially result in mortality.

The cause of impairment in the benthic macroinvertebrate community could not be positively determined. The adverse responses observed in toxicity tests could be associated with aluminum, lead, and iron, which exceed acceptable criteria in surface water, or with cyanide, iron, mercury, selenium, silver, vanadium, and cadmium in sediment. The adverse responses could also be the result of physical impairment caused by an orange-red flocculent, which is present in the tributary, coating the bottom substrate and "blanketing" the water column.

8.2 SAL TAYLOR CREEK. Ecological risks and recommendations for further action in Sal Taylor Creek are subdivided into three segments including Sal Taylor Creek upstream and east of the flight line (Subsection 8.2.1), Sal Taylor Creek downstream of the Site 8 tributary (Subsection 8.2.2), and the tributaries of Sal Taylor Creek (Subsection 8.2.3).

On February 10, 1991, approximately 900,000 gallons of jet propellant 5 (JP-5) jet fuel overflowed from a tank in the North Fuel Farm Area of NAS Cecil Field. The fuel flowed down the slope on the west side of the tank into a small drainage ditch that discharges into Sal Taylor Creek. A Contamination Assessment Report (CAR) was completed for each of the seven Sal Taylor Creek dam and/or containment sites, which were affected by the 1991 JP-5 fuel spill (CAR reports, ABB-ES, 1992). This work is being conducted under the Underground Storage Tank program at NAS Cecil Field. In their 1992 comments to the CAR, FDEP requested that sediment toxicity testing be completed to assess the toxicity of sediment to aquatic receptors in Sal Taylor Creek and document potential current adverse effects of the fuel spill. On October 7, 1994, it was agreed that additional sediment samples would be collected at each of the seven dam and/or containment sites in Sal Taylor Creek. The results of the analytical and toxicity testing data for sediment samples collected from all seven of the dam and/or containment sites will be included in the CAR addenda for the AVORD Dam, North Containment

Pond, AVORD-Perimeter Road, Gate 10 Dam, Alpha Dam, Possum Dam, and Gate 14 Dam sites (ABB-ES, 1995).

8.2.1 Upstream and East of the Flight Line Four surface water and sediment samples (STC-SW/SD/Bio/Tox-1, STC-SW/SD/Bio/Tox-2, STC-SW/SD/Bio/Tox-3, and STC-SW/SD/Bio-4) were collected in drainage ditches approximately 500 feet east of the runway. Three of the four ditch locations (STC-1, -3 and -4) receive storm water drainage from both the runway areas and the developed areas west of the runway (including Site 16) and carry discharge approximately 2,400 feet eastward toward Sal Taylor Creek. Sampling station STC-2 receives drainage from the runway, but is not connected to Site 16 via the storm water drainage system. A reference sample (STC-SW/SD/Bio/Tox-R1) was collected upstream of any known hazardous waste influence in Sal Taylor Creek just south of 103rd Street. The locations of the surface water and sediment locations are shown on Plate 2.

Risks were not identified for terrestrial and wetland wildlife resulting from exposures to ECPCs in surface water and sediment in the drainage ditches east of the flight line.

The benthic macroinvertebrate study indicated that the populations of invertebrates in the drainage ditches are generally poorly developed. A review of the habitat quality parameter data, including the reference station, represent a stressful situation for many types of aquatic organisms. The highly variable conditions associated with ephemeral streams, such as the drainage ditches, are not representative of aquatic habitat for which available bioassessment protocols were designed to evaluate; only certain types of aquatic macroinvertebrates are adapted to live in these habitats. There are no apparent trends in the status of the benthic macroinvertebrate community in the drainage ditches and the reference station in Sal Taylor Creek. It could not be concluded that contaminants in the sediment were contributing to the poorer condition observed in the drainage ditches.

Sediment toxicity testing results indicate that risks may be present for certain types of macroinvertebrate receptors at two of the three sampling stations in the drainage ditches east of the flight line (STC-1 and STC-3). Comparison of the adverse responses with the measurements of ECPCs in surface water and sediment revealed that risks to aquatic receptors may be associated with elevated concentrations of TRPH in sediment. Because the ditches receive storm water drainage from the runway area and much of the developed area west of the runways, it is believed that the presence of TRPH in the sediment of the drainage ditches is not related to Site 16.

Potential risks for aquatic receptors were evaluated for exposures to ECPCs in groundwater. The concentration of ECPCs in unfiltered groundwater were estimated because they are discharged to both the wetlands downgradient of surficial groundwater for Site 16 and Sal Taylor Creek. The exposure concentrations of groundwater ECPCs in Sal Taylor Creek were estimated based on concentrations measured in groundwater samples. Migration of groundwater contamination to the wetlands assumed no dilution. The risk characterization did not identify risks for aquatic receptors in Sal Taylor Creek associated with ECPCs in groundwater. However, risks associated with exposures to bis(2-ethylhexyl)phthalate, aluminum, iron, and zinc are possible for aquatic receptors in the wetlands. Concentrations of bis(2-ethylhexyl)phthalate, iron, and zinc appear to originate in the

intermediate aquifer and flow upward to the surficial aquifer; therefore, these detections are not believed to be associated with Site 16.

8.2.2 Sal Taylor Creek Downstream of the Site 8 Tributary Two surface water and sediment samples were collected in Sal Taylor Creek downstream of the Site 8 tributary and upstream of the Rowell Creek confluence. These sample locations include STC-SW/SD/Bio-6 and STC-SW/SD/Bio-7 (upstream to downstream; Plate 2). One sample was collected upstream of the Site 8 tributary (STC-SW/SD/Bio-5) and one sample was collected in Sal Taylor Creek downstream of the Rowell Creek confluence with Sal Taylor Creek (STC-SW/SD/Bio-8). PSCs from Site 8, the Boresite Range, Hazardous Waste Storage Area, and Firefighting Training Area, may impact Sal Taylor Creek in the area of sampling locations STC-6 and STC-7. In addition, the 1991 JP-5 fuel spill represents a source of contamination for this portion of Sal Taylor Creek.

A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at STC-Bio-7 and STC-Bio-8 lie within the predictable condition of the biological community in response to habitat quality. Station STC-Bio-6 exhibited higher benthic quality than expected and station STC-Bio-5, the upstream location, was classified as slightly impaired. These results indicate a healthy benthic macroinvertebrate community in Sal Taylor Creek downstream of Site 8.

The analytical results of the surface water and sediment samples from Sal Taylor Creek, collected downstream from Site 8, were qualitatively evaluated as a part of the ERA for OU 3. A review of the chemical data suggests that Site 8 surface water is not adversely affecting the quality of surface water in Sal Taylor Creek. The range of concentrations of ECPCs detected in surface water from Sal Taylor Creek are less than the ranges detected at Site 8, or in the upstream location (STC-SW-5). Comparison of ECPCs detected in sediment from Sal Taylor Creek showed similar results as surface water. The results of the macroinvertebrate study (i.e. water quality conditions and macroinvertebrate community structure) support the finding that contaminants from Site 8 are not adversely affecting Sal Taylor Creek.

8.2.3 Tributaries to Sal Taylor Creek A summary of ecological risks and recommendations for further action is discussed for the Site 8 tributary in Paragraph 8.2.3.1.

8.2.3.1 Site 8 Tributary The Site 8 tributary flows into Sal Taylor Creek just east of sampling station STC-6 (Plate 2). Two surface water and sediment samples were collected in the Site 8 tributary north of the confluence with Sal Taylor Creek (8-SW/SD/Bio-1 and 8-SW/SD/Bio-2 from north to south, respectively; Plate 2). PSCs from Site 8, the Boresite Range, Hazardous Waste Storage Area, and Firefighting Training Area may impact the Site 8 tributary.

Risks were not identified for terrestrial wildlife resulting from exposures to ECPCs in surface water and sediment in the Site 8 tributary.

A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at the downstream location (8-Bio-2) represent a poor environment for many types of aquatic organisms, as compared to the regional reference station. Physical habitat limitations are likely associated with the ephemeral nature of the man-made ditch. Comparison of the metrics between the

Site 8 sampling stations indicates no clear trends in the data, although there are some indicators of increased stress at 8-Bio-2.

8.3 YELLOW WATER CREEK. Yellow Water Creek, which flows through the southwest corner of the Yellow Water Weapons area, is the largest creek at NAS Cecil Field. Two surface water and sediment samples were collected in Yellow Water Creek downstream of the confluence with Caldwell Branch (YWC-SW/SD/Bio-1 and YWC-SW/SD/Bio-2 from north to south, respectively; Plate 2). In addition, one reference sample was collected upstream of Yellow Water Creek in Caldwell Branch (YWC-SW/SD/Bio-R1; Plate 2). Sampling station YWC-1 is located downstream of Site 15, the Blue 10 Ordnance Disposal Area, and 200 feet upstream of the road near the housing area, and station YWC-2 is located 200 feet upstream of Normandy Boulevard. Site 15 represents a PSC to Yellow Water Creek.

Risks were not identified for terrestrial wildlife resulting from exposure to ECPCs in surface water in the ditches leading to Caldwell Branch and Yellow Water Creek. Risks were, however, identified for small mammals exposed to sediment in the drainage ditches at Site 15. Lethal effects to the small omnivorous mammals may occur due to exposure to lead exposure point concentrations; however, no sublethal risks to wildlife receptors are expected to occur.

A review of the macroinvertebrate habitat quality parameter data suggests that habitat quality conditions at YWC-Bio-1 are moderately impaired. The other stations in Yellow Water Creek lie within or above the predictable condition of the biological community in response to habitat quality.

Potential risks to aquatic receptors and terrestrial plants were evaluated based on exposures to ECPCs in surface water, sediment, and groundwater. Exposure concentrations in these media are the detected concentrations at each surface water and sediment location, and the average and maximum groundwater concentration. Groundwater impacts to the ditches assumed no dilution upon discharge to the surface. Surface water benchmarks were exceeded for the following ECPCs: aluminum, copper, iron and lead. However, the benchmarks selected for aluminum, copper, and iron are somewhat conservative and would likely overestimate risks. It is likely that lead, which was detected at elevated concentrations in surface soil and is associated with past activities at the site, may pose a risk to aquatic receptors. Similarly, lead detected in sediment may cause risk to aquatic organisms. The results of the risk evaluation for aquatic organisms exposure to ECPCs detected in groundwater suggest that although concentrations of several analytes exceed benchmarks, adverse effects to aquatic organisms may be minimal or are unlikely to occur. This conclusion is based on the fact that groundwater concentrations are well below surface water concentrations; concentrations detected in groundwater were below relevant benchmarks; and uncertainty is associated with the presence of some of the analytes detected in filtered groundwater, but not in unfiltered groundwater.

REFERENCES

REFERENCES

ABB Environmental Services, Inc. (ABB-ES). 1992. *Technical Memorandum for Supplemental Sampling at Operable Units 1, 2, and 7.* Prepared for Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), North Charleston, South Carolina (September).

ABB-ES. 1993. *Site Management Plan, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (September).

ABB-ES. 1994a. *Baseline Risk Assessment, Operable Unit 1, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (December).

ABB-ES. 1994b. *Feasibility Study, Operable Unit 1, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (December).

ABB-ES. 1994c. *Interim Record of Decision, Site 5, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (September).

ABB-ES. 1994d. *Interim Record of Decision, Site 17, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (September).

ABB-ES. 1994e. *Non-Destructive Inspection Holding Tank Closure and Certification Report, Site 16, Operable Unit 7, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (September).

ABB-ES. 1995a. *Baseline Risk Assessment, Operable Unit 2, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (May).

ABB-ES. 1995b. *Baseline Risk Assessment, Operable Unit 8, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (May).

ABB-ES. 1995c. *Fish Sampling Plan, Lake Fretwell, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (April).

ABB-ES. 1995d. *Record of Decision, Operable Unit 1, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (September).

ABB-ES. 1995e. *Record of Decision, Operable Unit 2, Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (September).

ABB-ES. 1995f. *Interim Record of Decision, Site 11, Operable Unit 6, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (September).

ABB-ES. 1995g. *Feasibility Study, Operable Unit 7, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (August).

ABB-ES. 1995h. *Feasibility Study, Operable Unit 8, Naval Air Station Cecil Field, Jacksonville, Florida*: Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (June).

ABB-ES. 1995i. Trip report memorandum from Nancy Roka to Distribution regarding Ecological Field Activities conducted from September 18 to 25, 1995; Wakefield, Massachusetts (October 12).

ABB-ES. 1996a. *Remedial Investigation, Operable Unit 4, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (November).

ABB-ES. 1996b. *Baseline Risk Assessment, Operable Unit 7, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (January).

ABB-ES. 1997a. *Remedial Investigation, Operable Unit 3, Sites 7 and 8, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (August).

ABB-ES. 1997b. *Remedial Investigation, Operable Unit 6, Sites 14 and 15, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (October).

ABB-ES. 1997c. *Remedial Investigation, Operable Unit 6, Site 11, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (August).

ABB-ES. 1997d. *Baseline Risk Assessment, Operable Unit 8, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (September).

ABB-ES, 1998. Personal communication between Rick Malloy (FDEP) STORET data base manager and Charles Lyman (ABB-ES) January 27, 1998.

Alexander. 1982. *Oil, Fish, Wildlife, and Wetlands (A Review)*. Northeastern Environmental Science, Vol. 2, No. 1, pp. 13-24 (November).

American Society for Testing and Materials (ASTM). 1991. *Standard Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates*. Volume 11.04, Designation: E 1383-90, pp. 1085-1104, Philadelphia, Pennsylvania .

REFERENCES (Continued)

Ashton, R.E., Jr., and P.S. Ashton. 1988. *Handbook of Reptiles and Amphibians of Florida Part 1, The Snake.* Windward Publishing, Inc., Miami, Florida, pp. 176.

Ashton, R.E., Jr., and P.S. Ashton. 1989. *Handbook of Reptiles and Amphibians of Florida Part 3, Amphibians.* Volume 3: Windward Publishing, Inc., Miami, Florida.

Ashton, R.E., Jr., and P.S. Ashton. 1991. *Handbook of Reptiles and Amphibians of Florida Part 2, Lizards, Turtles, and Crocodiles.* Volume 2: Windward Publishing, Inc., Miami, Florida.

Baes, C.F. III, R.D. Sharp, A.L. Sjoreen, R.W. Shor. 1984. "A Review and Analysis of Parameter for Assessing Transport of Environmentally Released Radionuclides through Agriculture." ORNL-5786. Oak Ridge National Laboratory, Oak Ridge, Tennessee (September).

Barbour, M.T., J.L. Plafkin, B.P. Bradley, C.G. Graves, and R. W. Wisseman. 1992. *Evaluation of EPA's Rapid Bioassessment Benthic Metrics: Metric Redundancy and Variability Among Reference Stream Sites.* J. Environmental Toxicology and Chemistry, Volume 11: pages 437-449.

Beyer, W.N. 1990. "Evaluating Soil Contamination." *Biological Report* 90(2) U.S. Fish and Wildlife Service.

Beyer, N., E. Conner, and S. Gerould. 1991. Survey of Soil Ingestion by Wildlife; work funded by USEPA, Office of Policy Planning and Evaluation.

Briggs, G.G., R.H. Bromilow, and A.A. Evans. 1982. "Relationships Between Lipophilcity and Root Uptake and Translocation of Non-ionised Chemicals by Barley." *Pestic. Sci.* 14 (January):495-504.

Briggs, G.G., R.H. Bromilow, A.A. Evans, and M. Williams. 1983. "Relationships Between Lipophilicity and the Distribution of Non-ionised Chemicals in Barley Shoots Following Uptake by the Roots." *Pestic. Sci.* 14 (February):492-500.

Bull, John, and John Farrand, Jr. 1977. *The Audubon Society Field Guide to North American Birds, Eastern Region.* Chanticleer Press, Inc., New York.

Burst, Tom. 1995. Personal communication from Tom Burst, Natural Resource Officer for SOUTHNAVFACENGCOM, to Nancy Goddard, ABB-ES Biologist (November).

Burt, W.H., and R.P. Grossenheider. 1980. *A Field Guide to the Mammals.* Boston: Houghton and Mifflin Co.

Camp, Dresser, & McKee (CDM). 1994. *Wetlands Assessment, Wetland Delineation, and Terrestrial Habitat Mapping at Operable Units 1, 2, and 7: Naval Air Station Cecil Field, Jacksonville, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (April).

Cochran, Hank. 1995. Personal communication from Hank Cochran, NAS Cecil Field Forester, to Nancy T. Goddard, ABB-ES, Tallahassee, Florida, (December 6).

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Fish and Wildlife Service Report FWS/OBS-79/31.

CZR Incorporated. 1994. *Cecil Field Gopher Tortoise Survey and Management Plan*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

Duncan, W.H. and L.E. Foote. 1975. *Windflowers of the Southeastern United States*. The University of Georgia Press, Athens, Georgia.

EA Engineering, Science, and Technology (EA). 1994a. *Aquatic Biological Sampling Services Conducted at Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for ABB-ES, Arlington, Virginia (January).

EA. 1994b. *Addendum to Aquatic Biological Sampling Services Conducted at Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for ABB-ES, Arlington, Virginia (June).

Eno, C.F., and P.H. Everett. 1958. "Effects of Soil Applications of 10 Chlorinated Hydrocarbon Insecticides on Soil Microorganisms and the Growth of Stringless Black Valentine Beans." In *Proceedings of Soil Science Society of America*, Volume 22, 235-238.

Envirodyne Engineers. 1985. *Initial Assessment Study of Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for Naval Energy and Environmental Support Activity (NEESA), NEESA 13-073, Port Hueneme, California (July).

Environmental Consulting & Technology, Inc. (ECT). 1992. *Final Report on the Aquatic Macroinvertebrate and Fisheries Sampling of Rowell Creek, Naval Air Station Cecil Field, Duval County, Florida*. Prepared for ABB-ES (December).

Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual" *Technical Report Y-87-1*. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Environmental Science and Engineering (ESE). 1995a. *Toxicity Analysis of Sediment Samples from Site 15, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for ABB-ES (December).

ESE. 1995b. *Toxicity Analysis of Sediment Samples from Lake Fretwell, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for ABB-ES (July).

ESE. 1995c. *Toxicity Analysis of Soil and Sediment Samples From NAS Cecil Field, Jacksonville, Florida Site 8*. Prepared for ABB-ES (July).

Environmental Services & Permitting, Inc. (ESP). 1990. *Endangered Species Survey at the Jacksonville, Florida, Naval Complex*. Submitted to SOUTHNAVFACENGCOM, (August).

REFERENCES (Continued)

Florida Administrative Code (FAC). 1994. Florida Wildlife Code, Title 39. Florida Game and Fresh Water Fish Commission. FAC 39-1.004, pp. 118-122 (July 1).

Florida Department of Environmental Regulation (FDER). 1990. *Surface Waters of the State*. 17-301, pp. 1-13. Tallahassee, Florida.

Florida Department of Environmental Protection (FDEP). 1992. Personal Communication between Janet Burris of ABB-ES and Russ Frydenborg of FDEP, Division of Technical Service, Bureau of Laboratory Services, Biological Section.

FDEP. 1997. "Development of Risk-Based Soil Cleanup Target Levels." Chapter 62-770, *Florida Administrative Code*. Tallahassee, Florida (February).

Florida Game and Fresh Water Fish Commission (FGFWFC). 1994. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida. Compiled by D.A. Wood, Endangered Species Coordinator.

Florida Legislature. 1990. *Surface Waters of the State*. Chapter 17-301, Florida Administrative Code (FAC). pages 1-13, Tallahassee, Florida.

Florida Legislature. 1996. *Surface Water Quality Standards*, Chapter 62-302, Florida Administrative Code (FAC). Tallahassee, Florida (January).

Florida Natural Areas Inventory (FNAI). 1990. *Florida Natural Areas Inventory and Department of Natural Resources Guide to the Natural Communities of Florida*. Tallahassee, Florida.

FNAI. 1994. *County Matrix of Habitats and Distribution of Rare/Endangered Species in Florida, Florida Natural Areas Inventory*. Tallahassee, Florida.

FNAI. 1997. *Florida Natural Areas Inventory and Department of Natural Resources Guide to the Natural Communities of Florida*. Tallahassee, Florida.

Green, J.C., C.L. Bartels, W. J. Warren-Hicks, B.R. Parkhurst, G.L. Linder, S.A. Peterson, and W.E. Miller. 1989. *Protocols for the Short Term Toxicity Screening of Hazardous Waste Sites*. EPA 600/3-88/029.

Hebert and Keenleyside. 1995. "To Normalize or Not to Normalize? Fat is the Question" in *Environmental Toxicology and Chemistry*, Vol. 14, No. 5, pp. 801-807.

Hulzebos, E.M., D.M.M. Adema, E.M. Dirven van Breeman, L. Henzen, W.A. van Dis, H.A. Herbold, J.A. Hoekstra, R. Baerselman, and C.A.M. van Gestel. 1993. "Phytotoxicity Studies with Lactuca Sativa in Soil and Nutrient Solution." *Environmental Toxicology and Chemistry*, 12:1079-1094.

Humphrey, S.R. 1992. *Rare and Endangered Biota of Florida, Vol. I, Mammals*. Ray E. Ashton, Jr., Series Editor, University Press of Florida, ISBN 0-8130-1127-2.

Inchcape Testing Services/Aquatec Laboratories. 1995a. *Results of Groundwater and Soil Toxicity Tests Completed on Samples from Cecil Field Naval Air Station, Jacksonville, Florida*. Prepared for ABB-ES (February).

Inchcape Testing Services/Aquatec Laboratories. 1995b. *Fish Collection Forms and Laboratory Bench Sheets, Fish Sampling Program for Lake Fretwell and Upper Rowell Creek, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for ABB-ES (May).

Kale, H.W. 1978. *Rare and Endangered Biota of Florida, Volume II - Birds*. University of Florida, Gainesville, Out of print.

Levine, M.B., A.T. Hall, G.W. Barrett, and D.H. Taylor. 1989. "Heavy Metal Concentrations During Ten Years of Sludge Treatment to an Old-Field Community." *J. Environ. Qual*. 18:411-418.

Long, E.R., and L.G. Morgan. 1990. *The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program*. National Oceanic and Atmospheric Administration Technical Memorandum NOS OMA 52.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1993. *Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments*. National Oceanic and Atmospheric Administration, (September 15).

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments," *Environmental Management*, Vol. 19, No. 1, pp. 81-97.

MacDonald, D.D. 1994. *Approach to the Assessment of Sediment Quality in Florida Coastal Waters, Volume 1 - Development and Evaluation of Sediment Quality Assessment Guidelines*. Prepared for FDEP, Office of Water Policy, Tallahassee, Florida (November).

Mahaney. 1994. "Effects of Freshwater Petroleum Contamination on Amphibian Hatching and Metamorphosis". *Environmental Toxicology and Chemistry*. Vol. 13, No. 2, pp. 259-265.

Maughan, J.T. 1993. *Ecological Assessment of Hazardous Waste Sites*. Van Nostrand Reinhold. New York, New York, page 352.

McGrath, E.A., and M.M. Alexander. 1979. Observations on the Exposure of Larval Bullfrogs to Fuel Oil. Presented at the Northeast Wildlife Conference Annual Meeting.

Moler, P.E. 1992. *Rare and Endangered Biota of Florida, Vol. III - Amphibians and Reptiles*. Ray E. Ashton, Jr., Series Editor, University Press of Florida, ISBN 0-8130-1142-6.

National Academy of Sciences (NAS). 1977. *Drinking Water and Health: Safe Drinking Water Committee*. Washington, D.C.

National Research Council (NRC). 1982. Nutrient Requirements of Minks and Foxes, Second Revised Edition: Subcommittee on Furbearer Nutrition. National Academy Press, Washington, D.C.

Neuhauser, E.F., R.C. Loehr, M.R. Malecki, D.L. Milligan, and P.R. Durkin. 1985. "The Toxicity of Selected Organic Chemicals to the Earthworm *Eisenia fetida*." *Journal of Environmental Quality*, 14: 383-88.

Neuhauser, E.F., P.R. Durkin, M.R. Malecki, and M. Anatra. 1986. "Comparative Toxicity of Ten Organic Chemicals to Four Earthworm Species." *Com. Biochem. Physiol.* 83C(1):197-200.

NRC. 1984. Nutrient Requirements of Beef Cattle: Subcommittee on Beef Cattle Nutrition, National Academy Press, Washington, D.C.

O'Neill, P.E., and M.F. Mettee. 1982. *Alabama Coastal Region Ecological Characterization, 2. A Synthesis of Environmental Data*. Geological Survey of Alabama, University, Alabama.

Persaud, D., R. Jaagumagi, and A. Hayton. 1996. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. Ontario Ministry of the Environment. Queen's Printer for Ontario, page 23.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. "Rapid Bioassessment Protocols for Use in Streams and Rivers Benthic Macroinvertebrates and Fish." United States Environmental Protection Agency, Assessment and Watershed Protection Division; EPA/444/4-89-0021; Washington, D.C.

Quanterra Laboratories. 1995. *Analytical Data from Tissue Samples from Whole Fish and Fish Fillets, Fish Sampling Program for Lake Fretwell and Upper Rowell Creek, Naval Air Station Cecil Field, Jacksonville, Florida*. Prepared for ABB-ES (May).

Ryan, J.A., R.M. Bell, J.M. Davidson, and G.A. O'Connor. 1988. "Plant Uptake of Non-ionic Organic Chemicals from Soils." *Chemosphere*, 0045-6535/88, Great Britain. 17(12):2299-2323.

Springborn Laboratories. 1994. *Toxicity Evaluation of the Sediment and Soil from the Cecil Field Naval Air Station in Jacksonville, Florida*. SLI report 93-07-4874. Prepared for ABB-ES (March).

Suter, W. 1993. *Ecological Risk Assessment*. Lewis Publishers. Chelsea, Michigan.

Taylor, Walter Kingsley. 1992. *The Guide to Florida Windflowers*. Taylor Publishing Company. Dallas, Texas.

Terres, J.K. 1991. *Audubon Encyclopedia of North American Birds*. Avenel, New Jersey: Wings Books.

Travis, C.C., and A.D. Arms. 1988. "Bioconcentration of Organics in Beef, Milk, and Vegetation." *Environ. Sci. Tech.* 22:271-274.

U.S. Environmental Protection Agency (USEPA). 1976. *Quality Criteria for Water*. Washington, D.C. (July).

USEPA. 1980. "Ambient Water Quality Criteria for DDT." EPA-440/5-80-038. Office of Water Regulations and Standards Criteria and Standards Division, Washington D.C. (October).

USEPA. 1986. *Hazard Evaluation Division Standard Evaluation Procedure: Ecological Risk Assessment*. Office of Pesticide Programs, EPA 540/9-85-001, Washington, D.C.

USEPA. 1988. *Interim Sediment Criteria Values for Nonpolar Hydrophobic Organic Chemicals*. Office of Water Regulations and Standards. SCD No. 17, Washington, D.C.

USEPA. 1989a. *Risk Assessment Guidance for Superfund: Environmental Evaluation Manual*. Volume 2. EPA/540/1-89/002 (December).

USEPA. 1989b. *Ecological Assessment of Hazardous Waste Sites, A Field and Laboratory Reference*: Environmental Research Laboratory. EPA 600/3-89/013 Corvallis, Oregon (March).

USEPA. 1989c. *Rapid Bioassessment Protocols for Use in Streams and Rivers, Benthic Macroinvertebrates and Fish*. Office of Water, EPA/444/4-89-001, Washington D.C. (May).

USEPA. 1990. Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological of Surface Waters: Office of Research and Development; Washington D.C.; EPA/600/4-90/030 (November).

USEPA. 1991a. *Ecological Assessment of Superfund Sites: An Overview: Publication* 9345.0-051, Office of Solid Waste and Emergency Response. Washington, D.C. (December).

USEPA. 1991b. ECO Update: Volume 1, Number 1, December, Publication 9345.0-051.

USEPA. 1991c. Letter from Elmer W. Aiken, Health Assessment Officer, to Hazardous Waste Contractors, regarding Region IV Risk Assessment Guidance, Atlanta, Georgia (March 20).

USEPA. 1991d. *Water Quality Criteria Summary*. Washington, D.C. (May 1).

USEPA. 1992a. *Framework for Ecological Risk Assessment*. EPA/630/R-92/001, (February).

REFERENCES (Continued)

USEPA. 1992b. ECO Update: Publication 9345.0-051, Volume 1, Number 2, May.

USEPA. 1992c. ECO Update: Publication 9345.0-051. Volume 1, Number 3, August.

USEPA. 1992d. *Freshwater Quality Chronic Screening Values for Hazardous Waste Sites, Region IV*. Waste Management Division.

USEPA. 1993a. *Wildlife Exposure Factors Handbook*. Volume 1 and 2. Office of Research and Development. EPA/600/R-93/187a, b. Washington D.C. (December).

USEPA. 1993b. *Sediment Quality Criteria for the Protection of Benthic Organisms-Acenaphthene*. EPA-882-R-93-013. Office of Water and Office of Research and Development, Washington, D.C. (September).

USEPA. 1993c. *Sediment Quality Criteria for the Protection of Benthic Organisms-Dieldrin*. EPA-822-R-93-015. Office of Water and Office of Research and Development (September).

USEPA. 1993d. *Sediment Quality Criteria for the Protection of Benthic Organisms-Endrin*. EPA-822-R-93-016. Office of Water and Office of Research and Development, Washington, D.C. (September).

USEPA. 1993e. *Sediment Quality Criteria for the Protection of Benthic Organisms-Fluoranthene*. EPA-822-R-012. Office of Water and Office of Research and Development, Washington, D.C. (September).

USEPA. 1993f. *Sediment Quality Criteria for the Protection of Benthic Organisms-Phenanthrene*. EPA-822-R-92-014. Agency, Office of Water and Office of Research and Development, Washington, D.C. (September).

USEPA. 1995a. *Supplemental Guidance to RAGS: Ecological Screening Values, Region IV*. Bulletin No. 2, Atlanta, Georgia (November).

USEPA. 1995b. *Region III BTAG Screening Levels*. Philadelphia, Pennsylvania (August).

USEPA. 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. (Interim Final). USEPA Environmental Response Team, Edison, New Jersey (June).

U.S. Fish and Wildlife Service (USFWS). 1983. National Wetlands Inventory Map for Jacksonville Heights, Florida.

Ward, D.B. 1978. *Rare and Endangered Biota of Florida, Volume V - Plants*. University of Florida, Gainesville.

Wentsel, R.S., T.W. LaPoint, M. Simini, R.T. Checkai, D. Ludwig, and L.W. Brewer. 1996. *Tri Services Procedural Guidelines for Ecological Risk Assessments, Volumes I and II*. Written for the Air Force Center for Environmental Excellence, the Army Environmental Center, and the Naval Facilities Engineering Service Center (June).

REFERENCES (Continued)

Will, M.E. and G. W. Suter. 1995. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants*. 1994 Revision. Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, Tennessee (September).

Wolfe, S.H., J.A. Reidenauer, and D.B. Means. 1988. "An Ecological Characterization of the Florida Panhandle". U.S. Department of the Interior. *Fish and Wildlife Service, FWS Biological Report 88(12)*. OCS MMS 88-0063. Washington, D.C.

Wood, Don A. 1994. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida, Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Wood Don A. 1995. Personal communication from Don Wood, Florida Game and Fresh Water Fish Commission to Nancy T. Goddard, ABB-ES, August 31.

Wooding, John B. 1990. *Status, Life History, and Management of Fox Squirrels in Florida, Final Report*. Bureau of Wildlife Research, Florida Game and Fresh Water Fish Commission. Tallahassee, Florida (September).

Wooding, John B. 1994. Personal communication from John Wooding, Florida Game and Fresh Water Fish Commission, to Nancy T. Goddard, ABB-ES (November).

Wunderlin, Richard P. 1982. *Guide to the Vascular Plants of Central Florida*. University Press of Florida, Gainesville, Florida.

APPENDIX A

APPENDIX A

ECOLOGICAL RECEPTOR SPECIES AT NAS CECIL FIELD

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
PINE COMMUNITY	
Acacia sp.	Acacia
Acer rubrum	Red maple
Andropogon glomeratus	Broom sedge
Arisaema triphyllum	Jack-in-the-pulpit
Aristida condensata	Sandhills wiregrass
Aristida stricta	Pineland three-awn
Aster sp.	Aster
Berberis sp.	Barberry
Bidens pilosa	Spanish needles
Bignonia capreolata	Cross vine
Boletus bicolor	Two colored bolete
Callicarpa americana	Beautyberry
Carya glabra	Pignut hickory
Castanea pumila	Eastern chinquapin
Cenchrus spp.	Sandspur
Cephalanthus occidentalis	Buttonbush
Cicuta sp.	Water hemlock
Crataegus sp.	Hawthorne
Digitaria sp.	Crab grass
Echinochloa sp.	Backyard grasses
Eleusine sp.	Crab grass
Fistulena hepatica	Beefsteak polypore
Gelsemium sempervirens	Yellow jessamine
Gnaphalium obtusifolium	Rabbit tobacco
Ilex cassine	Dahoon holly
Ilex coriacea	Tall gallberry holly
Ilex glabra	Gallberry
Ilex myrtifolia	Myrtle-leaf holly
Ilex vomitoria	Yaupon
Liquidambar styraciflua	Sweet gum
Lonicera japonica	Japanese honeysuckle
Lonicera sp.	Honeysuckle
Lycopodium alopeuroides	Clubmoss
Lycopus sp.	Bugleweed
Lyonia lucida	Fetterbush
Lyonia mariana	Staggerbush
Omphalotus illudens	Jack o'lantern
Magnolia grandiflora	Bigleaf magnolia
Myrica cerifera	Southern bayberry
Osmunda cinnamonea	Cinnamon fern
Panicum sp.	Panic grass
Parthenocissus quinquefolia	Virginia creeper
Piloblephis rigida	Penny royal
Pinus elliottii	Slash pine

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
PINE COMMUNITY (cont.)	
Pinus palustris	Longleaf pine
Pinus taeda	Loblolly pine
Pityopsis sp.	Golden aster
Polypodium polypoides	Resurrection fern
Prunus caroliniana	Choke cherry
Prunus serotina	Black cherry
Pteridium aquilinum	Bracken fern
Quercus chapmanni	Chapman oak
Quercus laevis	Turkey oak
Quercus laurifolia	Diamond-leaf oak
Quercus myrtifolia	Myrtle oak
Quercus nigra	Water oak
Quercus pumila	Running oak
Quercus spp.	Oaks
Rhus coppalina	Shining sumac
Rubus trivialis	Dewberry
Rubus cuneifolius	Bramble
Rubus sp.	Blackberry
Salvia azurea	Blue sage
Serenoa repens	Saw palmetto
Smilax bona-nox	Catbriar
Smilax glauca	Greenbriar
Smilax rotundifolia	Bullbriar
Smilax sp.	Greenbriar
Solidago sp.	Goldenrod
Thelypteris kunthii	Fern
Tillandsia usneoides	Spanish moss
Toxicodendron radicans	Poison ivy
Vitis rotundifolia	Muscadine grape
Woodwardia virginica	Virginia chain fern
MESOPHYTIC HARDWOOD COMMUNITY	
Acer rubrum	Red maple
Amanita muscaria	Fly agaric
Amanita virosa	Destroying angel
Amphicarpa bracteata	Hog peanut
Anthaenantia rufa	Purple-top/purple silkyscale
Aralia spinosa	Devil's Walking stick
Assimina triloba	Pawpaw
Asplenium sp.	Spleenwort
Athyrium filix-femina	Lady fern
Calopogon tuberosus	Grass Pink [b]

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
MESOPHYTIC HARDWOOD COMMUNITY (cont.)	
Carex sp.	Sedges
Carpinus carolinensis	Hornbeam
Carya glabra	Pignut hickory
Centrosema virginiana	Butterfly pea
Cercis canadensis	Redbud
Cornus florida	Flowering dogwood
Diospyros virginiana	Persimmon
Erythrina herbacea	Coral bean
Galium sp.	Bedstraw
Gaylussacia frondosa	Dangleberry
Gordonaia lasianathus	Loblolly bay
Hamamelis virginiana	Witch-hazel
Hypericum hypericoides	St. John's-wort
Ilex glabra	Gallberry
Ilex opaca	American holly
Juniperus virginiana	Red cedar
Ligodium sp.	Climbing fern
Ligustrum lucidum	Wax-leaved ligustrum
Liquidamber styraciflue	Sweetgum
Lonicera japonica	Japanese honeysuckle
Lycopodium sp.	Club moss
Lyonia lucida	Fetterbush
Magnolia grandiflora	Magnolia
Monotropa uniflora	Indian pipe
Mitchella repens	Partridgeberry
Myrica cerifera	Bayberry, Wax myrtle
Nyssa sylvatica	Black gum
Osmunda cinnamomea	Cinnamon fern
Persea borbonis	Redbay
Pinus elliottii	Slash pine
Pinus palustris	Longleaf pine
Polypodium polypoides	Resurrection fern
Polypodium plumula	Comb fern
Prunus carolina	Carolina laurel cherery
Prunus serotina	Black cherry
Pterocaulon pyenostachyum	Blackroot
Quercus hemisphaerica	Laurel oak
Quercus michauxii	Swamp chestnut oak
Quercus nigra	Water oak
Quercus virginiana	Live oak
Rubus cuneifolius	Sand blackberry
Serenoa repens	Saw palmetto
Smilax bona-nox	Catbriar

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
MESOPHYTIC HARDWOOD COMMUNITY (cont.)	
Smilax sp.	Greenbriar
Smilax walterii	Coral greenbriar
Pinus palustris	Longleaf Pine
Pinus elliottii	Slash pine
Thelypteris quadrangularis	Fern
Ulmus alata	Winged elm
Vaccinium arboreum	Sparkleberry
Vaccinium sp.	Blueberry
Vitis rotundifolia	Muscadine grape
Woodwardia areolata	Netted chain fern
Dry Prairie	
Agalinis sp.	Agalinis
Digitaria sp.	Crab grass
Echinochloa sp.	Grasses
Eleusine sp.	Crab grass
Hypoxis hirsuta	Yellow star grass
Ipomoea sp.	Morning glory
Iris sp.	Iris
Liatris sp.	Blazing star
Quercus falcata	Spanish oak
Quercus pyrinoides	Dward Chinquapin Oak
Quercus virginiana	Live oak
Rhexia virginica	Meadow beauty
Rhus copallina	Winged sumac
Sabatia breviaolia	White sabatia
Sabatia sp.	Marsh pink
Serenoa repens	Saw palmetto
Xyris sp.	Yellow-eyed grass
WETLAND/FLOODPLAIN COMMUNITY	
Acer negundo	Box elder
Acer rubrum	Red maple
Adiantum pedatum	Maiden-hair fern
Agalinis sp.	Agalinis
Agalinas purpurea	Purple gerardia
Aletris farinosa	Colic root
Alnus serrulata	Alder
Alternanthera phhiloxeroides	Alligator weed
Amorpha fruticosa	False indigo
Ampelopsis arborea	Peppervine
Andropogon gerardii	Broomsedge

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
WETLAND/FLOODPLAIN COMMUNITY (cont.)	
Andropogon glomeratus	Broomsedge
Aralia spinosa	Devils walking stick
Arisaema triphyllum	Jack-in-the-pulpit
Ambrosia artemisiifolia	Common ragweed
Asclepias spp.	Milkweed
Arundinaria gigantea	Cane
Asplenium resiliens	Black-stemmed spleenwort
Athyrium filix-femina	Lady fern
Baccharis angustifolia	False willow
Baccharis glomeruliflora	Groundsel tree
Bacopa caroliniana	Lemon bacops
Betula nigra	River birch
Bignonia capreolata	Cross vine
Botrychium virginianum	Rattlesnake fern
Botrychium virginianum	Grape fern
Bracopohyta spp.	Moss
Bryophyta	Moss
Canna flaccida	Golden canna
Carex sp.	Sedge
Carex walteriana	Walter sedge
Carpinus caroliniana	Hornbeam
Carex sp.	Sedges
Cephalanthus occidentalis	Buttonbush
Cicuta mexicana	Water hemlock
Cladium sp.	Twig rush
Cnidoscolus stimulosus	Nettle
Coreopsis gladiata	Tickseed
Cornus foemina	Swamp dogwood
Cuscata sp.	Common dodder
Cyperus sp.	Sedge
Cyrilla racemiflora	Swamp titi
Dichromena sp.	White top sedge
Dichromena latifolia	White bracted sedge
Diodia virginiana	Buttonweed
Drosera intermedia	Sundew
Drosera rotundifolia	Sundew
Eleocharis spp.	Spikerush
Elephantopus carolinanus	Elephant's foot
Eriocaulon decangulare	Hat pins
Eupatorium capillifolium	Dog fennel
Flaveria linearis	Yellow-top
Fraxinus caroliniana	Water ash
Fraxinus pennsylvanica	Green ash

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
WETLAND/FLOODPLAIN COMMUNITY (cont.)	
Gallium sp.	Bedstraw
Gnaphalium sp.	Rabbit tobacco
Gordonia lasianthus	Loblolly bay
Hydrocotyle bonariensis	Water pennywort
Hydrocotyle umbellata	Water pennywort
Hypericum fasciculatum	St. John's-wort
Hypericum myrtifolia	St. John's wort
Hypoxis juncea	Yellowstar grass
Ilex cassine	Dahoon holly
Ilex coriacea	Gallberry
Ilex glabra	Gallberry
Ilex myrtifolia	Myrtle-leaved holly
Iris pseudacoris	Yellow flag
Juncus effusus	Soft rush
Juncus sp.	Rush
Lachnanthes caroliniana	Redroot
Lachnocaulon anceps	Bogbutton
Lemna spp.	Duckweed
Leucothoe racemosa	Swamp leucothoe
Leucothoe sp.	Sweetbells
Liatris sp.	Blazing star
Liquidambar styraciflua	Sweet gum
Lobelia cardinalis	Cardinal flower
Lobelia spp.	Lobelia
Ludwigia peruviana	Primrose willow
Lycopodium alopecuroides	
Lycopodium sp.	Clubmoss
Lycopus virginicus	Bugleweed
Lyonia ferruginea	Rusty lyonia
Lyonia lucida	Fetterbush
Lyonia mariana	Staggerbush
Magnolia virginiana	Sweet bay magnolia
Mikania sp.	Climbing hempweed
Myrica cerifera	Wax myrtle
Nuphar luteum	Spatterdock
Nymphaea odorata	Water lily
Nyssa sylvatica	Black gum
Onoclea sensibilis	Sensitive fern
Orontium aquaticum	Golden club
Osmunda cinnamonea	Cinnamon fern
Osmunda regalis	Royal fern
Ostrya sp.	Hophornbeam
Oxydendrum sp.	Sourwood

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
WETLAND/FLOODPLAIN COMMUNITY (cont.)	
Peltandra virginica	Green arum
Persea borbonia	Red bay
Persea palustris	Swamp red bay
Pinus elliottii	Slash pine
Pinus taedea	Loblolly pine
Pinus serotina	Pond pine
Polygonum punctatum	Dotted smartweed
Polygonum spp.	Smartweeds; Knotweeds
Polypodium polypoides	Resurrection fern
Pontedaria cordata	Pickerelweed
Quercus nigra	Water oak
Quercus phellos	Willow oak
Quercus spp.	Oaks
Quercus virginiana	Live oak
Rhexia mariana	Maryland meadow beauty
Rhexia virginica	Meadowbeauty
Rhododendron canescens	Wild azalea
Rhododendron viscosum	Swamp azalea
Rhus copallina	Winged sumac
Rhynchospora divergens	Beak rush
Rhynchospora microcarpa	Small-fruited beak rush
Rubus spp.	Blackberry
Sagitaria latifolia	Arrowhead
Salix nigra	Black Willow
Sambucus canadensis	Elderberry
Sarracenia minor	Hooded pitcherplant [b]
Sarracenia repens	Trumpet pitcherplant
Sarracenia rubra	Red pitcher/sweet pitcher plant
Sassafras albidum	Sassafras
Saururus cernuus	Lizard's tail
Scirpus sp.	Bulrush
Serenoa repens	Saw palmetto
Setaria spp.	Bristle grass
Smilax laurifolia	Laurel greenbriar
Smilax walteri	Redberry greenbriar
Smilax sp.	Greenbriar
Sphagnum spp.	Sphagnum moss
Taxodium distichum	Bald cypress
Thelypteris kunthii	Fern
Thelypteris noveboracensis	New York fern
Tillandsia usneoides	Spanish moss
Toxicodendron radicans	Poison ivy
Toxicodendron vernix	Poison sumac

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
WETLAND/FLOODPLAIN COMMUNITY (cont.)	
Typha latifolia	Cattail
Ulmus americana	American elm
Urtica dioica	Stinging nettle
Utricularia cornuta	Bladderwort
Utricularia inflata	Bladderwort
Utricularia purpurea	Purple bladderwort
Vibernum lentago	Nannyberry
Vaccinium arboreum	Sparkleberry
Vaccinium sp.	Blueberry
Viola floridana	Florida violet
Viola lanceolata	Long-leaf violet
Vitis rotundifolia	Muscadine grape
Woodwardia areolata	Netted chain fern
Woodwardia virginica	Virginia chain fern
DISTURBED UPLAND COMMUNITY	
Acacia	Acacia
Agalinis fasciculata	Agalinis
Albizia julibrissin	Mimosa
Allium canadense	Wild onion
Ambrosia artemissifolia	Ragweed
Ampelopsis arborea	Peppervine
Anagallis arvensis	Scarlet pimpernel
Andropogon glomeratus	Broom grass
Andropogon viscosum	Bluestem
Asplenium resiliens	Black-stemmed spleenwort
Aster sp.	Aster
Aster umbellatus	Flat-topped aster
Baccharis halmifolia	Groundsel-tree
Baptista sp.	Indigo
Bidens frondosa	Beggar ticks
Bidens pilosa	Spanish needles
Buchnera sp.	Buchnera
Callicarpa americana	Beauty berry
Campsis radicans	Trumpet creeper
Carex sp.	Sedge
Cassia sp.	Pea
Centrosema virginianum	Butterfly pea
Circium sp.	Thistle
Cladium sp.	Twig rush
Cladonia sp.	Deer moss
Cladonia cristatella	British soldier
Clematis crispa	Leather flower

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
DISTURBED UPLAND COMMUNITY (cont.)	
Cnidoscolus stimulosus	Nettle
Commelina erecta	Dayflower
Cornus florida	Flowering dogwood
Crotalaria rotundifolia	Rattlebox
Cuscuta gronovii	Dodder
Cyperus rivularis	Sedge
Daucus carota	Queen Anne's lace
Dichromena sp.	White-bracted sedge
Digitaria sp.	Crab grass
Dioscorea bulbifera	Air yam
Diospyros virginiana	Persimmon
Echinochloa sp.	Backyard grasses
Eleusine sp.	Crab grass
Eleocharis sp.	Spike rush
Erigeron canadensis	Horseweed
Erigeron quercifolius	Fleabane
Eupatorium capillifolium	Dog fennel
Eupatorium capitatum	Dog fennel
Eupatorium incarnatum	Ageratum
Euthamia minor	Flat-topped goldenrod
Geranium carolinianum	Wild geranium
Gnaphalium obtusifolium	Rabbit tobacco
Hedyotis procumbens	Innocence
Heleniuim amarum	Bitterweed
Helianthus angustifolia	Sunflower
Hydrocotyle umbellata	Water pennywort
Hypericum gentianoides	St. Johns wort
Hypochoeris radicata	Cat's ear
Ipomoea sp.	Bindweed
Juniperus virginiana	Southern red cedar
Juncus canadensis	Canada rush
Juncus sp.	Rush
Lactuca sp.	Wild lettuce
Lepidium virginicum	Field peppergrass
Liatris sp.	Blazing star
Ludwigia alternifolia	Seedbox
Lygodium japonicum	Japanese climbing fern
Melia azedarach	Chinaberry
Meliota alba	Tall white clover
Mikania scandens	Climbing hempweed
Morus alba	White mulberry
Oenothera laciniata	Primrose
Oxalis sp.	Sorrel

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
DISTURBED UPLAND COMMUNITY (cont.)	
Oxypolis sp.	Cowbane
Panicum sp.	Panic grass
Panicum vergatum	Panic grass
Parthenocissus quinquefolia	Virginia creeper
Paspalum notatum	Bahia grass
Passiflora incarnata	Passion flower
Phorodendron serotinum	Mistletoe
Phyla nodiflora	Capeweed
Phytolacca americana	Pokeweed
Pluchea odorata	Camphorweed
Poinsettia heterophylla	Wild poinsettia
Polygala nana	Bachelor button
Prunus caroliniana	Carolina laurel cherry
Pteridium aquilinum	Bracken fern
Quercus myrtifolia	Myrtle oak
Rhexia virginica	Meadow beauty
Robinia hispidus	Bristly locust
Rhus typhina	Staghorn sumac
Rhynchosia reniformis	Dollarweed
Rubus trivialis	Southern dewberry
Rubus spp.	Blackberry
Rudbeckia sp.	Black-eyed suzie
Rumex crispus	Dock
Rumex hastatulus	Hastate leaf dock
Sabal minor	Dwarf palmetto
Sabal palmetto	Sabal palm
Salvia lyrata	Lyre-leaved mint
Sambucus canadensis	Elderberry
Sapium sebiferum	Chinese tallow tree
Senecio aureus	Hawkweed
Sesbania sp.	Rattlebox
Smilax bona-nox	Bullbriar greenbriar
Solanum carolinense	Horse nettle
Solidago fistulosa	Goldenrod
Solidago sp.	Goldenrod
Sonchas asper	Sow thistle
Spiranthes sp.	Orchid
Stachys floridana	Hedge nettle
Symphoricarpos orbiculatus	Coralberry
Toxicodendron radicans	Poison ivy
Tradescantia virginiana	Spiderwort
Trichostema dichotomum	Blue curls
Trifolium spp.	Clovers

Table A-1
Characteristic Flora of Major Vegetative Cover Types

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Scientific Name	Common Name
DISTURBED UPLAND COMMUNITY (cont.)	
Ulmus alata	Winged Elm
Verbascum thapsus	Mullein
Verbena brasiliensis	Vervain
Viola sp.	Violet
Vitis rotundifolia	Muscadine grape
Xyris fimbriata	Yellow-eyed grass
Yucca aloifolia	Spanish bayonnet
Zanthoxylum clava-herculis	Southern prickly ash

Note:
[a] Sources: Godfrey and Wooten (1981); Dressler et al. (1991); Mickel, 1979; CZR, 1994.
[b] Sarracenia minor and Calopogon tuberosus are state-threatened species according to the Florida Department of Agriculture and Consumer Services (list published in Preservation of Native Flora of Florid Act, Section 581.185-187, Florida Statutes).

Table A-2
Fish Collected from the NAS Cecil Field Watersheds

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Atherinidae	*Labidesthes sicculus*	Brook silverside
Catostomidae	*Ereimyzon sucetta*	Lake chubsucker
Cyprinidae	*Notemigonus crysoleucas*	Golden shiner
	Notropis chalybaeus	Ironcolor shiner
	Notropis hypselopterus	Sailfin shiner
	Notropis petersoni	Coastal shiner
Centrarchidae	*Centrarchus macropterus*	Flier sunfish
	Elassoma sp.	Pygmy sunfish
	Lepomis auritus	Redbreast sunfish
	Lepomis gulosis	Warmouth
	Lepomis macrochirus	Bluegill
	Lepomis microlophus	Redear sunfish
	Lepomis spp.	Sunfish species
	Micropterus salmoides	Largemouth bass
Cyprinodontidae	*Fundulus spp.*	Killifish species
Ictaluridae	*Noturus gyrinus*	Tadpole madtom
Percidae	*Percina nigrofasciata*	Blackbanded darter
Poeciliidae	*Gambusia holbrooki*	Eastern mosquitofish
	Heterandria formosa	Least killifish

Source:
Aquatic Biological Sampling Services conducted at Naval Air Station Cecil Field,
EA Engineering, Science, and Technology, January 1994, and Addendum to report, EA Engineering, Science, and Technology, June 1994

Table A-3
Amphibians Expected to Occur in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Ambystomidae	*Ambystoma talpoideum*	Mole salamander
Bufonidae	*Bufo quercicus*	Oak toad
	Bufo terrestris	Southern toad
Hylidae	*Acris gryllus dorsalis*	Florida cricket frog
	Hyla chrysoscelis	Gray treefrog
	Hyla avivoca	Bird-voiced treefrog
	Hyla cinerea	Green treefrog
	Hyla crucifer bartramiana	Southern peeper
	Hyla femoralis	Pine woods treefrog
	Hyla gratiosa	Barking treefrog
	Hyla squirella	Squirrel treefrog
	Limnaeodus ocularis	Little grass frog
	Pseudacris cricifer	Spring peeper
	Pseudacris nigrita nigrita	Southern chorus frog
	Pseudacris ornata	Ornate chorus frog
Microhylidae	*Gastrophryne carolinensis*	Eastern narrowmouth toad
Pelobatidae	*Scaphiopus holbrooki*	Eastern spadefoot
Plethodontidae	*Desmognathus auriculatus*	Southern dusky salamander
	Eurycea quadridigitata	Dwarf salamander
	Plethodon glutinosus	Slimy salamander
	Pseudotriton montanus floridanus	Rusty mud salamander
Ranidae	*Rana areolata aesopus*	Florida gopher frog
	Rana catesbeiana	Bullfrog
	Rana clamitans clamitans	Green frog
	Rana grylio	Pig frog
	Rana heckscheri	River frog
	Rana sphenocephala	Southern leopard frog
Salamandridae	*Notophthalmus perstriatus*	Striped newt
	Notopthalmus viridescens louisianensis	Central newt
Sirenidae	*Pseudobranchus striatus*	Narrow-striped dwarf siren
	Siren intermedia	Lesser siren

Source:
Specimen records for Duval County, Florida (Ashton and Ashton, 1988).
Cecil Field Gopher Tortoise Survey and Management Plan, CZR Inc., Jacksonville, Florida, November, 1994.

Table A-4
Reptiles Expected to Occur in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Alligatoridae	*Alligator mississippiensis*	American alligator
Anguidae	*Ophisaurus spp.*	Glass lizard
Chelydridae	*Chelydra serpentina*	Snapping turtle
Colubridae	*Cemophora coccinea copei*	Scarlet snake
	Coluber constrictor priapur	Southern black racer
	Diadophis punctatus punctatur	Southern ringneck snake
	Drymarchon corais	Indigo snake
	Elaphe guttata	Corn snake
	Elaphe obsoleta quadrivattata	Yellow rat snake
	Farancia abacura abacura	Mud snake
	Farancia erytrogramma	Rainbow snake
	Heterodon platyrhinos	Eastern hognose snake
	Heterodon simus	Southern hognose snake
	Lampropeltis getulus	Common kingsnake
	Lampropeltis triangulum	Eastern milk snake
	Lampropeltis triangulum elapsoides	Scarlet kingsnake
	Masticophis flagellum flagellum	Coachwhip
	Nerodia fasciata	Southern water snake
	Nerodia rhombifera	Diamondback water snake
	Opheodrys aestivus	Rough green snake
	Pituophis melanoleucus mugitur	Florida pine snake
	Regina alleni	Striped crayfish snake
	Regina rigida rigida	Glossy crayfish snake
	Rhadinaea flavilata	Pine woods snake
	Seminatrix pygaea pygaea	North Florida swamp snake
	Storeria dekayi victa	Florida brown snake
	Storeria occipitomaculata obscura	Southern redbelly snake
	Tantilla relicta	Southeastern crowned snake
	Thamnophis sauritus sackeni	Southern ribbon snake
	Thamnophis sirtalis sirtalis	Eastern garter snake
Elapidae	*Micrurus fulvius fulvius*	Eastern Coral snake
Emydidae	*Clemmys guttata*	Spotted turtle
	Deirochelys reticularia chrysea	Chicken turtle
	Pseudemys nelsoni	
	Pseudemys floridana peninsylaris	Cooter
	Terrapene carolina	Eastern box turtle
Iguanidae	*Anolis carolinensis*	Green anole
	Sceloporus undulatus undulatus	Southern fence lizard
Kinosternidae	*Kinosternon subrubrum steindachneri*	Eastern mud turtle
	Sternotherus minor minor	Loggerhead musk turtle

Table A-4
Reptiles Expected to Occur in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Scincidae	*Eumeces egregius*	Peninsula mole skink
	Eumeces inexpectatus	Southeastern five-lined skink
	Eumeces laticeps	Broadhead skink
	Scincella lateralis	Ground skink
Teiidae	*Cnemidophorus sexlineatus*	Six-lined racerunner
Testudinidae	*Gopherus polyphemus*	Gopher tortoise
Viperidae	*Agkistrodon piscivorus caramto*	Florida cottonmouth
	Crotalus adamanteus	Eastern diamondback
	Sistrurus miliarus barbouri	Pigmy rattlesnake

Source:
Specimen records for Duval County, Florida (Ashton and Ashton, 1988b and 1991).
Cecil Field Gopher Tortoise Survey and Management Plan, CZR Inc., Jacksonville, Florida, November, 1994.

Table A-5
Birds Expected to Occur in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Accipitridae	*Accipiter cooperii*	Cooper's hawk
	Accipiter striatus	Sharp-shinned hawk
	Buteo jamaicensis	Red-tailed hawk
	Buteo lineatus	Red-shouldered hawk
	Buteo platypterus	Broad-winged hawk
	Circus cyaneus	Northern harrier
	Elanoides forficatus	American swallow-tailed kite
	Haliaeetus leucocephalus	Bald eagle
	Pandion haliaetus	Osprey
Alcedinidae	*Megaceryle alcyon*	Belted kingfisher
Anatidae	*Aix sponsa*	Wood duck
	Anas americana	American wigeon
	Anas clypeata	Northern shoveler
	Anas crecca	Green-winged teal
	Anas discors	Blue-winged teal
	Anas platyrhynchos	Mallard
	Anas rubripes	American black duck
	Anas strepera	Gadwall
	Aythya affinis	Lesser scaup
	Aythya americana	Redhead
	Aythya collaris	Ring-necked duck
	Aythya marila	Greater scaup
	Bucephala albeola	Bufflehead
	Bucephala clangula	Common goldeneye
	Lophodytes cucullatus	Hooded merganser
	Mergus serrator	Red-breasted merganser
	Oxyura jamaicensis	Ruddy duck
Anhingidae	*Anhinga anhinga*	Anhinga
Apodidae	*Chaetura pelagica*	Chimney swift
Ardeidae	*Ardea herodias*	Great blue heron
	Bubulcus ibis	Cattle egret
	Butorides striatus	Green-backed heron
	Casmerodius albus	Great egret
	Egretta thula	Snowy egret
	Egretta tricolor	Tricolored heron
	Egretta caerulea	Little blue heron
	Nycticorax nycticorax	Black-crowned night heron
	Nycticorax violaceus	Yellow-crowned night heron
Bombycillidae	*Bombycilla cedrorum*	Cedar waxwing
Caprimulgidae	*Caprimulgus carolinensis*	Chuck-will's-widow
	Caprimulgus vociferus	Whip-poor-will
	Chordeiles minor	Common nighthawk
Cathartidae	*Cathartes aura*	Turkey vulture
	Coragyps atratus	Black vulture
Certhiidae	*Certhia familiaris*	Brown creeper
Charadriidae	*Charadrius semipalmatus*	Semipalmated plover
	Charadrius vociferus	Killdeer
	Pluvialis squatarola	Black-bellied plover
Columbidae	*Columba livia*	Rock dove
	Columbina passerina	Common ground-dove
	Zenaida macroura	Mourning dove

Table A-5
Birds Expected to Occur in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Corvidae	*Corvus brachyrhynchos*	Common crow
	Corvus ossifragus	Fish crow
	Cyanocitta cristata	Blue jay
Cuculidae	*Coccyzus americanus*	Yellow-billed cuckoo
Emberizidae	*Aimophila aestivalis*	Bachman's sparrow
	Ammodramus henslowii	Henslow's sparrow
	Ammodramus leconteii	Le Conte's sparrow
	Ammodramus savannarum	Grasshopper sparrow
	Cardinalis cardinalis	Northern cardinal
	Carduelis tristis	American goldfinch
	Carpodacus purpureus	Purple finch
	Guiraca caerulea	Blue grosbeak
	Junco hyemalis	Dark-eyed junco
	Melospiza georgiana	Swamp sparrow
	Melospiza melodia	Song sparrow
	Passerculus sandwichensis	Savannah sparrow
	Passerina ciris	Painted bunting
	Pipilo erythrophthalmus	Rufous-sided towhee
	Pooecetes gramineus	Vesper sparrow
	Spizella passerina	Chipping sparrow
	Spizella pusilla	Field sparrow
	Zonotrichia albicollis	White-throated sparrow
Falconidae	*Falco columbarius*	Merlin
	Falco peregrinus	Peregrine falcon
	Falco sparverius	American kestrel
Gaviidae	*Gavia immer*	Common loon
	Gavia stellata	Red-throated loon
Hirundinidae	*Hirundo rustica*	Barn swallow
	Iridoprocne bicolor	Tree swallow
	Progne subis	Purple martin
	Stelgidopteryx seripennis	Northern rough-winged swallow
Icteridae	*Agelaius phoeniceus*	Red-winged blackbird
	Euphagus carolinus	Rusty blackbird
	Euphagus cyanocephalus	Brewer's blackbird
	Icterus galbula	Northern oriole
	Icterus spurius	Orchard oriole
	Molothrus ater	Brown-headed cowbird
	Quiscalus major	Boat-tailed grackle
	Quiscalus quiscula	Common grackle
	Sturnella magna	Eastern meadowlark
Laniidae	*Lanius ludovicianus*	Loggerhead shrike
Laridae	*Larus argentatus*	Herring gull
	Larus atricilla	Laughing gull
	Larus delawarensis	Ring-billed gull
	Larus marinus	Great black-backed gull
	Larus philadelphia	Bonaparte's gull
	Sterna caspia	Caspian tern
	Sterna forsteri	Forster's tern
	Sterna hirundo	Common tern
	Sterna maxima	Royal tern
Mimidae	*Dumatella carolinensis*	Gray catbird
	Mimus polyglottus	Northern mockingbird
	Toxostoma rufum	Brown thrasher

Table A-5
Birds Expected to Occur in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Paridae	*Parus bicolor*	Tufted titmouse
	Parus carolinensis	Carolina chickadee
Parulidae	*Dendroica coronata*	Yellow-rumped warbler
	Dendroica discolor	Prairie warbler
	Dendroica dominica	Yellow-throated warbler
	Dendroica palmarum	Palm warbler
	Dendroica pinus	Pine warbler
	Geothylpis trichas	Common yellowthroat
	Limnothlypis swainsonii	Swainson's warbler
	Mniotilta varia	Black-and-white warbler
	Parula americana	Northern parula
	Protondtaria citrea	Prothonotary warbler
	Seiuris aurocapillus	Ovenbird
	Vermivora celata	Orange-crowned warbler
Phalacrocoracidae	*Phalacrocorax auritus*	Double-crested cormorant
Phasianidae	*Colinus virginianus*	Common bobwhite
	Meleagris gallopavo	Wild turkey
Picidae	*Colaptes auratus*	Yellow-shafted flicker
	Dryocopus pileatus	Pileated woodpecker
	Melanerpes carolinus	Red-bellied woodpecker
	Melanerpes erythrocephalus	Red-headed woodpecker
	Picoides pubescens	Downy woodpecker
	Picoides villosus	Hairy woodpecker
	Sphyrapicus varius	Yellow-bellied sapsucker
Ploceidae	*Passer domesticus*	House sparrow
Podicipedidae	*Podiceps auritus*	Horned grebe
	Podilymbus podiceps	Pied-billed grebe
Rallidae	*Fulica americana*	American coot
	Gallinula chloropus	Common gallinule
	Porphyrula martinica	Purple gallinule
	Porzana carolina	Sora rail
	Rallus elegans	King rail
	Rallus limicola	Virginia rail
	Rallus longrostris	Clapper rail
Scolopacidae	*Actitis macularis*	Spotted sandpiper
	Arenaria interpres	Ruddy turnstone
	Calidris alpina	Dunlin
	Calidris canutus	Red knot
	Calidris melanotos	Pectoral sandpiper
	Calidris minutilla	Least sandpiper
	Calidris pusilla	Semipalmated sandpiper
	Capella gallinago	Common snipe
	Catoptrophorus semipalmatus	Willet
	Crocethia alba	Sanderling
	Limnodromus griseus	Short-billed dowitcher
	Limnodromus scolopaceus	Long-billed dowitcher
	Limosa fedoa	Marbled godwit
	Numenius phaeopus	Whimbrel
	Scolopax minor	American woodcock
	Tringa flavipes	Lesser yellowlegs
	Tringa melanoleuca	Greater yellowlegs
	Tringa solitaria	Solitary sandpiper

Table A-5
Birds Expected to Occur in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Sittidae	*Sitta canadensis*	Red-breasted nuthatch
	Sitta carolinensis	White-breasted nuthatch
	Sitta pusilla	Brown-headed nuthatch
Strigidae	*Asio flammeus*	Short-eared owl
	Bubo virginianus	Great horned owl
	Otus asio	Eastern screech owl
	Strix varia	Barred owl
Sturnidae	*Sturnus vulgaris*	European starling
Sylviidae	*Polioptila caerulea*	Blue-gray gnatcatcher
	Regulus calendula	Ruby-crowned kinglet
	Regulus satrapa	Golden-crowned kinglet
Thraupidae	*Piranga rubra*	Summer tanager
Threskiornithidae	*Eudocimus albus*	White ibis
	Plegadis falcinellus	Glossy ibis
Trochilidae	*Archilochus colubris*	Ruby-throated hummingbird
Troglodytidae	*Cistothorus palustris*	Marsh wren
	Cistothorus platensis	Sedge wren
	Thryothorus ludovicianus	Carolina wren
	Troglodytes aedon	House wren
	Troglodytes troglodytes	Winter wren
Turdidae	*Catharus guttata*	Hermit thrush
	Sialia sialis	Eastern bluebird
	Turdus migratorius	American robin
Tyrannidae	*Contopus virene*	Eastern wood pewee
	Empidonax sp.	Flycatcher
	Empidonax virescens	Acadian flycatcher
	Myiarchus crinitus	Great crested flycatcher
	Sayornis phoebe	Eastern phoebe
	Tyrannus tyrannus	Eastern kingbird
Tytonidae	*Tyto alba*	Common barn owl
Vireonidae	*Vireo flavifrons*	Yellow-throated vireo
	Vireo griseus	White-eyed vireo
	Vireo olivaceus	Red-eyed vireo
	Vireo solitarius	Solitary vireo

Source:
Regional distribution for northeastern Florida (Peterson, 1980). Many of these birds are regular or occasional visitors during springs and/or fall migration, and are not resident species.
Cecil Field Gopher Tortoise Survey and Management Plan, CZR Inc., Jacksonville, Florida, November, 1994.

Table A-6
Mammals Expected to Occur in the Vicinity of NAS Cecil Field

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Family	Scientific Name	Common Name
Canidae	*Urocyon cinereoargenteus*	Gray fox
Cervidae	*Odocoileus virginianus*	White-tailed deer
Cricetidae	*Neotoma floridana*	Eastern wood rat
	Oryzomys palustris	Marsh rice rat
	Peromyscus gossypinus	Cotton mouse
	Peromyscus nuttalli	Golden mouse
	Peromyscus polionotus	Old field mouse
	Reithrodontomys humulis	Eastern harvest mouse
	Sigmodon hispidus	Hispid cotton rat
Dasypodidae	*Dasypus novemcinctus*	Nine-banded armadillo
Didelphidae	*Didelphis virginiana*	Virginia oppossum
Felidae	*Lynx rufus*	Bobcat
Geomyidae	*Geomys pinetis*	Southeastern pocket gopher
Leporidae	*Sylvilagus floridanus*	Eastern cottontail
	Sylvilagus palustris	Marsh rabbit
Muridae	*Mus musculus*	House mouse
	Rattus norvegicus	Norway rat
Mustelidae	*Lutra canadensis*	River otter
	Mephitis mephitis	Striped skunk
	Mustela vison	Mink
	Spilogale putorius	Eastern spotted skunk
Procyonidae	*Procyon lotor*	Raccoon
Sciuridae	*Glaucomys volans*	Southern flying squirrel
	Sciurus carolinensis	Gray squirrel
	Sciurus niger shermani	Sherman's fox squirrel
Soricidae	*Blarina brevicauda*	Short-tailed shrew
	Cryptotis parva	Least shrew
	Sorex longirostirs	Southeastern shrew
Suidae	*Sus scrofa*	Wild boar
Talpidae	*Scalopus aquaticus*	Eastern mole
Vespertillionidae	*Eptesicus fuscus*	Big brown bat
	Lasiurus borealis	Red bat
	Lasiurus cinereus	Hoary bat
	Lasiurus intermedius	Northern yellow bat
	Lasiurus seminolus	Semiole bat
	Myotis austroriparius	Southeastern bat
	Pipistrellus subflavus	Eastern pipistrelle
	Plecotus rafinesquii	Eastern big-eared bat

Source:
Specimen records for Duval County, Florida (Ashton and Ashton, 1988 and 1991).

