Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-04-D-0055

N00204.AR.002201
NAS PENSACOLA
5090.3a

Rev. 2
09/19/08

Record of Decision
Operable Unit 2

Naval Air Station
Pensacola
Pensacola, Florida

Contract Task Order 0030

September 2008

NAVFAC
Naval Facilities Engineering Command
NAVFAC SOUTHEAST

NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH NUS, Inc.

TABLE OF CONTENTS

SECTION **PAGE NO.**
LIST OF ACRONYMS AND ABBREVIATIONS VI
1.0 DECLARATION OF THE RECORD OF DECISION 1-1
1.1 SITE NAME AND LOCATION 1-1
1.2 STATEMENT OF BASIS AND PURPOSE 1-1
1.3 ASSESSMENT OF THE SITE 1-1
1.4 DESCRIPTION OF THE SELECTED REMEDY 1-1
1.5 STATUTORY DETERMINATIONS 1-2
1.6 DATA CERTIFICATION CHECKLIST 1-3
1.7 AUTHORIZING SIGNATURES 1-3
2.0 DECISION SUMMARY 2-1
2.1 SITE NAME, LOCATION, AND DESCRIPTION 2-1
2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES 2-5
2.2.1 OU 2 History 2-5
2.2.2 OU 2 Investigations 2-8
2.3 COMMUNITY PARTICIPATION 2-12
2.4 SCOPE AND ROLE OF OPERABLE UNIT 2-13
2.5 SITE CHARACTERISTICS 2-13
2.5.1 General 2-13
2.5.2 Geology and Hydrogeology 2-15
2.5.3 Nature and Extent of Contamination 2-16
2.5.4 Current and Potential Future Land and Resource Uses 2-32
2.6 SUMMARY OF SITE RISKS 2-32
2.6.1 Human Health Risk Assessment 2-32
2.6.2 Ecological Risk Assessment 2-73
2.6.3 Risk Assessment Summary 2-73
2.7 REMEDIAL ACTION OBJECTIVES 2-73
2.7.1 Remedial Action Objectives 2-73
2.7.2 Cleanup Goals 2-74
2.8 DESCRIPTION OF ALTERNATIVES 2-75
2.8.1 Soil Alternatives 2-75
2.8.2 Groundwater Alternatives 2-83
2.9 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES 2-92
2.9.1 Comparison of Soil Remediation Alternatives by Category 2-93
2.9.2 Comparison of Groundwater Remediation Alternatives by Category 2-102
2.10 PRINCIPAL THREAT WASTE 2-106
2.11 SELECTED REMEDY 2-106
2.11.1 Summary of Rationale for Remedy Selection 2-106
2.11.2 Remedy Description 2-107
2.11.3 Contingency Remedy 2-110
2.11.4 Summary of Estimated Remedy Costs 2-110
2.11.5 Expected Outcomes of the Selected Remedy 2-111
2.12 STATUTORY DETERMINATIONS 2-111
2.12.1 Protection of Human Health and the Environment 2-111
2.12.2 Compliance with Applicable or Relevant and Appropriate Requirements 2-111
2.12.3 Cost-Effectiveness 2-112
2.12.4 Utilization of Permanent Solutions and Alternative Treatment Technologies 2-116
2.12.5 Preference for Treatment as a Principal Element 2-116
2.12.6 Five-Year Review Requirement 2-116
2.13 DOCUMENTATION OF SIGNIFICANT CHANGES 2-116

REFERENCES R-1

APPENDICES

A RESPONSIVENESS SUMMARY

TABLES

NUMBER

1-1 Data Certification Checklist 1-4
2-1 COCs and Concentrations in Soil – Site 11 2-17
2-2 COCs and Concentrations in Soil – Site 12 2-18
2-3 COCs and Concentrations in Soil – Site 25 2-20
2-4 COCs and Concentrations in Soil – Site 26 2-21
2-5 COCs and Concentrations in Soil – Site 27 2-23
2-6 COCs and Concentrations in Soil – Site 30 2-24
2-7 COCs and Concentrations in Groundwater – Site 11 2-26
2-8 COCs and Concentrations in Groundwater – Site 12 2-27
2-9 COCs and Concentrations in Groundwater – Site 25 2-29
2-10 COCs and Concentrations in Groundwater – Site 26 2-30
2-11 COCs and Concentrations in Groundwater – Site 27 2-31
2-12 COCs and Concentrations in Groundwater – Site 30 2-33
2-13 Summary of Non-Carcinogenic Toxicity Data Used in Risk Assessment 2-38
2-14 Summary of Carcinogenic Toxicity Data Used in Risk Assessment 2-41
2-15 Summary of Hazard Indices and ILCRs for Surface Soil at Site 11 2-44
2-16 Summary of Hazard Indices and ILCRs for Groundwater at Site 11 2-45
2-17 Summary of Hazard Indices and ILCRs for Site 11 2-47
2-18 Summary of Hazard Indices and ILCRs for Surface Soil at Site 12 2-50
2-19 Summary of Hazard Indices and ILCRs for Groundwater at Site 21 2-51
2-20 Summary of Hazard Indices and ILCRs for Site 12 2-52
2-21 Summary of Hazard Indices and ILCRs for Surface Soil at Site 25 2-54
2-22 Summary of Hazard Indices and ILCRs for Groundwater at Site 25 2-55
2-23 Summary of Hazard Indices and ILCRs for Site 25 2-56
2-24 Summary of Hazard Indices and ILCRs for Surface Soil and Groundwater at Site 26 2-58
2-25 Summary of Hazard Indices and ILCRs for Site 26 2-59
2-26 Summary of Hazard Indices and ILCRs for Surface Soil at Site 27 2-61
2-27 Summary of Hazard Indices and ILCRs for Groundwater at Site 27 2-62
2-28 Summary of Hazard Indices and ILCRs for Site 27 2-64
2-29 Summary of Hazard Indices and ILCRs for Surface Soil at Site 30 2-66
2-30 Summary of Hazard Indices and ILCRs for Groundwater at Site 30 West of Murray Road 2-67
2-31 Summary of Hazard Indices and ILCRs for Groundwater at Site 30 East of Murray Road 2-69
2-32 Summary of Hazard Indices and ILCRs for Site 30 2-71
2-33 Chemical of Concerns Cleanup Goals 2-75

TABLE OF CONTENTS (Continued)

NUMBER

2-34 Explanation of Detailed Analysis Criteria 2-77
2-35 Comparative Analysis of Remedial Action Alternatives For Soil Contamination 2-94
2-36 Comparative Analysis of Remedial Action Alternatives For Groundwater Contamination 2-96
2-37 Summary of Potential Chemical-Specific ARARs for Selected Remedy 2-113
2-38 Summary of Potential Action-Specific ARARs for Selected Remedy 2-114

FIGURES

NUMBER

2-1 Site Location Map 2-2
2-2 Site Area Map 2-3
2-3 Conceptual Site Model 2-14
2-4 Soil Areas to be Remediated 2-35
2-5 Extent of Groundwater Contamination 2-36
2-6 LUC Boundaries 2-79

LIST OF ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services, Inc.
ARAR	Applicable or relevant and appropriate requirement
BEQ	Benzo(a)pyrene equivalent
bls	Below land surface
BRA	Baseline risk assessment
BRAC	Base Realignment and Closure
CDI	Chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Chemical of concern
COPC	Chemical of potential concern
CTL	Cleanup Target Level
yd^3	Cubic yard
DCA	Dichloroethane
DCE	Dichloroethene
DPT	Direct-push technology
DRMO	Defense Reutilization and Marketing Office
E&E	Ecology & Environment, Inc.
EPC	Exposure point concentration
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FFA	Federal Facility Agreement
FS	Feasibility Study
GAC	Granular activated carbon
GCTL	Groundwater Cleanup Target Level
gpm	Gallons per minute
GSI	Groundwater/surface water interface
HHRA	Human health risk assessment
HI	Hazard Index
HQ	Hazard Quotient
HSWA	Hazardous and Solid Waste Amendments
IAS	Initial Assessment Study
ILCR	Incremental lifetime cancer risk
IRP	Installation Restoration Program

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

IWTP	Industrial wastewater treatment plant
JP	Jet fuel
kg	Kilograms
LDR	Land Disposal Restrictions
LUC	Land use control
MCL	Maximum Contaminant Level
MNA	Monitored natural attenuation
msl	Mean sea level
MSWCTL	Marine Surface Water Cleanup Target Level
NACIP	Navy Assessment and Control of Industrial Pollutants
NADEP	Naval Aviation Depot
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NFA	No further action
NFESC	Naval Facilities Engineering Service Center
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NPW	Net present worth
O&M	Operation and maintenance
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PID	Photoionization detector
PPE	Personal protection equipment
PRB	Permeable reactive barrier
PRG	Preliminary remediation goal
PWC	Public Works Center
RAO	Remedial Action Objective
RASO	Radiological Affairs Support Office
RBC	Risk-based criterion
RBCA	Risk-based corrective action
RC	Reference concentration
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

RfD	Reference dose
RI	Remedial Investigation
ROD	Record of Decision
RSL	Risk Screening Level
SARA	Superfund Amendments and Reauthorization Act
SCTL	Soil Cleanup Target Level
SSL	Soil screening level
SVOC	Semivolatile organic compound
SWCTL	Surface Water Cleanup Target Level
SWMU	Solid waste management unit
TAL	Target Analyte List
TBC	To be considered
TCA	Trichloroethane
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TRPH	Total recoverable petroleum hydrocarbons
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper confidence limit
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VOC	Volatile organic compound
WWTP	Waste Water Treatment Plant
ZVI	Zero-valent iron

1.0 DECLARATION OF THE RECORD OF DECISION

1.1 SITE NAME AND LOCATION

Operable Unit (OU) 2 is located at Naval Air Station (NAS) Pensacola, Pensacola, Florida, which is identified by the United States Environmental Protection Agency (USEPA) ID FL9170024567. The OU is located in the eastern portion of NAS Pensacola and consists of Site 11 – North Chevalier Field Disposal Area, Site 12 – Scrap Bins, Site 25 – Radium Spill Area, Site 26 – Supply Department Outside Storage Area, Site 27 – Radium Dial Shop Sewer, and Site 30 – Complex of Industrial Buildings and Industrial Wastewater Treatment Plant Sewer Line.

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedy for contaminated soil and groundwater at OU 2 at NAS Pensacola. The remedy was selected by the Navy and the USEPA in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) 300]. This decision document was prepared in accordance with USEPA decision document guidance (1999). This decision is based on the Administrative Record file for the site, which is located in the NAS Pensacola Library, Building 634, at NAS Pensacola. The United States Department of the Navy and the USEPA Region 4 issue this Record of Decision (ROD) (jointly). The Florida Department of Environmental Protection (FDEP) concurs with the selected remedy.

1.3 ASSESSMENT OF THE SITE

The response actions selected in this ROD are necessary to protect the public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment or of pollutants or contaminants from this site that may present an imminent and substantial endangerment to public health or welfare.

1.4 DESCRIPTION OF THE SELECTED REMEDY

OU 2 is part of a comprehensive environmental investigation and cleanup currently being performed at NAS Pensacola under the CERCLA program. This ROD addresses only OU 2; Sites 11, 12, 25, 26, 27, and 30. The selected remedy eliminates unacceptable exposures to contaminants in soil and groundwater. The selected remedy for OU 2 includes monitored natural attenuation (MNA) for groundwater, removal of selected soil areas, and land use controls (LUCs) that will limit exposure to soil,

prohibit any residential use activities, limit occupational exposure to groundwater, and restrict the use of groundwater at the site for potable purposes. The selected remedy was chosen based on evaluation of site conditions, site-related risks, future land use, applicable or relevant and appropriate requirements (ARARs), and Remedial Action Objectives (RAOs).

The major components of the selected remedy for OU 2 are as follows:

- Contaminated soil will be excavated such that the average soil contaminant concentrations based on the 95 percent upper confidence limit meet the State of Florida's industrial direct exposure Soil Cleanup Target Levels (SCTLs) Chapter 62-777, Florida Administrative Code (F.A.C.), as specified in 62-780.680 F.A.C. Vadose zone soil with contaminant concentrations that exceed FDEP's leachability SCTLs will be also excavated.

- Groundwater monitoring will be performed by collecting and analyzing groundwater samples to verify that no unacceptable contaminant migration is occurring and to evaluate reductions in contaminant concentrations through hydraulic dispersion and naturally occurring processes such as biodegradation, advection, and adsorption.

- LUCs will be implemented at OU 2 to restrict property use to non-residential and to restrict future uses of the surficial aquifer for potable purposes until the levels of contamination in the groundwater meet the State of Florida's Groundwater Cleanup Target Levels (GCTLs) in Chapter 62-777, F.A.C. The prohibited uses of the property under these criteria would include, but would not be limited to, any form of housing, child-care facilities, any kind of school including preschools, elementary schools, and secondary schools, playgrounds, and adult convalescent or nursing care facilities. Prohibited groundwater uses would include, but would not be restricted to, drinking, washing, cooking, cleaning, and turf irrigation.

The Navy shall prepare, in accordance with USEPA guidance and submit to the USEPA and FDEP, a LUC Remedial Design (RD) as well as all other post-ROD documents as specified in the Federal Facility Agreement (FFA) for NAS Pensacola dated October 23, 1990.

1.5 STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, is cost effective, and complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action. The nature of the selected remedy for OU 2 is such that ARARs will eventually be met through the removal of contaminated soil and MNA of groundwater. The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at this site. Of those alternatives that are protective of human health and the environment and that comply

with ARARs, the selected remedy meets the threshold criteria and provides the best balance of trade-offs in terms of the balancing and modifying criteria, while also considering the statutory preference for treatment. The selected remedy does not provide for treatment as a principal element; however, no source materials constituting principal threats are present at the site, and reductions in soil and groundwater contaminant concentrations are expected over time due to hydraulic dispersion, advection, adsorption, and biological processes. The remedy will result in hazardous substances, pollutants, or contaminants remaining on site at levels that prevent unlimited use and unrestricted exposure; therefore, in accordance with Section 121(c) of CERCLA and NCP §300.430(f)(5)(iii)(c), a statutory review will be conducted within 5 years of the initial remedial action, and every 5 years thereafter, to ensure that the remedy continues to be protective of human health and the environment. If it is determined that the chosen remedy is not being protective of human health and the environment because the LUC component of the selected remedy is not effective or for some other reason, it may become necessary for the Navy to undertake additional remedial action(s).

1.6 DATA CERTIFICATION CHECKLIST

The information required to be included in the ROD is summarized in Table 1-1. These data are presented in Section 2.0, Decision Summary, of this ROD. Additional information, if required, can be found in the Administrative Record file for OU 2.

1.7 AUTHORIZING SIGNATURES

Captain William P. Reavey
Commanding Officer
NAS Pensacola

29 SEP 08
Date

Franklin E. Hill
Director, Superfund Division
USEPA Region 4

Date

TABLE 1-1

**DATA CERTIFICATION CHECKLIST
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA**

Information	ROD Reference
Chemicals of concern (COCs) and their concentrations	Tables 2-1 through 2-12
Baseline risk represented by the COCs	Section 2.6.1.4 (pages 2-42 through 2-72); Tables 2-15 through 2-32
Cleanup goals established for the COCs and the basis for these levels	Section 2.7.2 (page 2-74)
Disposition of source materials constituting principal threat	Section 2.10 (page 2-106)
Current and reasonably anticipated future land use scenario used for risk assessment	Section 2.5.4 (page 2-34)
Potential land uses available at the sites as a result of the selected remedy	Section 2.11.5 (page 2-111)
Estimated capital, annual operating and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected	Section 2.11.4 (page 2-110)
Key factors that lead to the selection of the remedy	Section 2.11.1 (pages 2-106)

2.0 DECISION SUMMARY

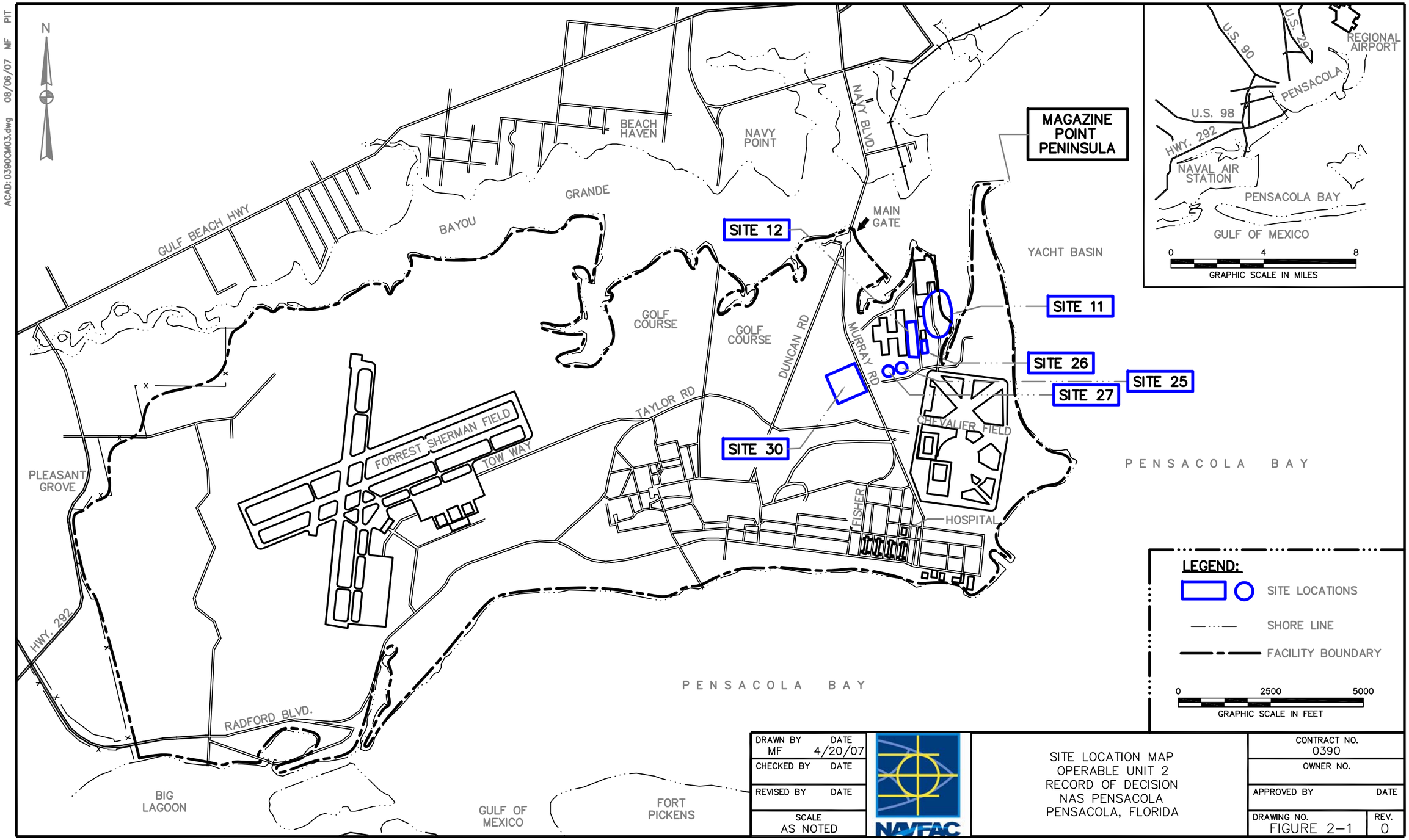
2.1 SITE NAME, LOCATION, AND DESCRIPTION