MACROINVERTEBRATE TAXA LIST FOR NAS-CECIL FIELD, JUNE 1996

Tricladida
Nemertea
Nematoda
Oligochaeta
    Lumbriculidae
    Enchytraeidae
    Tubificidae
    Tubificidae imm. w
    Tubificidae imm. w/o
    Limnodrilus hoffmeisteri
    Ilyodrilus templetoni
    Aulodrius pigueti
    Bothrioneurum vejdovskyanum
    Naididae
    Slavina appendiculata
    Dero
    Dero digitata
    Dero flabelliger
    Dero (Aulophorus)
    Dero furcata
    Dero (Dero)
    Nais
    Nais communis
    Pristina osborni
    Pristina aequiseta
    Pristina leidyi
Hirudinea
    Helobdella
    Helobdella elongata
    Helobdella triserialis
    Helobdella fusca
    Glossiphoniidae
    Placobdella papillifera
    Hirudinidae
    Erpobdellidae
    Mooreobdella microstoma
Gastropoda
    Pleuroceridae
    Hydrobiidae
    Lymnaeidae
    Ancylidae
    Planorbidae
    Physella
Pelecypoda
    Corbicula fluminea
    Sphaeriidae
    Unionidae
Arachnoidea
    Acarina

MACROINVERTEBRATE TAXA LIST FOR NAS-CECIL FIELD, JUNE 1996 (Continued)

Malacostraca
- *Asellus*
- Gammaridae
- *Gammarus*
- *Hyalella azteca*
- *Crangonyx*
- *Palaemonetes paludosus*
- Astacidae

Collembola

Ephemeroptera
- *Stenonema*
- *Stenacron*
- Baetidae
- Baetis
- *Callibaetis*
- *Centroptilum*
- Ephemerellidae
- *Caenis*
- *Paraleptophlebia*

Odonata
- Anisoptera
- Aeshnidae
- *Boyeria*
- *Nasiaeschna*
- Gomphidae
- *Dromogomphus*
- *Progomphus*
- Libellulidae
- Corduliidae
- Macromiidae
- Calopterygidae
- *Calopteryx*
- *Hetaerina*
- Coenagrionidae
- *Argia*

Hemiptera
- Belostomatidae
- Corixidae
- Notonectidae

Coleoptera
- *Haliplus*
- *Derovatellus*
- *Laccophilis*
- *Peltodytes*
- Dytiscidae
- *Celina*
- *Gyrinus*
- *Dineutus*
- Hydrophilidae
- *Tropisternus*
- *Berosus*

MACROINVERTEBRATE TAXA LIST FOR NAS-CECIL FIELD, JUNE 1996 (Continued)

Helichus
Elmidae
Stenelmis
Dubiraphia
Microcylloepus
Ancyronyx
Ancyronyx variegata
Curculionidae
Megaloptera
Corydalidae
Corydalus cornutus
Nigronia serricornis
Sialis
Trichoptera
Chimarra
Psychomyiidae
Lype diversa
Psychomyia flavida
Hydropsychidae
Cheumatopsyche
Hydropsyche
Hydroptilidae
Oxethira
Leptoceridae
Oecetis
Phylocentropus
Polycentropodidae
Cyrnellus fraternus
Polycentropus
Lepidoptera
Diptera
Chaoborus
Tipulidae
Tipula
Hexatoma
Bittacomorpha
Ceratopogonidae
Culicidae
Simuliidae
Chironomidae
Orthocladiinae
Tanypodinae
Clinotanypus
Coelotanypus
Procladius
Chironomini
Cricotopus bicinctus
Stenochironomus
Cladotanytarsus
Tanytarsini

MACROINVERTEBRATE TAXA LIST FOR NAS-CECIL FIELD, JUNE 1996 (Continued)

Tanytarsus
Tanytarsus Epler F
Chironomus
Cryptochironomus
Polypedilum fallax
Polypedilum convictum
Polypedilum illnoense
Polypedilum scalaenum
Ablabesmyia
Dicrotendipes
Nanocladius
Paralauterborniella
Rheotanytarsus
Parachironomus
Pentaneura
Parametriocnemus
Paratanytarsus
Larsia
Labrundinia
Nilotanypus
Rheocricotopus
Thienemanniella
Tribelos
Cryptotendipes
Paracladopelma
Phaenopsectra
Cladopelma
Stelechomyia
Xylotopus
Thienemannimyia
Cladotanytarsus
Mesosmittia
Harnischia
Natarsia
Glyptotendipes
Tanypus
Microtendipes
Pseudochironomus
Omisus
Endochironomus
Stictochironomus
Zavreliella
Empididae
Hemerodromia
Psychodidae
Stratiomyidae
Tabanidae

APPENDIX B

APPENDIX B

SURFACE WATER AND SEDIMENT ANALYTICAL DATA

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
18SD1	2-Butanone	17	J	18	ug/kg	16-AUG-93	90091001	AVOL
18SD1	Acetone	71		18	ug/kg	16-AUG-93	90091001	AVOL
18SD1	Benzo (b) fluoranthene	260	J	600	ug/kg	16-AUG-93	90091002	BSVO
18SD1	Benzo (k) fluoranthene	200	J	600	ug/kg	16-AUG-93	90091002	BSVO
18SD1	Chrysene	240	J	600	ug/kg	16-AUG-93	90091002	BSVO
18SD1	Fluoranthene	320	J	600	ug/kg	16-AUG-93	90091002	BSVO
18SD1	Pyrene	420	J	600	ug/kg	16-AUG-93	90091002	BSVO
18SD1	Aluminum	452		40	mg/kg	16-AUG-93	90091002	DMET
18SD1	Arsenic	1.2	J	2	mg/kg	16-AUG-93	90091002	DMET
18SD1	Barium	12.1	J	40	mg/kg	16-AUG-93	90091002	DMET
18SD1	Calcium	1540	J	1000	mg/kg	16-AUG-93	90091002	DMET
18SD1	Copper	5.3	J	5	mg/kg	16-AUG-93	90091002	DMET
18SD1	Iron	3520		20	mg/kg	16-AUG-93	90091002	DMET
18SD1	Lead	7.7	J	1	mg/kg	16-AUG-93	90091002	DMET
18SD1	Magnesium	112	J	1000	mg/kg	16-AUG-93	90091002	DMET
18SD1	Manganese	8.6		3	mg/kg	16-AUG-93	90091002	DMET
18SD1	Zinc	10.8		4	mg/kg	16-AUG-93	90091002	DMET
18SD1	Total organic carbon	15000		5	mg/kg	17-AUG-93	90091002	TOC
18SD1	Total petroleum hydrocarbon	120		1.6	mg/kg	17-AUG-93	90091002	TPH
18SD2	2-Butanone	13	J	14	ug/kg	16-AUG-93	90091003	AVOL
18SD2	Acetone	45		14	ug/kg	16-AUG-93	90091003	AVOL
18SD2	2,4-Dinitrotoluene	93	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Benzo (a) anthracene	170	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Benzo (a) pyrene	87	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Benzo (b) fluoranthene	360	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Benzo (k) fluoranthene	230	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Chrysene	380	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Fluoranthene	380	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	N-Nitrosodiphenylamine (1)	220	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Phenanthrene	84	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Pyrene	430	J	430	ug/kg	16-AUG-93	90091004	BSVO
18SD2	Aluminum	172		40	mg/kg	16-AUG-93	90091004	DMET
18SD2	Arsenic	0.99	J	2	mg/kg	16-AUG-93	90091004	DMET
18SD2	Barium	2.6	J	40	mg/kg	16-AUG-93	90091004	DMET
18SD2	Calcium	175	J	1000	mg/kg	16-AUG-93	90091004	DMET
18SD2	Chromium	3.3		2	mg/kg	16-AUG-93	90091004	DMET
18SD2	Copper	2	J	5	mg/kg	16-AUG-93	90091004	DMET
18SD2	Iron	1010		20	mg/kg	16-AUG-93	90091004	DMET
18SD2	Lead	7.3	J	1	mg/kg	16-AUG-93	90091004	DMET
18SD2	Magnesium	19.5	J	1000	mg/kg	16-AUG-93	90091004	DMET
18SD2	Manganese	4	J	3	mg/kg	16-AUG-93	90091004	DMET
18SD2	Zinc	5.1	J	4	mg/kg	16-AUG-93	90091004	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
18SD2	Total organic carbon	8810		5	mg/kg	17-AUG-93	90091004	TOC
18SD2	Total petroleum hydrocarbon	46.9		1.6	mg/kg	17-AUG-93	90091004	TPH
2SD1	2-Butanone	86	J	100	ug/kg	24-JUN-93	90053020	AVOL
2SD1	Acetone	410		100	ug/kg	24-JUN-93	90053020	AVOL
2SD1	Chlorobenzene	64	J	100	ug/kg	24-JUN-93	90053020	AVOL
2SD1	Fluoranthene	250	J	850	ug/kg	24-JUN-93	90053021	BSVO
2SD1	Pyrene	180	J	850	ug/kg	24-JUN-93	90053021	BSVO
2SD1	Aluminum	2280		40	mg/kg	24-JUN-93	90053021	DMET
2SD1	Barium	32.5	J	40	mg/kg	24-JUN-93	90053021	DMET
2SD1	Cadmium	3.5	J	1	mg/kg	24-JUN-93	90053021	DMET
2SD1	Calcium	3120	J	1000	mg/kg	24-JUN-93	90053021	DMET
2SD1	Iron	37000		20	mg/kg	24-JUN-93	90053021	DMET
2SD1	Lead	9		1	mg/kg	24-JUN-93	90053021	DMET
2SD1	Manganese	24.4		3	mg/kg	24-JUN-93	90053021	DMET
2SD1	Zinc	38.2		4	mg/kg	24-JUN-93	90053021	DMET
2SD1	Total organic carbon	94300		5	mg/kg	24-JUN-93	90053021	TOC
2SD2	2-Butanone	30	J	83	ug/kg	22-JUN-93	70383-10	AVOL
2SD2	Acetone	190	J	83	ug/kg	22-JUN-93	70383-10	AVOL
2SD2	Chlorobenzene	14	J	83	ug/kg	22-JUN-93	70383-10	AVOL
2SD2	Fluoranthene	340	J	2100	ug/kg	22-JUN-93	90050010	BSVO
2SD2	Pyrene	290	J	2100	ug/kg	22-JUN-93	90050010	BSVO
2SD2	Aluminum	2310		40	mg/kg	22-JUN-93	90050010	DMET
2SD2	Barium	61.7	J	40	mg/kg	22-JUN-93	90050010	DMET
2SD2	Calcium	2810	J	1000	mg/kg	22-JUN-93	90050010	DMET
2SD2	Copper	3.9	J	5	mg/kg	22-JUN-93	90050010	DMET
2SD2	Cyanide	1.7	J	1	mg/kg	22-JUN-93	90050010	DMET
2SD2	Iron	124000	J	20	mg/kg	22-JUN-93	90050010	DMET
2SD2	Lead	9.3		1	mg/kg	22-JUN-93	90050010	DMET
2SD2	Magnesium	175	J	1000	mg/kg	22-JUN-93	90050010	DMET
2SD2	Manganese	42.5		3	mg/kg	22-JUN-93	90050010	DMET
2SD2	Mercury	0.39	J	0.1	mg/kg	22-JUN-93	90050010	DMET
2SD2	Nickel	14.2	J	8	mg/kg	22-JUN-93	90050010	DMET
2SD2	Silver	4.5	J	2	mg/kg	22-JUN-93	90050010	DMET
2SD2	Vanadium	10.9	J	10	mg/kg	22-JUN-93	90050010	DMET
2SD2	Zinc	73.4		4	mg/kg	22-JUN-93	90050010	DMET
2SD2	Total organic carbon	35200		5	mg/kg	22-JUN-93	90050010	TOC
2SD2D	2-Butanone	28	J	91	ug/kg	22-JUN-93	70383-11	AVOL
2SD2D	Acetone	170	J	91	ug/kg	22-JUN-93	70383-11	AVOL
2SD2D	Chlorobenzene	12	J	91	ug/kg	22-JUN-93	70383-11	AVOL
2SD2D	Fluoranthene	370	J	2100	ug/kg	22-JUN-93	90050011	BSVO
2SD2D	Pyrene	300	J	2100	ug/kg	22-JUN-93	90050011	BSVO
2SD2D	Aluminum	3220		40	G/KGB	22-JUN-93	90050011	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
2SD2D	Barium	110	J	40	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Cadmium	6.2	J	1	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Calcium	5690	J	1000	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Copper	5.5	J	5	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Iron	233000	J	20	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Manganese	69.9		3	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Mercury	1	J	0.1	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Selenium	5.9	J	1	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Silver	7.5	J	2	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Zinc	94.9		4	G/KGB	22-JUN-93	90050011	DMET
2SD2D	Total organic carbon	46000		5	mg/kg	22-JUN-93	90050011	TOC
2SD2D	Total petroleum hydrocarbon	89		1.6	mg/kg	22-JUN-93	90050011	TPH
2SD3	2-Butanone	23	J	19	ug/kg	24-JUN-93	90053022	AVOL
2SD3	Acetone	220	J	19	ug/kg	24-JUN-93	90053022	AVOL
2SD3	Chlorobenzene	160	J	19	ug/kg	24-JUN-93	90053022	AVOL
2SD3	Toluene	6	J	19	ug/kg	24-JUN-93	90053022	AVOL
2SD3	1,4-Dichlorobenzene	140	J	570	ug/kg	24-JUN-93	90053023	BSVO
2SD3	Acenaphthene	70	J	570	ug/kg	24-JUN-93	90053023	BSVO
2SD3	Aluminum	8180		40	mg/kg	24-JUN-93	90053023	DMET
2SD3	Barium	25.9	J	40	mg/kg	24-JUN-93	90053023	DMET
2SD3	Cadmium	1.3	J	1	mg/kg	24-JUN-93	90053023	DMET
2SD3	Calcium	3830		1000	mg/kg	24-JUN-93	90053023	DMET
2SD3	Chromium	13.1		2	mg/kg	24-JUN-93	90053023	DMET
2SD3	Cyanide	0.72	J	1	mg/kg	24-JUN-93	90053023	DMET
2SD3	Iron	7320		20	mg/kg	24-JUN-93	90053023	DMET
2SD3	Lead	22.4		1	mg/kg	24-JUN-93	90053023	DMET
2SD3	Magnesium	138	J	1000	mg/kg	24-JUN-93	90053023	DMET
2SD3	Manganese	22.8		3	mg/kg	24-JUN-93	90053023	DMET
2SD3	Selenium	3.5		1	mg/kg	24-JUN-93	90053023	DMET
2SD3	Silver	1.4	J	2	mg/kg	24-JUN-93	90053023	DMET
2SD3	Vanadium	17.4	J	10	mg/kg	24-JUN-93	90053023	DMET
2SD3	Zinc	34.5		4	mg/kg	24-JUN-93	90053023	DMET
2SD3	Acid volatile sulfides	0.48		0.1	umole/	24-JUN-93	90053022	MISC
2SD3	Total organic carbon	83700		5	mg/kg	24-JUN-93	90053023	TOC
5SD1	Acetone	42		15	ug/kg	17-AUG-93	90093007	AVOL
5SD1	Ethylbenzene	9	J	15	ug/kg	17-AUG-93	90093007	AVOL
5SD1	Toluene	8	J	15	ug/kg	17-AUG-93	90093007	AVOL
5SD1	Xylenes (total)	53		15	ug/kg	17-AUG-93	90093007	AVOL
5SD1	2-Methylnaphthalene	1500		460	ug/kg	17-AUG-93	90093008	BSVO
5SD1	Fluorene	230	J	460	ug/kg	17-AUG-93	90093008	BSVO
5SD1	Naphthalene	1100		460	ug/kg	17-AUG-93	90093008	BSVO
5SD1	4,4-DDD	27	J	24	ug/kg	17-AUG-93	90093008	CPES

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
5SD1	Aroclor-1260	330	J	240	ug/kg	17-AUG-93	90093008	CPES
5SD1	Aluminum	1210	J	40	mg/kg	17-AUG-93	90093008	DMET
5SD1	Barium	7.2	J	40	mg/kg	17-AUG-93	90093008	DMET
5SD1	Beryllium	0.16	J	1	mg/kg	17-AUG-93	90093008	DMET
5SD1	Calcium	99.9	J	1000	mg/kg	17-AUG-93	90093008	DMET
5SD1	Chromium	1.4	J	2	mg/kg	17-AUG-93	90093008	DMET
5SD1	Iron	141		20	mg/kg	17-AUG-93	90093008	DMET
5SD1	Lead	6.4	J	1	mg/kg	17-AUG-93	90093008	DMET
5SD1	Magnesium	28.8	J	1000	mg/kg	17-AUG-93	90093008	DMET
5SD1	Manganese	0.91	J	3	mg/kg	17-AUG-93	90093008	DMET
5SD1	Zinc	3.9	J	4	mg/kg	17-AUG-93	90093008	DMET
5SD1	Total organic carbon	17100		5	mg/kg	17-AUG-93	90093008	TOC
5SD1	Total petroleum hydrocarbon	1450		1.6	mg/kg	17-AUG-93	90093008	TPH
5SD2	Acetone	13	J	14	ug/kg	25-JUN-93	90054018	AVOL
5SD2	Toluene	20		14	ug/kg	25-JUN-93	90054018	AVOL
5SD2	4-Methylphenol	75	J	520	ug/kg	25-JUN-93	90054019	BSVO
5SD2	Aroclor-1260	70		46	ug/kg	25-JUN-93	90054019	CPES
5SD2	Aluminum	693		40	mg/kg	25-JUN-93	90054019	DMET
5SD2	Barium	4.7	J	40	mg/kg	25-JUN-93	90054019	DMET
5SD2	Calcium	138	J	1000	mg/kg	25-JUN-93	90054019	DMET
5SD2	Chromium	0.92	J	2	mg/kg	25-JUN-93	90054019	DMET
5SD2	Iron	127		20	mg/kg	25-JUN-93	90054019	DMET
5SD2	Lead	3		1	mg/kg	25-JUN-93	90054019	DMET
5SD2	Magnesium	18.3	J	1000	mg/kg	25-JUN-93	90054019	DMET
5SD2	Vanadium	1.5	J	10	mg/kg	25-JUN-93	90054019	DMET
5SD2	Total organic carbon	6410		5	mg/kg	23-JUN-93	90054019	TOC
5SD2	Total petroleum hydrocarbon	170		1.6	mg/kg	25-JUN-93	90054026	TPH
5SD2D	Acetone	12	J	14	ug/kg	25-JUN-93	90054020	AVOL
5SD2D	Di-n-butylphthalate	170	J	520	ug/kg	25-JUN-93	90054021	BSVO
5SD2D	Aroclor-1260	60		47	ug/kg	25-JUN-93	90054021	CPES
5SD2D	Aluminum	765		40	mg/kg	25-JUN-93	90054021	DMET
5SD2D	Barium	4.8	J	40	mg/kg	25-JUN-93	90054021	DMET
5SD2D	Calcium	139	J	1000	mg/kg	25-JUN-93	90054021	DMET
5SD2D	Chromium	1.2	J	2	mg/kg	25-JUN-93	90054021	DMET
5SD2D	Iron	152		20	mg/kg	25-JUN-93	90054021	DMET
5SD2D	Lead	3.5		1	mg/kg	25-JUN-93	90054021	DMET
5SD2D	Magnesium	24.7	J	1000	mg/kg	25-JUN-93	90054021	DMET
5SD2D	Vanadium	1.2	J	10	mg/kg	25-JUN-93	90054021	DMET
5SD2D	Total organic carbon	8040		5	mg/kg	23-JUN-93	90054021	TOC
5SD3	Acetone	13	J	17	ug/kg	25-JUN-93	90054016	AVOL
5SD3	Toluene	13	J	17	ug/kg	25-JUN-93	90054016	AVOL
5SD3	4-Methylphenol	66	J	520	ug/kg	25-JUN-93	90054017	BSVO

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
5SD3	4,4-DDD	8		5	ug/kg	25-JUN-93	90054017	CPES
5SD3	4,4-DDE	3.7	J	5	ug/kg	25-JUN-93	90054017	CPES
5SD3	4,4-DDT	8.6		5	ug/kg	25-JUN-93	90054017	CPES
5SD3	Aroclor-1260	140		48	ug/kg	25-JUN-93	90054017	CPES
5SD3	Aluminum	1970		40	mg/kg	25-JUN-93	90054017	DMET
5SD3	Barium	11.2	J	40	mg/kg	25-JUN-93	90054017	DMET
5SD3	Calcium	304	J	1000	mg/kg	25-JUN-93	90054017	DMET
5SD3	Chromium	2.6	J	2	mg/kg	25-JUN-93	90054017	DMET
5SD3	Iron	203		20	mg/kg	25-JUN-93	90054017	DMET
5SD3	Lead	7.8		1	mg/kg	25-JUN-93	90054017	DMET
5SD3	Magnesium	59.4	J	1000	mg/kg	25-JUN-93	90054017	DMET
5SD3	Vanadium	3.5	J	10	mg/kg	25-JUN-93	90054017	DMET
5SD3	Total organic carbon	13900		5	mg/kg	25-JUN-93	90054017	TOC
5SD3	Total petroleum hydrocarbon	550		1.6	mg/kg	25-JUN-93	90054025	TPH
5SD4	2-Butanone	29	J	50	ug/kg	25-JUN-93	90054014	AVOL
5SD4	Acetone	110		50	ug/kg	25-JUN-93	90054014	AVOL
5SD4	Methylene chloride	11	J	50	ug/kg	25-JUN-93	90054014	AVOL
5SD4	Di-n-octylphthalate	410	J	2100	ug/kg	25-JUN-93	90054015	BSVO
5SD4	bis(2-Ethylhexyl) phthalate	1900	J	2100	ug/kg	25-JUN-93	90054015	BSVO
5SD4	Aluminum	11000		40	mg/kg	25-JUN-93	90054015	DMET
5SD4	Barium	55.4	J	40	mg/kg	25-JUN-93	90054015	DMET
5SD4	Calcium	2160	J	1000	mg/kg	25-JUN-93	90054015	DMET
5SD4	Chromium	10		2	mg/kg	25-JUN-93	90054015	DMET
5SD4	Iron	3370		20	mg/kg	25-JUN-93	90054015	DMET
5SD4	Lead	25		1	mg/kg	25-JUN-93	90054015	DMET
5SD4	Magnesium	341	J	1000	mg/kg	25-JUN-93	90054015	DMET
5SD4	Manganese	8.7	J	3	mg/kg	25-JUN-93	90054015	DMET
5SD4	Vanadium	9.3	J	10	mg/kg	25-JUN-93	90054015	DMET
5SD4	Zinc	39.1		4	mg/kg	25-JUN-93	90054015	DMET
5SD4	Total organic carbon	97600		5	mg/kg	25-JUN-93	90054015	TOC
5SD4	Total petroleum hydrocarbon	717		1.6	mg/kg	25-JUN-93	90054024	TPH
5SD5	2-Butanone	4	J	14	ug/kg	16-AUG-93	90091005	AVOL
5SD5	Acetone	24		14	ug/kg	16-AUG-93	90091005	AVOL
5SD5	Aluminum	366		40	mg/kg	16-AUG-93	90091006	DMET
5SD5	Barium	3	J	40	mg/kg	16-AUG-93	90091006	DMET
5SD5	Calcium	72.1	J	1000	mg/kg	16-AUG-93	90091006	DMET
5SD5	Iron	72.9		20	mg/kg	16-AUG-93	90091006	DMET
5SD5	Magnesium	13.2	J	1000	mg/kg	16-AUG-93	90091006	DMET
5SD5	Manganese	0.51	J	3	mg/kg	16-AUG-93	90091006	DMET
5SD5	Zinc	0.68	J	4	mg/kg	16-AUG-93	90091006	DMET
5SD5	Total organic carbon	3970		5	mg/kg	17-AUG-93	90091006	TOC
5SD5	Total petroleum hydrocarbon	23.3		1.6	mg/kg	17-AUG-93	90091006	TPH

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
5SD6	Aluminum	7060		40	mg/kg	16-AUG-93	90091014	DMET
5SD6	Arsenic	2.6	J	2	mg/kg	16-AUG-93	90091014	DMET
5SD6	Barium	18.7	J	40	mg/kg	16-AUG-93	90091014	DMET
5SD6	Calcium	1670	J	1000	mg/kg	16-AUG-93	90091014	DMET
5SD6	Chromium	10.9		2	mg/kg	16-AUG-93	90091014	DMET
5SD6	Copper	3.7	J	5	mg/kg	16-AUG-93	90091014	DMET
5SD6	Iron	1470		20	mg/kg	16-AUG-93	90091014	DMET
5SD6	Lead	101	J	1	mg/kg	16-AUG-93	90091014	DMET
5SD6	Magnesium	140	J	1000	mg/kg	16-AUG-93	90091014	DMET
5SD6	Manganese	5.1	J	3	mg/kg	16-AUG-93	90091014	DMET
5SD6	Mercury	0.09		0.1	mg/kg	16-AUG-93	90091014	DMET
5SD6	Vanadium	10.2	J	10	mg/kg	16-AUG-93	90091014	DMET
5SD6	Zinc	45.5		4	mg/kg	16-AUG-93	90091014	DMET
5SD6	Total organic carbon	33200		5	mg/kg	16-AUG-93	90091014	DMET
5SD6	Total petroleum hydrocarbon	40.1		1.6	mg/kg	17-AUG-93	90091014	TOC
5SD7	Acetone	830		42	ug/kg	17-AUG-93	90091014	TPH
5SD7	Aluminum	12700		40	mg/kg	17-AUG-93	90093005	AVOL
5SD7	Arsenic	4.5	J	2	mg/kg	17-AUG-93	90093006	DMET
5SD7	Barium	27.5	J	40	mg/kg	17-AUG-93	90093006	DMET
5SD7	Beryllium	0.63	J	1	mg/kg	17-AUG-93	90093006	DMET
5SD7	Calcium	4140		1000	mg/kg	17-AUG-93	90093006	DMET
5SD7	Chromium	16.7		2	mg/kg	17-AUG-93	90093006	DMET
5SD7	Iron	2730		20	mg/kg	17-AUG-93	90093006	DMET
5SD7	Lead	129	J	1	mg/kg	17-AUG-93	90093006	DMET
5SD7	Magnesium	329	J	1000	mg/kg	17-AUG-93	90093006	DMET
5SD7	Manganese	13		3	mg/kg	17-AUG-93	90093006	DMET
5SD7	Mercury	0.17		0.1	mg/kg	17-AUG-93	90093006	DMET
5SD7	Sodium	123	J	1000	mg/kg	17-AUG-93	90093006	DMET
5SD7	Zinc	81.8		4	mg/kg	17-AUG-93	90093006	DMET
5SD7	Total organic carbon	108000		5	mg/kg	17-AUG-93	90093006	DMET
5SD7	Total petroleum hydrocarbon	42.9		1.6	mg/kg	17-AUG-93	90093006	TOC
6SD1	4,4-DDE	3.5	J	5	ug/kg	28-JUN-93	90057008	TPH
6SD1	alpha-Chlordane	13		3	ug/kg	28-JUN-93	90057008	CPES
6SD1	gamma-Chlordane	13		3	ug/kg	28-JUN-93	90057008	CPES
6SD1	Aluminum	1120		40	mg/kg	28-JUN-93	90057008	CPES
6SD1	Barium	8.6	J	40	mg/kg	28-JUN-93	90057008	DMET
6SD1	Calcium	6130		1000	mg/kg	28-JUN-93	90057008	DMET
6SD1	Copper	3.8	J	5	mg/kg	28-JUN-93	90057008	DMET
6SD1	Iron	998		20	mg/kg	28-JUN-93	90057008	DMET
6SD1	Lead	5.2		1	mg/kg	28-JUN-93	90057008	DMET
6SD1	Magnesium	120	J	1000	mg/kg	28-JUN-93	90057008	DMET
6SD1	Manganese	8.5		3	mg/kg	28-JUN-93	90057008	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
6SD1	Zinc	48.1		4	mg/kg	28-JUN-93	90057008	DMET
6SD1	Total organic carbon	43200		5	mg/kg	28-JUN-93	90057008	TOC
8SD1	Acetone	3	J	13	ug/kg	21-JUN-93	70388-4	AVOL
8SD1	Aluminum	1130		40	mg/kg	21-JUN-93	90049005	DMET
8SD1	Barium	0.41	J	40	mg/kg	21-JUN-93	90049005	DMET
8SD1	Calcium	156	J	1000	mg/kg	21-JUN-93	90049005	DMET
8SD1	Copper	5.6	J	5	mg/kg	21-JUN-93	90049005	DMET
8SD1	Iron	43		20	mg/kg	21-JUN-93	90049005	DMET
8SD1	Magnesium	85.3	J	1000	mg/kg	21-JUN-93	90049005	DMET
8SD1	Total organic carbon	4050		5	mg/kg	21-JUN-93	90049005	TOC
8SD2	Di-n-butylphthalate	1400		440	ug/kg	21-JUN-93	90049006	BSVO
8SD2	bis(2-Ethylhexyl) phthalate	210	J	440	ug/kg	21-JUN-93	90049006	BSVO
8SD2	Aluminum	465		40	mg/kg	21-JUN-93	90049006	DMET
8SD2	Iron	37.9		20	mg/kg	21-JUN-93	90049006	DMET
8SD2	Total organic carbon	2140		5	mg/kg	21-JUN-93	90049006	TOC
9SD1	bis(2-Ethylhexyl) phthalate	200	J	410	ug/kg	27-JUN-93	90056013	BSVO
9SD1	Aroclor-1254	33	J	44	ug/kg	27-JUN-93	90056013	CPES
9SD1	Aluminum	681		40	mg/kg	27-JUN-93	90056013	DMET
9SD1	Iron	289	J	20	mg/kg	27-JUN-93	90056013	DMET
9SD1	Lead	1.5	J	1	mg/kg	27-JUN-93	90056013	DMET
9SD1	Selenium	0.53	J	1	mg/kg	27-JUN-93	90056013	DMET
9SD1	Vanadium	2.4	J	10	mg/kg	27-JUN-93	90056013	DMET
9SD1	Zinc	4	J	4	mg/kg	27-JUN-93	90056013	DMET
9SD1	Total organic carbon	2590		5	mg/kg	27-JUN-93	90056013	TOC
GCSD1	4-Methylphenol	88	J	550	ug/kg	27-JUN-93	90056019	BSVO
GCSD1	Benzo (b) fluoranthene	66	J	550	ug/kg	27-JUN-93	90056019	BSVO
GCSD1	Chrysene	72	J	550	ug/kg	27-JUN-93	90056019	BSVO
GCSD1	Fluoranthene	130	J	550	ug/kg	27-JUN-93	90056019	BSVO
GCSD1	Phenanthrene	73	J	550	ug/kg	27-JUN-93	90056019	BSVO
GCSD1	Pyrene	120	J	550	ug/kg	27-JUN-93	90056019	BSVO
GCSD1	alpha-Chlordane	3.3		2	ug/kg	27-JUN-93	90056019	CPES
GCSD1	Aluminum	827		40	mg/kg	27-JUN-93	90056019	DMET
GCSD1	Barium	6.6	J	40	mg/kg	27-JUN-93	90056019	DMET
GCSD1	Iron	385	J	20	mg/kg	27-JUN-93	90056019	DMET
GCSD1	Lead	7.1		1	mg/kg	27-JUN-93	90056019	DMET
GCSD1	Manganese	2.3	J	3	mg/kg	27-JUN-93	90056019	DMET
GCSD1	Vanadium	1.2	J	10	mg/kg	27-JUN-93	90056019	DMET
GCSD1	Zinc	10.4		4	mg/kg	27-JUN-93	90056019	DMET
GCSD1	Total organic carbon	12200		5	mg/kg	27-JUN-93	90056019	TOC
GCSD19	Di-n-butylphthalate	180	J	550	ug/kg	28-APR-95	A499H	BSVO
GCSD19	Aluminum	2340	J	40	mg/kg	28-APR-95	A499H	DMET
GCSD19	Barium	14.5		40	mg/kg	28-APR-95	A499H	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
GCSD19	Calcium	1360		1000	mg/kg	28-APR-95	A499H	DMET
GCSD19	Chromium	5.1	J	2	mg/kg	28-APR-95	A499H	DMET
GCSD19	Copper	3.7		5	mg/kg	28-APR-95	A499H	DMET
GCSD19	Iron	968		20	mg/kg	28-APR-95	A499H	DMET
GCSD19	Lead	17		0.6	mg/kg	28-APR-95	A499H	DMET
GCSD19	Magnesium	91.3		1000	mg/kg	28-APR-95	A499H	DMET
GCSD19	Manganese	4.7		3	mg/kg	28-APR-95	A499H	DMET
GCSD19	Nickel	1.5	J	8	mg/kg	28-APR-95	A499H	DMET
GCSD19	Sodium	266		1000	mg/kg	28-APR-95	A499H	DMET
GCSD19	Vanadium	4.8		10	mg/kg	28-APR-95	A499H	DMET
GCSD19	Total organic carbon	23000		330	mg/kg	28-APR-95	A5D290010005	TOC
GCSD2	Di-n-butylphthalate	310	J	580	ug/kg	26-JUN-93	90055012	BSVO
GCSD2	4,4-DDE	6.4		6	ug/kg	26-JUN-93	90055012	CPES
GCSD2	Aroclor-1254	180		56	ug/kg	26-JUN-93	90055012	CPES
GCSD2	Aroclor-1260	97		56	ug/kg	26-JUN-93	90055012	CPES
GCSD2	gamma-Chlordane	11		3	ug/kg	26-JUN-93	90055012	CPES
GCSD2	Aluminum	2670		40	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Barium	16.7	J	40	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Cadmium	1.1	J	1	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Calcium	1680	J	1000	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Copper	14.9		5	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Iron	1320		20	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Lead	16.9		1	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Magnesium	237	J	1000	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Manganese	6.1		3	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Vanadium	4.8	J	10	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Zinc	44.7		4	mg/kg	26-JUN-93	90055012	DMET
GCSD2	Total organic carbon	22600		5	mg/kg	26-JUN-93	90055012	TOC
GCSD3	alpha-Chlordane	8.2		3	ug/kg	30-JUN-93	90059008	CPES
GCSD3	Aluminum	2830		40	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Arsenic	2.1	J	2	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Barium	18.6	J	40	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Calcium	3220	J	1000	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Chromium	4.4		2	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Copper	3.7	J	5	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Iron	2150		20	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Lead	11	J	1	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Magnesium	167	J	1000	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Manganese	11.7		3	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Zinc	38.7	J	4	mg/kg	30-JUN-93	90059008	DMET
GCSD3	Total organic carbon	9900		5	mg/kg	30-JUN-93	90059008	TOC
GCSD4	2-Butanone	30	J	30	ug/kg	30-JUN-93	90059009	AVOL

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
GCSD4	Acetone	240		30	ug/kg	30-JUN-93	90059009	AVOL
GCSD4	4-Methylphenol	160	J	610	ug/kg	30-JUN-93	90059010	BSVO
GCSD4	alpha-Chlordane	19	J	5	ug/kg	30-JUN-93	90059010	CPES
GCSD4	gamma-Chlordane	15	J	5	ug/kg	30-JUN-93	90059010	CPES
GCSD4	Aluminum	1060		40	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Arsenic	1.7	J	2	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Barium	12	J	40	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Calcium	780	J	1000	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Copper	5.7	J	5	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Iron	323		20	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Lead	3.6	J	1	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Magnesium	94.4	J	1000	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Sodium	90.7	J	1000	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Zinc	19.2	J	4	mg/kg	30-JUN-93	90059010	DMET
GCSD4	Total organic carbon	15400		5	mg/kg	30-JUN-93	90059010	TOC
GCSD5	4-Methylphenol	100	J	440	ug/kg	30-JUN-93	90059012	BSVO
GCSD5	alpha-Chlordane	360	J	62	ug/kg	30-JUN-93	90059012	CPES
GCSD5	gamma-Chlordane	430	J	62	ug/kg	30-JUN-93	90059012	CPES
GCSD5	Aluminum	4850		40	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Arsenic	5.1	J	2	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Barium	4.9	J	40	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Calcium	6550	J	1000	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Chromium	9.4		2	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Copper	12.9		5	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Iron	1400		20	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Lead	8.6	J	1	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Magnesium	232	J	1000	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Manganese	8.6	J	3	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Zinc	56.2	J	4	mg/kg	30-JUN-93	90059012	DMET
GCSD5	Total organic carbon	5390		5	mg/kg	30-JUN-93	90059012	TOC
GCSD5D	2-Butanone	8	J	14	ug/kg	30-JUN-93	90059013	AVOL
GCSD5D	Toluene	31		14	ug/kg	30-JUN-93	90059013	AVOL
GCSD5D	alpha-Chlordane	350	J	58	ug/kg	30-JUN-93	90059014	CPES
GCSD5D	gamma-Chlordane	420	J	58	ug/kg	30-JUN-93	90059014	CPES
GCSD5D	Aluminum	6190		40	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Arsenic	9.9	J	2	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Barium	6	J	40	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Calcium	4760	J	1000	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Chromium	11.3		2	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Copper	10.5		5	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Iron	2130		20	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Lead	7.9	J	1	mg/kg	30-JUN-93	90059014	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
GCSD5D	Magnesium	212	J	1000	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Manganese	5	J	3	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Mercury	0.13		0.1	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Potassium	129	J	1000	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Zinc	37.5	J	4	mg/kg	30-JUN-93	90059014	DMET
GCSD5D	Total organic carbon	6690		5	mg/kg	30-JUN-93	90059014	TOC
LFSD1	Di-n-butylphthalate	910	J	820	ug/kg	23-JUN-93	90052029	BSVO
LFSD1	4,4-DDE	8.4		8	ug/kg	23-JUN-93	90052029	CPES
LFSD1	Aroclor-1254	250		82	ug/kg	23-JUN-93	90052029	CPES
LFSD1	Aroclor-1260	160		82	ug/kg	23-JUN-93	90052029	CPES
LFSD1	alpha-Chlordane	4.8		4	ug/kg	23-JUN-93	90052029	CPES
LFSD1	gamma-Chlordane	4	J	4	ug/kg	23-JUN-93	90052029	CPES
LFSD1	Aluminum	10600		40	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Barium	38.3	J	40	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Calcium	2670		1000	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Chromium	11.3		2	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Copper	27.6		5	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Iron	3270		20	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Lead	40.7		1	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Magnesium	627	J	1000	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Manganese	14.1	J	3	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Mercury	0.16		0.1	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Vanadium	12.2	J	10	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Zinc	85.2		4	mg/kg	23-JUN-93	90052029	DMET
LFSD1	Total organic carbon	69700		5	mg/kg	23-JUN-93	90052029	TOC
LFSD10	Di-n-butylphthalate	60	J	440	ug/kg	28-APR-95	A499G	BSVO
LFSD10	Aluminum	912	J	40	mg/kg	28-APR-95	A499G	DMET
LFSD10	Barium	4.6		40	mg/kg	28-APR-95	A499G	DMET
LFSD10	Calcium	585		1000	mg/kg	28-APR-95	A499G	DMET
LFSD10	Chromium	3.1	J	2	mg/kg	28-APR-95	A499G	DMET
LFSD10	Copper	1.4		5	mg/kg	28-APR-95	A499G	DMET
LFSD10	Iron	415		20	mg/kg	28-APR-95	A499G	DMET
LFSD10	Lead	3.4		0.6	mg/kg	28-APR-95	A499G	DMET
LFSD10	Magnesium	55.8		1000	mg/kg	28-APR-95	A499G	DMET
LFSD10	Manganese	4.8		3	mg/kg	28-APR-95	A499G	DMET
LFSD10	Nickel	1.5	J	8	mg/kg	28-APR-95	A499G	DMET
LFSD10	Sodium	196		1000	mg/kg	28-APR-95	A499G	DMET
LFSD10	Vanadium	1.6		10	mg/kg	28-APR-95	A499G	DMET
LFSD10	Total organic carbon	9200		270	mg/kg	28-APR-95	A5D290010004	TOC
LFSD11	Di-n-butylphthalate	140	J	520	ug/kg	26-APR-95	A47LX	BSVO
LFSD11	4,4-DDE	0.27	J	5	ug/kg	26-APR-95	A47LX	CPES
LFSD11	Aroclor-1260	4.1	J	53	ug/kg	26-APR-95	A47LX	CPES

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSD11	alpha-Chlordane	0.22	J	3	ug/kg	26-APR-95	A47LX	CPES
LFSD11	gamma-Chlordane	0.13	J	3	ug/kg	26-APR-95	A47LX	CPES
LFSD11	Aluminum	1800	J	40	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Barium	10.4		40	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Calcium	2900		1000	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Chromium	4	J	2	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Cobalt	0.8	J	10	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Copper	3.7		5	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Iron	1220		20	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Lead	14.8		0.6	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Magnesium	104		1000	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Manganese	7		3	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Nickel	1.9	J	8	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Potassium	18.6		1000	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Sodium	251		1000	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Vanadium	4.2		10	mg/kg	26-APR-95	A47LX	DMET
LFSD11	Total organic carbon	20000		320	mg/kg	26-APR-95	A47LX	DMET
LFSD12	Di-n-butylphthalate	110	J	520	ug/kg	26-APR-95	A5D270011001	TOC
LFSD12	Aluminum	1060	J	40	mg/kg	26-APR-95	A47M1	BSVO
LFSD12	Barium	6		40	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Calcium	5880		1000	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Chromium	5.8	J	2	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Copper	2.3		5	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Cyanide	0.18	J	0.5	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Iron	542		20	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Lead	4.7		0.6	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Magnesium	2980		1000	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Manganese	13.1		3	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Nickel	3.2	J	8	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Potassium	18.5		1000	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Sodium	220		1000	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Vanadium	2		10	mg/kg	26-APR-95	A47M1	DMET
LFSD12	Total organic carbon	5800		160	mg/kg	26-APR-95	A5D270011002	TOC
LFSD13	Di-n-butylphthalate	83	J	610	ug/kg	26-APR-95	A47M3	BSVO
LFSD13	Aluminum	2250	J	40	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Barium	7.7		40	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Calcium	523		1000	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Chromium	2.9	J	2	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Copper	3.2		5	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Iron	563		20	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Lead	6.4		0.6	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Magnesium	102		1000	mg/kg	26-APR-95	A47M3	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSD13	Manganese	3.1		3	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Nickel	1.5		8	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Potassium	27.4		1000	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Sodium	293		1000	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Vanadium	3.4		10	mg/kg	26-APR-95	A47M3	DMET
LFSD13	Total organic carbon	34000		370	mg/kg	26-APR-95	A47M3	DMET
LFSD14	Di-n-butylphthalate	380	J	2100	ug/kg	26-APR-95	A5D270011003	TOC
LFSD14	4,4-DDE	0.87	J	22	ug/kg	26-APR-95	A47M4	BSVO
LFSD14	Aluminum	10700	J	40	mg/kg	26-APR-95	A47M4	CPES
LFSD14	Arsenic	7.7		20	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Barium	101		40	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Cadmium	1.4		1	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Calcium	8300		1000	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Chromium	14.2	J	2	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Copper	32.7		5	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Iron	4110		20	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Lead	75.8		0.6	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Magnesium	789		1000	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Manganese	19.7		3	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Nickel	7.9	J	8	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Potassium	110		1000	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Sodium	1060		1000	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Vanadium	17.6		10	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Zinc	132		4	mg/kg	26-APR-95	A47M4	DMET
LFSD14	Total organic carbon	160000		3300	mg/kg	26-APR-95	A47M4	DMET
LFSD15	Di-n-butylphthalate	38	J	520	ug/kg	27-APR-95	A5D270011004	TOC
LFSD15	Aroclor-1260	14	J	53	ug/kg	27-APR-95	A4965	BSVO
LFSD15	Endrin aldehyde	0.31	J	5	ug/kg	27-APR-95	A4965	CPES
LFSD15	alpha-Chlordane	2.4	J	3	ug/kg	27-APR-95	A4965	CPES
LFSD15	Aluminum	2440	J	40	mg/kg	27-APR-95	A4965	CPES
LFSD15	Barium	10.9		40	mg/kg	27-APR-95	A4965	DMET
LFSD15	Cadmium	0.46		1	mg/kg	27-APR-95	A4965	DMET
LFSD15	Calcium	1090		1000	mg/kg	27-APR-95	A4965	DMET
LFSD15	Chromium	4.3	J	2	mg/kg	27-APR-95	A4965	DMET
LFSD15	Copper	6.7		5	mg/kg	27-APR-95	A4965	DMET
LFSD15	Cyanide	0.21	J	0.5	mg/kg	27-APR-95	A4965	DMET
LFSD15	Iron	869		20	mg/kg	27-APR-95	A4965	DMET
LFSD15	Lead	11.4		0.6	mg/kg	27-APR-95	A4965	DMET
LFSD15	Magnesium	96.4		1000	mg/kg	27-APR-95	A4965	DMET
LFSD15	Manganese	5.8		3	mg/kg	27-APR-95	A4965	DMET
LFSD15	Nickel	2.1	J	8	mg/kg	27-APR-95	A4965	DMET
LFSD15	Potassium	41.8		1000	mg/kg	27-APR-95	A4965	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSD15	Sodium	204		1000	mg/kg	27-APR-95	A4965	DMET
LFSD15	Vanadium	4.3		10	mg/kg	27-APR-95	A4965	DMET
LFSD15	Total organic carbon	15000		160	mg/kg	27-APR-95	A5D280074001	TOC
LFSD16	Di-n-butylphthalate	73	J	480	ug/kg	27-APR-95	A4966	BSVO
LFSD16	Aroclor-1260	3	J	48	ug/kg	27-APR-95	A4966	CPES
LFSD16	Aluminum	2890	J	40	mg/kg	27-APR-95	A4966	DMET
LFSD16	Barium	11.6		40	mg/kg	27-APR-95	A4966	DMET
LFSD16	Calcium	746		1000	mg/kg	27-APR-95	A4966	DMET
LFSD16	Chromium	7.9	J	2	mg/kg	27-APR-95	A4966	DMET
LFSD16	Copper	5.8		5	mg/kg	27-APR-95	A4966	DMET
LFSD16	Cyanide	0.26	J	0.5	mg/kg	27-APR-95	A4966	DMET
LFSD16	Iron	1020		20	mg/kg	27-APR-95	A4966	DMET
LFSD16	Lead	10		0.6	mg/kg	27-APR-95	A4966	DMET
LFSD16	Magnesium	109		1000	mg/kg	27-APR-95	A4966	DMET
LFSD16	Manganese	5		3	mg/kg	27-APR-95	A4966	DMET
LFSD16	Nickel	4.4	J	8	mg/kg	27-APR-95	A4966	DMET
LFSD16	Potassium	35		1000	mg/kg	27-APR-95	A4966	DMET
LFSD16	Sodium	227		1000	mg/kg	27-APR-95	A4966	DMET
LFSD16	Vanadium	4		10	mg/kg	27-APR-95	A4966	DMET
LFSD16	Total organic carbon	12000		150	mg/kg	27-APR-95	A5D280074002	TOC
LFSD17	Di-n-butylphthalate	200	J	520	ug/kg	27-APR-95	A4967	BSVO
LFSD17	4,4-DDE	0.18	J	5	ug/kg	27-APR-95	A4967	CPES
LFSD17	alpha-Chlordane	0.18	J	3	ug/kg	27-APR-95	A4967	CPES
LFSD17	Aluminum	3690	J	40	mg/kg	27-APR-95	A4967	DMET
LFSD17	Barium	15.5		40	mg/kg	27-APR-95	A4967	DMET
LFSD17	Calcium	1050		1000	mg/kg	27-APR-95	A4967	DMET
LFSD17	Chromium	6.6	J	2	mg/kg	27-APR-95	A4967	DMET
LFSD17	Copper	6.6		5	mg/kg	27-APR-95	A4967	DMET
LFSD17	Cyanide	0.41	J	0.5	mg/kg	27-APR-95	A4967	DMET
LFSD17	Iron	949		20	mg/kg	27-APR-95	A4967	DMET
LFSD17	Lead	14.7		0.6	mg/kg	27-APR-95	A4967	DMET
LFSD17	Magnesium	159		1000	mg/kg	27-APR-95	A4967	DMET
LFSD17	Manganese	8.2		3	mg/kg	27-APR-95	A4967	DMET
LFSD17	Nickel	2.9	J	8	mg/kg	27-APR-95	A4967	DMET
LFSD17	Potassium	53.2		1000	mg/kg	27-APR-95	A4967	DMET
LFSD17	Sodium	232		1000	mg/kg	27-APR-95	A4967	DMET
LFSD17	Vanadium	6.5		10	mg/kg	27-APR-95	A4967	DMET
LFSD17	Total organic carbon	19000		160	mg/kg	27-APR-95	A5D280074003	TOC
LFSD17D	Di-n-butylphthalate	170	J	510	ug/kg	27-APR-95	A4968	BSVO
LFSD17D	4,4-DDE	0.21	J	5	ug/kg	27-APR-95	A4968	CPES
LFSD17D	Dieldrin	0.46	J	5	ug/kg	27-APR-95	A4968	CPES
LFSD17D	alpha-Chlordane	0.2	J	3	ug/kg	27-APR-95	A4968	CPES

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSD17D	Aluminum	1940	J	40	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Barium	10.6		40	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Calcium	811		1000	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Chromium	4.3	J	2	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Copper	4.4		5	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Cyanide	0.41	J	0.5	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Iron	622		20	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Lead	9.8		0.6	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Magnesium	89.7		1000	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Manganese	3.7		3	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Nickel	2.1		8	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Potassium	18.8	J	1000	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Sodium	288		1000	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Vanadium	4.3		10	mg/kg	27-APR-95	A4968	DMET
LFSD17D	Total organic carbon	18000		150	mg/kg	27-APR-95	A5D280074004	TOC
LFSD2	Benzo (b) fluoranthene	91	J	610	ug/kg	23-JUN-93	90052027	BSVO
LFSD2	Chrysene	67	J	610	ug/kg	23-JUN-93	90052027	BSVO
LFSD2	Di-n-butylphthalate	660	J	610	ug/kg	23-JUN-93	90052027	BSVO
LFSD2	Pyrene	81	J	610	ug/kg	23-JUN-93	90052027	BSVO
LFSD2	4,4-DDD	4.1	J	6	ug/kg	23-JUN-93	90052027	CPES
LFSD2	4,4-DDE	18		6	ug/kg	23-JUN-93	90052027	CPES
LFSD2	4,4-DDT	2.2	J	6	ug/kg	23-JUN-93	90052027	CPES
LFSD2	Aroclor-1254	91		61	ug/kg	23-JUN-93	90052027	CPES
LFSD2	Aroclor-1260	62		61	ug/kg	23-JUN-93	90052027	CPES
LFSD2	Aluminum	5940		40	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Barium	27.8	J	40	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Calcium	2040	J	1000	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Chromium	6.3		2	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Copper	9.4	J	5	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Iron	1720		20	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Magnesium	188	J	1000	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Manganese	7.4	J	3	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Vanadium	7.3	J	10	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Zinc	22.9		4	mg/kg	23-JUN-93	90052027	DMET
LFSD2	Total organic carbon	52500		5	mg/kg	23-JUN-93	90052027	DMET
LFSD3	Di-n-butylphthalate	1000	J	890	ug/kg	23-JUN-93	90052027	TOC
LFSD3	Aluminum	4860		40	mg/kg	23-JUN-93	90052021	BSVO
LFSD3	Barium	15.7	J	40	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Calcium	915	J	1000	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Copper	10.8		5	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Iron	1580		20	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Lead	12.1		1	mg/kg	23-JUN-93	90052021	DMET

Appendix B-1 - Sediment Data
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Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSD3	Magnesium	165	J	1000	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Manganese	7.6	J	3	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Mercury	0.16		0.1	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Vanadium	6.9	J	10	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Zinc	39.6		4	mg/kg	23-JUN-93	90052021	DMET
LFSD3	Total organic carbon	20400		5	mg/kg	23-JUN-93	90052021	TOC
LFSD4	Di-n-butylphthalate	740	J	780	ug/kg	23-JUN-93	90052019	BSVO
LFSD4	bis(2-Ethylhexyl) phthalate	430	J	780	ug/kg	23-JUN-93	90052019	BSVO
LFSD4	4,4-DDE	2.7	J	7	ug/kg	23-JUN-93	90052019	CPES
LFSD4	Aroclor-1254	100		67	ug/kg	23-JUN-93	90052019	CPES
LFSD4	Aroclor-1260	68		67	ug/kg	23-JUN-93	90052019	CPES
LFSD4	Aluminum	7230		40	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Barium	24.4	J	40	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Calcium	1550	J	1000	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Chromium	7.1		2	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Copper	13.4		5	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Iron	2160		20	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Lead	16.1		1	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Magnesium	261	J	1000	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Manganese	9	J	3	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Mercury	0.08		0.1	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Vanadium	8.8	J	10	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Zinc	54		4	mg/kg	23-JUN-93	90052019	DMET
LFSD4	Total organic carbon	37200		5	mg/kg	23-JUN-93	90052019	TOC
LFSD5	Di-n-butylphthalate	740	J	700	ug/kg	23-JUN-93	90052017	BSVO
LFSD5	bis(2-Ethylhexyl) phthalate	310	J	700	ug/kg	23-JUN-93	90052017	BSVO
LFSD5	Aluminum	2160		40	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Barium	8.7	J	40	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Calcium	597	J	1000	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Copper	3.8	J	5	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Iron	967		20	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Lead	6.8		1	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Magnesium	83.5	J	1000	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Manganese	5.2	J	3	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Zinc	20.9		4	mg/kg	23-JUN-93	90052017	DMET
LFSD5	Total organic carbon	15400		5	mg/kg	23-JUN-93	90052017	TOC
LFSD6	2-Butanone	27	J	42	ug/kg	23-JUN-93	90052014	AVOL
LFSD6	Di-n-butylphthalate	380	J	520	ug/kg	23-JUN-93	90052015	BSVO
LFSD6	bis(2-Ethylhexyl) phthalate	300	J	520	ug/kg	23-JUN-93	90052015	BSVO
LFSD6	4,4-DDE	18	J	18	ug/kg	23-JUN-93	90052015	CPES
LFSD6	Aroclor-1254	830		180	ug/kg	23-JUN-93	90052015	CPES
LFSD6	Aroclor-1260	550		180	ug/kg	23-JUN-93	90052015	CPES

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSD6	alpha-Chlordane	6.2	J	9	ug/kg	23-JUN-93	90052015	CPES
LFSD6	gamma-Chlordane	6.9	J	9	ug/kg	23-JUN-93	90052015	CPES
LFSD6	Aluminum	20800		40	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Barium	79.7	J	40	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Cadmium	3.5	J	1	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Calcium	5390		1000	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Chromium	24.5		2	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Cobalt	4.1	J	10	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Copper	40.5		5	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Iron	7740		20	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Lead	67.7		1	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Magnesium	692	J	1000	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Manganese	30.6	J	3	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Mercury	0.23		0.1	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Nickel	12.7	J	8	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Selenium	2.2	J	1	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Vanadium	25.2	J	10	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Zinc	180		4	mg/kg	23-JUN-93	90052015	DMET
LFSD6	Total organic carbon	93000		5	mg/kg	23-JUN-93	90052015	TOC
LFSD7	Di-n-butylphthalate	2000	J	1900	ug/kg	23-JUN-93	90052012	BSVO
LFSD7	4,4-DDE	2.3	J	6	ug/kg	23-JUN-93	90052012	CPES
LFSD7	Aluminum	5590		40	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Barium	23.9	J	40	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Calcium	3710		1000	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Chromium	8.7		2	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Copper	27.8		5	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Iron	2770		20	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Lead	27.5		1	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Magnesium	484	J	1000	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Manganese	19.1	J	3	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Mercury	0.11		0.1	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Vanadium	12.7	J	10	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Zinc	81.7		4	mg/kg	23-JUN-93	90052012	DMET
LFSD7	Total organic carbon	22200		5	mg/kg	23-JUN-93	90052012	TOC
LFSD8	4-Methylphenol	77	J	570	ug/kg	23-JUN-93	90052023	BSVO
LFSD8	Di-n-butylphthalate	570	J	570	ug/kg	23-JUN-93	90052023	BSVO
LFSD8	Aluminum	2720		40	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Antimony	9.6	J	12	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Barium	8.8	J	40	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Calcium	350	J	1000	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Copper	3.9	J	5	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Iron	586		20	mg/kg	23-JUN-93	90052023	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSD8	Lead	6.2		1	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Magnesium	89.3	J	1000	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Manganese	3.1	J	3	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Zinc	20.9		4	mg/kg	23-JUN-93	90052023	DMET
LFSD8	Total organic carbon	60900		5	mg/kg	23-JUN-93	90052023	TOC
LFSD8D	4-Methylphenol	190	J	630	ug/kg	23-JUN-93	90052025	BSVO
LFSD8D	Di-n-butylphthalate	700	J	630	ug/kg	23-JUN-93	90052025	BSVO
LFSD8D	Di-n-octylphthalate	160	J	630	ug/kg	23-JUN-93	90052025	BSVO
LFSD8D	Aluminum	1960		40	mg/kg	23-JUN-93	90052025	DMET
LFSD8D	Barium	6.8	J	40	mg/kg	23-JUN-93	90052025	DMET
LFSD8D	Calcium	311	J	1000	mg/kg	23-JUN-93	90052025	DMET
LFSD8D	Copper	3.1	J	5	mg/kg	23-JUN-93	90052025	DMET
LFSD8D	Magnesium	62.5	J	1000	mg/kg	23-JUN-93	90052025	DMET
LFSD8D	Vanadium	2.8	J	10	mg/kg	23-JUN-93	90052025	DMET
LFSD8D	Zinc	17.1		4	mg/kg	23-JUN-93	90052025	DMET
LFSD8D	Total organic carbon	10200		5	mg/kg	23-JUN-93	90052025	TOC
LFSD9	Di-n-butylphthalate	34	J	480	ug/kg	28-APR-95	A499E	BSVO
LFSD9	4,4-DDE	0.66	J	5	ug/kg	28-APR-95	A499E	CPES
LFSD9	Endosulfan II	0.23	J	5	ug/kg	28-APR-95	A499E	CPES
LFSD9	alpha-Chlordane	0.38	J	2	ug/kg	28-APR-95	A499E	CPES
LFSD9	Aluminum	1300	J	40	mg/kg	28-APR-95	A499E	DMET
LFSD9	Barium	6.1		40	mg/kg	28-APR-95	A499E	DMET
LFSD9	Calcium	1110		1000	mg/kg	28-APR-95	A499E	DMET
LFSD9	Chromium	3.3	J	2	mg/kg	28-APR-95	A499E	DMET
LFSD9	Copper	3.4		5	mg/kg	28-APR-95	A499E	DMET
LFSD9	Cyanide	0.71	J	0.5	mg/kg	28-APR-95	A499E	DMET
LFSD9	Iron	493		20	mg/kg	28-APR-95	A499E	DMET
LFSD9	Lead	6.3		0.6	mg/kg	28-APR-95	A499E	DMET
LFSD9	Magnesium	106		1000	mg/kg	28-APR-95	A499E	DMET
LFSD9	Manganese	8.3		3	mg/kg	28-APR-95	A499E	DMET
LFSD9	Nickel	1.9		8	mg/kg	28-APR-95	A499E	DMET
LFSD9	Sodium	200		1000	mg/kg	28-APR-95	A499E	DMET
LFSD9	Vanadium	2.8		10	mg/kg	28-APR-95	A499E	DMET
LFSD9	Total organic carbon	11000		290	mg/kg	28-APR-95	A5D290010002	TOC
LFSD9D	Di-n-butylphthalate	0.088	J	0.5	mg/kg	04/28/95	A499F	BSVO
LFSD9D	Aluminum	1360	J	40	mg/kg	04/28/95	A499F	DMET
LFSD9D	Barium	5.9		40	mg/kg	04/28/95	A499F	DMET
LFSD9D	Calcium	921		1000	mg/kg	04/28/95	A499F	DMET
LFSD9D	Chromium	34.4	J	2	mg/kg	04/28/95	A499F	DMET
LFSD9D	Copper	3.6		5	mg/kg	04/28/95	A499F	DMET
LFSD9D	Iron	625		20	mg/kg	04/28/95	A499F	DMET
LFSD9D	Lead	6.5		0.6	mg/kg	04/28/95	A499F	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSD9D	Magnesium	74.7		1000	mg/kg	04/28/95	A499F	DMET
LFSD9D	Manganese	11.1		3	mg/kg	04/28/95	A499F	DMET
LFSD9D	Nickel	18.1		8	mg/kg	04/28/95	A499F	DMET
LFSD9D	Sodium	241		1000	mg/kg	04/28/95	A499F	DMET
LFSD9D	Vanadium	2.9		10	mg/kg	04/28/95	A499F	DMET
LFSD9D	Total organic carbon	12000		300	mg/kg	04/28/95	A5D290010003	TOC
RCGCSD1	2-Butanone	23		17	ug/kg	26-JUN-93	90055017	AVOL
RCGCSD1	Toluene	3	J	17	ug/kg	26-JUN-93	90055017	AVOL
RCGCSD1	4,4-DDE	1.9	J	5	ug/kg	26-JUN-93	90055018	CPES
RCGCSD1	alpha-Chlordane	1	J	3	ug/kg	26-JUN-93	90055018	CPES
RCGCSD1	gamma-Chlordane	1.6	J	3	ug/kg	26-JUN-93	90055018	CPES
RCGCSD1	Aluminum	9520		40	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Barium	21	J	40	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Calcium	5090		1000	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Chromium	9.9		2	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Copper	4.7	J	5	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Iron	1850		20	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Lead	17.9		1	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Magnesium	200	J	1000	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Manganese	7.2		3	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Potassium	148	J	1000	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Vanadium	9.7	J	10	mg/kg	26-JUN-93	90055018	DMET
RCGCSD1	Total organic carbon	27500		5	mg/kg	26-JUN-93	90055018	TOC
RCGCSD1D	2-Butanone	12	J	16	ug/kg	26-JUN-93	90055019	AVOL
RCGCSD1D	Benzo (b) fluoranthene	70	J	620	ug/kg	26-JUN-93	90055020	BSVO
RCGCSD1D	Di-n-butylphthalate	360	J	620	ug/kg	26-JUN-93	90055020	BSVO
RCGCSD1D	Fluoranthene	98	J	620	ug/kg	26-JUN-93	90055020	BSVO
RCGCSD1D	Pyrene	83	J	620	ug/kg	26-JUN-93	90055020	BSVO
RCGCSD1D	Aluminum	7120		40	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Barium	16.3	J	40	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Calcium	4420		1000	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Chromium	7.3		2	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Iron	1450		20	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Lead	14.5		1	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Magnesium	155	J	1000	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Manganese	6.1		3	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Vanadium	7.7	J	10	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Zinc	13.5		4	mg/kg	26-JUN-93	90055020	DMET
RCGCSD1D	Total organic carbon	30100		5	mg/kg	26-JUN-93	90055020	TOC
RCGCSD2	2-Butanone	10	J	14	ug/kg	26-JUN-93	90055015	AVOL
RCGCSD2	Aluminum	5800		40	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Barium	16	J	40	mg/kg	26-JUN-93	90055016	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCGCSD2	Calcium	988	J	1000	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Chromium	7.3		2	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Copper	3.4	J	5	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Iron	768		20	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Lead	17.4		1	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Magnesium	106	J	1000	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Manganese	2.7	J	3	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Vanadium	11.1	J	10	mg/kg	26-JUN-93	90055016	DMET
RCGCSD2	Acid volatile sulfides	0.16		0.1	umole/	26-JUN-93	90055016	MISC
RCGCSD2	Total organic carbon	20200		5	mg/kg	26-JUN-93	90055016	TOC
RCGCSD3	2-Butanone	3	J	13	ug/kg	26-JUN-93	90055013	AVOL
RCGCSD3	Aluminum	261		40	mg/kg	26-JUN-93	90055014	DMET
RCGCSD3	Calcium	212	J	1000	mg/kg	26-JUN-93	90055014	DMET
RCGCSD3	Iron	94.9		20	mg/kg	26-JUN-93	90055014	DMET
RCGCSD3	Vanadium	4.3	J	10	mg/kg	26-JUN-93	90055014	DMET
RCGCSD3	Total organic carbon	5100		5	mg/kg	26-JUN-93	90055014	TOC
RCGCSDR1	Acetone	21		14	ug/kg	17-AUG-93	90093003	AVOL
RCGCSDR1	Toluene	17		14	ug/kg	17-AUG-93	90093003	AVOL
RCGCSDR1	Benzo (b) fluoranthene	63	J	430	ug/kg	17-AUG-93	90093004	BSVO
RCGCSDR1	Aluminum	286		40	mg/kg	17-AUG-93	90093004	DMET
RCGCSDR1	Barium	2.3	J	40	mg/kg	17-AUG-93	90093004	DMET
RCGCSDR1	Calcium	123	J	1000	mg/kg	17-AUG-93	90093004	DMET
RCGCSDR1	Chromium	1	J	2	mg/kg	17-AUG-93	90093004	DMET
RCGCSDR1	Iron	155		20	mg/kg	17-AUG-93	90093004	DMET
RCGCSDR1	Lead	2.8	J	1	mg/kg	17-AUG-93	90093004	DMET
RCGCSDR1	Magnesium	14.8	J	1000	mg/kg	17-AUG-93	90093004	DMET
RCGCSDR1	Manganese	0.8	J	3	mg/kg	17-AUG-93	90093004	DMET
RCGCSDR1	Total organic carbon	1960		5	mg/kg	17-AUG-93	90093004	TOC
RCGCSDR1	Total petroleum hydrocarbon	16.8		1.6	mg/kg	17-AUG-93	90093004	TPH
RCSD1	Acetone	21	J	21	ug/kg	25-JUN-93	90054010	AVOL
RCSD1	Fluoranthene	92	J	660	ug/kg	25-JUN-93	90054011	BSVO
RCSD1	bis(2-Ethylhexyl) phthalate	240	J	660	ug/kg	25-JUN-93	90054011	BSVO
RCSD1	Aroclor-1254	200		62	ug/kg	25-JUN-93	90054011	CPES
RCSD1	Aroclor-1260	90	J	62	ug/kg	25-JUN-93	90054011	CPES
RCSD1	alpha-Chlordane	4	J	3	ug/kg	25-JUN-93	90054011	CPES
RCSD1	gamma-Chlordane	3	J	3	ug/kg	25-JUN-93	90054011	CPES
RCSD1	Aluminum	4560		40	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Barium	23.9	J	40	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Calcium	1880	J	1000	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Chromium	5.5		2	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Copper	31.1		5	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Iron	1860		20	mg/kg	25-JUN-93	90054011	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCSD1	Lead	17.1		1	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Magnesium	349	J	1000	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Manganese	5.6	J	3	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Vanadium	5.7	J	10	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Zinc	42.2		4	mg/kg	25-JUN-93	90054011	DMET
RCSD1	Acid volatile sulfides	0.32		0.1	umole/	23-JUN-93	90054010	MISC
RCSD1	Total organic carbon	25200		5	mg/kg	25-JUN-93	90054011	TOC
RCSD10	Methylene chloride	2	J	14	ug/kg	28-JUN-93	90057009	AVOL
RCSD10	Aroclor-1260	36	J	43	ug/kg	28-JUN-93	90057010	CPES
RCSD10	Aluminum	542		40	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Barium	5.7	J	40	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Calcium	554	J	1000	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Copper	1.6	J	5	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Iron	308		20	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Lead	2		1	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Magnesium	70.6	J	1000	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Manganese	2.8	J	3	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Nickel	3.4	J	8	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Zinc	5.5	J	4	mg/kg	28-JUN-93	90057010	DMET
RCSD10	Total organic carbon	1360		5	mg/kg	30-JUN-93	90059016	TOC
RCSD18	Di-n-butylphthalate	94	J	470	ug/kg	28-APR-95	A499D	BSVO
RCSD18	Aroclor-1260	6.6	J	48	ug/kg	28-APR-95	A499D	CPES
RCSD18	alpha-Chlordane	0.19	J	2	ug/kg	28-APR-95	A499D	CPES
RCSD18	Aluminum	1720	J	40	mg/kg	28-APR-95	A499D	DMET
RCSD18	Barium	9.4		40	mg/kg	28-APR-95	A499D	DMET
RCSD18	Calcium	987		1000	mg/kg	28-APR-95	A499D	DMET
RCSD18	Chromium	2.6	J	2	mg/kg	28-APR-95	A499D	DMET
RCSD18	Copper	4.8		5	mg/kg	28-APR-95	A499D	DMET
RCSD18	Cyanide	0.4	J	0.5	mg/kg	28-APR-95	A499D	DMET
RCSD18	Iron	631		20	mg/kg	28-APR-95	A499D	DMET
RCSD18	Lead	8.5		0.6	mg/kg	28-APR-95	A499D	DMET
RCSD18	Magnesium	76.4		1000	mg/kg	28-APR-95	A499D	DMET
RCSD18	Manganese	3.6		3	mg/kg	28-APR-95	A499D	DMET
RCSD18	Nickel	1.5	J	8	mg/kg	28-APR-95	A499D	DMET
RCSD18	Sodium	266		1000	mg/kg	28-APR-95	A499D	DMET
RCSD18	Vanadium	3		10	mg/kg	28-APR-95	A499D	DMET
RCSD18	Total organic carbon	17000		360	mg/kg	28-APR-95	A5D290010001	TOC
RCSD2	Acetone	44		24	ug/kg	25-JUN-93	90054012	AVOL
RCSD2	Fluoranthene	190	J	850	ug/kg	25-JUN-93	90054013	BSVO
RCSD2	Pyrene	150	J	850	ug/kg	25-JUN-93	90054013	BSVO
RCSD2	bis(2-Ethylhexyl) phthalate	300	J	850	ug/kg	25-JUN-93	90054013	BSVO
RCSD2	4,4-DDE	7.5	J	8	ug/kg	25-JUN-93	90054013	CPES

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCSD2	Aroclor-1254	270		85	ug/kg	25-JUN-93	90054013	CPES
RCSD2	Aroclor-1260	150		85	ug/kg	25-JUN-93	90054013	CPES
RCSD2	alpha-Chlordane	8	J	4	ug/kg	25-JUN-93	90054013	CPES
RCSD2	gamma-Chlordane	6.6		4	ug/kg	25-JUN-93	90054013	CPES
RCSD2	Aluminum	5660		40	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Barium	35.8	J	40	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Calcium	2790		1000	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Chromium	7.9		2	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Copper	21.5		5	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Iron	3700		20	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Lead	32.7		0.1	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Magnesium	243	J	1000	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Manganese	12.8		3	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Vanadium	10.3	J	10	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Zinc	75		4	mg/kg	25-JUN-93	90054013	DMET
RCSD2	Total organic carbon	62100		5	mg/kg	25-JUN-93	90054013	TOC
RCSD3	2-Butanone	6	J	14	ug/kg	26-JUN-93	90055021	AVOL
RCSD3	Di-n-butylphthalate	310	J	460	ug/kg	26-JUN-93	90055022	BSVO
RCSD3	bis(2-Ethylhexyl) phthalate	260	J	460	ug/kg	26-JUN-93	90055022	BSVO
RCSD3	4,4-DDE	1.8	J	4	ug/kg	26-JUN-93	90055022	CPES
RCSD3	Aroclor-1254	180		45	ug/kg	26-JUN-93	90055022	CPES
RCSD3	Aluminum	1010		40	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Barium	6.9	J	40	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Calcium	912	J	1000	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Copper	3.4	J	5	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Iron	599		20	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Lead	6.2		1	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Magnesium	85.8	J	1000	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Manganese	3	J	3	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Vanadium	1.2	J	10	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Zinc	14.6		4	mg/kg	26-JUN-93	90055022	DMET
RCSD3	Total organic carbon	6340		5	mg/kg	26-JUN-93	90055022	TOC
RCSD4	bis(2-Ethylhexyl) phthalate	510	J	580	ug/kg	27-JUN-93	90056011	BSVO
RCSD4	4,4-DDE	5.3	J	6	ug/kg	27-JUN-93	90056011	CPES
RCSD4	Aroclor-1260	140		65	ug/kg	27-JUN-93	90056011	CPES
RCSD4	Aluminum	4060		40	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Barium	62.4	J	40	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Copper	24.5		5	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Iron	2570	J	20	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Lead	25.7		1	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Magnesium	179	J	1000	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Manganese	25.7		3	mg/kg	27-JUN-93	90056011	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCSD4	Silver	2.1	J	2	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Vanadium	4.5	J	10	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Zinc	75.9		4	mg/kg	27-JUN-93	90056011	DMET
RCSD4	Total organic carbon	20300		5	mg/kg	27-JUN-93	90056011	TOC
RCSD5	Aroclor-1260	12	J	41	ug/kg	27-JUN-93	90056009	CPES
RCSD5	Aluminum	115		40	mg/kg	27-JUN-93	90056009	DMET
RCSD5	Copper	5.1	J	5	mg/kg	27-JUN-93	90056009	DMET
RCSD5	Iron	94.9	J	20	mg/kg	27-JUN-93	90056009	DMET
RCSD5	Lead	1	J	1	mg/kg	27-JUN-93	90056009	DMET
RCSD5	Magnesium	82.6	J	1000	mg/kg	27-JUN-93	90056009	DMET
RCSD5	Selenium	0.45	J	1	mg/kg	27-JUN-93	90056009	DMET
RCSD5	Zinc	2.4	J	4	mg/kg	27-JUN-93	90056009	DMET
RCSD5	Total organic carbon	1220		5	mg/kg	27-JUN-93	90056009	TOC
RCSD6	Aluminum	515		40	mg/kg	24-JUN-93	90053019	DMET
RCSD6	Barium	3.8	J	40	mg/kg	24-JUN-93	90053019	DMET
RCSD6	Calcium	204	J	1000	mg/kg	24-JUN-93	90053019	DMET
RCSD6	Iron	405		20	mg/kg	24-JUN-93	90053019	DMET
RCSD6	Lead	1.8		1	mg/kg	24-JUN-93	90053019	DMET
RCSD6	Manganese	3.2	J	3	mg/kg	24-JUN-93	90053019	DMET
RCSD6	Zinc	7.8		4	mg/kg	24-JUN-93	90053019	DMET
RCSD6	Total organic carbon	2740		5	mg/kg	24-JUN-93	90053019	TOC
RCSD7	Acetone	16		14	ug/kg	24-JUN-93	90053016	AVOL
RCSD7	Aluminum	470		40	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Barium	3.9	J	40	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Cadmium	1.5		1	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Calcium	234	J	1000	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Iron	368		20	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Lead	2.3		1	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Manganese	3	J	3	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Nickel	3.4	J	8	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Zinc	7.1		4	mg/kg	24-JUN-93	90053017	DMET
RCSD7	Acid volatile sulfides	0.11		0.1	umole/	24-JUN-93	90053016	MISC
RCSD7	Total organic carbon	2470		5	mg/kg	24-JUN-93	90053017	TOC
RCSD8	2-Butanone	5	J	13	ug/kg	24-JUN-93	90053012	AVOL
RCSD8	Acetone	44		13	ug/kg	24-JUN-93	90053012	AVOL
RCSD8	Aroclor-1260	21	J	45	ug/kg	24-JUN-93	90053013	CPES
RCSD8	Aluminum	699		40	mg/kg	24-JUN-93	90053013	DMET
RCSD8	Barium	6.3	J	40	mg/kg	24-JUN-93	90053013	DMET
RCSD8	Calcium	387	J	1000	mg/kg	24-JUN-93	90053013	DMET
RCSD8	Iron	524		20	mg/kg	24-JUN-93	90053013	DMET
RCSD8	Lead	2.3		1	mg/kg	24-JUN-93	90053013	DMET
RCSD8	Manganese	3.9	J	3	mg/kg	24-JUN-93	90053013	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCSD8	Potassium	122	J	1000	mg/kg	24-JUN-93	90053013	DMET
RCSD8	Zinc	8.9		4	mg/kg	24-JUN-93	90053013	DMET
RCSD8	Acid volatile sulfides	0.093		0.1	umole/	24-JUN-93	90053012	MISC
RCSD8	Total organic carbon	4420		5	mg/kg	24-JUN-93	90053013	TOC
RCSD8A	Acetone	14		13	ug/kg	24-JUN-93	90053014	AVOL
RCSD8A	bis(2-Ethylhexyl) phthalate	170	J	420	ug/kg	24-JUN-93	90053015	BSVO
RCSD8A	Aroclor-1260	29	J	42	ug/kg	24-JUN-93	90053015	CPES
RCSD8A	Aluminum	670		40	mg/kg	24-JUN-93	90053015	DMET
RCSD8A	Barium	5.3	J	40	mg/kg	24-JUN-93	90053015	DMET
RCSD8A	Calcium	241	J	1000	mg/kg	24-JUN-93	90053015	DMET
RCSD8A	Iron	308		20	mg/kg	24-JUN-93	90053015	DMET
RCSD8A	Lead	1.2		1	mg/kg	24-JUN-93	90053015	DMET
RCSD8A	Manganese	3.5	J	3	mg/kg	24-JUN-93	90053015	DMET
RCSD8A	Zinc	5.6		4	mg/kg	24-JUN-93	90053015	DMET
RCSD8A	Total organic carbon	4120		5	mg/kg	24-JUN-93	90053015	TOC
RCSD9	Acetone	39		12	ug/kg	24-JUN-93	90053010	AVOL
RCSD9	bis(2-Ethylhexyl) phthalate	150	J	430	ug/kg	24-JUN-93	90053011	BSVO
RCSD9	Aroclor-1260	20	J	45	ug/kg	24-JUN-93	90053011	CPES
RCSD9	Aluminum	586		40	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Barium	5.2	J	40	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Calcium	892	J	1000	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Copper	8.5		5	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Iron	400		20	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Lead	4.5		1	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Magnesium	172	J	1000	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Manganese	2.6	J	3	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Zinc	9		4	mg/kg	24-JUN-93	90053011	DMET
RCSD9	Total organic carbon	9300		5	mg/kg	24-JUN-93	90053011	TOC
RCSDR1	Acetone	14		13	ug/kg	17-AUG-93	90093001	AVOL
RCSDR1	Toluene	19		13	ug/kg	17-AUG-93	90093001	AVOL
RCSDR1	Aluminum	384		40	mg/kg	17-AUG-93	90093002	DMET
RCSDR1	Arsenic	1.1	J	2	mg/kg	17-AUG-93	90093002	DMET
RCSDR1	Barium	2.5	J	40	mg/kg	17-AUG-93	90093002	DMET
RCSDR1	Calcium	89.9	J	1000	mg/kg	17-AUG-93	90093002	DMET
RCSDR1	Iron	216		20	mg/kg	17-AUG-93	90093002	DMET
RCSDR1	Lead	2.2	J	1	mg/kg	17-AUG-93	90093002	DMET
RCSDR1	Magnesium	24.9	J	1000	mg/kg	17-AUG-93	90093002	DMET
RCSDR1	Manganese	2	J	3	mg/kg	17-AUG-93	90093002	DMET
RCSDR1	Total organic carbon	3760		5	mg/kg	17-AUG-93	90093002	TOC
RCSDR1	Total petroleum hydrocarbon	46.9		1.6	mg/kg	17-AUG-93	90093002	TPH
STCSD1	2-Butanone	5	J	15	ug/kg	22-JUN-93	70383-8	AVOL
STCSD1	Acetone	11	J	15	ug/kg	22-JUN-93	70383-8	AVOL

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
STCSD1	Toluene	4	J	15	ug/kg	22-JUN-93	70383-8	AVOL
STCSD1	bis(2-Ethylhexyl) phthalate	12000	J	24000	ug/kg	22-JUN-93	90050008	BSVO
STCSD1	Aluminum	1820		40	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Barium	3	J	40	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Cadmium	4.6		1	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Chromium	11.4		2	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Chromium,hexavalent	0.99		0.01	mg/l	22-JUN-93	90050008	DMET
STCSD1	Copper	11.5		5	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Iron	482	J	20	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Lead	29.9		1	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Magnesium	60.1	J	1000	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Mercury	0.06	J	0.1	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Zinc	76.8		4	mg/kg	22-JUN-93	90050008	DMET
STCSD1	Total organic carbon	7900		5	mg/kg	22-JUN-93	90050008	TOC
STCSD1	Total petroleum hydrocarbon	1920		1.6	mg/kg	22-JUN-93	90050008	TPH
STCSD2	Benzo (b) fluoranthene	5000	J	25000	ug/kg	22-JUN-93	90050009	BSVO
STCSD2	Benzo (k) fluoranthene	5000	J	25000	ug/kg	22-JUN-93	90050009	BSVO
STCSD2	Chrysene	4600	J	25000	ug/kg	22-JUN-93	90050009	BSVO
STCSD2	Fluoranthene	5100	J	25000	ug/kg	22-JUN-93	90050009	BSVO
STCSD2	Pyrene	4900	J	25000	ug/kg	22-JUN-93	90050009	BSVO
STCSD2	bis(2-Ethylhexyl) phthalate	75000	J	25000	ug/kg	22-JUN-93	90050009	BSVO
STCSD2	Aluminum	4530		40	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Barium	50	J	40	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Cadmium	11.6		1	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Calcium	555	J	1000	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Chromium	38.3		2	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Copper	35		5	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Iron	1070	J	20	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Lead	87		1	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Magnesium	549	J	1000	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Manganese	8.6		3	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Mercury	0.05	J	0.1	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Nickel	7.9	J	8	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Vanadium	10.6	J	10	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Zinc	145		4	mg/kg	22-JUN-93	90050009	DMET
STCSD2	Total organic carbon	14700		5	mg/kg	22-JUN-93	90050009	TOC
STCSD2	Total petroleum hydrocarbon	3440		1.6	mg/kg	22-JUN-93	90050009	TPH
STCSD3	2-Butanone	3	J	19	ug/kg	22-JUN-93	70383-7	AVOL
STCSD3	Acetone	8	J	19	ug/kg	22-JUN-93	70383-7	AVOL
STCSD3	Toluene	6	J	19	ug/kg	22-JUN-93	70383-7	AVOL
STCSD3	bis(2-Ethylhexyl) phthalate	8200	J	16000	ug/kg	22-JUN-93	90050007	BSVO
STCSD3	Aluminum	3890		40	mg/kg	22-JUN-93	90050007	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
STCSD3	Barium	11.1	J	40	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Calcium	436	J	1000	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Chromium	11.9		2	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Copper	13.5		5	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Iron	1500	J	20	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Lead	30.6		1	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Magnesium	138	J	1000	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Manganese	4.9	J	3	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Mercury	0.12	J	0.1	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Nickel	4.6	J	8	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Vanadium	6.8	J	10	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Zinc	109		4	mg/kg	22-JUN-93	90050007	DMET
STCSD3	Total organic carbon	11900		5	mg/kg	22-JUN-93	90050007	TOC
STCSD3	Total petroleum hydrocarbon	1030		1.6	mg/kg	22-JUN-93	90050007	TPH
STCSD4	Acetone	3	J	13	ug/kg	22-JUN-93	70383-6	AVOL
STCSD4	Aluminum	2810		40	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Barium	4.9	J	40	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Calcium	142	J	1000	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Copper	2.8	J	5	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Iron	463	J	20	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Lead	4.7		1	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Sodium	21.2	J	1000	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Vanadium	4.1	J	10	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Zinc	19.5		4	mg/kg	22-JUN-93	90050006	DMET
STCSD4	Total organic carbon	15600		5	mg/kg	22-JUN-93	90050006	TOC
STCSD4	Total petroleum hydrocarbon	214		1.6	mg/kg	22-JUN-93	90050006	TPH
STCSD5	2-Butanone	8	J	17	ug/kg	16-AUG-93	90091007	AVOL
STCSD5	Acetone	43		17	ug/kg	16-AUG-93	90091007	AVOL
STCSD5	Aroclor-1260	52		41	ug/kg	16-AUG-93	90091008	CPES
STCSD5	Aluminum	2150		40	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Arsenic	1.2	J	2	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Barium	5.6	J	40	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Calcium	4150		1000	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Chromium	3	J	2	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Copper	2.1	J	5	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Iron	492		20	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Lead	4	J	1	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Magnesium	85.1	J	1000	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Manganese	2.7	J	3	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Zinc	7.5		4	mg/kg	16-AUG-93	90091008	DMET
STCSD5	Total organic carbon	17600		5	mg/kg	17-AUG-93	90091008	TOC
STCSD5	Total petroleum hydrocarbon	144		1.6	mg/kg	17-AUG-93	90091008	TPH

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
STCSD5D	Aroclor-1260	55		48	ug/kg	29-JUN-93	90058021	CPES
STCSD5D	Aluminum	2260		40	mg/kg	29-JUN-93	90058021	DMET
STCSD5D	Calcium	3110		1000	mg/kg	29-JUN-93	90058021	DMET
STCSD5D	Chromium	3.7		2	mg/kg	29-JUN-93	90058021	DMET
STCSD5D	Iron	743		20	mg/kg	29-JUN-93	90058021	DMET
STCSD5D	Lead	6.6		1	mg/kg	29-JUN-93	90058021	DMET
STCSD5D	Magnesium	92.6	J	1000	mg/kg	29-JUN-93	90058021	DMET
STCSD5D	Zinc	6.7	J	4	mg/kg	29-JUN-93	90058021	DMET
STCSD5D	Total organic carbon	6410		5	mg/kg	29-JUN-93	90058021	TOC
STCSD6	Di-n-butylphthalate	290	J	420	ug/kg	26-JUN-93	90055026	BSVO
STCSD6	Aluminum	456		40	mg/kg	26-JUN-93	90055026	DMET
STCSD6	Calcium	11000		1000	mg/kg	26-JUN-93	90055026	DMET
STCSD6	Iron	170		20	mg/kg	26-JUN-93	90055026	DMET
STCSD6	Lead	2.7		1	mg/kg	26-JUN-93	90055026	DMET
STCSD6	Magnesium	80.3	J	1000	mg/kg	26-JUN-93	90055026	DMET
STCSD6	Manganese	1.7	J	3	mg/kg	26-JUN-93	90055026	DMET
STCSD6	Zinc	3.1	J	4	mg/kg	26-JUN-93	90055026	DMET
STCSD6	Total organic carbon	2680		5	mg/kg	26-JUN-93	90055026	TOC
STCSD7	2-Butanone	3	J	12	ug/kg	26-JUN-93	90055023	AVOL
STCSD7	Aluminum	855		40	mg/kg	26-JUN-93	90055024	DMET
STCSD7	Calcium	7750		1000	mg/kg	26-JUN-93	90055024	DMET
STCSD7	Iron	155		20	mg/kg	26-JUN-93	90055024	DMET
STCSD7	Lead	0.88		1	mg/kg	26-JUN-93	90055024	DMET
STCSD7	Magnesium	81.3	J	1000	mg/kg	26-JUN-93	90055024	DMET
STCSD7	Vanadium	0.65	J	10	mg/kg	26-JUN-93	90055024	DMET
STCSD7	Total organic carbon	2190		5	mg/kg	26-JUN-93	90055024	TOC
STCSD8	2-Butanone	3	J	14	ug/kg	28-JUN-93	90057013	AVOL
STCSD8	Aroclor-1260	67		42	ug/kg	28-JUN-93	90057014	CPES
STCSD8	Aluminum	838		40	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Beryllium	0.08	J	1	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Calcium	521	J	1000	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Copper	7.2		5	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Iron	185		20	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Lead	1.3		1	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Magnesium	157	J	1000	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Manganese	2.5	J	3	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Zinc	4.6	J	4	mg/kg	28-JUN-93	90057014	DMET
STCSD8	Total organic carbon	3760		5	mg/kg	28-JUN-93	90057014	TOC
STCSDR1	Acetone	38	J	14	ug/kg	16-AUG-93	90091011	AVOL
STCSDR1	Aluminum	1100		40	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Arsenic	0.84	J	2	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Barium	4	J	40	mg/kg	16-AUG-93	90091012	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
STCSDR1	Calcium	5640		1000	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Chromium	2.2	J	2	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Copper	1	J	5	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Iron	413		20	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Lead	7.2	J	1	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Magnesium	101	J	1000	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Manganese	1.9	J	3	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Zinc	10.9		4	mg/kg	16-AUG-93	90091012	DMET
STCSDR1	Total organic carbon	5000		5	mg/kg	17-AUG-93	90091012	TOC
STCSDR1	Total petroleum hydrocarbon	126		1.6	mg/kg	17-AUG-93	90091012	TPH
YWCSD1	bis(2-Ethylhexyl) phthalate	440	J	570	ug/kg	27-JUN-93	90056017	BSVO
YWCSD1	alpha-Chlordane	2.4	J	3	ug/kg	27-JUN-93	90056017	CPES
YWCSD1	Aluminum	786		40	mg/kg	27-JUN-93	90056017	DMET
YWCSD1	Barium	8.2	J	40	mg/kg	27-JUN-93	90056017	DMET
YWCSD1	Iron	506	J	20	mg/kg	27-JUN-93	90056017	DMET
YWCSD1	Lead	7.5		1	mg/kg	27-JUN-93	90056017	DMET
YWCSD1	Manganese	5.8		3	mg/kg	27-JUN-93	90056017	DMET
YWCSD1	Vanadium	1.3	J	10	mg/kg	27-JUN-93	90056017	DMET
YWCSD1	Zinc	14.3		4	mg/kg	27-JUN-93	90056017	DMET
YWCSD1	Total organic carbon	15800		5	mg/kg	27-JUN-93	90056017	TOC
YWCSD2	Aluminum	220		40	mg/kg	27-JUN-93	90056015	DMET
YWCSD2	Iron	181	J	20	mg/kg	27-JUN-93	90056015	DMET
YWCSD2	Lead	2.8		1	mg/kg	27-JUN-93	90056015	DMET
YWCSD2	Manganese	2.7	J	3	mg/kg	27-JUN-93	90056015	DMET
YWCSD2	Vanadium	0.62	J	10	mg/kg	27-JUN-93	90056015	DMET
YWCSD2	Zinc	3.3	J	4	mg/kg	27-JUN-93	90056015	DMET
YWCSD2	Total organic carbon	14100		5	mg/kg	27-JUN-93	90056015	TOC
YWCSD20	Di-n-butylphthalate	110	J	920	ug/kg	27-APR-95	A4969	BSVO
YWCSD20	Aluminum	7990	J	40	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Barium	97.6		40	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Calcium	2930		1000	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Chromium	7.3	J	2	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Cobalt	1.7		10	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Copper	25.2		5	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Cyanide	0.83	J	0.5	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Iron	3140		20	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Lead	23.5		0.6	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Magnesium	580		1000	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Manganese	8.7		3	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Nickel	3.2	J	8	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Potassium	67.5		1000	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Sodium	577		1000	mg/kg	27-APR-95	A4969	DMET

Appendix B-1 - Sediment Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
YWCSD20	Vanadium	14.9		10	mg/kg	27-APR-95	A4969	DMET
YWCSD20	Total organic carbon	23000		570	mg/kg	27-APR-95	A5D280074005	TOC
YWCSDR1	2-Butanone	3	J	13	ug/kg	28-JUN-93	90057011	AVOL
YWCSDR1	Aluminum	279		40	mg/kg	28-JUN-93	90057012	DMET
YWCSDR1	Calcium	267	J	1000	mg/kg	28-JUN-93	90057012	DMET
YWCSDR1	Copper	1.7	J	5	mg/kg	28-JUN-93	90057012	DMET
YWCSDR1	Iron	238		20	mg/kg	28-JUN-93	90057012	DMET
YWCSDR1	Lead	3.3		1	mg/kg	28-JUN-93	90057012	DMET
YWCSDR1	Manganese	4		3	mg/kg	28-JUN-93	90057012	DMET
YWCSDR1	Zinc	4.4	J	4	mg/kg	28-JUN-93	90057012	DMET
YWCSDR1	Total organic carbon	3520		5	mg/kg	28-JUN-93	90057012	TOC

Notes:
J = qualified as estimated
AVOL = volatile organics
BSVO = semivolatile organics
CPES = pesticides and polychlorinated biphenyls
DMET = inorganics
MISC = miscellaneous
TOC = total organic carbon
TPH = total petroleum hydrocarbon
ug/kg = micrograms per kilograms
mg/kg = milligrams per kilograms
umole = micromole

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
2-Butanone	18SD1	17	J	18	ug/kg	16-AUG-93	90091001	AVOL
2-Butanone	18SD2	13	J	14	ug/kg	16-AUG-93	90091003	AVOL
2-Butanone	2SD1	86	J	100	ug/kg	24-JUN-93	90053020	AVOL
2-Butanone	2SD2	30	J	83	ug/kg	22-JUN-93	70383-10	AVOL
2-Butanone	2SD2D	28	J	91	ug/kg	22-JUN-93	70383-11	AVOL
2-Butanone	2SD3	23	J	19	ug/kg	24-JUN-93	90053022	AVOL
2-Butanone	5SD4	29	J	50	ug/kg	25-JUN-93	90054014	AVOL
2-Butanone	5SD5	4	J	14	ug/kg	16-AUG-93	90091005	AVOL
2-Butanone	GCSD4	30	J	30	ug/kg	30-JUN-93	90059009	AVOL
2-Butanone	GCSD5D	8	J	14	ug/kg	30-JUN-93	90059013	AVOL
2-Butanone	LFSD6	27	J	42	ug/kg	23-JUN-93	90052014	AVOL
2-Butanone	RCGCSD1	23		17	ug/kg	26-JUN-93	90055017	AVOL
2-Butanone	RCGCSD1D	12	J	16	ug/kg	26-JUN-93	90055019	AVOL
2-Butanone	RCGCSD2	10	J	14	ug/kg	26-JUN-93	90055015	AVOL
2-Butanone	RCGCSD3	3	J	13	ug/kg	26-JUN-93	90055013	AVOL
2-Butanone	RCSD3	6	J	14	ug/kg	26-JUN-93	90055021	AVOL
2-Butanone	RCSD8	5	J	13	ug/kg	24-JUN-93	90053012	AVOL
2-Butanone	STCSD1	5	J	15	ug/kg	22-JUN-93	70383-8	AVOL
2-Butanone	STCSD3	3	J	19	ug/kg	22-JUN-93	70383-7	AVOL
2-Butanone	STCSD5	8	J	17	ug/kg	16-AUG-93	90091007	AVOL
2-Butanone	STCSD7	3	J	12	ug/kg	26-JUN-93	90055023	AVOL
2-Butanone	STCSD8	3	J	14	ug/kg	28-JUN-93	90057013	AVOL
2-Butanone	YWCSDR1	3	J	13	ug/kg	28-JUN-93	90057011	AVOL
Acetone	18SD1	71		18	ug/kg	16-AUG-93	90091001	AVOL
Acetone	18SD2	45		14	ug/kg	16-AUG-93	90091003	AVOL
Acetone	2SD1	410		100	ug/kg	24-JUN-93	90053020	AVOL
Acetone	2SD2	190	J	83	ug/kg	22-JUN-93	70383-10	AVOL
Acetone	2SD2D	170	J	91	ug/kg	22-JUN-93	70383-11	AVOL
Acetone	2SD3	220	J	19	ug/kg	24-JUN-93	90053022	AVOL
Acetone	5SD1	42		15	ug/kg	17-AUG-93	90093007	AVOL
Acetone	5SD2	13	J	14	ug/kg	25-JUN-93	90054018	AVOL
Acetone	5SD2D	12	J	14	ug/kg	25-JUN-93	90054020	AVOL
Acetone	5SD3	13	J	17	ug/kg	25-JUN-93	90054016	AVOL
Acetone	5SD4	110		50	ug/kg	25-JUN-93	90054014	AVOL
Acetone	5SD5	24		14	ug/kg	16-AUG-93	90091005	AVOL
Acetone	5SD7	830		42	ug/kg	17-AUG-93	90093005	AVOL
Acetone	8SD1	3	J	13	ug/kg	21-JUN-93	70388-4	AVOL
Acetone	GCSD4	240		30	ug/kg	30-JUN-93	90059009	AVOL
Acetone	RCGCSDR1	21		14	ug/kg	17-AUG-93	90093003	AVOL
Acetone	RCSD1	21	J	21	ug/kg	25-JUN-93	90054010	AVOL
Acetone	RCSD2	44		24	ug/kg	25-JUN-93	90054012	AVOL
Acetone	RCSD7	16		14	ug/kg	24-JUN-93	90053016	AVOL

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Acetone	RCSD8	44		13	ug/kg	24-JUN-93	90053012	AVOL
Acetone	RCSD8A	14		13	ug/kg	24-JUN-93	90053014	AVOL
Acetone	RCSD9	39		12	ug/kg	24-JUN-93	90053010	AVOL
Acetone	RCSDR1	14		13	ug/kg	17-AUG-93	90093001	AVOL
Acetone	STCSD1	11	J	15	ug/kg	22-JUN-93	70383-8	AVOL
Acetone	STCSD3	8	J	19	ug/kg	22-JUN-93	70383-7	AVOL
Acetone	STCSD4	3	J	13	ug/kg	22-JUN-93	70383-6	AVOL
Acetone	STCSD5	43		17	ug/kg	16-AUG-93	90091007	AVOL
Acetone	STCSDR1	38	J	14	ug/kg	16-AUG-93	90091011	AVOL
Chlorobenzene	2SD1	64	J	100	ug/kg	24-JUN-93	90053020	AVOL
Chlorobenzene	2SD2	14	J	83	ug/kg	22-JUN-93	70383-10	AVOL
Chlorobenzene	2SD2D	12	J	91	ug/kg	22-JUN-93	70383-11	AVOL
Chlorobenzene	2SD3	160	J	19	ug/kg	24-JUN-93	90053022	AVOL
Ethylbenzene	5SD1	9	J	15	ug/kg	17-AUG-93	90093007	AVOL
Methylene chloride	5SD4	11	J	50	ug/kg	25-JUN-93	90054014	AVOL
Methylene chloride	RCSD10	2	J	14	ug/kg	28-JUN-93	90057009	AVOL
Toluene	2SD3	6	J	19	ug/kg	24-JUN-93	90053022	AVOL
Toluene	5SD1	8	J	15	ug/kg	17-AUG-93	90093007	AVOL
Toluene	5SD2	20		14	ug/kg	25-JUN-93	90054018	AVOL
Toluene	5SD3	13	J	17	ug/kg	25-JUN-93	90054016	AVOL
Toluene	GCSD5D	31		14	ug/kg	30-JUN-93	90059013	AVOL
Toluene	RCGCSD1	3	J	17	ug/kg	26-JUN-93	90055017	AVOL
Toluene	RCGCSDR1	17		14	ug/kg	17-AUG-93	90093003	AVOL
Toluene	RCSDR1	19		13	ug/kg	17-AUG-93	90093001	AVOL
Toluene	STCSD1	4	J	15	ug/kg	22-JUN-93	70383-8	AVOL
Toluene	STCSD3	6	J	19	ug/kg	22-JUN-93	70383-7	AVOL
Xylenes (total)	5SD1	53		15	ug/kg	17-AUG-93	90093007	AVOL
1,4-Dichlorobenzene	2SD3	140	J	570	ug/kg	24-JUN-93	90053023	BSVO
2,4-Dinitrotoluene	18SD2	93	J	430	ug/kg	16-AUG-93	90091004	BSVO
2-Methylnaphthalene	5SD1	1500		460	ug/kg	17-AUG-93	90093008	BSVO
4-Methylphenol	5SD2	75	J	520	ug/kg	25-JUN-93	90054019	BSVO
4-Methylphenol	5SD3	66	J	520	ug/kg	25-JUN-93	90054017	BSVO
4-Methylphenol	GCSD1	88	J	550	ug/kg	27-JUN-93	90056019	BSVO
4-Methylphenol	GCSD4	160	J	610	ug/kg	30-JUN-93	90059010	BSVO
4-Methylphenol	GCSD5	100	J	440	ug/kg	30-JUN-93	90059012	BSVO
4-Methylphenol	LFSD8	77	J	570	ug/kg	23-JUN-93	90052023	BSVO
4-Methylphenol	LFSD8D	190	J	630	ug/kg	23-JUN-93	90052025	BSVO
Acenaphthene	2SD3	70	J	570	ug/kg	24-JUN-93	90053023	BSVO
Benzo (a) anthracene	18SD2	170	J	430	ug/kg	16-AUG-93	90091004	BSVO
Benzo (a) pyrene	18SD2	87	J	430	ug/kg	16-AUG-93	90091004	BSVO
Benzo (b) fluoranthene	18SD1	260	J	600	ug/kg	16-AUG-93	90091002	BSVO
Benzo (b) fluoranthene	18SD2	360	J	430	ug/kg	16-AUG-93	90091004	BSVO

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Benzo (b) fluoranthene	GCSD1	66	J	550	ug/kg	27-JUN-93	90056019	BSVO
Benzo (b) fluoranthene	LFSD2	91	J	610	ug/kg	23-JUN-93	90052027	BSVO
Benzo (b) fluoranthene	RCGCSD1D	70	J	620	ug/kg	26-JUN-93	90055020	BSVO
Benzo (b) fluoranthene	RCGCSDR1	63	J	430	ug/kg	17-AUG-93	90093004	BSVO
Benzo (b) fluoranthene	STCSD2	5000	J	25000	ug/kg	22-JUN-93	90050009	BSVO
Benzo (k) fluoranthene	18SD1	200	J	600	ug/kg	16-AUG-93	90091002	BSVO
Benzo (k) fluoranthene	18SD2	230	J	430	ug/kg	16-AUG-93	90091004	BSVO
Benzo (k) fluoranthene	STCSD2	5000	J	25000	ug/kg	22-JUN-93	90050009	BSVO
Chrysene	18SD1	240	J	600	ug/kg	16-AUG-93	90091002	BSVO
Chrysene	18SD2	380	J	430	ug/kg	16-AUG-93	90091004	BSVO
Chrysene	GCSD1	72	J	550	ug/kg	27-JUN-93	90056019	BSVO
Chrysene	LFSD2	67	J	610	ug/kg	23-JUN-93	90052027	BSVO
Chrysene	STCSD2	4600	J	25000	ug/kg	22-JUN-93	90050009	BSVO
Di-n-butylphthalate	5SD2D	170	J	520	ug/kg	25-JUN-93	90054021	BSVO
Di-n-butylphthalate	8SD2	1400		440	ug/kg	21-JUN-93	90049006	BSVO
Di-n-butylphthalate	GCSD19	180	J	550	ug/kg	28-APR-95	A499H	BSVO
Di-n-butylphthalate	GCSD2	310	J	580	ug/kg	26-JUN-93	90055012	BSVO
Di-n-butylphthalate	LFSD1	910	J	820	ug/kg	23-JUN-93	90052029	BSVO
Di-n-butylphthalate	LFSD10	60	J	440	ug/kg	28-APR-95	A499G	BSVO
Di-n-butylphthalate	LFSD11	140	J	520	ug/kg	26-APR-95	A47LX	BSVO
Di-n-butylphthalate	LFSD12	110	J	520	ug/kg	26-APR-95	A47M1	BSVO
Di-n-butylphthalate	LFSD13	83	J	610	ug/kg	26-APR-95	A47M3	BSVO
Di-n-butylphthalate	LFSD14	380	J	2100	ug/kg	26-APR-95	A47M4	BSVO
Di-n-butylphthalate	LFSD15	38	J	520	ug/kg	27-APR-95	A4965	BSVO
Di-n-butylphthalate	LFSD16	73	J	480	ug/kg	27-APR-95	A4966	BSVO
Di-n-butylphthalate	LFSD17	200	J	520	ug/kg	27-APR-95	A4967	BSVO
Di-n-butylphthalate	LFSD17D	170	J	510	ug/kg	27-APR-95	A4968	BSVO
Di-n-butylphthalate	LFSD2	660	J	610	ug/kg	23-JUN-93	90052027	BSVO
Di-n-butylphthalate	LFSD3	1000	J	890	ug/kg	23-JUN-93	90052021	BSVO
Di-n-butylphthalate	LFSD4	740	J	780	ug/kg	23-JUN-93	90052019	BSVO
Di-n-butylphthalate	LFSD5	740	J	700	ug/kg	23-JUN-93	90052017	BSVO
Di-n-butylphthalate	LFSD6	380	J	520	ug/kg	23-JUN-93	90052015	BSVO
Di-n-butylphthalate	LFSD7	2000	J	1900	ug/kg	23-JUN-93	90052012	BSVO
Di-n-butylphthalate	LFSD8	570	J	570	ug/kg	23-JUN-93	90052023	BSVO
Di-n-butylphthalate	LFSD8D	700	J	630	ug/kg	23-JUN-93	90052025	BSVO
Di-n-butylphthalate	LFSD9	34	J	480	ug/kg	28-APR-95	A499E	BSVO
Di-n-butylphthalate	LFSD9D	0.088	J	0.5	mg/kg	04/28/95	A499F	BSVO
Di-n-butylphthalate	RCGCSD1D	360	J	620	ug/kg	26-JUN-93	90055020	BSVO
Di-n-butylphthalate	RCSD18	94	J	470	ug/kg	28-APR-95	A499D	BSVO
Di-n-butylphthalate	RCSD3	310	J	460	ug/kg	26-JUN-93	90055022	BSVO
Di-n-butylphthalate	STCSD6	290	J	420	ug/kg	26-JUN-93	90055026	BSVO
Di-n-butylphthalate	YWCSD20	110	J	920	ug/kg	27-APR-95	A4969	BSVO

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Di-n-octylphthalate	5SD4	410	J	2100	ug/kg	25-JUN-93	90054015	BSVO
Di-n-octylphthalate	LFSD8D	160	J	630	ug/kg	23-JUN-93	90052025	BSVO
Fluoranthene	18SD1	320	J	600	ug/kg	16-AUG-93	90091002	BSVO
Fluoranthene	18SD2	380	J	430	ug/kg	16-AUG-93	90091004	BSVO
Fluoranthene	2SD1	250	J	850	ug/kg	24-JUN-93	90053021	BSVO
Fluoranthene	2SD2	340	J	2100	ug/kg	22-JUN-93	90050010	BSVO
Fluoranthene	2SD2D	370	J	2100	ug/kg	22-JUN-93	90050011	BSVO
Fluoranthene	GCSD1	130	J	550	ug/kg	27-JUN-93	90056019	BSVO
Fluoranthene	RCGCSD1D	98	J	620	ug/kg	26-JUN-93	90055020	BSVO
Fluoranthene	RCSD1	92	J	660	ug/kg	25-JUN-93	90054011	BSVO
Fluoranthene	RCSD2	190	J	850	ug/kg	25-JUN-93	90054013	BSVO
Fluoranthene	STCSD2	5100	J	25000	ug/kg	22-JUN-93	90050009	BSVO
Fluorene	5SD1	230	J	460	ug/kg	17-AUG-93	90093008	BSVO
N-Nitrosodiphenylamine (1)	18SD2	220	J	430	ug/kg	16-AUG-93	90091004	BSVO
Naphthalene	5SD1	1100		460	ug/kg	17-AUG-93	90093008	BSVO
Phenanthrene	18SD2	84	J	430	ug/kg	16-AUG-93	90091004	BSVO
Phenanthrene	GCSD1	73	J	550	ug/kg	27-JUN-93	90056019	BSVO
Pyrene	18SD1	420	J	600	ug/kg	16-AUG-93	90091002	BSVO
Pyrene	18SD2	430	J	430	ug/kg	16-AUG-93	90091004	BSVO
Pyrene	2SD1	180	J	850	ug/kg	24-JUN-93	90053021	BSVO
Pyrene	2SD2	290	J	2100	ug/kg	22-JUN-93	90050010	BSVO
Pyrene	2SD2D	300	J	2100	ug/kg	22-JUN-93	90050011	BSVO
Pyrene	GCSD1	120	J	550	ug/kg	27-JUN-93	90056019	BSVO
Pyrene	LFSD2	81	J	610	ug/kg	23-JUN-93	90052027	BSVO
Pyrene	RCGCSD1D	83	J	620	ug/kg	26-JUN-93	90055020	BSVO
Pyrene	RCSD2	150	J	850	ug/kg	25-JUN-93	90054013	BSVO
Pyrene	STCSD2	4900	J	25000	ug/kg	22-JUN-93	90050009	BSVO
bis(2-Ethylhexyl) phthalate	5SD4	1900	J	2100	ug/kg	25-JUN-93	90054015	BSVO
bis(2-Ethylhexyl) phthalate	8SD2	210	J	440	ug/kg	21-JUN-93	90049006	BSVO
bis(2-Ethylhexyl) phthalate	9SD1	200	J	410	ug/kg	27-JUN-93	90056013	BSVO
bis(2-Ethylhexyl) phthalate	LFSD4	430	J	780	ug/kg	23-JUN-93	90052019	BSVO
bis(2-Ethylhexyl) phthalate	LFSD5	310	J	700	ug/kg	23-JUN-93	90052017	BSVO
bis(2-Ethylhexyl) phthalate	LFSD6	300	J	520	ug/kg	23-JUN-93	90052015	BSVO
bis(2-Ethylhexyl) phthalate	RCSD1	240	J	660	ug/kg	25-JUN-93	90054011	BSVO
bis(2-Ethylhexyl) phthalate	RCSD2	300	J	850	ug/kg	25-JUN-93	90054013	BSVO
bis(2-Ethylhexyl) phthalate	RCSD3	260	J	460	ug/kg	26-JUN-93	90055022	BSVO
bis(2-Ethylhexyl) phthalate	RCSD4	510	J	580	ug/kg	27-JUN-93	90056011	BSVO
bis(2-Ethylhexyl) phthalate	RCSD8A	170	J	420	ug/kg	24-JUN-93	90053015	BSVO
bis(2-Ethylhexyl) phthalate	RCSD9	150	J	430	ug/kg	24-JUN-93	90053011	BSVO
bis(2-Ethylhexyl) phthalate	STCSD1	12000	J	24000	ug/kg	22-JUN-93	90050008	BSVO
bis(2-Ethylhexyl) phthalate	STCSD2	75000	J	25000	ug/kg	22-JUN-93	90050009	BSVO
bis(2-Ethylhexyl) phthalate	STCSD3	8200	J	16000	ug/kg	22-JUN-93	90050007	BSVO

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
bis(2-Ethylhexyl) phthalate	YWCSD1	440	J	570	ug/kg	27-JUN-93	90056017	BSVO
4,4-DDD	5SD1	27	J	24	ug/kg	17-AUG-93	90093008	CPES
4,4-DDD	5SD3	8		5	ug/kg	25-JUN-93	90054017	CPES
4,4-DDD	LFSD2	4.1	J	6	ug/kg	23-JUN-93	90052027	CPES
4,4-DDE	5SD3	3.7	J	5	ug/kg	25-JUN-93	90054017	CPES
4,4-DDE	6SD1	3.5	J	5	ug/kg	28-JUN-93	90057008	CPES
4,4-DDE	GCSD2	6.4		6	ug/kg	26-JUN-93	90055012	CPES
4,4-DDE	LFSD1	8.4		8	ug/kg	23-JUN-93	90052029	CPES
4,4-DDE	LFSD11	0.27	J	5	ug/kg	26-APR-95	A47LX	CPES
4,4-DDE	LFSD14	0.87	J	22	ug/kg	26-APR-95	A47M4	CPES
4,4-DDE	LFSD17	0.18	J	5	ug/kg	27-APR-95	A4967	CPES
4,4-DDE	LFSD17D	0.21	J	5	ug/kg	27-APR-95	A4968	CPES
4,4-DDE	LFSD2	18		6	ug/kg	23-JUN-93	90052027	CPES
4,4-DDE	LFSD4	2.7	J	7	ug/kg	23-JUN-93	90052019	CPES
4,4-DDE	LFSD6	18	J	18	ug/kg	23-JUN-93	90052015	CPES
4,4-DDE	LFSD7	2.3	J	6	ug/kg	23-JUN-93	90052012	CPES
4,4-DDE	LFSD9	0.66	J	5	ug/kg	28-APR-95	A499E	CPES
4,4-DDE	RCGCSD1	1.9	J	5	ug/kg	26-JUN-93	90055018	CPES
4,4-DDE	RCSD2	7.5	J	8	ug/kg	25-JUN-93	90054013	CPES
4,4-DDE	RCSD3	1.8	J	4	ug/kg	26-JUN-93	90055022	CPES
4,4-DDE	RCSD4	5.3	J	6	ug/kg	27-JUN-93	90056011	CPES
4,4-DDT	5SD3	8.6		5	ug/kg	25-JUN-93	90054017	CPES
4,4-DDT	LFSD2	2.2	J	6	ug/kg	23-JUN-93	90052027	CPES
Aroclor-1254	9SD1	33	J	44	ug/kg	27-JUN-93	90056013	CPES
Aroclor-1254	GCSD2	180		56	ug/kg	26-JUN-93	90055012	CPES
Aroclor-1254	LFSD1	250		82	ug/kg	23-JUN-93	90052029	CPES
Aroclor-1254	LFSD2	91		61	ug/kg	23-JUN-93	90052027	CPES
Aroclor-1254	LFSD4	100		67	ug/kg	23-JUN-93	90052019	CPES
Aroclor-1254	LFSD6	830		180	ug/kg	23-JUN-93	90052015	CPES
Aroclor-1254	RCSD1	200		62	ug/kg	25-JUN-93	90054011	CPES
Aroclor-1254	RCSD2	270		85	ug/kg	25-JUN-93	90054013	CPES
Aroclor-1254	RCSD3	180		45	ug/kg	26-JUN-93	90055022	CPES
Aroclor-1260	5SD1	330	J	240	ug/kg	17-AUG-93	90093008	CPES
Aroclor-1260	5SD2	70		46	ug/kg	25-JUN-93	90054019	CPES
Aroclor-1260	5SD2D	60		47	ug/kg	25-JUN-93	90054021	CPES
Aroclor-1260	5SD3	140		48	ug/kg	25-JUN-93	90054017	CPES
Aroclor-1260	GCSD2	97		56	ug/kg	26-JUN-93	90055012	CPES
Aroclor-1260	LFSD1	160		82	ug/kg	23-JUN-93	90052029	CPES
Aroclor-1260	LFSD11	4.1	J	53	ug/kg	26-APR-95	A47LX	CPES
Aroclor-1260	LFSD15	14	J	53	ug/kg	27-APR-95	A4965	CPES
Aroclor-1260	LFSD16	3	J	48	ug/kg	27-APR-95	A4966	CPES
Aroclor-1260	LFSD2	62		61	ug/kg	23-JUN-93	90052027	CPES

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Aroclor-1260	LFSD4	68		67	ug/kg	23-JUN-93	90052019	CPES
Aroclor-1260	LFSD6	550		180	ug/kg	23-JUN-93	90052015	CPES
Aroclor-1260	RCSD1	90	J	62	ug/kg	25-JUN-93	90054011	CPES
Aroclor-1260	RCSD10	36	J	43	ug/kg	28-JUN-93	90057010	CPES
Aroclor-1260	RCSD18	6.6	J	48	ug/kg	28-APR-95	A499D	CPES
Aroclor-1260	RCSD2	150		85	ug/kg	25-JUN-93	90054013	CPES
Aroclor-1260	RCSD4	140		65	ug/kg	27-JUN-93	90056011	CPES
Aroclor-1260	RCSD5	12	J	41	ug/kg	27-JUN-93	90056009	CPES
Aroclor-1260	RCSD8	21	J	45	ug/kg	24-JUN-93	90053013	CPES
Aroclor-1260	RCSD8A	29	J	42	ug/kg	24-JUN-93	90053015	CPES
Aroclor-1260	RCSD9	20	J	45	ug/kg	24-JUN-93	90053011	CPES
Aroclor-1260	STCSD5	52		41	ug/kg	16-AUG-93	90091008	CPES
Aroclor-1260	STCSD5D	55		48	ug/kg	29-JUN-93	90058021	CPES
Aroclor-1260	STCSD8	67		42	ug/kg	28-JUN-93	90057014	CPES
Dieldrin	LFSD17D	0.46	J	5	ug/kg	27-APR-95	A4968	CPES
Endosulfan II	LFSD9	0.23	J	5	ug/kg	28-APR-95	A499E	CPES
Endrin aldehyde	LFSD15	0.31	J	5	ug/kg	27-APR-95	A4965	CPES
alpha-Chlordane	6SD1	13		3	ug/kg	28-JUN-93	90057008	CPES
alpha-Chlordane	GCSD1	3.3		2	ug/kg	27-JUN-93	90056019	CPES
alpha-Chlordane	GCSD3	8.2		3	ug/kg	30-JUN-93	90059008	CPES
alpha-Chlordane	GCSD4	19	J	5	ug/kg	30-JUN-93	90059010	CPES
alpha-Chlordane	GCSD5	360	J	62	ug/kg	30-JUN-93	90059012	CPES
alpha-Chlordane	GCSD5D	350	J	58	ug/kg	30-JUN-93	90059014	CPES
alpha-Chlordane	LFSD1	4.8		4	ug/kg	23-JUN-93	90052029	CPES
alpha-Chlordane	LFSD11	0.22	J	3	ug/kg	26-APR-95	A47LX	CPES
alpha-Chlordane	LFSD15	2.4	J	3	ug/kg	27-APR-95	A4965	CPES
alpha-Chlordane	LFSD17	0.18	J	3	ug/kg	27-APR-95	A4967	CPES
alpha-Chlordane	LFSD17D	0.2	J	3	ug/kg	27-APR-95	A4968	CPES
alpha-Chlordane	LFSD6	6.2	J	9	ug/kg	23-JUN-93	90052015	CPES
alpha-Chlordane	LFSD9	0.38	J	2	ug/kg	28-APR-95	A499E	CPES
alpha-Chlordane	RCGCSD1	1	J	3	ug/kg	26-JUN-93	90055018	CPES
alpha-Chlordane	RCSD1	4	J	3	ug/kg	25-JUN-93	90054011	CPES
alpha-Chlordane	RCSD18	0.19	J	2	ug/kg	28-APR-95	A499D	CPES
alpha-Chlordane	RCSD2	8	J	4	ug/kg	25-JUN-93	90054013	CPES
alpha-Chlordane	YWCSD1	2.4	J	3	ug/kg	27-JUN-93	90056017	CPES
gamma-Chlordane	6SD1	13		3	ug/kg	28-JUN-93	90057008	CPES
gamma-Chlordane	GCSD2	11		3	ug/kg	26-JUN-93	90055012	CPES
gamma-Chlordane	GCSD4	15	J	5	ug/kg	30-JUN-93	90059010	CPES
gamma-Chlordane	GCSD5	430	J	62	ug/kg	30-JUN-93	90059012	CPES
gamma-Chlordane	GCSD5D	420	J	58	ug/kg	30-JUN-93	90059014	CPES
gamma-Chlordane	LFSD1	4	J	4	ug/kg	23-JUN-93	90052029	CPES
gamma-Chlordane	LFSD11	0.13	J	3	ug/kg	26-APR-95	A47LX	CPES

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
gamma-Chlordane	LFSD6	6.9	J	9	ug/kg	23-JUN-93	90052015	CPES
gamma-Chlordane	RCGCSD1	1.6	J	3	ug/kg	26-JUN-93	90055018	CPES
gamma-Chlordane	RCSD1	3	J	3	ug/kg	25-JUN-93	90054011	CPES
gamma-Chlordane	RCSD2	6.6		4	ug/kg	25-JUN-93	90054013	CPES
Aluminum	18SD1	452		40	mg/kg	16-AUG-93	90091002	DMET
Aluminum	18SD2	172		40	mg/kg	16-AUG-93	90091004	DMET
Aluminum	2SD1	2280		40	mg/kg	24-JUN-93	90053021	DMET
Aluminum	2SD2	2310		40	mg/kg	22-JUN-93	90050010	DMET
Aluminum	2SD2D	3220		40	G/KGB	22-JUN-93	90050011	DMET
Aluminum	2SD3	8180		40	mg/kg	24-JUN-93	90053023	DMET
Aluminum	5SD1	1210	J	40	mg/kg	17-AUG-93	90093008	DMET
Aluminum	5SD2	693		40	mg/kg	25-JUN-93	90054019	DMET
Aluminum	5SD2D	765		40	mg/kg	25-JUN-93	90054021	DMET
Aluminum	5SD3	1970		40	mg/kg	25-JUN-93	90054017	DMET
Aluminum	5SD4	11000		40	mg/kg	25-JUN-93	90054015	DMET
Aluminum	5SD5	366		40	mg/kg	16-AUG-93	90091006	DMET
Aluminum	5SD6	7060		40	mg/kg	16-AUG-93	90091014	DMET
Aluminum	5SD7	12700		40	mg/kg	17-AUG-93	90093006	DMET
Aluminum	6SD1	1120		40	mg/kg	28-JUN-93	90057008	DMET
Aluminum	8SD1	1130		40	mg/kg	21-JUN-93	90049005	DMET
Aluminum	8SD2	465		40	mg/kg	21-JUN-93	90049006	DMET
Aluminum	9SD1	681		40	mg/kg	27-JUN-93	90056013	DMET
Aluminum	GCSD1	827		40	mg/kg	27-JUN-93	90056019	DMET
Aluminum	GCSD19	2340	J	40	mg/kg	28-APR-95	A499H	DMET
Aluminum	GCSD2	2670		40	mg/kg	26-JUN-93	90055012	DMET
Aluminum	GCSD3	2830		40	mg/kg	30-JUN-93	90059008	DMET
Aluminum	GCSD4	1060		40	mg/kg	30-JUN-93	90059010	DMET
Aluminum	GCSD5	4850		40	mg/kg	30-JUN-93	90059012	DMET
Aluminum	GCSD5D	6190		40	mg/kg	30-JUN-93	90059014	DMET
Aluminum	LFSD1	10600		40	mg/kg	23-JUN-93	90052029	DMET
Aluminum	LFSD10	912	J	40	mg/kg	28-APR-95	A499G	DMET
Aluminum	LFSD11	1800	J	40	mg/kg	26-APR-95	A47LX	DMET
Aluminum	LFSD12	1060	J	40	mg/kg	26-APR-95	A47M1	DMET
Aluminum	LFSD13	2250	J	40	mg/kg	26-APR-95	A47M3	DMET
Aluminum	LFSD14	10700	J	40	mg/kg	26-APR-95	A47M4	DMET
Aluminum	LFSD15	2440	J	40	mg/kg	27-APR-95	A4965	DMET
Aluminum	LFSD16	2890	J	40	mg/kg	27-APR-95	A4966	DMET
Aluminum	LFSD17	3690	J	40	mg/kg	27-APR-95	A4967	DMET
Aluminum	LFSD17D	1940	J	40	mg/kg	27-APR-95	A4968	DMET
Aluminum	LFSD2	5940		40	mg/kg	23-JUN-93	90052027	DMET
Aluminum	LFSD3	4860		40	mg/kg	23-JUN-93	90052021	DMET
Aluminum	LFSD4	7230		40	mg/kg	23-JUN-93	90052019	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Aluminum	LFSD5	2160		40	mg/kg	23-JUN-93	90052017	DMET
Aluminum	LFSD6	20800		40	mg/kg	23-JUN-93	90052015	DMET
Aluminum	LFSD7	5590		40	mg/kg	23-JUN-93	90052012	DMET
Aluminum	LFSD8	2720		40	mg/kg	23-JUN-93	90052023	DMET
Aluminum	LFSD8D	1960		40	mg/kg	23-JUN-93	90052025	DMET
Aluminum	LFSD9	1300	J	40	mg/kg	28-APR-95	A499E	DMET
Aluminum	LFSD9D	1360	J	40	mg/kg	04/28/95	A499F	DMET
Aluminum	RCGCSD1	9520		40	mg/kg	26-JUN-93	90055018	DMET
Aluminum	RCGCSD1D	7120		40	mg/kg	26-JUN-93	90055020	DMET
Aluminum	RCGCSD2	5800		40	mg/kg	26-JUN-93	90055016	DMET
Aluminum	RCGCSD3	261		40	mg/kg	26-JUN-93	90055014	DMET
Aluminum	RCGCSDR1	286		40	mg/kg	17-AUG-93	90093004	DMET
Aluminum	RCSD1	4560		40	mg/kg	25-JUN-93	90054011	DMET
Aluminum	RCSD10	542		40	mg/kg	28-JUN-93	90057010	DMET
Aluminum	RCSD18	1720	J	40	mg/kg	28-APR-95	A499D	DMET
Aluminum	RCSD2	5660		40	mg/kg	25-JUN-93	90054013	DMET
Aluminum	RCSD3	1010		40	mg/kg	26-JUN-93	90055022	DMET
Aluminum	RCSD4	4060		40	mg/kg	27-JUN-93	90056011	DMET
Aluminum	RCSD5	115		40	mg/kg	27-JUN-93	90056009	DMET
Aluminum	RCSD6	515		40	mg/kg	24-JUN-93	90053019	DMET
Aluminum	RCSD7	470		40	mg/kg	24-JUN-93	90053017	DMET
Aluminum	RCSD8	699		40	mg/kg	24-JUN-93	90053013	DMET
Aluminum	RCSD8A	670		40	mg/kg	24-JUN-93	90053015	DMET
Aluminum	RCSD9	586		40	mg/kg	24-JUN-93	90053011	DMET
Aluminum	RCSDR1	384		40	mg/kg	17-AUG-93	90093002	DMET
Aluminum	STCSD1	1820		40	mg/kg	22-JUN-93	90050008	DMET
Aluminum	STCSD2	4530		40	mg/kg	22-JUN-93	90050009	DMET
Aluminum	STCSD3	3890		40	mg/kg	22-JUN-93	90050007	DMET
Aluminum	STCSD4	2810		40	mg/kg	22-JUN-93	90050006	DMET
Aluminum	STCSD5	2150		40	mg/kg	16-AUG-93	90091008	DMET
Aluminum	STCSD5D	2260		40	mg/kg	29-JUN-93	90058021	DMET
Aluminum	STCSD6	456		40	mg/kg	26-JUN-93	90055026	DMET
Aluminum	STCSD7	855		40	mg/kg	26-JUN-93	90055024	DMET
Aluminum	STCSD8	838		40	mg/kg	28-JUN-93	90057014	DMET
Aluminum	STCSDR1	1100		40	mg/kg	16-AUG-93	90091012	DMET
Aluminum	YWCSD1	786		40	mg/kg	27-JUN-93	90056017	DMET
Aluminum	YWCSD2	220		40	mg/kg	27-JUN-93	90056015	DMET
Aluminum	YWCSD20	7990	J	40	mg/kg	27-APR-95	A4969	DMET
Aluminum	YWCSDR1	279		40	mg/kg	28-JUN-93	90057012	DMET
Antimony	LFSD8	9.6	J	12	mg/kg	23-JUN-93	90052023	DMET
Arsenic	18SD1	1.2	J	2	mg/kg	16-AUG-93	90091002	DMET
Arsenic	18SD2	0.99	J	2	mg/kg	16-AUG-93	90091004	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Arsenic	5SD6	2.6	J	2	mg/kg	16-AUG-93	90091014	DMET
Arsenic	5SD7	4.5	J	2	mg/kg	17-AUG-93	90093006	DMET
Arsenic	GCSD3	2.1	J	2	mg/kg	30-JUN-93	90059008	DMET
Arsenic	GCSD4	1.7	J	2	mg/kg	30-JUN-93	90059010	DMET
Arsenic	GCSD5	5.1	J	2	mg/kg	30-JUN-93	90059012	DMET
Arsenic	GCSD5D	9.9	J	2	mg/kg	30-JUN-93	90059014	DMET
Arsenic	LFSD14	7.7		20	mg/kg	26-APR-95	A47M4	DMET
Arsenic	RCSDR1	1.1	J	2	mg/kg	17-AUG-93	90093002	DMET
Arsenic	STCSD5	1.2	J	2	mg/kg	16-AUG-93	90091008	DMET
Arsenic	STCSDR1	0.84	J	2	mg/kg	16-AUG-93	90091012	DMET
Barium	18SD1	12.1	J	40	mg/kg	16-AUG-93	90091002	DMET
Barium	18SD2	2.6	J	40	mg/kg	16-AUG-93	90091004	DMET
Barium	2SD1	32.5	J	40	mg/kg	24-JUN-93	90053021	DMET
Barium	2SD2	61.7	J	40	mg/kg	22-JUN-93	90050010	DMET
Barium	2SD2D	110	J	40	G/KGB	22-JUN-93	90050011	DMET
Barium	2SD3	25.9	J	40	mg/kg	24-JUN-93	90053023	DMET
Barium	5SD1	7.2	J	40	mg/kg	17-AUG-93	90093008	DMET
Barium	5SD2	4.7	J	40	mg/kg	25-JUN-93	90054019	DMET
Barium	5SD2D	4.8	J	40	mg/kg	25-JUN-93	90054021	DMET
Barium	5SD3	11.2	J	40	mg/kg	25-JUN-93	90054017	DMET
Barium	5SD4	55.4	J	40	mg/kg	25-JUN-93	90054015	DMET
Barium	5SD5	3	J	40	mg/kg	16-AUG-93	90091006	DMET
Barium	5SD6	18.7	J	40	mg/kg	16-AUG-93	90091014	DMET
Barium	5SD7	27.5	J	40	mg/kg	17-AUG-93	90093006	DMET
Barium	6SD1	8.6	J	40	mg/kg	28-JUN-93	90057008	DMET
Barium	8SD1	0.41	J	40	mg/kg	21-JUN-93	90049005	DMET
Barium	GCSD1	6.6	J	40	mg/kg	27-JUN-93	90056019	DMET
Barium	GCSD19	14.5		40	mg/kg	28-APR-95	A499H	DMET
Barium	GCSD2	16.7	J	40	mg/kg	26-JUN-93	90055012	DMET
Barium	GCSD3	18.6	J	40	mg/kg	30-JUN-93	90059008	DMET
Barium	GCSD4	12	J	40	mg/kg	30-JUN-93	90059010	DMET
Barium	GCSD5	4.9	J	40	mg/kg	30-JUN-93	90059012	DMET
Barium	GCSD5D	6	J	40	mg/kg	30-JUN-93	90059014	DMET
Barium	LFSD1	38.3	J	40	mg/kg	23-JUN-93	90052029	DMET
Barium	LFSD10	4.6		40	mg/kg	28-APR-95	A499G	DMET
Barium	LFSD11	10.4		40	mg/kg	26-APR-95	A47LX	DMET
Barium	LFSD12	6		40	mg/kg	26-APR-95	A47M1	DMET
Barium	LFSD13	7.7		40	mg/kg	26-APR-95	A47M3	DMET
Barium	LFSD14	101		40	mg/kg	26-APR-95	A47M4	DMET
Barium	LFSD15	10.9		40	mg/kg	27-APR-95	A4965	DMET
Barium	LFSD16	11.6		40	mg/kg	27-APR-95	A4966	DMET
Barium	LFSD17	15.5		40	mg/kg	27-APR-95	A4967	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Barium	LFSD17D	10.6		40	mg/kg	27-APR-95	A4968	DMET
Barium	LFSD2	27.8	J	40	mg/kg	23-JUN-93	90052027	DMET
Barium	LFSD3	15.7	J	40	mg/kg	23-JUN-93	90052021	DMET
Barium	LFSD4	24.4	J	40	mg/kg	23-JUN-93	90052019	DMET
Barium	LFSD5	8.7	J	40	mg/kg	23-JUN-93	90052017	DMET
Barium	LFSD6	79.7	J	40	mg/kg	23-JUN-93	90052015	DMET
Barium	LFSD7	23.9	J	40	mg/kg	23-JUN-93	90052012	DMET
Barium	LFSD8	8.8	J	40	mg/kg	23-JUN-93	90052023	DMET
Barium	LFSD8D	6.8	J	40	mg/kg	23-JUN-93	90052025	DMET
Barium	LFSD9	6.1		40	mg/kg	28-APR-95	A499E	DMET
Barium	LFSD9D	5.9		40	mg/kg	04/28/95	A499F	DMET
Barium	RCGCSD1	21	J	40	mg/kg	26-JUN-93	90055018	DMET
Barium	RCGCSD1D	16.3	J	40	mg/kg	26-JUN-93	90055020	DMET
Barium	RCGCSD2	16	J	40	mg/kg	26-JUN-93	90055016	DMET
Barium	RCGCSDR1	2.3	J	40	mg/kg	17-AUG-93	90093004	DMET
Barium	RCSD1	23.9	J	40	mg/kg	25-JUN-93	90054011	DMET
Barium	RCSD10	5.7	J	40	mg/kg	28-JUN-93	90057010	DMET
Barium	RCSD18	9.4		40	mg/kg	28-APR-95	A499D	DMET
Barium	RCSD2	35.8	J	40	mg/kg	25-JUN-93	90054013	DMET
Barium	RCSD3	6.9	J	40	mg/kg	26-JUN-93	90055022	DMET
Barium	RCSD4	62.4	J	40	mg/kg	27-JUN-93	90056011	DMET
Barium	RCSD6	3.8	J	40	mg/kg	24-JUN-93	90053019	DMET
Barium	RCSD7	3.9	J	40	mg/kg	24-JUN-93	90053017	DMET
Barium	RCSD8	6.3	J	40	mg/kg	24-JUN-93	90053013	DMET
Barium	RCSD8A	5.3	J	40	mg/kg	24-JUN-93	90053015	DMET
Barium	RCSD9	5.2	J	40	mg/kg	24-JUN-93	90053011	DMET
Barium	RCSDR1	2.5	J	40	mg/kg	17-AUG-93	90093002	DMET
Barium	STCSD1	3	J	40	mg/kg	22-JUN-93	90050008	DMET
Barium	STCSD2	50	J	40	mg/kg	22-JUN-93	90050009	DMET
Barium	STCSD3	11.1	J	40	mg/kg	22-JUN-93	90050007	DMET
Barium	STCSD4	4.9	J	40	mg/kg	22-JUN-93	90050006	DMET
Barium	STCSD5	5.6	J	40	mg/kg	16-AUG-93	90091008	DMET
Barium	STCSDR1	4	J	40	mg/kg	16-AUG-93	90091012	DMET
Barium	YWCSD1	8.2	J	40	mg/kg	27-JUN-93	90056017	DMET
Barium	YWCSD20	97.6		40	mg/kg	27-APR-95	A4969	DMET
Beryllium	5SD1	0.16	J	1	mg/kg	17-AUG-93	90093008	DMET
Beryllium	5SD7	0.63	J	1	mg/kg	17-AUG-93	90093006	DMET
Beryllium	STCSD8	0.08	J	1	mg/kg	28-JUN-93	90057014	DMET
Cadmium	2SD1	3.5	J	1	mg/kg	24-JUN-93	90053021	DMET
Cadmium	2SD2D	6.2	J	1	G/KGB	22-JUN-93	90050011	DMET
Cadmium	2SD3	1.3	J	1	mg/kg	24-JUN-93	90053023	DMET
Cadmium	GCSD2	1.1	J	1	mg/kg	26-JUN-93	90055012	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Cadmium	LFSD14	1.4		1	mg/kg	26-APR-95	A47M4	DMET
Cadmium	LFSD15	0.46		1	mg/kg	27-APR-95	A4965	DMET
Cadmium	LFSD6	3.5	J	1	mg/kg	23-JUN-93	90052015	DMET
Cadmium	RCSD7	1.5		1	mg/kg	24-JUN-93	90053017	DMET
Cadmium	STCSD1	4.6		1	mg/kg	22-JUN-93	90050008	DMET
Cadmium	STCSD2	11.6		1	mg/kg	22-JUN-93	90050009	DMET
Calcium	18SD1	1540	J	1000	mg/kg	16-AUG-93	90091002	DMET
Calcium	18SD2	175	J	1000	mg/kg	16-AUG-93	90091004	DMET
Calcium	2SD1	3120	J	1000	mg/kg	24-JUN-93	90053021	DMET
Calcium	2SD2	2810	J	1000	mg/kg	22-JUN-93	90050010	DMET
Calcium	2SD2D	5690	J	1000	G/KGB	22-JUN-93	90050011	DMET
Calcium	2SD3	3830		1000	mg/kg	24-JUN-93	90053023	DMET
Calcium	5SD1	99.9	J	1000	mg/kg	17-AUG-93	90093008	DMET
Calcium	5SD2	138	J	1000	mg/kg	25-JUN-93	90054019	DMET
Calcium	5SD2D	139	J	1000	mg/kg	25-JUN-93	90054021	DMET
Calcium	5SD3	304	J	1000	mg/kg	25-JUN-93	90054017	DMET
Calcium	5SD4	2160	J	1000	mg/kg	25-JUN-93	90054015	DMET
Calcium	5SD5	72.1	J	1000	mg/kg	16-AUG-93	90091006	DMET
Calcium	5SD6	1670	J	1000	mg/kg	16-AUG-93	90091014	DMET
Calcium	5SD7	4140		1000	mg/kg	17-AUG-93	90093006	DMET
Calcium	6SD1	6130		1000	mg/kg	28-JUN-93	90057008	DMET
Calcium	8SD1	156	J	1000	mg/kg	21-JUN-93	90049005	DMET
Calcium	GCSD19	1360		1000	mg/kg	28-APR-95	A499H	DMET
Calcium	GCSD2	1680	J	1000	mg/kg	26-JUN-93	90055012	DMET
Calcium	GCSD3	3220	J	1000	mg/kg	30-JUN-93	90059008	DMET
Calcium	GCSD4	780	J	1000	mg/kg	30-JUN-93	90059010	DMET
Calcium	GCSD5	6550	J	1000	mg/kg	30-JUN-93	90059012	DMET
Calcium	GCSD5D	4760	J	1000	mg/kg	30-JUN-93	90059014	DMET
Calcium	LFSD1	2670		1000	mg/kg	23-JUN-93	90052029	DMET
Calcium	LFSD10	585		1000	mg/kg	28-APR-95	A499G	DMET
Calcium	LFSD11	2900		1000	mg/kg	26-APR-95	A47LX	DMET
Calcium	LFSD12	5880		1000	mg/kg	26-APR-95	A47M1	DMET
Calcium	LFSD13	523		1000	mg/kg	26-APR-95	A47M3	DMET
Calcium	LFSD14	8300		1000	mg/kg	26-APR-95	A47M4	DMET
Calcium	LFSD15	1090		1000	mg/kg	27-APR-95	A4965	DMET
Calcium	LFSD16	746		1000	mg/kg	27-APR-95	A4966	DMET
Calcium	LFSD17	1050		1000	mg/kg	27-APR-95	A4967	DMET
Calcium	LFSD17D	811		1000	mg/kg	27-APR-95	A4968	DMET
Calcium	LFSD2	2040	J	1000	mg/kg	23-JUN-93	90052027	DMET
Calcium	LFSD3	915	J	1000	mg/kg	23-JUN-93	90052021	DMET
Calcium	LFSD4	1550	J	1000	mg/kg	23-JUN-93	90052019	DMET
Calcium	LFSD5	597	J	1000	mg/kg	23-JUN-93	90052017	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Calcium	LFSD6	5390		1000	mg/kg	23-JUN-93	90052015	DMET
Calcium	LFSD7	3710		1000	mg/kg	23-JUN-93	90052012	DMET
Calcium	LFSD8	350	J	1000	mg/kg	23-JUN-93	90052023	DMET
Calcium	LFSD8D	311	J	1000	mg/kg	23-JUN-93	90052025	DMET
Calcium	LFSD9	1110		1000	mg/kg	28-APR-95	A499E	DMET
Calcium	LFSD9D	921		1000	mg/kg	04/28/95	A499F	DMET
Calcium	RCGCSD1	5090		1000	mg/kg	26-JUN-93	90055018	DMET
Calcium	RCGCSD1D	4420		1000	mg/kg	26-JUN-93	90055020	DMET
Calcium	RCGCSD2	988	J	1000	mg/kg	26-JUN-93	90055016	DMET
Calcium	RCGCSD3	212	J	1000	mg/kg	26-JUN-93	90055014	DMET
Calcium	RCGCSDR1	123	J	1000	mg/kg	17-AUG-93	90093004	DMET
Calcium	RCSD1	1880	J	1000	mg/kg	25-JUN-93	90054011	DMET
Calcium	RCSD10	554	J	1000	mg/kg	28-JUN-93	90057010	DMET
Calcium	RCSD18	987		1000	mg/kg	28-APR-95	A499D	DMET
Calcium	RCSD2	2790		1000	mg/kg	25-JUN-93	90054013	DMET
Calcium	RCSD3	912	J	1000	mg/kg	26-JUN-93	90055022	DMET
Calcium	RCSD6	204	J	1000	mg/kg	24-JUN-93	90053019	DMET
Calcium	RCSD7	234	J	1000	mg/kg	24-JUN-93	90053017	DMET
Calcium	RCSD8	387	J	1000	mg/kg	24-JUN-93	90053013	DMET
Calcium	RCSD8A	241	J	1000	mg/kg	24-JUN-93	90053015	DMET
Calcium	RCSD9	892	J	1000	mg/kg	24-JUN-93	90053011	DMET
Calcium	RCSDR1	89.9	J	1000	mg/kg	17-AUG-93	90093002	DMET
Calcium	STCSD2	555	J	1000	mg/kg	22-JUN-93	90050009	DMET
Calcium	STCSD3	436	J	1000	mg/kg	22-JUN-93	90050007	DMET
Calcium	STCSD4	142	J	1000	mg/kg	22-JUN-93	90050006	DMET
Calcium	STCSD5	4150		1000	mg/kg	16-AUG-93	90091008	DMET
Calcium	STCSD5D	3110		1000	mg/kg	29-JUN-93	90058021	DMET
Calcium	STCSD6	11000		1000	mg/kg	26-JUN-93	90055026	DMET
Calcium	STCSD7	7750		1000	mg/kg	26-JUN-93	90055024	DMET
Calcium	STCSD8	521	J	1000	mg/kg	28-JUN-93	90057014	DMET
Calcium	STCSDR1	5640		1000	mg/kg	16-AUG-93	90091012	DMET
Calcium	YWCSD20	2930		1000	mg/kg	27-APR-95	A4969	DMET
Calcium	YWCSDR1	267	J	1000	mg/kg	28-JUN-93	90057012	DMET
Chromium	18SD2	3.3		2	mg/kg	16-AUG-93	90091004	DMET
Chromium	2SD3	13.1		2	mg/kg	24-JUN-93	90053023	DMET
Chromium	5SD1	1.4	J	2	mg/kg	17-AUG-93	90093008	DMET
Chromium	5SD2	0.92	J	2	mg/kg	25-JUN-93	90054019	DMET
Chromium	5SD2D	1.2	J	2	mg/kg	25-JUN-93	90054021	DMET
Chromium	5SD3	2.6	J	2	mg/kg	25-JUN-93	90054017	DMET
Chromium	5SD4	10		2	mg/kg	25-JUN-93	90054015	DMET
Chromium	5SD6	10.9		2	mg/kg	16-AUG-93	90091014	DMET
Chromium	5SD7	16.7		2	mg/kg	17-AUG-93	90093006	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Chromium	GCSD19	5.1	J	2	mg/kg	28-APR-95	A499H	DMET
Chromium	GCSD3	4.4		2	mg/kg	30-JUN-93	90059008	DMET
Chromium	GCSD5	9.4		2	mg/kg	30-JUN-93	90059012	DMET
Chromium	GCSD5D	11.3		2	mg/kg	30-JUN-93	90059014	DMET
Chromium	LFSD1	11.3		2	mg/kg	23-JUN-93	90052029	DMET
Chromium	LFSD10	3.1	J	2	mg/kg	28-APR-95	A499G	DMET
Chromium	LFSD11	4	J	2	mg/kg	26-APR-95	A47LX	DMET
Chromium	LFSD12	5.8	J	2	mg/kg	26-APR-95	A47M1	DMET
Chromium	LFSD13	2.9	J	2	mg/kg	26-APR-95	A47M3	DMET
Chromium	LFSD14	14.2	J	2	mg/kg	26-APR-95	A47M4	DMET
Chromium	LFSD15	4.3	J	2	mg/kg	27-APR-95	A4965	DMET
Chromium	LFSD16	7.9	J	2	mg/kg	27-APR-95	A4966	DMET
Chromium	LFSD17	6.6	J	2	mg/kg	27-APR-95	A4967	DMET
Chromium	LFSD17D	4.3	J	2	mg/kg	27-APR-95	A4968	DMET
Chromium	LFSD2	6.3		2	mg/kg	23-JUN-93	90052027	DMET
Chromium	LFSD4	7.1		2	mg/kg	23-JUN-93	90052019	DMET
Chromium	LFSD6	24.5		2	mg/kg	23-JUN-93	90052015	DMET
Chromium	LFSD7	8.7		2	mg/kg	23-JUN-93	90052012	DMET
Chromium	LFSD9	3.3	J	2	mg/kg	28-APR-95	A499E	DMET
Chromium	LFSD9D	34.4	J	2	mg/kg	04/28/95	A499F	DMET
Chromium	RCGCSD1	9.9		2	mg/kg	26-JUN-93	90055018	DMET
Chromium	RCGCSD1D	7.3		2	mg/kg	26-JUN-93	90055020	DMET
Chromium	RCGCSD2	7.3		2	mg/kg	26-JUN-93	90055016	DMET
Chromium	RCGCSDR1	1	J	2	mg/kg	17-AUG-93	90093004	DMET
Chromium	RCSD1	5.5		2	mg/kg	25-JUN-93	90054011	DMET
Chromium	RCSD18	2.6	J	2	mg/kg	28-APR-95	A499D	DMET
Chromium	RCSD2	7.9		2	mg/kg	25-JUN-93	90054013	DMET
Chromium	STCSD1	11.4		2	mg/kg	22-JUN-93	90050008	DMET
Chromium	STCSD2	38.3		2	mg/kg	22-JUN-93	90050009	DMET
Chromium	STCSD3	11.9		2	mg/kg	22-JUN-93	90050007	DMET
Chromium	STCSD5	3	J	2	mg/kg	16-AUG-93	90091008	DMET
Chromium	STCSD5D	3.7		2	mg/kg	29-JUN-93	90058021	DMET
Chromium	STCSDR1	2.2	J	2	mg/kg	16-AUG-93	90091012	DMET
Chromium	YWCSD20	7.3	J	2	mg/kg	27-APR-95	A4969	DMET
Chromium,hexavalent	STCSD1	0.99		0.01	mg/l	22-JUN-93	90050008	DMET
Cobalt	LFSD11	0.8	J	10	mg/kg	26-APR-95	A47LX	DMET
Cobalt	LFSD6	4.1	J	10	mg/kg	23-JUN-93	90052015	DMET
Cobalt	YWCSD20	1.7		10	mg/kg	27-APR-95	A4969	DMET
Copper	18SD1	5.3	J	5	mg/kg	16-AUG-93	90091002	DMET
Copper	18SD2	2	J	5	mg/kg	16-AUG-93	90091004	DMET
Copper	2SD2	3.9	J	5	mg/kg	22-JUN-93	90050010	DMET
Copper	2SD2D	5.5	J	5	G/KGB	22-JUN-93	90050011	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Copper	5SD6	3.7	J	5	mg/kg	16-AUG-93	90091014	DMET
Copper	6SD1	3.8	J	5	mg/kg	28-JUN-93	90057008	DMET
Copper	8SD1	5.6	J	5	mg/kg	21-JUN-93	90049005	DMET
Copper	GCSD19	3.7		5	mg/kg	28-APR-95	A499H	DMET
Copper	GCSD2	14.9		5	mg/kg	26-JUN-93	90055012	DMET
Copper	GCSD3	3.7	J	5	mg/kg	30-JUN-93	90059008	DMET
Copper	GCSD4	5.7	J	5	mg/kg	30-JUN-93	90059010	DMET
Copper	GCSD5	12.9		5	mg/kg	30-JUN-93	90059012	DMET
Copper	GCSD5D	10.5		5	mg/kg	30-JUN-93	90059014	DMET
Copper	LFSD1	27.6		5	mg/kg	23-JUN-93	90052029	DMET
Copper	LFSD10	1.4		5	mg/kg	28-APR-95	A499G	DMET
Copper	LFSD11	3.7		5	mg/kg	26-APR-95	A47LX	DMET
Copper	LFSD12	2.3		5	mg/kg	26-APR-95	A47M1	DMET
Copper	LFSD13	3.2		5	mg/kg	26-APR-95	A47M3	DMET
Copper	LFSD14	32.7		5	mg/kg	26-APR-95	A47M4	DMET
Copper	LFSD15	6.7		5	mg/kg	27-APR-95	A4965	DMET
Copper	LFSD16	5.8		5	mg/kg	27-APR-95	A4966	DMET
Copper	LFSD17	6.6		5	mg/kg	27-APR-95	A4967	DMET
Copper	LFSD17D	4.4		5	mg/kg	27-APR-95	A4968	DMET
Copper	LFSD2	9.4	J	5	mg/kg	23-JUN-93	90052027	DMET
Copper	LFSD3	10.8		5	mg/kg	23-JUN-93	90052021	DMET
Copper	LFSD4	13.4		5	mg/kg	23-JUN-93	90052019	DMET
Copper	LFSD5	3.8	J	5	mg/kg	23-JUN-93	90052017	DMET
Copper	LFSD6	40.5		5	mg/kg	23-JUN-93	90052015	DMET
Copper	LFSD7	27.8		5	mg/kg	23-JUN-93	90052012	DMET
Copper	LFSD8	3.9	J	5	mg/kg	23-JUN-93	90052023	DMET
Copper	LFSD8D	3.1	J	5	mg/kg	23-JUN-93	90052025	DMET
Copper	LFSD9	3.4		5	mg/kg	28-APR-95	A499E	DMET
Copper	LFSD9D	3.6		5	mg/kg	04/28/95	A499F	DMET
Copper	RCGCSD1	4.7	J	5	mg/kg	26-JUN-93	90055018	DMET
Copper	RCGCSD2	3.4	J	5	mg/kg	26-JUN-93	90055016	DMET
Copper	RCSD1	31.1		5	mg/kg	25-JUN-93	90054011	DMET
Copper	RCSD10	1.6	J	5	mg/kg	28-JUN-93	90057010	DMET
Copper	RCSD18	4.8		5	mg/kg	28-APR-95	A499D	DMET
Copper	RCSD2	21.5		5	mg/kg	25-JUN-93	90054013	DMET
Copper	RCSD3	3.4	J	5	mg/kg	26-JUN-93	90055022	DMET
Copper	RCSD4	24.5		5	mg/kg	27-JUN-93	90056011	DMET
Copper	RCSD5	5.1	J	5	mg/kg	27-JUN-93	90056009	DMET
Copper	RCSD9	8.5		5	mg/kg	24-JUN-93	90053011	DMET
Copper	STCSD1	11.5		5	mg/kg	22-JUN-93	90050008	DMET
Copper	STCSD2	35		5	mg/kg	22-JUN-93	90050009	DMET
Copper	STCSD3	13.5		5	mg/kg	22-JUN-93	90050007	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Copper	STCSD4	2.8	J	5	mg/kg	22-JUN-93	90050006	DMET
Copper	STCSD5	2.1	J	5	mg/kg	16-AUG-93	90091008	DMET
Copper	STCSD8	7.2		5	mg/kg	28-JUN-93	90057014	DMET
Copper	STCSDR1	1	J	5	mg/kg	16-AUG-93	90091012	DMET
Copper	YWCSD20	25.2		5	mg/kg	27-APR-95	A4969	DMET
Copper	YWCSDR1	1.7	J	5	mg/kg	28-JUN-93	90057012	DMET
Cyanide	2SD2	1.7	J	1	mg/kg	22-JUN-93	90050010	DMET
Cyanide	2SD3	0.72	J	1	mg/kg	24-JUN-93	90053023	DMET
Cyanide	LFSD12	0.18	J	0.5	mg/kg	26-APR-95	A47M1	DMET
Cyanide	LFSD15	0.21	J	0.5	mg/kg	27-APR-95	A4965	DMET
Cyanide	LFSD16	0.26	J	0.5	mg/kg	27-APR-95	A4966	DMET
Cyanide	LFSD17	0.41	J	0.5	mg/kg	27-APR-95	A4967	DMET
Cyanide	LFSD17D	0.41	J	0.5	mg/kg	27-APR-95	A4968	DMET
Cyanide	LFSD9	0.71	J	0.5	mg/kg	28-APR-95	A499E	DMET
Cyanide	RCSD18	0.4	J	0.5	mg/kg	28-APR-95	A499D	DMET
Cyanide	YWCSD20	0.83	J	0.5	mg/kg	27-APR-95	A4969	DMET
Iron	18SD1	3520		20	mg/kg	16-AUG-93	90091002	DMET
Iron	18SD2	1010		20	mg/kg	16-AUG-93	90091004	DMET
Iron	2SD1	37000		20	mg/kg	24-JUN-93	90053021	DMET
Iron	2SD2	124000	J	20	mg/kg	22-JUN-93	90050010	DMET
Iron	2SD2D	233000	J	20	G/KGB	22-JUN-93	90050011	DMET
Iron	2SD3	7320		20	mg/kg	24-JUN-93	90053023	DMET
Iron	5SD1	141		20	mg/kg	17-AUG-93	90093008	DMET
Iron	5SD2	127		20	mg/kg	25-JUN-93	90054019	DMET
Iron	5SD2D	152		20	mg/kg	25-JUN-93	90054021	DMET
Iron	5SD3	203		20	mg/kg	25-JUN-93	90054017	DMET
Iron	5SD4	3370		20	mg/kg	25-JUN-93	90054015	DMET
Iron	5SD5	72.9		20	mg/kg	16-AUG-93	90091006	DMET
Iron	5SD6	1470		20	mg/kg	16-AUG-93	90091014	DMET
Iron	5SD7	2730		20	mg/kg	17-AUG-93	90093006	DMET
Iron	6SD1	998		20	mg/kg	28-JUN-93	90057008	DMET
Iron	8SD1	43		20	mg/kg	21-JUN-93	90049005	DMET
Iron	8SD2	37.9		20	mg/kg	21-JUN-93	90049006	DMET
Iron	9SD1	289	J	20	mg/kg	27-JUN-93	90056013	DMET
Iron	GCSD1	385	J	20	mg/kg	27-JUN-93	90056019	DMET
Iron	GCSD19	968		20	mg/kg	28-APR-95	A499H	DMET
Iron	GCSD2	1320		20	mg/kg	26-JUN-93	90055012	DMET
Iron	GCSD3	2150		20	mg/kg	30-JUN-93	90059008	DMET
Iron	GCSD4	323		20	mg/kg	30-JUN-93	90059010	DMET
Iron	GCSD5	1400		20	mg/kg	30-JUN-93	90059012	DMET
Iron	GCSD5D	2130		20	mg/kg	30-JUN-93	90059014	DMET
Iron	LFSD1	3270		20	mg/kg	23-JUN-93	90052029	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Iron	LFSD10	415		20	mg/kg	28-APR-95	A499G	DMET
Iron	LFSD11	1220		20	mg/kg	26-APR-95	A47LX	DMET
Iron	LFSD12	542		20	mg/kg	26-APR-95	A47M1	DMET
Iron	LFSD13	563		20	mg/kg	26-APR-95	A47M3	DMET
Iron	LFSD14	4110		20	mg/kg	26-APR-95	A47M4	DMET
Iron	LFSD15	869		20	mg/kg	27-APR-95	A4965	DMET
Iron	LFSD16	1020		20	mg/kg	27-APR-95	A4966	DMET
Iron	LFSD17	949		20	mg/kg	27-APR-95	A4967	DMET
Iron	LFSD17D	622		20	mg/kg	27-APR-95	A4968	DMET
Iron	LFSD2	1720		20	mg/kg	23-JUN-93	90052027	DMET
Iron	LFSD3	1580		20	mg/kg	23-JUN-93	90052021	DMET
Iron	LFSD4	2160		20	mg/kg	23-JUN-93	90052019	DMET
Iron	LFSD5	967		20	mg/kg	23-JUN-93	90052017	DMET
Iron	LFSD6	7740		20	mg/kg	23-JUN-93	90052015	DMET
Iron	LFSD7	2770		20	mg/kg	23-JUN-93	90052012	DMET
Iron	LFSD8	586		20	mg/kg	23-JUN-93	90052023	DMET
Iron	LFSD9	493		20	mg/kg	28-APR-95	A499E	DMET
Iron	LFSD9D	625		20	mg/kg	04/28/95	A499F	DMET
Iron	RCGCSD1	1850		20	mg/kg	26-JUN-93	90055018	DMET
Iron	RCGCSD1D	1450		20	mg/kg	26-JUN-93	90055020	DMET
Iron	RCGCSD2	768		20	mg/kg	26-JUN-93	90055016	DMET
Iron	RCGCSD3	94.9		20	mg/kg	26-JUN-93	90055014	DMET
Iron	RCGCSDR1	155		20	mg/kg	17-AUG-93	90093004	DMET
Iron	RCSD1	1860		20	mg/kg	25-JUN-93	90054011	DMET
Iron	RCSD10	308		20	mg/kg	28-JUN-93	90057010	DMET
Iron	RCSD18	631		20	mg/kg	28-APR-95	A499D	DMET
Iron	RCSD2	3700		20	mg/kg	25-JUN-93	90054013	DMET
Iron	RCSD3	599		20	mg/kg	26-JUN-93	90055022	DMET
Iron	RCSD4	2570	J	20	mg/kg	27-JUN-93	90056011	DMET
Iron	RCSD5	94.9	J	20	mg/kg	27-JUN-93	90056009	DMET
Iron	RCSD6	405		20	mg/kg	24-JUN-93	90053019	DMET
Iron	RCSD7	368		20	mg/kg	24-JUN-93	90053017	DMET
Iron	RCSD8	524		20	mg/kg	24-JUN-93	90053013	DMET
Iron	RCSD8A	308		20	mg/kg	24-JUN-93	90053015	DMET
Iron	RCSD9	400		20	mg/kg	24-JUN-93	90053011	DMET
Iron	RCSDR1	216		20	mg/kg	17-AUG-93	90093002	DMET
Iron	STCSD1	482	J	20	mg/kg	22-JUN-93	90050008	DMET
Iron	STCSD2	1070	J	20	mg/kg	22-JUN-93	90050009	DMET
Iron	STCSD3	1500	J	20	mg/kg	22-JUN-93	90050007	DMET
Iron	STCSD4	463	J	20	mg/kg	22-JUN-93	90050006	DMET
Iron	STCSD5	492		20	mg/kg	16-AUG-93	90091008	DMET
Iron	STCSD5D	743		20	mg/kg	29-JUN-93	90058021	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Iron	STCSD6	170		20	mg/kg	26-JUN-93	90055026	DMET
Iron	STCSD7	155		20	mg/kg	26-JUN-93	90055024	DMET
Iron	STCSD8	185		20	mg/kg	28-JUN-93	90057014	DMET
Iron	STCSDR1	413		20	mg/kg	16-AUG-93	90091012	DMET
Iron	YWCSD1	506	J	20	mg/kg	27-JUN-93	90056017	DMET
Iron	YWCSD2	181	J	20	mg/kg	27-JUN-93	90056015	DMET
Iron	YWCSD20	3140		20	mg/kg	27-APR-95	A4969	DMET
Iron	YWCSDR1	238		20	mg/kg	28-JUN-93	90057012	DMET
Lead	18SD1	7.7	J	1	mg/kg	16-AUG-93	90091002	DMET
Lead	18SD2	7.3	J	1	mg/kg	16-AUG-93	90091004	DMET
Lead	2SD1	9		1	mg/kg	24-JUN-93	90053021	DMET
Lead	2SD2	9.3		1	mg/kg	22-JUN-93	90050010	DMET
Lead	2SD3	22.4		1	mg/kg	24-JUN-93	90053023	DMET
Lead	5SD1	6.4	J	1	mg/kg	17-AUG-93	90093008	DMET
Lead	5SD2	3		1	mg/kg	25-JUN-93	90054019	DMET
Lead	5SD2D	3.5		1	mg/kg	25-JUN-93	90054021	DMET
Lead	5SD3	7.8		1	mg/kg	25-JUN-93	90054017	DMET
Lead	5SD4	25		1	mg/kg	25-JUN-93	90054015	DMET
Lead	5SD6	101	J	1	mg/kg	16-AUG-93	90091014	DMET
Lead	5SD7	129	J	1	mg/kg	17-AUG-93	90093006	DMET
Lead	6SD1	5.2		1	mg/kg	28-JUN-93	90057008	DMET
Lead	9SD1	1.5	J	1	mg/kg	27-JUN-93	90056013	DMET
Lead	GCSD1	7.1		1	mg/kg	27-JUN-93	90056019	DMET
Lead	GCSD19	17		0.6	mg/kg	28-APR-95	A499H	DMET
Lead	GCSD2	16.9		1	mg/kg	26-JUN-93	90055012	DMET
Lead	GCSD3	11	J	1	mg/kg	30-JUN-93	90059008	DMET
Lead	GCSD4	3.6	J	1	mg/kg	30-JUN-93	90059010	DMET
Lead	GCSD5	8.6	J	1	mg/kg	30-JUN-93	90059012	DMET
Lead	GCSD5D	7.9	J	1	mg/kg	30-JUN-93	90059014	DMET
Lead	LFSD1	40.7		1	mg/kg	23-JUN-93	90052029	DMET
Lead	LFSD10	3.4		0.6	mg/kg	28-APR-95	A499G	DMET
Lead	LFSD11	14.8		0.6	mg/kg	26-APR-95	A47LX	DMET
Lead	LFSD12	4.7		0.6	mg/kg	26-APR-95	A47M1	DMET
Lead	LFSD13	6.4		0.6	mg/kg	26-APR-95	A47M3	DMET
Lead	LFSD14	75.8		0.6	mg/kg	26-APR-95	A47M4	DMET
Lead	LFSD15	11.4		0.6	mg/kg	27-APR-95	A4965	DMET
Lead	LFSD16	10		0.6	mg/kg	27-APR-95	A4966	DMET
Lead	LFSD17	14.7		0.6	mg/kg	27-APR-95	A4967	DMET
Lead	LFSD17D	9.8		0.6	mg/kg	27-APR-95	A4968	DMET
Lead	LFSD3	12.1		1	mg/kg	23-JUN-93	90052021	DMET
Lead	LFSD4	16.1		1	mg/kg	23-JUN-93	90052019	DMET
Lead	LFSD5	6.8		1	mg/kg	23-JUN-93	90052017	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Lead	LFSD6	67.7		1	mg/kg	23-JUN-93	90052015	DMET
Lead	LFSD7	27.5		1	mg/kg	23-JUN-93	90052012	DMET
Lead	LFSD8	6.2		1	mg/kg	23-JUN-93	90052023	DMET
Lead	LFSD9	6.3		0.6	mg/kg	28-APR-95	A499E	DMET
Lead	LFSD9D	6.5		0.6	mg/kg	04/28/95	A499F	DMET
Lead	RCGCSD1	17.9		1	mg/kg	26-JUN-93	90055018	DMET
Lead	RCGCSD1D	14.5		1	mg/kg	26-JUN-93	90055020	DMET
Lead	RCGCSD2	17.4		1	mg/kg	26-JUN-93	90055016	DMET
Lead	RCGCSDR1	2.8	J	1	mg/kg	17-AUG-93	90093004	DMET
Lead	RCSD1	17.1		1	mg/kg	25-JUN-93	90054011	DMET
Lead	RCSD10	2		1	mg/kg	28-JUN-93	90057010	DMET
Lead	RCSD18	8.5		0.6	mg/kg	28-APR-95	A499D	DMET
Lead	RCSD2	32.7		0.1	mg/kg	25-JUN-93	90054013	DMET
Lead	RCSD3	6.2		1	mg/kg	26-JUN-93	90055022	DMET
Lead	RCSD4	25.7		1	mg/kg	27-JUN-93	90056011	DMET
Lead	RCSD5	1	J	1	mg/kg	27-JUN-93	90056009	DMET
Lead	RCSD6	1.8		1	mg/kg	24-JUN-93	90053019	DMET
Lead	RCSD7	2.3		1	mg/kg	24-JUN-93	90053017	DMET
Lead	RCSD8	2.3		1	mg/kg	24-JUN-93	90053013	DMET
Lead	RCSD8A	1.2		1	mg/kg	24-JUN-93	90053015	DMET
Lead	RCSD9	4.5		1	mg/kg	24-JUN-93	90053011	DMET
Lead	RCSDR1	2.2	J	1	mg/kg	17-AUG-93	90093002	DMET
Lead	STCSD1	29.9		1	mg/kg	22-JUN-93	90050008	DMET
Lead	STCSD2	87		1	mg/kg	22-JUN-93	90050009	DMET
Lead	STCSD3	30.6		1	mg/kg	22-JUN-93	90050007	DMET
Lead	STCSD4	4.7		1	mg/kg	22-JUN-93	90050006	DMET
Lead	STCSD5	4	J	1	mg/kg	16-AUG-93	90091008	DMET
Lead	STCSD5D	6.6		1	mg/kg	29-JUN-93	90058021	DMET
Lead	STCSD6	2.7		1	mg/kg	26-JUN-93	90055026	DMET
Lead	STCSD7	0.88		1	mg/kg	26-JUN-93	90055024	DMET
Lead	STCSD8	1.3		1	mg/kg	28-JUN-93	90057014	DMET
Lead	STCSDR1	7.2	J	1	mg/kg	16-AUG-93	90091012	DMET
Lead	YWCSD1	7.5		1	mg/kg	27-JUN-93	90056017	DMET
Lead	YWCSD2	2.8		1	mg/kg	27-JUN-93	90056015	DMET
Lead	YWCSD20	23.5		0.6	mg/kg	27-APR-95	A4969	DMET
Lead	YWCSDR1	3.3		1	mg/kg	28-JUN-93	90057012	DMET
Magnesium	18SD1	112	J	1000	mg/kg	16-AUG-93	90091002	DMET
Magnesium	18SD2	19.5	J	1000	mg/kg	16-AUG-93	90091004	DMET
Magnesium	2SD2	175	J	1000	mg/kg	22-JUN-93	90050010	DMET
Magnesium	2SD3	138	J	1000	mg/kg	24-JUN-93	90053023	DMET
Magnesium	5SD1	28.8	J	1000	mg/kg	17-AUG-93	90093008	DMET
Magnesium	5SD2	18.3	J	1000	mg/kg	25-JUN-93	90054019	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Magnesium	5SD2D	24.7	J	1000	mg/kg	25-JUN-93	90054021	DMET
Magnesium	5SD3	59.4	J	1000	mg/kg	25-JUN-93	90054017	DMET
Magnesium	5SD4	341	J	1000	mg/kg	25-JUN-93	90054015	DMET
Magnesium	5SD5	13.2	J	1000	mg/kg	16-AUG-93	90091006	DMET
Magnesium	5SD6	140	J	1000	mg/kg	16-AUG-93	90091014	DMET
Magnesium	5SD7	329	J	1000	mg/kg	17-AUG-93	90093006	DMET
Magnesium	6SD1	120	J	1000	mg/kg	28-JUN-93	90057008	DMET
Magnesium	8SD1	85.3	J	1000	mg/kg	21-JUN-93	90049005	DMET
Magnesium	GCSD19	91.3		1000	mg/kg	28-APR-95	A499H	DMET
Magnesium	GCSD2	237	J	1000	mg/kg	26-JUN-93	90055012	DMET
Magnesium	GCSD3	167	J	1000	mg/kg	30-JUN-93	90059008	DMET
Magnesium	GCSD4	94.4	J	1000	mg/kg	30-JUN-93	90059010	DMET
Magnesium	GCSD5	232	J	1000	mg/kg	30-JUN-93	90059012	DMET
Magnesium	GCSD5D	212	J	1000	mg/kg	30-JUN-93	90059014	DMET
Magnesium	LFSD1	627	J	1000	mg/kg	23-JUN-93	90052029	DMET
Magnesium	LFSD10	55.8		1000	mg/kg	28-APR-95	A499G	DMET
Magnesium	LFSD11	104		1000	mg/kg	26-APR-95	A47LX	DMET
Magnesium	LFSD12	2980		1000	mg/kg	26-APR-95	A47M1	DMET
Magnesium	LFSD13	102		1000	mg/kg	26-APR-95	A47M3	DMET
Magnesium	LFSD14	789		1000	mg/kg	26-APR-95	A47M4	DMET
Magnesium	LFSD15	96.4		1000	mg/kg	27-APR-95	A4965	DMET
Magnesium	LFSD16	109		1000	mg/kg	27-APR-95	A4966	DMET
Magnesium	LFSD17	159		1000	mg/kg	27-APR-95	A4967	DMET
Magnesium	LFSD17D	89.7		1000	mg/kg	27-APR-95	A4968	DMET
Magnesium	LFSD2	188	J	1000	mg/kg	23-JUN-93	90052027	DMET
Magnesium	LFSD3	165	J	1000	mg/kg	23-JUN-93	90052021	DMET
Magnesium	LFSD4	261	J	1000	mg/kg	23-JUN-93	90052019	DMET
Magnesium	LFSD5	83.5	J	1000	mg/kg	23-JUN-93	90052017	DMET
Magnesium	LFSD6	692	J	1000	mg/kg	23-JUN-93	90052015	DMET
Magnesium	LFSD7	484	J	1000	mg/kg	23-JUN-93	90052012	DMET
Magnesium	LFSD8	89.3	J	1000	mg/kg	23-JUN-93	90052023	DMET
Magnesium	LFSD8D	62.5	J	1000	mg/kg	23-JUN-93	90052025	DMET
Magnesium	LFSD9	106		1000	mg/kg	28-APR-95	A499E	DMET
Magnesium	LFSD9D	74.7		1000	mg/kg	04/28/95	A499F	DMET
Magnesium	RCGCSD1	200	J	1000	mg/kg	26-JUN-93	90055018	DMET
Magnesium	RCGCSD1D	155	J	1000	mg/kg	26-JUN-93	90055020	DMET
Magnesium	RCGCSD2	106	J	1000	mg/kg	26-JUN-93	90055016	DMET
Magnesium	RCGCSDR1	14.8	J	1000	mg/kg	17-AUG-93	90093004	DMET
Magnesium	RCSD1	349	J	1000	mg/kg	25-JUN-93	90054011	DMET
Magnesium	RCSD10	70.6	J	1000	mg/kg	28-JUN-93	90057010	DMET
Magnesium	RCSD18	76.4		1000	mg/kg	28-APR-95	A499D	DMET
Magnesium	RCSD2	243	J	1000	mg/kg	25-JUN-93	90054013	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Magnesium	RCSD3	85.8	J	1000	mg/kg	26-JUN-93	90055022	DMET
Magnesium	RCSD4	179	J	1000	mg/kg	27-JUN-93	90056011	DMET
Magnesium	RCSD5	82.6	J	1000	mg/kg	27-JUN-93	90056009	DMET
Magnesium	RCSD9	172	J	1000	mg/kg	24-JUN-93	90053011	DMET
Magnesium	RCSDR1	24.9	J	1000	mg/kg	17-AUG-93	90093002	DMET
Magnesium	STCSD1	60.1	J	1000	mg/kg	22-JUN-93	90050008	DMET
Magnesium	STCSD2	549	J	1000	mg/kg	22-JUN-93	90050009	DMET
Magnesium	STCSD3	138	J	1000	mg/kg	22-JUN-93	90050007	DMET
Magnesium	STCSD5	85.1	J	1000	mg/kg	16-AUG-93	90091008	DMET
Magnesium	STCSD5D	92.6	J	1000	mg/kg	29-JUN-93	90058021	DMET
Magnesium	STCSD6	80.3	J	1000	mg/kg	26-JUN-93	90055026	DMET
Magnesium	STCSD7	81.3	J	1000	mg/kg	26-JUN-93	90055024	DMET
Magnesium	STCSD8	157	J	1000	mg/kg	28-JUN-93	90057014	DMET
Magnesium	STCSDR1	101	J	1000	mg/kg	16-AUG-93	90091012	DMET
Magnesium	YWCSD20	580		1000	mg/kg	27-APR-95	A4969	DMET
Manganese	18SD1	8.6		3	mg/kg	16-AUG-93	90091002	DMET
Manganese	18SD2	4	J	3	mg/kg	16-AUG-93	90091004	DMET
Manganese	2SD1	24.4		3	mg/kg	24-JUN-93	90053021	DMET
Manganese	2SD2	42.5		3	mg/kg	22-JUN-93	90050010	DMET
Manganese	2SD2D	69.9		3	G/KGB	22-JUN-93	90050011	DMET
Manganese	2SD3	22.8		3	mg/kg	24-JUN-93	90053023	DMET
Manganese	5SD1	0.91	J	3	mg/kg	17-AUG-93	90093008	DMET
Manganese	5SD4	8.7	J	3	mg/kg	25-JUN-93	90054015	DMET
Manganese	5SD5	0.51	J	3	mg/kg	16-AUG-93	90091006	DMET
Manganese	5SD6	5.1	J	3	mg/kg	16-AUG-93	90091014	DMET
Manganese	5SD7	13		3	mg/kg	17-AUG-93	90093006	DMET
Manganese	6SD1	8.5		3	mg/kg	28-JUN-93	90057008	DMET
Manganese	GCSD1	2.3	J	3	mg/kg	27-JUN-93	90056019	DMET
Manganese	GCSD19	4.7		3	mg/kg	28-APR-95	A499H	DMET
Manganese	GCSD2	6.1		3	mg/kg	26-JUN-93	90055012	DMET
Manganese	GCSD3	11.7		3	mg/kg	30-JUN-93	90059008	DMET
Manganese	GCSD5	8.6	J	3	mg/kg	30-JUN-93	90059012	DMET
Manganese	GCSD5D	5	J	3	mg/kg	30-JUN-93	90059014	DMET
Manganese	LFSD1	14.1	J	3	mg/kg	23-JUN-93	90052029	DMET
Manganese	LFSD10	4.8		3	mg/kg	28-APR-95	A499G	DMET
Manganese	LFSD11	7		3	mg/kg	26-APR-95	A47LX	DMET
Manganese	LFSD12	13.1		3	mg/kg	26-APR-95	A47M1	DMET
Manganese	LFSD13	3.1		3	mg/kg	26-APR-95	A47M3	DMET
Manganese	LFSD14	19.7		3	mg/kg	26-APR-95	A47M4	DMET
Manganese	LFSD15	5.8		3	mg/kg	27-APR-95	A4965	DMET
Manganese	LFSD16	5		3	mg/kg	27-APR-95	A4966	DMET
Manganese	LFSD17	8.2		3	mg/kg	27-APR-95	A4967	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Manganese	LFSD17D	3.7		3	mg/kg	27-APR-95	A4968	DMET
Manganese	LFSD2	7.4	J	3	mg/kg	23-JUN-93	90052027	DMET
Manganese	LFSD3	7.6	J	3	mg/kg	23-JUN-93	90052021	DMET
Manganese	LFSD4	9	J	3	mg/kg	23-JUN-93	90052019	DMET
Manganese	LFSD5	5.2	J	3	mg/kg	23-JUN-93	90052017	DMET
Manganese	LFSD6	30.6	J	3	mg/kg	23-JUN-93	90052015	DMET
Manganese	LFSD7	19.1	J	3	mg/kg	23-JUN-93	90052012	DMET
Manganese	LFSD8	3.1	J	3	mg/kg	23-JUN-93	90052023	DMET
Manganese	LFSD9	8.3		3	mg/kg	28-APR-95	A499E	DMET
Manganese	LFSD9D	11.1		3	mg/kg	04/28/95	A499F	DMET
Manganese	RCGCSD1	7.2		3	mg/kg	26-JUN-93	90055018	DMET
Manganese	RCGCSD1D	6.1		3	mg/kg	26-JUN-93	90055020	DMET
Manganese	RCGCSD2	2.7	J	3	mg/kg	26-JUN-93	90055016	DMET
Manganese	RCGCSDR1	0.8	J	3	mg/kg	17-AUG-93	90093004	DMET
Manganese	RCSD1	5.6	J	3	mg/kg	25-JUN-93	90054011	DMET
Manganese	RCSD10	2.8	J	3	mg/kg	28-JUN-93	90057010	DMET
Manganese	RCSD18	3.6		3	mg/kg	28-APR-95	A499D	DMET
Manganese	RCSD2	12.8		3	mg/kg	25-JUN-93	90054013	DMET
Manganese	RCSD3	3	J	3	mg/kg	26-JUN-93	90055022	DMET
Manganese	RCSD4	25.7		3	mg/kg	27-JUN-93	90056011	DMET
Manganese	RCSD6	3.2	J	3	mg/kg	24-JUN-93	90053019	DMET
Manganese	RCSD7	3	J	3	mg/kg	24-JUN-93	90053017	DMET
Manganese	RCSD8	3.9	J	3	mg/kg	24-JUN-93	90053013	DMET
Manganese	RCSD8A	3.5	J	3	mg/kg	24-JUN-93	90053015	DMET
Manganese	RCSD9	2.6	J	3	mg/kg	24-JUN-93	90053011	DMET
Manganese	RCSDR1	2	J	3	mg/kg	17-AUG-93	90093002	DMET
Manganese	STCSD2	8.6		3	mg/kg	22-JUN-93	90050009	DMET
Manganese	STCSD3	4.9	J	3	mg/kg	22-JUN-93	90050007	DMET
Manganese	STCSD5	2.7	J	3	mg/kg	16-AUG-93	90091008	DMET
Manganese	STCSD6	1.7	J	3	mg/kg	26-JUN-93	90055026	DMET
Manganese	STCSD8	2.5	J	3	mg/kg	28-JUN-93	90057014	DMET
Manganese	STCSDR1	1.9	J	3	mg/kg	16-AUG-93	90091012	DMET
Manganese	YWCSD1	5.8		3	mg/kg	27-JUN-93	90056017	DMET
Manganese	YWCSD2	2.7	J	3	mg/kg	27-JUN-93	90056015	DMET
Manganese	YWCSD20	8.7		3	mg/kg	27-APR-95	A4969	DMET
Manganese	YWCSDR1	4		3	mg/kg	28-JUN-93	90057012	DMET
Mercury	2SD2	0.39	J	0.1	mg/kg	22-JUN-93	90050010	DMET
Mercury	2SD2D	1	J	0.1	G/KGB	22-JUN-93	90050011	DMET
Mercury	5SD6	0.09		0.1	mg/kg	16-AUG-93	90091014	DMET
Mercury	5SD7	0.17		0.1	mg/kg	17-AUG-93	90093006	DMET
Mercury	GCSD5D	0.13		0.1	mg/kg	30-JUN-93	90059014	DMET
Mercury	LFSD1	0.16		0.1	mg/kg	23-JUN-93	90052029	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Mercury	LFSD3	0.16		0.1	mg/kg	23-JUN-93	90052021	DMET
Mercury	LFSD4	0.08		0.1	mg/kg	23-JUN-93	90052019	DMET
Mercury	LFSD6	0.23		0.1	mg/kg	23-JUN-93	90052015	DMET
Mercury	LFSD7	0.11		0.1	mg/kg	23-JUN-93	90052012	DMET
Mercury	STCSD1	0.06	J	0.1	mg/kg	22-JUN-93	90050008	DMET
Mercury	STCSD2	0.05	J	0.1	mg/kg	22-JUN-93	90050009	DMET
Mercury	STCSD3	0.12	J	0.1	mg/kg	22-JUN-93	90050007	DMET
Nickel	2SD2	14.2	J	8	mg/kg	22-JUN-93	90050010	DMET
Nickel	GCSD19	1.5	J	8	mg/kg	28-APR-95	A499H	DMET
Nickel	LFSD10	1.5	J	8	mg/kg	28-APR-95	A499G	DMET
Nickel	LFSD11	1.9	J	8	mg/kg	26-APR-95	A47LX	DMET
Nickel	LFSD12	3.2	J	8	mg/kg	26-APR-95	A47M1	DMET
Nickel	LFSD13	1.5		8	mg/kg	26-APR-95	A47M3	DMET
Nickel	LFSD14	7.9	J	8	mg/kg	26-APR-95	A47M4	DMET
Nickel	LFSD15	2.1	J	8	mg/kg	27-APR-95	A4965	DMET
Nickel	LFSD16	4.4	J	8	mg/kg	27-APR-95	A4966	DMET
Nickel	LFSD17	2.9	J	8	mg/kg	27-APR-95	A4967	DMET
Nickel	LFSD17D	2.1		8	mg/kg	27-APR-95	A4968	DMET
Nickel	LFSD6	12.7	J	8	mg/kg	23-JUN-93	90052015	DMET
Nickel	LFSD9	1.9		8	mg/kg	28-APR-95	A499E	DMET
Nickel	LFSD9D	18.1		8	mg/kg	04/28/95	A499F	DMET
Nickel	RCSD10	3.4	J	8	mg/kg	28-JUN-93	90057010	DMET
Nickel	RCSD18	1.5	J	8	mg/kg	28-APR-95	A499D	DMET
Nickel	RCSD7	3.4	J	8	mg/kg	24-JUN-93	90053017	DMET
Nickel	STCSD2	7.9	J	8	mg/kg	22-JUN-93	90050009	DMET
Nickel	STCSD3	4.6	J	8	mg/kg	22-JUN-93	90050007	DMET
Nickel	YWCSD20	3.2	J	8	mg/kg	27-APR-95	A4969	DMET
Potassium	GCSD5D	129	J	1000	mg/kg	30-JUN-93	90059014	DMET
Potassium	LFSD11	18.6		1000	mg/kg	26-APR-95	A47LX	DMET
Potassium	LFSD12	18.5		1000	mg/kg	26-APR-95	A47M1	DMET
Potassium	LFSD13	27.4		1000	mg/kg	26-APR-95	A47M3	DMET
Potassium	LFSD14	110		1000	mg/kg	26-APR-95	A47M4	DMET
Potassium	LFSD15	41.8		1000	mg/kg	27-APR-95	A4965	DMET
Potassium	LFSD16	35		1000	mg/kg	27-APR-95	A4966	DMET
Potassium	LFSD17	53.2		1000	mg/kg	27-APR-95	A4967	DMET
Potassium	LFSD17D	18.8	J	1000	mg/kg	27-APR-95	A4968	DMET
Potassium	RCGCSD1	148	J	1000	mg/kg	26-JUN-93	90055018	DMET
Potassium	RCSD8	122	J	1000	mg/kg	24-JUN-93	90053013	DMET
Potassium	YWCSD20	67.5		1000	mg/kg	27-APR-95	A4969	DMET
Selenium	2SD2D	5.9	J	1	G/KGB	22-JUN-93	90050011	DMET
Selenium	2SD3	3.5		1	mg/kg	24-JUN-93	90053023	DMET
Selenium	9SD1	0.53	J	1	mg/kg	27-JUN-93	90056013	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Selenium	LFSD6	2.2	J	1	mg/kg	23-JUN-93	90052015	DMET
Selenium	RCSD5	0.45	J	1	mg/kg	27-JUN-93	90056009	DMET
Silver	2SD2	4.5	J	2	mg/kg	22-JUN-93	90050010	DMET
Silver	2SD2D	7.5	J	2	G/KGB	22-JUN-93	90050011	DMET
Silver	2SD3	1.4	J	2	mg/kg	24-JUN-93	90053023	DMET
Silver	RCSD4	2.1	J	2	mg/kg	27-JUN-93	90056011	DMET
Sodium	5SD7	123	J	1000	mg/kg	17-AUG-93	90093006	DMET
Sodium	GCSD19	266		1000	mg/kg	28-APR-95	A499H	DMET
Sodium	GCSD4	90.7	J	1000	mg/kg	30-JUN-93	90059010	DMET
Sodium	LFSD10	196		1000	mg/kg	28-APR-95	A499G	DMET
Sodium	LFSD11	251		1000	mg/kg	26-APR-95	A47LX	DMET
Sodium	LFSD12	220		1000	mg/kg	26-APR-95	A47M1	DMET
Sodium	LFSD13	293		1000	mg/kg	26-APR-95	A47M3	DMET
Sodium	LFSD14	1060		1000	mg/kg	26-APR-95	A47M4	DMET
Sodium	LFSD15	204		1000	mg/kg	27-APR-95	A4965	DMET
Sodium	LFSD16	227		1000	mg/kg	27-APR-95	A4966	DMET
Sodium	LFSD17	232		1000	mg/kg	27-APR-95	A4967	DMET
Sodium	LFSD17D	288		1000	mg/kg	27-APR-95	A4968	DMET
Sodium	LFSD9	200		1000	mg/kg	28-APR-95	A499E	DMET
Sodium	LFSD9D	241		1000	mg/kg	04/28/95	A499F	DMET
Sodium	RCSD18	266		1000	mg/kg	28-APR-95	A499D	DMET
Sodium	STCSD4	21.2	J	1000	mg/kg	22-JUN-93	90050006	DMET
Sodium	YWCSD20	577		1000	mg/kg	27-APR-95	A4969	DMET
Vanadium	2SD2	10.9	J	10	mg/kg	22-JUN-93	90050010	DMET
Vanadium	2SD3	17.4	J	10	mg/kg	24-JUN-93	90053023	DMET
Vanadium	5SD2	1.5	J	10	mg/kg	25-JUN-93	90054019	DMET
Vanadium	5SD2D	1.2	J	10	mg/kg	25-JUN-93	90054021	DMET
Vanadium	5SD3	3.5	J	10	mg/kg	25-JUN-93	90054017	DMET
Vanadium	5SD4	9.3	J	10	mg/kg	25-JUN-93	90054015	DMET
Vanadium	5SD6	10.2	J	10	mg/kg	16-AUG-93	90091014	DMET
Vanadium	9SD1	2.4	J	10	mg/kg	27-JUN-93	90056013	DMET
Vanadium	GCSD1	1.2	J	10	mg/kg	27-JUN-93	90056019	DMET
Vanadium	GCSD19	4.8		10	mg/kg	28-APR-95	A499H	DMET
Vanadium	GCSD2	4.8	J	10	mg/kg	26-JUN-93	90055012	DMET
Vanadium	LFSD1	12.2	J	10	mg/kg	23-JUN-93	90052029	DMET
Vanadium	LFSD10	1.6		10	mg/kg	28-APR-95	A499G	DMET
Vanadium	LFSD11	4.2		10	mg/kg	26-APR-95	A47LX	DMET
Vanadium	LFSD12	2		10	mg/kg	26-APR-95	A47M1	DMET
Vanadium	LFSD13	3.4		10	mg/kg	26-APR-95	A47M3	DMET
Vanadium	LFSD14	17.6		10	mg/kg	26-APR-95	A47M4	DMET
Vanadium	LFSD15	4.3		10	mg/kg	27-APR-95	A4965	DMET
Vanadium	LFSD16	4		10	mg/kg	27-APR-95	A4966	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Vanadium	LFSD17	6.5		10	mg/kg	27-APR-95	A4967	DMET
Vanadium	LFSD17D	4.3		10	mg/kg	27-APR-95	A4968	DMET
Vanadium	LFSD2	7.3	J	10	mg/kg	23-JUN-93	90052027	DMET
Vanadium	LFSD3	6.9	J	10	mg/kg	23-JUN-93	90052021	DMET
Vanadium	LFSD4	8.8	J	10	mg/kg	23-JUN-93	90052019	DMET
Vanadium	LFSD6	25.2	J	10	mg/kg	23-JUN-93	90052015	DMET
Vanadium	LFSD7	12.7	J	10	mg/kg	23-JUN-93	90052012	DMET
Vanadium	LFSD8D	2.8	J	10	mg/kg	23-JUN-93	90052025	DMET
Vanadium	LFSD9	2.8		10	mg/kg	28-APR-95	A499E	DMET
Vanadium	LFSD9D	2.9		10	mg/kg	04/28/95	A499F	DMET
Vanadium	RCGCSD1	9.7	J	10	mg/kg	26-JUN-93	90055018	DMET
Vanadium	RCGCSD1D	7.7	J	10	mg/kg	26-JUN-93	90055020	DMET
Vanadium	RCGCSD2	11.1	J	10	mg/kg	26-JUN-93	90055016	DMET
Vanadium	RCGCSD3	4.3	J	10	mg/kg	26-JUN-93	90055014	DMET
Vanadium	RCSD1	5.7	J	10	mg/kg	25-JUN-93	90054011	DMET
Vanadium	RCSD18	3		10	mg/kg	28-APR-95	A499D	DMET
Vanadium	RCSD2	10.3	J	10	mg/kg	25-JUN-93	90054013	DMET
Vanadium	RCSD3	1.2	J	10	mg/kg	26-JUN-93	90055022	DMET
Vanadium	RCSD4	4.5	J	10	mg/kg	27-JUN-93	90056011	DMET
Vanadium	STCSD2	10.6	J	10	mg/kg	22-JUN-93	90050009	DMET
Vanadium	STCSD3	6.8	J	10	mg/kg	22-JUN-93	90050007	DMET
Vanadium	STCSD4	4.1	J	10	mg/kg	22-JUN-93	90050006	DMET
Vanadium	STCSD7	0.65	J	10	mg/kg	26-JUN-93	90055024	DMET
Vanadium	YWCSD1	1.3	J	10	mg/kg	27-JUN-93	90056017	DMET
Vanadium	YWCSD2	0.62	J	10	mg/kg	27-JUN-93	90056015	DMET
Vanadium	YWCSD20	14.9		10	mg/kg	27-APR-95	A4969	DMET
Zinc	18SD1	10.8		4	mg/kg	16-AUG-93	90091002	DMET
Zinc	18SD2	5.1	J	4	mg/kg	16-AUG-93	90091004	DMET
Zinc	2SD1	38.2		4	mg/kg	24-JUN-93	90053021	DMET
Zinc	2SD2	73.4		4	mg/kg	22-JUN-93	90050010	DMET
Zinc	2SD2D	94.9		4	G/KGB	22-JUN-93	90050011	DMET
Zinc	2SD3	34.5		4	mg/kg	24-JUN-93	90053023	DMET
Zinc	5SD1	3.9	J	4	mg/kg	17-AUG-93	90093008	DMET
Zinc	5SD4	39.1		4	mg/kg	25-JUN-93	90054015	DMET
Zinc	5SD5	0.68	J	4	mg/kg	16-AUG-93	90091006	DMET
Zinc	5SD6	45.5		4	mg/kg	16-AUG-93	90091014	DMET
Zinc	5SD7	81.8		4	mg/kg	17-AUG-93	90093006	DMET
Zinc	6SD1	48.1		4	mg/kg	28-JUN-93	90057008	DMET
Zinc	9SD1	4	J	4	mg/kg	27-JUN-93	90056013	DMET
Zinc	GCSD1	10.4		4	mg/kg	27-JUN-93	90056019	DMET
Zinc	GCSD2	44.7		4	mg/kg	26-JUN-93	90055012	DMET
Zinc	GCSD3	38.7	J	4	mg/kg	30-JUN-93	90059008	DMET