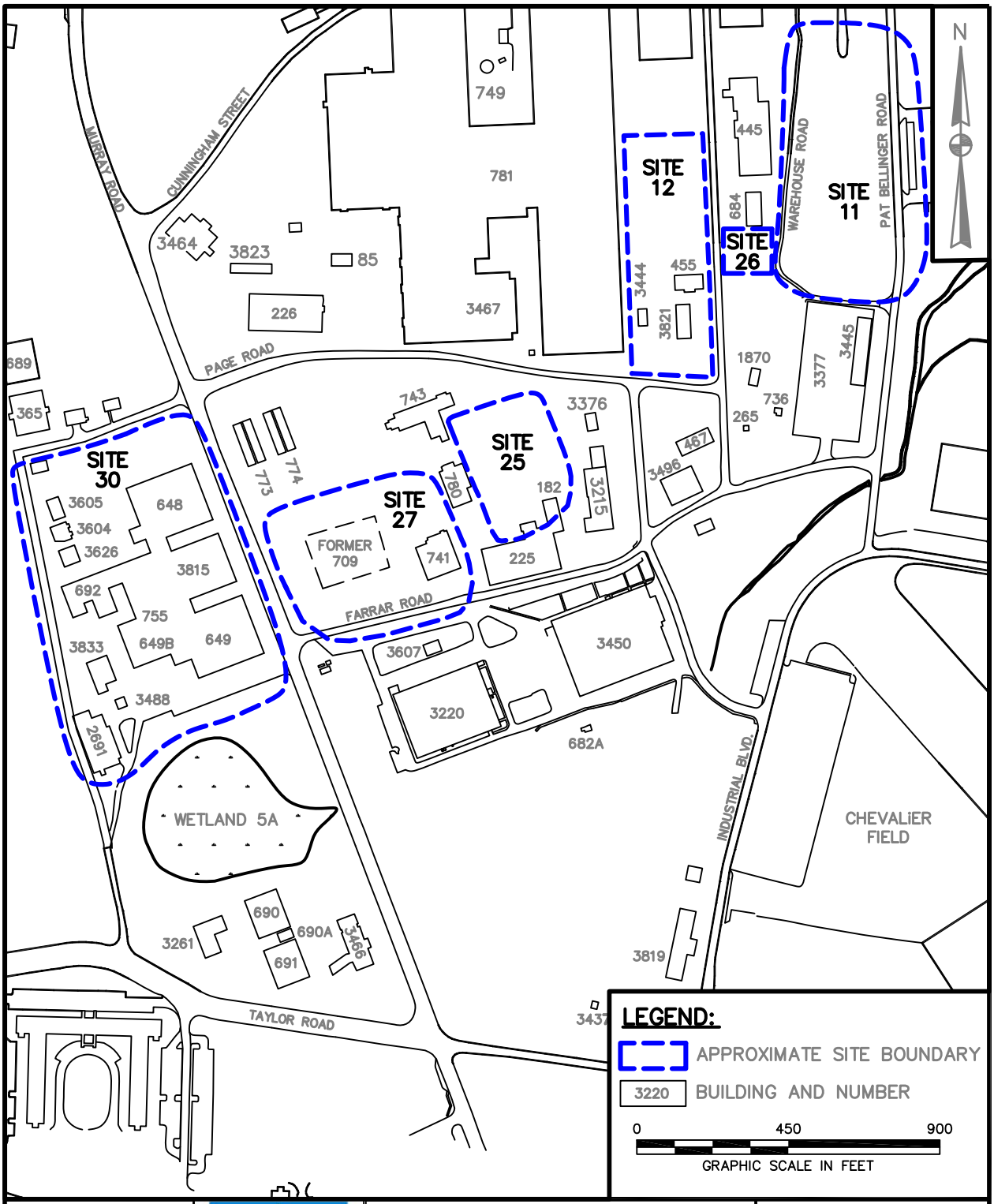
OU 2 (Sites 11, 12, 25, 26, 27, and 30) is within the boundaries of NAS Pensacola (USEPA ID FL9170024567) in Pensacola, Escambia County, Florida (see Figure 2-1). The Navy is the lead agency in the investigations of the OU, with support from USEPA and FDEP. The Navy has maintained a presence in the Pensacola area since 1825, when a Navy yard was established on Pensacola Bay. Between 1828 and 1835, the Navy acquired approximately 2,300 acres as operations expanded. Several natural disasters in the early 1900s destroyed the yard and forced it into maintenance status in 1911. Three years later, the Navy's first permanent air station was established on the site of the old Navy yard. The air station has been the primary training base for Naval aviators since that time and continues to expand.

OU 2 is comprised of six individual sites: Site 11 – North Chevalier Field Disposal Area, Site 12 – Scrap Bins, Site 25 – Radium Spill Area, Site 26 – Supply Department Outside Storage Area, Site 27 – Radium Dial Shop Sewer, and Site 30 – Complex of Industrial Buildings and Industrial Wastewater Treatment Plant Sewer Line (see Figure 2-2). The OU is primarily paved or covered by buildings and is approximately 68 acres in size. The sites comprising OU 2, described below, are north of Chevalier Field, near Murray Road, and west of Pensacola Bay.

Site 11 – North Chevalier Field Disposal Area is a former landfill where industrial and municipal wastes were disposed of and burned from the late 1930s to the mid-1940s. The area occupies approximately 20 acres southwest of an extension of Bayou Grande called the Yacht Basin. Surface elevations at the site are approximately 5 feet above mean sea level (msl), and the site surface slopes gently eastward toward Bayou Grande. Two prefabricated buildings, Buildings 3627 and 3628, are near the center of the site. Building 3445, at the site's southeastern corner, is used to store outdated office equipment. Much of the site is covered with vegetation. Fenced areas to the north and south of Building 3445 are used for outside storage of boats, trucks, and heavy equipment. Pat Bellinger Road runs north-south through the center of Site 11.

Site 12 – Scrap Bins is currently referred to as the Defense Reutilization and Marketing Office (DRMO) Recyclable Materials Center and is used to store scrap metal. The site is approximately 800 feet northwest of former Chevalier Field and immediately west and upgradient of Site 26. Most of the site area is enclosed by a chain-link fence and covered with a large concrete pad which is used as a heavy equipment storage area. Buildings 455 and 3821 are in the southern portion of the site. Building 455 houses an office, break area, and storage warehouse, and Building 3821 is a storage warehouse. A third building, Building 3444, has been demolished.


ACAD: 0390CM03.dwg 08/06/07 MF PIT
N
GULF BEACH HWY
BAYOU
GRANDE
BEACH HAVEN
NAVY POINT
NAVY BLVD.
MAIN GATE
SITE 12
MAGAZINE POINT PENINSULA
YACHT BASIN
SITE 11
SITE 26
SITE 25
SITE 27
GOLF COURSE
GOLF COURSE
DUNCAN RD
MURRAY RD
TAYLOR RD
SITE 30
CHEVALIER FIELD
FORREST SHERMAN FIELD
TOW WAY
PLEASANT GROVE
FISHER
HOSPITAL
PENSACOLA BAY
HWY. 292
RADFORD BLVD.
PENSACOLA BAY
BIG LAGOON
GULF OF MEXICO
FORT PICKENS
U.S. 90
U.S. 29
REGIONAL AIRPORT
PENSACOLA
U.S. 98
HWY. 292
NAVAL AIR STATION
PENSACOLA BAY
GULF OF MEXICO
0 4 8
GRAPHIC SCALE IN MILES
LEGEND:
SITE LOCATIONS
SHORE LINE
FACILITY BOUNDARY
0 2500 5000
GRAPHIC SCALE IN FEET
DRAWN BY MF DATE 4/20/07
CHECKED BY DATE
REVISED BY DATE
SCALE AS NOTED
NAVFAC
SITE LOCATION MAP
OPERABLE UNIT 2
RECORD OF DECISION
NAS PENSACOLA
PENSACOLA, FLORIDA
CONTRACT NO. 0390
OWNER NO.
APPROVED BY DATE
DRAWING NO. FIGURE 2-1
REV. 0
FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98



DRAWN BY MF	DATE 4/20/07	SITE AREA MAP OPERABLE UNIT 2 RECORD OF DECISION NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0390
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2–2 / REV. 0

NAVFAC

FORM CADD NO. SDIV-AV.DWG - REV 1 - 9/10/98

Site 25 – Radium Spill Area is an approximately 50-foot by 50-foot concrete-paved area located immediately east of Murray Road and north of Farrar Road. The site is flat with land surface elevations averaging approximately 22 to 25 feet above msl. Where exposed, site surface soil is sandy and well drained. The site includes an area east of the radium decontamination building (Building 780) where a radium spill is reported to have occurred. A former helicopter scrap yard approximately 25 feet east of Building 780 is currently used as a parking area for Navy Exchange semi-trailers. Building 780 currently houses the Joint Oil Analysis Laboratory, which is used to check the quality of oil from aircraft and vehicles.

Site 26 – Supply Department Outside Storage Area is northwest of former Chevalier Field and immediately south of Building 684. The approximately 150-foot by 200-foot area houses an open metal shed near a former chemical storage building. DRMO uses this area to store paints, fuels, and solvents. Site access is limited by an 8-foot chain-link fence surrounding the storage area. The concrete pavement inside the fence is bordered by sandy soil and mowed grass. Site 26 is bounded on the west by a paved road and on the east by a wooded area (Site 11). The site gently slopes eastward to a topographic break where elevations abruptly drop to approximately 5 feet above msl.

Site 27 – Radium Dial Shop Sewer extends through the concrete foundation of former Building 709. The building was demolished, and the foundation is currently a parking lot. The building foundation is 2 to 4 feet above the surrounding area. Outside the foundation, the ground surface over the sewer is unpaved. The site is approximately 150 feet west of Building 780 and bounded by Farrar and Murray Roads on the south and west, respectively. An adjacent parking lot north of the building foundation is asphalt-paved, and a gravel and shell parking lot is northeast of the foundation. All roads within the site are paved with either concrete or asphalt.

Site 30 – Complex of Industrial Buildings and Industrial Wastewater Treatment Plant Sewer Line covers approximately 35 acres and is also known as the Building 649 complex. The complex includes interconnected Buildings 647, 648, 649, 649B, 692, 755, and 3815 and several smaller, separate, associated buildings. The buildings were used by the Dynamic Component Division of the former Naval Aviation Depot (NADEP) and several aircraft component repair functions. In addition to the buildings, the Site 30 investigation included a portion of the sewer line from the Building 649 complex to the industrial wastewater treatment plant (IWTP). The sewer line investigation included lines at Sites 25, 27, and 30 and their downstream segments along with the sewer extending from the Building 649 complex, the feeder line from Building 3220, and the main line running to the IWTP. Wetland 5A is located to the south of Site 30. Surface water from the wetland drains to the southeast to a ditch that flows northeastward to the Yacht Basin.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Navy has conducted environmental studies at NAS Pensacola under the Navy Assessment and Control of Industrial Pollutants (NACIP) program, which was incorporated into the Installation Restoration Program (IRP) in 1986. This NACIP program consisted of an Initial Assessment Study (IAS) followed by a two-part Confirmation/Verification Study.

The following summarizes previous site investigations and other environmental actions that took place at NAS Pensacola before its placement on the National Priorities List (NPL) in December 1989:

- IAS onsite survey, 1982
- IAS final report, June 1983
- Confirmation Study, 1984
- Verification Study, July 1984
- Characterization Study, March 1986
- Resource Conservation and Recovery Act (RCRA) Facility Assessment, 1988
- RCRA/Hazardous and Solid Waste Amendments (HSWA) Permit, August 1988
- RCRA Closure Permits

A FFA for NAS Pensacola was signed by FDEP, USEPA, and the Navy on October 23, 1990. Following the listing of NAS Pensacola on the NPL and the signing of the FFA, remedial response activities at the facility have been completed under CERCLA authority. OU 2 is one of 21 OUs that has been identified at NAS Pensacola. NAS Pensacola must also satisfy the ongoing requirements of its state RCRA/HSWA permit, issued on August 26, 1988, for the treatment, storage, and disposal of hazardous materials and waste and the investigation and remediation of releases of hazardous waste and/or constituents from solid waste management units (SWMUs). The HSWA permit (0154498 004 HF) was last renewed on January 16, 2002, and is still in effect. There have been no cited violations under federal or state environmental law or any past or pending enforcement actions pertaining to the cleanup of sites at OU 2. Additionally, the LUCs should follow the Memorandum of Agreement (MOA) between USEPA, FDEP and NAS Pensacola dated September 24, 1999.

2.2.1 OU 2 History

2.2.1.1 Site 11

According to the IAS conducted by the Naval Facilities Engineering Service Center (NFESC), the Site 11 landfill was used to burn refuse through the mid-1940s. During this time, it received combustibles such as fuels, solvents, and waste oil from aircraft engine overhauls. During landfill operations from the early 1930s to the 1940s, approximately 24 cubic yards (yd^3) of material were disposed daily from several NAS

Pensacola locations. During this time, an unknown number of 55-gallon drums of unknown contents were observed. Until the 1950s, oil slicks were noted during heavy rains in the Yacht Basin.

2.2.1.2 Site 12

Site 12 is currently referred to as the DRMO Recyclable Materials Center and used to store scrap metal. From the early 1930s to the 1940s, garbage was stored at Site 12 in an area known as "Pig Sty Hill" near Building 455. Approximately 16 yd^3 (described as two truckloads) per day of wet garbage were stored here before being hauled off for livestock feed. The site has since been used as a scrap metals storage area.

2.2.1.3 Site 25

Building 780 currently houses the Joint Oil Analysis Laboratory, which is used for quality assurance analysis of oil from aircraft and vehicles. Building 780 was constructed in 1951 to house oxygen and carbon dioxide shops. In approximately 1975, a radium decontamination operation was added to Building 780. Radium wastes from this operation were stored in a drum on site before being disposed. In 1978, a spill occurred in the storage area between Building 780 and the scrap yard. Approximately 25 gallons of low-level radium paint waste spilled from a ruptured, eroded drum onto the underlying concrete floor. The waste was reportedly cleaned, placed in a secure container, and sent to a proper disposal site. The exact location of the spill, the details of the cleanup operation, and whether the waste reached unpaved soil were not determined from the existing records.

2.2.1.4 Site 26

The Supply Department Outside Storage Area, Site 26, is northwest of former Chevalier Field and immediately south of Building 684. DRMO uses this area to store paints, fuels, and solvents. From 1956 until 1964, the supply department used Site 26 to store incoming paint strippers and acids. Containers of these materials placed outside on steel matting sometimes leaked, discharging the materials onto the ground.

2.2.1.5 Site 27

Site 27, the Radium Dial Shop Sewer, extends through the remaining concrete foundation of Building 709, which is currently a parking lot. The building foundation is 2 to 4 feet above the surrounding area. Beyond the building foundation, the sewer easement is unpaved. Originally, the site consisted of a small radium dial shop in former Building 709 with a connection to the sanitary sewer. However, the results of

analysis of Remedial Investigation (RI) soil samples collected in the vicinity of the Building 709 foundation expanded the site area to approximately 6 acres.

Building 709, constructed in 1941, was used for several operations including carburetor repair, propeller repair, painting and maintenance, various instrument shops (including a radium paint room), and a plating shop. In 1949, a small shop in Building 709 was used to rework luminous instrument dials. Worn and damaged instruments were returned to this shop to be stripped and repainted. From 1941 to 1965, the stripping procedure required soaking the instruments in benzene, scraping them in a benzene or water bath, or dry scraping and painting them under a ventilation hood. After 1965, the procedure switched to scanning the instruments for radium and then stripping them with paint stripper and a lye-nitric acid solution. Contaminated instrument cases were soaked in another acid solution called “Turco” and then scrubbed with a wire brush.

Building 709 also housed a large plating operation from 1941 to approximately 1970. The operation involved the use of 50 solution tanks ranging from 50 to 3,865 gallons in capacity.

A routine disposal operation in former Building 709 involved washing spent cleaning solutions and luminous paint down the drains into the sanitary sewer. The disposed wastes from this location included cleaning solutions containing benzene, white pigments, phosphorus, radium, and small amounts of acidic or caustic solutions. Plating wastes from former Building 709 and shops in Buildings 604 and 649/755 were periodically dumped through drains into the sanitary sewer. Most of the building drains connected to a single line draining into the sanitary sewer line. From 1941 to 1948, all wastes from former Building 709 were discharged directly into Pensacola Bay. From 1941 to 1962, concentrated cyanide wastes from Building 709 were periodically dumped into the sanitary sewer. After 1962, the cyanide was drummed and disposed 15 miles offshore in the Gulf of Mexico, although small quantities of cyanide continued to be discharged into the sewer. Plating operations ceased in Building 709 in 1970 or 1973. Building 709 has been removed, and the old building foundation is used as a parking lot.