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Zinc	GCSD4	19.2	J	4	mg/kg	30-JUN-93	90059010	DMET
Zinc	GCSD5	56.2	J	4	mg/kg	30-JUN-93	90059012	DMET
Zinc	GCSD5D	37.5	J	4	mg/kg	30-JUN-93	90059014	DMET
Zinc	LFSD1	85.2		4	mg/kg	23-JUN-93	90052029	DMET
Zinc	LFSD14	132		4	mg/kg	26-APR-95	A47M4	DMET
Zinc	LFSD2	22.9		4	mg/kg	23-JUN-93	90052027	DMET
Zinc	LFSD3	39.6		4	mg/kg	23-JUN-93	90052021	DMET
Zinc	LFSD4	54		4	mg/kg	23-JUN-93	90052019	DMET
Zinc	LFSD5	20.9		4	mg/kg	23-JUN-93	90052017	DMET
Zinc	LFSD6	180		4	mg/kg	23-JUN-93	90052015	DMET
Zinc	LFSD7	81.7		4	mg/kg	23-JUN-93	90052012	DMET
Zinc	LFSD8	20.9		4	mg/kg	23-JUN-93	90052023	DMET
Zinc	LFSD8D	17.1		4	mg/kg	23-JUN-93	90052025	DMET
Zinc	RCGCSD1D	13.5		4	mg/kg	26-JUN-93	90055020	DMET
Zinc	RCSD1	42.2		4	mg/kg	25-JUN-93	90054011	DMET
Zinc	RCSD10	5.5	J	4	mg/kg	28-JUN-93	90057010	DMET
Zinc	RCSD2	75		4	mg/kg	25-JUN-93	90054013	DMET
Zinc	RCSD3	14.6		4	mg/kg	26-JUN-93	90055022	DMET
Zinc	RCSD4	75.9		4	mg/kg	27-JUN-93	90056011	DMET
Zinc	RCSD5	2.4	J	4	mg/kg	27-JUN-93	90056009	DMET
Zinc	RCSD6	7.8		4	mg/kg	24-JUN-93	90053019	DMET
Zinc	RCSD7	7.1		4	mg/kg	24-JUN-93	90053017	DMET
Zinc	RCSD8	8.9		4	mg/kg	24-JUN-93	90053013	DMET
Zinc	RCSD8A	5.6		4	mg/kg	24-JUN-93	90053015	DMET
Zinc	RCSD9	9		4	mg/kg	24-JUN-93	90053011	DMET
Zinc	STCSD1	76.8		4	mg/kg	22-JUN-93	90050008	DMET
Zinc	STCSD2	145		4	mg/kg	22-JUN-93	90050009	DMET
Zinc	STCSD3	109		4	mg/kg	22-JUN-93	90050007	DMET
Zinc	STCSD4	19.5		4	mg/kg	22-JUN-93	90050006	DMET
Zinc	STCSD5	7.5		4	mg/kg	16-AUG-93	90091008	DMET
Zinc	STCSD5D	6.7	J	4	mg/kg	29-JUN-93	90058021	DMET
Zinc	STCSD6	3.1	J	4	mg/kg	26-JUN-93	90055026	DMET
Zinc	STCSD8	4.6	J	4	mg/kg	28-JUN-93	90057014	DMET
Zinc	STCSDR1	10.9		4	mg/kg	16-AUG-93	90091012	DMET
Zinc	YWCSD1	14.3		4	mg/kg	27-JUN-93	90056017	DMET
Zinc	YWCSD2	3.3	J	4	mg/kg	27-JUN-93	90056015	DMET
Zinc	YWCSDR1	4.4	J	4	mg/kg	28-JUN-93	90057012	DMET
Acid volatile sulfides	2SD3	0.48		0.1	umole/	24-JUN-93	90053022	MISC
Acid volatile sulfides	RCGCSD2	0.16		0.1	umole/	26-JUN-93	90055016	MISC
Acid volatile sulfides	RCSD1	0.32		0.1	umole/	23-JUN-93	90054010	MISC
Acid volatile sulfides	RCSD7	0.11		0.1	umole/	24-JUN-93	90053016	MISC
Acid volatile sulfides	RCSD8	0.093		0.1	umole/	24-JUN-93	90053012	MISC

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Total organic carbon	18SD1	15000		5	mg/kg	17-AUG-93	90091002	TOC
Total organic carbon	18SD2	8810		5	mg/kg	17-AUG-93	90091004	TOC
Total organic carbon	2SD1	94300		5	mg/kg	24-JUN-93	90053021	TOC
Total organic carbon	2SD2	35200		5	mg/kg	22-JUN-93	90050010	TOC
Total organic carbon	2SD2D	46000		5	mg/kg	22-JUN-93	90050011	TOC
Total organic carbon	2SD3	83700		5	mg/kg	24-JUN-93	90053023	TOC
Total organic carbon	5SD1	17100		5	mg/kg	17-AUG-93	90093008	TOC
Total organic carbon	5SD2	6410		5	mg/kg	23-JUN-93	90054019	TOC
Total organic carbon	5SD2D	8040		5	mg/kg	23-JUN-93	90054021	TOC
Total organic carbon	5SD3	13900		5	mg/kg	25-JUN-93	90054017	TOC
Total organic carbon	5SD4	97600		5	mg/kg	25-JUN-93	90054015	TOC
Total organic carbon	5SD5	3970		5	mg/kg	17-AUG-93	90091006	TOC
Total organic carbon	5SD6	33200		5	mg/kg	17-AUG-93	90091014	TOC
Total organic carbon	5SD7	108000		5	mg/kg	17-AUG-93	90093006	TOC
Total organic carbon	6SD1	43200		5	mg/kg	28-JUN-93	90057008	TOC
Total organic carbon	8SD1	4050		5	mg/kg	21-JUN-93	90049005	TOC
Total organic carbon	8SD2	2140		5	mg/kg	21-JUN-93	90049006	TOC
Total organic carbon	9SD1	2590		5	mg/kg	27-JUN-93	90056013	TOC
Total organic carbon	GCSD1	12200		5	mg/kg	27-JUN-93	90056019	TOC
Total organic carbon	GCSD19	23000		330	mg/kg	28-APR-95	A5D290010005	TOC
Total organic carbon	GCSD2	22600		5	mg/kg	26-JUN-93	90055012	TOC
Total organic carbon	GCSD3	9900		5	mg/kg	30-JUN-93	90059008	TOC
Total organic carbon	GCSD4	15400		5	mg/kg	30-JUN-93	90059010	TOC
Total organic carbon	GCSD5	5390		5	mg/kg	30-JUN-93	90059012	TOC
Total organic carbon	GCSD5D	6690		5	mg/kg	30-JUN-93	90059014	TOC
Total organic carbon	LFSD1	69700		5	mg/kg	23-JUN-93	90052029	TOC
Total organic carbon	LFSD10	9200		270	mg/kg	28-APR-95	A5D290010004	TOC
Total organic carbon	LFSD11	20000		320	mg/kg	26-APR-95	A5D270011001	TOC
Total organic carbon	LFSD12	5800		160	mg/kg	26-APR-95	A5D270011002	TOC
Total organic carbon	LFSD13	34000		370	mg/kg	26-APR-95	A5D270011003	TOC
Total organic carbon	LFSD14	160000		3300	mg/kg	26-APR-95	A5D270011004	TOC
Total organic carbon	LFSD15	15000		160	mg/kg	27-APR-95	A5D280074001	TOC
Total organic carbon	LFSD16	12000		150	mg/kg	27-APR-95	A5D280074002	TOC
Total organic carbon	LFSD17	19000		160	mg/kg	27-APR-95	A5D280074003	TOC
Total organic carbon	LFSD17D	18000		150	mg/kg	27-APR-95	A5D280074004	TOC
Total organic carbon	LFSD2	52500		5	mg/kg	23-JUN-93	90052027	TOC
Total organic carbon	LFSD3	20400		5	mg/kg	23-JUN-93	90052021	TOC
Total organic carbon	LFSD4	37200		5	mg/kg	23-JUN-93	90052019	TOC
Total organic carbon	LFSD5	15400		5	mg/kg	23-JUN-93	90052017	TOC
Total organic carbon	LFSD6	93000		5	mg/kg	23-JUN-93	90052015	TOC
Total organic carbon	LFSD7	22200		5	mg/kg	23-JUN-93	90052012	TOC
Total organic carbon	LFSD8	60900		5	mg/kg	23-JUN-93	90052023	TOC

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Total organic carbon	LFSD8D	10200		5	mg/kg	23-JUN-93	90052025	TOC
Total organic carbon	LFSD9	11000		290	mg/kg	28-APR-95	A5D290010002	TOC
Total organic carbon	LFSD9D	12000		300	mg/kg	04/28/95	A5D290010003	TOC
Total organic carbon	RCGCSD1	27500		5	mg/kg	26-JUN-93	90055018	TOC
Total organic carbon	RCGCSD1D	30100		5	mg/kg	26-JUN-93	90055020	TOC
Total organic carbon	RCGCSD2	20200		5	mg/kg	26-JUN-93	90055016	TOC
Total organic carbon	RCGCSD3	5100		5	mg/kg	26-JUN-93	90055014	TOC
Total organic carbon	RCGCSDR1	1960		5	mg/kg	17-AUG-93	90093004	TOC
Total organic carbon	RCSD1	25200		5	mg/kg	25-JUN-93	90054011	TOC
Total organic carbon	RCSD10	1360		5	mg/kg	30-JUN-93	90059016	TOC
Total organic carbon	RCSD18	17000		360	mg/kg	28-APR-95	A5D290010001	TOC
Total organic carbon	RCSD2	62100		5	mg/kg	25-JUN-93	90054013	TOC
Total organic carbon	RCSD3	6340		5	mg/kg	26-JUN-93	90055022	TOC
Total organic carbon	RCSD4	20300		5	mg/kg	27-JUN-93	90056011	TOC
Total organic carbon	RCSD5	1220		5	mg/kg	27-JUN-93	90056009	TOC
Total organic carbon	RCSD6	2740		5	mg/kg	24-JUN-93	90053019	TOC
Total organic carbon	RCSD7	2470		5	mg/kg	24-JUN-93	90053017	TOC
Total organic carbon	RCSD8	4420		5	mg/kg	24-JUN-93	90053013	TOC
Total organic carbon	RCSD8A	4120		5	mg/kg	24-JUN-93	90053015	TOC
Total organic carbon	RCSD9	9300		5	mg/kg	24-JUN-93	90053011	TOC
Total organic carbon	RCSDR1	3760		5	mg/kg	17-AUG-93	90093002	TOC
Total organic carbon	STCSD1	7900		5	mg/kg	22-JUN-93	90050008	TOC
Total organic carbon	STCSD2	14700		5	mg/kg	22-JUN-93	90050009	TOC
Total organic carbon	STCSD3	11900		5	mg/kg	22-JUN-93	90050007	TOC
Total organic carbon	STCSD4	15600		5	mg/kg	22-JUN-93	90050006	TOC
Total organic carbon	STCSD5	17600		5	mg/kg	17-AUG-93	90091008	TOC
Total organic carbon	STCSD5D	6410		5	mg/kg	29-JUN-93	90058021	TOC
Total organic carbon	STCSD6	2680		5	mg/kg	26-JUN-93	90055026	TOC
Total organic carbon	STCSD7	2190		5	mg/kg	26-JUN-93	90055024	TOC
Total organic carbon	STCSD8	3760		5	mg/kg	28-JUN-93	90057014	TOC
Total organic carbon	STCSDR1	5000		5	mg/kg	17-AUG-93	90091012	TOC
Total organic carbon	YWCSD1	15800		5	mg/kg	27-JUN-93	90056017	TOC
Total organic carbon	YWCSD2	14100		5	mg/kg	27-JUN-93	90056015	TOC
Total organic carbon	YWCSD20	23000		570	mg/kg	27-APR-95	A5D280074005	TOC
Total organic carbon	YWCSDR1	3520		5	mg/kg	28-JUN-93	90057012	TOC
Total petroleum hydrocarbon	18SD1	120		1.6	mg/kg	17-AUG-93	90091002	TPH
Total petroleum hydrocarbon	18SD2	46.9		1.6	mg/kg	17-AUG-93	90091004	TPH
Total petroleum hydrocarbon	2SD2D	89		1.6	mg/kg	22-JUN-93	90050011	TPH
Total petroleum hydrocarbon	5SD1	1450		1.6	mg/kg	17-AUG-93	90093008	TPH
Total petroleum hydrocarbon	5SD2	170		1.6	mg/kg	25-JUN-93	90054026	TPH
Total petroleum hydrocarbon	5SD3	550		1.6	mg/kg	25-JUN-93	90054025	TPH
Total petroleum hydrocarbon	5SD4	717		1.6	mg/kg	25-JUN-93	90054024	TPH

Appendix B-2 - Sediment Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Total petroleum hydrocarbon	5SD5	23.3		1.6	mg/kg	17-AUG-93	90091006	TPH
Total petroleum hydrocarbon	5SD6	40.1		1.6	mg/kg	17-AUG-93	90091014	TPH
Total petroleum hydrocarbon	5SD7	42.9		1.6	mg/kg	17-AUG-93	90093006	TPH
Total petroleum hydrocarbon	RCGCSDR1	16.8		1.6	mg/kg	17-AUG-93	90093004	TPH
Total petroleum hydrocarbon	RCSDR1	46.9		1.6	mg/kg	17-AUG-93	90093002	TPH
Total petroleum hydrocarbon	STCSD1	1920		1.6	mg/kg	22-JUN-93	90050008	TPH
Total petroleum hydrocarbon	STCSD2	3440		1.6	mg/kg	22-JUN-93	90050009	TPH
Total petroleum hydrocarbon	STCSD3	1030		1.6	mg/kg	22-JUN-93	90050007	TPH
Total petroleum hydrocarbon	STCSD4	214		1.6	mg/kg	22-JUN-93	90050006	TPH
Total petroleum hydrocarbon	STCSD5	144		1.6	mg/kg	17-AUG-93	90091008	TPH
Total petroleum hydrocarbon	STCSDR1	126		1.6	mg/kg	17-AUG-93	90091012	TPH

Notes:
J = qualified as estimated
AVOL = volatile organics
BSVO = semivolatile organics
CPES = pesticides and polychlorinated biphenyls
DMET = inorganics
MISC = miscellaneous
TOC = total organic carbon
TPH = total petroleum hydrocarbon
ug/kg = micrograms per kilograms
mg/kg = milligrams per kilograms
umole = micromole

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
18SW1	Aluminum	530	J	200	ug/l	29-JUN-93	90058002	DMET
18SW1	Barium	18.3	J	200	ug/l	29-JUN-93	90058002	DMET
18SW1	Calcium	5980		5000	ug/l	29-JUN-93	90058002	DMET
18SW1	Iron	6580	J	100	ug/l	29-JUN-93	90058002	DMET
18SW1	Magnesium	1590	J	5000	ug/l	29-JUN-93	90058002	DMET
18SW1	Manganese	72.9		15	ug/l	29-JUN-93	90058002	DMET
18SW1	Potassium	1690	J	5000	ug/l	29-JUN-93	90058002	DMET
18SW1	Sodium	4450	J	5000	ug/l	29-JUN-93	90058002	DMET
18SW1	Zinc	32.8		20	ug/l	29-JUN-93	90058002	DMET
18SW2	Aluminum	487	J	200	ug/l	29-JUN-93	90058003	DMET
18SW2	Calcium	4100	J	5000	ug/l	29-JUN-93	90058003	DMET
18SW2	Iron	5540	J	100	ug/l	29-JUN-93	90058003	DMET
18SW2	Magnesium	1180	J	5000	ug/l	29-JUN-93	90058003	DMET
18SW2	Manganese	30.4		15	ug/l	29-JUN-93	90058003	DMET
18SW2	Potassium	2120	J	5000	ug/l	29-JUN-93	90058003	DMET
18SW2	Sodium	3960	J	5000	ug/l	29-JUN-93	90058003	DMET
18SW2	Zinc	16.8	J	20	ug/l	29-JUN-93	90058003	DMET
2SW1	Chlorobenzene	4	J	10	ug/l	24-JUN-93	90053007	AVOL
2SW1	1,4-Dichlorobenzene	2	J	10	ug/l	24-JUN-93	90053007	BSVO
2SW1	Aluminum	91.9		200	ug/l	24-JUN-93	90053007	DMET
2SW1	Barium	39.3	J	200	ug/l	24-JUN-93	90053007	DMET
2SW1	Calcium	17500		5000	ug/l	24-JUN-93	90053007	DMET
2SW1	Iron	8990		100	ug/l	24-JUN-93	90053007	DMET
2SW1	Magnesium	1610	J	5000	ug/l	24-JUN-93	90053007	DMET
2SW1	Manganese	106		15	ug/l	24-JUN-93	90053007	DMET
2SW1	Sodium	4260	J	5000	ug/l	24-JUN-93	90053007	DMET
2SW2	Chlorobenzene	2	J	10	ug/l	22-JUN-93	70383-12	AVOL
2SW2	Aluminum	463		200	ug/l	22-JUN-93	90050012	DMET
2SW2	Barium	45.2	J	200	ug/l	22-JUN-93	90050012	DMET
2SW2	Calcium	19200		5000	ug/l	22-JUN-93	90050012	DMET
2SW2	Iron	27500		100	ug/l	22-JUN-93	90050012	DMET
2SW2	Lead	3.3		5	ug/l	22-JUN-93	90050012	DMET
2SW2	Magnesium	1550	J	5000	ug/l	22-JUN-93	90050012	DMET
2SW2	Manganese	103		15	ug/l	22-JUN-93	90050012	DMET
2SW2	Nickel	12.8	J	40	ug/l	22-JUN-93	90050012	DMET
2SW2	Sodium	3920	J	5000	ug/l	22-JUN-93	90050012	DMET
2SW2	Zinc	15.4	J	20	ug/l	22-JUN-93	90050012	DMET
2SW2D	Chlorobenzene	2	J	10	ug/l	22-JUN-93	70383-13	AVOL
2SW2D	Aluminum	510		200	ug/l	22-JUN-93	90050013	DMET
2SW2D	Barium	47.5	J	200	ug/l	22-JUN-93	90050013	DMET
2SW2D	Calcium	19300		5000	ug/l	22-JUN-93	90050013	DMET
2SW2D	Cyanide	10		10	ug/l	22-JUN-93	90050013	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
2SW2D	Iron	36300		100	ug/l	22-JUN-93	90050013	DMET
2SW2D	Lead	3.3		5	ug/l	22-JUN-93	90050013	DMET
2SW2D	Magnesium	1540	J	5000	ug/l	22-JUN-93	90050013	DMET
2SW2D	Manganese	105		15	ug/l	22-JUN-93	90050013	DMET
2SW2D	Sodium	3990	J	5000	ug/l	22-JUN-93	90050013	DMET
2SW2D	Zinc	18.1	J	20	ug/l	22-JUN-93	90050013	DMET
2SW3	Chlorobenzene	2	J	10	ug/l	24-JUN-93	90053008	AVOL
2SW3	Aluminum	36.8		200	ug/l	24-JUN-93	90053008	DMET
2SW3	Barium	37.9	J	200	ug/l	24-JUN-93	90053008	DMET
2SW3	Calcium	19700		5000	ug/l	24-JUN-93	90053008	DMET
2SW3	Iron	6430		100	ug/l	24-JUN-93	90053008	DMET
2SW3	Magnesium	1620	J	5000	ug/l	24-JUN-93	90053008	DMET
2SW3	Manganese	101		15	ug/l	24-JUN-93	90053008	DMET
2SW3	Sodium	4250	J	5000	ug/l	24-JUN-93	90053008	DMET
5SW1	4-Methyl-2-pentanone	3	J	10	ug/l	25-JUN-93	90054007	AVOL
5SW1	Toluene	2	J	10	ug/l	25-JUN-93	90054007	AVOL
5SW1	Aluminum	658	J	200	ug/l	25-JUN-93	90054007	DMET
5SW1	Barium	20.7	J	200	ug/l	25-JUN-93	90054007	DMET
5SW1	Calcium	6000		5000	ug/l	25-JUN-93	90054007	DMET
5SW1	Iron	3610		100	ug/l	25-JUN-93	90054007	DMET
5SW1	Lead	2.9	J	5	ug/l	25-JUN-93	90054007	DMET
5SW1	Magnesium	1020	J	5000	ug/l	25-JUN-93	90054007	DMET
5SW1	Manganese	35.5		15	ug/l	25-JUN-93	90054007	DMET
5SW1	Sodium	5760		5000	ug/l	25-JUN-93	90054007	DMET
5SW1	Vanadium	44.3	J	50	ug/l	25-JUN-93	90054007	DMET
5SW1	Zinc	38.7		20	ug/l	25-JUN-93	90054007	DMET
5SW2	Acetone	14		10	ug/l	25-JUN-93	90054005	AVOL
5SW2	Aluminum	766	J	200	ug/l	25-JUN-93	90054005	DMET
5SW2	Barium	22.7	J	200	ug/l	25-JUN-93	90054005	DMET
5SW2	Cadmium	0.19	J	5	ug/l	25-JUN-93	90054005	DMET
5SW2	Calcium	5900		5000	ug/l	25-JUN-93	90054005	DMET
5SW2	Iron	2760		100	ug/l	25-JUN-93	90054005	DMET
5SW2	Lead	2.3	J	5	ug/l	25-JUN-93	90054005	DMET
5SW2	Magnesium	754	J	5000	ug/l	25-JUN-93	90054005	DMET
5SW2	Manganese	9.1	J	15	ug/l	25-JUN-93	90054005	DMET
5SW2	Sodium	4640	J	5000	ug/l	25-JUN-93	90054005	DMET
5SW2	Vanadium	6.5	J	50	ug/l	25-JUN-93	90054005	DMET
5SW2	Zinc	14.9	J	20	ug/l	25-JUN-93	90054005	DMET
5SW2D	Acetone	14		10	ug/l	25-JUN-93	90054006	AVOL
5SW2D	Aluminum	1090	J	200	ug/l	25-JUN-93	90054006	DMET
5SW2D	Barium	24.4	J	200	ug/l	25-JUN-93	90054006	DMET
5SW2D	Calcium	6000		5000	ug/l	25-JUN-93	90054006	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
5SW2D	Iron	3090		100	ug/l	25-JUN-93	90054006	DMET
5SW2D	Lead	2.8	J	5	ug/l	25-JUN-93	90054006	DMET
5SW2D	Magnesium	762	J	5000	ug/l	25-JUN-93	90054006	DMET
5SW2D	Manganese	9.4	J	15	ug/l	25-JUN-93	90054006	DMET
5SW2D	Sodium	4640	J	5000	ug/l	25-JUN-93	90054006	DMET
5SW2D	Vanadium	7.3	J	50	ug/l	25-JUN-93	90054006	DMET
5SW3	Acetone	16		10	ug/l	25-JUN-93	90054004	AVOL
5SW3	Toluene	2	J	10	ug/l	25-JUN-93	90054004	AVOL
5SW3	Aluminum	149	J	200	ug/l	25-JUN-93	90054004	DMET
5SW3	Barium	16.2	J	200	ug/l	25-JUN-93	90054004	DMET
5SW3	Calcium	2880	J	5000	ug/l	25-JUN-93	90054004	DMET
5SW3	Iron	1250		100	ug/l	25-JUN-93	90054004	DMET
5SW3	Magnesium	626	J	5000	ug/l	25-JUN-93	90054004	DMET
5SW3	Manganese	8	J	15	ug/l	25-JUN-93	90054004	DMET
5SW3	Sodium	4720	J	5000	ug/l	25-JUN-93	90054004	DMET
5SW4	Acetone	10		10	ug/l	25-JUN-93	90054003	AVOL
5SW4	Aluminum	2320	J	200	ug/l	25-JUN-93	90054003	DMET
5SW4	Barium	48.6	J	200	ug/l	25-JUN-93	90054003	DMET
5SW4	Calcium	8020		5000	ug/l	25-JUN-93	90054003	DMET
5SW4	Iron	1680		100	ug/l	25-JUN-93	90054003	DMET
5SW4	Lead	6.4		5	ug/l	25-JUN-93	90054003	DMET
5SW4	Magnesium	1400	J	5000	ug/l	25-JUN-93	90054003	DMET
5SW4	Manganese	9.1	J	15	ug/l	25-JUN-93	90054003	DMET
5SW4	Sodium	6310		5000	ug/l	25-JUN-93	90054003	DMET
5SW4	Vanadium	2.5	J	50	ug/l	25-JUN-93	90054003	DMET
5SW4	Zinc	27.2		20	ug/l	25-JUN-93	90054003	DMET
5SW5	Acetone	16		10	ug/l	25-JUN-93	90054008	AVOL
5SW5	Aluminum	738	J	200	ug/l	25-JUN-93	90054008	DMET
5SW5	Barium	14.2	J	200	ug/l	25-JUN-93	90054008	DMET
5SW5	Calcium	2470	J	5000	ug/l	25-JUN-93	90054008	DMET
5SW5	Chromium	3.3	J	10	ug/l	25-JUN-93	90054008	DMET
5SW5	Iron	1260		100	ug/l	25-JUN-93	90054008	DMET
5SW5	Lead	1.2	J	5	ug/l	25-JUN-93	90054008	DMET
5SW5	Magnesium	576	J	5000	ug/l	25-JUN-93	90054008	DMET
5SW5	Manganese	9.2	J	15	ug/l	25-JUN-93	90054008	DMET
5SW5	Sodium	5220		5000	ug/l	25-JUN-93	90054008	DMET
5SW5	Zinc	40.7		20	ug/l	25-JUN-93	90054008	DMET
5SW6	Aluminum	365	J	200	ug/l	29-JUN-93	90058007	DMET
5SW6	Barium	26.9	J	200	ug/l	29-JUN-93	90058007	DMET
5SW6	Calcium	14800		5000	ug/l	29-JUN-93	90058007	DMET
5SW6	Iron	153	J	100	ug/l	29-JUN-93	90058007	DMET
5SW6	Magnesium	2000	J	5000	ug/l	29-JUN-93	90058007	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
5SW6	Manganese	41.6		15	ug/l	29-JUN-93	90058007	DMET
5SW6	Potassium	3700	J	5000	ug/l	29-JUN-93	90058007	DMET
5SW6	Sodium	26500	J	5000	ug/l	29-JUN-93	90058007	DMET
5SW6	Zinc	45.4		20	ug/l	29-JUN-93	90058007	DMET
5SW7	Aluminum	552	J	200	ug/l	29-JUN-93	90058008	DMET
5SW7	Barium	27.6	J	200	ug/l	29-JUN-93	90058008	DMET
5SW7	Calcium	20400		5000	ug/l	29-JUN-93	90058008	DMET
5SW7	Iron	263	J	100	ug/l	29-JUN-93	90058008	DMET
5SW7	Magnesium	2490	J	5000	ug/l	29-JUN-93	90058008	DMET
5SW7	Manganese	35.8		15	ug/l	29-JUN-93	90058008	DMET
5SW7	Potassium	3790	J	5000	ug/l	29-JUN-93	90058008	DMET
5SW7	Sodium	18200	J	5000	ug/l	29-JUN-93	90058008	DMET
5SW7	Zinc	45.7		20	ug/l	29-JUN-93	90058008	DMET
6SW1	Acetone	10	J	10	ug/l	28-JUN-93	90057001	AVOL
6SW1	Barium	25	J	200	ug/l	28-JUN-93	90057001	DMET
6SW1	Calcium	22600		5000	ug/l	28-JUN-93	90057001	DMET
6SW1	Copper	3.7	J	25	ug/l	28-JUN-93	90057001	DMET
6SW1	Iron	818		100	ug/l	28-JUN-93	90057001	DMET
6SW1	Magnesium	2460	J	5000	ug/l	28-JUN-93	90057001	DMET
6SW1	Manganese	36		15	ug/l	28-JUN-93	90057001	DMET
6SW1	Potassium	599	J	5000	ug/l	28-JUN-93	90057001	DMET
6SW1	Sodium	5830		5000	ug/l	28-JUN-93	90057001	DMET
6SW1	Zinc	26.2		20	ug/l	28-JUN-93	90057001	DMET
8SW1	Aluminum	3170	J	200	ug/l	21-JUN-93	90049002	DMET
8SW1	Barium	11.6	J	200	ug/l	21-JUN-93	90049002	DMET
8SW1	Calcium	3120	J	5000	ug/l	21-JUN-93	90049002	DMET
8SW1	Copper	2.5	J	25	ug/l	21-JUN-93	90049002	DMET
8SW1	Iron	267		100	ug/l	21-JUN-93	90049002	DMET
8SW1	Lead	4.7		5	ug/l	21-JUN-93	90049002	DMET
8SW1	Magnesium	1110	J	5000	ug/l	21-JUN-93	90049002	DMET
8SW1	Manganese	30.9		15	ug/l	21-JUN-93	90049002	DMET
8SW1	Potassium	695	J	5000	ug/l	21-JUN-93	90049002	DMET
8SW1	Sodium	2430	J	5000	ug/l	21-JUN-93	90049002	DMET
8SW2	Aluminum	379	J	200	ug/l	21-JUN-93	90049003	DMET
8SW2	Barium	13.7	J	200	ug/l	21-JUN-93	90049003	DMET
8SW2	Calcium	1850	J	5000	ug/l	21-JUN-93	90049003	DMET
8SW2	Iron	537		100	ug/l	21-JUN-93	90049003	DMET
8SW2	Magnesium	1080	J	5000	ug/l	21-JUN-93	90049003	DMET
8SW2	Manganese	16		15	ug/l	21-JUN-93	90049003	DMET
8SW2	Selenium	2.3	J	5	ug/l	21-JUN-93	90049003	DMET
8SW2	Sodium	2300	J	5000	ug/l	21-JUN-93	90049003	DMET
9SW1	Aluminum	928		200	ug/l	27-JUN-93	90056003	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
9SW1	Iron	3570	J	100	ug/l	27-JUN-93	90056003	DMET
9SW1	Lead	1.6	J	5	ug/l	27-JUN-93	90056003	DMET
9SW1	Magnesium	894	J	5000	ug/l	27-JUN-93	90056003	DMET
9SW1	Manganese	43.8		15	ug/l	27-JUN-93	90056003	DMET
9SW1	Potassium	394	J	5000	ug/l	27-JUN-93	90056003	DMET
9SW1	Sodium	2060	J	5000	ug/l	27-JUN-93	90056003	DMET
9SW1	Vanadium	7.9	J	50	ug/l	27-JUN-93	90056003	DMET
9SW1	Zinc	12.3	J	20	ug/l	27-JUN-93	90056003	DMET
GCSW1	Acetone	11		10	ug/l	27-JUN-93	90056006	AVOL
GCSW1	Barium	26.6	J	200	ug/l	27-JUN-93	90056006	DMET
GCSW1	Calcium	21100		5000	ug/l	27-JUN-93	90056006	DMET
GCSW1	Iron	781	J	100	ug/l	27-JUN-93	90056006	DMET
GCSW1	Magnesium	2300	J	5000	ug/l	27-JUN-93	90056006	DMET
GCSW1	Manganese	39.1		15	ug/l	27-JUN-93	90056006	DMET
GCSW1	Nickel	9.3	J	40	ug/l	27-JUN-93	90056006	DMET
GCSW1	Potassium	2850	J	5000	ug/l	27-JUN-93	90056006	DMET
GCSW1	Sodium	4330	J	5000	ug/l	27-JUN-93	90056006	DMET
GCSW1	Zinc	9	J	20	ug/l	27-JUN-93	90056006	DMET
GCSW2	Barium	23.4	J	200	ug/l	26-JUN-93	90055002	DMET
GCSW2	Calcium	13900		5000	ug/l	26-JUN-93	90055002	DMET
GCSW2	Iron	953	J	100	ug/l	26-JUN-93	90055002	DMET
GCSW2	Magnesium	2810	J	5000	ug/l	26-JUN-93	90055002	DMET
GCSW2	Potassium	866	J	5000	ug/l	26-JUN-93	90055002	DMET
GCSW2	Sodium	6680		5000	ug/l	26-JUN-93	90055002	DMET
GCSW2	Total Keljdahl Nitrogen	0.71		0.04	mg/l	17-AUG-93	90096006	EH2O
GCSW2	Total Nitrogen	0.71		0	mg/l	17-AUG-93	90096006	EH2O
GCSW2	Total Phosphorous	0.04		0.01	mg/l	17-AUG-93	90096006	EH2O
GCSW3	Aluminum	2070	J	200	ug/l	30-JUN-93	90059002	DMET
GCSW3	Arsenic	4.5	J	10	ug/l	30-JUN-93	90059002	DMET
GCSW3	Barium	39.2	J	200	ug/l	30-JUN-93	90059002	DMET
GCSW3	Calcium	24500		5000	ug/l	30-JUN-93	90059002	DMET
GCSW3	Copper	3.5	J	25	ug/l	30-JUN-93	90059002	DMET
GCSW3	Iron	5030		100	ug/l	30-JUN-93	90059002	DMET
GCSW3	Magnesium	2970	J	5000	ug/l	30-JUN-93	90059002	DMET
GCSW3	Manganese	68.5		15	ug/l	30-JUN-93	90059002	DMET
GCSW3	Potassium	1490	J	5000	ug/l	30-JUN-93	90059002	DMET
GCSW3	Sodium	3580	J	5000	ug/l	30-JUN-93	90059002	DMET
GCSW3	Zinc	38.6		20	ug/l	30-JUN-93	90059002	DMET
GCSW4	Chloromethane	3	J	10	ug/l	30-JUN-93	90059003	AVOL
GCSW4	alpha-Chlordane	0.016	J	0.016	ug/l	30-JUN-93	90059003	CPES
GCSW4	gamma-Chlordane	0.012	J	0.012	ug/l	30-JUN-93	90059003	CPES
GCSW4	Arsenic	5.9	J	10	ug/l	30-JUN-93	90059003	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
GCSW4	Calcium	32300		5000	ug/l	30-JUN-93	90059003	DMET
GCSW4	Copper	3.8	J	25	ug/l	30-JUN-93	90059003	DMET
GCSW4	Iron	58.8	J	100	ug/l	30-JUN-93	90059003	DMET
GCSW4	Magnesium	9760		5000	ug/l	30-JUN-93	90059003	DMET
GCSW4	Potassium	2000	J	5000	ug/l	30-JUN-93	90059003	DMET
GCSW4	Sodium	4550	J	5000	ug/l	30-JUN-93	90059003	DMET
GCSW4	Zinc	21		20	ug/l	30-JUN-93	90059003	DMET
GCSW5	alpha-Chlordane	0.14	J	0.05	UJG/L	30-JUN-93	90059004	CPES
GCSW5	gamma-Chlordane	0.11	J	0.05	UJG/L	30-JUN-93	90059004	CPES
GCSW5	Aluminum	144000	J	200	ug/l	30-JUN-93	90059004	DMET
GCSW5	Arsenic	360	J	10	ug/l	30-JUN-93	90059004	DMET
GCSW5	Barium	392	J	200	ug/l	30-JUN-93	90059004	DMET
GCSW5	Beryllium	21.4	J	5	ug/l	30-JUN-93	90059004	DMET
GCSW5	Cadmium	36.9	J	5	ug/l	30-JUN-93	90059004	DMET
GCSW5	Calcium	17800	J	5000	ug/l	30-JUN-93	90059004	DMET
GCSW5	Chromium	542	J	10	ug/l	30-JUN-93	90059004	DMET
GCSW5	Cobalt	17	J	50	ug/l	30-JUN-93	90059004	DMET
GCSW5	Copper	6370	J	25	ug/l	30-JUN-93	90059004	DMET
GCSW5	Iron	90400	J	100	ug/l	30-JUN-93	90059004	DMET
GCSW5	Lead	581	J	5	ug/l	30-JUN-93	90059004	DMET
GCSW5	Magnesium	41700	J	5000	ug/l	30-JUN-93	90059004	DMET
GCSW5	Manganese	1340	J	15	ug/l	30-JUN-93	90059004	DMET
GCSW5	Mercury	1.7	J	0.2	ug/l	30-JUN-93	90059004	DMET
GCSW5	Nickel	85.2	J	40	ug/l	30-JUN-93	90059004	DMET
GCSW5	Potassium	6680	J	5000	ug/l	30-JUN-93	90059004	DMET
GCSW5	Selenium	4.4	J	5	ug/l	30-JUN-93	90059004	DMET
GCSW5	Silver	10.6	J	10	ug/l	30-JUN-93	90059004	DMET
GCSW5	Sodium	5600	J	5000	ug/l	30-JUN-93	90059004	DMET
GCSW5	Vanadium	174	J	50	ug/l	30-JUN-93	90059004	DMET
GCSW5	Zinc	8350	J	20	ug/l	30-JUN-93	90059004	DMET
GCSW5D	alpha-Chlordane	0.32	J	0.1	ug/l	30-JUN-93	90059005	CPES
GCSW5D	gamma-Chlordane	0.3	J	0.1	ug/l	30-JUN-93	90059005	CPES
GCSW5D	Aluminum	16700	J	200	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Arsenic	48.1	J	10	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Barium	74.8		200	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Cadmium	4.3	J	5	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Calcium	80200	J	5000	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Chromium	34.6	J	10	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Copper	289	J	25	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Iron	8670	J	100	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Lead	95.3	J	5	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Magnesium	8480	J	5000	ug/l	30-JUN-93	90059005	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
GCSW5D	Manganese	225	J	15	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Mercury	1.9	J	0.2	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Potassium	746	J	5000	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Silver	0.82	J	10	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Sodium	3270	J	5000	ug/l	30-JUN-93	90059005	DMET
GCSW5D	Zinc	642	J	20	ug/l	30-JUN-93	90059005	DMET
LFSW1	Aluminum	84.9		200	ug/l	23-JUN-93	90052009	DMET
LFSW1	Barium	23	J	200	ug/l	23-JUN-93	90052009	DMET
LFSW1	Beryllium	0.29	J	5	ug/l	23-JUN-93	90052009	DMET
LFSW1	Calcium	13900		5000	ug/l	23-JUN-93	90052009	DMET
LFSW1	Iron	862	J	100	ug/l	23-JUN-93	90052009	DMET
LFSW1	Magnesium	2850	J	5000	ug/l	23-JUN-93	90052009	DMET
LFSW1	Sodium	6850		5000	ug/l	23-JUN-93	90052009	DMET
LFSW1	Total Keljdahl Nitrogen	0.64		0.04	mg/l	18-AUG-93	90096018	EH2O
LFSW1	Total Nitrogen	0.64		0	mg/l	18-AUG-93	90096018	EH2O
LFSW1	Total Phosphorous	0.03		0.01	mg/l	18-AUG-93	90096018	EH2O
LFSW2	Aluminum	112		200	ug/l	23-JUN-93	90052008	DMET
LFSW2	Barium	23.4	J	200	ug/l	23-JUN-93	90052008	DMET
LFSW2	Beryllium	0.23	J	5	ug/l	23-JUN-93	90052008	DMET
LFSW2	Calcium	13900		5000	ug/l	23-JUN-93	90052008	DMET
LFSW2	Iron	872	J	100	ug/l	23-JUN-93	90052008	DMET
LFSW2	Magnesium	2860	J	5000	ug/l	23-JUN-93	90052008	DMET
LFSW2	Sodium	6940		5000	ug/l	23-JUN-93	90052008	DMET
LFSW3	Aluminum	84.4		200	ug/l	23-JUN-93	90052005	DMET
LFSW3	Barium	23	J	200	ug/l	23-JUN-93	90052005	DMET
LFSW3	Calcium	13700		5000	ug/l	23-JUN-93	90052005	DMET
LFSW3	Copper	2.5	J	25	ug/l	23-JUN-93	90052005	DMET
LFSW3	Iron	838	J	100	ug/l	23-JUN-93	90052005	DMET
LFSW3	Magnesium	2830	J	5000	ug/l	23-JUN-93	90052005	DMET
LFSW3	Mercury	0.08	J	0.2	ug/l	23-JUN-93	90052005	DMET
LFSW3	Potassium	782		5000	ug/l	23-JUN-93	90052005	DMET
LFSW3	Sodium	6790		5000	ug/l	23-JUN-93	90052005	DMET
LFSW4	Aluminum	93.4		200	ug/l	23-JUN-93	90052004	DMET
LFSW4	Barium	23.5	J	200	ug/l	23-JUN-93	90052004	DMET
LFSW4	Calcium	13800		5000	ug/l	23-JUN-93	90052004	DMET
LFSW4	Copper	2.5	J	25	ug/l	23-JUN-93	90052004	DMET
LFSW4	Iron	847	J	100	ug/l	23-JUN-93	90052004	DMET
LFSW4	Magnesium	2820	J	5000	ug/l	23-JUN-93	90052004	DMET
LFSW4	Manganese	7.6	J	15	ug/l	23-JUN-93	90052004	DMET
LFSW4	Mercury	0.14	J	0.2	ug/l	23-JUN-93	90052004	DMET
LFSW4	Potassium	646		5000	ug/l	23-JUN-93	90052004	DMET
LFSW4	Sodium	6710		5000	ug/l	23-JUN-93	90052004	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSW5	Aluminum	87.2		200	ug/l	23-JUN-93	90052003	DMET
LFSW5	Barium	22.4	J	200	ug/l	23-JUN-93	90052003	DMET
LFSW5	Beryllium	0.27	J	5	ug/l	23-JUN-93	90052003	DMET
LFSW5	Calcium	13500		5000	ug/l	23-JUN-93	90052003	DMET
LFSW5	Copper	1.7	J	25	ug/l	23-JUN-93	90052003	DMET
LFSW5	Iron	790	J	100	ug/l	23-JUN-93	90052003	DMET
LFSW5	Magnesium	2740	J	5000	ug/l	23-JUN-93	90052003	DMET
LFSW5	Mercury	0.5		0.2	ug/l	23-JUN-93	90052003	DMET
LFSW5	Potassium	948		5000	ug/l	23-JUN-93	90052003	DMET
LFSW5	Sodium	6490		5000	ug/l	23-JUN-93	90052003	DMET
LFSW5	Zinc	9.5	J	20	ug/l	23-JUN-93	90052003	DMET
LFSW6	Aluminum	751		200	ug/l	23-JUN-93	90052002	DMET
LFSW6	Barium	29.6	J	200	ug/l	23-JUN-93	90052002	DMET
LFSW6	Calcium	14000		5000	ug/l	23-JUN-93	90052002	DMET
LFSW6	Copper	3.9	J	25	ug/l	23-JUN-93	90052002	DMET
LFSW6	Iron	1270	J	100	ug/l	23-JUN-93	90052002	DMET
LFSW6	Lead	7.8		5	ug/l	23-JUN-93	90052002	DMET
LFSW6	Magnesium	2920	J	5000	ug/l	23-JUN-93	90052002	DMET
LFSW6	Manganese	19.1		15	ug/l	23-JUN-93	90052002	DMET
LFSW6	Mercury	0.33		0.2	ug/l	23-JUN-93	90052002	DMET
LFSW6	Potassium	961		5000	ug/l	23-JUN-93	90052002	DMET
LFSW6	Sodium	7070		5000	ug/l	23-JUN-93	90052002	DMET
LFSW6	Zinc	24.5		20	ug/l	23-JUN-93	90052002	DMET
LFSW6	Total Keljdahl Nitrogen	0.63		0.04	mg/l	18-AUG-93	90096019	EH2O
LFSW6	Total Nitrogen	0.63		0	mg/l	18-AUG-93	90096019	EH2O
LFSW6	Total Phosphorous	0.05		0.01	mg/l	18-AUG-93	90096019	EH2O
LFSW7	Acetone	7	J	10	ug/l	23-JUN-93	90052001	AVOL
LFSW7	Aluminum	94		200	ug/l	23-JUN-93	90052001	DMET
LFSW7	Barium	23.8	J	200	ug/l	23-JUN-93	90052001	DMET
LFSW7	Calcium	14200		5000	ug/l	23-JUN-93	90052001	DMET
LFSW7	Copper	3.4	J	25	ug/l	23-JUN-93	90052001	DMET
LFSW7	Iron	890	J	100	ug/l	23-JUN-93	90052001	DMET
LFSW7	Lead	7.7		5	ug/l	23-JUN-93	90052001	DMET
LFSW7	Magnesium	2850	J	5000	ug/l	23-JUN-93	90052001	DMET
LFSW7	Manganese	12.9	J	15	ug/l	23-JUN-93	90052001	DMET
LFSW7	Mercury	0.34		0.2	ug/l	23-JUN-93	90052001	DMET
LFSW7	Nickel	13	J	40	ug/l	23-JUN-93	90052001	DMET
LFSW7	Potassium	654	J	5000	ug/l	23-JUN-93	90052001	DMET
LFSW7	Sodium	7570		5000	ug/l	23-JUN-93	90052001	DMET
LFSW7	Zinc	30.3		20	ug/l	23-JUN-93	90052001	DMET
LFSW8	Aluminum	84.1		200	ug/l	23-JUN-93	90052006	DMET
LFSW8	Barium	18.5	J	200	ug/l	23-JUN-93	90052006	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
LFSW8	Calcium	12300		5000	ug/l	23-JUN-93	90052006	DMET
LFSW8	Copper	1.7	J	25	ug/l	23-JUN-93	90052006	DMET
LFSW8	Iron	864	J	100	ug/l	23-JUN-93	90052006	DMET
LFSW8	Magnesium	2590	J	5000	ug/l	23-JUN-93	90052006	DMET
LFSW8	Manganese	8.6	J	15	ug/l	23-JUN-93	90052006	DMET
LFSW8	Potassium	508		5000	ug/l	23-JUN-93	90052006	DMET
LFSW8	Sodium	6670		5000	ug/l	23-JUN-93	90052006	DMET
LFSW8D	Chloroform	2	J	10	ug/l	23-JUN-93	90052007	AVOL
LFSW8D	Aluminum	192		200	ug/l	23-JUN-93	90052007	DMET
LFSW8D	Barium	21	J	200	ug/l	23-JUN-93	90052007	DMET
LFSW8D	Calcium	12500		5000	ug/l	23-JUN-93	90052007	DMET
LFSW8D	Iron	1560	J	100	ug/l	23-JUN-93	90052007	DMET
LFSW8D	Magnesium	2630	J	5000	ug/l	23-JUN-93	90052007	DMET
LFSW8D	Manganese	28.2		15	ug/l	23-JUN-93	90052007	DMET
LFSW8D	Potassium	462		5000	ug/l	23-JUN-93	90052007	DMET
LFSW8D	Sodium	6620		5000	ug/l	23-JUN-93	90052007	DMET
RCGCSW1	Aluminum	171	J	200	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Barium	48.1	J	200	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Calcium	9110		5000	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Iron	1710	J	100	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Magnesium	2140	J	5000	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Manganese	22.3		15	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Potassium	1120	J	5000	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Sodium	7780		5000	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Vanadium	3.7	J	50	ug/l	26-JUN-93	90055005	DMET
RCGCSW1	Nitrate/Nitrite	0.02		0.02	mg/l	17-AUG-93	90096004	EH2O
RCGCSW1	Total Keljdahl Nitrogen	0.29		0.04	mg/l	17-AUG-93	90096004	EH2O
RCGCSW1	Total Nitrogen	0.31		0	mg/l	17-AUG-93	90096004	EH2O
RCGCSW1	Total Phosphorous	0.03		0.01	mg/l	17-AUG-93	90096004	EH2O
RCGCSW1D	Barium	36.5	J	200	ug/l	26-JUN-93	90055006	DMET
RCGCSW1D	Calcium	9160		5000	ug/l	26-JUN-93	90055006	DMET
RCGCSW1D	Iron	1710	J	100	ug/l	26-JUN-93	90055006	DMET
RCGCSW1D	Magnesium	2110	J	5000	ug/l	26-JUN-93	90055006	DMET
RCGCSW1D	Manganese	20.1		15	ug/l	26-JUN-93	90055006	DMET
RCGCSW1D	Nickel	9.8	J	40	ug/l	26-JUN-93	90055006	DMET
RCGCSW1D	Potassium	790	J	5000	ug/l	26-JUN-93	90055006	DMET
RCGCSW1D	Sodium	7640		5000	ug/l	26-JUN-93	90055006	DMET
RCGCSW2	bis(2-Ethylhexyl) phthalate	6	J	10	ug/l	26-JUN-93	90055004	BSVO
RCGCSW2	Aluminum	202	J	200	ug/l	26-JUN-93	90055004	DMET
RCGCSW2	Barium	36.3	J	200	ug/l	26-JUN-93	90055004	DMET
RCGCSW2	Calcium	9150		5000	ug/l	26-JUN-93	90055004	DMET
RCGCSW2	Iron	1630	J	100	ug/l	26-JUN-93	90055004	DMET

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(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCGCSW2	Magnesium	2150	J	5000	ug/l	26-JUN-93	90055004	DMET
RCGCSW2	Manganese	19.6		15	ug/l	26-JUN-93	90055004	DMET
RCGCSW2	Potassium	698	J	5000	ug/l	26-JUN-93	90055004	DMET
RCGCSW2	Sodium	7930		5000	ug/l	26-JUN-93	90055004	DMET
RCGCSW2	Nitrate/Nitrite	0.03		0.02	mg/l	17-AUG-93	90096003	EH2O
RCGCSW2	Total Keljdahl Nitrogen	0.4		0.04	mg/l	17-AUG-93	90096003	EH2O
RCGCSW2	Total Nitrogen	0.43		0	mg/l	17-AUG-93	90096003	EH2O
RCGCSW2	Total Phosphorous	0.04		0.01	mg/l	17-AUG-93	90096003	EH2O
RCGCSW3	Barium	37.2	J	200	ug/l	26-JUN-93	90055003	DMET
RCGCSW3	Calcium	11900		5000	ug/l	26-JUN-93	90055003	DMET
RCGCSW3	Iron	1360	J	100	ug/l	26-JUN-93	90055003	DMET
RCGCSW3	Magnesium	2600	J	5000	ug/l	26-JUN-93	90055003	DMET
RCGCSW3	Manganese	18.6		15	ug/l	26-JUN-93	90055003	DMET
RCGCSW3	Potassium	1040	J	5000	ug/l	26-JUN-93	90055003	DMET
RCGCSW3	Sodium	8150		5000	ug/l	26-JUN-93	90055003	DMET
RCGCSW3	Nitrate/Nitrite	0.02		0.02	mg/l	17-AUG-93	90096005	EH2O
RCGCSW3	Total Keljdahl Nitrogen	0.89		0.04	mg/l	17-AUG-93	90096005	EH2O
RCGCSW3	Total Nitrogen	0.91		0	mg/l	17-AUG-93	90096005	EH2O
RCGCSW3	Total Phosphorous	0.06		0.01	mg/l	17-AUG-93	90096005	EH2O
RCGCSWR1	Acetone	10	J	10	ug/l	28-JUN-93	90057005	AVOL
RCGCSWR1	Aluminum	287	J	200	ug/l	28-JUN-93	90057005	DMET
RCGCSWR1	Barium	30	J	200	ug/l	28-JUN-93	90057005	DMET
RCGCSWR1	Calcium	8060		5000	ug/l	28-JUN-93	90057005	DMET
RCGCSWR1	Copper	5.1	J	25	ug/l	28-JUN-93	90057005	DMET
RCGCSWR1	Iron	1440		100	ug/l	28-JUN-93	90057005	DMET
RCGCSWR1	Magnesium	1850	J	5000	ug/l	28-JUN-93	90057005	DMET
RCGCSWR1	Manganese	9.2	J	15	ug/l	28-JUN-93	90057005	DMET
RCGCSWR1	Potassium	790	J	5000	ug/l	28-JUN-93	90057005	DMET
RCGCSWR1	Sodium	7320		5000	ug/l	28-JUN-93	90057005	DMET
RCSW1	Acetone	12		10	ug/l	25-JUN-93	90054001	AVOL
RCSW1	Methylene chloride	1	J	10	ug/l	25-JUN-93	90054001	AVOL
RCSW1	Aluminum	86.9	J	200	ug/l	25-JUN-93	90054001	DMET
RCSW1	Barium	25	J	200	ug/l	25-JUN-93	90054001	DMET
RCSW1	Cadmium	0.26	J	5	ug/l	25-JUN-93	90054001	DMET
RCSW1	Calcium	14400		5000	ug/l	25-JUN-93	90054001	DMET
RCSW1	Iron	925		100	ug/l	25-JUN-93	90054001	DMET
RCSW1	Lead	3.4		5	ug/l	25-JUN-93	90054001	DMET
RCSW1	Magnesium	2920	J	5000	ug/l	25-JUN-93	90054001	DMET
RCSW1	Sodium	7020		5000	ug/l	25-JUN-93	90054001	DMET
RCSW1	Vanadium	3	J	50	ug/l	25-JUN-93	90054001	DMET
RCSW1	Nitrate/Nitrite	0.02		0.02	mg/l	18-AUG-93	90096017	EH2O
RCSW1	Total Keljdahl Nitrogen	0.54		0.04	mg/l	18-AUG-93	90096017	EH2O

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCSW1	Total Nitrogen	0.54		0	mg/l	18-AUG-93	90096017	EH2O
RCSW1	Total Phosphorous	0.02		0.01	mg/l	18-AUG-93	90096017	EH2O
RCSW10	Acetone	9	J	10	ug/l	28-JUN-93	90057002	AVOL
RCSW10	Chloroform	1	J	10	ug/l	28-JUN-93	90057002	AVOL
RCSW10	Calcium	24000		5000	ug/l	28-JUN-93	90057002	DMET
RCSW10	Iron	523		100	ug/l	28-JUN-93	90057002	DMET
RCSW10	Magnesium	7530		5000	ug/l	28-JUN-93	90057002	DMET
RCSW10	Manganese	15.3		15	ug/l	28-JUN-93	90057002	DMET
RCSW10	Potassium	3300	J	5000	ug/l	28-JUN-93	90057002	DMET
RCSW10	Sodium	18400		5000	ug/l	28-JUN-93	90057002	DMET
RCSW2	Aluminum	107	J	200	ug/l	25-JUN-93	90054002	DMET
RCSW2	Barium	25.7	J	200	ug/l	25-JUN-93	90054002	DMET
RCSW2	Calcium	14700		5000	ug/l	25-JUN-93	90054002	DMET
RCSW2	Iron	996		100	ug/l	25-JUN-93	90054002	DMET
RCSW2	Magnesium	2990	J	5000	ug/l	25-JUN-93	90054002	DMET
RCSW2	Manganese	7.8	J	15	ug/l	25-JUN-93	90054002	DMET
RCSW2	Sodium	7240		5000	ug/l	25-JUN-93	90054002	DMET
RCSW3	Bromodichloromethane	2	J	0	ug/l	26-JUN-93	90055007	AVOL
RCSW3	Chloroform	5	J	10	ug/l	26-JUN-93	90055007	AVOL
RCSW3	Aluminum	141	J	200	ug/l	26-JUN-93	90055007	DMET
RCSW3	Calcium	26500		5000	ug/l	26-JUN-93	90055007	DMET
RCSW3	Iron	702	J	100	ug/l	26-JUN-93	90055007	DMET
RCSW3	Magnesium	9670		5000	ug/l	26-JUN-93	90055007	DMET
RCSW3	Manganese	10.7	J	15	ug/l	26-JUN-93	90055007	DMET
RCSW3	Potassium	4500	J	5000	ug/l	26-JUN-93	90055007	DMET
RCSW3	Silver	0.24	J	10	ug/l	26-JUN-93	90055007	DMET
RCSW3	Sodium	27200		5000	ug/l	26-JUN-93	90055007	DMET
RCSW3	Nitrate/Nitrite	3.7		0.02	mg/l	18-AUG-93	90096020	EH2O
RCSW3	Total Keljdahl Nitrogen	1.4		0.04	mg/l	18-AUG-93	90096020	EH2O
RCSW3	Total Nitrogen	5.1		0	mg/l	18-AUG-93	90096020	EH2O
RCSW3	Total Phosphorous	1.27		0.01	mg/l	18-AUG-93	90096020	EH2O
RCSW4	Bromodichloromethane	2	J	0	ug/l	27-JUN-93	90056002	AVOL
RCSW4	Chloroform	6	J	10	ug/l	27-JUN-93	90056002	AVOL
RCSW4	Aluminum	184	J	200	ug/l	27-JUN-93	90056002	DMET
RCSW4	Calcium	22200		5000	ug/l	27-JUN-93	90056002	DMET
RCSW4	Iron	750	J	100	ug/l	27-JUN-93	90056002	DMET
RCSW4	Magnesium	7240		5000	ug/l	27-JUN-93	90056002	DMET
RCSW4	Manganese	17.6		15	ug/l	27-JUN-93	90056002	DMET
RCSW4	Potassium	3360	J	5000	ug/l	27-JUN-93	90056002	DMET
RCSW4	Silver	0.19	J	10	ug/l	27-JUN-93	90056002	DMET
RCSW4	Sodium	20700		5000	ug/l	27-JUN-93	90056002	DMET
RCSW4	Zinc	17.2	J	20	ug/l	27-JUN-93	90056002	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCSW4	Nitrate/Nitrite	2.26		0.02	mg/l	18-AUG-93	90096009	EH2O
RCSW4	Total Keljdahl Nitrogen	1.33		0.04	mg/l	18-AUG-93	90096009	EH2O
RCSW4	Total Nitrogen	3.59		0	mg/l	18-AUG-93	90096009	EH2O
RCSW4	Total Phosphorous	0.6		0.01	mg/l	18-AUG-93	90096009	EH2O
RCSW5	Bromodichloromethane	2	J	0	ug/l	27-JUN-93	90056001	AVOL
RCSW5	Chloroform	6	J	10	ug/l	27-JUN-93	90056001	AVOL
RCSW5	Aluminum	137	J	200	ug/l	27-JUN-93	90056001	DMET
RCSW5	Calcium	22100		5000	ug/l	27-JUN-93	90056001	DMET
RCSW5	Iron	647	J	100	ug/l	27-JUN-93	90056001	DMET
RCSW5	Lead	1.4	J	5	ug/l	27-JUN-93	90056001	DMET
RCSW5	Magnesium	7340		5000	ug/l	27-JUN-93	90056001	DMET
RCSW5	Manganese	15.7		15	ug/l	27-JUN-93	90056001	DMET
RCSW5	Potassium	3420	J	5000	ug/l	27-JUN-93	90056001	DMET
RCSW5	Sodium	21200		5000	ug/l	27-JUN-93	90056001	DMET
RCSW5	Zinc	14.4	J	20	ug/l	27-JUN-93	90056001	DMET
RCSW5	Nitrate/Nitrite	2.31		0.02	mg/l	18-AUG-93	90096013	EH2O
RCSW5	Total Keljdahl Nitrogen	1.32		0.04	mg/l	18-AUG-93	90096013	EH2O
RCSW5	Total Nitrogen	3.63		0	mg/l	18-AUG-93	90096013	EH2O
RCSW5	Total Phosphorous	0.64		0.01	mg/l	18-AUG-93	90096013	EH2O
RCSW6	Aluminum	124		200	ug/l	24-JUN-93	90053006	DMET
RCSW6	Barium	16.8	J	200	ug/l	24-JUN-93	90053006	DMET
RCSW6	Calcium	25100		5000	ug/l	24-JUN-93	90053006	DMET
RCSW6	Iron	738		100	ug/l	24-JUN-93	90053006	DMET
RCSW6	Magnesium	8390		5000	ug/l	24-JUN-93	90053006	DMET
RCSW6	Manganese	16.8		15	ug/l	24-JUN-93	90053006	DMET
RCSW6	Potassium	4240	J	5000	ug/l	24-JUN-93	90053006	DMET
RCSW6	Sodium	23100		5000	ug/l	24-JUN-93	90053006	DMET
RCSW6	Zinc	15.4	J	20	ug/l	24-JUN-93	90053006	DMET
RCSW7	Aluminum	601		200	ug/l	24-JUN-93	90053005	DMET
RCSW7	Barium	20	J	200	ug/l	24-JUN-93	90053005	DMET
RCSW7	Calcium	24900		5000	ug/l	24-JUN-93	90053005	DMET
RCSW7	Chromium	4	J	10	ug/l	24-JUN-93	90053005	DMET
RCSW7	Iron	1130		100	ug/l	24-JUN-93	90053005	DMET
RCSW7	Magnesium	8230		5000	ug/l	24-JUN-93	90053005	DMET
RCSW7	Manganese	21.2		15	ug/l	24-JUN-93	90053005	DMET
RCSW7	Potassium	4320	J	5000	ug/l	24-JUN-93	90053005	DMET
RCSW7	Sodium	22500		5000	ug/l	24-JUN-93	90053005	DMET
RCSW7	Zinc	24.7		20	ug/l	24-JUN-93	90053005	DMET
RCSW7	Nitrate/Nitrite	2.32		0.02	mg/l	18-AUG-93	90096012	EH2O
RCSW7	Total Keljdahl Nitrogen	1.44		0.04	mg/l	18-AUG-93	90096012	EH2O
RCSW7	Total Nitrogen	3.76		0	mg/l	18-AUG-93	90096012	EH2O
RCSW7	Total Phosphorous	0.64		0.01	mg/l	18-AUG-93	90096012	EH2O

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCSW8	Aluminum	93.2		200	ug/l	24-JUN-93	90053003	DMET
RCSW8	Barium	14.7	J	200	ug/l	24-JUN-93	90053003	DMET
RCSW8	Calcium	25300		5000	ug/l	24-JUN-93	90053003	DMET
RCSW8	Iron	653		100	ug/l	24-JUN-93	90053003	DMET
RCSW8	Magnesium	8550		5000	ug/l	24-JUN-93	90053003	DMET
RCSW8	Manganese	17.8		15	ug/l	24-JUN-93	90053003	DMET
RCSW8	Potassium	4350		5000	ug/l	24-JUN-93	90053003	DMET
RCSW8	Sodium	24100		5000	ug/l	24-JUN-93	90053003	DMET
RCSW8	Zinc	17.1	J	20	ug/l	24-JUN-93	90053003	DMET
RCSW8	Nitrate/Nitrite	2.45		0.02	mg/l	18-AUG-93	90096011	EH2O
RCSW8	Total Keljdahl Nitrogen	1.28		0.04	mg/l	18-AUG-93	90096011	EH2O
RCSW8	Total Nitrogen	3.73		0	mg/l	18-AUG-93	90096011	EH2O
RCSW8	Total Phosphorous	0.61		0.01	mg/l	18-AUG-93	90096011	EH2O
RCSW8A	Aluminum	153		200	ug/l	24-JUN-93	90053004	DMET
RCSW8A	Barium	16.8	J	200	ug/l	24-JUN-93	90053004	DMET
RCSW8A	Calcium	25000		5000	ug/l	24-JUN-93	90053004	DMET
RCSW8A	Iron	785		100	ug/l	24-JUN-93	90053004	DMET
RCSW8A	Magnesium	8390		5000	ug/l	24-JUN-93	90053004	DMET
RCSW8A	Manganese	19.2		15	ug/l	24-JUN-93	90053004	DMET
RCSW8A	Potassium	4550		5000	ug/l	24-JUN-93	90053004	DMET
RCSW8A	Sodium	23300		5000	ug/l	24-JUN-93	90053004	DMET
RCSW8A	Zinc	17.5	J	20	ug/l	24-JUN-93	90053004	DMET
RCSW9	Chloroform	1	J	10	ug/l	24-JUN-93	90053002	AVOL
RCSW9	Aluminum	91.5		200	ug/l	24-JUN-93	90053002	DMET
RCSW9	Barium	14.4	J	200	ug/l	24-JUN-93	90053002	DMET
RCSW9	Calcium	25900		5000	ug/l	24-JUN-93	90053002	DMET
RCSW9	Iron	587		100	ug/l	24-JUN-93	90053002	DMET
RCSW9	Magnesium	8860		5000	ug/l	24-JUN-93	90053002	DMET
RCSW9	Manganese	16.2		15	ug/l	24-JUN-93	90053002	DMET
RCSW9	Potassium	4620		5000	ug/l	24-JUN-93	90053002	DMET
RCSW9	Sodium	25400		5000	ug/l	24-JUN-93	90053002	DMET
RCSW9	Zinc	22.7		20	ug/l	24-JUN-93	90053002	DMET
RCSW9	Nitrate/Nitrite	2.26		0.02	mg/l	18-AUG-93	90096010	EH2O
RCSW9	Total Keljdahl Nitrogen	1.44		0.04	mg/l	18-AUG-93	90096010	EH2O
RCSW9	Total Nitrogen	3.7		0	mg/l	18-AUG-93	90096010	EH2O
RCSW9	Total Phosphorous	0.61		0.01	mg/l	18-AUG-93	90096010	EH2O
RCSWR1	Aluminum	332	J	200	ug/l	21-JUN-93	90049001	DMET
RCSWR1	Barium	36.9	J	200	ug/l	21-JUN-93	90049001	DMET
RCSWR1	Calcium	4610	J	5000	ug/l	21-JUN-93	90049001	DMET
RCSWR1	Iron	3830		100	ug/l	21-JUN-93	90049001	DMET
RCSWR1	Lead	3.1		5	ug/l	21-JUN-93	90049001	DMET
RCSWR1	Magnesium	1690	J	5000	ug/l	21-JUN-93	90049001	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
RCSWR1	Manganese	16.5		15	ug/l	21-JUN-93	90049001	DMET
RCSWR1	Potassium	450	J	5000	ug/l	21-JUN-93	90049001	DMET
RCSWR1	Sodium	6810		5000	ug/l	21-JUN-93	90049001	DMET
STCSW1	Toluene	2	J	10	ug/l	22-JUN-93	70383-3	AVOL
STCSW1	Aluminum	490		200	ug/l	22-JUN-93	90050003	DMET
STCSW1	Barium	18.6	J	200	ug/l	22-JUN-93	90050003	DMET
STCSW1	Beryllium	0.49	J	5	ug/l	22-JUN-93	90050003	DMET
STCSW1	Cadmium	37.3		5	ug/l	22-JUN-93	90050003	DMET
STCSW1	Calcium	6510		5000	ug/l	22-JUN-93	90050003	DMET
STCSW1	Copper	11.9	J	25	ug/l	22-JUN-93	90050003	DMET
STCSW1	Iron	1470		100	ug/l	22-JUN-93	90050003	DMET
STCSW1	Lead	14.1		5	ug/l	22-JUN-93	90050003	DMET
STCSW1	Magnesium	1190	J	5000	ug/l	22-JUN-93	90050003	DMET
STCSW1	Sodium	3120	J	5000	ug/l	22-JUN-93	90050003	DMET
STCSW1	Zinc	68.4		20	ug/l	22-JUN-93	90050003	DMET
STCSW1	Total Keljdahl Nitrogen	1.62		0.04	mg/l	18-AUG-93	90096008	EH2O
STCSW1	Total Nitrogen	1.62		0	mg/l	18-AUG-93	90096008	EH2O
STCSW1	Total Phosphorous	0.06		0.01	mg/l	18-AUG-93	90096008	EH2O
STCSW2	Toluene	2	J	10	ug/l	22-JUN-93	70383-4	AVOL
STCSW2	Aluminum	9350		200	ug/l	22-JUN-93	90050004	DMET
STCSW2	Barium	62.9	J	200	ug/l	22-JUN-93	90050004	DMET
STCSW2	Beryllium	7.8	J	5	ug/l	22-JUN-93	90050004	DMET
STCSW2	Cadmium	40.8		5	ug/l	22-JUN-93	90050004	DMET
STCSW2	Calcium	11100		5000	ug/l	22-JUN-93	90050004	DMET
STCSW2	Chromium	36.4		10	ug/l	22-JUN-93	90050004	DMET
STCSW2	Copper	65.2		25	ug/l	22-JUN-93	90050004	DMET
STCSW2	Iron	5800		100	ug/l	22-JUN-93	90050004	DMET
STCSW2	Lead	118		5	ug/l	22-JUN-93	90050004	DMET
STCSW2	Magnesium	2930	J	5000	ug/l	22-JUN-93	90050004	DMET
STCSW2	Manganese	24.5		15	ug/l	22-JUN-93	90050004	DMET
STCSW2	Mercury	0.33		0.2	ug/l	22-JUN-93	90050004	DMET
STCSW2	Nickel	10.5	J	40	ug/l	22-JUN-93	90050004	DMET
STCSW2	Silver	0.35	J	10	ug/l	22-JUN-93	90050004	DMET
STCSW2	Sodium	4010	J	5000	ug/l	22-JUN-93	90050004	DMET
STCSW2	Vanadium	22.4	J	50	ug/l	22-JUN-93	90050004	DMET
STCSW2	Zinc	557		20	ug/l	22-JUN-93	90050004	DMET
STCSW2	Nitrate/Nitrite	0.03		0.02	mg/l	18-AUG-93	90096007	EH2O
STCSW2	Total Keljdahl Nitrogen	0.78		0.04	mg/l	18-AUG-93	90096007	EH2O
STCSW2	Total Nitrogen	0.81		0	mg/l	18-AUG-93	90096007	EH2O
STCSW2	Total Phosphorous	0.16		0.01	mg/l	18-AUG-93	90096007	EH2O
STCSW3	1,2-Dichloroethene (total)	9	J	10	ug/l	22-JUN-93	70383-2	AVOL
STCSW3	Trichloroethene	20		10	ug/l	22-JUN-93	70383-2	AVOL

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
STCSW3	Aluminum	292		200	ug/l	22-JUN-93	90050002	DMET
STCSW3	Barium	18.5	J	200	ug/l	22-JUN-93	90050002	DMET
STCSW3	Calcium	10800		5000	ug/l	22-JUN-93	90050002	DMET
STCSW3	Copper	2.4	J	25	ug/l	22-JUN-93	90050002	DMET
STCSW3	Iron	847		100	ug/l	22-JUN-93	90050002	DMET
STCSW3	Magnesium	3290	J	5000	ug/l	22-JUN-93	90050002	DMET
STCSW3	Sodium	5200		5000	ug/l	22-JUN-93	90050002	DMET
STCSW3	Zinc	25.7		20	ug/l	22-JUN-93	90050002	DMET
STCSW4	1,2-Dichloroethene (total)	4	J	10	ug/l	22-JUN-93	70383-1	AVOL
STCSW4	Trichloroethene	8	J	10	ug/l	22-JUN-93	70383-1	AVOL
STCSW4	Aluminum	369		200	ug/l	22-JUN-93	90050001	DMET
STCSW4	Barium	17.6	J	200	ug/l	22-JUN-93	90050001	DMET
STCSW4	Cadmium	0.32	J	5	ug/l	22-JUN-93	90050001	DMET
STCSW4	Calcium	10100		5000	ug/l	22-JUN-93	90050001	DMET
STCSW4	Copper	5	J	25	ug/l	22-JUN-93	90050001	DMET
STCSW4	Iron	1020		100	ug/l	22-JUN-93	90050001	DMET
STCSW4	Magnesium	3080	J	5000	ug/l	22-JUN-93	90050001	DMET
STCSW4	Manganese	9.6	J	15	ug/l	22-JUN-93	90050001	DMET
STCSW4	Sodium	4800	J	5000	ug/l	22-JUN-93	90050001	DMET
STCSW4	Zinc	25.4		20	ug/l	22-JUN-93	90050001	DMET
STCSW5	Aluminum	1170	J	200	ug/l	29-JUN-93	90058005	DMET
STCSW5	Barium	21.8	J	200	ug/l	29-JUN-93	90058005	DMET
STCSW5	Beryllium	0.23	J	5	ug/l	29-JUN-93	90058005	DMET
STCSW5	Calcium	9420		5000	ug/l	29-JUN-93	90058005	DMET
STCSW5	Iron	1160	J	100	ug/l	29-JUN-93	90058005	DMET
STCSW5	Magnesium	1560	J	5000	ug/l	29-JUN-93	90058005	DMET
STCSW5	Manganese	11.4	J	15	ug/l	29-JUN-93	90058005	DMET
STCSW5	Potassium	977	J	5000	ug/l	29-JUN-93	90058005	DMET
STCSW5	Sodium	3020	J	5000	ug/l	29-JUN-93	90058005	DMET
STCSW5	Thallium	1.9	J	10	ug/l	29-JUN-93	90058005	DMET
STCSW5	Total Keljdahl Nitrogen	0.65		0.04	mg/l	18-AUG-93	90096014	EH20
STCSW5	Total Nitrogen	0.65		0	mg/l	18-AUG-93	90096014	EH20
STCSW5	Total Phosphorous	0.2		0.01	mg/l	18-AUG-93	90096014	EH20
STCSW5D	Aluminum	774	J	200	ug/l	29-JUN-93	90058006	DMET
STCSW5D	Barium	22.5	J	200	ug/l	29-JUN-93	90058006	DMET
STCSW5D	Calcium	9570		5000	ug/l	29-JUN-93	90058006	DMET
STCSW5D	Iron	930	J	100	ug/l	29-JUN-93	90058006	DMET
STCSW5D	Magnesium	1580	J	5000	ug/l	29-JUN-93	90058006	DMET
STCSW5D	Manganese	9.8	J	15	ug/l	29-JUN-93	90058006	DMET
STCSW5D	Potassium	738	J	5000	ug/l	29-JUN-93	90058006	DMET
STCSW5D	Sodium	3160	J	5000	ug/l	29-JUN-93	90058006	DMET
STCSW6	Calcium	9750		5000	ug/l	26-JUN-93	90055009	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
STCSW6	Iron	432	J	100	ug/l	26-JUN-93	90055009	DMET
STCSW6	Magnesium	2010	J	5000	ug/l	26-JUN-93	90055009	DMET
STCSW6	Potassium	825	J	5000	ug/l	26-JUN-93	90055009	DMET
STCSW6	Sodium	3940	J	5000	ug/l	26-JUN-93	90055009	DMET
STCSW6	Total Keljdahl Nitrogen	0.22		0.04	mg/l	18-AUG-93	90096015	EH2O
STCSW6	Total Nitrogen	0.22		0	mg/l	18-AUG-93	90096015	EH2O
STCSW6	Total Phosphorous	0.02		0.01	mg/l	18-AUG-93	90096015	EH2O
STCSW7	Calcium	9940		5000	ug/l	26-JUN-93	90055008	DMET
STCSW7	Iron	437	J	100	ug/l	26-JUN-93	90055008	DMET
STCSW7	Magnesium	2030	J	5000	ug/l	26-JUN-93	90055008	DMET
STCSW7	Potassium	448	J	5000	ug/l	26-JUN-93	90055008	DMET
STCSW7	Sodium	3840	J	5000	ug/l	26-JUN-93	90055008	DMET
STCSW8	Acetone	9	J	10	ug/l	28-JUN-93	90057003	AVOL
STCSW8	Aluminum	182	J	200	ug/l	28-JUN-93	90057003	DMET
STCSW8	Barium	15	J	200	ug/l	28-JUN-93	90057003	DMET
STCSW8	Calcium	12200		5000	ug/l	28-JUN-93	90057003	DMET
STCSW8	Copper	1.8	J	25	ug/l	28-JUN-93	90057003	DMET
STCSW8	Iron	439		100	ug/l	28-JUN-93	90057003	DMET
STCSW8	Magnesium	3010	J	5000	ug/l	28-JUN-93	90057003	DMET
STCSW8	Manganese	7	J	15	ug/l	28-JUN-93	90057003	DMET
STCSW8	Potassium	1290	J	5000	ug/l	28-JUN-93	90057003	DMET
STCSW8	Selenium	1.8	J	5	ug/l	28-JUN-93	90057003	DMET
STCSW8	Sodium	7060		5000	ug/l	28-JUN-93	90057003	DMET
STCSWR1	Chloromethane	3	J	10	ug/l	29-JUN-93	90058004	AVOL
STCSWR1	Aluminum	348	J	200	ug/l	29-JUN-93	90058004	DMET
STCSWR1	Calcium	33000		5000	ug/l	29-JUN-93	90058004	DMET
STCSWR1	Iron	381	J	100	ug/l	29-JUN-93	90058004	DMET
STCSWR1	Magnesium	1280	J	5000	ug/l	29-JUN-93	90058004	DMET
STCSWR1	Potassium	1560	J	5000	ug/l	29-JUN-93	90058004	DMET
STCSWR1	Sodium	2980	J	5000	ug/l	29-JUN-93	90058004	DMET
STCSWR1	Zinc	18.4	J	20	ug/l	29-JUN-93	90058004	DMET
YWCSW1	Acetone	15		10	ug/l	27-JUN-93	90056005	AVOL
YWCSW1	Aluminum	272		200	ug/l	27-JUN-93	90056005	DMET
YWCSW1	Calcium	13500		5000	ug/l	27-JUN-93	90056005	DMET
YWCSW1	Iron	336	J	100	ug/l	27-JUN-93	90056005	DMET
YWCSW1	Magnesium	1660	J	5000	ug/l	27-JUN-93	90056005	DMET
YWCSW1	Manganese	13.6	J	15	ug/l	27-JUN-93	90056005	DMET
YWCSW1	Potassium	1320	J	5000	ug/l	27-JUN-93	90056005	DMET
YWCSW1	Sodium	3030	J	5000	ug/l	27-JUN-93	90056005	DMET
YWCSW1	Zinc	22		20	ug/l	27-JUN-93	90056005	DMET
YWCSW2	Barium	23.3	J	200	ug/l	27-JUN-93	90056004	DMET
YWCSW2	Calcium	15000		5000	ug/l	27-JUN-93	90056004	DMET

Appendix B-3 - Surface Water Data
(Sorted by Sample Identifier)

Sample Identifier	Chemical Name	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
YWCSW2	Iron	384	J	100	ug/l	27-JUN-93	90056004	DMET
YWCSW2	Magnesium	2120	J	5000	ug/l	27-JUN-93	90056004	DMET
YWCSW2	Manganese	8.6	J	15	ug/l	27-JUN-93	90056004	DMET
YWCSW2	Potassium	1320	J	5000	ug/l	27-JUN-93	90056004	DMET
YWCSW2	Sodium	4210	J	5000	ug/l	27-JUN-93	90056004	DMET
YWCSW2	Zinc	5.8	J	20	ug/l	27-JUN-93	90056004	DMET
YWCSWR1	Acetone	10	J	10	ug/l	28-JUN-93	90057004	AVOL
YWCSWR1	Barium	23	J	200	ug/l	28-JUN-93	90057004	DMET
YWCSWR1	Calcium	12800		5000	ug/l	28-JUN-93	90057004	DMET
YWCSWR1	Copper	1.9	J	25	ug/l	28-JUN-93	90057004	DMET
YWCSWR1	Iron	1070		100	ug/l	28-JUN-93	90057004	DMET
YWCSWR1	Magnesium	2650	J	5000	ug/l	28-JUN-93	90057004	DMET
YWCSWR1	Manganese	11.6	J	15	ug/l	28-JUN-93	90057004	DMET
YWCSWR1	Potassium	636	J	5000	ug/l	28-JUN-93	90057004	DMET
YWCSWR1	Sodium	4650	J	5000	ug/l	28-JUN-93	90057004	DMET

Notes:
J = qualified as estimated
AVOL = volatile organics
BSVO = semivolatile organics
CPES = pesticides and polychlorinated biphenyls
DMET = inorganics
ug/l = micrograms per liter

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
1,2-Dichloroethene (total)	STCSW3	9	J	10	ug/l	22-JUN-93	70383-2	AVOL
1,2-Dichloroethene (total)	STCSW4	4	J	10	ug/l	22-JUN-93	70383-1	AVOL
4-Methyl-2-pentanone	5SW1	3	J	10	ug/l	25-JUN-93	90054007	AVOL
Acetone	5SW2	14		10	ug/l	25-JUN-93	90054005	AVOL
Acetone	5SW2D	14		10	ug/l	25-JUN-93	90054006	AVOL
Acetone	5SW3	16		10	ug/l	25-JUN-93	90054004	AVOL
Acetone	5SW4	10		10	ug/l	25-JUN-93	90054003	AVOL
Acetone	5SW5	16		10	ug/l	25-JUN-93	90054008	AVOL
Acetone	6SW1	10	J	10	ug/l	28-JUN-93	90057001	AVOL
Acetone	GCSW1	11		10	ug/l	27-JUN-93	90056006	AVOL
Acetone	LFSW7	7	J	10	ug/l	23-JUN-93	90052001	AVOL
Acetone	RCGCSWR1	10	J	10	ug/l	28-JUN-93	90057005	AVOL
Acetone	RCSW1	12		10	ug/l	25-JUN-93	90054001	AVOL
Acetone	RCSW10	9	J	10	ug/l	28-JUN-93	90057002	AVOL
Acetone	STCSW8	9	J	10	ug/l	28-JUN-93	90057003	AVOL
Acetone	YWCSW1	15		10	ug/l	27-JUN-93	90056005	AVOL
Bromodichloromethane	YWCSWR1	10	J	10	ug/l	28-JUN-93	90057004	AVOL
Bromodichloromethane	RCSW3	2	J	0	ug/l	26-JUN-93	90055007	AVOL
Bromodichloromethane	RCSW4	2	J	0	ug/l	27-JUN-93	90056002	AVOL
Chlorobenzene	RCSW5	2	J	0	ug/l	27-JUN-93	90056001	AVOL
Chlorobenzene	2SW1	4	J	10	ug/l	24-JUN-93	90053007	AVOL
Chlorobenzene	2SW2	2	J	10	ug/l	22-JUN-93	70383-12	AVOL
Chlorobenzene	2SW2D	2	J	10	ug/l	22-JUN-93	70383-13	AVOL
Chloroform	2SW3	2	J	10	ug/l	24-JUN-93	90053008	AVOL
Chloroform	LFSW8D	2	J	10	ug/l	23-JUN-93	90052007	AVOL
Chloroform	RCSW10	1	J	10	ug/l	28-JUN-93	90057002	AVOL
Chloroform	RCSW3	5	J	10	ug/l	26-JUN-93	90055007	AVOL
Chloroform	RCSW4	6	J	10	ug/l	27-JUN-93	90056002	AVOL
Chloroform	RCSW5	6	J	10	ug/l	27-JUN-93	90056001	AVOL
Chloroform	RCSW9	1	J	10	ug/l	24-JUN-93	90053002	AVOL
Chloromethane	GCSW4	3	J	10	ug/l	30-JUN-93	90059003	AVOL
Chloromethane	STCSWR1	3	J	10	ug/l	29-JUN-93	90058004	AVOL
Methylene chloride	RCSW1	1	J	10	ug/l	25-JUN-93	90054001	AVOL
Toluene	5SW1	2	J	10	ug/l	25-JUN-93	90054007	AVOL
Toluene	5SW3	2	J	10	ug/l	25-JUN-93	90054004	AVOL
Toluene	STCSW1	2	J	10	ug/l	22-JUN-93	70383-3	AVOL
Toluene	STCSW2	2	J	10	ug/l	22-JUN-93	70383-4	AVOL
Trichloroethene	STCSW3	20		10	ug/l	22-JUN-93	70383-2	AVOL
Trichloroethene	STCSW4	8	J	10	ug/l	22-JUN-93	70383-1	AVOL
1,4-Dichlorobenzene	2SW1	2	J	10	ug/l	24-JUN-93	90053007	BSVO
bis(2-Ethylhexyl) phthalate	RCGCSW2	6	J	10	ug/l	26-JUN-93	90055004	BSVO
alpha-Chlordane	GCSW4	0.016	J	0.016	ug/l	30-JUN-93	90059003	CPES

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
alpha-Chlordane	GCSW5	0.14	J	0.05	UJG/L	30-JUN-93	90059004	CPES
alpha-Chlordane	GCSW5D	0.32	J	0.1	ug/l	30-JUN-93	90059005	CPES
gamma-Chlordane	GCSW4	0.012	J	0.012	ug/l	30-JUN-93	90059003	CPES
gamma-Chlordane	GCSW5	0.11	J	0.05	UJG/L	30-JUN-93	90059004	CPES
gamma-Chlordane	GCSW5D	0.3	J	0.1	ug/l	30-JUN-93	90059005	CPES
Aluminum	18SW1	530	J	200	ug/l	29-JUN-93	90058002	DMET
Aluminum	18SW2	487	J	200	ug/l	29-JUN-93	90058003	DMET
Aluminum	2SW1	91.9		200	ug/l	24-JUN-93	90053007	DMET
Aluminum	2SW2	463		200	ug/l	22-JUN-93	90050012	DMET
Aluminum	2SW2D	510		200	ug/l	22-JUN-93	90050013	DMET
Aluminum	2SW3	36.8		200	ug/l	24-JUN-93	90053008	DMET
Aluminum	5SW1	658	J	200	ug/l	25-JUN-93	90054007	DMET
Aluminum	5SW2	766	J	200	ug/l	25-JUN-93	90054005	DMET
Aluminum	5SW2D	1090	J	200	ug/l	25-JUN-93	90054006	DMET
Aluminum	5SW3	149	J	200	ug/l	25-JUN-93	90054004	DMET
Aluminum	5SW4	2320	J	200	ug/l	25-JUN-93	90054003	DMET
Aluminum	5SW5	738	J	200	ug/l	25-JUN-93	90054008	DMET
Aluminum	5SW6	365	J	200	ug/l	29-JUN-93	90058007	DMET
Aluminum	5SW7	552	J	200	ug/l	29-JUN-93	90058008	DMET
Aluminum	8SW1	3170	J	200	ug/l	21-JUN-93	90049002	DMET
Aluminum	8SW2	379	J	200	ug/l	21-JUN-93	90049003	DMET
Aluminum	9SW1	928		200	ug/l	27-JUN-93	90056003	DMET
Aluminum	GCSW3	2070	J	200	ug/l	30-JUN-93	90059002	DMET
Aluminum	GCSW5	144000	J	200	ug/l	30-JUN-93	90059004	DMET
Aluminum	GCSW5D	16700	J	200	ug/l	30-JUN-93	90059005	DMET
Aluminum	LFSW1	84.9		200	ug/l	23-JUN-93	90052009	DMET
Aluminum	LFSW2	112		200	ug/l	23-JUN-93	90052008	DMET
Aluminum	LFSW3	84.4		200	ug/l	23-JUN-93	90052005	DMET
Aluminum	LFSW4	93.4		200	ug/l	23-JUN-93	90052004	DMET
Aluminum	LFSW5	87.2		200	ug/l	23-JUN-93	90052003	DMET
Aluminum	LFSW6	751		200	ug/l	23-JUN-93	90052002	DMET
Aluminum	LFSW7	94		200	ug/l	23-JUN-93	90052001	DMET
Aluminum	LFSW8	84.1		200	ug/l	23-JUN-93	90052006	DMET
Aluminum	LFSW8D	192		200	ug/l	23-JUN-93	90052007	DMET
Aluminum	RCGCSW1	171	J	200	ug/l	26-JUN-93	90055005	DMET
Aluminum	RCGCSW2	202	J	200	ug/l	26-JUN-93	90055004	DMET
Aluminum	RCGCSWR1	287	J	200	ug/l	28-JUN-93	90057005	DMET
Aluminum	RCSW1	86.9	J	200	ug/l	25-JUN-93	90054001	DMET
Aluminum	RCSW2	107	J	200	ug/l	25-JUN-93	90054002	DMET
Aluminum	RCSW3	141	J	200	ug/l	26-JUN-93	90055007	DMET
Aluminum	RCSW4	184	J	200	ug/l	27-JUN-93	90056002	DMET
Aluminum	RCSW5	137	J	200	ug/l	27-JUN-93	90056001	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Aluminum	RCSW6	124		200	ug/l	24-JUN-93	90053006	DMET
Aluminum	RCSW7	601		200	ug/l	24-JUN-93	90053005	DMET
Aluminum	RCSW8	93.2		200	ug/l	24-JUN-93	90053003	DMET
Aluminum	RCSW8A	153		200	ug/l	24-JUN-93	90053004	DMET
Aluminum	RCSW9	91.5		200	ug/l	24-JUN-93	90053002	DMET
Aluminum	RCSWR1	332	J	200	ug/l	21-JUN-93	90049001	DMET
Aluminum	STCSW1	490		200	ug/l	22-JUN-93	90050003	DMET
Aluminum	STCSW2	9350		200	ug/l	22-JUN-93	90050004	DMET
Aluminum	STCSW3	292		200	ug/l	22-JUN-93	90050002	DMET
Aluminum	STCSW4	369		200	ug/l	22-JUN-93	90050001	DMET
Aluminum	STCSW5	1170	J	200	ug/l	29-JUN-93	90058005	DMET
Aluminum	STCSW5D	774	J	200	ug/l	29-JUN-93	90058006	DMET
Aluminum	STCSW8	182	J	200	ug/l	28-JUN-93	90057003	DMET
Aluminum	STCSWR1	348	J	200	ug/l	29-JUN-93	90058004	DMET
Aluminum	YWCSW1	272		200	ug/l	27-JUN-93	90056005	DMET
Arsenic	GCSW3	4.5	J	10	ug/l	30-JUN-93	90059002	DMET
Arsenic	GCSW4	5.9	J	10	ug/l	30-JUN-93	90059003	DMET
Arsenic	GCSW5	360	J	10	ug/l	30-JUN-93	90059004	DMET
Arsenic	GCSW5D	48.1	J	10	ug/l	30-JUN-93	90059005	DMET
Barium	18SW1	18.3	J	200	ug/l	29-JUN-93	90058002	DMET
Barium	2SW1	39.3	J	200	ug/l	24-JUN-93	90053007	DMET
Barium	2SW2	45.2	J	200	ug/l	22-JUN-93	90050012	DMET
Barium	2SW2D	47.5	J	200	ug/l	22-JUN-93	90050013	DMET
Barium	2SW3	37.9	J	200	ug/l	24-JUN-93	90053008	DMET
Barium	5SW1	20.7	J	200	ug/l	25-JUN-93	90054007	DMET
Barium	5SW2	22.7	J	200	ug/l	25-JUN-93	90054005	DMET
Barium	5SW2D	24.4	J	200	ug/l	25-JUN-93	90054006	DMET
Barium	5SW3	16.2	J	200	ug/l	25-JUN-93	90054004	DMET
Barium	5SW4	48.6	J	200	ug/l	25-JUN-93	90054003	DMET
Barium	5SW5	14.2	J	200	ug/l	25-JUN-93	90054008	DMET
Barium	5SW6	26.9	J	200	ug/l	29-JUN-93	90058007	DMET
Barium	5SW7	27.6	J	200	ug/l	29-JUN-93	90058008	DMET
Barium	6SW1	25	J	200	ug/l	28-JUN-93	90057001	DMET
Barium	8SW1	11.6	J	200	ug/l	21-JUN-93	90049002	DMET
Barium	8SW2	13.7	J	200	ug/l	21-JUN-93	90049003	DMET
Barium	GCSW1	26.6	J	200	ug/l	27-JUN-93	90056006	DMET
Barium	GCSW2	23.4	J	200	ug/l	26-JUN-93	90055002	DMET
Barium	GCSW3	39.2	J	200	ug/l	30-JUN-93	90059002	DMET
Barium	GCSW5	392	J	200	ug/l	30-JUN-93	90059004	DMET
Barium	GCSW5D	74.8		200	ug/l	30-JUN-93	90059005	DMET
Barium	LFSW1	23	J	200	ug/l	23-JUN-93	90052009	DMET
Barium	LFSW2	23.4	J	200	ug/l	23-JUN-93	90052008	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Barium	LFSW3	23	J	200	ug/l	23-JUN-93	90052005	DMET
Barium	LFSW4	23.5	J	200	ug/l	23-JUN-93	90052004	DMET
Barium	LFSW5	22.4	J	200	ug/l	23-JUN-93	90052003	DMET
Barium	LFSW6	29.6	J	200	ug/l	23-JUN-93	90052002	DMET
Barium	LFSW7	23.8	J	200	ug/l	23-JUN-93	90052001	DMET
Barium	LFSW8	18.5	J	200	ug/l	23-JUN-93	90052006	DMET
Barium	LFSW8D	21	J	200	ug/l	23-JUN-93	90052007	DMET
Barium	RCGCSW1	48.1	J	200	ug/l	26-JUN-93	90055005	DMET
Barium	RCGCSW1D	36.5	J	200	ug/l	26-JUN-93	90055006	DMET
Barium	RCGCSW2	36.3	J	200	ug/l	26-JUN-93	90055004	DMET
Barium	RCGCSW3	37.2	J	200	ug/l	26-JUN-93	90055003	DMET
Barium	RCGCSWR1	30	J	200	ug/l	28-JUN-93	90057005	DMET
Barium	RCSW1	25	J	200	ug/l	25-JUN-93	90054001	DMET
Barium	RCSW2	25.7	J	200	ug/l	25-JUN-93	90054002	DMET
Barium	RCSW6	16.8	J	200	ug/l	24-JUN-93	90053006	DMET
Barium	RCSW7	20	J	200	ug/l	24-JUN-93	90053005	DMET
Barium	RCSW8	14.7	J	200	ug/l	24-JUN-93	90053003	DMET
Barium	RCSW8A	16.8	J	200	ug/l	24-JUN-93	90053004	DMET
Barium	RCSW9	14.4	J	200	ug/l	24-JUN-93	90053002	DMET
Barium	RCSWR1	36.9	J	200	ug/l	21-JUN-93	90049001	DMET
Barium	STCSW1	18.6	J	200	ug/l	22-JUN-93	90050003	DMET
Barium	STCSW2	62.9	J	200	ug/l	22-JUN-93	90050004	DMET
Barium	STCSW3	18.5	J	200	ug/l	22-JUN-93	90050002	DMET
Barium	STCSW4	17.6	J	200	ug/l	22-JUN-93	90050001	DMET
Barium	STCSW5	21.8	J	200	ug/l	29-JUN-93	90058005	DMET
Barium	STCSW5D	22.5	J	200	ug/l	29-JUN-93	90058006	DMET
Barium	STCSW8	15	J	200	ug/l	28-JUN-93	90057003	DMET
Barium	YWCSW2	23.3	J	200	ug/l	27-JUN-93	90056004	DMET
Barium	YWCSWR1	23	J	200	ug/l	28-JUN-93	90057004	DMET
Beryllium	GCSW5	21.4	J	5	ug/l	30-JUN-93	90059004	DMET
Beryllium	LFSW1	0.29	J	5	ug/l	23-JUN-93	90052009	DMET
Beryllium	LFSW2	0.23	J	5	ug/l	23-JUN-93	90052008	DMET
Beryllium	LFSW5	0.27	J	5	ug/l	23-JUN-93	90052003	DMET
Beryllium	STCSW1	0.49	J	5	ug/l	22-JUN-93	90050003	DMET
Beryllium	STCSW2	7.8	J	5	ug/l	22-JUN-93	90050004	DMET
Beryllium	STCSW5	0.23	J	5	ug/l	29-JUN-93	90058005	DMET
Cadmium	5SW2	0.19	J	5	ug/l	25-JUN-93	90054005	DMET
Cadmium	GCSW5	36.9	J	5	ug/l	30-JUN-93	90059004	DMET
Cadmium	GCSW5D	4.3	J	5	ug/l	30-JUN-93	90059005	DMET
Cadmium	RCSW1	0.26	J	5	ug/l	25-JUN-93	90054001	DMET
Cadmium	STCSW1	37.3		5	ug/l	22-JUN-93	90050003	DMET
Cadmium	STCSW2	40.8		5	ug/l	22-JUN-93	90050004	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Cadmium	STCSW4	0.32	J	5	ug/l	22-JUN-93	90050001	DMET
Calcium	18SW1	5980		5000	ug/l	29-JUN-93	90058002	DMET
Calcium	18SW2	4100	J	5000	ug/l	29-JUN-93	90058003	DMET
Calcium	2SW1	17500		5000	ug/l	24-JUN-93	90053007	DMET
Calcium	2SW2	19200		5000	ug/l	22-JUN-93	90050012	DMET
Calcium	2SW2D	19300		5000	ug/l	22-JUN-93	90050013	DMET
Calcium	2SW3	19700		5000	ug/l	24-JUN-93	90053008	DMET
Calcium	5SW1	6000		5000	ug/l	25-JUN-93	90054007	DMET
Calcium	5SW2	5900		5000	ug/l	25-JUN-93	90054005	DMET
Calcium	5SW2D	6000		5000	ug/l	25-JUN-93	90054006	DMET
Calcium	5SW3	2880	J	5000	ug/l	25-JUN-93	90054004	DMET
Calcium	5SW4	8020		5000	ug/l	25-JUN-93	90054003	DMET
Calcium	5SW5	2470	J	5000	ug/l	25-JUN-93	90054008	DMET
Calcium	5SW6	14800		5000	ug/l	29-JUN-93	90058007	DMET
Calcium	5SW7	20400		5000	ug/l	29-JUN-93	90058008	DMET
Calcium	6SW1	22600		5000	ug/l	28-JUN-93	90057001	DMET
Calcium	8SW1	3120	J	5000	ug/l	21-JUN-93	90049002	DMET
Calcium	8SW2	1850	J	5000	ug/l	21-JUN-93	90049003	DMET
Calcium	GCSW1	21100		5000	ug/l	27-JUN-93	90056006	DMET
Calcium	GCSW2	13900		5000	ug/l	26-JUN-93	90055002	DMET
Calcium	GCSW3	24500		5000	ug/l	30-JUN-93	90059002	DMET
Calcium	GCSW4	32300		5000	ug/l	30-JUN-93	90059003	DMET
Calcium	GCSW5	17800	J	5000	ug/l	30-JUN-93	90059004	DMET
Calcium	GCSW5D	80200	J	5000	ug/l	30-JUN-93	90059005	DMET
Calcium	LFSW1	13900		5000	ug/l	23-JUN-93	90052009	DMET
Calcium	LFSW2	13900		5000	ug/l	23-JUN-93	90052008	DMET
Calcium	LFSW3	13700		5000	ug/l	23-JUN-93	90052005	DMET
Calcium	LFSW4	13800		5000	ug/l	23-JUN-93	90052004	DMET
Calcium	LFSW5	13500		5000	ug/l	23-JUN-93	90052003	DMET
Calcium	LFSW6	14000		5000	ug/l	23-JUN-93	90052002	DMET
Calcium	LFSW7	14200		5000	ug/l	23-JUN-93	90052001	DMET
Calcium	LFSW8	12300		5000	ug/l	23-JUN-93	90052006	DMET
Calcium	LFSW8D	12500		5000	ug/l	23-JUN-93	90052007	DMET
Calcium	RCGCSW1	9110		5000	ug/l	26-JUN-93	90055005	DMET
Calcium	RCGCSW1D	9160		5000	ug/l	26-JUN-93	90055006	DMET
Calcium	RCGCSW2	9150		5000	ug/l	26-JUN-93	90055004	DMET
Calcium	RCGCSW3	11900		5000	ug/l	26-JUN-93	90055003	DMET
Calcium	RCGCSWR1	8060		5000	ug/l	28-JUN-93	90057005	DMET
Calcium	RCSW1	14400		5000	ug/l	25-JUN-93	90054001	DMET
Calcium	RCSW10	24000		5000	ug/l	28-JUN-93	90057002	DMET
Calcium	RCSW2	14700		5000	ug/l	25-JUN-93	90054002	DMET
Calcium	RCSW3	26500		5000	ug/l	26-JUN-93	90055007	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Calcium	RCSW4	22200		5000	ug/l	27-JUN-93	90056002	DMET
Calcium	RCSW5	22100		5000	ug/l	27-JUN-93	90056001	DMET
Calcium	RCSW6	25100		5000	ug/l	24-JUN-93	90053006	DMET
Calcium	RCSW7	24900		5000	ug/l	24-JUN-93	90053005	DMET
Calcium	RCSW8	25300		5000	ug/l	24-JUN-93	90053003	DMET
Calcium	RCSW8A	25000		5000	ug/l	24-JUN-93	90053004	DMET
Calcium	RCSW9	25900		5000	ug/l	24-JUN-93	90053002	DMET
Calcium	RCSWR1	4610	J	5000	ug/l	21-JUN-93	90049001	DMET
Calcium	STCSW1	6510		5000	ug/l	22-JUN-93	90050003	DMET
Calcium	STCSW2	11100		5000	ug/l	22-JUN-93	90050004	DMET
Calcium	STCSW3	10800		5000	ug/l	22-JUN-93	90050002	DMET
Calcium	STCSW4	10100		5000	ug/l	22-JUN-93	90050001	DMET
Calcium	STCSW5	9420		5000	ug/l	29-JUN-93	90058005	DMET
Calcium	STCSW5D	9570		5000	ug/l	29-JUN-93	90058006	DMET
Calcium	STCSW6	9750		5000	ug/l	26-JUN-93	90055009	DMET
Calcium	STCSW7	9940		5000	ug/l	26-JUN-93	90055008	DMET
Calcium	STCSW8	12200		5000	ug/l	28-JUN-93	90057003	DMET
Calcium	STCSWR1	33000		5000	ug/l	29-JUN-93	90058004	DMET
Calcium	YWCSW1	13500		5000	ug/l	27-JUN-93	90056005	DMET
Calcium	YWCSW2	15000		5000	ug/l	27-JUN-93	90056004	DMET
Calcium	YWCSWR1	12800		5000	ug/l	28-JUN-93	90057004	DMET
Chromium	5SW5	3.3	J	10	ug/l	25-JUN-93	90054008	DMET
Chromium	GCSW5	542	J	10	ug/l	30-JUN-93	90059004	DMET
Chromium	GCSW5D	34.6	J	10	ug/l	30-JUN-93	90059005	DMET
Chromium	RCSW7	4	J	10	ug/l	24-JUN-93	90053005	DMET
Chromium	STCSW2	36.4		10	ug/l	22-JUN-93	90050004	DMET
Cobalt	GCSW5	17	J	50	ug/l	30-JUN-93	90059004	DMET
Copper	6SW1	3.7	J	25	ug/l	28-JUN-93	90057001	DMET
Copper	8SW1	2.5	J	25	ug/l	21-JUN-93	90049002	DMET
Copper	GCSW3	3.5	J	25	ug/l	30-JUN-93	90059002	DMET
Copper	GCSW4	3.8	J	25	ug/l	30-JUN-93	90059003	DMET
Copper	GCSW5	6370	J	25	ug/l	30-JUN-93	90059004	DMET
Copper	GCSW5D	289	J	25	ug/l	30-JUN-93	90059005	DMET
Copper	LFSW3	2.5	J	25	ug/l	23-JUN-93	90052005	DMET
Copper	LFSW4	2.5	J	25	ug/l	23-JUN-93	90052004	DMET
Copper	LFSW5	1.7	J	25	ug/l	23-JUN-93	90052003	DMET
Copper	LFSW6	3.9	J	25	ug/l	23-JUN-93	90052002	DMET
Copper	LFSW7	3.4	J	25	ug/l	23-JUN-93	90052001	DMET
Copper	LFSW8	1.7	J	25	ug/l	23-JUN-93	90052006	DMET
Copper	RCGCSWR1	5.1	J	25	ug/l	28-JUN-93	90057005	DMET
Copper	STCSW1	11.9	J	25	ug/l	22-JUN-93	90050003	DMET
Copper	STCSW2	65.2		25	ug/l	22-JUN-93	90050004	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Copper	STCSW3	2.4	J	25	ug/l	22-JUN-93	90050002	DMET
Copper	STCSW4	5	J	25	ug/l	22-JUN-93	90050001	DMET
Copper	STCSW8	1.8	J	25	ug/l	28-JUN-93	90057003	DMET
Copper	YWCSWR1	1.9	J	25	ug/l	28-JUN-93	90057004	DMET
Cyanide	2SW2D	10		10	ug/l	22-JUN-93	90050013	DMET
Iron	18SW1	6580	J	100	ug/l	29-JUN-93	90058002	DMET
Iron	18SW2	5540	J	100	ug/l	29-JUN-93	90058003	DMET
Iron	2SW1	8990		100	ug/l	24-JUN-93	90053007	DMET
Iron	2SW2	27500		100	ug/l	22-JUN-93	90050012	DMET
Iron	2SW2D	36300		100	ug/l	22-JUN-93	90050013	DMET
Iron	2SW3	6430		100	ug/l	24-JUN-93	90053008	DMET
Iron	5SW1	3610		100	ug/l	25-JUN-93	90054007	DMET
Iron	5SW2	2760		100	ug/l	25-JUN-93	90054005	DMET
Iron	5SW2D	3090		100	ug/l	25-JUN-93	90054006	DMET
Iron	5SW3	1250		100	ug/l	25-JUN-93	90054004	DMET
Iron	5SW4	1680		100	ug/l	25-JUN-93	90054003	DMET
Iron	5SW5	1260		100	ug/l	25-JUN-93	90054008	DMET
Iron	5SW6	153	J	100	ug/l	29-JUN-93	90058007	DMET
Iron	5SW7	263	J	100	ug/l	29-JUN-93	90058008	DMET
Iron	6SW1	818		100	ug/l	28-JUN-93	90057001	DMET
Iron	8SW1	267		100	ug/l	21-JUN-93	90049002	DMET
Iron	8SW2	537		100	ug/l	21-JUN-93	90049003	DMET
Iron	9SW1	3570	J	100	ug/l	27-JUN-93	90056003	DMET
Iron	GCSW1	781	J	100	ug/l	27-JUN-93	90056006	DMET
Iron	GCSW2	953	J	100	ug/l	26-JUN-93	90055002	DMET
Iron	GCSW3	5030		100	ug/l	30-JUN-93	90059002	DMET
Iron	GCSW4	58.8	J	100	ug/l	30-JUN-93	90059003	DMET
Iron	GCSW5	90400	J	100	ug/l	30-JUN-93	90059004	DMET
Iron	GCSW5D	8670	J	100	ug/l	30-JUN-93	90059005	DMET
Iron	LFSW1	862	J	100	ug/l	23-JUN-93	90052009	DMET
Iron	LFSW2	872	J	100	ug/l	23-JUN-93	90052008	DMET
Iron	LFSW3	838	J	100	ug/l	23-JUN-93	90052005	DMET
Iron	LFSW4	847	J	100	ug/l	23-JUN-93	90052004	DMET
Iron	LFSW5	790	J	100	ug/l	23-JUN-93	90052003	DMET
Iron	LFSW6	1270	J	100	ug/l	23-JUN-93	90052002	DMET
Iron	LFSW7	890	J	100	ug/l	23-JUN-93	90052001	DMET
Iron	LFSW8	864	J	100	ug/l	23-JUN-93	90052006	DMET
Iron	LFSW8D	1560	J	100	ug/l	23-JUN-93	90052007	DMET
Iron	RCGCSW1	1710	J	100	ug/l	26-JUN-93	90055005	DMET
Iron	RCGCSW1D	1710	J	100	ug/l	26-JUN-93	90055006	DMET
Iron	RCGCSW2	1630	J	100	ug/l	26-JUN-93	90055004	DMET
Iron	RCGCSW3	1360	J	100	ug/l	26-JUN-93	90055003	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Iron	RCGCSWR1	1440		100	ug/l	28-JUN-93	90057005	DMET
Iron	RCSW1	925		100	ug/l	25-JUN-93	90054001	DMET
Iron	RCSW10	523		100	ug/l	28-JUN-93	90057002	DMET
Iron	RCSW2	996		100	ug/l	25-JUN-93	90054002	DMET
Iron	RCSW3	702	J	100	ug/l	26-JUN-93	90055007	DMET
Iron	RCSW4	750	J	100	ug/l	27-JUN-93	90056002	DMET
Iron	RCSW5	647	J	100	ug/l	27-JUN-93	90056001	DMET
Iron	RCSW6	738		100	ug/l	24-JUN-93	90053006	DMET
Iron	RCSW7	1130		100	ug/l	24-JUN-93	90053005	DMET
Iron	RCSW8	653		100	ug/l	24-JUN-93	90053003	DMET
Iron	RCSW8A	785		100	ug/l	24-JUN-93	90053004	DMET
Iron	RCSW9	587		100	ug/l	24-JUN-93	90053002	DMET
Iron	RCSWR1	3830		100	ug/l	21-JUN-93	90049001	DMET
Iron	STCSW1	1470		100	ug/l	22-JUN-93	90050003	DMET
Iron	STCSW2	5800		100	ug/l	22-JUN-93	90050004	DMET
Iron	STCSW3	847		100	ug/l	22-JUN-93	90050002	DMET
Iron	STCSW4	1020		100	ug/l	22-JUN-93	90050001	DMET
Iron	STCSW5	1160	J	100	ug/l	29-JUN-93	90058005	DMET
Iron	STCSW5D	930	J	100	ug/l	29-JUN-93	90058006	DMET
Iron	STCSW6	432	J	100	ug/l	26-JUN-93	90055009	DMET
Iron	STCSW7	437	J	100	ug/l	26-JUN-93	90055008	DMET
Iron	STCSW8	439		100	ug/l	28-JUN-93	90057003	DMET
Iron	STCSWR1	381	J	100	ug/l	29-JUN-93	90058004	DMET
Iron	YWCSW1	336	J	100	ug/l	27-JUN-93	90056005	DMET
Iron	YWCSW2	384	J	100	ug/l	27-JUN-93	90056004	DMET
Iron	YWCSWR1	1070		100	ug/l	28-JUN-93	90057004	DMET
Lead	2SW2	3.3		5	ug/l	22-JUN-93	90050012	DMET
Lead	2SW2D	3.3		5	ug/l	22-JUN-93	90050013	DMET
Lead	5SW1	2.9	J	5	ug/l	25-JUN-93	90054007	DMET
Lead	5SW2	2.3	J	5	ug/l	25-JUN-93	90054005	DMET
Lead	5SW2D	2.8	J	5	ug/l	25-JUN-93	90054006	DMET
Lead	5SW4	6.4		5	ug/l	25-JUN-93	90054003	DMET
Lead	5SW5	1.2	J	5	ug/l	25-JUN-93	90054008	DMET
Lead	8SW1	4.7		5	ug/l	21-JUN-93	90049002	DMET
Lead	9SW1	1.6	J	5	ug/l	27-JUN-93	90056003	DMET
Lead	GCSW5	581	J	5	ug/l	30-JUN-93	90059004	DMET
Lead	GCSW5D	95.3	J	5	ug/l	30-JUN-93	90059005	DMET
Lead	LFSW6	7.8		5	ug/l	23-JUN-93	90052002	DMET
Lead	LFSW7	7.7		5	ug/l	23-JUN-93	90052001	DMET
Lead	RCSW1	3.4		5	ug/l	25-JUN-93	90054001	DMET
Lead	RCSW5	1.4	J	5	ug/l	27-JUN-93	90056001	DMET
Lead	RCSWR1	3.1		5	ug/l	21-JUN-93	90049001	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Lead	STCSW1	14.1		5	ug/l	22-JUN-93	90050003	DMET
Lead	STCSW2	118		5	ug/l	22-JUN-93	90050004	DMET
Magnesium	18SW1	1590	J	5000	ug/l	29-JUN-93	90058002	DMET
Magnesium	18SW2	1180	J	5000	ug/l	29-JUN-93	90058003	DMET
Magnesium	2SW1	1610	J	5000	ug/l	24-JUN-93	90053007	DMET
Magnesium	2SW2	1550	J	5000	ug/l	22-JUN-93	90050012	DMET
Magnesium	2SW2D	1540	J	5000	ug/l	22-JUN-93	90050013	DMET
Magnesium	2SW3	1620	J	5000	ug/l	24-JUN-93	90053008	DMET
Magnesium	5SW1	1020	J	5000	ug/l	25-JUN-93	90054007	DMET
Magnesium	5SW2	754	J	5000	ug/l	25-JUN-93	90054005	DMET
Magnesium	5SW2D	762	J	5000	ug/l	25-JUN-93	90054006	DMET
Magnesium	5SW3	626	J	5000	ug/l	25-JUN-93	90054004	DMET
Magnesium	5SW4	1400	J	5000	ug/l	25-JUN-93	90054003	DMET
Magnesium	5SW5	576	J	5000	ug/l	25-JUN-93	90054008	DMET
Magnesium	5SW6	2000	J	5000	ug/l	29-JUN-93	90058007	DMET
Magnesium	5SW7	2490	J	5000	ug/l	29-JUN-93	90058008	DMET
Magnesium	6SW1	2460	J	5000	ug/l	28-JUN-93	90057001	DMET
Magnesium	8SW1	1110	J	5000	ug/l	21-JUN-93	90049002	DMET
Magnesium	8SW2	1080	J	5000	ug/l	21-JUN-93	90049003	DMET
Magnesium	9SW1	894	J	5000	ug/l	27-JUN-93	90056003	DMET
Magnesium	GCSW1	2300	J	5000	ug/l	27-JUN-93	90056006	DMET
Magnesium	GCSW2	2810	J	5000	ug/l	26-JUN-93	90055002	DMET
Magnesium	GCSW3	2970	J	5000	ug/l	30-JUN-93	90059002	DMET
Magnesium	GCSW4	9760		5000	ug/l	30-JUN-93	90059003	DMET
Magnesium	GCSW5	41700	J	5000	ug/l	30-JUN-93	90059004	DMET
Magnesium	GCSW5D	8480	J	5000	ug/l	30-JUN-93	90059005	DMET
Magnesium	LFSW1	2850	J	5000	ug/l	23-JUN-93	90052009	DMET
Magnesium	LFSW2	2860	J	5000	ug/l	23-JUN-93	90052008	DMET
Magnesium	LFSW3	2830	J	5000	ug/l	23-JUN-93	90052005	DMET
Magnesium	LFSW4	2820	J	5000	ug/l	23-JUN-93	90052004	DMET
Magnesium	LFSW5	2740	J	5000	ug/l	23-JUN-93	90052003	DMET
Magnesium	LFSW6	2920	J	5000	ug/l	23-JUN-93	90052002	DMET
Magnesium	LFSW7	2850	J	5000	ug/l	23-JUN-93	90052001	DMET
Magnesium	LFSW8	2590	J	5000	ug/l	23-JUN-93	90052006	DMET
Magnesium	LFSW8D	2630	J	5000	ug/l	23-JUN-93	90052007	DMET
Magnesium	RCGCSW1	2140	J	5000	ug/l	26-JUN-93	90055005	DMET
Magnesium	RCGCSW1D	2110	J	5000	ug/l	26-JUN-93	90055006	DMET
Magnesium	RCGCSW2	2150	J	5000	ug/l	26-JUN-93	90055004	DMET
Magnesium	RCGCSW3	2600	J	5000	ug/l	26-JUN-93	90055003	DMET
Magnesium	RCGCSWR1	1850	J	5000	ug/l	28-JUN-93	90057005	DMET
Magnesium	RCSW1	2920	J	5000	ug/l	25-JUN-93	90054001	DMET
Magnesium	RCSW10	7530		5000	ug/l	28-JUN-93	90057002	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Magnesium	RCSW2	2990	J	5000	ug/l	25-JUN-93	90054002	DMET
Magnesium	RCSW3	9670		5000	ug/l	26-JUN-93	90055007	DMET
Magnesium	RCSW4	7240		5000	ug/l	27-JUN-93	90056002	DMET
Magnesium	RCSW5	7340		5000	ug/l	27-JUN-93	90056001	DMET
Magnesium	RCSW6	8390		5000	ug/l	24-JUN-93	90053006	DMET
Magnesium	RCSW7	8230		5000	ug/l	24-JUN-93	90053005	DMET
Magnesium	RCSW8	8550		5000	ug/l	24-JUN-93	90053003	DMET
Magnesium	RCSW8A	8390		5000	ug/l	24-JUN-93	90053004	DMET
Magnesium	RCSW9	8860		5000	ug/l	24-JUN-93	90053002	DMET
Magnesium	RCSWR1	1690	J	5000	ug/l	21-JUN-93	90049001	DMET
Magnesium	STCSW1	1190	J	5000	ug/l	22-JUN-93	90050003	DMET
Magnesium	STCSW2	2930	J	5000	ug/l	22-JUN-93	90050004	DMET
Magnesium	STCSW3	3290	J	5000	ug/l	22-JUN-93	90050002	DMET
Magnesium	STCSW4	3080	J	5000	ug/l	22-JUN-93	90050001	DMET
Magnesium	STCSW5	1560	J	5000	ug/l	29-JUN-93	90058005	DMET
Magnesium	STCSW5D	1580	J	5000	ug/l	29-JUN-93	90058006	DMET
Magnesium	STCSW6	2010	J	5000	ug/l	26-JUN-93	90055009	DMET
Magnesium	STCSW7	2030	J	5000	ug/l	26-JUN-93	90055008	DMET
Magnesium	STCSW8	3010	J	5000	ug/l	28-JUN-93	90057003	DMET
Magnesium	STCSWR1	1280	J	5000	ug/l	29-JUN-93	90058004	DMET
Magnesium	YWCSW1	1660	J	5000	ug/l	27-JUN-93	90056005	DMET
Magnesium	YWCSW2	2120	J	5000	ug/l	27-JUN-93	90056004	DMET
Magnesium	YWCSWR1	2650	J	5000	ug/l	28-JUN-93	90057004	DMET
Manganese	18SW1	72.9		15	ug/l	29-JUN-93	90058002	DMET
Manganese	18SW2	30.4		15	ug/l	29-JUN-93	90058003	DMET
Manganese	2SW1	106		15	ug/l	24-JUN-93	90053007	DMET
Manganese	2SW2	103		15	ug/l	22-JUN-93	90050012	DMET
Manganese	2SW2D	105		15	ug/l	22-JUN-93	90050013	DMET
Manganese	2SW3	101		15	ug/l	24-JUN-93	90053008	DMET
Manganese	5SW1	35.5		15	ug/l	25-JUN-93	90054007	DMET
Manganese	5SW2	9.1	J	15	ug/l	25-JUN-93	90054005	DMET
Manganese	5SW2D	9.4	J	15	ug/l	25-JUN-93	90054006	DMET
Manganese	5SW3	8	J	15	ug/l	25-JUN-93	90054004	DMET
Manganese	5SW4	9.1	J	15	ug/l	25-JUN-93	90054003	DMET
Manganese	5SW5	9.2	J	15	ug/l	25-JUN-93	90054008	DMET
Manganese	5SW6	41.6		15	ug/l	29-JUN-93	90058007	DMET
Manganese	5SW7	35.8		15	ug/l	29-JUN-93	90058008	DMET
Manganese	6SW1	36		15	ug/l	28-JUN-93	90057001	DMET
Manganese	8SW1	30.9		15	ug/l	21-JUN-93	90049002	DMET
Manganese	8SW2	16		15	ug/l	21-JUN-93	90049003	DMET
Manganese	9SW1	43.8		15	ug/l	27-JUN-93	90056003	DMET
Manganese	GCSW1	39.1		15	ug/l	27-JUN-93	90056006	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Manganese	GCSW3	68.5		15	ug/l	30-JUN-93	90059002	DMET
Manganese	GCSW5	1340	J	15	ug/l	30-JUN-93	90059004	DMET
Manganese	GCSW5D	225	J	15	ug/l	30-JUN-93	90059005	DMET
Manganese	LFSW4	7.6	J	15	ug/l	23-JUN-93	90052004	DMET
Manganese	LFSW6	19.1		15	ug/l	23-JUN-93	90052002	DMET
Manganese	LFSW7	12.9	J	15	ug/l	23-JUN-93	90052001	DMET
Manganese	LFSW8	8.6	J	15	ug/l	23-JUN-93	90052006	DMET
Manganese	LFSW8D	28.2		15	ug/l	23-JUN-93	90052007	DMET
Manganese	RCGCSW1	22.3		15	ug/l	26-JUN-93	90055005	DMET
Manganese	RCGCSW1D	20.1		15	ug/l	26-JUN-93	90055006	DMET
Manganese	RCGCSW2	19.6		15	ug/l	26-JUN-93	90055004	DMET
Manganese	RCGCSW3	18.6		15	ug/l	26-JUN-93	90055003	DMET
Manganese	RCGCSWR1	9.2	J	15	ug/l	28-JUN-93	90057005	DMET
Manganese	RCSW10	15.3		15	ug/l	28-JUN-93	90057002	DMET
Manganese	RCSW2	7.8	J	15	ug/l	25-JUN-93	90054002	DMET
Manganese	RCSW3	10.7	J	15	ug/l	26-JUN-93	90055007	DMET
Manganese	RCSW4	17.6		15	ug/l	27-JUN-93	90056002	DMET
Manganese	RCSW5	15.7		15	ug/l	27-JUN-93	90056001	DMET
Manganese	RCSW6	16.8		15	ug/l	24-JUN-93	90053006	DMET
Manganese	RCSW7	21.2		15	ug/l	24-JUN-93	90053005	DMET
Manganese	RCSW8	17.8		15	ug/l	24-JUN-93	90053003	DMET
Manganese	RCSW8A	19.2		15	ug/l	24-JUN-93	90053004	DMET
Manganese	RCSW9	16.2		15	ug/l	24-JUN-93	90053002	DMET
Manganese	RCSWR1	16.5		15	ug/l	21-JUN-93	90049001	DMET
Manganese	STCSW2	24.5		15	ug/l	22-JUN-93	90050004	DMET
Manganese	STCSW4	9.6	J	15	ug/l	22-JUN-93	90050001	DMET
Manganese	STCSW5	11.4	J	15	ug/l	29-JUN-93	90058005	DMET
Manganese	STCSW5D	9.8	J	15	ug/l	29-JUN-93	90058006	DMET
Manganese	STCSW8	7	J	15	ug/l	28-JUN-93	90057003	DMET
Manganese	YWCSW1	13.6	J	15	ug/l	27-JUN-93	90056005	DMET
Manganese	YWCSW2	8.6	J	15	ug/l	27-JUN-93	90056004	DMET
Manganese	YWCSWR1	11.6	J	15	ug/l	28-JUN-93	90057004	DMET
Mercury	GCSW5	1.7	J	0.2	ug/l	30-JUN-93	90059004	DMET
Mercury	GCSW5D	1.9	J	0.2	ug/l	30-JUN-93	90059005	DMET
Mercury	LFSW3	0.08	J	0.2	ug/l	23-JUN-93	90052005	DMET
Mercury	LFSW4	0.14	J	0.2	ug/l	23-JUN-93	90052004	DMET
Mercury	LFSW5	0.5		0.2	ug/l	23-JUN-93	90052003	DMET
Mercury	LFSW6	0.33		0.2	ug/l	23-JUN-93	90052002	DMET
Mercury	LFSW7	0.34		0.2	ug/l	23-JUN-93	90052001	DMET
Mercury	STCSW2	0.33		0.2	ug/l	22-JUN-93	90050004	DMET
Nickel	2SW2	12.8	J	40	ug/l	22-JUN-93	90050012	DMET
Nickel	GCSW1	9.3	J	40	ug/l	27-JUN-93	90056006	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Nickel	GCSW5	85.2	J	40	ug/l	30-JUN-93	90059004	DMET
Nickel	LFSW7	13	J	40	ug/l	23-JUN-93	90052001	DMET
Nickel	RCGCSW1D	9.8	J	40	ug/l	26-JUN-93	90055006	DMET
Nickel	STCSW2	10.5	J	40	ug/l	22-JUN-93	90050004	DMET
Potassium	18SW1	1690	J	5000	ug/l	29-JUN-93	90058002	DMET
Potassium	18SW2	2120	J	5000	ug/l	29-JUN-93	90058003	DMET
Potassium	5SW6	3700	J	5000	ug/l	29-JUN-93	90058007	DMET
Potassium	5SW7	3790	J	5000	ug/l	29-JUN-93	90058008	DMET
Potassium	6SW1	599	J	5000	ug/l	28-JUN-93	90057001	DMET
Potassium	8SW1	695	J	5000	ug/l	21-JUN-93	90049002	DMET
Potassium	9SW1	394	J	5000	ug/l	27-JUN-93	90056003	DMET
Potassium	GCSW1	2850	J	5000	ug/l	27-JUN-93	90056006	DMET
Potassium	GCSW2	866	J	5000	ug/l	26-JUN-93	90055002	DMET
Potassium	GCSW3	1490	J	5000	ug/l	30-JUN-93	90059002	DMET
Potassium	GCSW4	2000	J	5000	ug/l	30-JUN-93	90059003	DMET
Potassium	GCSW5	6680	J	5000	ug/l	30-JUN-93	90059004	DMET
Potassium	GCSW5D	746	J	5000	ug/l	30-JUN-93	90059005	DMET
Potassium	LFSW3	782		5000	ug/l	23-JUN-93	90052005	DMET
Potassium	LFSW4	646		5000	ug/l	23-JUN-93	90052004	DMET
Potassium	LFSW5	948		5000	ug/l	23-JUN-93	90052003	DMET
Potassium	LFSW6	961		5000	ug/l	23-JUN-93	90052002	DMET
Potassium	LFSW7	654	J	5000	ug/l	23-JUN-93	90052001	DMET
Potassium	LFSW8	508		5000	ug/l	23-JUN-93	90052006	DMET
Potassium	LFSW8D	462		5000	ug/l	23-JUN-93	90052007	DMET
Potassium	RCGCSW1	1120	J	5000	ug/l	26-JUN-93	90055005	DMET
Potassium	RCGCSW1D	790	J	5000	ug/l	26-JUN-93	90055006	DMET
Potassium	RCGCSW2	698	J	5000	ug/l	26-JUN-93	90055004	DMET
Potassium	RCGCSW3	1040	J	5000	ug/l	26-JUN-93	90055003	DMET
Potassium	RCGCSWR1	790	J	5000	ug/l	28-JUN-93	90057005	DMET
Potassium	RCSW10	3300	J	5000	ug/l	28-JUN-93	90057002	DMET
Potassium	RCSW3	4500	J	5000	ug/l	26-JUN-93	90055007	DMET
Potassium	RCSW4	3360	J	5000	ug/l	27-JUN-93	90056002	DMET
Potassium	RCSW5	3420	J	5000	ug/l	27-JUN-93	90056001	DMET
Potassium	RCSW6	4240	J	5000	ug/l	24-JUN-93	90053006	DMET
Potassium	RCSW7	4320	J	5000	ug/l	24-JUN-93	90053005	DMET
Potassium	RCSW8	4350		5000	ug/l	24-JUN-93	90053003	DMET
Potassium	RCSW8A	4550		5000	ug/l	24-JUN-93	90053004	DMET
Potassium	RCSW9	4620		5000	ug/l	24-JUN-93	90053002	DMET
Potassium	RCSWR1	450	J	5000	ug/l	21-JUN-93	90049001	DMET
Potassium	STCSW5	977	J	5000	ug/l	29-JUN-93	90058005	DMET
Potassium	STCSW5D	738	J	5000	ug/l	29-JUN-93	90058006	DMET
Potassium	STCSW6	825	J	5000	ug/l	26-JUN-93	90055009	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Potassium	STCSW7	448	J	5000	ug/l	26-JUN-93	90055008	DMET
Potassium	STCSW8	1290	J	5000	ug/l	28-JUN-93	90057003	DMET
Potassium	STCSWR1	1560	J	5000	ug/l	29-JUN-93	90058004	DMET
Potassium	YWCSW1	1320	J	5000	ug/l	27-JUN-93	90056005	DMET
Potassium	YWCSW2	1320	J	5000	ug/l	27-JUN-93	90056004	DMET
Potassium	YWCSWR1	636	J	5000	ug/l	28-JUN-93	90057004	DMET
Selenium	8SW2	2.3	J	5	ug/l	21-JUN-93	90049003	DMET
Selenium	GCSW5	4.4	J	5	ug/l	30-JUN-93	90059004	DMET
Selenium	STCSW8	1.8	J	5	ug/l	28-JUN-93	90057003	DMET
Silver	GCSW5	10.6	J	10	ug/l	30-JUN-93	90059004	DMET
Silver	GCSW5D	0.82	J	10	ug/l	30-JUN-93	90059005	DMET
Silver	RCSW3	0.24	J	10	ug/l	26-JUN-93	90055007	DMET
Silver	RCSW4	0.19	J	10	ug/l	27-JUN-93	90056002	DMET
Silver	STCSW2	0.35	J	10	ug/l	22-JUN-93	90050004	DMET
Sodium	18SW1	4450	J	5000	ug/l	29-JUN-93	90058002	DMET
Sodium	18SW2	3960	J	5000	ug/l	29-JUN-93	90058003	DMET
Sodium	2SW1	4260	J	5000	ug/l	24-JUN-93	90053007	DMET
Sodium	2SW2	3920	J	5000	ug/l	22-JUN-93	90050012	DMET
Sodium	2SW2D	3990	J	5000	ug/l	22-JUN-93	90050013	DMET
Sodium	2SW3	4250	J	5000	ug/l	24-JUN-93	90053008	DMET
Sodium	5SW1	5760		5000	ug/l	25-JUN-93	90054007	DMET
Sodium	5SW2	4640	J	5000	ug/l	25-JUN-93	90054005	DMET
Sodium	5SW2D	4640	J	5000	ug/l	25-JUN-93	90054006	DMET
Sodium	5SW3	4720	J	5000	ug/l	25-JUN-93	90054004	DMET
Sodium	5SW4	6310		5000	ug/l	25-JUN-93	90054003	DMET
Sodium	5SW5	5220		5000	ug/l	25-JUN-93	90054008	DMET
Sodium	5SW6	26500	J	5000	ug/l	29-JUN-93	90058007	DMET
Sodium	5SW7	18200	J	5000	ug/l	29-JUN-93	90058008	DMET
Sodium	6SW1	5830		5000	ug/l	28-JUN-93	90057001	DMET
Sodium	8SW1	2430	J	5000	ug/l	21-JUN-93	90049002	DMET
Sodium	8SW2	2300	J	5000	ug/l	21-JUN-93	90049003	DMET
Sodium	9SW1	2060	J	5000	ug/l	27-JUN-93	90056003	DMET
Sodium	GCSW1	4330	J	5000	ug/l	27-JUN-93	90056006	DMET
Sodium	GCSW2	6680		5000	ug/l	26-JUN-93	90055002	DMET
Sodium	GCSW3	3580	J	5000	ug/l	30-JUN-93	90059002	DMET
Sodium	GCSW4	4550	J	5000	ug/l	30-JUN-93	90059003	DMET
Sodium	GCSW5	5600	J	5000	ug/l	30-JUN-93	90059004	DMET
Sodium	GCSW5D	3270	J	5000	ug/l	30-JUN-93	90059005	DMET
Sodium	LFSW1	6850		5000	ug/l	23-JUN-93	90052009	DMET
Sodium	LFSW2	6940		5000	ug/l	23-JUN-93	90052008	DMET
Sodium	LFSW3	6790		5000	ug/l	23-JUN-93	90052005	DMET
Sodium	LFSW4	6710		5000	ug/l	23-JUN-93	90052004	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Sodium	LFSW5	6490		5000	ug/l	23-JUN-93	90052003	DMET
Sodium	LFSW6	7070		5000	ug/l	23-JUN-93	90052002	DMET
Sodium	LFSW7	7570		5000	ug/l	23-JUN-93	90052001	DMET
Sodium	LFSW8	6670		5000	ug/l	23-JUN-93	90052006	DMET
Sodium	LFSW8D	6620		5000	ug/l	23-JUN-93	90052007	DMET
Sodium	RCGCSW1	7780		5000	ug/l	26-JUN-93	90055005	DMET
Sodium	RCGCSW1D	7640		5000	ug/l	26-JUN-93	90055006	DMET
Sodium	RCGCSW2	7930		5000	ug/l	26-JUN-93	90055004	DMET
Sodium	RCGCSW3	8150		5000	ug/l	26-JUN-93	90055003	DMET
Sodium	RCGCSWR1	7320		5000	ug/l	28-JUN-93	90057005	DMET
Sodium	RCSW1	7020		5000	ug/l	25-JUN-93	90054001	DMET
Sodium	RCSW10	18400		5000	ug/l	28-JUN-93	90057002	DMET
Sodium	RCSW2	7240		5000	ug/l	25-JUN-93	90054002	DMET
Sodium	RCSW3	27200		5000	ug/l	26-JUN-93	90055007	DMET
Sodium	RCSW4	20700		5000	ug/l	27-JUN-93	90056002	DMET
Sodium	RCSW5	21200		5000	ug/l	27-JUN-93	90056001	DMET
Sodium	RCSW6	23100		5000	ug/l	24-JUN-93	90053006	DMET
Sodium	RCSW7	22500		5000	ug/l	24-JUN-93	90053005	DMET
Sodium	RCSW8	24100		5000	ug/l	24-JUN-93	90053003	DMET
Sodium	RCSW8A	23300		5000	ug/l	24-JUN-93	90053004	DMET
Sodium	RCSW9	25400		5000	ug/l	24-JUN-93	90053002	DMET
Sodium	RCSWR1	6810		5000	ug/l	21-JUN-93	90049001	DMET
Sodium	STCSW1	3120	J	5000	ug/l	22-JUN-93	90050003	DMET
Sodium	STCSW2	4010	J	5000	ug/l	22-JUN-93	90050004	DMET
Sodium	STCSW3	5200		5000	ug/l	22-JUN-93	90050002	DMET
Sodium	STCSW4	4800	J	5000	ug/l	22-JUN-93	90050001	DMET
Sodium	STCSW5	3020	J	5000	ug/l	29-JUN-93	90058005	DMET
Sodium	STCSW5D	3160	J	5000	ug/l	29-JUN-93	90058006	DMET
Sodium	STCSW6	3940	J	5000	ug/l	26-JUN-93	90055009	DMET
Sodium	STCSW7	3840	J	5000	ug/l	26-JUN-93	90055008	DMET
Sodium	STCSW8	7060		5000	ug/l	28-JUN-93	90057003	DMET
Sodium	STCSWR1	2980	J	5000	ug/l	29-JUN-93	90058004	DMET
Sodium	YWCSW1	3030	J	5000	ug/l	27-JUN-93	90056005	DMET
Sodium	YWCSW2	4210	J	5000	ug/l	27-JUN-93	90056004	DMET
Sodium	YWCSWR1	4650	J	5000	ug/l	28-JUN-93	90057004	DMET
Thallium	STCSW5	1.9	J	10	ug/l	29-JUN-93	90058005	DMET
Vanadium	5SW1	44.3	J	50	ug/l	25-JUN-93	90054007	DMET
Vanadium	5SW2	6.5	J	50	ug/l	25-JUN-93	90054005	DMET
Vanadium	5SW2D	7.3	J	50	ug/l	25-JUN-93	90054006	DMET
Vanadium	5SW4	2.5	J	50	ug/l	25-JUN-93	90054003	DMET
Vanadium	9SW1	7.9	J	50	ug/l	27-JUN-93	90056003	DMET
Vanadium	GCSW5	174	J	50	ug/l	30-JUN-93	90059004	DMET