2.2.1.6 Site 30

Operations in the Site 30 complex began in the 1940s and continued until NADEP closed. Aircraft and parts were painted in booths in the Building 649 complex beginning in 1940. The paints used at NAS Pensacola were cellulose nitrate lacquer, zinc chromate, nitrate dope, acetate dope, “day glow,” epoxy, and enamel. Thinners used were lacquer thinner, toluene, and MT 6096.

A tin-cadmium plating shop operated in the Building 649 complex from the mid-1940s to the early 1960s. At this time, it was replaced by a magnesium treatment line, which operated until the early 1970s. Near Building 649, 15 tanks ranging in capacity from 200 to 500 gallons contained solutions of tin, cadmium, and cyanide. Additionally, a 250-gallon tank stored trichloroethene (TCE), and a 500-gallon underground

storage tank (UST) on Building 649's northern end stored waste oil. The contents were drained periodically into a "ditch" east of the building. Based on current topography and historical data, this ditch was either Wetland 5A or a topographical low draining into it. When the tin-cadmium operation was replaced by a magnesium treatment line in the early 1970s, the 15 tanks near Building 649 were then used to store acids, caustics, degreasers, chromate solutions, and potassium permanganate.

In the summer of 1994 as part of an interim removal action, the NAS Pensacola Public Works Center (PWC) removed an aircraft engine shipping container from Wetland 5A immediately southeast of Building 649. The shipping container, referred to as the waste receiving structure, had been used as an oil-water separator. Wetland 5A was sampled under the Site 41 (NAS Pensacola Combined Wetlands) investigation. A second plating shop in Building 755 was used from the early 1960s until the early 1970s and included 50 tanks ranging in capacity from 50 to 200 gallons and containing metal plating solution including nickel, chromium, silver, lead, and tin.

Concentrated cyanide wastes generated in Buildings 649 and 755 were disposed in the same manner as Building 709's cyanide waste. Disposal involved discharging the wastes down the sewer from 1941 to 1962 and discarding drummed waste in the Gulf of Mexico after 1962. Cyanide waste generation stopped in the early 1960s when the tin-cadmium line was replaced by the magnesium treatment line. Overflow discharged into the sewer.

An empty fiberglass UST mounted in concrete is still located near Building 692's southeastern corner. Installed in 1986, this tank stored JP-1/JP-5 (jet fuel) calibration fluid for use in Building 692. The fiberglass tank replaced an older steel tank also used to store calibration fluid. The older tank had at least one undocumented spill. A UST along the western side of Building 692 supplied Building 755 with methyl ethyl ketone via underground pipes. Several other USTs were located along the northern side of Building 692; their exact contents are unknown. Some of the storage tanks may have contained chromium wastes.

The original wastewater treatment plant, built in 1948, was replaced in 1971 with a modern plant that could accept industrial wastes. Most facilities discharging to the sewer did so without any pretreatment or waste segregation. The waste stream has included paint strippers, heavy metals, pesticides, radioactive wastes, fuels, cyanide waste, and waste oil. The IWTP sewer line consisted of vitreous clay and cast-iron piping installed both before and after 1971.

2.2.2 OU 2 Investigations

The following investigations and studies have been conducted in and around OU 2:

- 1976 – Radiation Survey/Removal: According to Naval Energy and Environmental Support Activity (NEESA) accounts, the Radiological Affairs Support Office (RASO) conducted an investigation of radium contamination in the sewer lines at the demolished Building 709 area (Site 27). The contaminated drain pipe was excavated to a depth of 18 inches, and the remaining area was capped and abandoned (NEESA, 1983).

- 1983 – Initial Assessment Study (IAS): The NAS Pensacola IAS involved review of historical documents and aerial photographs, interviews, and site inspections. Although 29 sites were identified as having possible contamination, none were thought to present an immediate risk to human health or the environment. Sediment samples were collected from Bayou Grande near Site 11, and metals were detected at concentrations in excess of toxicity levels. The IAS recommended seven sites, including Sites 11 and 27, for a confirmation study to evaluate suspected contaminants (NEESA, 1983).

- 1984 – Verification Study: As a follow-up to the IAS, several monitoring wells and piezometers were installed throughout NAS Pensacola at all the OU 2 sites, with the exception of Sites 12 and 25. At Site 11, volatile organic compounds (VOCs) were detected, and installation of additional monitoring wells was recommended. Samples from one well at Site 27 had gross alpha radiation at levels less than drinking water standards, and chlorinated hydrocarbons were detected in the parts per billion range. The installation of additional monitoring wells was recommended. A well was installed north of Building 648, next to Site 30 at former Site 31, and low concentrations of VOCs were detected. Sediment samples collected from a ditch at Site 30 contained concentrations of cadmium, magnesium, and copper (G&M, 1984).

- 1986 – Characterization Study: Sites 11, 27, and 30 were investigated in this study. VOCs were detected in monitoring wells northwest of former Chevalier Field (Site 11). VOCs were not detected in the deep well at Site 27. No further action was recommended for Sites 27 and 30. Lead, mercury, and VOCs were detected at Site 11. Two zones of contamination were identified at Site 11, and additional work was recommended (G&M, 1986).

- 1991 – Site Investigation: VOC and radioactive contamination were evaluated in soil at Sites 25 and 27, and all parameters were at or near background levels (ABB-ES, 1991).

- 1991 to 1992 – Contamination Assessment/Remedial Activities Investigations: As part of the Navy's IRP, Ecology and Environment, Inc. (E&E) conducted Phase I contamination assessments for 22 sites to identify principal areas and primary chemicals of potential concern (COPCs) and to recommend subsequent investigations. Fieldwork included site reconnaissance, surface emission surveys, particulate air screening, utilities surveys, soil and groundwater sampling, and hydrologic

assessments. Groundwater samples, which were collected with bailers and analyzed unfiltered, were characterized by high turbidity resulting in high metals results. The findings were reported in interim data reports for each site and are summarized as follows:

- Site 11 – Metals, totals recoverable petroleum hydrocarbons (TRPH), VOCs, polynuclear aromatic hydrocarbons (PAHs), and phenol were present in unsaturated soil over an extensive area of the site. The soil contamination was attributed to past waste disposal and burning activities at the site. Groundwater was contaminated with metals at concentrations exceeding primary drinking water standards. TRPH, VOCs, PAHs, and phenols were also present in groundwater. Some wells contained floating petroleum product. Potential impacts to Bayou Grande from soil and groundwater contamination at Site 11 were noted (E&E, 1991a).

- Site 12 – Contamination was detected in sediment, soil, and groundwater. Metals, TRPH, VOCs, PAHs, phenols, and polychlorinated biphenyls (PCBs) were the primary contaminants. A potential source of radiation was documented in the southeastern area of the site. Further investigation was recommended (E&E, 1991b).

- Site 26 – The Site 26 investigation conclusions stated that limited soil and groundwater contamination was present. Metals (arsenic, cadmium, and chromium), TRPH, VOCs, and PAHs were the primary contaminants. Further investigation was recommended (E&E, 1991c).

- Site 25 and 27 – This investigation involved a screening surface radiation survey, a soil head-space survey, and soil and groundwater sampling. At Site 25, analyses showed isolated areas of TRPH, PCB, metals, and radium-226 contamination in soil. Metals and radium-226 contamination were present in groundwater. All groundwater samples had concentrations of radium-226 nearly equal to or greater than primary drinking water standards (E&E, 1992a). At Site 27, metals were reported in soil near the drain and sewer lines at the former Building 709 location. Metals and radium-226 were detected at apparent locations of surface spills to the south of the building. VOCs, PAHs, and phenols were detected on the northern side of the building. Groundwater results showed metals and radium-226 near the spill locations and radium-226 at the drain and sewer lines. Arsenic, lead, TRPH, phenols, and xylene were detected in groundwater on the northern side of the former building (E&E, 1992b).

- Site 30 – Metals, TRPH, PAHs, phenols, and VOCs were detected in surface water, groundwater, and soil. The most contaminated areas were near the Building 648 complex and next to Site 11. Further assessment was recommended. Although metals, TRPH, VOC, and PAH contamination were identified near the IWTP sewer, the IWTP sewer was not identified as the source, but no other source was identified at that time (E&E, 1992c).

- 1992 – Site Inspection Report: Site 25 and 27 surface soil samples were analyzed for Target Analyte List (TAL) metals, RCRA Toxicity Characteristic Leaching Procedure (TCLP) metals, and limited semivolatile organic compounds (SVOCs). Instead of studying source areas, the investigations focused on adjacent areas that may have been affected by source areas. TCLP metals and SVOCs were not detected at concentrations exceeding background levels. The report concluded that soil in the area sampled would be classified as nonhazardous if removed during the construction of a proposed cold storage facility (ABB-ES, 1991).

- 1992 – NADEP Installation Restoration Conference: The results from 18 UST investigations at NAS Pensacola were presented. Groundwater data were presented for one UST near Building 709, four USTs in the Building 649 complex, and five USTs near Buildings 3220 and 3450. Most UST sites had petroleum and solvent contamination. The study documented contaminants and presented isoconcentration contour plots for some parameters. This presentation was not formally published but resulted in the transfer of solvent-contaminated UST sites to the IRP.

- 1992 – USEPA Field Investigation for Sites 1, 11, and 30: USEPA sampled surface water, sediment, and four wells near Site 11, along with the wetlands associated with Site 30. Metals were detected in sediment at Bayou Grande next to Site 11 and in the wetlands south of the Building 649 complex. Recommendations included additional sampling in Bayou Grande, the removal of the waste-receiving structure in Wetland 5A, and follow-up sampling (USEPA, 1992).

- 1993 – Contamination Assessment Report, South of Building 3450: The investigation identified TRPH contamination in soil and chlorinated contaminants in groundwater near a former UST at Site 30 (ABB-ES, 1993).

- 1994 – Wetland 5A Removal Action South of Buildings 649 and 755 at Site 30: The Navy PWC removed and properly disposed of the waste receiving structure and its contents, along with all sediment that with photoionization detector (PID) measurements greater than 10 parts per million. The waste receiving structure was sent to DRMO for recycling. The sediment, sludge, and other contents of the waste receiving structure were classified and disposed as nonhazardous waste.

Silt fencing was used during the project, and additional precautions were taken to reduce the impact of the removal action on the downgradient wetlands. Three surface water samples were collected from a downgradient location before, during, and after the removal action to assess the impact on downgradient Wetland 5B. Out of the three samples collected, maximum concentrations of lead and zinc were detected in the sample collected before removal, which indicates that the removal action did not affect Wetland 5B. Sediment samples were collected from beneath the waste receiving structure and oil/water separator immediately after their removal. Concentrations of a variety of constituents in both sediment samples exceeded FDEP sediment quality assessment guidelines. Wetland 5A contamination is addressed in the Site 41 (OU 16) Remedial Investigation (RI) report.

- 1997 – OU 2 Remedial Investigation: RI field activities at OU 2 were conducted between July 1993 and December 1995. Shallow (0 to 1 foot) and subsurface (1 foot to the water table in 2-foot increments) soil samples were collected using hollow-stem auger drilling techniques and trenching. Groundwater samples were collected in two phases. The selection of Phase I groundwater sample locations was based on previous investigations and a preliminary soil gas survey, and Phase II locations were determined by consensus at the January 1995 NAS Pensacola Partnering Team meeting. Phase I samples were collected using a submersible pump or bailers, and Phase II samples were collected with a peristaltic pump using a low-flow sampling protocol. Thus, the Phase II groundwater samples had lower turbidities and lower concentrations of metals. The RI also included radium-226 screening at Sites 12, 25, 26, and 27; a contaminant source survey; a habitat and biota survey; and specific capacity testing of constructed monitoring wells (Ensafe, 1997).

- 2004 – OU 2 Remedial Investigation Addendum: To support preparation of the Feasibility Study (FS), Phase III soil and groundwater samples were collected to assess the conditions at OU 2 in 2003. Soil sampling was targeted at locations where leachability-based FDEP SCTLs were exceeded in the RI. Twenty-five direct-push (DPT) borings were advanced, and 32 soil samples were collected from the intervals within which leachability-based SCTLs were exceeded. Groundwater samples were collected from 69 locations selected based on previous FDEP GCTL exceedances or in locations within or downgradient of previously identified plumes. The analytical parameters included metals, pesticides, PCBs, SVOCs, VOCs, and MNA indicator parameters. The new data were compared to previous analytical data to document changes from the RI and to support the FS (Ensafe, 2005b).

2.3 COMMUNITY PARTICIPATION

The Navy has performed public participation activities in accordance with CERCLA and to the extent practicable the NCP throughout the CERCLA site cleanup process. A public notice of the availability of the Proposed Plan (TtNUS, 2008) was placed in the Pensacola News Journal on May 11, 2008. A 45-

day comment period was held from May 12 to June 25, 2008. Public comments and the responses to these comments are presented in the Responsiveness Summary provided in Appendix A.

Documents pertaining to OU 2 are available to the public at the Information Repository located at the John C. Pace, University of West Florida Library. This ROD will become part of the Administrative Record file [NCP §300.825(a)(2)].

2.4 SCOPE AND ROLE OF OPERABLE UNIT

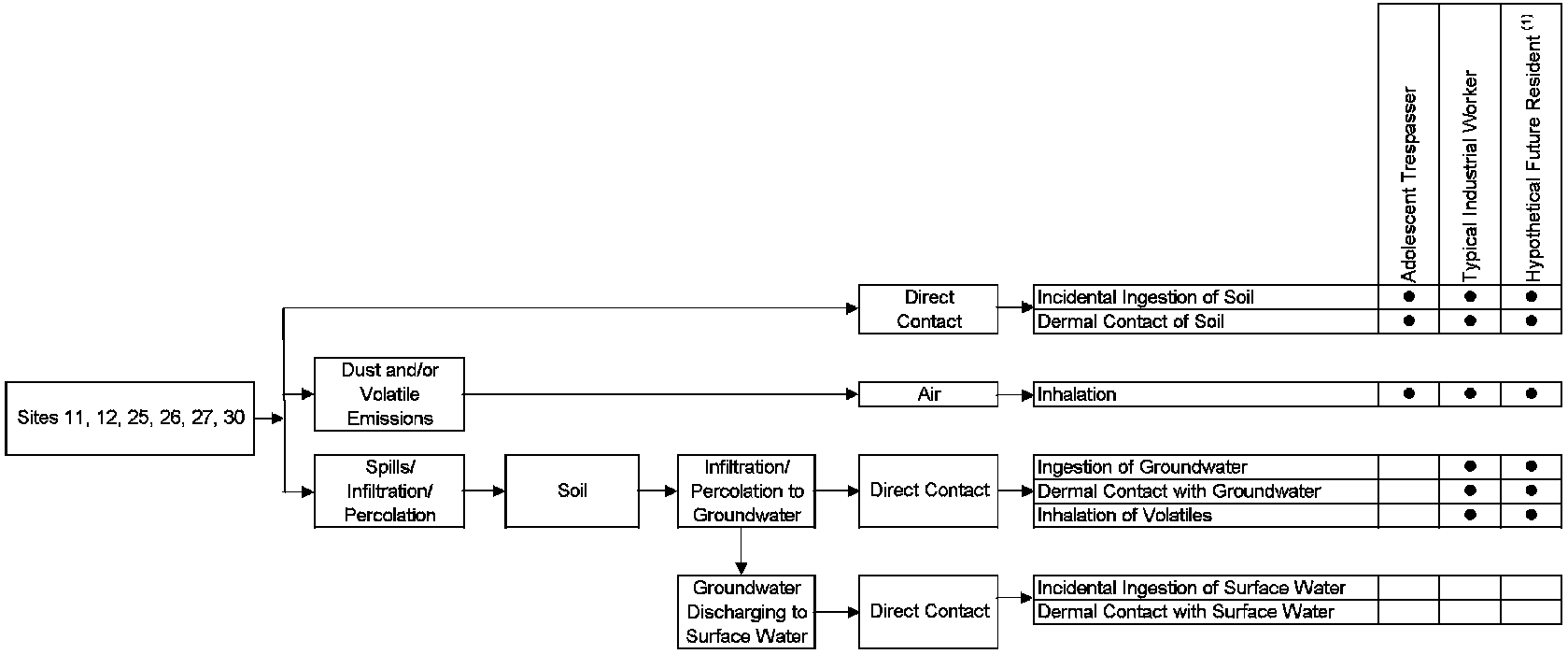
As with many NPL sites, the problems at NAS Pensacola are complex. As a result, NAS Pensacola was organized into 21 separate OUs. Each OU consists of one site or several sites that are in close proximity or have similar disposal methods in common. The IRP at NAS Pensacola is governed by the FFA and Site Management Plan. Remedial response activities at the facility are performed under CERCLA authority, and the ongoing requirements of the state RCRA/HSWA permit must also be satisfied. Fuel tank sites are subject to FDEP Petroleum Contamination Site Cleanup Criteria. The scope of each OU is defined in the Fiscal Year 2005 Site Management Plan for NAS Pensacola, which is in the Administrative Record. OU 2 is comprised of sites that are close to each other and within the same watershed. Remedies have already been selected and implemented for 11 OUs. OUs 5 and 7 were merged into OU2. OU 8 was merged into OU 13, and OU 9 was merged into OU 6. RIs for OU 19, (Site 44), OU 20 (Site 45), and OU 21 (Site 46) are currently in progress. A final RI Report has been completed for OU 16 (Site 41) and an FS is in progress. An FS is being prepared for OU 18 (Site 43). This is the only ROD for OU 2.

Investigations at OU 2 indicated the presence of soil and groundwater contamination from past operating practices. This contamination could pose an unacceptable human health risk if residential development occurred at the site or if the groundwater was used as a potable water source. No previous actions have been taken in response to the contamination at OU 2. The remedy documented in this ROD will achieve the RAOs listed in Section 2.7. This is in accordance with the overall cleanup strategy for NAS Pensacola, which involves continued use of the facility as an active Naval Air Station and continued use of the sites in OU 2 for industrial purposes.

2.5 SITE CHARACTERISTICS

Contaminant sources, detected concentrations, fate and transport, contaminated media, and geologic and hydrogeologic conditions of OU 2 are discussed in Sections 6, 7, and 9 of the OU 2 RI Report (EnSafe, 1997) and RI Addendum (EnSafe, 2005a). These site characteristics are summarized below. Figure 2-3 is a conceptual site model that illustrates the threats posed by the sites at OU 2.

ACAD: 0390CM11.dwg 06/12/08 CK PIT



LEGEND

● = Complete exposure pathway.
A blank space indicates that the exposure route is not complete for this receptor.

1 - Residential development of OU 2 is not anticipated.
Evaluated for risk management decision-making purposes only.

DRAWN BY CK DATE 6/12/08	CONCEPTUAL SITE MODEL OPERABLE UNIT 2 RECORD OF DECISION NAS PENSICOLA PENSACOLA, FLORIDA	CONTRACT NO. 0390	
CHECKED BY DATE		OWNER NO.	
REVISED BY DATE		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 2-3	REV. 0

FORM CADD NO. SDIV-AH.DWG - REV 1 - 9/10/98

2.5.1 General

OU 2 lies within a developed area of the base and covers approximately 68 acres. OU 2 is in close proximity to Pensacola Bay, and Site 11 is within a few hundred feet of the bay. The entire site area is generally flat, with land surface elevations approximately 5 to 25 feet above msl. The extensive pavement at OU 2 generally inhibits percolation of rainfall through site soil; however, infiltration does occur in some exposed areas. Rainwater from OU 2 tends to flow over paved and unpaved surfaces into the existing storm water sewer system. Wetlands can be found at several low lying areas throughout NAS Pensacola, and Wetland 5A lies to the south of Site 30.

Surface soil at NAS Pensacola consists primarily of highly permeable sands, which limit stream formation. However, several naturally occurring intermittent streams and numerous man-made drainage ditches flow south into Pensacola Bay, which has a mean depth of 10 feet in the NAS Pensacola area.

2.5.2 Geology and Hydrogeology

Three main hydrogeologic units underlie the site. These units, in ascending order, are the Floridan aquifer system, the intermediate aquifer system or confining unit, and the surficial/sand-and-gravel aquifer. The FDEP groundwater classification of the surficial aquifer is G-1, which applies to potable uses of groundwater from single source aquifers with total dissolved solids concentrations less than 3,000 mg/L.

The depth to groundwater at OU 2 ranges from approximately 12 feet below land surface (bls) in the upland areas of the base to less than 1 foot bls near the shore of Bayou Grande. Groundwater flow at OU 2 is generally to the east toward Pensacola Bay, although locally, shallow groundwater flows toward wetlands. Groundwater is not currently used as a potable water source at NAS Pensacola, which receives its potable water from Naval Technical Training Center Corry Station, approximately 4 miles north of the facility. Wells at OU 2 monitor both the shallow and intermediate zones of the surficial aquifer.

Based on the water level measurements taken during the RI, the groundwater gradient at the site is approximately 0.0001 to 0.006. The estimated velocity of groundwater flow calculated, using Darcy's Law, ranges from 0.89 to 4.2 feet per day.

2.5.3 Nature and Extent of Contamination

2.5.3.1 Soil

One soil sampling event during the RI was performed at all sites in OU 2 and is summarized in the RI Report. Soil data identified constituents greater than FDEP residential SCTLs, industrial SCTLs, leachability SCTLs, and background reference concentrations (RCs) in surface and subsurface soil. The estimated volume of soil that exceeds industrial SCTLs is 18,252 yd^3. The SCTLs are in Chapter 62-777, F.A.C.

2.5.3.1.1 Site 11

The source of contamination at Site 11 was identified as a former landfill, where trenching revealed evidence of a “seam” of blackened debris at the water table. This oily material contained corroded bits of metal and other debris.

Organic compounds detected in soil at Site 11 in excess of FDEP residential SCTLs included carcinogenic PAHs, evaluated collectively as benzo(a)pyrene equivalents (BEQs) and Aroclor-1260. Inorganics detected in soil in excess of FDEP residential SCTLs included arsenic and chromium. Chromium was detected at a concentration in excess of FDEP leachability to groundwater SCTL. Inorganics detected in excess of NAS Pensacola background RCs included aluminum, arsenic, and cadmium. BEQs and chromium were detected at concentrations in excess of FDEP industrial SCTLs. A summary of the analytical results is provided in Table 2-1.

2.5.3.1.2 Site 12

The storage of scrap metals may continue to contribute to the metals contamination at this site. Although it was not noted during the RI field investigation, past storage of old transformers pending their disposal may have contributed to the PCB contamination at Site 12. Residual fuels and oils from scrapped aircraft and vehicles stored at the site are possible sources of SVOCs at Site 12.

Organic compounds detected in soil at Site 12 in excess of FDEP residential SCTLs included BEQs and Aroclor-1260. Inorganics detected in soil in excess of FDEP residential SCTLs included arsenic, cadmium, and copper. Antimony, cadmium, and chromium were detected at concentrations in excess of FDEP leachability to groundwater SCTLs. Inorganics detected in excess of NAS Pensacola background RCs included aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, and manganese. BEQs and Aroclor-1260 were detected at concentrations in excess of FDEP industrial SCTLs. A summary of the analytical results is provided in Table 2-2.

TABLE 2-1

SOIL COCs AND CONCENTRATIONS IN SOIL - SITE 11
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Range of Detection	EPC	FDEP SCTL			Reference Concentration
					Residential	Industrial	Leachability	
Aluminum	mg/kg	19/19	109 - 26,700	23,654	72,000	NA	NA	3,833
Aroclor-1254	µg/kg	1/19	220	32	500	2,600	17,000	NA
Aroclor-1260	µg/kg	6/19	43 - 1,400	292	500	2,600	17,000	NA
Arsenic	mg/kg	5/19	0.47 - 4.1	3	2.1	12	NA	1.56
BEQs	µg/kg	7/19	62 - 6,959	2,648	100	700	8,000	NA
Cadmium	mg/kg	8/19	1.3 - 23.3	10	82	1,700	7.5	1
Chromium	mg/kg	17/19	2.3 - 1,610	357	210	470	38	6.17

BEQs - Benzo(a)pyrene equivalents.
EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
SCTL - Soil Cleanup Target Level.
NA - Not applicable.
For Aroclors, SCTLs are for the total mixture.
Reference Concentrations are NAS Pensacola background concentrations.

TABLE 2-2

SOIL COCs AND CONCENTRATIONS IN SOIL - SITE 12
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Range of Detection	EPC	FDEP SCTL			Reference Concentration
					Residential	Industrial	Leachability	
Aluminum	mg/kg	15/15	324 - 16,100	14,949	72,000	NA	NA	3,833
Anitmony	mg/kg	7/15	0.59 - 12.5	7	26	370	5	9.49
Aroclor-1254	µg/kg	1/15	280	280*	500	2,600	17,000	NA
Aroclor-1260	µg/kg	15/15	26 - 15,000	15*	500	2,600	17,000	NA
Arsenic	mg/kg	5/15	1.4 - 2.8	2	2.1	12	NA	1.56
Benzo(a)pyrene Equiv.	µg/kg	15/15	6.04 - 2,846	1	100	700	8,000	NA
Beryllium	mg/kg	1/15	0.43	0.085	120	1,400	63	0.41
Cadmium	mg/kg	12-15	2.1 - 562	562*	82	1,700	7.5	1
Chromium	mg/kg	15/15	1.1 - 70.8	53	210	470	38	6.17
Copper	mg/kg	14/15	4 - 516	516*	110	89,000	NA	5.74
Manganese	mg/kg	15/15	2.2 - 390	352	1,600	43,000	NA	21.36

BEQs - Benzo(a)pyrene equivalents.
EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
SCTL - Soil Cleanup Target Level.
NA - Not applicable.
For Aroclors, SCTLs are for the total mixture.
Reference Concentrations are NAS Pensacola background concentrations.
* - EPC is maximum detected concentration.

2.5.3.1.3 Site 25

Improper storage and disposal of materials at Building 780 are possible sources of soil contamination at the site. Another location of concern at Site 25 is the storage yard north of Building 225, which was used as a metal prefabricating shop by the NAS Pensacola PWC. This yard contains racks of materials such as metal sheeting and piping. The loading dock where the radium paint spill and cleanup occurred was investigated in the RI, but no evidence of radium-226 contamination was found.

Organic compounds detected in soil at Site 25 in excess of FDEP residential SCTLs included BEQ, Aroclor-1254, Aroclor-1260, and dieldrin. Dieldrin was detected at a concentration in excess of FDEP leachability to groundwater SCTL. Inorganics detected in soil in excess of FDEP residential SCTLs included arsenic, chromium, and, mercury. Cadmium, chromium, mercury, and silver were detected at concentrations in excess of FDEP leachability to groundwater SCTLs. Inorganics detected in excess of NAS Pensacola background RCs included aluminum, arsenic, beryllium, cadmium, chromium, manganese, mercury, silver, and zinc. BEQs were detected at concentrations in excess of FDEP industrial SCTLs. A summary of the analytical results is provided in Table 2-3.

2.5.3.1.4 Site 26

Possible sources of contamination include the storage of paints, fuels, and solvents.

Organic compounds detected in soil at Site 26 in excess of FDEP residential SCTLs included BEQs. No organics were detected at concentrations in excess of FDEP leachability to groundwater SCTLs. No inorganics were detected in soil in excess of FDEP residential SCTLs, leachability to groundwater SCTLs, or NAS Pensacola background RCs. A summary of the analytical results is provided in Table 2-4.

2.5.3.1.5 Site 27

This site was originally investigated because of the sewer from the Radium Dial Shop. The sources of organic and inorganic contaminants are uncertain.

The radiological survey revealed a small area of contamination south of former Building 709. From the size of the area, the contamination appeared to be from a spill adjacent to an old stairway from Building 709. Outside this limited area, no significant soil radiological contamination was found on this site.

Organic compounds detected in soil at Site 27 in excess of FDEP residential SCTLs included BEQs and dieldrin. BEQs and dieldrin were detected at concentrations in excess of FDEP leachability to groundwater SCTLs. Inorganics detected in soil in excess of FDEP residential SCTLs included arsenic, chromium, and mercury. Cadmium, chromium, mercury, and silver were detected at concentrations in

TABLE 2-3

SOIL COCs AND CONCENTRATIONS IN SOIL - SITE 25
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Range of Detection	EPC	FDEP SCTL			Reference Concentration
					Residential	Industrial	Leachability	
Aluminum	mg/kg	16/16	1,320 - 15,300	6,382	72,000	NA	NA	3,833
Aroclor-1254	µg/kg	4/16	59 - 910	0.22	500	2,600	17,000	NA
Aroclor-1260	µg/kg	7/16	1.8 - 1,100	1.08	500	2,600	17,000	NA
Arsenic	mg/kg	7/16	0.72 - 4.5	2.14	2.1	12	NA	1.56
Benzo(a)pyrene Equiv.	µg/kg	7/16	18 - 7,341	1.58	100	700	8,000	NA
Beryllium	mg/kg	1/16	1	0.57	120	1,400	63	0.41
Cadmium	mg/kg	6/16	1.4 - 34.6	34.6*	82	1,700	7.5	1
Chromium	mg/kg	14/16	1.7 - 234	201	210	470	38	6.17
Dieldrin	µg/kg	8/16	0.094 - 71	0.039	60	300	2	NA
Manganese	mg/kg	12/16	3.1 - 359	277	1,600	43,000	NA	21.36
Mercury	mg/kg	6/16	0.23 - 3.7	1.3	3	17	2.1	0.1
Silver	mg/kg	4/16	0.87 - 45.5	12	410	8,200	17	2.07
Zinc	mg/kg	12/16	3 - 4,360	4,360*	26,000	630,000	6,000	16.87

BEQs - Benzo(a)pyrene equivalents.
EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
SCTL - Soil Cleanup Target Level.
NA - Not applicable.
For Aroclors, SCTLs are for the total mixture.
Reference Concentrations are NAS Pensacola background concentrations.
* - EPC is maximum detected concentration.

TABLE 2-4

SOIL COCs AND CONCENTRATIONS IN SOIL - SITE 26
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Range of Detection	EPC	FDEP SCTL			Reference Concentration
					Residential	Industrial	Leachability	
Benzo(a)pyrene Equiv.	µg/kg	2/5	170 - 200	200*	100	700	8,000	NA

BEQs - Benzo(a)pyrene equivalents.
EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
SCTL - Soil Cleanup Target Level.
NA - Not applicable.
Reference Concentrations are NAS Pensacola background concentrations.
* - EPC is maximum detected concentration.

excess of FDEP leachability to groundwater SCTLs. Inorganics detected in excess of NAS Pensacola background RCs included aluminum, arsenic, beryllium, cadmium, chromium, manganese, mercury, and silver. BEQs, dieldrin, and mercury were detected at concentrations in excess of FDEP industrial SCTLs. A summary of the analytical results is provided in Table 2-5.

2.5.3.1.6 Site 30

Maintenance operations such as painting, solvent use, and plating are the most likely sources of contamination at this site.

Organic compounds detected in soil at Site 30 in excess of FDEP residential SCTLs included BEQs, Aroclor-1242, Aroclor-1254, Aroclor-1260, and dieldrin. BEQs and dieldrin were detected at concentrations in excess of FDEP leachability to groundwater SCTLs. Inorganics detected in soil in excess of FDEP residential SCTLs included arsenic and chromium. Cadmium and chromium were detected at concentrations in excess of FDEP leachability to groundwater SCTLs. Inorganics detected in excess of NAS Pensacola background RCs included aluminum, arsenic, beryllium, cadmium, chromium, and manganese. BEQs and Aroclor-1242 were detected at concentrations in excess of FDEP industrial SCTLs. A summary of the analytical results is provided in Table 2-6.

For the risk assessment, the monitoring wells were divided into two groups based on proximity to one another. One group is west of Murray Road in the general vicinity of the Building 649 complex. The second set is east of Murray Road in the general vicinity of the IWTP sewer.

2.5.3.2 Groundwater

RI groundwater sampling data were compared to Chapter 62-777, F.A.C., GCTLs, Surface Water Cleanup Target Levels (SWCTLs), and background RCs to evaluate the nature and extent of contamination. Chapter 62-777 incorporates all primary and secondary Florida groundwater standards as provided in Chapters 62-520 and 62-550, F.A.C., and all surface water standards as provided in Chapter 62-302, F.A.C. Concentrations of inorganics were also compared to their background RCs. RCs for aluminum, antimony, and iron exceeded their associated GCTLs, indicating that these metals naturally occur at relatively high concentrations at NAS Pensacola. Based on the data collected during the RI, the estimated volume of groundwater with aluminum, iron, and manganese concentrations greater than GCTLs is approximately 14,400,000 gallons. The estimated volume of groundwater with barium, cadmium, chromium, and lead concentrations greater than GCTLs is approximately 2,260,000 gallons. The estimated volume of groundwater with VOC concentrations greater than GCTLs is approximately 13,500,000 gallons. The estimated volume of groundwater with SVOC concentrations greater than GCTLs is approximately 820,000 gallons.

TABLE 2-5

COCs AND CONCENTRATIONS IN SOIL - SITE 27
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Range of Detection	EPC	FDEP SCTL			Reference Concentration
					Residential	Industrial	Leachability	
Aluminum	mg/kg	40/40	660 - 30,200	6,145	80,000	NA	NA	3,833
Arsenic	mg/kg	25/40	0.76 - 5.9	2.14	2.1	12	NA	1.56
Benzo(a)pyrene Equiv.	µg/kg	13/41	4.1 - 9,526	0.64	100	700	8,000	NA
Beryllium	mg/kg	1/40	0.44	0.38	120	1,400	63	0.41
Cadmium	mg/kg	13/40	11 - 67.1	4.90	82	1,700	7.5	1
Chromium	mg/kg	31/40	2.2 - 314	69	210	470	38	6.17
Dieldrin	µg/kg	19/40	0.079 - 800	0.035	60	300	2	NA
Manganese	mg/kg	29/40	3.3 - 636	132	1,600	43,000	NA	21.36
Mercury	mg/kg	14/40	0.11 - 84	1.32	3	17	2.1	0.1
Silver	mg/kg	3/40	0.87 - 156	1.80	410	8,200	17	2.07

BEQs - Benzo(a)pyrene equivalents.
EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
SCTL - Soil Cleanup Target Level.
NA - Not applicable.
For Aroclors, SCTLs are for the total mixture.
Reference Concentrations are NAS Pensacola background concentrations.

TABLE 2-6

SOIL COCs AND CONCENTRATIONS IN SOIL - SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Range of Detection	EPC	FDEP SCTL			Reference Concentration
					Residential	Industrial	Leachability	
Aluminum	mg/kg	58/58	76.7 - 19,300	5,469	72,000	NA	NA	3,833
Aroclor-1242	µg/kg	1/59	10,000	0.035	500	2,600	17,000	NA
Aroclor-1254	µg/kg	3/59	69 - 1,800	0.029	500	2,600	17,000	NA
Aroclor-1260	µg/kg	11/59	45 - 580	0.047	500	2,600	17,000	NA
Arsenic	mg/kg	29/58	0.41 - 4.8	1.13	2.1	12	NA	1.56
Benzo(a)pyrene Equiv.	µg/kg	14/59	0.42 - 29,230	1.34	100	700	8,000	NA
Beryllium	mg/kg	9/58	0.21 - 1.3	0.16	120	1,400	63	0.41
Cadmium	mg/kg	19/58	1.1 - 35.9	2.7	82	1,700	7.5	1
Chromium	mg/kg	50/58	2.1 - 395	54	210	470	38	6.17
Dieldrin	µg/kg	14/59	3.8 - 64	0.0054	60	300	2	NA
Manganese	mg/kg	39/58	0.6 - 266	47	1,600	43,000	NA	21.36

BEQs - Benzo(a)pyrene equivalents.
EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
SCTL - Soil Cleanup Target Level.
NA - Not applicable.
For Aroclors, SCTLs are for the total mixture.
Reference Concentrations are NAS Pensacola background concentrations.