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Vanadium	RCGCSW1	3.7	J	50	ug/l	26-JUN-93	90055005	DMET
Vanadium	RCSW1	3	J	50	ug/l	25-JUN-93	90054001	DMET
Vanadium	STCSW2	22.4	J	50	ug/l	22-JUN-93	90050004	DMET
Zinc	18SW1	32.8		20	ug/l	29-JUN-93	90058002	DMET
Zinc	18SW2	16.8	J	20	ug/l	29-JUN-93	90058003	DMET
Zinc	2SW2	15.4	J	20	ug/l	22-JUN-93	90050012	DMET
Zinc	2SW2D	18.1	J	20	ug/l	22-JUN-93	90050013	DMET
Zinc	5SW1	38.7		20	ug/l	25-JUN-93	90054007	DMET
Zinc	5SW2	14.9	J	20	ug/l	25-JUN-93	90054005	DMET
Zinc	5SW4	27.2		20	ug/l	25-JUN-93	90054003	DMET
Zinc	5SW5	40.7		20	ug/l	25-JUN-93	90054008	DMET
Zinc	5SW6	45.4		20	ug/l	29-JUN-93	90058007	DMET
Zinc	5SW7	45.7		20	ug/l	29-JUN-93	90058008	DMET
Zinc	6SW1	26.2		20	ug/l	28-JUN-93	90057001	DMET
Zinc	9SW1	12.3	J	20	ug/l	27-JUN-93	90056003	DMET
Zinc	GCSW1	9	J	20	ug/l	27-JUN-93	90056006	DMET
Zinc	GCSW3	38.6		20	ug/l	30-JUN-93	90059002	DMET
Zinc	GCSW4	21		20	ug/l	30-JUN-93	90059003	DMET
Zinc	GCSW5	8350	J	20	ug/l	30-JUN-93	90059004	DMET
Zinc	GCSW5D	642	J	20	ug/l	30-JUN-93	90059005	DMET
Zinc	LFSW5	9.5	J	20	ug/l	23-JUN-93	90052003	DMET
Zinc	LFSW6	24.5		20	ug/l	23-JUN-93	90052002	DMET
Zinc	LFSW7	30.3		20	ug/l	23-JUN-93	90052001	DMET
Zinc	RCSW4	17.2	J	20	ug/l	27-JUN-93	90056002	DMET
Zinc	RCSW5	14.4	J	20	ug/l	27-JUN-93	90056001	DMET
Zinc	RCSW6	15.4	J	20	ug/l	24-JUN-93	90053006	DMET
Zinc	RCSW7	24.7		20	ug/l	24-JUN-93	90053005	DMET
Zinc	RCSW8	17.1	J	20	ug/l	24-JUN-93	90053003	DMET
Zinc	RCSW8A	17.5	J	20	ug/l	24-JUN-93	90053004	DMET
Zinc	RCSW9	22.7		20	ug/l	24-JUN-93	90053002	DMET
Zinc	STCSW1	68.4		20	ug/l	22-JUN-93	90050003	DMET
Zinc	STCSW2	557		20	ug/l	22-JUN-93	90050004	DMET
Zinc	STCSW3	25.7		20	ug/l	22-JUN-93	90050002	DMET
Zinc	STCSW4	25.4		20	ug/l	22-JUN-93	90050001	DMET
Zinc	STCSWR1	18.4	J	20	ug/l	29-JUN-93	90058004	DMET
Zinc	YWCSW1	22		20	ug/l	27-JUN-93	90056005	DMET
Zinc	YWCSW2	5.8	J	20	ug/l	27-JUN-93	90056004	DMET
Nitrate/Nitrite	RCGCSW1	0.02		0.02	mg/l	17-AUG-93	90096004	EH2O
Nitrate/Nitrite	RCGCSW2	0.03		0.02	mg/l	17-AUG-93	90096003	EH2O
Nitrate/Nitrite	RCGCSW3	0.02		0.02	mg/l	17-AUG-93	90096005	EH2O
Nitrate/Nitrite	RCSW1	0.02		0.02	mg/l	18-AUG-93	90096017	EH2O
Nitrate/Nitrite	RCSW3	3.7		0.02	mg/l	18-AUG-93	90096020	EH2O

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Nitrate/Nitrite	RCSW4	2.26		0.02	mg/l	18-AUG-93	90096009	EH20
Nitrate/Nitrite	RCSW5	2.31		0.02	mg/l	18-AUG-93	90096013	EH20
Nitrate/Nitrite	RCSW7	2.32		0.02	mg/l	18-AUG-93	90096012	EH20
Nitrate/Nitrite	RCSW8	2.45		0.02	mg/l	18-AUG-93	90096011	EH20
Nitrate/Nitrite	RCSW9	2.26		0.02	mg/l	18-AUG-93	90096010	EH20
Nitrate/Nitrite	STCSW2	0.03		0.02	mg/l	18-AUG-93	90096007	EH20
Total Keljdahl Nitrogen	GCSW2	0.71		0.04	mg/l	17-AUG-93	90096006	EH20
Total Keljdahl Nitrogen	LFSW1	0.64		0.04	mg/l	18-AUG-93	90096018	EH20
Total Keljdahl Nitrogen	LFSW6	0.63		0.04	mg/l	18-AUG-93	90096019	EH20
Total Keljdahl Nitrogen	RCGCSW1	0.29		0.04	mg/l	17-AUG-93	90096004	EH20
Total Keljdahl Nitrogen	RCGCSW2	0.4		0.04	mg/l	17-AUG-93	90096003	EH20
Total Keljdahl Nitrogen	RCGCSW3	0.89		0.04	mg/l	17-AUG-93	90096005	EH20
Total Keljdahl Nitrogen	RCSW1	0.54		0.04	mg/l	18-AUG-93	90096017	EH20
Total Keljdahl Nitrogen	RCSW3	1.4		0.04	mg/l	18-AUG-93	90096020	EH20
Total Keljdahl Nitrogen	RCSW4	1.33		0.04	mg/l	18-AUG-93	90096009	EH20
Total Keljdahl Nitrogen	RCSW5	1.32		0.04	mg/l	18-AUG-93	90096013	EH20
Total Keljdahl Nitrogen	RCSW7	1.44		0.04	mg/l	18-AUG-93	90096012	EH20
Total Keljdahl Nitrogen	RCSW8	1.28		0.04	mg/l	18-AUG-93	90096011	EH20
Total Keljdahl Nitrogen	RCSW9	1.44		0.04	mg/l	18-AUG-93	90096010	EH20
Total Keljdahl Nitrogen	STCSW1	1.62		0.04	mg/l	18-AUG-93	90096008	EH20
Total Keljdahl Nitrogen	STCSW2	0.78		0.04	mg/l	18-AUG-93	90096007	EH20
Total Keljdahl Nitrogen	STCSW5	0.65		0.04	mg/l	18-AUG-93	90096014	EH20
Total Keljdahl Nitrogen	STCSW6	0.22		0.04	mg/l	18-AUG-93	90096015	EH20
Total Nitrogen	GCSW2	0.71		0	mg/l	17-AUG-93	90096006	EH20
Total Nitrogen	LFSW1	0.64		0	mg/l	18-AUG-93	90096018	EH20
Total Nitrogen	LFSW6	0.63		0	mg/l	18-AUG-93	90096019	EH20
Total Nitrogen	RCGCSW1	0.31		0	mg/l	17-AUG-93	90096004	EH20
Total Nitrogen	RCGCSW2	0.43		0	mg/l	17-AUG-93	90096003	EH20
Total Nitrogen	RCGCSW3	0.91		0	mg/l	17-AUG-93	90096005	EH20
Total Nitrogen	RCSW1	0.54		0	mg/l	18-AUG-93	90096017	EH20
Total Nitrogen	RCSW3	5.1		0	mg/l	18-AUG-93	90096020	EH20
Total Nitrogen	RCSW4	3.59		0	mg/l	18-AUG-93	90096009	EH20
Total Nitrogen	RCSW5	3.63		0	mg/l	18-AUG-93	90096013	EH20
Total Nitrogen	RCSW7	3.76		0	mg/l	18-AUG-93	90096012	EH20
Total Nitrogen	RCSW8	3.73		0	mg/l	18-AUG-93	90096011	EH20
Total Nitrogen	RCSW9	3.7		0	mg/l	18-AUG-93	90096010	EH20
Total Nitrogen	STCSW1	1.62		0	mg/l	18-AUG-93	90096008	EH20
Total Nitrogen	STCSW2	0.81		0	mg/l	18-AUG-93	90096007	EH20
Total Nitrogen	STCSW5	0.65		0	mg/l	18-AUG-93	90096014	EH20
Total Nitrogen	STCSW6	0.22		0	mg/l	18-AUG-93	90096015	EH20
Total Phosphorous	GCSW2	0.04		0.01	mg/l	17-AUG-93	90096006	EH20
Total Phosphorous	LFSW1	0.03		0.01	mg/l	18-AUG-93	90096018	EH20

Appendix B-4 - Surface Water Data
(Sorted by Chemical Type and Chemical Name)

Chemical Name	Sample Identifier	Result	Qualifier	Required Detection Limit	Units	Sample Date	Laboratory Identifier	Chemical Type
Total Phosphorous	LFSW6	0.05		0.01	mg/l	18-AUG-93	90096019	EH20
Total Phosphorous	RCGCSW1	0.03		0.01	mg/l	17-AUG-93	90096004	EH20
Total Phosphorous	RCGCSW2	0.04		0.01	mg/l	17-AUG-93	90096003	EH20
Total Phosphorous	RCGCSW3	0.06		0.01	mg/l	17-AUG-93	90096005	EH20
Total Phosphorous	RCSW1	0.02		0.01	mg/l	18-AUG-93	90096017	EH20
Total Phosphorous	RCSW3	1.27		0.01	mg/l	18-AUG-93	90096020	EH20
Total Phosphorous	RCSW4	0.6		0.01	mg/l	18-AUG-93	90096009	EH20
Total Phosphorous	RCSW5	0.64		0.01	mg/l	18-AUG-93	90096013	EH20
Total Phosphorous	RCSW7	0.64		0.01	mg/l	18-AUG-93	90096012	EH20
Total Phosphorous	RCSW8	0.61		0.01	mg/l	18-AUG-93	90096011	EH20
Total Phosphorous	RCSW9	0.61		0.01	mg/l	18-AUG-93	90096010	EH20
Total Phosphorous	STCSW1	0.06		0.01	mg/l	18-AUG-93	90096008	EH20
Total Phosphorous	STCSW2	0.16		0.01	mg/l	18-AUG-93	90096007	EH20
Total Phosphorous	STCSW5	0.2		0.01	mg/l	18-AUG-93	90096014	EH20
Total Phosphorous	STCSW6	0.02		0.01	mg/l	18-AUG-93	90096015	EH20

Notes:
J = qualified as estimated
AVOL = volatile organics
BSVO = semivolatile organics
CPES = pesticides and polychlorinated biphenyls
DMET = inorganics
ug/l = micrograms per liter

APPENDIX C

APPENDIX C

BIOLOGICAL STUDIES AT NAS CECIL FIELD

APPENDIX C

BIOLOGICAL STUDIES AT NAS CECIL FIELD

This appendix lists the references available for each of the biological studies that have been completed at Naval Air Station Cecil Field. The type of study and report content is described below each of the references. Studies are listed in chronological order.

A matrix showing the types of studies completed for the OUs and PSCs at NAS Cecil Field is depicted in Table C-1. A timeline of the biological studies completed at the facility is shown on Figure C-1.

1. Southeastern Environmental Laboratories (SEL), 1991, Lake Fretwell Fish Analysis, Naval Air Station Cecil Field, Jacksonville, Florida, prepared by SEL and NAS Cecil Field Public Works Division, May.

   This document summarizes the results of the 1991 fish sampling effort in Lake Fretwell at NAS Cecil Field. Fish samples were collected by NAS Cecil Field's Public Works Division and shipped to SEL for analysis.

2. Environmental Consulting & Technology, Inc. (ECT), 1992, Final Report on the Aquatic Macroinvertebrate and Fisheries Sampling of Rowell Creek, Naval Air Station Cecil Field, Duval County, Florida, prepared for ABB Environmental Services, Inc. (ABB-ES), December.

   This report summarizes the results of the December 1991 macroinvertebrate and fisheries sampling effort in Rowell Creek at NAS Cecil Field. The objectives of macroinvertebrate and fisheries sampling were to identify and inventory the local fauna, to develop representative species lists for the various water bodies at NAS Cecil Field, and to characterize the diversity of resident populations. Samples were collected from six biological sampling stations at Rowell Creek.

3. CDM Federal Programs, Inc. (CDM), 1993, Wetlands Delineation, Potential Source of Contamination No. 1 Study Area, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, November.

   This document summarizes the results of the wetlands delineation at OU 1 (Site 1) at NAS Cecil Field. Wetlands were identified in accordance with Federal and State of Florida guidelines.

4. CDM, 1993, Wetlands Delineation, Potential Source of Contamination No. 2 Study Area, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, November.

   This document summarizes the results of the wetlands delineation at OU 1 (Site 2) at NAS Cecil Field. Wetlands were identified in accordance with Federal and State of Florida guidelines.

TABLE C-1
NAS CECIL FIELD ECOLOGICAL INVESTIGATION MATRIX

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

	A	B	C	D	E	F	G	H	I	J	K	L			M	N	O	P	Q	R	S	T
												1	2	3								
Operable Unit 1																						
Site 1	X		X		X	X		X				X	X	X	X	X	X	X	X	X	X	
Site 2	X		X		X	X						X		X	X	X	X	X	X	X	X	
Operable Unit 2																						
Site 5	X	X	X		X	X						X		X	X	X	X	X	X	X	X	IP
Site 17	X	X	X															X	X	X	X	IP
Operable Unit 7																						
Site 16					X	X		X				X	X	X	X	X	X	X	X	X	X	IP
Operable Unit 8																						
Site 3	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	
Operable Unit 3																						
Site 7																						
Site 8												X		X	X							
Operable Unit 4																						
Site 10																						
Operable Unit 5																						
Site 14																						
Site 15	X		X																			
Operable Unit 6																						
Site 11								X				X	X	X								IP
Lake Fretwell						X	X		X			X	X	X	X	X	X				X	

KEY

A = Soil toxicity test -- Earthworm, *Eisenia foetida*
B = Earthworm tissue analyses
C = Soil toxicity test -- Lettuce seed, *Lactuca sativa*
D = Plant tissue analyses
E = Sediment toxicity test -- Water flea, *Ceriodaphnia dubia*
F = Sediment toxicity test -- Amphipod, *Hyallela azteca*
G = Sediment toxicity test -- Midge larvae, *Chironomus tentans*
H = Fish sample (qualitative)
I = Fish sampling and analysis (quantitative)
J = Groundwater toxicity test -- Water flea, *Ceriodaphnia dubia*
K = Groundwater toxicity test -- Fathead minnow, *Pimephales promelas*
L = Benthic macroinvertebrate sample and community analysis
    1 = ponar dredge
    2 = Hester-Dendy
    3 = dip nets
M = Water quality parameters
N = Surface water samples
O = Sediment samples
P = Soil samples
Q = Groundwater samples
R = Wetland delineation
S = Ecological Risk Assessment
T = Remedial Action or Interim Remedial Action

X = Work completed
IP = Work in progress

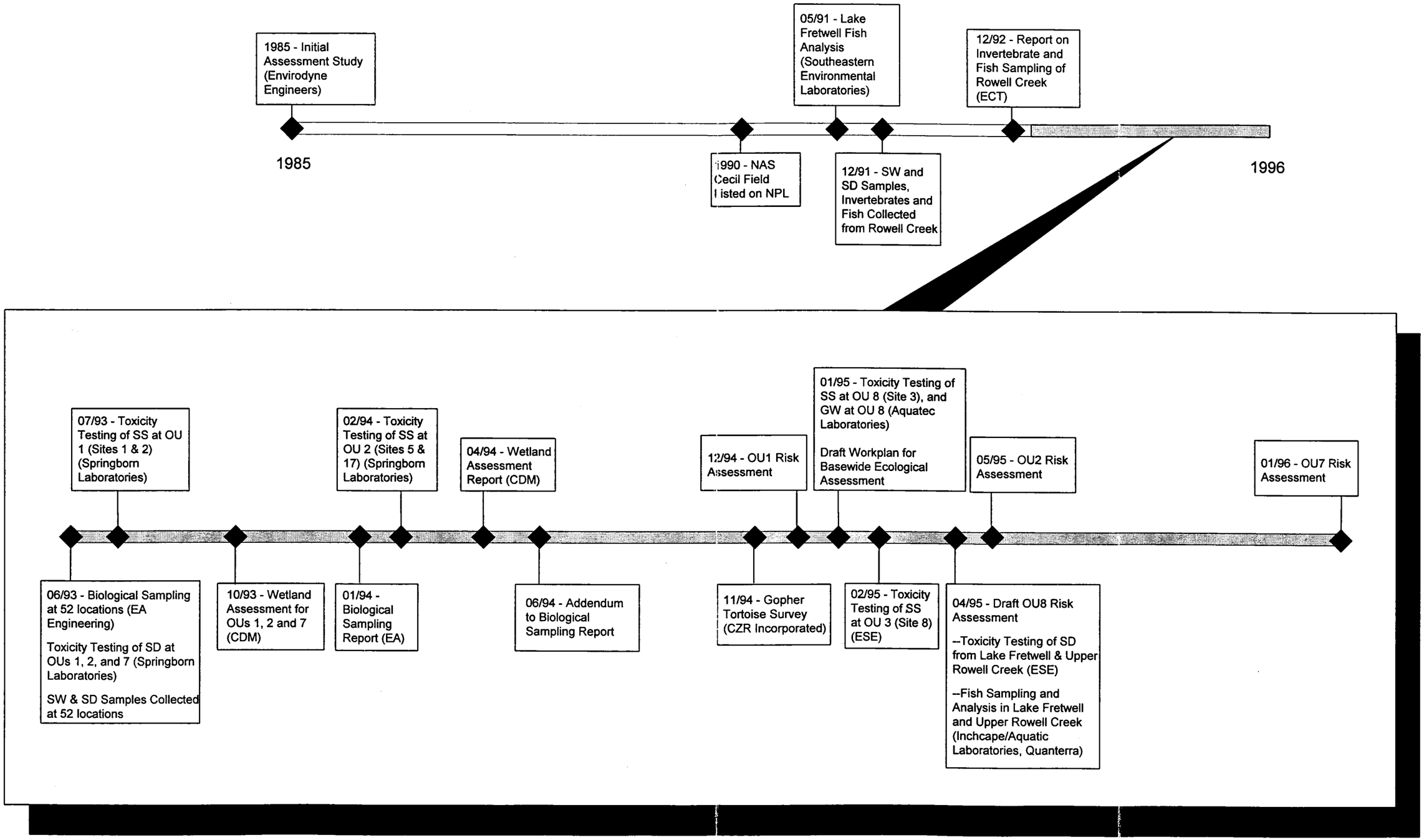

Figure C-1
Timeline of Biological Studies

Baseline Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

1-2

5. CDM, 1993, Wetlands Delineation, Potential Source of Contamination No. 3 Study Area, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, November.

This document summarizes the results of the wetlands delineation at OU 8 (Site 3) at NAS Cecil Field. Wetlands were identified in accordance with Federal and State of Florida guidelines.

6. CDM, 1993, Wetlands Delineation, Potential Source of Contamination No. 4 Study Area, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, November.

This document summarizes the results of the wetlands delineation at OU 2 (Site 4) at NAS Cecil Field. Wetlands were identified in accordance with Federal and State of Florida guidelines.

7. CDM, 1993, Wetlands Delineation, Potential Source of Contamination No. 5 Study Area, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, November.

This document summarizes the results of the wetlands delineation at OU 2 (Site 5) at NAS Cecil Field. Wetlands were identified in accordance with Federal and State of Florida guidelines.

8. CDM, 1993, Wetlands Delineation, Potential Source of Contamination No. 17 Study Area, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, November.

This document summarizes the results of the wetlands delineation at OU 2 (Site 17) at NAS Cecil Field. Wetlands were identified in accordance with Federal and State of Florida guidelines.

9. CDM, 1993, Wetland Report, Potential Sources of Contamination Nos. 1, 2, 3, 4, 5, & 17 Study Areas, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, November.

This report summarizes the results of the wetlands assessment performed for wetlands identified at OUs 1, 2, and 8 (Sites 1, 2, 3, 4, 5, and 17). Wetlands were identified and characterized, and functional assessments of the wetlands are included in the report.

10. CDM, 1993, Terrestrial Habitat Mapping of Potential Sources of Contamination Nos. 1, 2, 3, 4, 5, 16 & 17 Study Areas, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, November.

This report identifies terrestrial wildlife habitats at OUs 1, 2, 7, and 8 (Sites 1, 2, 3, 4, 5, 16, and 17) at NAS Cecil Field. Habitats are shown on several maps.

11. EA Engineering, Science, and Technology, 1994, Aquatic Biological Sampling Services Conducted at Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, January.

This document summarizes the results of the June 1993 aquatic biological sampling over several streams and lakes at NAS Cecil Field. The objectives of sampling were to characterize aquatic habitats and to collect macroinvertebrates and fish. Biological sampling was conducted at several stations in Rowell Creek, Sal Taylor Creek, Yellow Water Creek, Lake Fretwell, and tributaries to these water bodies. Reference locations as well as locations where OU or PSC activity may have impacted aquatic habitat were sampled. This report focuses on data collected from Rowell Creek, the Rowell Creek golf course reference station, Sal Taylor Creek, and the Site 2 area.

12. CDM, 1994, Wetlands Assessment, Wetland Delineation and Terrestrial Habitat Mapping at Operable Units 1, 2, and 7, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, April.

This document summarizes the overall results of an effort in 1993-94 to assess and delineate wetlands and to map terrestrial habitats at OUs 1, 2, 7, and 8 (Sites 1, 2, 3, 4, 5, 16, and 17) at NAS Cecil Field. Wetlands were identified in accordance with Federal and State of Florida guidelines. Wetland plant communities and upland plant communities were described according to classification systems available from the Florida Natural Areas Inventory (FNAI) and the U.S. Fish and Wildlife Service (USFWS). The functional assessments of the wetlands identified at these OUs were completed using a computer model called the Wetland Evaluation Technique (WET). Terrestrial wildlife habitats identified at the OUs are shown on several maps.

13. Springborn Laboratories, 1994, Toxicity Evaluation of the Sediment and Soil from the Cecil Field Naval Air Station in Jacksonville, Florida: SLI report 93-07-4874, prepared for ABB-ES, March.

This document summarizes the results of the 1993 toxicity testing of sediment and surface soil at OU 2 (Sites 5 and 17) at NAS Cecil Field. Tests completed for sediment samples were short-term chronic toxicity tests with water fleas (C. dubia) and acute toxicity tests with amphipods (H. azteca). Tests completed for soil samples were 14-day subacute toxicity tests with earthworms (E. foetida) and 120-hour germination toxicity tests with lettuce seeds (L. sativa).

14. EA Engineering, Science, and Technology, Inc., 1994, Addendum to Aquatic Biological Sampling Services Conducted at Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, June.

This document summarizes the results of the June 1993 aquatic biological sampling over several streams and lakes at NAS Cecil Field. The objectives of sampling were to characterize aquatic habitats and to collect macroinvertebrates and fish. Biological sampling was conducted at several stations in Rowell Creek, Sal Taylor Creek, Yellow Water Creek, Lake Fretwell, and tributaries to these water bodies. Reference locations as well as locations where OU or PSC activity may have impacted aquatic habitat were sampled. This report focuses on data collected at the remaining stations that were not discussed at length in EA's January 1994 document.

15. CZR Incorporated, 1994, Cecil Field Gopher Tortoise Survey and Management Plan, Naval Air Station Cecil Field, Jacksonville, Florida, November.

This document presents the results of a gopher tortoise field survey completed at NAS Cecil Field in 1994. Gopher tortoise populations were studied to identify suitable habitat, to estimate population numbers, to determine management areas and develop management recommendations, and to determine the existence of other endangered, threatened, or special concern species at four NAS Cecil Field facilities: Cecil Field, the Yellow Water Weapons Complex, Outlying Landing Field Whitehouse, and Rodman Bomb Target. Potential tortoise habitat was identified and surveyed; burrows were classified and mapped; and flora and fauna observations were recorded in field notes in this report.

16. Inchcape Testing Services/Aquatec Laboratories, 1995, Results of Groundwater and Soil Toxicity Tests Completed on Samples from Cecil Field Naval Air Station, Jacksonville, Florida: prepared for ABB-ES, February.

    This document summarizes the results of toxicity testing of 9 surface soil and 2 groundwater samples collected at OU 8 (Site 3) in November 1994. Tests completed for surface soil samples were 5-day lettuce seed (L. sativa) germination tests and 28-day earthworm (E. foetida) survival tests. Tests completed for groundwater samples were chronic toxicity tests for the water flea (C. dubia) and the fathead minnow (P. promelas).

17. Inchcape Testing Services/Aquatec Laboratories, 1995, Fish Collection Forms and Laboratory Bench Sheets, Fish Sampling Program for Lake Fretwell and Upper Rowell Creek, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, May.

    This package summarizes the <u>non-analytical</u> data collected during the April 1995 fish sampling effort at Lake Fretwell and upper Rowell Creek. The overall objective of the fish sampling effort was to determine the concentrations of contaminants present in the tissue of fish that are prey for other wildlife, in order to assess the latter's potential exposure to contaminants present in Lake Fretwell and upper Rowell Creek. The fish collection forms indicate the time, date, sample location, and depths at which fish were collected. The laboratory bench sheets contain the following information: species of fish collected; number of each type of species collected at each location; fish weight; total length of fish; and other remarks such as presence of parasites, lesions, deformities, or other abnormalities that were observed during fish sampling and inspection.

18. Quanterra Laboratories, 1995, Analytical Data from Tissue Samples from Whole Fish and Fish Fillets, Fish Sampling Program for Lake Fretwell and Upper Rowell Creek, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, May.

    This package summarizes the analytical data collected during the April 1995 fish sampling effort at Lake Fretwell and Upper Rowell Creek. Tissues from both whole fish and fish fillets were analyzed for metals, pesticides, and PCBs.

19. Environmental Science and Engineering, 1995, Toxicity Analysis of Sediment Samples from Lake Fretwell, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, July.

This document summarizes the results of toxicity testing of 13 sediment samples that were collected from Lake Fretwell in April 1995. The tests performed were whole sediment bioassays for 14-day survival and growth of two invertebrate species, amphipods (H. azteca) and (C. tentans).

20. ESE, 1995, Toxicity Analysis of Soil Samples from Site 15, Naval Air Station Cecil Field, Jacksonville, Florida: prepared for ABB-ES, December.

This document summarizes the results of toxicity testing of six soil samples that were collected from Site 15 in July and August 1995. The tests performed were whole soil and definitive (dilution-series) bioassays for 30-day survival and growth of earthworms (E. foetida) and 5-day germination tests with lettuce seeds (L. sativa).

APPENDIX D

APPENDIX D

SUPPORTING ECOLOGICAL INFORMATION FOR LAKE FRETWELL RISK ASSESSMENT

APPENDIX D-1

SURFACE WATER/SEDIMENT SPREADSHEETS FOR LAKE FRETWELL

Appendix D-1
Exposure Parameters and Assumptions for Representative Wildlife Species at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Representative Wildlife Species		Percent Prey in Diet [a]			Home Range [a]		Site Foraging	Food Ingestion Rate [a]	Water Ingestion Rate [a]	Body Weight [a]
		Aquatic Organisms	Plants	Sediment	(acres)	ED [b]	Frequency [c]	(kg/day)	(l/day)	(kg)
Florida water rat	(Small Omniv. Mammal)	8%	90%	2%	0.42	1.0	1.00E+00	0.027	0.037	0.33
Kingfisher	(Piscivorous bird)	93%	0%	7%	35	1.0	1.00E+00	0.014	0.0165	0.15
Great blue heron	(Piscivorous bird)	98%	0%	2%	1.5	1.0	1.00E+00	0.401	0.10	2.23
Raccoon	(Piscivorous Mammal)	93%	0%	7%	385	1.0	1.00E+00	0.214	0.34	3.99

NOTES:
[a] From Table 7.5.
[b] ED = Exposure Duration (percentage of year receptor is expected to be found at study area)
[c] SFF = Site Foraging Frequency (calculated by dividing site area by receptor home range and multiplying by exposure duration (cannot exceed 1.0)).

Appendix D-1

Estimation of ECPC Exposure Concentrations for Representative Wildlife Species at Lake Fretwell
Maximum Surface Water and Sediment Concentrations
Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA

ECPC	MAXIMUM SEDIMENT CONCENTRATION [a] (mg/kg)	MAX. SURFACE WATER CONCENTRATION [b] [mg/l]
Acetone		0.007
Chloroform		0.0035
Di-n-butylphthalate	0.38	
4,4-DDE	0.00087	
Aroclor-1260	0.014	
Endosulfan II	0.00012	
Endrin aldehyde	0.00031	
alpha-Chlordane	0.0024	
gamma-Chlordane	0.00013	
Aluminum		0.751
Arsenic	7.7	
Beryllium		0.00029
Cadmium	1.4	
Chromium	18.9	
Copper		0.0071
Lead	75.8	0.0078
Manganese	19.7	
Mercury		0.0005
Nickel	10	0.013
Zinc	132	0.0303

ESTIMATED TISSUE LEVELS IN PRIMARY FOOD ITEMS

Aquatic BCF	Aquatic Organism Tissue Concent. [c] (mg/kg)
	0.0E+00
	0.0E+00
	0.0E+00
	2.4E-02
	6.4E-01
	0.0E+00
	0.0E+00
	1.5E-02
	4.2E-03
	2.7E+02
	0.0E+00
	0.0E+00
	0.0E+00
	0.0E+00
	2.3E+01
	2.9E+00
	2.2E+01
	1.3E+00
	3.3E+00
	1.6E+02

[a] From Table 7-3.
[b] From Table 7-1.
[c] Aquatic organism tissue concentrations for pesticides, PCBs, and metals based on the maximum detected concentration in fish tissue collected from the Lake Fretwell area. The fish data are presented in Section 5.5.
ECPC = Ecological Chemical of Potential Concern

Appendix D-1
Hazard Quotients and Indices for Potential Lethal Effects for Representative Wildlife Species Associated with Maximum Exposure Concentrations of ECPCs in Surface Waters and Sediments at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	***Florida water rat***			***Raccoon***		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	7.8E-04	6.00E+02	1.31E-06	6.0E-04	6.00E+02	1.01E-06
Chloroform	3.9E-04	1.64E+02	2.39E-06	3.0E-04	1.64E+02	1.84E-06
Di-n-butylphthalate	6.2E-04	1.30E+03	4.77E-07	1.4E-03	1.30E+03	1.09E-06
4,4-DDE	1.6E-04	1.40E+02	1.13E-06	1.2E-03	1.20E+01	1.00E-04
Aroclor-1260	4.2E-03	1.00E+02	4.21E-05	3.2E-02	1.50E+02	2.13E-04
Endosulfan II	2.0E-07	5.00E+00	3.93E-08	4.5E-07	5.00E+00	9.01E-08
Endrin aldehyde	5.1E-07	6.00E-01	8.45E-07	1.2E-06	6.00E-01	1.94E-06
alpha-Chlordane	1.0E-04	4.00E+01	2.55E-06	7.6E-04	4.00E+01	1.89E-05
gamma-Chlordane	2.8E-05	4.00E+01	6.93E-07	2.1E-04	4.00E+01	5.25E-06
Aluminum	1.9E+00	7.40E+02	2.50E-03	1.4E+01	7.40E+02	1.83E-02
Arsenic	1.3E-02	1.53E+02	8.24E-05	2.9E-02	2.90E+01	9.97E-04
Beryllium	3.3E-05	2.00E+00	1.63E-05	2.5E-05	2.00E+00	1.25E-05
Cadmium	2.3E-03	3.00E+01	7.64E-05	5.3E-03	3.00E+01	1.75E-04
Chromium	3.1E-02	4.00E+01	7.73E-04	7.1E-02	4.00E+01	1.77E-03
Copper	1.5E-01	1.88E+02	8.08E-04	1.2E+00	1.88E+02	6.13E-03
Lead	1.4E-01	6.00E+01	2.40E-03	4.3E-01	6.00E+01	7.17E-03
Manganese	1.8E-01	4.50E+01	3.90E-03	1.2E+00	8.00E+01	1.46E-02
Mercury	8.6E-03	3.60E+00	2.38E-03	6.5E-02	1.00E-01	6.49E-01
Nickel	3.9E-02	1.34E+01	2.94E-03	2.0E-01	1.34E+01	1.52E-02
Zinc	1.3E+00	3.90E+02	3.32E-03	8.7E+00	3.90E+02	2.23E-02
SUMMARY HAZARD INDEX			1.9E-02			7.4E-01

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = 1/5 of the lowest reported LD50 or lowest reported adverse effect level (LOAEL) for mortality from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-1
Hazard Quotients and Indices for Potential Lethal Effects for Representative Wildlife Species Associated with Maximum Exposure Concentrations of ECPCs in Surface Waters and Sediments at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	***Kingfisher***			***Great blue heron***		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	7.7E-04			3.17E-04		
Chloroform	3.9E-04			1.59E-04		
Di-n-butylphthalate	2.5E-03			1.37E-03		
4,4-DDE	2.1E-03	4.48E+02	4.66E-06	4.23E-03	4.48E+02	9.45E-06
Aroclor-1260	5.6E-02	1.60E+01	3.48E-03	1.13E-01	1.60E+01	7.05E-03
Endosulfan II	7.8E-07	6.20E+00	1.26E-07	4.32E-07	6.20E+00	6.96E-08
Endrin aldehyde	2.0E-06	3.60E-01	5.63E-06	1.11E-06	3.60E-01	3.10E-06
alpha-Chlordane	1.3E-03	4.80E+00	2.75E-04	2.65E-03	4.80E+00	5.52E-04
gamma-Chlordane	3.7E-04	4.80E+00	7.61E-05	7.41E-04	4.80E+00	
Aluminum	2.4E+01			4.76E+01		
Arsenic	5.0E-02	6.46E+01	7.79E-04	2.77E-02	6.46E+01	4.29E-04
Beryllium	3.2E-05			1.31E-05		
Cadmium	9.1E-03			5.03E-03		
Chromium	1.2E-01	2.52E+01	4.90E-03	6.80E-02	2.52E+01	2.70E-03
Copper	2.0E+00	2.10E+00	9.55E-01	4.07E+00	2.10E+00	1.94E+00
Lead	7.5E-01	7.50E+01	9.97E-03	7.84E-01	7.50E+01	1.05E-02
Manganese	2.0E+00			3.93E+00		
Mercury	1.1E-01	2.20E+00	5.13E-02	2.29E-01	2.20E+00	1.04E-01
Nickel	3.5E-01	6.08E+01	5.81E-03	6.18E-01	6.08E+01	1.02E-02
Zinc	1.5E+01	1.29E+03	1.17E-02	2.94E+01	1.29E+03	2.27E-02
SUMMARY HAZARD INDEX			1.0E+00			2.1E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = 1/5 of the lowest reported LD50 or lowest reported adverse effect level (LOAEL) for mortality from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-1
Hazard Quotients and Indices for Potential Sublethal Effects for Representative Wildlife Species Associated with Maximum Exposure Concentrations of ECPCs in Surface Waters and Sediments at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	*Florida water rat*			*Raccoon*		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	7.8E-04	2.73E+05	2.87E-09	6.0E-04	2.73E+05	2.21E-09
Chloroform	3.9E-04	2.60E+02	1.51E-06	3.0E-04	2.60E+02	1.16E-06
Di-n-butylphthalate	6.2E-04	1.25E+02	4.97E-06	1.4E-03	1.25E+02	1.14E-05
4,4-DDE	1.6E-04	2.00E-02	7.93E-03	1.2E-03	3.54E+03	3.39E-07
Aroclor-1260	4.2E-03	6.40E+00	6.58E-04	3.2E-02	7.50E-03	4.26E+00
Endosulfan II	2.0E-07	2.60E-01	7.55E-07	4.5E-07	2.60E-01	1.73E-06
Endrin aldehyde	5.1E-07	1.00E-01	5.07E-06	1.2E-06	1.00E-01	1.16E-05
alpha-Chlordane	1.0E-04	3.04E+00	3.36E-05	7.6E-04	3.04E+00	2.49E-04
gamma-Chlordane	2.8E-05	3.04E+00	9.11E-06	2.1E-04	3.04E+00	6.91E-05
Aluminum	1.9E+00	1.00E+02	1.85E-02	1.4E+01	1.00E+02	1.35E-01
Arsenic	1.3E-02	1.40E+01	9.00E-04	2.9E-02	1.40E+01	2.06E-03
Beryllium	3.3E-05			2.5E-05		
Cadmium	2.3E-03	2.15E+01	1.07E-04	5.3E-03	2.15E+01	2.44E-04
Chromium	3.1E-02	1.40E+03	2.21E-05	7.1E-02	1.40E+03	5.07E-05
Copper	1.5E-01	1.00E+02	1.52E-03	1.2E+00	1.00E+02	1.15E-02
Lead	1.4E-01	2.50E+00	5.76E-02	4.3E-01	2.50E+00	1.72E-01
Manganese	1.8E-01	1.40E+02	1.25E-03	1.2E+00	1.40E+02	8.33E-03
Mercury	8.6E-03	5.00E-01	1.71E-02	6.5E-02	1.00E-01	6.49E-01
Nickel	3.9E-02	5.00E+01	7.88E-04	2.0E-01	5.00E+01	4.07E-03
Zinc	1.3E+00	2.00E+02	6.46E-03	8.7E+00	2.00E+02	4.34E-02
SUMMARY HAZARD INDEX			1.1E-01			5.3E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = Lowest reported adverse effect level (LOAEL) for reproduction or growth from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-1
Hazard Quotients and Indices for Potential Sublethal Effects for Representative Wildlife Species Associated with Maximum Exposure Concentrations of ECPCs in Surface Waters and Sediments at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	*Kingfisher*			*Great blue heron*		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	7.7E-04			3.2E-04		
Chloroform	3.9E-04			1.6E-04		
Di-n-butylphthalate	2.5E-03			1.4E-03		
4,4-DDE	2.1E-03	5.80E-01	3.60E-03	4.2E-03	5.80E-01	7.30E-03
Aroclor-1260	5.6E-02	9.00E-01	6.18E-02	1.1E-01	9.00E+00	1.25E-02
Endosulfan II	7.8E-07			4.3E-07		
Endrin aldehyde	2.0E-06			1.1E-06		
alpha-Chlordane	1.3E-03	3.10E-02	4.25E-02	2.7E-03	3.10E-02	8.55E-02
gamma-Chlordane	3.7E-04	3.10E-02	1.18E-02	7.4E-04	3.10E-02	2.39E-02
Aluminum	2.4E+01			4.8E+01		
Arsenic	5.0E-02			2.8E-02		
Beryllium	3.2E-05			1.3E-05		
Cadmium	9.1E-03	1.00E+01	9.15E-04	5.0E-03	1.00E+01	5.03E-04
Chromium	1.2E-01	2.00E+02	6.17E-04	6.8E-02	2.00E+02	3.40E-04
Copper	2.0E+00	2.90E+01	6.92E-02	4.1E+00	2.90E+01	1.40E-01
Lead	7.5E-01	6.25E+00	1.20E-01	7.8E-01	6.25E+00	1.25E-01
Manganese	2.0E+00			3.9E+00		
Mercury	1.1E-01	6.40E-02	1.76E+00	2.3E-01	6.40E-02	3.58E+00
Nickel	3.5E-01			6.2E-01		
Zinc	1.5E+01			2.9E+01		
SUMMARY HAZARD INDEX			2.1E+00			4.0E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = Lowest reported adverse effect level (LOAEL) for reproduction or growth from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-1

Estimation of ECPC Exposure Concentrations for Representative Wildlife Species at Lake Fretwell
Average Surface Water and Sediment Concentrations
Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA

ECPC	AVERAGE SEDIMENT CONCENTRATION [a] (mg/kg)	AVG. SURFACE WATER CONCENTRATION [b] [mg/l]
Acetone		0.007
Chloroform		0.0035
Di-n-butylphthalate	0.113	
4,4-DDE	0.00049	
Aroclor-1260	0.007	
Endosulfan II	0.00012	
Endrin aldehyde	0.00031	
alpha-Chlordane	0.00094	
gamma-Chlordane	0.00013	
Aluminum		0.181
Arsenic	7.7	
Beryllium		0.00026
Cadmium	0.93	
Chromium	7.6	
Copper		0.0035
Lead	16.6	0.0078
Manganese	8.5	
Mercury		0.00028
Nickel	4.1	0.013
Zinc	132	0.0214

ESTIMATED TISSUE LEVELS IN PRIMARY FOOD ITEMS

Aquatic BCF	Aquatic Organism Tissue Concent. [c] (mg/kg)
	0.0E+00
	0.0E+00
	0.0E+00
	2.4E-02
	6.4E-01
	0.0E+00
	0.0E+00
	1.5E-02
	4.2E-03
	2.7E+02
	0.0E+00
	0.0E+00
	0.0E+00
	0.0E+00
	2.3E+01
	2.9E+00
	2.2E+01
	1.3E+00
	3.3E+00
	1.6E+02

[a] From Table 7-3.
[b] From Table 7-1.
[c] Aquatic organism tissue concentrations for pesticides, PCBs, and metals based on the maximum detected concentration in fish tissue collected from the Lake Fretwell.
The fish data are presented in Section 5.5.
ECPC = Ecological Chemical of Potential Concern

Appendix D-1
Hazard Quotients and Indices for Potential Lethal Effects for Representative Wildlife Species Associated with Average Exposure Concentrations of ECPCs in Surface Waters and Sediments at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	Florida water rat			Raccoon		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	7.8E-04	6.00E+02	1.31E-06	6.0E-04	6.00E+02	1.01E-06
Chloroform	3.9E-04	1.64E+02	2.39E-06	3.0E-04	1.64E+02	1.84E-06
Di-n-butylphthalate	1.8E-04	1.30E+03	1.42E-07	4.2E-04	1.30E+03	3.26E-07
4,4-DDE	1.6E-04	1.40E+02	1.13E-06	1.2E-03	1.20E+01	9.99E-05
Aroclor-1260	4.2E-03	1.00E+02	4.20E-05	3.2E-02	1.50E+02	2.13E-04
Endosulfan II	2.0E-07	5.00E+00	3.93E-08	4.5E-07	5.00E+00	9.01E-08
Endrin aldehyde	5.1E-07	6.00E-01	8.45E-07	1.2E-06	6.00E-01	1.94E-06
alpha-Chlordane	1.0E-04	4.00E+01	2.49E-06	7.5E-04	4.00E+01	1.88E-05
gamma-Chlordane	2.8E-05	4.00E+01	6.93E-07	2.1E-04	4.00E+01	5.25E-06
Aluminum	1.8E+00	7.40E+02	2.42E-03	1.3E+01	7.40E+02	1.82E-02
Arsenic	1.3E-02	1.53E+02	8.24E-05	2.9E-02	2.90E+01	9.97E-04
Beryllium	2.9E-05	2.00E+00	1.46E-05	2.2E-05	2.00E+00	1.12E-05
Cadmium	1.5E-03	3.00E+01	5.07E-05	3.5E-03	3.00E+01	1.16E-04
Chromium	1.2E-02	4.00E+01	3.11E-04	2.9E-02	4.00E+01	7.13E-04
Copper	1.5E-01	1.88E+02	8.06E-04	1.2E+00	1.88E+02	6.13E-03
Lead	4.7E-02	6.00E+01	7.84E-04	2.1E-01	6.00E+01	3.46E-03
Manganese	1.6E-01	4.50E+01	3.49E-03	1.1E+00	8.00E+01	1.41E-02
Mercury	8.5E-03	3.60E+00	2.37E-03	6.5E-02	1.00E-01	6.49E-01
Nickel	3.0E-02	1.34E+01	2.22E-03	1.8E-01	1.34E+01	1.35E-02
Zinc	1.3E+00	3.90E+02	3.31E-03	8.7E+00	3.90E+02	2.23E-02
SUMMARY HAZARD INDEX			1.6E-02			7.3E-01

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = 1/5 of the lowest reported LD50 or lowest reported adverse effect level (LOAEL) for mortality from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-1
Hazard Quotients and Indices for Potential Lethal Effects for Representative Wildlife Species Associated with Average Exposure Concentrations of ECPCs in Surface Waters and Sediments at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	*Kingfisher*			*Great blue heron*		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	7.7E-04			3.17E-04		
Chloroform	3.9E-04			1.59E-04		
Di-n-butylphthalate	7.4E-04			4.06E-04		
4,4-DDE	2.1E-03	4.48E+02	4.66E-06	4.23E-03	4.48E+02	9.44E-06
Aroclor-1260	5.6E-02	1.60E+01	3.47E-03	1.13E-01	1.60E+01	7.05E-03
Endosulfan II	7.8E-07	6.20E+00	1.26E-07	4.32E-07	6.20E+00	6.96E-08
Endrin aldehyde	2.0E-06	3.60E-01	5.63E-06	1.11E-06	3.60E-01	3.10E-06
alpha-Chlordane	1.3E-03	4.80E+00	2.73E-04	2.65E-03	4.80E+00	5.51E-04
gamma-Chlordane	3.7E-04	4.80E+00	7.61E-05	7.41E-04	4.80E+00	1.54E-04
Aluminum	2.3E+01			4.76E+01		
Arsenic	5.0E-02	6.46E+01	7.79E-04	2.77E-02	6.46E+01	4.29E-04
Beryllium	2.9E-05			1.18E-05		
Cadmium	6.1E-03			3.34E-03		
Chromium	5.0E-02	2.52E+01	1.97E-03	2.73E-02	2.52E+01	1.08E-03
Copper	2.0E+00	2.10E+00	9.55E-01	4.07E+00	2.10E+00	1.94E+00
Lead	3.6E-01	7.50E+01	4.81E-03	5.71E-01	7.50E+01	7.61E-03
Manganese	2.0E+00			3.89E+00		
Mercury	1.1E-01	2.20E+00	5.13E-02	2.29E-01	2.20E+00	1.04E-01
Nickel	3.1E-01	6.08E+01	5.18E-03	5.97E-01	6.08E+01	9.82E-03
Zinc	1.5E+01	1.29E+03	1.17E-02	2.94E+01	1.29E+03	2.27E-02
SUMMARY HAZARD INDEX			1.0E+00			2.1E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = 1/5 of the lowest reported LD50 or lowest reported adverse effect level (LOAEL) for mortality from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-1
Hazard Quotients and Indices for Potential Sublethal Effects for Representative Wildlife Species Associated with Average Exposure Concentrations of ECPCs in Surface Waters and Sediments at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	*Florida water rat*			*Raccoon*		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	7.8E-04	2.73E+05	2.87E-09	6.0E-04	2.73E+05	2.21E-09
Chloroform	3.9E-04	2.60E+02	1.51E-06	3.0E-04	2.60E+02	1.16E-06
Di-n-butylphthalate	1.8E-04	1.25E+02	1.48E-06	4.2E-04	1.25E+02	3.39E-06
4,4-DDE	1.6E-04	2.00E-02	7.89E-03	1.2E-03	3.54E+03	3.39E-07
Aroclor-1260	4.2E-03	6.40E+00	6.56E-04	3.2E-02	7.50E-03	4.26E+00
Endosulfan II	2.0E-07	2.60E-01	7.55E-07	4.5E-07	2.60E-01	1.73E-06
Endrin aldehyde	5.1E-07	1.00E-01	5.07E-06	1.2E-06	1.00E-01	1.16E-05
alpha-Chlordane	1.0E-04	3.04E+00	3.28E-05	7.5E-04	3.04E+00	2.47E-04
gamma-Chlordane	2.8E-05	3.04E+00	9.11E-06	2.1E-04	3.04E+00	6.91E-05
Aluminum	1.8E+00	1.00E+02	1.79E-02	1.3E+01	1.00E+02	1.35E-01
Arsenic	1.3E-02	1.40E+01	9.00E-04	2.9E-02	1.40E+01	2.06E-03
Beryllium	2.9E-05			2.2E-05		
Cadmium	1.5E-03	2.15E+01	7.08E-05	3.5E-03	2.15E+01	1.62E-04
Chromium	1.2E-02	1.40E+03	8.88E-06	2.9E-02	1.40E+03	2.04E-05
Copper	1.5E-01	1.00E+02	1.52E-03	1.2E+00	1.00E+02	1.15E-02
Lead	4.7E-02	2.50E+00	1.88E-02	2.1E-01	2.50E+00	8.31E-02
Manganese	1.6E-01	1.40E+02	1.12E-03	1.1E+00	1.40E+02	8.03E-03
Mercury	8.5E-03	5.00E-01	1.71E-02	6.5E-02	1.00E-01	6.49E-01
Nickel	3.0E-02	5.00E+01	5.95E-04	1.8E-01	5.00E+01	3.62E-03
Zinc	1.3E+00	2.00E+02	6.46E-03	8.7E+00	2.00E+02	4.34E-02
SUMMARY HAZARD INDEX			7.3E-02			5.2E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = Lowest reported adverse effect level (LOAEL) for reproduction or growth from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-1
Hazard Quotients and Indices for Potential Sublethal Effects for Representative Wildlife Species Associated with Average Exposure Concentrations of ECPCs in Surface Waters and Sediments at Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	***Kingfisher***			***Great blue heron***		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	7.7E-04			3.2E-04		
Chloroform	3.9E-04			1.6E-04		
Di-n-butylphthalate	7.4E-04			4.1E-04		
4,4-DDE	2.1E-03	5.80E-01	3.60E-03	4.2E-03	5.80E-01	7.30E-03
Aroclor-1260	5.6E-02	9.00E-01	6.18E-02	1.1E-01	9.00E+00	1.25E-02
Endosulfan II	7.8E-07			4.3E-07		
Endrin aldehyde	2.0E-06			1.1E-06		
alpha-Chlordane	1.3E-03	3.10E-02	4.22E-02	2.6E-03	3.10E-02	8.54E-02
gamma-Chlordane	3.7E-04	3.10E-02	1.18E-02	7.4E-04	3.10E-02	2.39E-02
Aluminum	2.3E+01			4.8E+01		
Arsenic	5.0E-02			2.8E-02		
Beryllium	2.9E-05			1.2E-05		
Cadmium	6.1E-03	1.00E+01	6.08E-04	3.3E-03	1.00E+01	3.34E-04
Chromium	5.0E-02	2.00E+02	2.48E-04	2.7E-02	2.00E+02	1.37E-04
Copper	2.0E+00	2.90E+01	6.92E-02	4.1E+00	2.90E+01	1.40E-01
Lead	3.6E-01	6.25E+00	5.78E-02	5.7E-01	6.25E+00	9.14E-02
Manganese	2.0E+00			3.9E+00		
Mercury	1.1E-01	6.40E-02	1.76E+00	2.3E-01	6.40E-02	3.58E+00
Nickel	3.1E-01			6.0E-01		
Zinc	1.5E+01			2.9E+01		
SUMMARY HAZARD INDEX			2.0E+00			3.9E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = Lowest reported adverse effect level (LOAEL) for reproduction or growth from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

APPENDIX D-2

SURFACE WATER/SEDIMENT SPREADSHEETS FOR ROWELL CREEK UPSTREAM OF LAKE FRETWELL

Appendix D-2

Estimation of ECPC Exposure Concentrations for Representative Wildlife Species at Rowell Creek Upstream of Lake Fretwell
Maximum Surface Water and Sediment Concentrations
Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA

ECPC	MAXIMUM SEDIMENT CONCENTRATION [a] (mg/kg)	MAX. SURFACE WATER CONCENTRATION [b] [mg/l]
Acetone		0.012
Methylene chloride		0.001
Di-n-butylphthalate	0.185	
4,4-DDE	0.0002	
Aroclor-1260	0.0066	
Dieldrin	0.0015	
alpha-Chlordane	0.00019	
Cadmium		0.00026
Vanadium		0.003

ESTIMATED TISSUE LEVELS IN PRIMARY FOOD ITEMS

Aquatic BCF	Aquatic Organism Tissue Concent. [c] (mg/kg)
	0.0E+00
	0.0E+00
	0.0E+00
	3.0E-02
	2.5E-01
	0.0E+00
	3.4E-03
	0.0E+00
	0.0E+00

[a] From Table 7-4.
[b] From Table 7-2.
[c] Aquatic organism tissue concentrations for pesticides, PCBs, and metals based on the maximum detected concentration in fish tissue from Rowell Creek upstream of Lake Fretwell. The fish data are presented in Section 5.5.
ECPC = Ecological Chemical of Potential Concern

Appendix D-2
Exposure Parameters and Assumptions for Representative Wildlife Species at Rowell Creek Upstream of Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

Representative Wildlife Species		Percent Prey in Diet [a]		Sediment	Home Range [a] (acres)	ED [b]	Site Foraging Frequency [c]	Food Ingestion Rate [a] (kg/day)	Water Ingestion Rate [a] (l/day)	Body Weight [a] (kg)
		Aquatic Organisms	Plants							
Florida water rat	(Small Omniv. Mammal)	8%	90%	2%	0.42	1.0	1.00E+00	0.027	0.037	0.33
Kingfisher	(Piscivorous bird)	93%	0%	7%	35	1.0	1.00E+00	0.014	0.0165	0.15
Great blue heron	(Piscivorous bird)	98%	0%	2%	1.5	1.0	1.00E+00	0.401	0.10	2.23
Raccoon	(Piscivorous Mammal)	93%	0%	7%	385	1.0	1.00E+00	0.214	0.34	3.99

NOTES:
[a] From Table 7-5.
[b] ED = Exposure Duration (percentage of year receptor is expected to be found at study area)
[c] SFF = Site Foraging Frequency (calculated by dividing site area by receptor home range and multiplying by exposure duration (cannot exceed 1.0)).

Appendix D-2
Hazard Quotients and Indices for Potential Lethal Effects for Representative Wildlife Species Associated with Maximum Exposure Concentrations of ECPCs in Surface Waters and Sediments at Rowell Creek Upstream of Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	***Florida water rat***			***Raccoon***		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	1.3E-03	6.00E+02	2.24E-06	1.0E-03	6.00E+02	1.72E-06
Methylene chloride	1.1E-04	3.20E+02	3.50E-07	8.6E-05	3.20E+02	2.69E-07
Di-n-butylphthalate	3.0E-04	1.30E+03	2.32E-07	6.9E-04	1.30E+03	5.33E-07
4,4-DDE	2.0E-04	1.40E+02	1.40E-06	1.5E-03	1.20E+01	1.25E-04
Aroclor-1260	1.6E-03	1.00E+02	1.65E-05	1.2E-02	1.50E+02	8.33E-05
Dieldrin	2.5E-06	7.60E+00	3.23E-07	5.6E-06	5.00E+00	1.13E-06
alpha-Chlordane	2.3E-05	4.00E+01	5.64E-07	1.7E-04	4.00E+01	4.26E-06
Cadmium	2.9E-05	3.00E+01	9.72E-07	2.2E-05	3.00E+01	7.47E-07
Vanadium	3.4E-04			2.6E-04		
SUMMARY HAZARD INDEX			2.3E-05			2.2E-04

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = 1/5 of the lowest reported LD50 or lowest reported adverse effect level (LOAEL) for mortality from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-2
Hazard Quotients and Indices for Potential Lethal Effects for Representative Wildlife Species Associated with Maximum Exposure Concentrations of ECPCs in Surface Waters and Sediments at Rowell Creek Upstream of Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	***Kingfisher***			***Great blue heron***		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	1.3E-03			5.43E-04		
Methylene chloride	1.1E-04			4.53E-05		
Di-n-butylphthalate	1.2E-03			6.65E-04		
4,4-DDE	2.6E-03	4.48E+02	5.82E-06	5.29E-03	4.48E+02	1.18E-05
Aroclor-1260	2.2E-02	1.60E+01	1.36E-03	4.41E-02	1.60E+01	2.75E-03
Dieldrin	9.8E-06	6.00E-01	1.63E-05	5.39E-06	6.00E-01	8.99E-06
alpha-Chlordane	3.0E-04	4.80E+00	6.17E-05	6.00E-04	4.80E+00	
Cadmium	2.9E-05			1.18E-05		
Vanadium	3.3E-04	1.92E+01	1.72E-05	1.36E-04	1.92E+01	7.08E-06
SUMMARY HAZARD INDEX			1.5E-03			2.8E-03

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = 1/5 of the lowest reported LD50 or lowest reported adverse effect level (LOAEL) for mortality from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Appendix D-2
Hazard Quotients and Indices for Potential Sublethal Effects for Representative Wildlife Species Associated with Maximum Exposure Concentrations of ECPCs in Surface Waters and Sediments at Rowell Creek Upstream of Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	*Florida water rat*			*Raccoon*		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	1.3E-03	2.73E+05	4.93E-09	1.0E-03	2.73E+05	3.79E-09
Methylene chloride	1.1E-04			8.6E-05		
Di-n-butylphthalate	3.0E-04	1.25E+02	2.42E-06	6.9E-04	1.25E+02	5.56E-06
4,4-DDE	2.0E-04	2.00E-02	9.83E-03	1.5E-03	3.54E+03	4.23E-07
Aroclor-1260	1.6E-03	6.40E+00	2.57E-04	1.2E-02	7.50E-03	1.67E+00
Dieldrin	2.5E-06	1.40E-02	1.75E-04	5.6E-06	2.19E+00	2.57E-06
alpha-Chlordane	2.3E-05	3.04E+00	7.42E-06	1.7E-04	3.04E+00	5.60E-05
Cadmium	2.9E-05	2.15E+01	1.36E-06	2.2E-05	2.15E+01	1.04E-06
Vanadium	3.4E-04	8.40E+00	4.00E-05	2.6E-04	8.40E+00	3.08E-05
SUMMARY HAZARD INDEX			1.0E-02			1.7E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = Lowest reported adverse effect level (LOAEL) for reproduction or growth from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV).

Appendix D-2
Hazard Quotients and Indices for Potential Sublethal Effects for Representative Wildlife Species Associated with Maximum Exposure Concentrations of ECPCs in Surface Waters and Sediments at Rowell Creek Upstream of Lake Fretwell

Basewide Ecological Assessment Report
NAS Cecil Field, Jacksonville, Florida

ANALYTE	***Kingfisher***			***Great blue heron***		
	PDE	RTV	HQ	PDE	RTV	HQ
Acetone	1.3E-03			5.4E-04		
Methylene chloride	1.1E-04			4.5E-05		
Di-n-butylphthalate	1.2E-03			6.7E-04		
4,4-DDE	2.6E-03	5.80E-01	4.49E-03	5.3E-03	5.80E-01	9.12E-03
Aroclor-1260	2.2E-02	9.00E-01	2.42E-02	4.4E-02	9.00E+00	4.90E-03
Dieldrin	9.8E-06			5.4E-06		
alpha-Chlordane	3.0E-04	3.10E-02	9.56E-03	6.0E-04	3.10E-02	1.93E-02
Cadmium	2.9E-05	1.00E+01	2.86E-06	1.2E-05	1.00E+01	1.18E-06
Vanadium	3.3E-04	1.10E+01	3.00E-05	1.4E-04	1.10E+01	1.24E-05
SUMMARY HAZARD INDEX			3.8E-02			3.3E-02

PDE = Potential Dietary Exposure (mg/kgBW/day) calculated according to equations in Table 3-2.
RTV = Reference Toxicity Value (mg/kgBW/day) = Lowest reported adverse effect level (LOAEL) for reproduction or growth from Appendix D-4 for closest related species.
HQ = Hazard Quotient (calculated by dividing PDE by RTV).

APPENDIX D-3

SUMMARY OF RTVs

Appendix D-3
Summary of Reference Ingestion Toxicity Values for Wildlife Receptors
(mg/kg/BW/day)

Basewide Ecological Assessment Report
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Florida Water Rat		Raccoon		Kingfisher		Great Blue Heron	
	Lethal [a]	Sublethal [b]	Lethal	Sublethal	Lethal	Sublethal	Lethal	Sublethal
Acetone	600	273000	600	273000				
Bromodichloromethane	94	50	94	50				
Chloroform	164	260	164	260				
Methylene chloride	320		320					
Di-n-butylphthalate	1303	125	1303	125				
4,4-DDE	140	.02 [c]	12 [d]	3540 [e]	448 [f]	0.58	448 [f]	0.58
Aroclor-1260	100	6.4	150	0.0075	16	0.9	16	9.0
Chlordane	40	3.04	40	3.04	4.8	0.031	4.8	0.031
Dieldrin	7.6	0.014	5.0	2.19	0.6		0.6	
Endosulfan II	5	0.26	5	0.26	6.2		6.2	
Endrin aldehyde	0.60	0.1	0.60	0.1	0.36		0.36	
Aluminum	740	100	740	100				
Arsenic	153	14	29	14	64.6		64.6	
Beryllium	2		2					
Cadmium	30	21.5	30	21.5		10		10
Chromium	40	1400	40	1400	25.2	200	25.2	200
Copper	188	100	188	100	2.1	29	2.1	29
Lead	60	2.5	60	2.5	75	6.25	75	6.25
Manganese	45	140	80	140				
Mercury	3.6	0.5	0.1	0.01	2.2	0.064	2.2	0.064
Nickel	13.4	50	13.4	50	60.8		60.8	
Silver	181.2	18.1	181.2	18.1				
Vanadium		8.4		8.4	19.2	11	19.2	11
Zinc	390	200	390	200	1292		1292	

[a] 1/5th of the LD50 value or lowest reported dose associated with mortality for the closest related species.
[b] The lowest reported dose associated with adverse effects to growth or reproduction for the closest related species.
[c] The 4,4'-DDT sublethal LOAEL rat value was used as a surrogate.
[d] One-fifth of the 4,4'-DDT lethal LD50 dog value was used as a surrogate.
[e] The 4,4'-DDT sublethal LOAEL dog value was used as a surrogate.
[f] One-fifth of the 4,4'-DDT lethal LD50 mallard value was used as a surrogate.