Although contaminants were detected in both soil and groundwater samples, no strong correlation between soil and groundwater contamination was identified in the RI Report (Ensafe, 1997).

2.5.3.2.1 Site 11

As previously mentioned, the source of contamination at Site 11 was identified as a former landfill, where trenching revealed evidence of a “seam” of blackened debris at the water table. This oily material contained corroded bits of metal and other debris.

Organic compounds detected in groundwater at Site 11 in excess of FDEP GCTLs included benzene, 1,1-dichloroethene (DCE), 1,2-dichloroethane (DCA), cis-1,2-DCE, total 1,2-DCE, dieldrin, 1,1,2,2-tetrachloroethane, tetrachloroethene (PCE), TCE, and vinyl chloride, naphthalene, and aldrin. Inorganics detected in groundwater in excess of FDEP GCTLs included aluminum, arsenic, barium, beryllium, cadmium, chromium, manganese, and vanadium. Inorganics detected in excess of NAS Pensacola background RCs included aluminum, barium, beryllium, , cadmium, chromium, manganese andvanadium. However, after an evaluation of all the available data and taking in consideration more recently collected groundwater samples, aluminum and manganese should not be part of the COCs. In groundwater samples collected recently aluminum was not detected at concentrations above the NAS Pensacola background RC. Moreover, aluminum and manganese were not detected at concentrations in excess of the risk-based Oak Ridge National Laboratory Regional Screening Levels (RSLs). Therefore, based on the more recently collected data, aluminum and manganese would not be regarded as COCs in groundwater at Site 11. A summary of the analytical results is provided in Table 2-7.

2.5.3.2.2 Site 12

The storage of scrap metals, past storage of old transformers pending their disposal and residual fuels and oils from scrapped aircraft and vehicles stored at the site are possible sources of contaminantsat Site 12.

The only organic compound detected in groundwater at Site 12 in excess of FDEP GCTLs was dieldrin. No inorganics were detected in groundwater in excess of FDEP GCTLs or NAS Pensacola background RCs. A summary of the analytical results is provided in Table 2-8.

2.5.3.2.3 Site 25

Improper storage and disposal of materials, mostly metallic are the source of contaminants at this site. The loading dock where the radium paint spill and cleanup occurred was investigated in the RI, but no evidence of radium-226 contamination was found.

TABLE 2-7

GROUNDWATER COCs AND CONCENTRATIONS IN GROUNDWATER - SITE 11
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Maximum Concentration	EPC	FDEP GCTL	FDEP MSWCTL	Reference Concentration
Aldrin	µg/L	2/24	0.026	0.017*	0.002	0.00014	NA
Arsenic	µg/L	17/31	230	20*	10	50	2.8
Barium	µg/L	23/31	3,800	720	2000	NA	13.2
Benzene	µg/L	3/9	3	3**	1	71.28	NA
Beryllium	µg/L	3/31	11	4.6*	4	0.13	1.1
Cadmium	µg/L	3/31	8	6.3*	5	9.30	3.4
Chloroform	µg/L	4/33	2	1.1*	70	470.8	NA
Chromium	µg/L	5/31	770	160*	100	NA	35
1,1-Dichloroethene	µg/L	4/9	10	10**	7	3.2	NA
1,2-Dichloroethane	µg/L	3/31	9	8.1	3	37	NA
cis-1,2-Dichloroethene	µg/L	7/9	970	970**	70	NA	NA
1,2-Dichloroethene (total)	µg/L	9/24	580	130*	63	700	NA
1,2-Dichloropropane	µg/L	1/9	3	3**	5	14	NA
Dieldrin	µg/L	2/24	0.03	0.02*	0.002	0.00014	NA
Naphthalene	µg/L	3/25	60	36*	14	26	NA
1,1,2,2-Tetrachloroethane	µg/L	1/33	2	2**	0.2	10.8	NA
Tetrachloroethene	µg/L	4/33	23	8.1*	3	8.85	NA
Trichloroethene	µg/L	10/33	50	11.5	3	80.7	NA
Vanadium	µg/L	10/31	490	63*	53	NA	9.6
Vinyl chloride	µg/L	9/33	230	59*	1	2.4	NA

EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
GCTL - Groundwater Cleanup Target Level.
MSWCTL - Marine Surface Water Cleanup Target Level.
NA - not applicable.
Reference Concentrations are NAS Pensacola background concentrations.
* - EPC is arithmetic concentration.
** - EPC is maximum detected concetration.

TABLE 2-8

GROUNDWATER COCs AND CONCENTRATIONS IN GROUNDWATER - SITE 12
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Maximum Concentration	EPC	FDEP GCTL	FDEP MSWCTL	Reference Concentration
Aroclor-1260	µg/L	1/12	0.42	0.42**	5	0.000045	NA
Chloroform	µg/L	5/12	3	1.7*	70	470.8	NA
1,1-Dichloroethene	µg/L	2/12	0.9	0.85*	7	3.2	NA
Dieldrin	µg/L	5/12	0.3	0.1*	0.002	0.00014	NA
Heptachlor epoxide	µg/L	1/12	0.011	0.011*	0.2	0.00004	NA

EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
GCTL - Groundwater Cleanup Target Level.
MSWCTL - Marine Surface Water Cleanup Target Level.
NA - not applicable.
Reference Concentrations are NAS Pensacola background concentrations.
* - EPC is arithmetic concentration.
** - EPC is maximum detected concetration.

Organic compounds detected in groundwater at Site 25 in excess of FDEP GCTLs included PCE, TCE, and vinyl chloride. Mercury was detected in groundwater in excess of its FDEP GCTL and NAS Pensacola background RC. A summary of the analytical results is provided in Table 2-9.

2.5.3.2.4 Site 26

Possible sources of groundwater contamination include the storage of paints, fuels, and solvents.

The only organic compound detected in groundwater at Site 26 in excess of FDEP GCTLs was dieldrin. The only inorganics detected in groundwater in excess of FDEP GCTLs was cadmium. Inorganics detected in excess of NAS Pensacola background RCs included arsenic and cadmium. A summary of the analytical results is provided in Table 2-10.

2.5.3.2.5 Site 27

This site was originally investigated because of the sewer from the Radium Dial Shop. The sources of organic and inorganic contaminants are uncertain.

Organic compounds detected in groundwater at Site 27 in excess of FDEP GCTLs included 1,1-DCA, 1,2-DCA, 1,1-DCE, total 1,2-DCE, PCE, 1,1,1- Trichloroethane (TCA), TCE, vinyl chloride, 4-methylphenol, pentachlorophenol, and diedrin. Inorganics detected in groundwater in excess of FDEP GCTLs and NAS Pensacola background RCs included chromium and manganese. However, in more recently collected groundwater samples, manganese was not detected at concentrations in excess of the risk-based RSLs. Therefore, based on the more recently collected data, manganese would not be regarded as a COC in groundwater at Site 27. A summary of the analytical results is provided in Table 2-11.

2.5.3.2.6 Site 30

Maintenance operations in the buildings at Site 30 such as painting, solvent use, and plating probably contributed to groundwater contamination at this site. The IWTP sewer line may also have been a source of groundwater contamination.

Organic compounds detected in groundwater at Site 30 in excess of FDEP GCTLs included benzene, chloroform, 1,2-DCA, 1,1-DCE, PCE, 1,1,1-TCA, TCE, vinyl chloride, methylene chloride, 1,4-dichlorobenzene (DCB), and chlorobenzene. Inorganics detected in groundwater in excess of FDEP GCTLs included cadmium, chromium, and manganese. Inorganics detected in excess of NAS Pensacola background RCs included arsenic, barium, cadmium, chromium, and manganese. However, in more recently collected groundwater samples, manganese was not detected at concentrations in excess of the risk-based RSLs. Therefore, based on the more recently collected data, manganese would not be

TABLE 2-9

GROUNDWATER COCs AND CONCENTRATIONS IN GROUNDWATER - SITE 25
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Maximum Concentration	EPC	FDEP GCTL	FDEP MSWCTL	Reference Concentration
Chloroform	µg/L	3/16	3	1.6*	70	470.8	NA
1,1-Dichloroethene	µg/L	10/16	4	2.4	7	3.2	NA
Mercury	µg/L	11/17	4.7	4.1	2	0.25	0.20
Tetrachloroethene	µg/L	8/16	5	1.8*	3	8.85	NA
Trichloroethene	µg/L	9/16	17	17**	3	80.7	NA
Vinyl chloride	µg/L	1/16	7	7**	1	2.4	NA

EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
GCTL - Groundwater Cleanup Target Level.
MSWCTL - Marine Surface Water Cleanup Target Level.
NA - not applicable.
Reference Concentrations are NAS Pensacola background concentrations.
* - EPC is arithmetic concentration.
** - EPC is maximum detected concetration.

TABLE 2-10

GROUNDWATER COCs AND CONCENTRATIONS IN GROUNDWATER - SITE 26
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Maximum Concentration	EPC	FDEP GCTL	FDEP MSWCTL	Reference Concentration
Arsenic	µg/L	1/4	4.7	4.7**	10	50	2.8
Cadmium	µg/L	2/4	13.9	13.9**	5	8.80	3.4
Dieldrin	µg/L	3/4	0.026	0.026**	0.002	0.00014	NA
Tetrachloroethene	µg/L	2/4	2	2**	3	8.85	NA
Trichloroethene	µg/L	1/4	0.5	0.5**	3	80.7	NA
Vinyl Chloride	µg/L	1/4	0.6	0.6**	1	2.4	NA

EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
GCTL - Groundwater Cleanup Target Level.
MSWCTL - Marine Surface Water Cleanup Target Level.
NA - not applicable.
Reference Concentrations are NAS Pensacola background concentrations.
** - EPC is maximum detected concetration.

TABLE 2-11

GROUNDWATER COCs AND CONCENTRATIONS IN GROUNDWATER - SITE 27
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COC	Units	Frequency of Detection	Maximum Concentration	EPC	FDEP GCTL	FDEP MSWCTL	Reference Concentration
Chloroform	µg/L	5/32	4	2.3*	70	470.8	NA
Chromium	µg/L	23/33	5,800	1,900	100	50	35
1,4-Dichlorobenzene	µg/L	2/36	15	8.5*	75	3.0	NA
1,1-Dichloroethane	µg/L	24/32	300	160	3	37	NA
1,2-Dichloroethane	µg/L	1/7	37	37**	3	37	NA
1,1-Dichloroethene	µg/L	16/32	110	35	7	3.2	NA
1,2-Dichloroethene (total)	µg/L	4/25	130	39*	63	700	NA
Dieldrin	µg/L	5/25	0.0095	0.0055	0.002	0.00014	NA
4-Methylphenol	µg/L	7/31	100	25*	3.5	70	NA
Pentachlorophenol	µg/L	2/31	2	1.5*	1	7.9	NA
Tetrachloroethene	µg/L	13/32	62	14*	3	8.85	NA
1,1,1-Trichloroethane	µg/L	19/32	300	110	200	270	NA
Trichloroethene	µg/L	9/32	1,300	18*	3	80.7	NA
Vinyl chloride	µg/L	1/32	4	4**	1	2.4	NA

EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
GCTL - Groundwater Cleanup Target Level.
MSWCTL - Marine Surface Water Cleanup Target Level.
NA - not applicable.
* - EPC is arithmetic concentration.
Reference Concentrations are NAS Pensacola background concentrations.
** - EPC is maximum detected concetration.

regarded as a COC in groundwater at Site 30. A summary of the analytical results is provided in Table 2-12.

2.5.4 Current and Potential Future Land and Resource Uses

The area of OU 2 is currently an industrial area, and because NAS Pensacola is not proposed for Base Realignment and Closure, it is reasonable to assume that the facility and OU 2 will continue to be used for industrial or nonresidential purposes in the foreseeable future. The groundwater at OU 2 is not used at this time, and NAS Pensacola does not anticipate its future use. However, groundwater beneath OU-2 is considered a potential source of drinking water (G-2) under FDEP regulations.

2.6 SUMMARY OF SITE RISKS

2.6.1 Human Health Risk Assessment

The human health risk assessment (HHRA) estimates what risks the site poses if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the human health risk assessment for OU 2.

To determine potential risks to human health from exposure to contaminants in soil and groundwater at OU 2, the HHRA was presented in the RI Report (Ensafe, 1997), which is in the Administrative Record file. Human health risk associated with exposure to contaminants in soil and groundwater was assessed for current and future site workers, hypothetical future site residents, and hypothetical adolescent trespassers. Florida's acceptable carcinogenic risk, per Chapter 62-777, F.A.C., is 1×10^{-6} (1 in 1,000,000). USEPA's acceptable target carcinogenic risk range, per the NCP (40 CFR 300), is 1×10^{-4} to 1×10^{-6} (1 in 10,000 to 1 in 1,000,000). Because of the geographic separation of the sites, each site was evaluated separately and is discussed separately. The results of the human health risk assessments are summarized below. Figure 2-4 presents the OU 2 soil areas requiring remedial action. The OU 2 groundwater contaminant plumes are shown on Figure 2-5.

2.6.1.1 Identification of Chemicals of Concern

Chemicals of concern (COCs) were determined based on the human health risk assessment prepared as part of the RI. The most common COCs in soil at the sites are PAHs, metals, and PCBs. Pesticides are COCs in soil at two of the sites. The most common COCs in groundwater are VOCs, metals, and pesticides. PCBs are COCs in groundwater at one site. Tables 2-1 through 2-6 list the soil COCs retained for Site 11, Site 12, Site 25, Site 26, Site 27, and Site 30, respectively. Frequencies of detection, ranges of detected concentrations, exposure point concentrations (EPCs), SCTLs, and RCs are also

TABLE 2-12

GROUNDWATER COCs AND CONCENTRATIONS IN GROUNDWATER - SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2

COC	Units	Frequency of Detection	Maximum Concentration	EPC	FDEP GCTL	FDEP MSWCTL	Reference Concentration
Wells West of Murray Road							
Arsenic	µg/L	9/41	20	7.2*	10	50	2.8
Barium	µg/L	6/41	56	35*	2,000	NA	13.2
Benzene	µg/L	4/49	250	64*	1	71.28	NA
Cadmium	µg/L	4/41	110	32*	5	8.80	3.4
Chloroform	µg/L	8/49	80	16	70	470.8	NA
Chromium	µg/L	15/41	1,400	190*	100	50	35
1,4-Dichlorobenzene	µg/L	6/50	30	12*	75	3.0	NA
1,2-Dichloroethane	µg/L	4/49	220	110*	3	37	NA
1,1-Dichloroethene	µg/L	17/49	510	91*	7	3.2	NA
Tetrachloroethene	µg/L	17/49	1,100	100*	3	8.85	NA
1,1,1-Trichloroethane	µg/L	31/49	2,100	1,300	200	270	NA
Trichloroethene	µg/L	16/49	58	15	3	80.7	NA
Vinyl chloride	µg/L	3/49	1	0.57*	1	2.4	NA

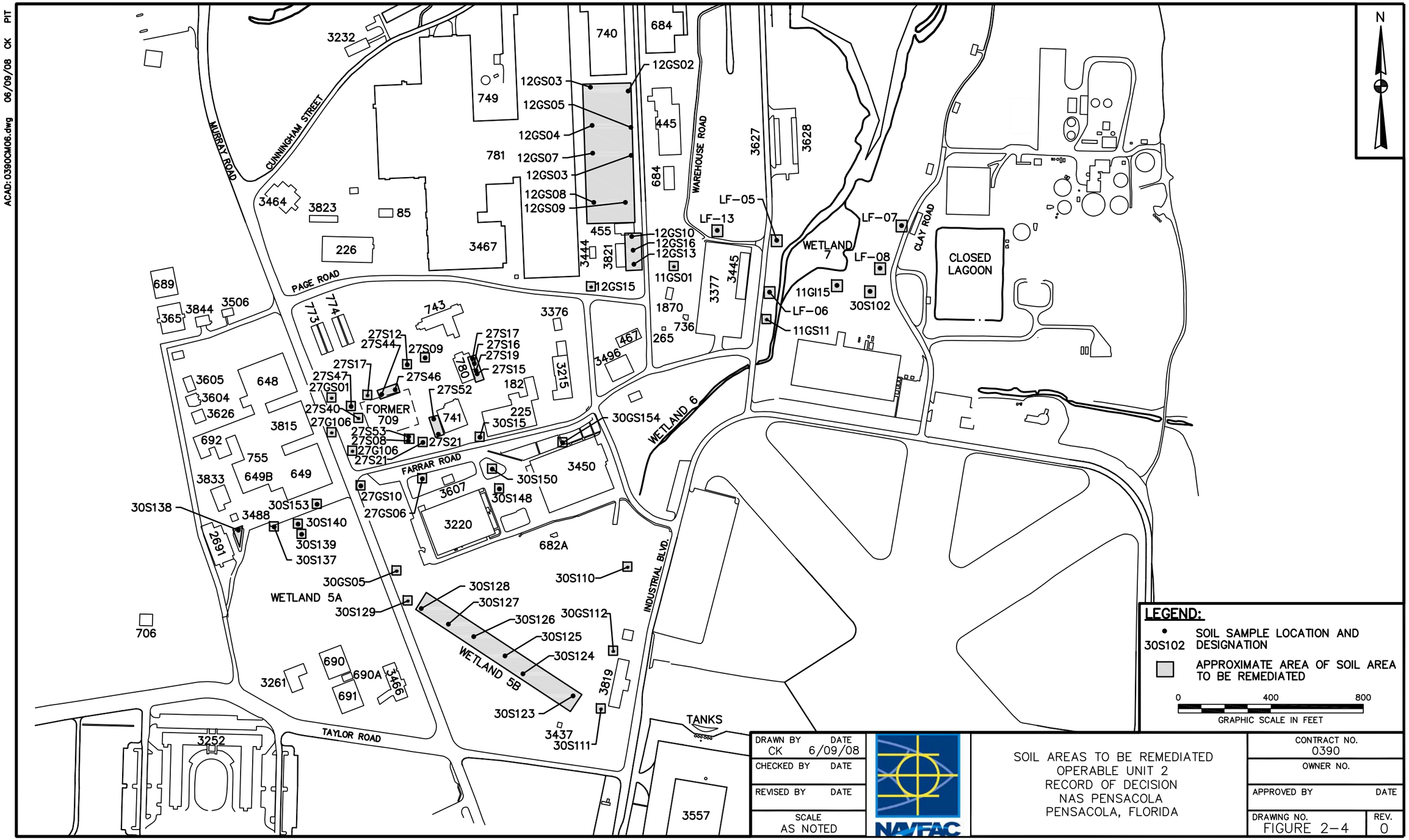
TABLE 2-12

GROUNDWATER COCs AND CONCENTRATIONS IN GROUNDWATER - SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2

COC	Units	Frequency of Detection	Maximum Concentration	EPC	FDEP GCTL	FDEP MSWCTL	Reference Concentration
Wells East of Murray Road							
Arsenic	µg/L	12/36	19	6.5*	10	50	2.8
Barium	µg/L	6/36	580	230*	2,000	NA	13.2
Benzene	µg/L	5/36	7	2.8*	1	71.3	NA
Cadmium	µg/L	3/36	8.6	4.8*	5	8.8	3.4
Carbon tetrachloride	µg/L	1/36	2	2**	3	4.42	NA
Chlorobenzene	µg/L	10/35	720	140*	100	17	NA
Chloroform	µg/L	7/36	5	2.1*	70	470.8	NA
1,4-Dichlorobenzene	µg/L	5/36	180	7.3*	75	3.0	NA
1,2-Dichloroethane	µg/L	1/36	1	1**	3	37	NA
1,1-Dichloroethene	µg/L	14/36	410	51*	7	3.2	NA
Heptachlor epoxide	µg/L	1/34	0.029	0.029**	0.2	0.00004	NA
Methylene chloride	µg/L	4/36	11	9.3	3	1,580	NA
Tetrachloroethene	µg/L	14/36	3	1.3*	3	8.85	NA
1,1,1-Trichloroethane	µg/L	18/36	950	94*	200	270	NA
Trichloroethene	µg/L	7/36	34	15	3	80.7	NA
Vinyl chloride	µg/L	3/36	110	48*	1	2.4	NA

EPC - Exposure point concentration; 95 percent upper confidence limit unless otherwise noted.
FDEP - Florida Department of Environmental Protection.
GCTL - Groundwater Cleanup Target Level.
MSWCTL - Marine Surface Water Cleanup Target Level.
NA - not applicable.
Reference Concentrations are NAS Pensacola background concentrations.
* - EPC is arithmetic concentration.
** - EPC is maximum detected concetration.

ACAD: 0390CM06.dwg 06/09/08 CK PIT



LEGEND:

- • 30S102 — SOIL SAMPLE LOCATION AND DESIGNATION
- APPROXIMATE AREA OF SOIL AREA TO BE REMEDIATED

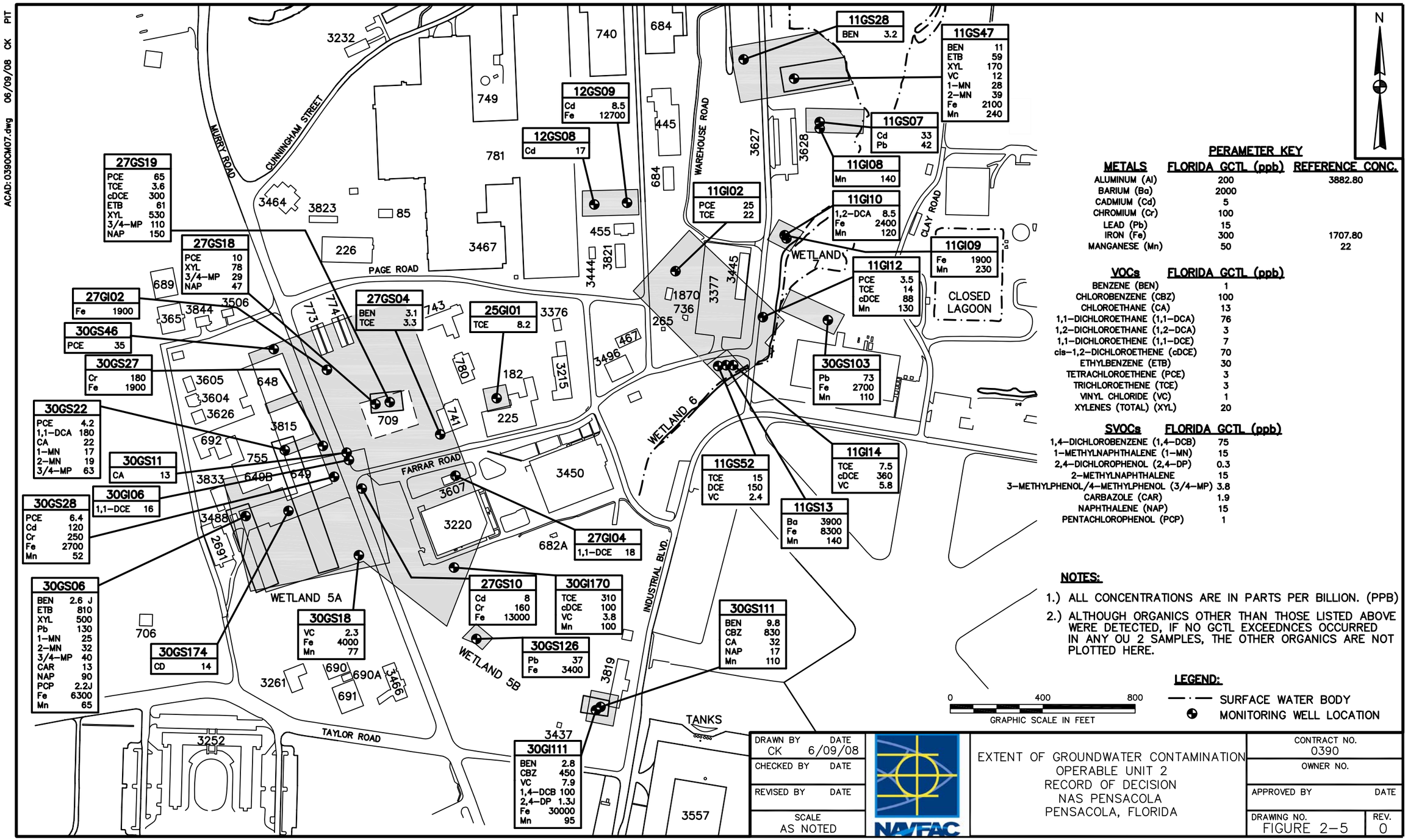
0 400 800
GRAPHIC SCALE IN FEET

DRAWN BY CK	DATE 6/09/08	SOIL AREAS TO BE REMEDIATED OPERABLE UNIT 2 RECORD OF DECISION NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0390
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-4 / REV. 0

NAVFAC

FORM CADD NO. SDIV-BH.DWG - REV 1 - 9/10/98

ACAD:0390CM07.dwg 06/09/08 CK PIT



PERAMETER KEY

METALS	FLORIDA GCTL (ppb)	REFERENCE CONC.
ALUMINUM (Al)	200	3882.80
BARIUM (Ba)	2000	
CADMIUM (Cd)	5	
CHROMIUM (Cr)	100	
LEAD (Pb)	15	
IRON (Fe)	300	1707.80
MANGANESE (Mn)	50	22

VOCs	FLORIDA GCTL (ppb)
BENZENE (BEN)	1
CHLOROBENZENE (CBZ)	100
CHLOROETHANE (CA)	13
1,1-DICHLOROETHANE (1,1-DCA)	76
1,2-DICHLOROETHANE (1,2-DCA)	3
1,1-DICHLOROETHENE (1,1-DCE)	7
cis-1,2-DICHLOROETHENE (cDCE)	70
ETHYLBENZENE (ETB)	30
TETRACHLOROETHENE (PCE)	3
TRICHLOROETHENE (TCE)	3
VINYL CHLORIDE (VC)	1
XYLENES (TOTAL) (XYL)	20

SVOCs	FLORIDA GCTL (ppb)
1,4-DICHLOROBENZENE (1,4-DCB)	75
1-METHYLNAPHTHALENE (1-MN)	15
2,4-DICHLOROPHENOL (2,4-DP)	0.3
2-METHYLNAPHTHALENE	15
3-METHYLPHENOL/4-METHYLPHENOL (3/4-MP)	3.8
CARBAZOLE (CAR)	1.9
NAPHTHALENE (NAP)	15
PENTACHLOROPHENOL (PCP)	1

NOTES:

1.) ALL CONCENTRATIONS ARE IN PARTS PER BILLION. (PPB)

2.) ALTHOUGH ORGANICS OTHER THAN THOSE LISTED ABOVE WERE DETECTED, IF NO GCTL EXCEEDNCES OCCURRED IN ANY OU 2 SAMPLES, THE OTHER ORGANICS ARE NOT PLOTTED HERE.

LEGEND:

—·— SURFACE WATER BODY

⊕ MONITORING WELL LOCATION

DRAWN BY CK	DATE 6/09/08	EXTENT OF GROUNDWATER CONTAMINATION OPERABLE UNIT 2 RECORD OF DECISION NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0390
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED		NAVFAC	DRAWING NO. FIGURE 2-5 / REV. 0

FORM CADD NO. SDIV-BH.DWG - REV 1 - 9/10/98

presented. Tables 2-7 through 2-12 list the groundwater COCs retained for Site 11, Site 12, Site 25, Site 26, Site 27, and Site 30, respectively. Frequencies of detection, maximum concentrations, EPCs, GCTLs, marine surface water cleanup target levels (MSWCTLs), and RCs are also presented. GCTLs consist of risk-based concentrations and MCLs. For those constituents where MCLs are available, the GCTLs are represented by the MCLs.

All data for the OU 2 RI were validated in accordance with USEPA Contract Laboratory Program Functional Guidelines. The data validation concluded that the overall quality of the analytical work was satisfactory and usable for site remediation and risk assessment, although a few results were found to be unusable. For soil, the 95 percent upper confidence limit (UCL) of the arithmetic mean concentration of a COC was used as the EPC in the risk calculations. In cases where there were insufficient data to calculate a UCL, the maximum concentration was used as the EPC. These exceptions are noted in Tables 2-1 through 2-6. Similarly, the human health risk assessment evaluated the detected concentrations in groundwater and the greater of the 95 percent UCL of the arithmetic mean concentration of a COC or the arithmetic mean was used as the EPC in risk calculations as noted on Tables 2-7 through 2-12. For groundwater the use of the 95 percent UCL was only included in the risk summary for determination of COCs. The 95 percent UCL procedure was not used for any remedial determinations.

2.6.1.2 Exposure Assessment

For all sites, the potentially exposed populations evaluated were current and future site workers, future site residents, future adolescent trespassers, and future construction workers. Dermal contact and incidental ingestion of surface soil were exposure pathways for current and future site workers, future residents, and adolescent trespassers. Additional pathways for future residents and future workers included ingestion of groundwater and inhalation of VOCs through domestic use of groundwater. Dermal contact and incidental exposure of subsurface soil were exposure pathways for future construction workers. The maximum concentrations of chromium in surface soil of Sites 11, 27, and 30 were greater than the soil-to-air soil screening level (SSL), so exposure to chromium via dust inhalation was also evaluated for resident, worker, and trespasser receptors in the risk assessment.

2.6.1.3 Toxicity Assessment

Table 2-13 summarizes non-carcinogenic risk information, and Table 2-14 summarizes carcinogenic risk information for COCs in soil and groundwater at all six sites. For some constituents, no toxicity criteria are available. In those cases, cross-assignments are made based on similar structural and toxicological similarities to other chemicals. The risk-based concentration (RBC) for endosulfan was cross-assigned to endosulfan I, endosulfan II, and endosulfan sulfate. The RBC for naphthalene was cross-assigned to 2-methylnaphthlene. The RBC for acenaphthene was cross-assigned to acenaphthylene. The RBC for

TABLE 2-13

SUMMARY OF NON-CARCINOGENIC TOXICITY DATA USED IN RISK ASSESSMENT
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 3

Chemical	Oral Reference Dose (mg/kg/day)		Conf. Level	Critical Effect	Uncertainty Factor Oral	Inhalation Reference Dose (mg/kg/day)		Conf. Level	Critical Effect	Uncertainty Factor Inhalation
Aluminum	1	d				ND				
Aldrin	0.00003	a	M	liver toxicity	1000	ND				
Antimony	0.0004	a	L	increased mortality	1000	ND				
Arsenic	0.0003	a	M	hyperpigmentation	3	ND				
alpha-BHC	ND					ND				
Barium	0.07	a	M	increased blood pressure		0.000143	b			
Benzene	ND					0.00171	d			
Benzo(a)pyrene equivalents	ND					ND				
Beryllium	0.005	a	L	roscopic organ char	100	ND				
bis(2-Ethylhexyl) phthalate	0.02	a	M	increased liver weight	1000	ND				
Bromodichloromethane	0.02	a	M	renal cytomegaly	1000	ND				
2-Butanone	0.6	a				0.286	a			
Cadmium (food)	0.001	a	H	proteinuria	10	ND				
Cadmium (water)	0.0005	a	H	proteinuria	10	ND				
Carbazole	ND					ND				
Carbon tetrachloride	0.0007	a	M	liver lesions	1000	0.000571	d			
Chlorobenzene	0.02	a	M	liver changes	1000	0.00571	c			10000
Chloroethane	0.4	d				2.86	a	M	delayed fetal ossification	300
Chloroform	0.01	a	M/L	fatty cysts in liver	1000	ND				
Chloromethane	0.257	a	H	hepatotoxicity	300	0.257	a	H	hepatotoxicity	
Chromium (trivalent)	1	a	L		100/10	ND				
Chromium (hexavalent)	0.005	a	L		500	ND				
Copper	0.0371	b				ND				
Dibromochloromethane	0.02	a	M	renal cytomegaly	1000	ND				
1,1-Dichloroethane	0.1	b				0.143	c			

TABLE 2-13

SUMMARY OF NON-CARCINOGENIC TOXICITY DATA USED IN RISK ASSESSMENT
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 3

Chemical	Oral Reference Dose (mg/kg/day)		Conf. Level	Critical Effect	Uncertainty Factor Oral	Inhalation Reference Dose (mg/kg/day)		Conf. Level	Critical Effect	Uncertainty Factor Inhalation
1,1-Dichloroethene	0.009	a	M	liver lesions	1000	ND				
1,2-Dichlorobenzene	0.09	a	M	liver necrosis	1000	0.09	b	M	whole body weight gain	1000
1,2-Dichloroethane	ND					0.00286	d			
1,2-Dichloroethene (cis)	0.01	b				ND				
1,2-Dichloroethene (total)	0.009	b	L	increased serum phosphatase	1000	ND				
1,3-Dichlorobenzene	0.089	d				ND				
1,4-Dichlorobenzene	ND					0.229	a	M	increased liver weight	100
4,4'-DDD	ND					ND				
Dieldrin	0.00005	a	M	liver lesions	100	ND				
Ethylbenzene	0.1	a	L	liver and kidney toxicity	1000	0.286	a		liver and kidney toxicity	1000
Heptachlor	0.0005	a	L	liver weight increase	300	ND				
Heptachlor epoxide	0.000013	a	L	liver weight increase	1000	ND				
Iron	0.3	d				ND				
Lead	ND					ND				
4-Methylphenol	0.005	b		CNS/respiratory distress	1000	ND				
Manganese (food)	0.047	a		neurological effects	1	ND				
Manganese (dietary exposure)	0.023	a		neurological effects	1	0.0000143	a	M	neurological effects	1000
Mercury	0.0003	a	M	CNS/memory disturbances	30	ND				
Methylene chloride	0.06	a	M	liver toxicity	100	0.857	a		liver toxicity	

TABLE 2-13

SUMMARY OF NON-CARCINOGENIC TOXICITY DATA USED IN RISK ASSESSMENT
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 3 OF 3

Chemical	Oral Reference Dose (mg/kg/day)		Conf. Level	Critical Effect	Uncertainty Factor Oral	Inhalation Reference Dose (mg/kg/day)		Conf. Level	Critical Effect	Uncertainty Factor Inhalation
Naphthalene	0.04	b				ND				
Nickel	0.02	a	M	decreased body weight	300	ND				
Aroclor-1242	ND					ND				
Aroclor-1254	0.00002	a				ND				
Aroclor-1260	ND					ND				
Pentachlorophenol	0.03	a	M	fetotoxicity	100	ND				
Silver	0.005	a	L	argyria	3	ND				
1,1,2,2-Tetrachloroethane	ND					ND				
Tetrachloroethene	0.01	a	M	hepatotoxicity	1000	ND				
Toluene	0.2	a	M	increased liver weight	1000	0.114	a		neurological effects	300
Toxaphene	ND					ND				
1,1,1-Trichloroethane	0.035	d				0.286	d			
Trichloroethene	0.006	d				0.006	d			
Vanadium	0.007	a		unclear	100	ND				
Vinyl chloride	ND					ND				
Xylene	2	a	M	hyperactivity, mortality	100	ND				
Zinc	0.3	a	M	decreased enzyme levels	3	ND				

a Integrated Risk Information System (IRIS), 1995.
b Health Effects Assessment Summary Tables (HEAST), 1995.
c HEAST alternative method.
d USEPA Environmental Criteria and Assessment Office - Cincinnati (provisional).
ND Not determined due to lack of information.
Blanks indicate no information.