APPENDIX D-4

INGESTION TOXICITY INFORMATION

Appendix D-4
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
Volatile Organic Compounds							
Acetone	Rat	Oral	NR	LD_{50}	5,800		RTECS, 1994
	Rat	Single Oral Dose		LD_{50}	9,750		Sax, 1984
	Rat	Oral	NR	LOAEL for reproductive effects		273,000	RTECS, 1994
	Mouse	Oral	NR	LD_{50}	3,000		RTECS, 1994
	Rabbit	Oral	NR	LD_{50}	5,340		RTECS, 1994
Bromodichloromethane	Rat	Oral LD_{50}	1 dose	LD_{50}	470		ATSDR, 1988a
	Rat	Oral LD_{50}	1 dose	LD_{50}	943		ATSDR, 1988a
	Mouse	Oral LD_{50}	1 dose	LD_{50}	675		ATSDR, 1988a
	Rat	Oral (acute)	6-10 days of gestation	LOAEL for phytotoxicity		50	ATSDR, 1988a
Chloroform	Dog (Beagle)	Oral (chronic)	7.5 years	Liver cyst formation		12.9	IRIS, 1991
	Rat	Oral	NR	Mortality	908		RTECS, 1994
	Rat	Oral	NR	Reproductive effects		1,260	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		4,000	RTECS, 1994
	Mouse	Oral	NR	Reproductive effects		2,177	RTECS, 1994
	Mouse	Oral	NR	Reproductive effects		2,115	RTECS, 1994
	Guinea pig	Oral	NR	Mortality	820		RTECS, 1994
	Rabbit	Oral	NR	Reproductive effects		260	RTECS, 1994
Methylene chloride	Rat	Oral (chronic)	2 years	LOAEL for liver toxicity		52.6	IRIS, 1991
	Rat	Oral LD_{50}	NR	Mortality	1,600		RTECS, 1994
	Dog	Oral LD_{50}	NR	Mortality	3,000		RTECS, 1994
	Rat	Oral (subchronic)	3 months	NOAEL for mortality, blood chemistry, histopathology		125	USEPA, 1984a
	Rabbit	Single oral dose	1 dose	LD_{50}	1,900		Sax, 1984
	Mouse	Oral	NR	LOAEL for reproductive effects		15,000	RTECS, 1994

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
Semivolatile Organic Compounds							
Di-*n*-butylphthalate	Rat	Oral (subchronic)	48 days	LOAEL for reproductive effects		125	ATSDR, 1989
	Rat	Oral (chronic)	1 year	LOAEL for mortality	600		IRIS, 1991
	Mouse	Single oral dose	1 dose	LD_{50}	6,513		Sax, 1984
Pesticides and PCBs							
4,4'-DDE	Rat	Oral	NR	LD_{50}	800		RTECS, 1994
4,4'-DDE	Mouse	Oral	NR	LD_{50}	700		RTECS, 1994
	Hamster	Oral	NR	LD_{50}	>5,000		RTECS, 1994
	Mallard	Oral	NR	Eggshell thinning		2.91	USEPA, 1993a
	Mallard	Oral	2 years	Embryo mortality, cracked eggs		0.58	USEPA, 1993a
	Kestrel	Oral	NR	Eggshell thinning		0.39	USEPA, 1993a
Aroclor-1260	Rat	Oral dose	NR	LD_{50}	1,315		RTECS, 1993
	Rat	Oral dose	NR	LD_{50}	500		Eisler, 1986
	Rat	Oral dose	NR	LD_{50}	1,300		Eisler, 1986
	Rat	Oral	NR	LOAEL for reproductive effects		1,674	RTECS, 1993
	Rat	Oral (chronic)	2 generations	LOAEL for reduced litter size		7.6	USEPA, 1985b
	Rat	Oral (subchronic)	9 weeks	LOAEL for fetal mortality; maternal toxicity		6.4	ATSDR, 1987a
	Mouse	Oral	NR	LOAEL for reproductive effects		74	RTECS, 1993
	Mink	Oral dose	NR	LD_{50}	4,000		Eisler, 1986
	Mink	Oral dose	NR	LD_{50}	3,000		Eisler, 1986
	Mink	Oral dose	NR	LD_{50}	750		Eisler, 1986

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
	Mink	Oral (subchronic)	4 months	LOAEL for impaired reproduction		0.0075	Newell et al., 1987
	Dog (beagle)	Oral (chronic)	2 years	LOAEL (not described)		0.37	USEPA, 1976
	Chicken	Oral (chronic)	NR	LOAEL for embryonic mortality		0.9	USEPA, 1976
	American kestrel	Oral (chronic)	69 days	LOAEL for reduced sperm concentration		9	Eisler, 1986
	Bobwhite	Oral dose	8 days	LD_{50}	80		Eisler, 1986
	Mallard	Oral dose	8 days	LD_{50}	111		Eisler, 1986
Chlordane	Rat	Oral	NR	LD_{50}	283		RTECS, 1994
	Rat	Single oral dose		LD_{50}	430		Allen et al., 1979
	Rat	Single oral dose		LD_{50}	335		Allen et al., 1979
	Rat	Oral	NR	LD_{50}	200		RTECS, 1994
	Mouse	Oral	NR	LD_{50}	145		RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		3.36	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		152	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		7	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		3.04	RTECS, 1994
	Rabbit	Single oral dose		LD_{50}	300		Allen et al., 1979
	Rabbit	Single oral dose		LD_{50}	100		RTECS, 1994
	Hamster	Oral	NR	LD_{50}	1,720		RTECS, 1994
	Dog	Single oral dose		LD_{50}	200		Allen et al., 1979
	Domestic mammal	Oral	NR	LD_{50}	50		RTECS, 1994
	Goat	Single oral dose		LD_{50}	180		Allen et al., 1979
	Chicken	Oral	NR	LD_{50}	220		RTECS, 1994
	Duck	Oral	NR	LD_{50}	1,200		RTECS, 1994

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
	Mallard	Oral	5 days	LD_{50}	62[a]		Hill et al., 1975
	Japanese quail	Oral	5 days	LD_{50}	35[a]		Hill et al., 1975
	Bobwhite	Oral	5 days	LD_{50}	29[a]		Hill et al., 1975
	Pheasant	Single oral dose	NR	LD_{50}	24		USFWS, 1984
	Young chicken	Chronic	4 week	NOAEL for egg hatchability and growth		0.031	Eisler, 1990 [a]
Dieldrin	Mouse	Single oral dose	1 dose	LD_{50}	38		Allen et al., 1979
	Mouse	Oral	NR	LD_{50}	38		RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		30.6	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		15	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		2.25	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		12.5	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		4.5	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		6.25	RTECS, 1994
	Rat	Oral	NR	LOAEL for reproductive effects		0.014	RTECS, 1994
	Rat	Oral	NR	LOAEL for reproductive effects		0.336	RTECS, 1994
	Rat	Single oral dose		LD_{50}	46		Allen et al., 1979
	Rat	Oral	NR	LD_{50}	38.3		RTECS, 1994
	Dog	Oral	NR	LOAEL for reproductive effects		2.19	RTECS, 1994
	Hamster	Oral	NR	LOAEL for reproductive effects		30	RTECS, 1994
	Guinea pig	Single oral dose		LD_{50}	25		Allen et al., 1979
	Guinea pig	Oral	NR	LD_{50}	49		RTECS, 1994
	Rabbit	Single oral dose		LD_{50}	45		Allen et al., 1979
	Rabbit	Oral	NR	LD_{50}	45		RTECS, 1994
	Goat	Single oral dose		LD_{50}	100		Allen et al., 1979

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
Dieldrin (cont'd)	Sheep	Single oral dose		LD_{50}	50		Allen et al., 1979
	Cattle	Single oral dose		LD_{50}	60		Allen et al., 1979
	Mule deer	Single oral dose		LD_{50}	75		Allen et al., 1979
	Cat	Single oral dose		LD_{50}	300		Allen et al., 1979
	Cat	Oral	NR	LD_{50}	500		RTECS, 1994
	Dog	Single oral dose		LD_{50}	65		Allen et al., 1979
	Dog	Oral	NR	LD_{50}	65		RTECS, 1994
	Hamster	Oral	NR	LD_{50}	60		RTECS, 1994
	Pig	Oral	NR	LD_{50}	38		RTECS, 1994
	Monkey	Oral	NR	LD_{50}	3		RTECS, 1994
	House sparrow	Single oral dose		LD_{50}	48		USFWS, 1984
	Chicken	Single oral dose		LD_{50}	20		Allen et al., 1979
	Chicken	Oral	NR	LD_{50}	20		RTECS, 1994
	Rock dove	Single oral dose		LD_{50}	27		USFWS, 1984
	Gray partridge	Single oral dose		LD_{50}	9		USFWS, 1984
	Chukar	Single oral dose		LD_{50}	25		USFWS, 1984
	Japanese quail	Oral	5 days	LD_{50}	6[a]		Hill et al., 1975
	Japanese quail	Single oral dose		LD_{50}	70		USFWS, 1984
	California quail	Single oral dose		LD_{50}	9		USFWS, 1984
	Quail	Oral	NR	LD_{50}	10.78		RTECS, 1994
	Bobwhite	Oral	5 days	LD_{50}	3[a]		Hill et al., 1975
	Pheasant	Single oral dose		LD_{50}	79		USFWS, 1984
	Mallard	Oral	5 days	LD_{50}	12[a]		Hill et al., 1975
	Mallard	Oral	5 days	LD_{50}	11[a]		Hill et al., 1975
	Mallard	Oral	NR	LD_{50}	381		RTECS, 1994

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
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Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
Dieldrin (cont'd)	Mallard	Single oral dose		LD_{50}	381		USFWS, 1984
Endosulfan II	Mouse	Oral (chronic)	78 weeks	Mortality		0.9	ATSDR, 1991e
	Mouse	Oral (chronic)	78 weeks	Ovarian cyst development		0.26	ATSDR, 1991e
	Rat	Single oral dose	1 dose	Mortality	24		ATSDR, 1991e
	Rat	Oral (chronic)	2 years	Reduced testes weight		10	USEPA, 1980b
	Rat	Oral (chronic)	2 years	LOAEL for reduced testes weight		10	USEPA, 1980b
	Rat	Oral (chronic)	2 generations	LOAEL for kidney toxicity		0.15	IRIS, 1991
	Mallard	Single oral dose	1 dose	Mortality	33		USFWS, 1984
	Mallard	Single oral dose	1 dose	Mortality	31.2		USFWS, 1984
	Pheasant	Single oral dose	1 dose	Mortality	80		USFWS, 1984
Endrin (surrogate for endrin aldehyde)	Mouse	Oral (chronic)	80 weeks	LOAEL for mortality	0.53		ATSDR, 1989
	Dog	Oral (chronic)	19 months	LOAEL for decreased weight gain		0.1	USEPA, 1985b
	Rat	Single oral dose	1 dose	LD_{50}	3		Sax, 1984
	Bird	Single oral dose	1 dose	LD_{50}	1.8		Sax, 1984
Inorganic Analytes							
Aluminum	Mouse	Oral (chronic)	2-3 generations	LOAEL for reduced body weight gain of newborns		425	NIOSH, 1985
	Rat	Oral (subchronic)	1-5 days	LOAEL for reduced growth		100	Bernuzzi, et al., 1989
	Rat	Oral LD_{50}	NR	Mortality	3,700		Sax, 1984
Arsenic	Rat	Oral	NR	LD_{50}	763		RTECS, 1994
	Mouse	Oral	NR	LD_{50}	145		RTECS, 1994
	Hamster	Single oral dose	Gestation	7 - 36% fetal mortality		14	ATSDR, 1992a
	Pheasant	Single oral dose		LD_{50}	386		Eisler, 1988a

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
Naval Air Station Cecil Field
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Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
	Mallard	Single oral dose		LD_{50}	323		Eisler, 1988a
Beryllium	Rat	Single oral dose		LD_{50}	10		USEPA, 1985a
Cadmium	Rat	Oral	NR	LOAEL for reproductive effects		155	RTECS, 1993
	Rat	Oral	NR	LOAEL for reproductive effects		220	RTECS, 1993
	Rat	Oral	NR	LOAEL for reproductive effects		21.5	RTECS. 1993
	Rat	Oral	NR	LOAEL for reproductive effects		23	RTECS, 1993
	Rat	Single oral dose		LD_{50}	250		Eisler, 1985
	Rat	Single oral dose	NR	LD_{50}	225		RTECS, 1993
	Mouse	Single oral dose		LD_{50}	890		RTECS, 1993
	Mouse	Oral	NR	LOAEL for reproductive effects		448	RTECS, 1993
	Mouse	Oral	NR	LOAEL for reproductive effects		1,700	RTECS, 1993
	Guinea pig	Single oral dose		LD_{50}	150		Eisler, 1985
	Mallard	Oral (subchronic)	90 days	Egg production suppressed		10	Eisler, 1985
	Mallard	Oral (subchronic)	29 days	NOAEL for survivorship		2.1	Demayo et al., 1982
Chromium	Rat	Oral LD_{50}		Mortality	200		ATSDR, 1991
	Rat	Oral (subchronic)	90 days	NOAEL for histopathologic and reproductive effects		1,400	Invankovic and Preussman, 1975
	Japanese quail	Oral LD_{50}	5 days	Mortality	126		Hill and Camardese, 1986
	Black duck	Oral (subchronic)	5 months	NOAEL for reproductive effects		200	Outridge and Scheu-hammer, 1993
Copper	Rat	Single oral dose		LOAEL for reproductive effects		152	NIOSH, 1985 and RTECS, 1994
	Rat	Oral LD_{50}	NR	Mortality	940		Sax, 1984
	Mouse	Oral	30 days	Decreased litter sizes with teratogenic effects		100	Lecyk, 1980
	Mallard	Oral	NR	LOAEL		29	NRC, 1977

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
	Mallard	Oral (subchronic)	29 days	NOAEL for survivorship	2.1		Demayo et al., 1982
Lead	Guinea pig	Single oral dose		LD_{50}	300		Sax, 1984
	Rat	Oral	3 weeks	50% of progeny dead		200	
	Rat	Oral (subchronic)	12-14 days	Decreased fetal body weight		2.5	McClain and Becker, 1972
	Rat	Oral	NR	LOAEL for reproductive effects		790	RTECS, 1994
	Rat	Oral	NR	LOAEL for reproductive effects		1,140	RTECS, 1994
	Rat	Oral	NR	LOAEL for reproductive effects		520	RTECS, 1994
	Rat	Oral	NR	LOAEL for reproductive effects		1,100	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		1,120	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		6,300	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		300	RTECS, 1994
	Mouse	Oral	NR	LOAEL for reproductive effects		4,800	RTECS, 1994
	Domestic animal	Oral	NR	LOAEL for reproductive effects		662	RTECS, 1994
	Japanese quail	Oral LD_{50}	5 days	Mortality	24,752		Hill and Camerdese, 1986
	Rock dove	Oral (chronic)	NR	Kidney pathology; learning deficiencies		6.25	Anders er al., 1982 and Dietz et al., 1979
	Rock dove	Oral LD_{50}	NR	Mortality	375		Kendall and Scanlon, 1985
Lead acetate	Chicken	Oral	4 weeks	Growth rate suppressed; no mortality or hematological effects		169	Eisler, 1988b
Metallic lead powder	American kestrel nestlings	Oral	10 days	Reduced growth and brain weight; abnormal development		125	Eisler, 1988b
Tetraethyl lead	Rat	Single oral dose		LD_{50}	12		Eisler, 1988b
	Cattle	Oral	105 days	LOAEL for mortality	6		Eisler, 1988b
	Horse	Oral	NR	LOAEL for mortality	2.4		Eisler, 1988b

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

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Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
Triethyl lead chloride	Starling	Oral	11 days	Reduced food consumption; no mortality		2.8	Eisler, 1988b
Manganese	Mouse	Oral (subchronic)	6 months	NOAEL for mortality		2,300	ATSDR, 1990e
	Mouse	Oral (subchronic)	90 days	LOAEL for delayed growth of testes		140	ATSDR, 1990e
	Mouse	Oral (chronic)	103 weeks	NOAEL for mortality		810	ATSDR, 1990e
	Rat	Single oral dose	1 dose	LD_{50}	410		ATSDR, 1990e
	Rat	Oral (acute)	20 days	LD_{50}	225		ATSDR, 1990e
	Rat	Oral (subchronic)	10 weeks	NOAEL for hepatic effects		12	ATSDR, 1990e
	Rat	Oral (subchronic)	20 days	NOAEL for decreased litter weight during gestation		620	ATSDR, 1990e
	Rat	Oral (subchronic)	103 weeks	LOAEL for mortality	930		ATSDR, 1990e
	Guinea pig	Single oral dose	1 dose	LD_{50}	400		USEPA, 1984d
	Monkey	Oral (chronic)	18 months	LOAEL for weakness, rigidity		25	ATSDR, 1990e
	Rodents/ livestock	Oral (subchronic)	10 days - 2 months	LOAEL for decreased growth rate		250	Cunningham et al., 1966
	Mouse	Oral (subchronic)	180 days	NOAEL for mortality		2,300	Gianutsos and Murray, 1982
Mercury	Mouse	Single oral dose		LD_{50}	22		NIOSH, 1985
	Mouse	Oral	50 days	Embryotoxicity		0.9	Suzuki, 1979
	Mouse	Oral	Day 0-18 (gest)	Embryolethality and teratogenicity		0.7	Suzuki, 1979
	Rat	Single oral dose		LD_{50}	18		NIOSH, 1985
	Rat	Oral	Day 6-14 (gest)	Retarded fetus growth		4	Suzuki, 1979
	Chicken	Single oral dose		LD_{50}	20		Fimreite, 1979
	Bantam chicken	Single oral dose		LD_{50}	190		Fimreite, 1979
	Japanese quail	Oral	NR	LOAEL for reproductive effects		5	Fimreite, 1979
	Bobwhite quail	Oral	5 days	LD_{50}	523		Hill et. al., 1975

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
Inorganic mercury	Mouse	Oral	18 days	LOAEL for mortality	6.3		Suzuki, 1979
	Mouse	Oral	38 days	LOAEL for mortality	5		Suzuki, 1979
	Mouse	Oral	Day 6-17 (gest)	Stillbirths and neonatal death		4	Suzuki, 1979
	Japanese quail	Diet	3 weeks	Depressed gonad weights		0.81[a]	Eisler, 1987b
	Japanese quail	NR	14d post treatment	LD_{50}	31.1		Eisler, 1987b
	Coturnix	NR	14d post treatment	LD_{50}	26 to 54		Eisler, 1987b
Ethylmercury	Rock dove	Single oral dose		LD_{50}	22.8		Eisler, 1987b
	Prairie chicken	Single oral dose		LD_{50}	11.5		Eisler, 1987b
	Chuckar	Single oral dose		LD_{50}	26.9		Eisler, 1987b
	Gray partridge	Single oral dose		LD_{50}	17.6		Eisler, 1987b
Methylmercury	Mink	Diet	2 months	Fatal to 100%	0.048[a]		Eisler, 1987b
	House sparrow	NR	14d post treatment	LD_{50}	12.6 to 37.8		Eisler, 1987b
	Coturnix	NR	14d post treatment	LD_{50}	11 to 27		Eisler, 1987b
	Fulvous whistling duck	NR	14d post treatment	LD_{50}	37.8		Eisler, 1987b
	Black duck	Oral	28 weeks	Reproduction inhibited		0.22[a]	Eisler, 1987b
	Northern bobwhite	NR	14d post treatment	LD_{50}	23.8		Eisler, 1987b
Organomercury	Mule deer	Single oral dose		LD_{50}	17.9		Eisler, 1987b
	Japanese quail	NR	14d post treatment	LD_{50}	14.4 to 33.7		Eisler, 1987b
	Ring-necked pheasant	NR	14d post treatment	LD_{50}	11.5 to 26.8		Eisler, 1987b
	River otter	Diet	NR	Fatal	0.14[a]		Eisler, 1987b

See notes at end of table.

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

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Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	
	Rat	Oral	NR	Reduced fertility		0.5	Eisler, 1987b
	Pig	Oral	Pregnancy	High incidence of stillbirths		0.5	Eisler, 1987b
	Monkey	Oral	Day 20-30 (gest)	Maternally toxic and abortient		0.5	Eisler, 1987b
	Cat	Oral	Day 10-58 (gest)	Increased incidence of anomalous fetuses		0.25	Eisler, 1987b
	Dog	Oral	Pregnancy	High incidence of stillbirths		0.1 to 0.25	Eisler, 1987b
	Mallard	Oral	NR	Reproduction, behavior		0.064	USEPA, 1993
	Gray pheasant	Oral	30 days	Reduced reproductive ability		0.64	Eisler, 1987b
Nickel	Rat	Single oral dose	1 dose	LD_{50}	67		ATSDR, 1987d
	Rat	Oral	NR	LOAEL for reproductive effects		158	RTECS, 1994
	Rat	Oral	2 years	Decreased body weight gain		50	ATSDR, 1987d
	Japanese quail	Oral (acute)	5 days	Mortality	304		Hill and Camardese, 1986
Silver	Mouse	Intraperitoneal (acute)		Mortality	34		NIOSH, 1985
	Mouse	Oral (chronic)	125 days	LOAEL for hypoactivity		18.1	ATSDR, 1990f
	Rat	Oral	2 week	NOAEL for mortality		181.2	ATSDR, 1990f
	Rat	Oral (chronic)	37 weeks	LOAEL for lack of weight gain		222.2	ATSDR, 1990f
Vanadium	Rat	Oral (subchronic)	2 months	LOAEL for hypertension		15	Susic and Kentera, 1986
	Rat	Oral (subchronic)	35 days	NOAEL for developmental effects		8.4	Domingo et al., 1986
	Japanese quail	Oral dose	5 days	LD_{50}	96		Hill and Camardese, 1986
	Chicken	Oral (subchronic)	6 weeks	LOAEL for decreased egg-laying		11	Berg et al., 1963
Zinc	Rat	Single oral dose		LD_{50}	2,510		Sax, 1984
	Rat	Oral	Gestation	Fetal resorptions in 4-20% of population		200	Schlicker and Cox, 1968
	Ferret	Oral	3-13 days	LOAEL for mortality	390		Straube et. al., 1980
Zinc phosphide	Mallard	Diet	5 days	LC50	6,458[a]		Hill et. al., 1975

Appendix D-4 (Continued)
Ingestion Toxicity Information for Wildlife Receptors

Basewide Ecological Risk Assessment
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Chemical	Test Species	Test Type	Duration	Effect	Result (mg/kg BW/day)		Reference
					Lethal	Sublethal	

a) Converted to dose per kilogram body weight by multiplying by food ingestion rate and dividing by body weight.

Notes:
mg/kg BW/day = milligrams per kilogram body weight per day.
NR = not reported.
LD_{50} = Dose resulting in 50 percent mortality in test population.
RTECS = Registry of Toxic Effects of Chemical Substances.
LOAEL = lowest observed adverse effect level.
NOAEL = no observed adverse effect level.
ATSDR = Agency for Toxic Substance and Disease Registry.
IRIS = Integrated Risk Information System.
NIOSH = National Institute for Occupational Safety and Health.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
USEPA = U.S. Environmental Protection Agency.
% = percent.
14d = 14 days
USFWS = U.S. Fish and Wildlife Service.

Appendix D-4 Reference List

Agency for Toxic Substances and Disease Registry (ATSDR). 1987a. "Toxicological Profile for Selected PCBs"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

ATSDR. 1987b. "Toxicological Profile for Dieldrin"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

ATSDR. 1987c. "Toxicological Profile for Beryllium"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

ATSDR. 1987d. "Toxicological Profile for Nickel"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

ATSDR. 1988a. "Toxicological Profile for Dichloromethanes"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (December).

ATSDR. 1988b. "Toxicological Profile for Selenium"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (December).

ATSDR. 1989. "Toxicological Profile for Di-*n*-butylphthalate"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

ATSDR. 1990a. "Toxicological Profile for 2,3-Benzofuran"; Agency for Toxic Substances and Disease Registry; U.S. Public Health Service.

ATSDR. 1990b. "Toxicological Profile for Cresols: o-Cresol, p-Cresol, m-Cresol"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (February).

ATSDR. 1990c. "Toxicological Profile for Naphthalene and 2-Methylnaphthalene"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (February).

ATSDR. 1990d. "Toxicological Profile for Barium"; Agency for Toxic Substances and Disease Registry; U.S. Public Health Service.

ATSDR. 1990e. "Toxicological Profile for Manganese"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

ATSDR. 1990f. "Toxicological Profile for Silver"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

ATSDR. 1991a. "Toxicological Profile for 2-Butanone"; Agency for Toxic Substances and Disease Registry; U.S. Public Health Service.

ATSDR. 1991b. "Toxicological Profile for Dieldrin"; Agency for Toxic Substances and Disease Registry; U.S. Public Health Service.

ATSDR. 1991c. "Toxicological Profile for Chromium"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

ATSDR. 1991d. "Toxicological Profile for Cobalt"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

ATSDR. 1991e. "Toxicological Profile for Endosulfan"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (December).

ATSDR. 1992a. "Toxicological Profile for Arsenic"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

ATSDR. 1992b. "Toxicological Profile for Toluene"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

ATSDR. 1992c. "Toxicological Profile for Chlordane"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

ATSDR. 1993a. "Toxicological Profile for Naphthalene". Agency for Toxic Substances and Disease Registry; U.S. Public Health Service.

ATSDR. 1993b. "Toxicological Profile for Benzo(a)pyrene"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

ATSDR. 1993c. "Toxicological Profile for Diethylphthalate"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service

Allen, J.R. et al. 1979. "Comparative Toxicology of Chlorinated Compounds on Mammalian Species"; *Pharmac. Ther.*; 7: 513-549.

Anders, E., D.D. Dietz, C.R. Bagnell, Jr., J. Gaynor, M.R. Krigman, D.W. Ross, J.D. Leander, and P. Mushak. 1982. "Morphological, Pharmacokinetics, and Hematological Studies of Lead Exposed Pigeons"; *Environ. Res.*; Vol. 28; 344-363.

Arthur D. Little, Inc. 1981. "Reference Constants for Priority Pollutants and Selected Chemicals"; Reference No. 84204; March, 1981; 33pp.

Aquatic Retrieval System. 1994. USEPA on-line Aquatic Database Record Search; April, (Toxicity Data) and July, (Bioconcentration Factors), 1994.

Baes, C.F. III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor. 1984. "A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture"; Oak Ridge National Laboratory; ORNL-5786; September 1984.

Bailey, S., P.J. Bunyan, D.M. Jennings and A. Taylor. 1970. Pestic. Sci. 1,66 (1970).

Barker, R.J. 1958. "Notes on some ecological effects of DDT sprayed on elms"; Journal of Wildlife Management, Vol. 22, Pgs. 269-274.

Berg, L.R., G.E. Bearse, and L.H. Merrill. 1963, Vanadium toxicity in laying hens. *Poult. Sci.* 42:1407-1411.

Bernuzzi, V., D.Desor, and P.R. Lehr. 1989. "Effects of Postnatal Aluminum Lactate Exposure on Neuromotor Maturation in Rat"; *Bulletin of Environmental Contamination and Toxicology* 42:451-5.

Beyer, W.N. 1990. "Evaluating Soil Contamination"; U.S. Fish and Wildlife Service, Biological Report 90(2).

Beyer, W.N. and E.J. Cromartie. 1987. A survey of Pb, Cu, Zn, Cd, Cr, As and Se in earthworms and soil from diverse sites. Env. Mon. Assessment. 8(1987) 27-36.

Beyer, W.N. and C. D. Gish. 1980. "Persistence in Earthworms and Potential Hazards to Birds of Soil applied DDT, Dieldrin, and Heptachlor"; J. of Applied Ecology, Vol. 17, pgs. 295-307.

Collett, N. and D.L. Harrison. 1968. "Some observations on the effects of using organochlorine sprays in an orchard"; New Zealand Journal of Science, Vol. 11, Pgs. 371-379.

Cramp, S., and P.J.S. Olney. 1967. Sixth Report Joint Committee British Trust for Ornithology and Royal Society for Protection of Birds on Toxic Chemicals. 26 pp.

Cunningham, G.N., M.B. Wise, and E.R. Barrick. 1966. Effect of high dietary levels of manganese on the performance and blood constituents of calves. J. Animal Sci. 25:532.

Davis, B.N.K. 1968. "The soil macrofauna and organochlorine insectice residues at twelve agricultural sites near Huntingdon"; Annals of Applied Biology, Vol. 61, pgs. 29-45.

Davis, B.N.K., and R.B. Harrison. *Nature, Lond.*, 211, 1424 (1966).

Demayo, A., M.C. Taylor, and K.W. Taylor. 1982. *Effects of Copper on Humans, Laboratory and Farm Animals, Terrestrial Plants, and Aquatic Life; CRC Critical Reviews in Environmental Control*; August; pp. 183-255.

Diercxsens, P., D. deWeck, N. Borsinger, B. Rosset, and J. Tarradellas. 1985. "Earthworm Contamination by PCBs and Heavy Metals"; *Chemosphere* 14:511-522.

Dietz, D.D., D.E. McMilland, and P. Mushak. 1979. "Effects of Chronic Lead Administration on Acquisition and Performance of Serial Position Sequences by Pigeons"; Toxicol. *Appl. Pharmacol.*; Vol. 47; 377-384.

Dimond, J.B., G.Y. Belyea, R.E. Kadunce, S.A. Getchell, and J.A. Blease. 1970. "DDT residues in robins and earthworms associated with contaminated forest soils"; The Canadian Entomologist, Vol. 102, Pgs. 1122-1130.

Domingo, J.L., J.L. Paternain, J.M. Llobet, and J Corbella. 1986. "Effects of Vanadium on Reproduction, Gestation, Parturition, and Lactation in Rats Upon Oral Administration"; *Life Sciences* 39:819-824.

Donahue, R.L., R.W. Miller, J.C. Skickluna. 1977. "Soils: An Introduction to Soils and Plant Growth"; 4th ed. Prentice-Hall, New Jersey, 1977.

Dunning, J.B. 1984. *Body Weights of 686 Species of North American Birds*. Western Bird Banding Association; Monograph No. 1; Cave Creek, Arizona; May, 1984.

Edwards, C.A. and A.R. Thompson. 1973. "Pesticides and the soil fauna"; Residue Reviews, Vol. 45, pgs. 1-79.

Eisler, R. 1985. "Cadmium Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review"; U.S. Fish and Wildlife Service Biological Report 85(1.2), 46 pp.

Eisler, R. 1986. Polychlorinated Biphenyl Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review; U.S. Fish Wildl. Serv. Biol. Rep. 85(1.7); 72 pp.

Eisler, R. 1987a. "Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review"; U.S. Fish and Wildlife Service Biological Report 85 (1.11), 81 pp.

Eisler, R. 1987b. "Mercury Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review"; U.S. Fish and Wildlife Service Biological Report 85 (1.10), 90 pp.

Eisler, R. 1988a. "Arsenic Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review"; U.S. Fish and Wildlife Service Biological Report 85 (1.12), 92 pp.

Eisler, R. 1988b. "Lead Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review"; U.S. Fish and Wildlife Service Biological Report 85 (1.14), 134 pp.

Eisler, R. 1990. Chlordane Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review; U.S. Fish Wildl. Serv. Biol. Rep. 85(1.21). 49 pp.

Fimreite, N. 1979. "Accumulation and Effects of Mercury on Birds"; Pages 601-626 in *The Biogeochemistry of Mercury in the Environment*, J.O. Nriagu (Ed.); Elsevier/-North Holland Biomedical Press, New York.

Forsyth, D.J. and T.J. Peterle. 1984. Species and Age Differences in Accumulation of ^{36} Cl-DDT by Voles and Shrews in the Field. Env. Poll. (series A); 33 (1984): 327-340.

Frakes, R.A., R.P. Sharma, C.C. Willhite, et al. 1986. Effect of cyanogenic glycosides and protein content in cassava diets on hamster prenatal development. Fundam. Appl. Toxicol. 7:191-198.

Garten, C.T. and J.R. Trabalka. 1983. "Evaluation of Models for Predicting Terrestrial Food Chain Behavior of Xenobiotics"; *Environ. Sci. Technol.*, Vol. 17, No. 10, p. 590-595.

Gianutsos, G., and M.T. Murray. 1982. Alterations in brain dopamine and GABA following inorganic or organic manganese administration. Neurotoxicology 3:75-81.

Gish, C.D. 1970. "Organochlorine insecticide residues in soils and soil invertebrates from agricultural lands"; Pesticides Monit. J., Vol. 3, No. 71.

Grant, L.D., C.A. Kimmel, G.L. West, C.M. Martinez-Vargas, and J.L. Howard. 1980. "Chronic Low-level Lead Toxicity in the Rat: II. Effects on Postnatal Physical and Behavioral Development"; *Toxicol. Appl. Pharmacol.*; Vol. 56; 42-58.

Hansch, C.H. and A. Leo. 1979. *Substituent Constants for Correlation Analysis in Chemistry and Biology*; John Wiley and Sons, Inc., 330 pp.

Heinz, G.H., D.J. Hoffman, and L.G. Gold. 1988. "Toxicity of Organic and Inorganic Selenium to Mallard Ducklings"; Arch. Env. Contam. Toxicol. (17): 561-568.

Hermayer, K.L., P.E. Stake, and R.L. Shippe. 1977. "Evaluation of Dietary Zinc, Cadmium, Tin, Lead, Bismuth and Arsenic Toxicity in Hens"; Poult. Sci. (56):1721 (Abstr.).

Hill, E.F. et al. 1975. "Lethal Dietary Toxicities of Environmental Pollutants to Birds"; U.S. Fish and Wildlife Service Special Scientific Report, Wildlife No. 191, Washington, D.C.

Hill, E.F., and M.B. Camardese. 1986. "Lethal Dietary Toxicities of Environmental Contaminants and Pesticides to Coturnix", U.S. Fish and Wildlife Service Tech. Rep. No. 2, Washington, D.C.

Hunt, L.B., and R.J. Sacho. 1969. J. Wild. Mgmt. 33, 336 (1969).

Integrated Risk Information System (IRIS). 1988-1993. "Volumes I and II. Chemical Files", U.S. Environmental Protection Agency.

Ivankovic, S., and R. Prenssmann. 1975. "Absence of Toxic and Carcinogenic Effects After Administration of High Doses of Chromium Oxide Pigment in Sub-acute and Long-term Feeding Experiments in Rats"; *Food Cosmetics and Toxicology* 13:347-51.

Jeffries, D.J. and B.N.K. Davis. 1968. "Dynamics of Dieldrin in Soil, Earthworms, and Song Thrushes"; J. Wildl. Manag., Vol. 32, pgs. 441-456.

Kenaga, E.E. 1973. "Factors to be Considered in the Evaluation of Pesticides to Birds in Their Environment"; in *Environmental Quality and Safety. Global Aspects of Chemistry, Toxicology and Technology as Applied to the Environment*; Volume 2, Academic Press, New York, NY; p. 166-181.

Kendall, R.J., and P.F. Scanlon. 1985. "Histology and Ultrastructure of Kidney Tissue from Ringed Turtle Doves that Ingested Lead"; *J. Environ. Pathol. Toxicol. Oncol.*; Vol. 6; 85-96.

Kimmel, C.A., L.D. Grant, C.S. Sloan, and B.C. Gladen. 1980. "Chronic Low-level Lead Toxicity on the Rat"; *Toxicol. Appl. Pharmacol.*; Vol. 56; 28-41.

Lecyk, M. 1980. Toxicity of Cupric Sulfate in Mice Embryonic Development. *Zool. Pol.* 28(2):101-105.

Levine, M.B., A.T. Hall, G.W. Barrett, and D.H. Taylor. 1989. "Heavy Metal Concentrations During Ten Years of Sludge Treatment to an Old-Field Community"; J. Environ. Qual., Vol. 18, pgs. 411-418.

Lindquist, O., K. Johansson, M. Aastrup, A. Andersson, L. Bringmark, G. Housenius, L. Håkanson, Å. Iverfeldt, M. Meili, and B. Timm. 1991. "Mercury in the Swedish Environment-Recent Research on Causes, Consequences and Corrective Measures"; Water, Air, and Soil Pollution (55): xi-xiii, 1991.

Llobet, J.M. et al. 1988. "Subchronic Oral Toxicity of Zinc in Rats"; *Bulletin of Environmental Contamination and Toxicology* 41:36-43.

Longcore, J.R., and R.C. Stendell. 1977. "Shell Thinning and Reproductive Impairment in Black Ducks After Cessation of DDE Dosage"; *Arch. Environm. Contam.*

MacFadyen, A. 1980. "Advances in Ecological Research"; Academic Press, Vol. 11, pgs. 218-327.

Machener, L. and D. Lorke. 1981. "Embryotoxic Effect of Cadmium on Rats upon Oral Administration"; Toxicology and Applied Pharmacology; Vol. 58:438-443.

MacKenzie,K.M. and D.M. Angevine. 1981. "Infertility in Mice Exposed in Utero to Benzo(a)pyrene"; *Biol. Repro.*; Vol. 24; 183-191.

Maughan, J.T. 1993. *Ecological Assessment of Hazardous Waste Sites*; New York, NY; Van Nostrand Reinhold; p. 352.

McClain, R.M., and B.A. Becker. 1972. "Effects of Organo-lead Compounds on Rat Embryonic and Fetal Development"; *Toxicology and Applied Pharmacology* 21: 265-274

McClain, M.A.R., and L.C. Hall. 1972. "DDE Thins Screech Owl Eggshells"; *Bull. Environ. Contam. Toxicol.* 8:65.

Merry, R.H., K.G. Tiller, and A.M. Alston. 1986. "The effects of contamination of soil with copper, lead, and arsenic on the growth and composition of plants. I. Effects of season, genotype, soil temperature and fertilizers"; Plant Soil, Vol. 91, pgs. 115-128.

National Cancer Institute. 1978. "Bioassays of Aldrin and Dieldrin for Possible Carcinogenicity"; Bethesda, MD: National Institutes of Health, National Cancer Institute, Division of Cancer Cause and Prevention, Carcinogenesis Program; U.S. Department of Health, Education, and Welfare, Publication No. 78-821.

National Institute for Occupational Safety and Health (NIOSH). 1985. "Registry of Toxic Effects of Chemical Substances"; *NIOSH Publication* No. 86-103, U.S. Department of Health and Human Services.

National Research Council (NRC). 1984. *Nutrient Requirements of Poultry*; Subcommittee on Poultry Nutrition; National Academy Press, Washington, D.C.

Newell, A.J., D.W. Johnson, and L.K. Allen. 1987. "Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife"; Technical Report 87-3, Division of Fish and Wildlife.

Outridge,P.M., and A.M. Scheuhammer. 1993. Bioaccumulation and toxicology of chromium: Implications for wildlife. *Rev. Environ. Contam. Toxicol.* 130:31-77

Peakall, D.B., and M.C. Peakall. 1973. "Effect of Polychlorinated Biphenyl on the Reproduction of Artificially Incubated Dove Eggs"; *Journal of Applied Ecology* 10: 863-868.

Pimentel, D.D., M.N. Culliney, G.S. Stoewsand, J.L. Anderson, C.A. Bache, W.H. Gutenmann, and D.J. Lisk. 1984. "Cadmium in Japanese quail fed earthworms inhabiting a gold course"; Nutr. Rep. Int., Vol. 30 pgs 475-481.

Potter et al. 1974. Total ^{14}C Residues and Dieldrin Residues in Milk and Tissues of Cows Fed Dieldrin-^{14}C; J. Agr. Food Chem., 22(5), 889-899.

Registry of Toxic Effects of Chemical Substances (RTECS). 1993, 1994. On-line Database Search.

Sax, N.I. 1984. *Dangerous Properties of Industrial Material*; 6th Edition; Van Nostrand Reinhold Company, New York.

Schlicker, S.A., and D.H. Cox. 1968. "Maternal Dietary Zinc, and Development and Zinc, Iron, and Copper Content of the Rat Fetus"; *J. Nutrition*; Vol. 95; 287-294.

Sheppard, M.I., D.H. Thibault, and S.C. Sheppard. 1985. "Concentrations and concentration ratios of U, As, and Co in Scots Pine grown in a waste-site soil and an experimentally contaminated soil"; Water Air Soil Pollut., Vol. 26,

Smith, R.M, W.L. Cunningham Jr., and G.A. Van Gelder. 1976. "Dieldrin Toxicity and Successive Discrimination Reversal in Squirrel Monkeys, *Saimiri sciureus*"; J. *Toxicol. Environ. Health*; Vol. 1; 747.

Smith, G.J., G.H. Heinz, D.J. Hoffman, J.W. Spann, and A.J. Krynitsky. 1988. "Reproduction in Black-Crowned Night Herons Fed Selenium"; Lake and Reservoir Management; 4(2): 175-180.

Stoewsand, G.S., W.H. Gutenmann, and D.J. Lisk. 1978. "Wheat Grown on Fly Ash: High Selenium Uptake and Response When Fed to Japanese Quail"; *J. Agric. Food Chem.*, Vol. 26, No. 3.

Straube,E.F., N.H. Schuster, and A.J. Sinclair. 1980. "Zinc Toxicity in the Ferret"; *J. Comp. Pathol.*; Vol. 90; 355-361.

Susic, D., and D. Kentera. 1986. Effect of chronic vanadate administration on pulmonary circulation in the rat. *Respiration* 49:68-72.

Suter, Glen W. 1993. "Ecological Risk Assessment"; Lewis Publishers, Chelsea, Michigan.

Suzuki, T. 1979. "Dose-effect and Dose-response Relationships of Mercury and its Derivatives"; Pages 399-431 in The Biogeochemistry of Mercury in the Environment, J.O. Nriagu (Ed.); Elsevier/North Holland Biomedical Press, New York.

Toxicology Data Bank (TDB). 1984. National Library of Medicine.

Travis, C.C., and A.D. Arms. 1988. "Bioconcentration of Organics in Beef, Milk, and Vegetation"; *Environ. Sci. Tech.*; Vol. 22; 271-274.

United States Environmental Protection Agency. 1976. *National Conference on Polychlorinated Biphenyls, Conference Proceedings*; Office of Toxic Substances; U.S. Environmental Protection Agency; EPA-560/6-75-004; p. 471.

USEPA. 1980a. "Ambient Water Quality Criteria for Cadmium"; Report No. 440/5-80-025; Office of Water Regulations and Standards Criteria and Standards Division, Washington D.C.; October.

USEPA. 1980b. "Ambient Water Quality Criteria for Endosulfan"; Washington, D.C.; Report No. 440/5-80-043.

USEPA. 1980c. "Ambient Water Quality Criteria for Phenol"; Washington, D.C.; Report No. 440/5-80-066.

USEPA. 1984a. "Health Effects Assessment for Methylene Chloride", Environmental Criteria and Assessment Office, September.

USEPA. 1984b. "Health Effects Assessment for Acenaphthylene", Environmental Criteria and Assessment Office, September, 1984.

USEPA. 1984c. "Health Effects Assessment for Benzo(a)pyrene"; Office of Emergency and Remedial Response, United States Environmental Protection Agency, ECAO-CIN-H)22; September 1984.

USEPA. 1984d. "Health Assessment Document for Manganese", U.S. Environmental Protection Agency, Environmental Criteria and Assessment Office, EPA-600/8-83-013F; Cincinnati, Ohio; August, 1984.

USEPA. 1985a. "Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Beryllium"; U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C.

USEPA. 1985b. "Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: DDT/DDE/DDD"; U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C.

USEPA. 1985c. "Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Polychlorinated Biphenyls"; U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C.

USEPA. 1985d. "Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Mercury"; U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C.

USEPA. 1985e. "Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Beryllium"; U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C.

USEPA. 1988a. "Health Effects Advisory for Chlordane"; Office of Drinking Water, Washington, D.C.

USEPA. 1988b. "Recommendations for and Documentation of Biological Values for Use in Risk Assessment"; PB 88-179874, EPA 600/6-87-008, Washington, D.C.

USEPA. 1990a. "Basics of Pump-and-Treat Ground Water Remediation Technology"; U.S. Environmental Protection Agency, Office of Research and Development, EPA-600/8-90/003.

USEPA. 1990b. "Health Effects Advisory for Naphthalene"; U.S. Environmental Protection Agency, Office of Drinking Water, Washington, D.C.

USEPA. 1992. "Dermal Exposure Assessment: Principals and Applications Interim Report". Office of Research and Development. EPA/600/8-91/011B. January.

USEPA. 1993a. Superfund Chemical Data Matrix (SCDM); March, 1993.

USEPA. 1993b. *Great Lakes Quality Initiative Criteria Documents for the Protection of Wildlife (Proposal)*; Office of Water, Office of Science and Technology; EPA-822-r-93-007; Washington, DC, April, 1993.

United States Fish and Wildlife Service (USFWS). 1984. Handbook of Toxicity of Pesticides to Wildlife; fish and Wildlife Service; U.S. Department of the Interior; Resource Publication 153; Washington, D.C.

Verschueren, Karel. 1983. *Handbook of Environmental Data on Organic Chemicals: Second Edition*; Van Nostrand Reinhold, New York, 1310 pp.

Virgo, B.B., and G.D. Bellward. 1975. "Effects of Dietary Dieldrin on Reproduction in the Swiss-Vancouver (SWV) Mouse"; *Environ. Physiol. Biochem*; Vol. 5; 440-450.

Wang, D.S., R.W. Weaver, and J.R. Melton. 1984. "Microbial decomposition of plant tissue contaminated with arsenic and mercury"; Environ. Pollut., Vol. 43a, pgs. 275-282.

Webber, M.D., H.D. Monteith, and D.G.M. Corneau. 1983. Assessment of Heavy Metals and PCBs at Sludge Application Sites, J. WPCF. 55(2): 187-195.

Weimeyer, S.N. et al. 1986. Residues in American Kestrels and Relations to Reproduction; U.S. Fish and Wildlife Service Technical Report No. 6, Washington D.C.

Wheatley, G.A. and J.A. Hardman. 1968. "Organochlorine insecticide residues in earthworms from arable soils"; J. Sci. Fd Agric., Vol. 19, April 1968.

APPENDIX D-5

TOXICITY ANALYSES OF SEDIMENT SAMPLES FROM NAS CECIL FIELD, JACKSONVILLE, FLORIDA, LAKE FRETWELL

FINAL REPORT

TOXICITY ANALYSIS OF SEDIMENT SAMPLES FROM
NAS CECIL FIELD, JACKSONVILLE, FLORIDA
LAKE FRETWELL

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EXECUTIVE SUMMARY

Whole sediment toxicity tests were conducted at Environmental Science & Engineering, Inc. (ESE) with the freshwater invertebrates, *Hyalella azteca* and *Chironomus tentans*, on samples collected from the Lake Fretwell site of NAS Cecil Field, Jacksonville, Florida. The effect criteria for the tests were survival and growth. A total of 13 sediments including a control and a reference were used in the toxicity tests.

After 14 days of exposure, survival of *Hyalella azteca* in the reference (YWCSDTOX20), was significantly different ($P \leq 0.05$) from the control sediment. Survival of *Hyalella azteca* in samples from sample stations LFSDTOX11 and LFSDTOX12 were significantly different from the reference sediment. Growth, as weight and length, of *Hyalella azteca* in the sediment from all the sample stations was not significantly different from the control and reference. Growth of *Hyalella azteca* in sediments from sample stations LFSDTOX11 and LFSDTOX12 could not be determined due to 100 percent mortality. Survival of *Chironomus tentans* exposed to sediment from sample stations LFSDTOX9, LFSDTOX13, LFSDTOX14, LFSDTOX15, and RCSDTOX18 were significantly different from the control sediment. Survival of *Chironomus tentans* exposed to sediment from sample stations LFSDTOX9 and RCSDTOX18 were significantly different from the reference sediment. Growth of *Chironomus tentans* exposed to the sediment samples was not significantly different from the control or reference sediments.

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Appendix C: *Chironomus tentans* Sediment Test Raw Data

1.0 INTRODUCTION

Whole sediment bioassays were conducted at Environmental Science & Engineering, Inc. (ESE) on samples collected from Lake Fretwell, NAS Cecil Field, Jacksonville, Florida, to determine the potential toxicity of the test samples. Test organisms used for sediment toxicity tests were the freshwater invertebrates, *Hyalella azteca* and *Chironomus tentans*. The effect criteria for both species were survival and growth.

Sediment bioassays were conducted following ASTM E 1383-94 guidelines entitled *Standard Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates* and ESE in-house protocols. All raw data related to this study are maintained at ESE, 14220 West Newberry Road, Gainesville, Florida.

2.0 SAMPLE RECEIPT

Test sediments, collected between April 25 and 28, 1995, were received on ice at the ESE Gainesville office between April 26 and 29, 1995. Test samples were received in quantities of ~10-11 kilograms each. Upon receipt, the coolers were opened and the contents checked against the chain-of-custody to ensure that all the recorded samples were present. The temperature of the coolers was then measured using the temperature blanks provided in the coolers. Any observations were recorded in the sample receipt logbook. Approximately 25 L of control sediment were collected by ESE personnel for the whole sediment bioassays. The site from which the control sediment was collected, Marineland, Florida, has proven to be uncontaminated in previous tests. Chain-of-custody and other documentation are presented in Appendix A. All sediment samples were stored in a refrigerator at 4 $\pm$ 2 °C during the testing period.

3.0 WHOLE SEDIMENT BIOASSAY PROCEDURES

3.1 TEST ORGANISMS

Whole sediment bioassays were conducted using juvenile (second or third instar) *H. azteca* and second instar *C. tentans*. *H. azteca* (2-3 mm in length) were obtained from Chesapeake Cultures

(Hayes, VA) and *C. tentans* (second instar) were obtained from Environmental Consulting & Testing (Superior, WI). The suppliers' breeding and holding conditions, such as temperature and water hardness, were similar to those of the testing conditions, therefore, organisms were held <24 hours prior to test initiation. Test organisms were acclimated to any differences in water chemistry by diluting the receiving water with test dilution water to 50 percent of receiving water.

3.2 TEST DESIGN

Initiation of the whole sediment tests was staggered due to the schedule of sample receipt. Tests with sediment samples LFSDTOX11, LFSDTOX12, LFSDTOX13, LFSDTOX14, LFSDTOX15, LFSDTOX16, LFSDTOX17, and YWCSDTOX20 (reference) were initiated on April 29, 1995, while tests with samples LFSDTOX9, LFSDTOX10, RCSDTOX18, and GCSDTOX19 were initiated on April 30, 1995. Separate controls were used for each series of tests for *C. tentans* and *H. azteca*.

Prior to use in the tests, sediment samples were individually sieved using a 1 mm Nytex screen to homogenize the samples and remove any large debris or indigenous organisms. No water was added to aid in sieving. Approximately 200 grams of test or control sediment were introduced to the test chambers and uniformly leveled. Test chambers were 2 L glass jars (23 cm height and 13 cm diameter). Approximately 400 mL of overlying reconstituted freshwater were added to each test chamber and allowed to settle overnight with aeration provided at a rate of 60 bubbles per minute (bpm). The overlying water was siphoned out the following day and 800 mL of reconstituted water was added to achieve a ratio of 1 part sediment to 4 parts overlying water. The test system was then allowed to settle for 2 hours. Water quality measurements were taken and the test organisms were indiscriminately added to the test chambers. Whole sediment tests were conducted using four replicates of twenty *H. azteca* and four replicates of fifteen *C. tentans*, for a total of 80 *H. azteca* and 60 *C. tentans* per sample.

The whole sediment tests were 14-day static renewal tests, with the *H. azteca* test being renewed twice weekly and the *C. tentans* test being renewed once weekly. During renewals, approximately 50 percent of the overlying water was siphoned through a 0.5 mm mesh sieve. Any test organisms trapped on the sieve were pipetted back into the appropriate test chamber. New dilution water was then slowly siphoned into the test chamber while diverting the flow onto the side of the test chamber to minimize resuspension of the sediments. Dilution water for *H. azteca* was hard reconstituted water with a hardness of approximately 134 mg/L as $CaCO_3$; and dilution water for *C. tentans* was moderately hard reconstituted water with a hardness of approximately 85 mg/L as $CaCO_3$. *H. azteca* were fed 0.2 mL of a rabbit chow (Alachua County Feed and Seed Store, Gainesville, FL) solution twice a week following renewal of overlying water. *C. tentans* were fed a 1:6 ratio (5 mg: 30 mg) of Tetramin (That Fish Place, Lancaster, PA) and ground cereal leaves (Sigma Chemical Company, St. Louis, MO) weekly following renewal of overlying water.

The tests were conducted in a waterbath adjusted to maintain a temperature of 20 $\pm$ 2 °C under fluorescent lighting with a daily photoperiod of 16 hours light (600 Lux) and 8 hours dark. All test chambers were aerated at approximately 60 bpm. Temperature, pH, and dissolved oxygen concentrations (DO), were measured daily. On renewal days, water quality parameters (temperature, pH, DO, and conductivity) were measured prior to and immediately following renewal of overlying water. Water quality measurements were taken with the following instruments: temperature--Fisher Scientific digital thermocouple; pH--SA 290 Orion pH meter with an Orion 91-57 triode; dissolved oxygen--YSI, Model 57 DO meter; and conductivity--YSI, Model 33 SCT conductivity meter. Instruments were calibrated daily during the test period.

The test chambers were observed daily for organism entrapment at surface of overlying water, sediment avoidance, reproductive behavior, and organism emergence. The effect criteria for the tests were mortality and growth (measured as dry weight and/or length). At test termination, the overlying water was swirled and then poured through a 0.5 mm Nytex screen to collect and

count the test organisms. If all organisms were not immediately found, the remaining sediment was poured into a 0.50 mm nytex screen sieve or a glass pan for further observation. Individual lengths of *H. azteca* were measured at test termination using a Nikon dissecting microscope equipped with a micrometer. Growth, as group dry weight, was measured for both species by placing the organisms in pre-weighed aluminum pans and drying the organisms in a Blue-M oven at 60 °C for 24 hours. After 24 hours, the weigh pans were removed from the oven and placed in a desiccator to cool. When cooled, the weight of the pans were measured on a American Scientific S/P 180 analytical balance and the group weight of the organisms was determined.

4.0 STATISTICAL ANALYSIS

All bioassay data were evaluated by a statistical comparison of mean survival or growth in the test samples with the control samples using appropriate statistical procedures. Analysis of variance followed by the Duncan's Multiple Range Test (Snedecor and Cochran, 1980) and Dunnett's t-test (EPA/600/4-89/001) were used to determine statistical significance. Data were first checked for normality and homogeneity of variance using Shapiro-Wilk's and Bartlett's tests, respectively. If either of these assumptions were not met, data was transformed using a square-root arcsine transformation and checked for normality and homogeneity of variance prior to statistical analysis. Survival and growth in sediments from sample stations LFSDTOX9, LFSDTOX11, LFSDTOX12, LFSDTOX13, LFSDTOX14, LFSDTOX15, LFSDTOX16, LFSDTOX17, and the reference, YWCSDTOX20, were statistically compared to control 1. Survival and growth in sediments from sample stations LFSDTOX9, LFSDTOX10 RCSDTOX18, and GCSDTOX19 were statistically compared to control 2.

5.0 RESULTS AND DISCUSSION

A summary of all the biological endpoint data for samples from the Lake Fretwell of NAS Cecil Field, Jacksonville, Florida, is presented in Table 1.

Test conditions, including lighting, hardness, alkalinity, conductivity, temperature, and pH levels remained at acceptable levels throughout the testing period. Exposure water quality parameters are presented in Table 2 and 3 for *H. azteca* and *C. tentans*, respectively. Survival and growth data of the whole sediment bioassays with *H. azteca* and *C.tentans*, are presented in Tables 4 and 5, respectively. Control survivals were within acceptable limits for both organisms. Control survival of *H. azteca* was 100 percent in the first test series and 88 percent in the second test series. Control survival for *C. tentans* was 85 percent in the first test series and 75 percent in the second test series. Complete laboratory raw data are provided in Appendix B and C for *H. azteca* and *C. tentans*, respectively.

Survival of *H. azteca* in the laboratory control was significantly ($p \leq 0.05$) different from the sediments from sample stations LFSDTOX11, LFSDTOX12, LFSDTOX14, and YWCSDTOX20 (Table 4). Survival of *H. azteca* in the reference sample, YWCSDTOX20, was significantly ($p \leq 0.05$) different from sediments from sample stations LFSDTOX11 and LFSDTOX12. Growth of *H. azteca*, measured as length and dry weight, was not significantly ($p \leq 0.05$) different from the control and reference, and all other sediments tested. Growth of *H. azteca* in samples from sample stations LFSDTOX11 and LFSDTOX12 could not be determined due to 100 percent mortality (Table 4). Survival of *C. tentans* was significantly ($p \leq 0.05$) different from the control in sediment from stations LFSDTOX9, LFSDTOX13, LFSDTOX14, LFSDTOX15, and RCSDTOX18 (Table 5). Survival of *C. tentans* in the reference sediment was significantly ($p \leq 0.05$) different from sediments from only 2 stations: LFSDTOX9 and RCSDTOX18. Growth of *C. tentans* was not significantly ($p \leq 0.05$) different in any of the test sediments from the control and the reference sediments.

Behavioral observations recorded included organism emergence from the sediments and at the surface of the overlying water possibly due to toxicity, and amplexus (reproductive behavior of *H. azteca* noted at test termination).

6.0 CONCLUSION

The whole-sediment bioassay results indicate that survival of *H. azteca* was significantly ($p \leq 0.05$) different from the control in sediment from sample stations LFSDTOX11, LFSDTOX12, LFSDTOX14, and YWCSDTOX20 (reference). Survival of *H. azteca* in the reference sediment was significantly different from sediments from sample stations LFSDTOX11 and LFSDTOX12. Growth of *H. azteca*, measured as length and group dry weight, could not be determined in sediments from stations LFSDTOX11 and LFSDTOX12 due to 100 percent mortality. The whole-sediment bioassay results also indicate that survival of *C. tentans* was significantly ($p \leq 0.05$) different from the control in sediments from stations LFSDTOX9, LFSDTOX13, LFSDTOX14, LFSDTOX15, and RCSDTOX18. Survival of *C. tentans* in the reference was significantly different from sediments from sample stations LFSDTOX9 and RCSDTOX18. Growth of *C. tentans* was not significantly different in the control or reference, and any of the test sediments.

7.0 REFERENCES

American Society for Testing and Materials. ASTM E 1383-94. *Standard Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates*. 1994.

Gulley, D.D., A.M. Boelter, and H.L. Bergman. 1991. *Toxstat 3.3*. Department of Zoology and Physiology, University of Wyoming. April 1991.

Hamilton, M.A., R.C. Russo, and R.V. Thurston. 1977. *Trimmed Spearman-Karber Method for Estimating Median Lethal Concentrations in Toxicity Bioassays*. Environmental Science and Technology. 11(7):714-719; Correction 12(4):417 (1978).

Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods. 7th Edition. The Iowa State University Press, Ames, Iowa.

U.S. Environmental Protection Agency (EPA). 1988. *Computer Program and Users Guide for Probit and Dunnett's Analysis of Data from Acute and Short Term Chronic Toxicity Tests with Aquatic Organisms*. Prepared by Statistical Support Staff, Computer Sciences Corporation. Prepared for the Biological Methods Branch, Environmental Monitoring and Support Laboratory, Cincinnati, OH, 1988.

Table 1. Summary of Whole Sediment Bioassays Conducted with Samples From Lake Fretwell (LF), NAS Cecil Field, Jacksonville, Florida.

CECIL FIELD (SITE LF): SEDIMENT BIOASSAY RESULTS					
STATION NUMBER	*CHIRONOMUS* SURVIVAL	*CHIRONOMUS* MEAN GROWTH:WT	*HYALELLA* SURVIVAL	*HYALELLA* MEAN GROWTH:WT	*HYALELLA* MEAN GROWTH:LN
CONTROL 1	85%	1.06 g	100%	0.28	3.3 mm
LFSDTOX11	82%	1.74 g	0%*[a]	--	--
LFSDTOX12	80%	1.47 g	0%*[a]	--	--
LFSDTOX13	65%*	1.72 g	100%	0.29	3.4 mm
LFSDTOX14	62%*	1.91 g	93%*	0.29	3.4 mm
LFSDTOX15	63%*	1.37 g	100%	0.39	3.6 mm
LFSDTOX16	77%	1.87 g	98%	0.42	3.6 mm
LFSDTOX17	67%	0.88 g	100%	0.37	3.5 mm
YWCSDTOX20 (REF)	75%	1.05 g	95%*	0.32	3.4 mm

CECIL FIELD (SITE LF): SEDIMENT BIOASSAY RESULTS					
STATION NUMBER	CHIRONOMUS SURVIVAL	CHIRONOMUS MEAN GROWTH:WT	HYALELLA SURVIVAL	HYALELLA MEAN GROWTH:WT	HYALELLA MEAN GROWTH:LN
CONTROL 2	75%	1.45 g	88%	0.40	3.4 mm
LFSDTOX9	42%*[a]	1.50 g	94%	0.46	3.7 mm
LFSDTOX10	87%	1.47 g	99%	0.47	3.7 mm
RCSDTOX18	18%*[a]	1.17 g	98%	0.41	3.5 mm
GCSDTOX19	75%	1.24 g	88%	0.43	3.6 mm

Note: Growth of *H. azteca*, as group dry weight, is expressed as milligrams per organism.
WT = Weight
LN = Length
*significantly different from the control sediment
[a]significantly different from the reference sediment

Source: ESE, 1995

Table 2. Water Quality Measurement Ranges of Overlying Water During a 14-Day Toxicity Test Using Whole Sediment from NAS Cecil Field, Jacksonville, Florida, with *Hyalella azteca*

	Hyalella azteca			
Sample	Temp (°C)	pH (s.u.)	DO (mg/L)	Cond. (μmhos/cm)
Controls	19.9 - 21.1	7.9 - 8.4	7.7 - 8.8	230 - 275
LFSDTOX9	20.0 - 21.0	7.9 - 8.2	8.0 - 8.7	210 - 278
LFSDTOX10	20.0 - 21.1	8.1 - 8.3	7.9 - 8.6	180 - 250
LFSDTOX11	20.5 - 21.1	7.8 - 8.3	7.8 - 8.6	245 - 275
LFSDTOX12	19.8 - 21.1	7.6 - 8.4	7.7 - 8.6	230 - 270
LFSDTOX13	19.8 - 21.1	8.0 - 8.3	7.6 - 8.5	175 - 245
LFSDTOX14	19.8 - 21.1	7.5 - 8.2	7.7 - 8.6	110 - 220
LFSDTOX15	19.8 - 21.1	7.8 - 8.2	7.5 - 8.6	165 - 245
LFSDTOX16	19.9 - 21.0	7.8 - 8.3	7.5 - 8.6	185 - 250
LFSDTOX17	20.0 - 21.1	7.7 - 8.2	7.6 - 8.6	120 - 220
RCSDTOX18	19.9 - 21.9	7.6 - 8.2	7.6 - 8.7	130 - 235
GCSDTOX19	20.0 - 21.1	7.9 - 8.3	7.6 - 8.7	145 - 235
YWCSDTOX20(REF)	20.0 - 21.1	7.7 - 8.3	7.5 - 8.5	180 - 235

Source: ESE, 1995

Table 3. Water Quality Measurement Ranges of Overlying Water During a 14-Day Toxicity Test Using Whole Sediment from NAS Cecil Field, Jacksonville, Florida, with *Chironomus tentans*

	Chironomus tentans			
Sample	Temp (°C)	pH (s.u.)	DO (mg/L)	Cond. (μmhos/cm)
Controls	19.9 - 21.2	7.8 - 8.3	7.8 - 9.0	245 - 295
LFSDTOX9	19.9 - 21.0	7.5 - 8.2	7.5 - 9.0	250 - 285
LFSDTOX10	20.0 - 21.0	7.5 - 8.2	7.5 - 8.8	220 - 275
LFSDTOX11	20.0 - 21.2	7.7 - 8.2	7.9 - 8.8	268 - 300
LFSDTOX12	20.0 - 21.2	7.9 - 8.2	7.9 - 8.8	260 - 295
LFSDTOX13	20.1 - 21.2	7.4 - 8.2	7.9 - 8.7	210 - 260
LFSDTOX14	20.1 - 21.2	7.0 - 8.1	8.0 - 8.7	170 - 225
LFSDTOX15	20.1 - 21.2	6.9 - 7.9	7.9 - 8.6	200 - 255
LFSDTOX16	20.1 - 21.2	7.4 - 7.9	7.8 - 8.5	210 - 260
LFSDTOX17	20.0 - 21.2	7.0 - 8.0	7.8 - 8.6	185 - 250
RCSDTOX18	19.9 - 21.0	7.0 - 8.1	8.0 - 8.7	200 - 275
GCSDTOX19	20.0 - 21.1	7.2 - 7.9	7.9 - 8.7	200 - 260
YWCSDTOX20(REF)	20.0 - 21.2	7.3 - 7.8	7.8 - 8.7	200 - 260

Source: ESE, 1995.

Table 4. Survival and Growth of *Hyalella azteca* After 14 Days of Exposure to Whole Sediments Collected From NAS Cecil Field, Jacksonville, Florida (Page 1 of 2)

Sample	Replicate[a]	No. Alive (% Survival)	Growth/weight (mg/organism)	Growth/length (mm)
Control 1	A	20	0.26	3.3
	B	20	0.32	3.4
	C	20	0.28	3.4
	D	20	0.25	3.1
		80 (100%)	0.28[b]	3.3[b]
Control 2	A	18	0.38	3.2
	B	18	0.40	3.4
	C	19	0.43	3.5
	D	15	0.39	3.3
		70 (88%)	0.40[b]	3.4[b]
LFSDTOX9	A	19	0.54	3.8
	B	20	0.43	3.6
	C	18	0.48	3.7
	D	18	0.40	3.5
		75 (94%)	0.46[b]	3.7[b]
LFSDTOX10	A	19	0.46	3.7
	B	20	0.48	3.6
	C	20	0.50	3.6
	D	20	0.45	3.7
		79 (99%)	0.47[b]	3.7[b]
LFSDTOX11	A	0	--	--
	B	0	--	--
	C	0	--	--
	D	0	--	--
		0 (0%)[cd]	--	--
LFSDTOX12	A	0	--	--
	B	0	--	--
	C	0	--	--
	D	0	--	--
		0 (0%)[cd]	--	--
LFSDTOX13	A	20	0.25	3.2
	B	20	0.30	3.4
	C	20	0.31	3.4
	D	20	0.29	3.4
		80 (100%)	0.29[b]	3.4[b]
LFSDTOX14	A	17	0.31	3.5
	B	19	0.25	3.3
	C	18	0.32	3.5
	D	20	0.29	3.4
		74 (93%)[c]	0.29[b]	3.4[b]

Table 4. Survival and Growth of *Hyalella azteca* After 14 Days of Exposure to Whole Sediments Collected From NAS Cecil Field, Jacksonville, Florida (Page 2 of 2)

Sample	Replicate[a]	No. Alive (% Survival)	Growth/weight (mg/organism)	Growth/length (mm)
LFSDTOX15	A	20	0.40	3.5
	B	20	0.38	3.6
	C	20	0.41	3.7
	D	20	0.35	3.4
		80 (100%)	0.39[b]	3.6[b]
LFSDTOX16	A	20	0.42	3.5
	B	18	0.44	3.5
	C	19	0.41	3.6
	D	20	0.42	3.6
		77 (96%)	0.42[b]	3.6[b]
LFSDTOX17	A	20	0.28	3.2
	B	20	0.38	3.6
	C	20	0.39	3.6
	D	20	0.41	3.6
		80 (100%)	0.37[b]	3.5[b]
RCSDTOX18	A	18	0.42	3.4
	B	19	0.46	3.7
	C	20	0.36	3.3
	D	20	0.38	3.5
		77 (96%)	0.41[b]	3.5[b]
GCSDTOX19	A	16	0.40	3.5
	B	16	0.45	3.6
	C	18	0.43	3.6
	D	20	0.43	3.7
		70 (88%)[c]	0.43[b]	3.6[b]
YWCSDTOX20 (REF)	A	18	0.30	3.3
	B	20	0.34	3.5
	C	19	0.31	3.4
	D	19	0.33	3.4
		76 (95%)[c]	0.32[b]	3.4[b]

[a]Twenty organisms exposed per replicate
[b]Total mean growth of *H. azteca* (A+B+C+D/4)
[c] = Significantly different from control 1
[d] = Significantly different from the reference

Source: ESE 1995.

Table 5. Survival and Growth of *Chironomus tentans* After 14 Days of Exposure to Whole Sediments Collected From NAS Cecil Field, Jacksonville, Florida (Page 1 of 2)

Sample	Replicate[a]	No. Alive (% Survival)	Growth/weight (mg/organism)
Control 1	A	14	0.99
	B	13	0.96
	C	14	1.03
	D	10	1.27
		51 (85%)	1.06[b]
Control 2	A	10	1.11
	B	13	1.55
	C	11	1.60
	D	11	1.55
		45 (75%)	1.45[b]
LFSDTOX9	A	5	1.94
	B	8	1.26
	C	5	0.96
	D	7	1.84
		25 (42%)[de]	1.50[b]
LFSDTOX10	A	15	1.33
	B	13	1.42
	C	13	1.60
	D	11	1.54
		52 (87%)	1.47[b]
LFSDTOX11	A	13	2.01
	B	13	1.75
	C	11	1.98
	D	13	1.22
		50 (83%)	1.74[b]
LFSDTOX12	A	12	1.65
	B	13	1.22
	C	11	1.87
	D	12	1.13
		48 (80%)	1.47[b]
LFSDTOX13	A	10	1.60
	B	11	1.59
	C	8	1.83
	D	10	1.84
		39 (65%)[c]	1.72[b]
LFSDTOX14	A	11	2.01
	B	8	1.63
	C	9	2.20
	D	9	1.80
		37 (62%)[c]	1.91[b]

Table 5. Survival and Growth of *Chironomus tentans* After 14 Days of Exposure to Whole Sediments Collected From NAS Cecil Field, Jacksonville, Florida (Page 2 of 2)

Sample	Replicate[a]	No. Alive (% Survival)	Growth/weight (mg/organism)
LFSDTOX15	A	10	1.26
	B	8	2.06
	C	11	1.40
	D	9	0.76
		38 (63%)[c]	1.37[b]
LFSDTOX16	A	9	2.20
	B	11	1.55
	C	12	2.08
	D	14	1.66
		46 (77%)	1.87[b]
LFSDTOX17	A	12	1.26
	B	11	0.94
	C	9	0.50
	D	8	0.80
		40 (67%)	0.88[b]
RCSDTOX18	A	5	1.68
	B	1	0.60
	C	4	1.58
	D	1	0.80
		11 (18%)[de]	1.17[b]
GCSDTOX19	A	12	1.19
	B	10	1.07
	C	13	1.42
	D	10	1.27
		45 (75%)	1.24[b]
YWCSDTOX20 (REF)	A	9	0.93
	B	11	1.16
	C	15	0.93
	D	10	1.19
		45 (75%)	1.05[b]

[a]Fifteen organisms exposed per replicate
[b]Total mean growth of *C. tentans* (A+B+C+D/4)
[c] = Significantly different from control 1
[d] = Significantly different from control 2
[e] = Significantly different from the reference

Source: ESE 1995.

Appendix C: *Chironomus tentans* Sediment Test Raw Data

C. tentans CR
4-1-2-96
SURVIVAL

Cecil Field (Site LF): Sediment Bioassay Results
File: CECIL Transform: NO TRANSFORMATION

Bartlett's test for homogeneity of variance
Calculated B1 statistic = 5.66

Table Chi-square value = 18.48 (alpha = 0.01, df = 7)
Table Chi-square value = 14.07 (alpha = 0.05, df = 7)

Data PASS B1 homogeneity test at 0.01 level. Continue analysis.

Cecil Field (Site LF): Sediment Bioassay Results
File: CECIL Transform: NO TRANSFORMATION

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	7	43.219	6.174	2.343
Within (Error)	24	63.250	2.635	
Total	31	106.469		

Critical F value = 2.42 (0.05,7,24)
Since F < Critical F FAIL TO REJECT Ho: All equal

Cecil Field (Site LF): Sediment Bioassay Results
File: CECIL Transform: NO TRANSFORMATION

DUNNETT'S TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	YWCSDTOX20	11.250	11.250		
2	LFSDTOX11	12.500	12.500	-1.089	
3	LFSDTOX12	12.000	12.000	-0.653	
4	LFSDTOX13	9.750	9.750	1.307	
5	LFSDTOX14	9.250	9.250	1.742	
6	LFSDTOX15	9.500	9.500	1.525	
7	LFSDTOX16	11.500	11.500	-0.218	
8	LFSDTOX17	10.000	10.000	1.089	

Dunnett table value = 2.48 (1 Tailed Value, P=0.05, df=24,7)

Cecil Field (Site LF): Sediment Bioassay Results
File: CECIL Transform: NO TRANSFORMATION

DUNNETT'S TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	YWCSDTOX20	4			
2	LFSDTOX11	4	2.847	25.3	-1.250
3	LFSDTOX12	4	2.847	25.3	-0.750
4	LFSDTOX13	4	2.847	25.3	1.500
5	LFSDTOX14	4	2.847	25.3	2.000
6	LFSDTOX15	4	2.847	25.3	1.750
7	LFSDTOX16	4	2.847	25.3	-0.250
8	LFSDTOX17	4	2.847	25.3	1.250

H. azteca
CR 1-2-96
SURVIVAL

CECIL
File: B:\DRY. Transform: NO TRANSFORMATION

STEEL'S MANY-ONE RANK TEST - Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	RANK SUM	CRIT. VALUE	df	SIG
1	YWC	19.000				
2	11	0.000	10.00	None	4.00	
3	12	0.000	10.00	None	4.00	
4	13	20.000	24.00	None	4.00	
5	14	18.500	16.00	None	4.00	
6	15	20.000	24.00	None	4.00	
7	16	19.250	19.50	None	4.00	
8	17	20.000	24.00	None	4.00	

Critical values use k = 7, are 1 tailed, and alpha = 0.05

WARNING - There are no critical values for this combination of groups and replicates.