TABLE 2-14

SUMMARY OF CARCINOGENIC TOXICITY DATA USED IN RISK ASSESSMENT
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Chemical	Oral Slope Factor $(mg/kg/day)^{-1}$	Inhalation Slope Factor $(mg/kg/day)^{-1}$	Weight of Evidence/Cancer Guideline Description	Source	Date
Aldrin	17	-	B2	IRIS	1995
Arsenic	1.75	-	A	IRIS	1995
BEQs	7.3	-	B2	IRIS	1995
Benzene	0.029	-	A	IRIS	1995
Beryllium	4.3	8.4	B2	IRIS	1995
Bis(2-Ethylhexyl)phthalate	0.014	-	B2	IRIS	1995
Chlorobenzene	-	-	D	IRIS	1995
Chloroform	0.0061	0.0805	B2	IRIS	1995
Chromium (VI)	-	42	A	IRIS	1995
Copper	-	-	D	IRIS	1995
4-4'-DDD	0.24	-	B2	IRIS	1995
1,4-Dichlorobenzene	0.24	-	B2	IRIS	1995
1,1-Dichloroethane	-	-	D	IRIS	1995
1,2-Dichloroethane	0.091	0.091	B2	IRIS	1995
1,1-Dichloroethene	0.6	0.175	C	IRIS	1995
Dieldrin	16	16.1	B2	IRIS	1995
Ethylbenzene	-	-	D	IRIS	1995
Heptachlor	4.5	-	B2	IRIS	1995
Heptachlor epoxide	9.1	-	B2	IRIS	1995
Lead	-	-	B2	IRIS	1995
Mercury	-	-	D	IRIS	1995
Methylene chloride	0.0075	0.00164	B2	IRIS	1995
Naphthalene	-	-	D	IRIS	1995
PCBs (soil)	2	-	B2	IRIS	1995
PCBs (groundwater)	0.4	-	B2	IRIS	1995
Pentachlorophenol	0.12	-	-	IRIS	1995
1,1,2,2-Tetrachloroethane	0.2	0.023	C	IRIS	1995
Tetrachloroethene	0.052	0.00203	B2-C	IRIS	1995
Toluene	-	-	D	IRIS	1995
Trichloroethene	0.011	0.006	B2	IRIS	1995
Vinyl chloride	1.9	0.3	A	IRIS	1995
Xylene	-	-	D	IRIS	1995
Zinc	-	-	D	IRIS	1995

- indicates no information available.
A - Human carcinogen.
B2 - Probable human carcinogen, based on laboratory animal date in absence of human data.
C - Possible human carcinogen.
D - Not classifiable for carcinogenic potential.
IRIS - Integrated Risk Information System.

This table provides carcinogenic risk information which is relevant to the contaminants of concern in both soil and groundwater. At this time, slope factors are not available for the dermal exposure route. Thus, dermal slope factors using in the assessment have been extrapolated from oral values. Adjustments are made according to the type of contaminant as follows:
Oral-to-dermal absorption factors: VOCs - 80%; SVOCs - 50%; Inorganics - 20%

endrin was cross-assigned to endrin aldehyde and endrin ketone. The RBC for gamma-BHC was cross-assigned to delta-BHC.

2.6.1.4 Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

Where: risk = a unitless probability of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$

These risks are probabilities that are usually expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. USEPA's generally acceptable risk range from site-related exposures is 1×10^{-4} to 1×10^{-6}. However, FDEP's acceptable risk level is 1×10^{-6}.

When the HHRA was prepared, beryllium was considered to be carcinogenic through inhalation, ingestion, and dermal contact exposure routes. However, after the RI report was finalized, USEPA identified beryllium as being carcinogenic through the inhalation route only. The HHRA was not revised to reflect this change, and the risk discussion and risk tables in this ROD still include the carcinogenic risks from beryllium for all exposure routes. In no case was beryllium the only risk driver, and even if the other routes of exposure to beryllium were excluded from the risk assessment, the conclusions of the HHRA would not change.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) to a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a

medium or across all media to which a given individual may reasonably be exposed. An HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI}/\text{RfD}$$

Where:

CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

A full risk assessment was not performed for construction workers. Instead, PRGs were developed in the RI report for the construction worker scenario to evaluate potential risk and hazard from direct contact with subsurface soil during construction events. These PRGs were calculated assuming the construction worker would be exposed to chemicals in the subsurface soil through incidental ingestion, dermal contact, and inhalation of volatiles and particulates. Maximum subsurface soil concentrations detected at each site were compared to the PRGs.

Lead was evaluated using the USEPA's Lead Uptake/Biokinetics Model to predict mean blood-lead levels in children based on exposure to impacted environmental media. The model assesses the potential health effects of elevated lead levels at each site.

The carcinogenic and non-carcinogenic risks for each site are summarized below. Only the exposure pathways and receptors that yield unacceptable risks are listed. The risks from all other exposure pathways and receptors were acceptable.

Site 11

The HHRA identified aluminum, arsenic, cadmium, chromium, lead, Aroclor-1260, and BEQs as chemicals of concern (COCs) in soil. Arsenic, beryllium, 1,2-DCE, chloroform, 1,2-DCA, 1,1,2,2-tetrachloroethane, PCE, TCE, vinyl chloride, aldrin, and dieldrin were identified as COCs in groundwater.

Tables 2-15 through 2-17 summarize the incremental lifetime cancer risks (ILCR) and HIs for each COC and each pathway at Site 11.

TABLE 2-15

SUMMARY OF HAZARD INDICES AND ILCRs FOR SURFACE SOIL AT SITE 11
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker		Future Trespasser	
						HI	ILCR	HI	ILCR
Surface Soil	Incidental Ingestion	Aluminum	0.032	0.30	ND	0.012	ND	0.0075	ND
		Aroclor-1254	0.0022	0.020	9.9E-08	0.0008	1.1E-08	0.00050	2.9E-09
		Aroclor-1260	ND	ND	9.1E-07	ND	1.0E-07	ND	2.6E-08
		Arsenic	0.012	0.11	6.0E-06	0.004	6.7E-07	0.0027	1.7E-07
		BEQs	ND	ND	3.0E-05	ND	3.4E-06	ND	8.7E-07
		Cadmium	0.014	0.13	ND	0.0051	ND	0.0033	ND
		Chromium	0.098	0.91	ND	0.035	ND	0.023	ND
		Lead	ND	ND	ND	ND	ND	ND	ND
	Dermal Contact	Aluminum	0.0066	0.022	ND	0.0047	ND	0.0015	ND
		Aroclor-1254	0.0018	0.006	4.5E-08	0.0013	1.8E-08	0.00041	2.3E-09
		Aroclor-1260	ND	ND	4.1E-07	ND	1.7E-07	ND	2.2E-08
		Arsenic	0.0024	0.008	6.7E-07	0.0017	2.7E-07	0.00055	3.5E-08
		BEQs	ND	ND	1.4E-05	ND	5.5E-06	ND	7.2E-07
		Cadmium	0.0029	0.010	ND	0.0021	ND	0.00068	ND
		Chromium	0.020	0.066	ND	0.014	ND	0.0046	ND
		Lead	ND	ND	ND	ND	ND	ND	ND
	Inhalation	Chromium	ND	ND	1.8E-06	ND	7.9E-07	ND	9.0E-08
Surface Soil Pathway Sum			0.2	2	5.2E-05	0.1	1.0E-05	0.04	1.9E-06

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.
BEQs - Benzo(a)pyrene equivalents.

TABLE 2-16

SUMMARY OF HAZARD INDICES AND ILCRs FOR GROUNDWATER AT SITE 11
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker	
						HI	ILCR
Groundwater	Ingestion	Aluminum	0.36	0.84	ND	0.13	ND
		Aldrin	0.015	0.036	4.29E-06	0.0055	1.4E-06
		Arsenic	1.8	4.3	4.55E-04	0.66	1.5E-04
		Barium	0.28	0.66	ND	0.10	ND
		Benzene	ND	ND	1.31E-06	ND	4.2E-07
		Beryllium*	0.025	0.059	2.98E-04	0.0090	9.5E-05
		Cadmium	0.35	0.81	ND	0.12	ND
		Chlorobenzene	0.0068	0.016	ND	0.0024	ND
		Chloroform	0.0029	0.0069	9.88E-08	0.0011	3.2E-08
		Chromium	0.90	2.1	ND	0.32	ND
		1,1-Dichloroethene	0.030	0.071	9.04E-05	0.011	2.9E-05
		1,1-Dichloroethane	0.020	0.046	ND	0.0070	ND
		1,2-Dichloroethane	ND	ND	1.11E-05	ND	3.5E-06
		1,2-Dichloroethene (cis)	2.7	6.2	ND	0.95	ND
		1,2-Dichloroethene (total)	0.39	0.91	ND	0.14	ND
		1,2-Dichloropropane	ND	ND	3.07E-06	ND	9.8E-07
		Dieldrin	0.011	0.025	4.75E-06	0.0039	1.5E-06
		Ethylbenzene	0.012	0.028	ND	0.0042	ND
		Heptachlor epoxide	0.012	0.029	8.1E-07	0.0044	2.6E-07
		Lead	ND	ND	ND	ND	ND
		Manganese	0.30	0.70	ND	0.11	ND
		Naphthalene	0.025	0.058	ND	0.0089	ND
		Nickel	0.26	0.61	ND	0.094	ND
		1,1,2,2-Tetrachloroethane	ND	ND	6.0E-06	ND	1.9E-06
		Tetrachloroethene	0.022	0.052	6.3E-06	0.008	2.0E-06
		Trichloroethene	0.052	0.12	1.9E-06	0.019	6.1E-07
		Vanadium	0.24	0.57	ND	0.087	ND
		Vinyl chloride	ND	ND	1.7E-03	ND	5.4E-04
		Xylene	0.0016	0.0038	ND	0.0006	ND

TABLE 2-16

SUMMARY OF HAZARD INDICES AND ILCRs FOR GROUNDWATER AT SITE 11
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker	
						HI	ILCR
Groundwater (continued)	Inhalation	Benzene	0.048	0.11	1.3E-06	0.017	4.2E-07
		Chlorobenzene	0.024	0.056	ND	0.0086	ND
		Chloroform	0.0029	0.0069	1.3E-06	0.0011	4.2E-07
		1,1-Dichloroethene	0.030	0.071	2.6E-05	0.011	8.4E-06
		1,1-Dichloroethane	0.014	0.032	ND	0.0049	ND
		1,2-Dichloroethane	0.077	0.18	1.1E-05	0.028	3.5E-06
		1,2-Dichloroethene (cis)	2.7	6.2	ND	0.95	ND
		1,2-Dichloroethene (total)	0.39	0.91	ND	0.14	ND
		1,2-Dichloropropane	0.072	0.17	ND	0.026	ND
		Ethylbenzene	0.0042	0.010	ND	0.0015	ND
		1,1,2,2-Tetrachloroethane	ND	ND	6.1E-08	ND	2.0E-08
		Tetrachloroethene	0.022	0.052	2.5E-07	0.0079	7.9E-08
		Trichloroethene	0.05	0.12	1.0E-06	0.019	3.3E-07
		Vinyl chloride	ND	ND	2.7E-04	ND	8.6E-05
		Xylene	ND	ND	ND	ND	ND
Groundwater Pathway Sum			12	27	3E-03	4	9E-04

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.
*- After the Baseline Risk Assessment was finalized, the USEPA considered beryllium as a carcinogen through the inhalation exposure route only.

TABLE 2-17

SUMMARY OF HAZARD INDICES AND ILCRs AT SITE 11
OPEERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)	HI (Trespasser)	ILCR (Trespasser)
Surface Soil	Incidental Ingestion	0.03	1	4E-05	0.06	4E-06	0.04	1E-06
	Dermal Contact	0.03	0.1	1E-05	0.02	6E-06	0.008	8E-07
	Inhalation	ND	ND	2E-06	ND	8E-07	NA	NA
Groundwater	Ingestion	8	19	3E-03	3	8E-04	NA	NA
	Inhalation	3	8	3E-04	1	1E-04	NA	NA
Sum for all Pathways		12	28	3E-03	4	9E-04	0.04	2E-06

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

Hypothetical Future Site Residents

The ingestion, dermal contact, and inhalation ILCRs for hypothetical future site residents due to surface soil at Site 11 are 4×10^{-5}, 1×10^{-5}, and 2×10^{-6}, respectively, greater than USEPA's target risk range (1×10^{-4} to 1×10^{-6}) and FDEP's target risk level (1×10^{-6}). Aroclor-1260, arsenic, and BEQs are the primary risk contributors for the ingestion pathway. Aroclor-1260 and BEQs are the primary risk contributors for the dermal pathway. Chromium is the primary risk contributor for the inhalation pathway.

The HI for soil for the child resident is 1 for the ingestion pathway, equal to the USEPA and FDEP target level of 1. Aluminum, arsenic, cadmium, chromium, and iron are the primary risk contributors for this pathway.

The ingestion and inhalation ILCRs for groundwater are 3×10^{-3} and 3×10^{-4}, respectively. Arsenic, beryllium, and vinyl chloride are the primary contributors to the risk for the ingestion pathway. Vinyl chloride is the primary contributor to the risk for the inhalation pathway.

HIs for groundwater for the adult and child resident are 8 and 19, respectively, for the ingestion pathway, and 3 and 8, respectively, for the inhalation pathway. Arsenic, chromium, 1,2-DCE (total), and manganese are the primary contributors to the risk for the ingestion pathway. 1,2-DCE (total) is the primary contributor to the risk for the inhalation pathway. Using the Lead Uptake/Biokinetics Model, lead was determined not to be a COC for hypothetical future site residents at Site 11.

Hypothetical Future and Current Site Workers

The ingestion and dermal contact ILCRs for hypothetical future and current site workers due to surface soil at Site 11 are 4×10^{-6} and 6×10^{-6}, respectively. BEQs are the primary risk contributors for both the ingestion and dermal contact pathways.

The ingestion and inhalation ILCRs for groundwater are 8×10^{-4} and 1×10^{-4}, respectively. Arsenic, beryllium, and vinyl chloride are the primary contributors to the risk for the ingestion pathway. The primary contributors to the risk for the inhalation pathway are 1,1-DCE, 1,2-DCA, and vinyl chloride.

HIs for groundwater for the ingestion and inhalation pathways are 3 and 1, respectively. Arsenic, barium cadmium, chromium, cis-1,2-DCE, and 1,2-DCE (total) are the primary contributors to the risk for the ingestion pathway.

Hypothetical Future Adolescent Trespassers

The ingestion ILCR for hypothetical future adolescent trespassers due to surface soil at Site 11 is 1×10^{-6}. BEQs are the primary risk contributors for this pathway.

Future Construction Workers

The maximum concentrations of chemicals in subsurface soil at Site 11 are less than the site-specific construction worker PRG.

Site 12

The HHRA identified aluminum, antimony, arsenic, cadmium, chromium, copper, BEQs, Aroclor-1254, and Aroclor-1260 as COCs in soil. Chloroform, 1,1-DCE, PCE, Aroclor-1260, dieldrin, and heptachlor epoxide were identified as COCs in groundwater.

Tables 2-18 through 2-20 summarize the ILCRs and HIs for each COC and each pathway at Site 12.

Hypothetical Future Site Residents

The ingestion and dermal contact ILCRs for hypothetical future site residents due to surface soil are 7 x 10^{-5} and 3 x 10^{-5}, respectively, greater than USEPA's target risk range (1 x 10^{-4} to 1 x 10^{-6}) and FDEP's target risk level (1 x 10^{-6}). Aroclor-1260, arsenic, and BEQs are the primary risk contributors for the ingestion pathway. Aroclor-1260 and BEQs are the primary risk contributors for the dermal pathway.

HI for soil for the child resident is 8 for the ingestion pathway, greater than the USEPA and FDEP target level of 1. Cadmium is the primary contributor to the risk for this pathway.

The ingestion and inhalation ILCRs for groundwater are 4 x 10^{-5} and 4 x 10^{-6}, respectively. Aroclor-1260, 1,1-DCE, dieldrin, and heptachlor epoxide are the primary contributors to the risk for the ingestion pathway. The primary contributors to risk for the inhalation pathway are chromium and 1,1-DCE.

Hypothetical Future and Current Site Workers

The ingestion and dermal contact ILCRs for hypothetical future and current site workers due to surface soil at Site 12 are 7 x 10^{-6} and 1 x 10^{-5}, respectively. Aroclor-1260 and BEQs are the primary risk contributors for both the ingestion and dermal contact pathways.

The ingestion and inhalation ILCRs for groundwater are 1 x 10^{-5} and 1 x 10^{-6}, respectively. The primary contributors to risk for the ingestion pathway are 1,1-DCE and dieldrin.

Hypothetical Future Adolescent Trespassers

The ingestion and dermal contact ILCRs for hypothetical future adolescent trespassers due to surface soil at Site 12 are 2 x 10^{-6} and 1 x 10^{-6}, respectively. Aroclor-1260 is the primary risk contributor for both the ingestion and dermal pathways.