CECIL
File: B:\DRY. Transform: NO TRANSFORMATION

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	7	2279.969	325.710	801.747
Within (Error)	24	9.750	0.406	
Total	31	2289.719		

Critical F value = 2.42 (0.05,7,24)

Since F > Critical F REJECT Ho: All equal

CECIL
File: B:\DRY. Transform: NO TRANSFORMATION

DUNNETT'S TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	YWC	19.000	19.000		
2	11	0.000	0.000	42.157	*
3	12	0.000	0.000	42.157	*
4	13	20.000	20.000	-2.219	
5	14	18.500	18.500	1.109	
6	15	20.000	20.000	-2.219	
7	16	19.250	19.250	-0.555	
8	17	20.000	20.000	-2.219	

Dunnett table value = 2.48 (1 Tailed Value, P=0.05, df=24,7)

CECIL
File: B:\DRY. Transform: NO TRANSFORMATION

DUNNETT'S TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	YWC	4			
2	11	4	1.118	5.9	19.000
3	12	4	1.118	5.9	19.000
4	13	4	1.118	5.9	-1.000
5	14	4	1.118	5.9	0.500
6	15	4	1.118	5.9	-1.000
7	16	4	1.118	5.9	-0.250
8	17	4	1.118	5.9	-1.000

APPENDIX D-6

AQUIRE DATA

APPENDIX D-6
AQUIRE Toxicity Information

Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Cladocera*; Crustacean	< 24 H	FW; LAB	ST	18 H	(NR)	LC50	1220000	UG/L	200211	81
Acetone	*Palaemonetes kadiakensis*; Grass shrimp, freshwater prawn	JUVENILE	FW; LAB	ST	18 H	(NR)	LC50	2610000	UG/L	200212	81
Acetone	*Culex restuans*; White dotted mosquito	3RD INSTAR	FW; LAB	ST	18 H	(NR)	LC50	6190000	UG/L	200373	81
Acetone	*Centrarchidae*; Fish	5.3-7.2 CM, 3.5-3.9 G	FW; LAB	ST	96 H	(NR)	LC50	8300000	UG/L	202219	68
Acetone	*Amphipoda*; Crustacean	JUVENILE, 14-16 ANTENNA SEGMENTS	LAB	ST	18 H	(NR)	LC50	2780000	UG/L	202456	81
Acetone	*Corbicula manilensis*; Asiatic clam	1.0-2.7 G	FW; LAB	ST	96 H	(NR)	LC50	>20000000	UG/L	203161	79
Acetone	*Poeciliidae*; Fish	2-3 MO	FW; LAB	RN	14 D	(NR)	LC50	637000	UG/L	209503	81
Acetone	*Centrarchidae*; Fish	NR	FW; LAB	ST	96 H	(NR)	LC50	8300000	UG/L	213424	68
Acetone	*Cladocera*; Crustacean	1ST INSTAR, < 24 H	FW; LAB	ST	48 H	7.0 to 8.2 (Mean 7.7)	EC50IM	13500000	UG/L	213812	80
Acetone	*Gambusia affinis*; Mosquitofish	ADULT, FEMALE	FW; LAB	ST	24 H	8.0 to 8.5	LC50	13500000	UG/L	215458	57
Acetone	*Gambusia affinis*; MosquitofishS	ADULT, FEMALE	FW; LAB	ST	48 H	8.0 to 8.5	LC50	13000000	UG/L	215459	57
Acetone	*Gambusia affinis*; Mosquitofish	ADULT, FEMALE	FW; LAB	ST	96 H	8.0 to 8.5	LC50	13000000	UG/L	215460	57
Acetone	*Lepomis humilis*; Orangespotted sunfish	4-6 G	FW; LAB	ST	1 H	(NR)	LET	14250000 to 15050000	UG/L	215469	17
Acetone	*Scenedesmus quadricauda*; Green algae	NR	LAB	ST	NR	7.0	PGR	7500000	UG/L	217549	77
Acetone	*Cladocera*; Crustacean	NR	FW; LAB	ST	24 H	(NR)	LC50	10000	UG/L	218332	65
Acetone	*Cladocera*; Crustacean	NR	FW; LAB	ST	48 H	(NR)	LC50	10000	UG/L	218333	65

APPENDIX D-6
AQUIRE Toxicity Information

Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Rasbora heteromorpha*; Harlequinfish, red rasbora	1.3-3 CM	FW; LAB	RN	24 H	7.2	LC50	5700000	UG/L	219277	69
Acetone	*Rasbora heteromorpha*; Harlequinfish, red rasbora	1.3-3 CM	FW; LAB	RN	48 H	7.2	LC50	4000000	UG/L	219278	69
Acetone	*Scenedesmus quadricauda*; Green algae	INITIAL CULTURE TURBIDITY REPORTED	LAB	ST	7 D	(NR)	PGR	7500000	UG/L	223927	80
Acetone	*Entosiphon sulcatum*; Flagellate euglenoid	INITIAL CULTURE TURBIDITY REPORTED	LAB	ST	72 H	(NR)	PGR	28000	UG/L	223928	80
Acetone	*Chlorella pyrenoidosa*; Green algae	INITIAL CONC:1.0 MG CLR/L	LAB	ST	76 H	(NR)	GRO	330	UG/L	223929	78
Acetone	*Chlorella pyrenoidosa*; Green algae	INITIAL CONC:1.0 MG CLR/L	LAB	ST	76 H	(NR)	CEL	3330	UG/L	223930	78
Acetone	*Chlamydomonas eugametos*; Green algae	INITIAL CONC: 100000 CELLS/ML	LAB	ST	48 H	6.7	PGR	10000000	UG/L	223931	80
Acetone	*Cladocera*; Crustacean	< 24 H	FW; LAB	ST	48 H	(NR)	LC50	12600000	UG/L	225554	78
Acetone	*Cladocera*; Crustacean	< 24 H	FW; LAB	ST	48 H	(NR)	LC50	13300000	UG/L	225555	78
Acetone	*Cladocera*; Crustacean	< 24 H	FW; LAB	ST	48 H	(NR)	LC50	12100000	UG/L	225556	78
Acetone	*Cladocera*; Crustacean	< 24 H	FW; LAB	ST	48 H	(NR)	LC50	8800000	UG/L	225557	78
Acetone	*Cladocera*; Crustacean	11 D	FW; LAB	ST	48 H	(NR)	LC50	7460000	UG/L	225558	78
Acetone	*Cladocera*; Crustacean	11 D	FW; LAB	ST	48 H	(NR)	LC50	7810000	UG/L	225559	78
Acetone	*Selenastrum capricornutum*; Green algae	NR	LAB	ST	1 to 16 D	(NR)	PGR	40000000	UG/L	226760	75
Acetone	*Chlamydomonas reinhardtii*; Green algae	NR	LAB	ST	1 to 17 D	(NR)	PGR	79000	UG/L	226761	75
Acetone	*Chlorophyta*; ALGAE	NR	LAB	ST	1 to 20 D	(NR)	PGR	79000	UG/L	226762	75
Acetone	*Chrysophyta*; ALGAE	NR	LAB	ST	1 to 18 D	(NR)	PGR	79000	UG/L	226763	75

APPENDIX D-6
AQUIRE Toxicity Information

Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Chlorophyta*; ALGAE	NR	LAB	ST	1 to 14 D	(NR)	PGR	79000	UG/L	226764	75
Acetone	*Algae*, phytoplankton, algal mat	NITZSCHIA, SCENEDESMUS SP	LAB	ST	1 to 14 D	(NR)	PGR	79000	UG/L	226765	75
Acetone	*Gastropoda*; Mollusk	NR	FW; LAB	NR	48 H	(NR)	LC50	35000000	UG/L	229285	72
Acetone	*Semisulcospira libertina*; Marsh snail	NR	FW; LAB	NR	48 H	(NR)	LC50	35000000	UG/L	229286	72
Acetone	*Cipangopaludina malleata*; Mud snail	NR	FW; LAB	NR	48 H	(NR)	LC50	48000000	UG/L	229287	72
Acetone	*Gastropoda*; Mollusk	NR	FW; LAB	NR	48 H	(NR)	LC50	35000000	UG/L	229288	72
Acetone	*Chlorella pyrenoidosa*; Green algae	NR	LAB	ST	6.8 D	(NR)	PGR	10000000	UG/L	229289	75
Acetone	*Chlorella pyrenoidosa*; Green algae	INIT CONC 1000000 CELLS	LAB	ST	70 H	(NR)	PSE	10000000	UG/L	229290	75
Acetone	*Ambystoma mexicanum*; Salamander	3-4 WK	FW; LAB	ST	48 H	(NR)	LC50	20000000	UG/L	234302	80
Acetone	*Pipidae*; Amphibian	3-4 WK	FW; LAB	ST	48 H	(NR)	LC50	24000000	UG/L	234303	80
Acetone	*Cladocera*; Crustacean	24 H	FW; LAB	ST	24 H	7.6 to 7.7	LC50	>10000000	UG/L	253088	77
Acetone	*Leuciscus idus*; Ide, silver or golden orfe	NR	FW; LAB	ST	NR	(NR)	LC50	7505000	UG/L	255185	78
Acetone	*Scenedesmus quadricauda*; Green algae	NR	LAB	ST	8 D	(NR)	PGR	7500000	UG/L	257059	78
Acetone	*Anacystis aeruginosa*; Blue-green algae	NR	LAB	ST	8 D	(NR)	PGR	530000	UG/L	257060	78
Acetone	*Anacystis aeruginosa*; Blue-green algae	NR	LAB	ST	NR	7.0	MOR	530000	UG/L	261408	78
Acetone	*Scenedesmus quadricauda*; Green algae	NR	LAB	ST	NR	7.0	MOR	7500000	UG/L	261409	78

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Pimephales promelas*; Fathead minnow	NR	FW; LAB	FT	96 H	(NR)	MOR	9100000	ug/L	261999	78
Acetone	*Salvelinus fontinalis*; Brook trout	NR	FW; LAB	FT	96 H	(NR)	MOR	6070000	ug/L	262000	78
Acetone	*Lepomis macrochirus*; Bluegill	NR	FW; LAB	FT	96 H	(NR)	MOR	7300000	ug/L	262001	78
Acetone	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	FINGERLING, 9.4 CM, 10.8 G	FW; LAB	FT	24 H	8.0	LC50	6100000	UG/L	267444	78
Acetone	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	FINGERLING, 10.0 CM, 10.2 G	FW; LAB	ST	6 H	8.0	LET	12500000	UG/L	267445	78
Acetone	*Chironomus tentans*; Midge	2ND INSTAR, 10-14 D, MIXED SPECIES	FW; LAB	ST	48 H	(NR)	MOR	46900000	ug/L	268145	86
Acetone	*Daphnia magna*; Water flea	< 24 H, MIXED SPECIES	FW; LAB	ST	48 H	(NR)	MOR	23500000	ug/L	268147	86
Acetone	*Pimephales promelas*; Fathead minnow	0.12 G	FW; LAB	FT	96 H	7.5	LC50	8140000	UG/L	274731	83
Acetone	*Pimephales promelas*; Fathead minnow	0.12 G	FW; LAB	FT	96 H	7.5	LC50	7310000	UG/L	274732	83
Acetone	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	1.0 G	FW; LAB	ST	96 H	7.2 to 7.5	LC50	5540000	UG/L	276007	80
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	7 D	7.8 to 7.9	MOR	550000	UG/L	276274	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	14 D	7.8 to 7.9	MOR	550000	UG/L	276275	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	21 D	7.8 to 7.9	MOR	550000	UG/L	276276	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	28 D	7.8 to 7.9	MOR	550000	UG/L	276277	83

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	7 D	7.8 to 7.9	MOR	1100000	UG/L	276278	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	14 D	7.8 to 7.9	MOR	1100000	UG/L	276279	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	21 D	7.8 to 7.9	MOR	1100000	UG/L	276280	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	28 D	7.8 to 7.9	MOR	1100000	UG/L	276281	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	7 D	7.8 to 7.9	MOR	2200000	UG/L	276282	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	14 D	7.8 to 7.9	MOR	2200000	UG/L	276283	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	21 D	7.8 to 7.9	MOR	2200000	UG/L	276284	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	28 D	7.8 to 7.9	MOR	2200000	UG/L	276285	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	7 D	7.8 to 7.9	MOR	4300000	UG/L	276286	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	14 D	7.8 to 7.9	MOR	4300000	UG/L	276288	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	21 D	7.8 to 7.9	MOR	4300000	UG/L	276290	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	28 D	7.8 to 7.9	MOR	4300000	UG/L	276292	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	7 D	7.8 to 7.9	LET	8700000	UG/L	276296	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	ST	24 H	7.9 to 8.3	LC50	35000000	UG/L	276301	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	ST	48 H	7.9 to 8.3	LC50	31000000	UG/L	276305	83

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	28 D	7.8 to 7.9	REP	1100000	UG/L	276309	83
Acetone	*Cladocera*; Crustacean	<= 24 H	FW; LAB	FT	28 D	7.8 to 7.9	REP	4300000	UG/L	276311	83
Acetone	*Selenastrum capricornutum*; Green algae	LOG PHASE	FW; LAB	NR	96 H	(NR)	GRO	7000000	UG/L	276591	83
Acetone	*Chlorella pyrenoidosa*; Green algae	LOG PHASE	FW; LAB	NR	48 H	(NR)	GRO	3400000	UG/L	276592	83
Acetone	*Scenedesmus pannonicus*; Green algae	LOG PHASE	FW; LAB	NR	48 H	(NR)	GRO	4740000	UG/L	276593	83
Acetone	*Diptera*; Insect	3RD INSTAR	FW; LAB	NR	48 H	(NR)	LC50	15000000	UG/L	276594	83
Acetone	*Diptera*; Insect	3RD INSTAR	FW; LAB	NR	48 H	(NR)	LC50	17000000	UG/L	276595	83
Acetone	*Cnidarians*; CNIDARIA	BUDLESS	FW; LAB	NR	48 H	(NR)	LC50	13500000	UG/L	276596	83
Acetone	*Lymnaea stagnalis*; Great pond snail	3-4 WK	FW; LAB	NR	48 H	(NR)	LC50	7000000	UG/L	276597	83
Acetone	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	5-8 WK	FW; LAB	NR	48 H	7 to 8	LC50	7400000	UG/L	276598	83
Acetone	*Oryzias latipes*; Medaka, high-eyes	4-5 WK	FW; LAB	NR	48 H	(NR)	LC50	14300000	UG/L	276599	83
Acetone	*Pimephales promelas*; Fathead minnow	3-4 WK	FW; LAB	NR	48 H	(NR)	LC50	15000000	UG/L	276600	83
Acetone	*Tubificidae*; Oligoca	NR	FW; LAB	ST	48 H	(NR)	LC50	15000000	UG/L	296306	83
Acetone	*Diptera*; Insect	NR	FW; LAB	ST	48 H	(NR)	LC50	13000000	UG/L	296307	83
Acetone	*Hirudinea*; ANNELIDA	NR	FW; LAB	ST	48 H	(NR)	LC50	7000000	UG/L	296308	83
Acetone	*Asellus aquaticus*; Aquatic sowbug	NR	FW; LAB	ST	48 H	(NR)	LC50	7550000	UG/L	296309	83

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Lymnaea stagnalis*; Great pond snail	NR	FW; LAB	ST	48 H	(NR)	LC50	7000000	UG/L	296310	83
Acetone	*Dugesia lugubris*; Turbellarian, planarian	NR	FW; LAB	ST	48 H	(NR)	LC50	7500000	UG/L	296311	83
Acetone	*Cnidarians*; CNIDARIA	NR	FW; LAB	ST	48 H	(NR)	LC50	13500000	UG/L	296312	83
Acetone	*Corixa punctata*; Water boatman	NR	FW; LAB	ST	48 H	(NR)	LC50	5000000	UG/L	296313	83
Acetone	*Amphipoda*; Crustacean	NR	FW; LAB	ST	48 H	(NR)	LC50	6000000	UG/L	296314	83
Acetone	*Odonata*; Insect	NR	FW; LAB	ST	48 H	(NR)	LC50	6400000	UG/L	296315	83
Acetone	*Plecoptera*; Insect	NR	FW; LAB	ST	48 H	(NR)	LC50	10300000	UG/L	296316	83
Acetone	*Ephemeroptera*; Insect	NR	FW; LAB	ST	48 H	(NR)	LC50	7600000	UG/L	296317	83
Acetone	*Cladocera*; Crustacean	1ST AND 2ND INSTAR LARVAE	FW; LAB	ST	96 H	6.5 to 8.5	LC50	> 100000	UG/L	298027	86
Acetone	*Dugesia tigrina*; Turbellarian, flatworm	JUVENILE, 0.006 G	FW; LAB	ST	96 H	6.5 to 8.5	LC50	> 100000	UG/L	298028	86
Acetone	*Helisoma trivolvis*; Ramshorn snail	JUVENILE, 0.180 G	FW; LAB	ST	96 H	6.5 to 8.5	LC50	> 100000	UG/L	298029	86
Acetone	*Pimephales promelas*; Fathead minnow	JUVENILE, 0.2-0.5 G	FW; LAB	ST	96 H	6.5 to 8.5	LC50	> 100000	UG/L	298030	86
Acetone	*Amphipoda*; Crustacean	JUVENILE, 0.007 G	FW; LAB	ST	96 H	6.5 to 8.5	LC50	> 100000	UG/L	298031	86
Acetone	*Asellus intermedius*; Aquatic sowbug	JUVENILE, 0.012 G	FW; LAB	ST	96 H	6.5 to 8.5	LC50	> 100000	UG/L	298032	86
Acetone	*Lumbriculus variegatus*; Oligochaete	JUVENILE, 0.006 G	FW; LAB	ST	96 H	6.5 to 8.5	LC50	> 100000	UG/L	298033	86
Acetone	*Pimephales promelas*; Fathead minnow	28 D, 19.2 MM, 0.076 G	FW; LAB	FT	96 H	6.9	LC50	7280000	UG/L	302606	84

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Pimephales promelas*; Fathead minnow	33 D, 22.6 MM, 0.159 G	FW; LAB	FT	96 H	7.6	LC50	8120000	UG/L	302608	84
Acetone	*Pimephales promelas*; Fathead minnow	32 D, 18.0 MM, 0.087 G	FW; LAB	FT	96 H	7.6	LC50	6210000	UG/L	302624	84
Acetone	*Oryzias latipes*; Medaka, high-eyes	NR	FW; LAB	ST	24 H	(NR)	MOR	>10000000	ug/L	308253	86
Acetone	*Oryzias latipes*; Medaka, high-eyes	NR	FW; LAB	ST	48 H	(NR)	MOR	>10000000	ug/L	308254	86
Acetone	*Oryzias latipes*; Medaka, high-eyes	NR	FW; LAB	ST	24 H	(NR)	MOR	>10000000	ug/L	308255	86
Acetone	*Oryzias latipes*; Medaka, high-eyes	NR	FW; LAB	ST	48 H	(NR)	MOR	>10000000	ug/L	308256	86
Acetone	*Oryzias latipes*; Medaka, high-eyes	NR	FW; LAB	ST	24 H	(NR)	MOR	8300000	ug/L	308257	86
Acetone	*Oryzias latipes*; Medaka, high-eyes	NR	FW; LAB	ST	48 H	(NR)	MOR	8300000	ug/L	308258	86
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	ST	48 H	8.2	MOR	8098000	ug/L	313505	91
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	RN	240 H	8.2	MOR	6693000	ug/L	313506	91
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	RN	to 10 D	8.2	REP EC50	6469000	ug/L	313507	91
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	RN	to 10 D	8.2	REP EC50	5908000	ug/L	313508	91
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	RN	to 10 D	8.2	REP EC50	6928000	ug/L	313509	91
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	ST	to 10 D	8.2	MOR	1866000	ug/L	313510	91
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	RN	to 10 D	8.2	REP	5184000	ug/L	313511	91

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	RN	to 10 D	8.2	REP	5184000	ug/L	313512	91
Acetone	*Ceriodaphnia dubia*; Water flea	NEONATE, <12 H	FW; LAB	RN	to 10 D	8.2	REP	5184000	ug/L	313513	91
Acetone	*Daphnia magna*; Water flea	NEONATE, <12 H	FW; LAB	ST	to 11 D	8.2	REP	3110000	ug/L	313515	91
Acetone	*Daphnia magna*; Water flea	NEONATE, <12 H	FW; LAB	ST	to 11 D	8.2	REP	5184000	ug/L	313516	91
Acetone	*Daphnia magna*; Water flea	NEONATE, <12 H	FW; LAB	ST	to 11 D	8.2	REP	3110000	ug/L	313517	91
Acetone	*Daphnia magna*; Water flea	NEONATE, <12 H	FW; LAB	ST	48 H	8.2	MOR	9218000	ug/L	313518	91
Acetone	*Daphnia magna*; Water flea	NEONATE, <12 H	FW; LAB	ST	240 H	8.2	MOR	4068000	ug/L	313519	91
Acetone	*Daphnia magna*; Water flea	NEONATE, <12 H	FW; LAB	ST	to 11 D	8.2	REP EC50	6389000	ug/L	313520	91
Acetone	*Daphnia magna*; Water flea	NEONATE, <12 H	FW; LAB	ST	to 11 D	8.2	REP EC50	6406000	ug/L	313521	91
Acetone	*Daphnia magna*; Water flea	NEONATE, <12 H	FW; LAB	ST	to 11 D	8.2	REP EC50	6714000	ug/L	313522	91
Acetone	*Brachionus calyciflorus*; Rotifer	NEONATE	FW; LAB	ST	24 H	(NR)	MOR	51000	ug/L	313866	91
Mercury	*Caridina rajadhari*; Freshwater prawn	NR	FW; LAB	ST	48 H	(NR)	LC50	6.918	UG/L	202828	85
Mercury	*Caridina rajadhari*; Freshwater prawn	NR	FW; LAB	ST	72 H	(NR)	LC50	5.784	UG/L	202830	85
Mercury	*Caridina rajadhari*; Freshwater prawn	NR	FW; LAB	ST	96 H	(NR)	LC50	4.786	UG/L	202831	85
Mercury	*Lamellidens marginalis*; Mussel	NR	FW; LAB	RN	96 H	(NR)	LC50	10000	UG/L	219525	89

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Mercury	*Myriophyllum spicatum*; Water-milfoil	4 CM APEX	FW; LAB	ST	32 D	(NR)	EC50BM	3400	UG/L	231768	74
Mercury	*Myriophyllum spicatum*; Water-milfoil	4 CM APEX	FW; LAB	ST	32 D	(NR)	EC50BM	4400	UG/L	231769	74
Mercury	*Myriophyllum spicatum*; Water-milfoil	4 CM APEX	FW; LAB	ST	32 D	(NR)	EC50GR	12000	UG/L	231770	74
Mercury	*Myriophyllum spicatum*; Water-milfoil	4 CM APEX	FW; LAB	ST	32 D	(NR)	EC50GR	1200	UG/L	231771	74
Mercury	*Dugesia tigrina*; Turbellarian, flatworm	NR	FW; LAB	ST	96 H	7.3 to 7.9	LC50	270	UG/L	240762	74
Mercury	*Potamogeton crispus*; Curled pondweed	NR	FW; LAB	NR	NR	(NR)	PSE	5000	UG/L	257788	77
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	60 H	(NR)	LET	1000	UG/L	270876	57
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	7 D	(NR)	MOR	700	UG/L	270877	57
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	7 D	(NR)	MOR	500	UG/L	270878	57
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	7 D	(NR)	MOR	300	UG/L	270879	57
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	7 D	(NR)	MOR	290	UG/L	270880	57
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	1.25 H	(NR)	LET	100000	UG/L	270881	57
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	2.5 H	(NR)	LET	75000	UG/L	270882	57
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	4.5 H	(NR)	LET	50000	UG/L	270883	57
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	8.5 H	(NR)	LET	5000	UG/L	270884	57

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	24.25 H	(NR)	LET	1500	UG/L	270885	57
Mercury	*Cyprinidae*; Fish	1 SUMMER	FW; LAB	ST	4.5 H	(NR)	LET	50000	UG/L	270886	57
Mercury	*Cyprinidae*; Fish	1 SUMMER	FW; LAB	ST	12.58 H	(NR)	LET	5000	UG/L	270887	57
Mercury	*Cyprinidae*; Fish	1 SUMMER	FW; LAB	ST	72 H	(NR)	LET	1500	UG/L	270888	57
Mercury	*Cyprinidae*; Fish	1 SUMMER	FW; LAB	ST	4.25 D	(NR)	LET	1300	UG/L	270889	57
Mercury	*Cyprinidae*; Fish	1 SUMMER	FW; LAB	ST	7 D	(NR)	MOR	1000	UG/L	270890	57
Mercury	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	1 SUMMER	FW; LAB	ST	8.17 H	(NR)	LET	800	UG/L	270891	57
Mercury	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	1 SUMMER	FW; LAB	ST	11 H	(NR)	LET	500	UG/L	270892	57
Mercury	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	1 SUMMER	FW; LAB	ST	13.67 H	(NR)	LET	350	UG/L	270893	57
Mercury	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	1 SUMMER	FW; LAB	ST	7 D	(NR)	MOR	150	UG/L	270894	57
Mercury	*Salvelinus fontinalis*; Brook trout	1 SUMMER	FW; LAB	ST	7 D	(NR)	MOR	250	UG/L	270895	57
Mercury	*Salvelinus fontinalis*; Brook trout	1 SUMMER	FW; LAB	ST	16.33 H	(NR)	LET	800	UG/L	270896	57
Mercury	*Salvelinus fontinalis*; Brook trout	1 SUMMER	FW; LAB	ST	18 H	(NR)	LET	500	UG/L	270897	57
Mercury	*Salvelinus fontinalis*; Brook trout	1 SUMMER	FW; LAB	ST	21 H	(NR)	LET	350	UG/L	2708	
Mercury	*Cyprinidae*; Minnow, carp family	1 SUMMER	FW; LAB	ST	84 H	(NR)	LET	800	UG/L	271406	57

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Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Mercury	*Cyprinidae*; Fish	1 SUMMER	FW; LAB	ST	7.17 D	(NR)	LET	1100	UG/L	271407	57
Mercury	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	1 SUMMER	FW; LAB	ST	5.33 D	(NR)	LET	250	UG/L	271408	57
Mercury	*Salvelinus fontinalis*; Brook trout	1 SUMMER	FW; LAB	ST	4.25 D	(NR)	LET	300	UG/L	271409	57
Mercury	*Cyprinidae*; Minnow, carp family	2 SUMMERS	FW; LAB	ST	58 H	(NR)	LET	4500	UG/L	271410	57
Mercury	*Cyprinidae*; Fish	2 SUMMERS	FW; LAB	ST	4.3 D	(NR)	LET	1500	UG/L	271411	57
Mercury	*Oncorhynchus mykiss*; Rainbow trout, donaldson trout	2 SUMMERS	FW; LAB	ST	24 H	(NR)	LET	500	UG/L	271412	57
Mercury	*Salvelinus fontinalis*; Brook trout	2 SUMMERS	FW; LAB	ST	88 H	(NR)	LET	500	UG/L	271413	57
Mercury	*Amphipoda*; Crustacean	NR	FW; LAB	ST	7 D	(NR)	LET	100	UG/L	271414	57
Mercury	*Tubifex tubifex*; Tubificid worm	NR	FW; LAB	ST	7 D	(NR)	LET	300	UG/L	271415	57
Mercury	*Diptera*; Insect	LARVAE	FW; LAB	ST	7 D	(NR)	LET	3500	UG/L	271416	57
Mercury	*Trichoptera*; Insect	LARVAE	FW; LAB	ST	7 D	(NR)	LET	2000	UG/L	271417	57
Mercury	*Copepoda*; Crustacean	ADULT	FW; LAB	ST	48 H	(NR)	LC50	600	UG/L	279705	88
Mercury	*Diptera*; Insect	LARVAE	FW; LAB	ST	48 H	(NR)	LC50	290	UG/L	279711	88
Mercury	*Diptera*; Insect	LARVA-STATE L1	FW; LAB	ST	24 H	7 to 8.5	LC50	2280	UG/L	284329	89
Mercury	*Diptera*; Insect	LARVA-STATE L2	FW; LAB	ST	24 H	7 to 8.5	LC50	23400	UG/L	284330	89
Mercury	*Diptera*; Insect	LARVA-STATE L2	FW; LAB	ST	48 H	7 to 8.5	LC50	8040	UG/L	284331	89
Mercury	*Diptera*; Insect	LARVA-STATE L2	FW; LAB	ST	72 H	7 to 8.5	LC50	570	UG/L	284332	89
Mercury	*Diptera*; Insect	LARVA-STATE L2	FW; LAB	ST	96 H	7 to 8.5	LC50	240	UG/L	284333	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	24 H	7 to 8.5	LC50	29600	UG/L	284334	89

APPENDIX D-6
AQUIRE Toxicity Information

Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	48 H	7 to 8.5	LC50	6700	UG/L	284335	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	72 H	7 to 8.5	LC50	580	UG/L	284336	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	96 H	7 to 8.5	LC50	280	UG/L	284337	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	24 H	7 to 8.5	LC50	32300	UG/L	284338	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	48 H	7 to 8.5	LC50	6860	UG/L	284339	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	72 H	7 to 8.5	LC50	3040	UG/L	284340	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	96 H	7 to 8.5	LC50	570	UG/L	284341	89
Mercury	*Diptera*; Insect	LARVA-STATE L1	FW; LAB	ST	24 H	7 to 8.5	LC50	1690	UG/L	284342	89
Mercury	*Diptera*; Insect	LARVA-STATE L2	FW; LAB	ST	24 H	7 to 8.5	LC50	1960	UG/L	284343	89
Mercury	*Diptera*; Insect	LARVA-STATE L2	FW; LAB	ST	48 H	7 to 8.5	LC50	820	UG/L	284344	89
Mercury	*Diptera*; Insect	LARVA-STATE L2	FW; LAB	ST	72 H	7 to 8.5	LC50	260	UG/L	284345	89
Mercury	*Diptera*; Insect	LARVA-STATE L2	FW; LAB	ST	96 H	7 to 8.5	LC50	220	UG/L	284346	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	24 H	7 to 8.5	LC50	750	UG/L	284347	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	48 H	7 to 8.5	LC50	240	UG/L	284348	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	72 H	7 to 8.5	LC50	230	UG/L	284349	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	96 H	7 to 8.5	LC50	230	UG/L	284350	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	24 H	7 to 8.5	LC50	4800	UG/L	284351	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	48 H	7 to 8.5	LC50	790	UG/L	284352	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	72 H	7 to 8.5	LC50	710	UG/L	284439	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	96 H	7 to 8.5	LC50	480	UG/L	284440	89
Mercury	*Diptera*; Insect	LARVA-STATE L1	FW; LAB	ST	24 H	7 to 8.5	LC50	3180	UG/L	284442	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	24 H	7 to 8.5	LC50	2430	UG/L	284445	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	48 H	7 to 8.5	LC50	1760	UG/L	284450	89

APPENDIX D-6
AQUIRE Toxicity Information

Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	72 H	7 to 8.5	LC50	1360	UG/L	284453	89
Mercury	*Diptera*; Insect	LARVA-STATE L3	FW; LAB	ST	96 H	7 to 8.5	LC50	600	UG/L	284454	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	24 H	7 to 8.5	LC50	3230	UG/L	284456	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	48 H	7 to 8.5	LC50	1280	UG/L	284459	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	72 H	7 to 8.5	LC50	880	UG/L	284464	89
Mercury	*Diptera*; Insect	LARVA-STATE L4	FW; LAB	ST	96 H	7 to 8.5	LC50	880	UG/L	284467	89
Mercury	*Diptera*; Insect	EGGS	FW; LAB	ST	<=24 H	7 to 8.5	MOR	>10000	UG/L	284468	89
Mercury	*Diptera*; Insect	EGGS	FW; LAB	ST	7 to 96 H	7 to 8.5	MOR	>=320	UG/L	284470	89
Mercury	*Diptera*; Insect	EGGS	FW; LAB	ST	<=24 H	7 to 8.5	MOR	>=3200	UG/L	284572	89
Mercury	*Diptera*; Insect	EGGS	FW; LAB	ST	7 to 96 H	7 to 8.5	MOR	>=320	UG/L	284605	89
Mercury	*Caridina rajadhari*; Freshwater prawn	NR	FW; LAB	ST	24 H	(NR)	LC50	9.120	UG/L	288530	85
Mercury	*Lamellidens marginalis*; Mussel	32 G	FW; LAB	ST	48 H	(NR)	OC	5910	UG/L	292756	84
Mercury	*Lamellidens marginalis*; Mussel	5.0-6.0 CM	FW; LAB	RN	96 H	(NR)	LC50	5000	UG/L	311739	91
Mercury	*Lamellidens marginalis*; Mussel	5.0-6.0 CM	FW; LAB	RN	1 to 30 D	(NR)	GRO	500 to 2000	UG/L	311740	91
Mercury	*Lamellidens marginalis*; Mussel	5.0-6.0 CM	FW; LAB	RN	1 to 30 D	(NR)	OC	500 to 2000	UG/L	311741	91
Mercury	*Brachionus calyciflorus*; Rotifer	NEONATE	FW; LAB	ST	24 H	(NR)	LC50	60	UG/L	313882	91
Vanadium oxide sulfate	*Carassius auratus*; Goldfish	3-5 CM, 0.3-2.9 G	FW; LAB	ST - LAB	6 D	6.0 to 6.5	LC50	1,020	UG/L	228999	79
Vanadium oxide sulfate	*Poecilia reticulata*; Guppy	1.5-2.5 CM, 0.1-0.5 G	FW; LAB	ST - LAB	6 D	6.0 to 6.5	LC50	128	UG/L	229000	79

APPENDIX D-6
AQUIRE Toxicity Information

Chemical Name	Species Identification	Age/Life Stage	Test Condition	Route/ Method	Duration	pH	Endpoint	Effect Conc.	Units	Aquire Ref. #	Yr
Vanadium oxide sulfate	*Lepomis macrochirus*; Bluegill	NR	FW; LAB	ST - LAB	96 H	7.4	LC50	6,000	UG/L	287133	60
Vanadium oxide sulfate	*Pimephales promelas*; Fathead minnow	NR	FW; LAB	ST - LAB	96 H	7.4	LC50	4,800	UG/L	287131	60

APPENDIX D-7

STATISTICAL ANALYSES OF SEDIMENT TOXICOLOGICAL AND CHEMICAL DATA

APPENDIX D-7

STATISTICAL ANALYSES OF SEDIMENT TOXICOLOGICAL AND CHEMICAL DATA

Simple linear regressions were completed to determine if a relationship is present between ECPCs in sediment and mortality observed in the sediment toxicity testing. The regressions were completed by use of the Lotus 1,2,3 Version 4 for Windows computer software. An orcsine transformation was applied to all percentage mortality data prior to the regression analysis. Simple regression models assume that both the dependent and independent factors are continuous variables. The orcsine transformation helps to normalize the dependent response distribution.

Appendix D-7
Di-n-butylphthalate
Lake Fretwell and Rowell Creek Upstream of Lake Fretwell
Simple Linear Regressions

Statistical Analysis of Sediment Toxicological and Chemical Data

Di-n-butylphthalate in Sediment versus Amphipod Mortality

	Di-n-butyl. Sediment (ug/kg) (x)	Amphipod Mortality (y)
LF-SD-9	34	94
LF-SD-10	60	99
LF-SD-11	140	0
LF-SD-12	110	0
LF-SD-13	83	100
LF-SD-14	380	93
LF-SD-15	38	100
LF-SD-16	73	98
LF-SD-17	200	100
RC-SD-18	94	98
GC-SD-19	180	88
YWC-SD-2	110	95

Regression Output:

Constant		42.56391
Std Err of Y Est		37.98497
R Squared		0.000918
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)	0.01152	
Std Err of Coef.	0.120207	

Di-n-butylphthalate in Sediment versus Midge Larvae Mortality

	Di-n-butyl. Sediment (mg/kg) (x)	Midge Larvae Mortality (y)
LF-SD-9	34	42
LF-SD-10	60	87
LF-SD-11	140	82
LF-SD-12	110	80
LF-SD-13	83	65
LF-SD-14	380	62
LF-SD-15	38	63
LF-SD-16	73	77
LF-SD-17	200	67
RC-SD-18	94	18
GC-SD-19	180	75
YWC-SD-2	110	75

Regression Output:

Constant		41.88128
Std Err of Y Est		14.50514
R Squared		0.001628
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)	0.005862	
Std Err of Coef.	0.045903	

Appendix D-7
4,4-DDE
Lake Fretwell and Rowell Creek Upstream of Lake Fretwell
Simple Linear Regressions

Statistical Analysis of Sediment Toxicological and Chemical Data

4,4-DDE in Sediment versus Amphipod Mortality

	4,4-DDE Sediment (ug/kg) (x)	Amphipod Mortality (y)
LF-SD-9	0.66	94
LF-SD-11	0.27	0
LF-SD-14	0.87	93
LF-SD-17	0.21	100

Regression Output:

Constant		47.58821
Std Err of Y Est		46.17903
R Squared		0.035669
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	-22.9517	
Std Err of Coef.	84.38486	

4,4-DDE in Sediment versus Midge Larvae Mortality

	4,4-DDE Sediment (ug/kg) (x)	Midge Larvae Mortality (y)
LF-SD-9	0.66	42
LF-SD-11	0.27	82
LF-SD-14	0.87	62
LF-SD-17	0.21	67

Regression Output:

Constant		47.86608
Std Err of Y Est		14.01121
R Squared		0.154948
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	-15.5046	
Std Err of Coef.	25.60327	

Appendix D-7
Aroclor-1260
Lake Fretwell and Rowell Creek Upstream of Lake Fretwell
Simple Linear Regressions

Statistical Analysis of Sediment Toxicological and Chemical Data

Aroclor-1260 in Sediment versus Amphipod Mortality

	Aroclor Sediment (ug/kg) (x)	Amphipod Mortality (y)
LF-SD-11	4.1	0
LF-SD-15	14	100
LF-SD-16	3	98
RC-SD-18	6.6	98

Regression Output:

Constant		68.29232
Std Err of Y Est		47.8087
R Squared		0.203515
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	-3.98517	
Std Err of Coef.	5.574719	

Aroclor-1260 in Sediment versus Midge Larvae Mortality

	Aroclor Sediment (mg/kg) (x)	Midge Larvae Mortality (y)
LF-SD-11	4.1	82
LF-SD-15	14	63
LF-SD-16	3	77
RC-SD-18	6.6	18

Regression Output:

Constant		46.27482
Std Err of Y Est		23.65407
R Squared		0.072682
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	-1.09203	
Std Err of Coef.	2.758175	

Appendix D-7
alpha-Chlordane
Lake Fretwell and Rowell Creek Upstream of Lake Fretwell
Simple Linear Regressions

Statistical Analysis of Sediment Toxicological and Chemical Data

alpha-Chlordane in Sediment versus Amphipod Mortality

	a-Chlordane Sediment (ug/kg) (x)	Amphipod Mortality (y)
LF-SD-9	0.38	94
LF-SD-11	0.22	0
LF-SD-15	2.4	100
LF-SD-17	0.2	100
RC-SD-18	0.19	98

Regression Output:

Constant		59.45443
Std Err of Y Est		36.7974
R Squared		0.307437
No. of Observations		5
Degrees of Freedom		3
X Coefficient(s)	-21.9859	
Std Err of Coef.	19.05175	

alpha-Chlordane in Sediment versus Midge Larvae Mortality

	a-Chlordan Sediment (mg/kg) (x)	Midge Larvae Mortality (y)
LF-SD-9	0.38	42
LF-SD-11	0.22	82
LF-SD-15	2.4	63
LF-SD-17	0.2	67
RC-SD-18	0.19	18

Regression Output:

Constant		31.48707
Std Err of Y Est		19.11389
R Squared		0.029976
No. of Observations		5
Degrees of Freedom		3
X Coefficient(s)	3.013178	
Std Err of Coef.	9.896162	

Appendix D-7
Lead
Lake Fretwell and Rowell Creek Upstream of Lake Fretwell
Simple Linear Regressions

Statistical Analysis of Sediment Toxicological and Chemical Data

Lead in Sediment versus Amphipod Mortality

	Sediment (mg/kg) (x)	Amphipod Mortality (y)
LF-SD-9	6.3	94
LF-SD-10	3.4	99
LF-SD-11	14.8	0
LF-SD-12	4.7	0
LF-SD-13	6.4	100
LF-SD-14	75.8	93
LF-SD-15	11.4	100
LF-SD-16	10	98
LF-SD-17	14.7	100
RC-SD-18	8.5	98
GC-SD-19	17	88
YWC-SD-2	23.5	95

Regression Output:

Constant		52.52697
Std Err of Y Est		36.46762
R Squared		0.079142
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)	-0.52037	
Std Err of Coef.	0.561316	

Lead in Sediment versus Midge Larvae Mortality

	Lead Sediment (mg/kg) (x)	Midge Larvae Mortality (y)
LF-SD-9	6.3	42
LF-SD-10	3.4	87
LF-SD-11	14.8	82
LF-SD-12	4.7	80
LF-SD-13	6.4	65
LF-SD-14	75.8	62
LF-SD-15	11.4	63
LF-SD-16	10	77
LF-SD-17	14.7	67
RC-SD-18	8.5	18
GC-SD-19	17	75
YWC-SD-2	23.5	75

Regression Output:

Constant		42.34569
Std Err of Y Est		14.51303
R Squared		0.000542
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)	0.016446	
Std Err of Coef.	0.223387	

Appendix D-7
Manganese
Lake Fretwell and Rowell Creek Upstream of Lake Fretwell
Simple Linear Regressions

Statistical Analysis of Sediment Toxicological and Chemical Data

Manganese in Sediment versus Amphipod Mortality

	Manganese Sediment (mg/kg) (x)	Amphipod Mortality (y)
LF-SD-9	8.3	94
LF-SD-10	4.8	99
LF-SD-11	7	0
LF-SD-12	13.1	0
LF-SD-13	3.1	100
LF-SD-14	19.7	93
LF-SD-15	5.8	100
LF-SD-16	5	98
LF-SD-17	8.2	100
RC-SD-18	3.6	98
GC-SD-19	4.7	88
YWC-SD-2	8.7	95

Regression Output:

Constant		68.10221
Std Err of Y Est		34.72163
R Squared		0.165209
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)	-3.14301	
Std Err of Coef.	2.234177	

Manganesel in Sediment versus Midge Larvae Mortality

	Manganese Sediment (mg/kg) (x)	Midge Larvae Mortality (y)
LF-SD-9	8.3	42
LF-SD-10	4.8	87
LF-SD-11	7	82
LF-SD-12	13.1	80
LF-SD-13	3.1	65
LF-SD-14	19.7	62
LF-SD-15	5.8	63
LF-SD-16	5	77
LF-SD-17	8.2	67
RC-SD-18	3.6	18
GC-SD-19	4.7	75
YWC-SD-2	8.7	75

Regression Output:

Constant		39.67453
Std Err of Y Est		14.39407
R Squared		0.016859
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)	0.383539	
Std Err of Coef.	0.926192	

Appendix D-7
Nickel
Lake Fretwell and Rowell Creek Upstream of Lake Fretwell
Simple Linear Regressions

Statistical Analysis of Sediment Toxicological and Chemical Data

Nickel in Sediment versus Amphipod Mortality

	Nickel Sediment (mg/kg) (x)	Amphipod Mortality (y)
LF-SD-9	1.9	94
LF-SD-10	1.5	99
LF-SD-11	1.9	0
LF-SD-12	3.2	0
LF-SD-13	1.5	100
LF-SD-14	7.9	93
LF-SD-15	2.1	100
LF-SD-16	4.4	98
LF-SD-17	2.9	100
RC-SD-18	1.5	98
GC-SD-19	1.5	88
YWC-SD-2	3.2	95

Regression Output:

Constant		56.44705
Std Err of Y Est		37.0023
R Squared		0.051941
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)	-4.45656	
Std Err of Coef.	6.020881	

Nickel in Sediment versus Midge Larvae Mortality

	Nickel Sediment (mg/kg) (x)	Midge Larvae Mortality (y)
LF-SD-9	1.9	42
LF-SD-10	1.5	87
LF-SD-11	1.9	82
LF-SD-12	3.2	80
LF-SD-13	1.5	65
LF-SD-14	7.9	62
LF-SD-15	2.1	63
LF-SD-16	4.4	77
LF-SD-17	2.9	67
RC-SD-18	1.5	18
GC-SD-19	1.5	75
YWC-SD-2	3.2	75

Regression Output:

Constant		39.90262
Std Err of Y Est		14.39364
R Squared		0.016918
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)	0.971599	
Std Err of Coef.	2.342081	

APPENDIX E

APPENDIX E

PLATES

LIST OF PLATES

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4-13	PSC 9, Surface and Subsurface Soil Sample Lcations
4-14	PSC 12, Surface Soil Sample Locations
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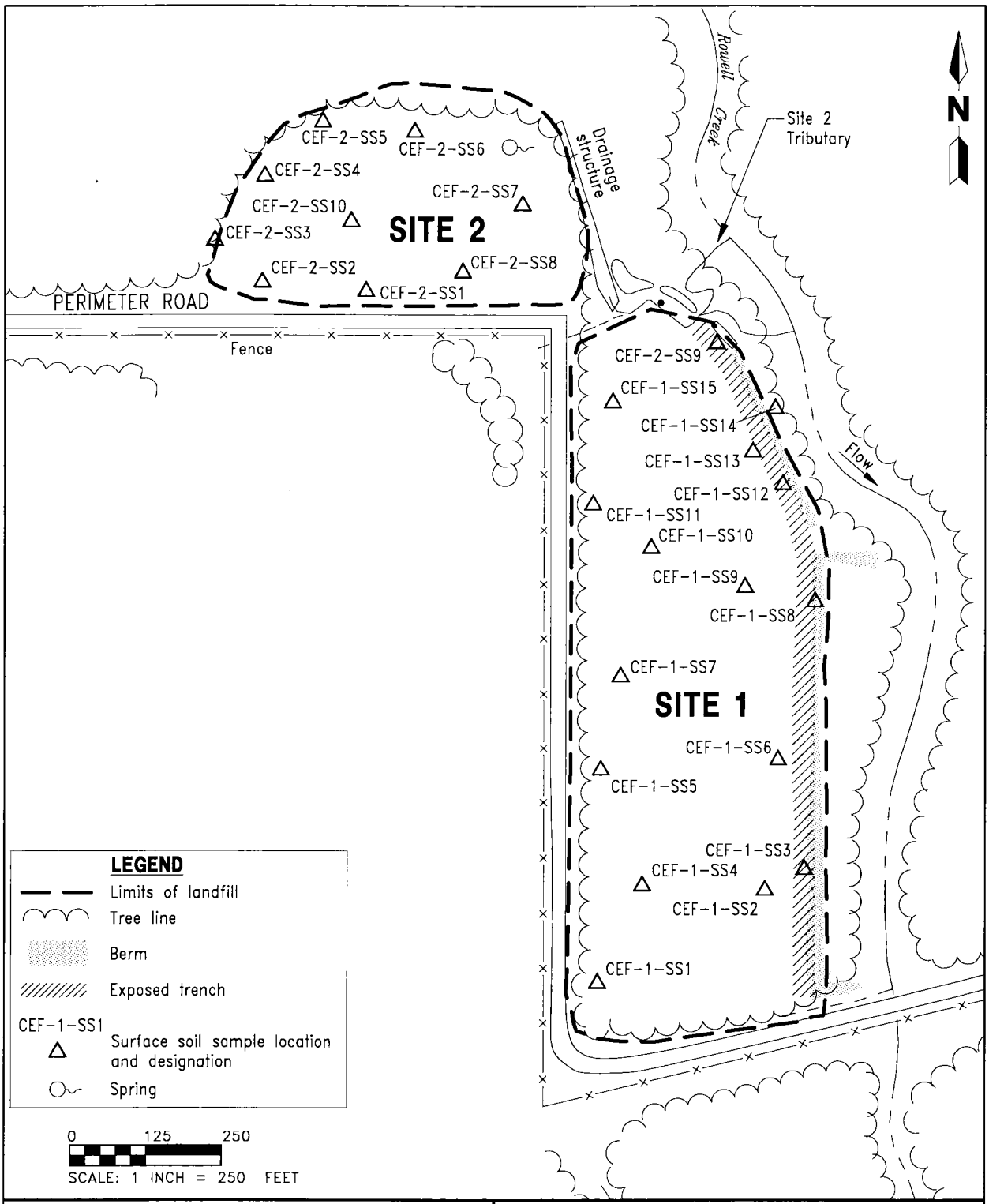

FIGURE 4-1
SITE 1 AND SITE 2, SURFACE SOIL SAMPLE LOCATIONS

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

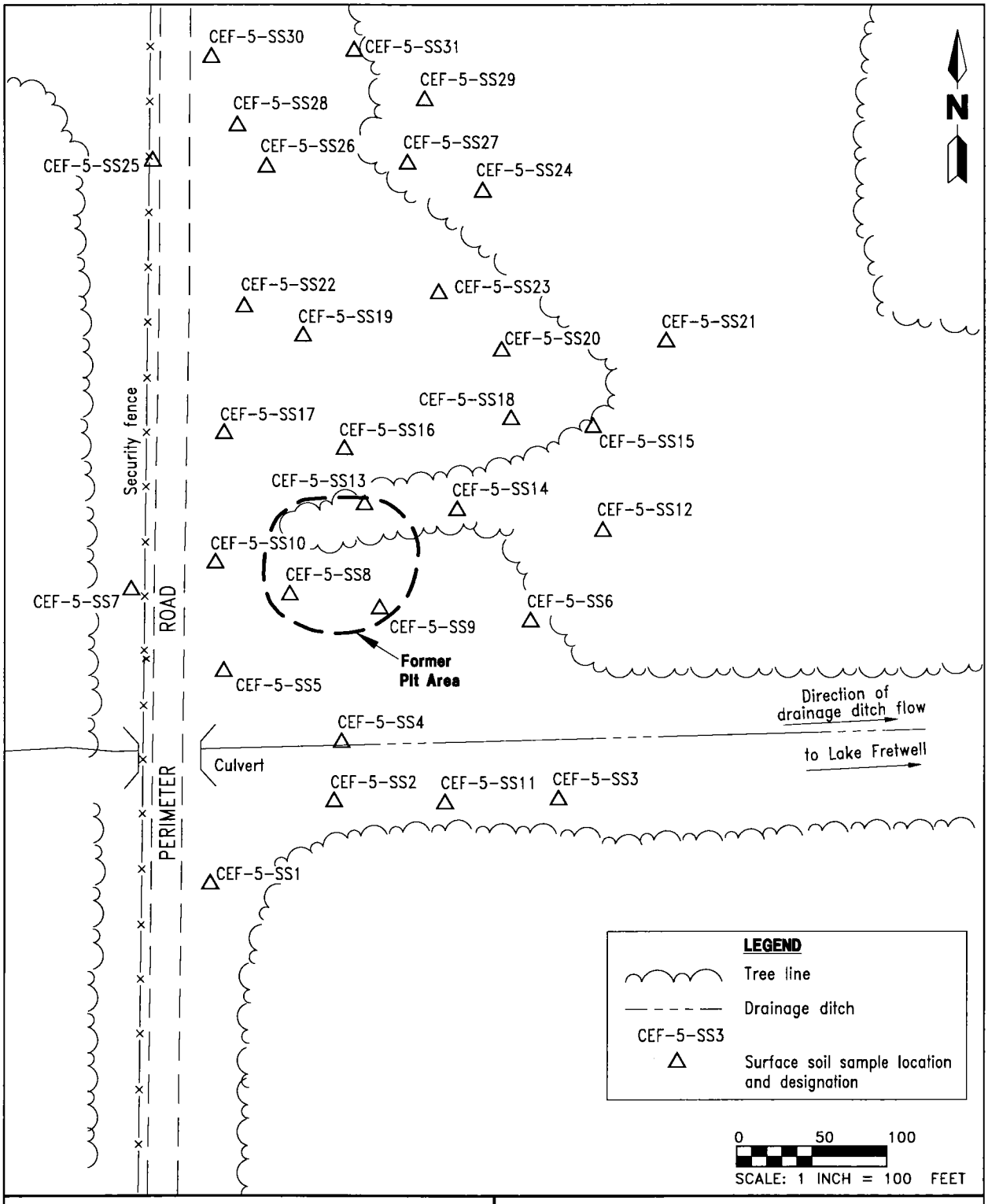

FIGURE 4-2
SITE 5, SURFACE SOIL SAMPLE LOCATIONS

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

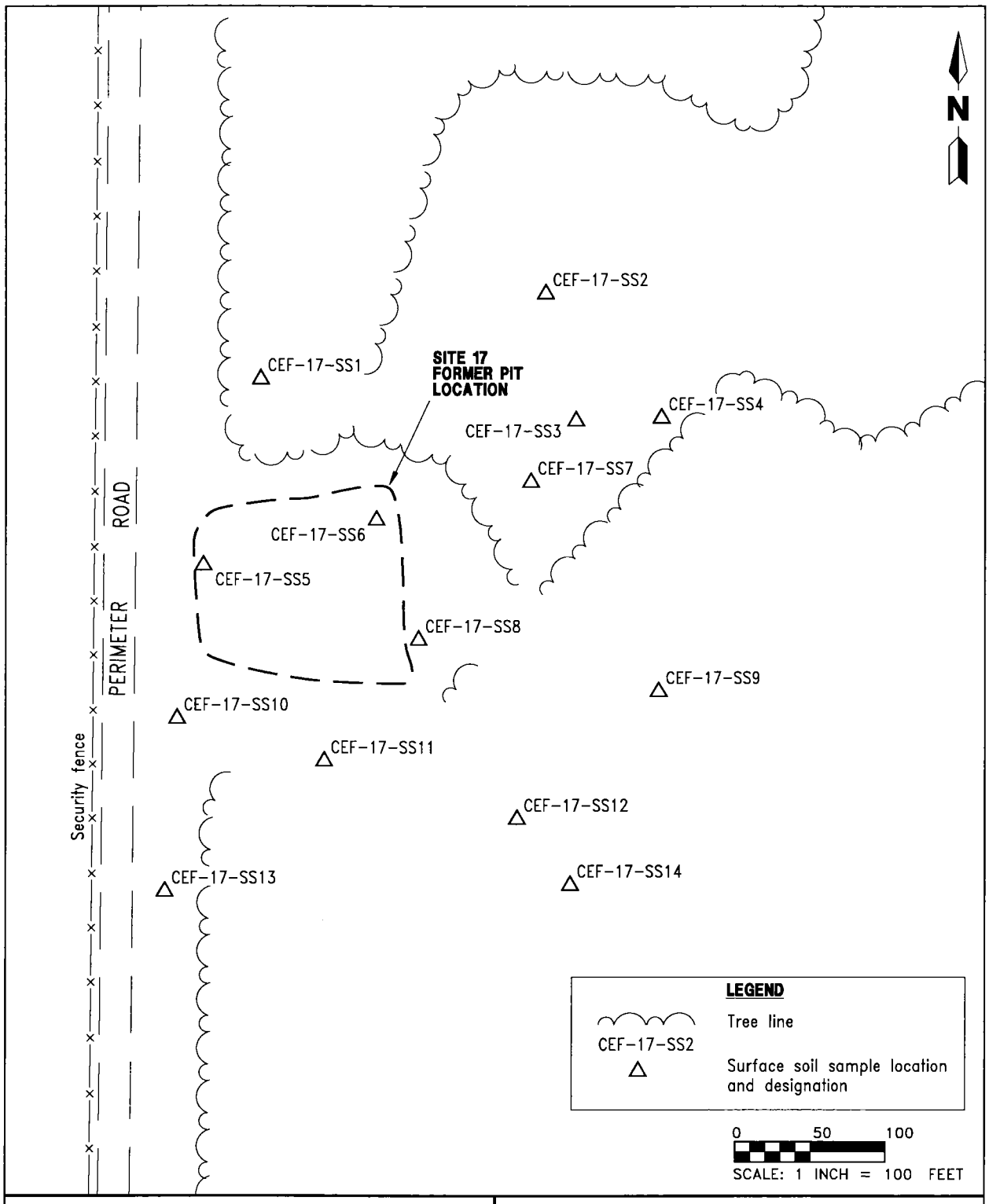

FIGURE 4-3
SITE 17, CONFIRMATORY SURFACE SOIL SAMPLE LOCATIONS

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

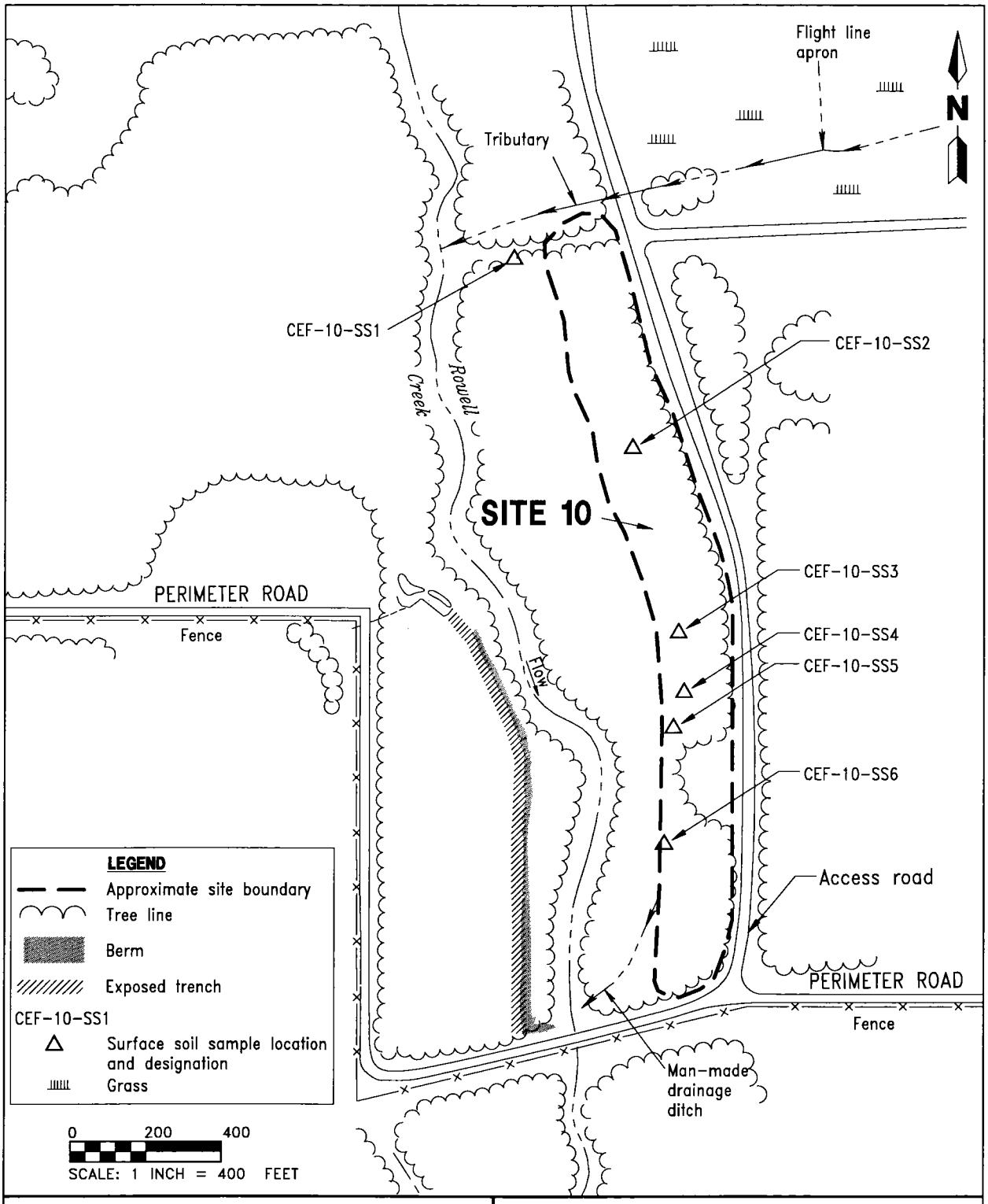

FIGURE 4-6
SITE 10, SURFACE SOIL SAMPLE LOCATIONS

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

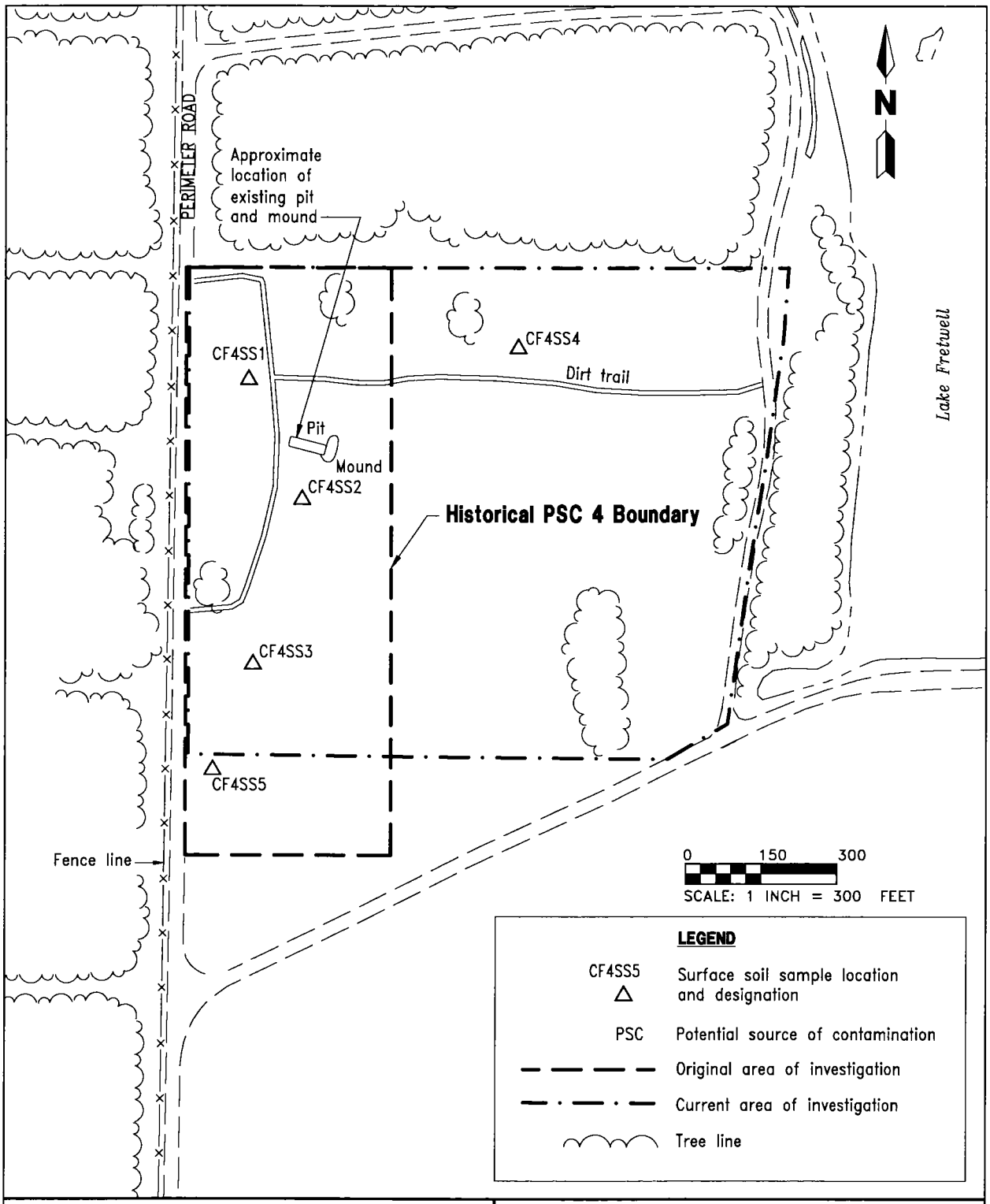

FIGURE 4-11
PSC 4, SURFACE SOIL SAMPLE LOCATIONS

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

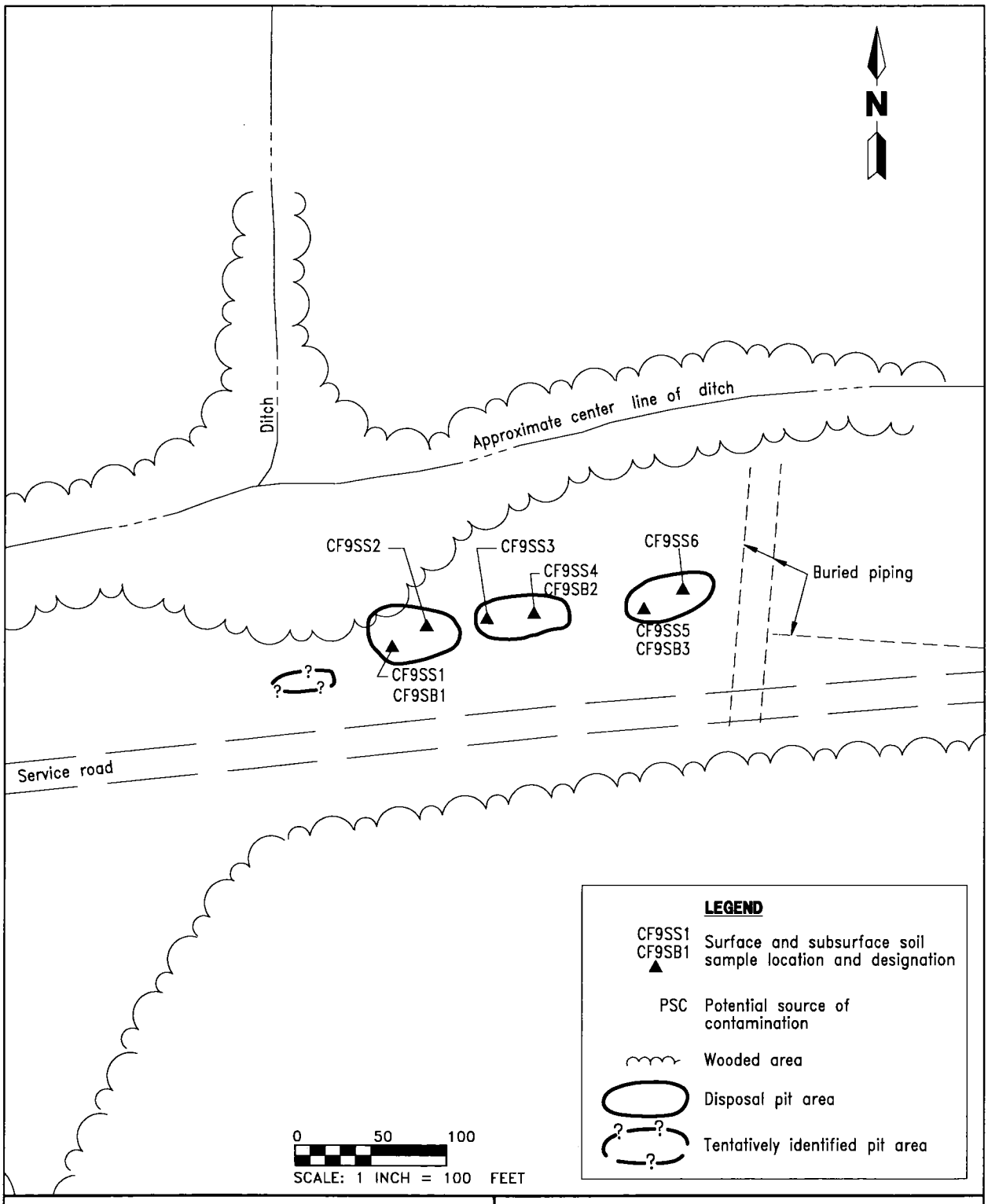

FIGURE 4-13
PSC 9, SURFACE AND SUBSURFACE SOIL SAMPLE LOCATIONS

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA

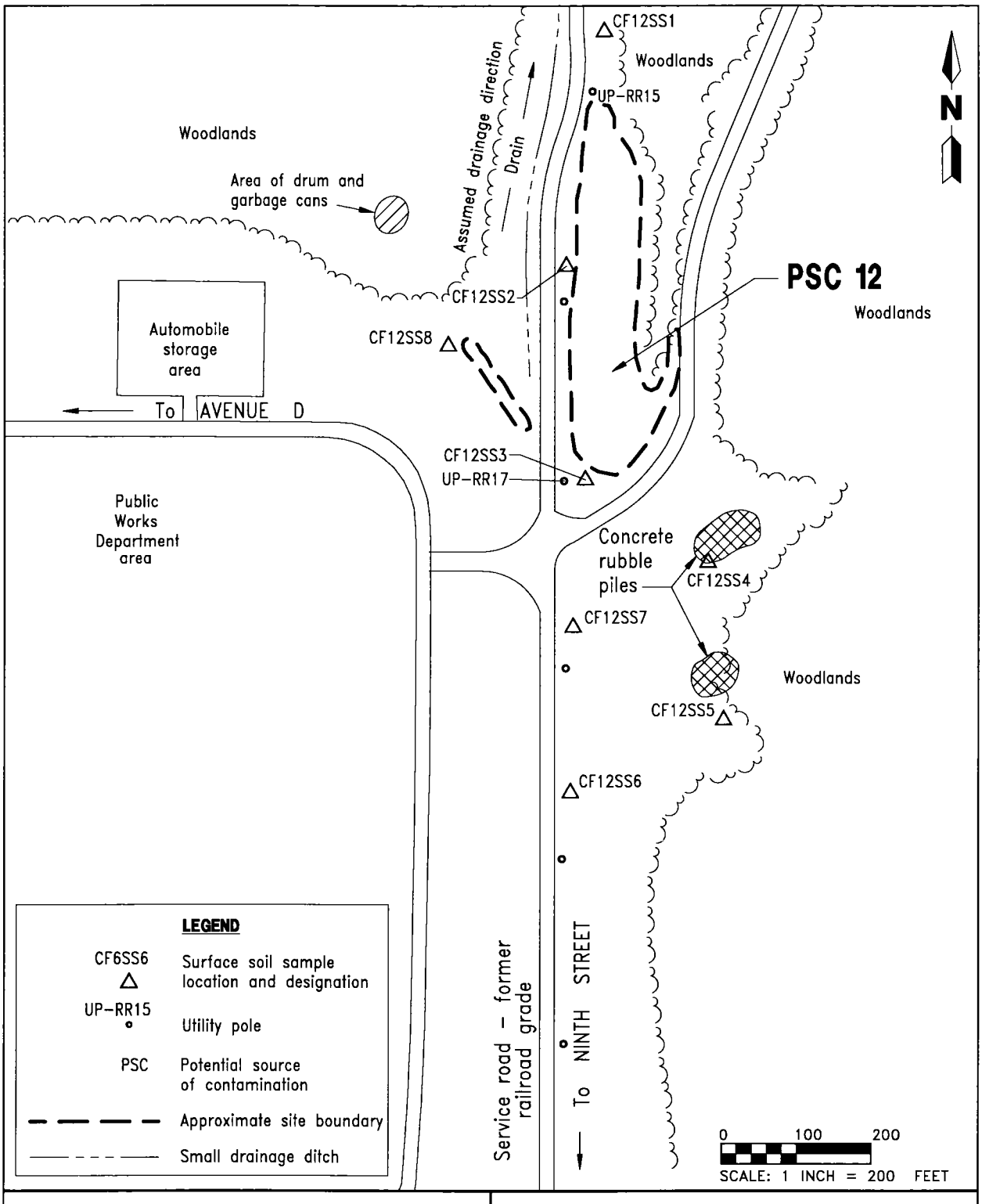

FIGURE 4-14
PSC 12, SURFACE SOIL SAMPLE LOCATIONS

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

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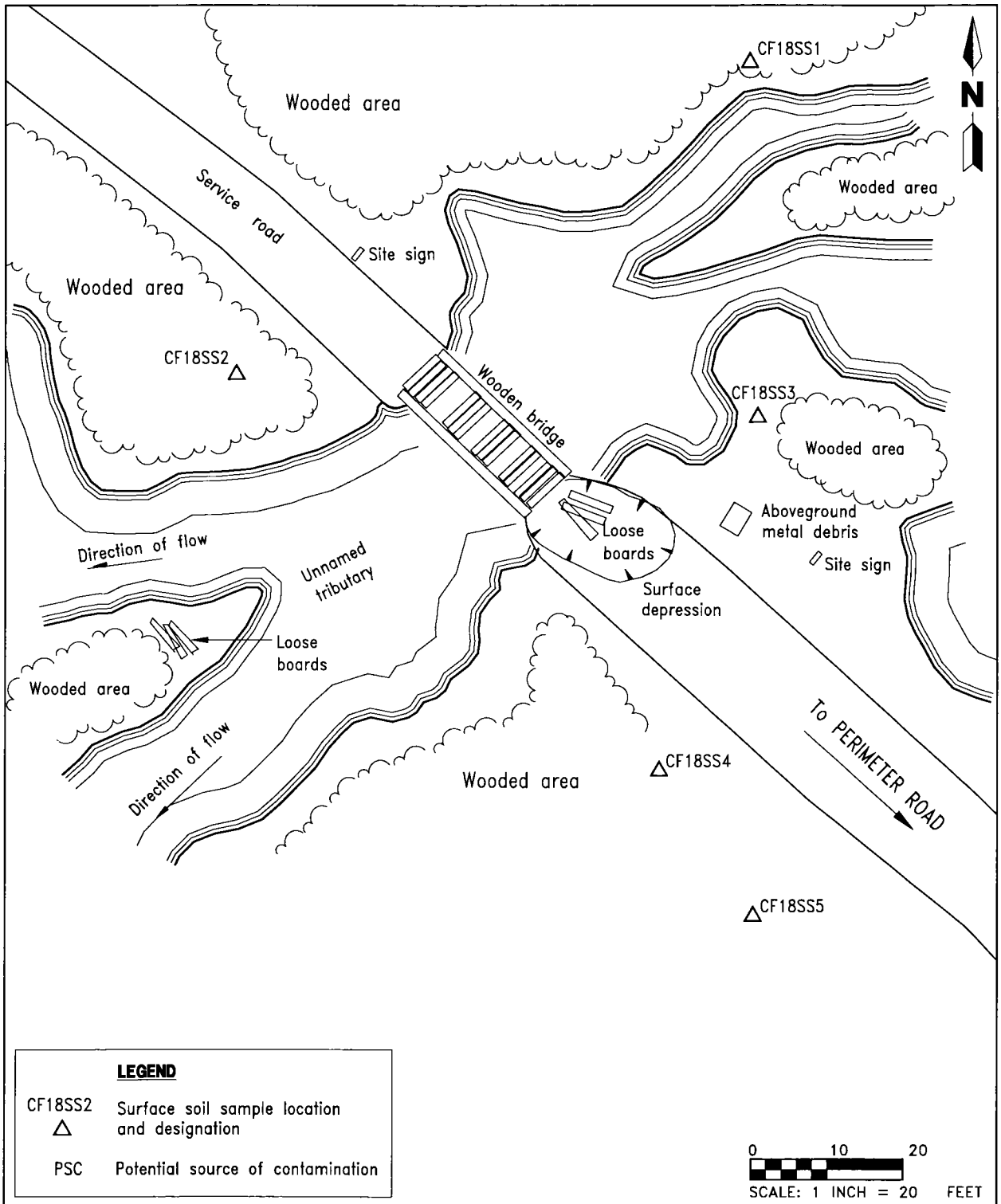

FIGURE 4-15
PSC 18, SURFACE SOIL SAMPLE LOCATIONS

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BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Source: NAS Cecil Field Master Plan, November 1988

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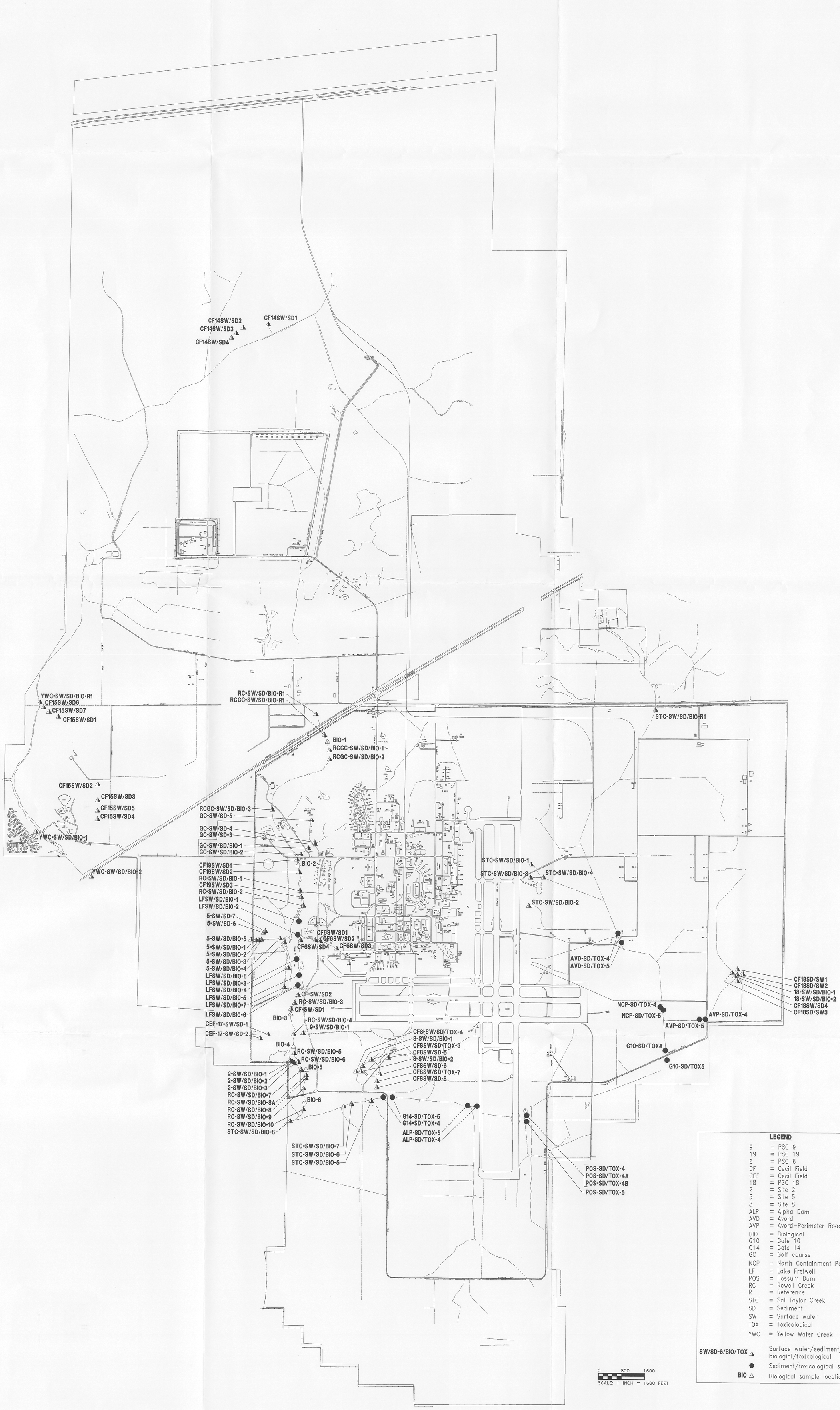
PLATE 1
UPLAND HABITATS AND WETLANDS
AT ALL OUs/PSCs

BASEWIDE ECOLOGICAL
ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA



LEGEND

9	=	PSC 9
19	=	PSC 19
6	=	PSC 6
CF	=	Cecil Field
CEF	=	Cecil Field
18	=	PSC 18
2	=	Site 2
5	=	Site 5
8	=	Site 8
ALP	=	Alpha Dam
AVD	=	Avord
AVP	=	Avord–Perimeter Road
BIO	=	Biological
G10	=	Gate 10
G14	=	Gate 14
GC	=	Golf course
NCP	=	North Containment Pond
LF	=	Lake Fretwell
POS	=	Possum Dam
RC	=	Rowell Creek
R	=	Reference
STC	=	Sal Taylor Creek
SD	=	Sediment
SW	=	Surface water
TOX	=	Toxicological
YWC	=	Yellow Water Creek

SW/SD-6/BIO/TOX ▲ Surface water/sediment/biological/toxicological

● Sediment/toxicological sample location

BIO △ Biological sample location

PLATE 2
SURFACE WATER/SEDIMENT/BIOLOGICAL/ TOXICOLOGICAL SAMPLING LOCATIONS

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA

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N

SITE 11
(OU 6)

PSC 12

PSC 19

SITE 5
(OU 2)

PSC 6

PSC 4

SITE 7
(OU 3)

SITE 16
(OU 7)

SITE 3
(OU 8)

SITE 17
(OU 2)

PSC 9

SITE 2
(OU 1)

SITE 10
(OU 4)

SITE 8
(OU 3)

SITE 1
(OU 1)

OLD YELLOW WATER ROAD

BOULEVARD

NORMANDY BOULEVARD

PERIMETER ROAD

CORONADO STREET

BUCCANEER STREET

"D" AVENUE

"A" AVENUE

"B" AVENUE

"C" AVENUE

"E" AVENUE

"F" AVENUE

"J" AVENUE

6th ST

6th STREET

7th STREET

8th STREET

9th STREET

10th STREET

1st STREET

2nd STREET

3rd STREET

4th STREET

LOOP ROAD

JET ROAD

CIRCLE

RUNWAY 18R - 36L

RUNWAY 9L - 27R

RUNWAY 9R - 27L

LAKE NEWMAN

LAKE FRETWELL

PARKING

STORAGE

MOBILE HOMES

P/A

LEGEND

- Site boundary
- Monitoring well with groundwater toxicity analysis
- IR Monitoring well cluster
- IR monitoring wells
- BRAC monitoring wells
- UST monitoring wells
- DPT groundwater screening locations

BRAC — Base Realignment and Closure
UST — Underground storage tank
DPT — Direct-push technology
IR — Installation Restoration
OU — Operable unit
PSC — Potential source of contamination

NOTE:
See Figure 3A-1 for PSC 18 groundwater/toxicological sampling locations.

0 300 600
SCALE: 1 INCH = 600 FEET

PLATE 3-A
MAIN BASE
GROUNDWATER/TOXICOLOGICAL SAMPLING LOCATIONS

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

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N

SITE 14
(OU 5)
CF14MW2S
CF14MW1S
CF14MW3S

NORTH PERIMETER ROAD
661 660 659 658 657 656 655 654 653 652 651 650

778-799
627
625
624
626
629
630
630
636
631
XFMR
623
639
621
780-777
640
632
617
705
618
618
615
WAREHOUSE ROAD
EAST PERIMETER ROAD
RAIL HEAD ROAD
SOUTH PERIMETER ROAD
608
609
709
607
606
605
604
716
715

WILDCAT ROAD
OLD YELLOW WATER ROAD
STREET
647
646
645
610
B STREET
A STREET
MARINER STREET
CORONADO STREET
BUCCANEER STREET
AVENGER STREET

CF15MW4S
CF15MW5S
CF15MW6S
CF15MW3S
CF15MW2S
CF15MW7S
CF15MW1S
CF15MW8S

SITE 15
(OU 5)

BOULEVARD
NORMANDY
PERIMETER ROAD
368
"J" AVENUE
288B
278
288
288A
337
371
238
370
874
398
397

3069
3064
3067
3064 LS
3065
3072
3072 LS
3073 LS
3073
3071
3045

0 300 600
SCALE: 1 INCH = 600 FEET

LEGEND

- Monitoring well
- Site boundary
- OU — Operable unit

PLATE 3-B
YELLOW WATER WEAPONS AREA
GROUNDWATER/TOXICOLOGICAL
SAMPLING LOCATIONS

BASEWIDE ECOLOGICAL ASSESSMENT REPORT

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

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Site		Sample identifiers	# Samples	Reference
SITE 1	(OU 1)	CEF-1-SS1 through CEF-1-SS15	15	Figure 4-1
SITE 2	(OU 1)	CEF-2-SS1 through CEF-2-SS10	10	Figure 4-1
SITE 3	(OU 8)	CF3SS1 through CF3SS24	24	Figure 4-10
SITE 5	(OU 2)	CEF-5-SS1 through CEF-5-SS31	31	Figure 4-2
SITE 17	(OU 2)	CEF-17-SS1 through CEF-17-SS14	14	Figure 4-3
SITE 7	(OU 3)	CF7SS1 through CF7SS52	52	Figure 4-4
SITE 8	(OU 3)	CF8SS1 through CF8SS22, and CF8SS24 through CF8SS35	34	Figure 4-5
SITE 10	(OU 4)	CEF-10-SS1 through CEF-10-SS6	6	Figure 4-6
SITE 11	(OU 6)	CF11SS1 through CF11SS36	33	Figure 4-9
SITE 14	(OU 5)	CF14SS1 through CF14SS7	7	Figure 4-7
SITE 15	(OU 5)	CF15SS1 through CF15SS43, and CF15SS45 through CF15SS73	72	Figure 4-8
PSC 4		CF4SS1 through CF4SS5	5	Figure 4-11
PSC 6		CF6SS1 through CF6SS10	16	Figure 4-12
PSC 9		CF9SS1 through CF9SS6; CF9SB1, SB2, SB3	9	Figure 4-13
PSC 12		CF12SS1 through CF12SS8	8	Figure 4-14
PSC 18		CF18SS1 through CF18SS5	5	Figure 4-15
PSC 19		CF19SS1 through CF19SS5	5	Figure 4-16

NOTE:
See Figures 4-7 and 4-8 for OU 5, Sites 14 and 15 surface soil/toxicological sampling locations.

SITE 11 (OU 6)
PSC 12
SITE 16 (OU 7)
PSC 19
SITE 5 (OU 2)
PSC 6
SITE 7 (OU 3)
PSC 4
SITE 3 (OU 8)
SITE 17 (OU 2)
PSC 9
SITE 10 (OU 4)
SITE 2 (OU 1)
SITE 1 (OU 1)
SITE 8 (OU 3)
PSC 18

RUNWAY 18R - 36L
RUNWAY 9L - 27R
RUNWAY 9R - 27L

LEGEND
Site boundary
PSC Potential source of contamination
OU Operable unit

0 300 600
SCALE: 1 INCH = 600 FEET

PLATE 4
SURFACE SOIL/TOXICOLOGICAL SAMPLING LOCATIONS

BASEWIDE ECOLOGICAL ASSESSMENT REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

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