TABLE 2-18

SUMMARY OF HAZARD INDICES AND ILCRs FOR SURFACE SOIL AT SITE 12
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker HI	Site Worker ILCR	Future Trespasser HI	Future Trespasser ILCR
Surface Soil	Incidental Ingestion	Aluminum	0.020	0.19	ND	0.0073	ND	0.0047	ND
		Antimony	0.023	0.21	ND	0.0082	ND	0.0053	ND
		Aroclor-1254	0.019	0.18	8.8E-07	0.0068	9.8E-08	0.0044	2.5E-08
		Aroclor-1260	ND	ND	4.7E-05	ND	5.2E-06	ND	1.4E-06
		Arsenic	0.0076	0.071	3.9E-06	0.0027	4.4E-07	0.0018	1.1E-07
		BEQs	ND	ND	1.3E-05	ND	1.4E-06	ND	3.7E-07
		Beryllium*	0.000023	0.00022	5.7E-07	0.00001	6.4E-08	0.00001	1.7E-08
		Cadmium	0.770	7.19	ND	0.27	ND	0.18	ND
		Chromium	0.015	0.14	ND	0.0052	ND	0.0034	ND
		Copper	0.018	0.16	ND	0.0063	ND	0.0041	ND
		Manganese	0.010	0.10	ND	0.0037	ND	0.0024	ND
	Dermal Contact	Aluminum	0.0042	0.014	ND	0.0030	ND	0.0010	ND
		Antimony	0.0047	0.016	ND	0.0034	ND	0.0011	ND
		Aroclor-1254	0.016	0.052	3.9E-07	0.011	1.6E-07	0.0036	2.1E-08
		Aroclor-1260	ND	ND	2.1E-05	ND	8.6E-06	ND	1.1E-06
		Arsenic	0.0016	0.0052	4.4E-07	0.001	1.8E-07	0.00036	2.3E-08
		BEQs	ND	ND	5.7E-06	ND	2.3E-06	ND	3.0E-07
		Beryllium*	0.000005	0.00002	6.4E-08	0.000003	2.6E-08	0.000001	3.4E-09
		Cadmium	0.16	0.52	ND	0.11	ND	0.037	ND
		Chromium	0.0030	0.010	ND	0.0021	ND	0.00070	ND
		Copper	0.0036	0.012	ND	0.0026	ND	0.00084	ND
		Manganese	0.0021	0.007	ND	0.0015	ND	0.00049	ND
Surface Soil Pathway Sum			1	9	9E-05	0.5	2E-05	0.2	3E-06

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.
BEQs - Benzo(a)pyrene equivalents.
*- After the Baseline Risk Assessment was finalized, the USEPA considered beryllium as a carcinogen through the inhalation exposure route only.

TABLE 2-19

SUMMARY OF HAZARD INDICES AND ILCRs FOR GROUNDWATER AT SITE 12
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker HI	Site Worker ILCR
Groundwater	Ingestion	Aroclor-1260	ND	ND	2.5E-06	ND	8.1E-07
		Cadmium	0.25	0.6	ND	0.09	ND
		Chloroform	0.0047	0.011	1.6E-07	0.0017	5.0E-08
		4,4'-DDD	ND	ND	4.0E-07	ND	1.3E-07
		1,1-Dichloroethane	0.00094	0.0022	ND	0.00034	ND
		1,1-Dichloroethene	0.0026	0.0060	7.7E-06	0.00092	2.5E-06
		cis-1,2-Dichloroethene	0.0082	0.019	ND	0.0029	ND
		Dieldrin	0.06	0.013	2.5E-05	0.020	8.0E-06
		Heptachlor epoxide	0.023	0.054	1.5E-06	0.0083	4.8E-07
		Tetrachlorothene	0.0031	0.0073	9.0E-07	0.0011	2.9E-07
	Inhalation	Chloroform	0.0047	0.011	2.1E-06	0.0017	6.6E-07
		1,1-Dichloroethane	0.00094	0.0022	ND	0.00034	ND
		1,1-Dichloroethene	0.0026	0.0060	2.2E-06	0.00092	7.2E-07
		cis-1,2-Dichloroethene	0.0082	0.019	ND	0.0029	ND
		Tetrachlorothene	0.0031	0.0073	3.5E-08	0.0011	1.1E-08
Groundwater Pathway Sum			0.4	0.9	4E-05	0.1	1E-05

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

TABLE 2-20

SUMMARY OF HAZARD INDICES AND ILCRs AT SITE 12
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)	HI (Trespasser)	ILCR (Trespasser)
Surface Soil	Incidental Ingestion	0.9	8.2	7E-05	0.3	7.3E-06	0.2	2E-06
	Dermal Contact	0.2	0.6	3E-05	0.1	1E-05	0.04	1E-06
Groundwater	Ingestion	0.3	0.8	4E-05	0.1	1E-05	NA	NA
	Inhalation	0.02	0.05	4E-06	0.007	1E-06	NA	NA
Sum for all Pathways		1	10	1E-04	0.6	3E-05	0.2	3E-06

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

Future Construction Workers

The maximum concentrations of chemicals in subsurface soil at Site 12 are less than the site-specific construction worker PRGs.

Site 25

The HHRA identified arsenic, beryllium, cadmium, chromium, zinc, BEQs, and Aroclor-1254 as COCs in soil. Chloroform, 1,1-DCE, PCE, TCE, and vinyl chloride were identified as COCs in groundwater.

Tables 2-21 through 2-23 summarize the ILCRs and HIs for each COC and each pathway at Site 25.

Hypothetical Future Site Residents

The ingestion and dermal contact ILCRs for hypothetical future site residents due to surface soil at Site 25 are 3×10^{-5} and 1×10^{-5}, respectively, greater than USEPA's target risk range (1×10^{-4} to 1×10^{-6}) and FDEP's target risk level (1×10^{-6}). Arsenic, BEQs, and beryllium are the primary risk contributors for the ingestion pathway. BEQs are the primary risk contributors for the dermal pathway.

HI for soil for the child resident is 1 for the ingestion pathway, equal to the USEPA and FDEP target level of 1. Aroclor-1254, cadmium, chromium, and zinc are the primary risk contributors for this pathway.

The ingestion and inhalation ILCRs for groundwater are 2×10^{-4} and 4×10^{-5}, respectively. Vinyl chloride is the primary contributor to risk for the ingestion pathway. Chloroform, 1,1-DCE, TCE, and vinyl chloride are the primary contributors to risk for the inhalation pathway.

HI for groundwater for the child resident is 1 for the ingestion pathway, and mercury and TCE are the primary contributors to risk.

Using the Lead Uptake/Biokinetics Model, lead was determined not to be a COC for hypothetical future site residents at Site 25.

Hypothetical Future and Current Site Workers

The ingestion and dermal contact ILCRs for hypothetical future and current site workers due to surface soil at Site 25 are 3×10^{-6} and 4×10^{-6}, respectively. BEQs are the primary risk contributors for both the ingestion and dermal contact pathways.

The ingestion and inhalation ILCRs for groundwater are 7×10^{-5} and 1×10^{-5}, respectively. TCE and vinyl chloride are the primary contributors to risk for both pathways.

TABLE 2-21

SUMMARY OF HAZARD INDICES AND ILCRs FOR SURFACE SOIL AT SITE 25
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker HI	Site Worker ILCR	Future Trespasser HI	Future Trespasser ILCR
Surface Soil	Incidental Ingestion	Aluminum	0.0087	0.082	ND	0.0031	ND	0.0020	ND
		Aroclor-1254	0.015	0.14	6.9E-07	0.0054	7.7E-08	0.0035	2.0E-08
		Aroclor-1260	ND	ND	6.0E-07	ND	6.7E-08	ND	1.7E-08
		Arsenic	0.0098	0.091	5.0E-06	0.0035	5.6E-07	0.0023	1.5E-07
		BEQs	ND	ND	1.8E-05	ND	2.0E-06	ND	5.2E-07
		Beryllium*	0.00016	0.0015	3.8E-06	0.0001	4.3E-07	0.000036	1.1E-07
		Cadmium	0.047	0.442	ND	0.017	ND	0.011	ND
		Chromium	0.055	0.515	ND	0.020	ND	0.013	ND
		Dieldrin	0.0011	0.010	9.8E-07	0.00038	1.1E-07	0.00025	2.8E-08
		Lead	ND	ND	ND	ND	ND	ND	ND
		Manganese	0.0081	0.075	ND	0.0029	ND	0.0019	ND
		Mercury	0.0060	0.056	ND	0.0021	ND	0.0014	ND
		Silver	0.0032	0.030	ND	0.0011	ND	0.00074	ND
		Zinc	0.020	0.186	ND	0.0071	ND	0.0046	ND
	Dermal Contact	Aluminum	0.0018	0.0059	ND	0.0013	ND	0.00041	ND
		Aroclor-1254	0.012	0.041	3.1E-07	0.0088	1.3E-07	0.0029	1.6E-08
		Aroclor-1260	ND	ND	2.7E-07	ND	1.1E-07	ND	1.4E-08
		Arsenic	0.0020	0.0066	5.6E-07	0.0014	2.3E-07	0.00046	3.0E-08
		BEQs	ND	ND	8.1E-06	ND	3.3E-06	ND	4.3E-07
		Beryllium*	0.000032	0.00011	4.3E-07	0.00002	1.7E-07	0.000007	2.3E-08
		Cadmium	0.0097	0.032	ND	0.0069	ND	0.0022	ND
		Chromium	0.011	0.0373	ND	0.0081	ND	0.0026	ND
		Dieldrin	0.00088	0.0029	4.4E-07	0.00063	1.8E-07	0.00020	2.3E-08
		Lead	ND	ND	ND	ND	ND	ND	ND
		Manganese	0.0017	0.0055	ND	0.0012	ND	0.00038	ND
		Mercury	0.0012	0.0041	ND	0.00088	ND	0.00028	ND
		Silver	0.00066	0.0022	ND	0.00047	ND	0.00015	ND
		Zinc	0.0041	0.013	ND	0.0029	ND	0.00094	ND
Surface Soil Pathway Sum			0.2	2	4E-05	0.0950	7E-06	0.05	1E-06

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.
BEQs - Benzo(a)pyrene equivalents.
*- After the Baseline Risk Assessment was finalized, the USEPA considered beryllium as a carcinogen through the inhalation exposure route only.

TABLE 2-22

SUMMARY OF HAZARD INDICES AND ILCRs FOR GROUNDWATER AT SITE 25
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker	
						HI	ILCR
Groundwater	Ingestion	Chloroform	0.0044	0.010	1.5E-07	0.0016	4.7E-08
		1,1-Dichloroethane	0.022	0.051	ND	0.0078	ND
		1,1-Dichloroethene	0.0072	0.017	2.1E-05	0.0026	6.8E-06
		Heptachlor epoxide	0.0070	0.016	4.5E-07	0.0025	1.4E-07
		Mercury	0.38	0.88	ND	0.13	ND
		Tetrachloroethene	0.0049	0.011	1.4E-06	0.0017	4.4E-07
		1,1,1-Trichloroethane	0.015	0.035	ND	0.0053	ND
		Trichloroethene	0.078	0.18	2.8E-06	0.028	9.0E-07
		Vinyl chloride	ND	ND	2.0E-04	ND	6.4E-05
	Inhalation	Chloroform	0.0044	0.010	1.9E-06	0.0016	6.2E-07
		1,1-Dichloroethane	0.015	0.036	ND	0.00011	ND
		1,1-Dichloroethene	0.0072	0.017	6.2E-06	0.0026	2.0E-06
		Tetrachloroethene	0.0049	0.011	5.4E-08	0.0017	1.7E-08
		1,1,1-Trichloroethane	0.0018	0.0043	ND	0.00065	ND
		Trichloroethene	0.078	0.18	1.5E-06	0.028	4.9E-07
		Vinyl chloride	ND	ND	3.2E-05	ND	1.0E-05
Groundwater Pathway Sum			0.6	1	3E-04	0.2	9E-05

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

TABLE 2-23

SUMMARY OF HAZARD INDICES AND ILCRs AT SITE 25
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)	HI (Trespasser)	ILCR (Trespasser)
Surface Soil	Incidental Ingestion	0.1	1	3E-05	0.05	3E-06	0.05	8E-07
	Dermal Contact	0.04	0.1	1E-05	0.03	4E-06	0.01	5E-07
Groundwater	Ingestion	0.5	1	2E-04	0.2	7E-05	NA	NA
	Inhalation	0.1	0.3	4E-05	0.03	1E-05	NA	NA
Sum for all Pathways		0.8	3	3E-04	0.3	9E-05	0.06	1E-06

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

Hypothetical Future Adolescent Trespassers

There are no unacceptable risks for hypothetical future adolescent trespassers exposed to surface soil at Site 25.

Future Construction Workers

The maximum concentrations of chemicals in subsurface soil at Site 25 are less than the site-specific construction worker PRGs.

Site 26

The HHRA identified BEQs as COCs in soil. Arsenic, beryllium, cadmium, PCE and dieldrin were identified as COCs in groundwater.

Tables 2-24 and 2-25 summarize the ILCRs and HIs for each COC and each pathway.

Hypothetical Future Site Residents

The ingestion and dermal contact ILCRs for hypothetical future site residents due to surface soil at Site 26 are 2×10^{-6} and 1×10^{-6}, respectively greater than or equal to USEPA's target risk range (1×10^{-4} to 1×10^{-6}) and FDEP's target risk level (1×10^{-6}). BEQs are the primary risk contributors for both the ingestion and dermal contact pathways.

The ingestion and inhalation ILCRs for groundwater are 1×10^{-4} and 3×10^{-6}, respectively. Arsenic, dieldrin, PCE, and vinyl chloride are the primary risk contributors for the ingestion pathway. Vinyl chloride is the primary contributor for the inhalation pathway.

HIs for groundwater for the adult and child resident for the ingestion pathway are 1 and 3, respectively, greater than or equal to the USEPA and FDEP target level of 1. Arsenic and cadmium are the primary contributors to risk for this pathway.

Hypothetical Future and Current Site Workers

There are no unacceptable risks for hypothetical future and current site workers exposed to surface soil at Site 26.

The ingestion ILCR for groundwater is 4×10^{-5}, and arsenic, dieldrin, and vinyl chloride are the primary contributors to risk.

TABLE 2-24

SUMMARY OF HAZARD INDICES AND ILCRs FOR SURFACE SOIL AND GROUNDWATER AT SITE 26
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker		Future Trespasser	
						HI	ILCR	HI	ILCR
Surface Soil	Incidental Ingestion	BEQs	ND	ND	2.3E-06	ND	2.6E-07	ND	7.0E-08
	Dermal Contact	BEQs	ND	ND	1.0E-06	ND	4.3E-07	ND	6.0E-08
Surface Soil Pathway Sum			ND	ND	3.4E-06	ND	6.9E-07	ND	1.3E-07
Groundwater	Ingestion	Arsenic	0.43	1.0	1.1E-04	0.15	3.4E-05	NA	NA
		Cadmium	0.76	1.8	ND	0.27	ND	NA	NA
		Dieldrin	0.014	0.033	6.3E-06	0.0051	2.0E-06	NA	NA
		Heptachlor epoxide	0.01	0.0	4.1E-07	0.002	1.3E-07	NA	NA
		Tetrachloroethene	0.0055	0.013	1.6E-06	0.0020	5.0E-07	NA	NA
		Trichloroethene	0.00	0.0	8.3E-08	0.00082	2.6E-08	NA	NA
		Vinyl chloride	ND	ND	1.7E-05	ND	5.5E-06	NA	NA
	Inhalation	Tetrachloroethene	0.0055	0.013	6.1E-08	0.0020	2.0E-08	NA	NA
		Trichloroethene	0.00	0.0	4.5E-08	0.0008	1.4E-08	NA	NA
		Vinyl chloride	ND	ND	2.7E-06	ND	8.7E-07	NA	NA
Groundwater Pathway Sum			1	3	1E-04	0.4	4E-05	NA	NA
Sum for All Pathways			1	3	1E-04	0.4	4E-05	ND	1E-07

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.
BEQs - Benzo(a)pyrene equivalents.

TABLE 2-25

SUMMARY OF HAZARD INDICES AND ILCRs AT SITE 26
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)	HI (Trespasser)	ILCR (Trespasser)
Surface Soil	Incidental Ingestion	ND	ND	2E-06	ND	3E-07	ND	7E-08
	Dermal Contact	ND	ND	1E-06	ND	4E-07	ND	6E-08
Groundwater	Ingestion	1	3	1E-04	0.4	4E-05	NA	NA
	Inhalation	0.008	0.02	3E-06	0.003	9E-07	NA	NA
Sum for All Pathways		1	3	1E-04	0.4	4E-05	ND	1E-07

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

Hypothetical Future Adolescent Trespassers

There are no unacceptable risks for the hypothetical future adolescent trespassers exposed to surface soil at Site 26.

Future Construction Workers

The maximum concentrations of chemicals in subsurface soil at Site 26 are less than the site-specific construction worker PRGs.

Site 27

The HHRA identified arsenic, beryllium, and BEQs as COCs in soil. Chromium, iron, 1,4-dichlorobenzene, 1,1-DCE, 1,2-DCA, chloroform, PCE, TCE, and dieldrin were identified as COCs in groundwater.

Tables 2-26 through 2-28 summarize the ILCRs and HIs for each COC and each pathway at Site 27.

Hypothetical Future Site Residents

The ingestion and dermal contact ILCRs for hypothetical future site residents due to surface soil at Site 27 are 2×10^{-5} and 5×10^{-6}, respectively, greater than USEPA's target risk range (1×10^{-4} to 1×10^{-6}) and FDEP's target risk level (1×10^{-6}). Arsenic, BEQs, and beryllium are the primary risk contributors for the ingestion pathway. BEQs and dieldrin are the primary risk contributors for the dermal pathway.

The ingestion and inhalation ILCRs for groundwater are 5×10^{-4} and 2×10^{-4}, respectively. 1,2-DCA, 1,1-DCE, PCE, and vinyl chloride are the primary contributors to risk for the ingestion pathway. The primary contributors to risk for the inhalation pathway are 1,2-DCA, 1,1-DCE, and vinyl chloride.

HIs for groundwater for the adult and child resident are 12 and 28, respectively, for the ingestion pathway, and 2 for the child resident for the inhalation pathway, greater than the USEPA and FDEP target level of 1. Chromium is the primary contributor to risk for the ingestion pathway. 1,2-DCA, 1,1-DCE, 1,2-DCE (total), and TCE are the primary contributors to risk for the inhalation pathway.

Using the Lead Uptake/Biokinetics Model, lead was determined not to be a COC for hypothetical future site residents at Site 27.

Hypothetical Future and Current Site Workers

The ingestion and dermal contact ILCRs for hypothetical future and current site workers due to surface soil at Site 27 are 2×10^{-6} and 2×10^{-6}, respectively. Arsenic, BEQs, and beryllium are the primary risk contributors for both the ingestion and dermal contact pathways.

TABLE 2-26

SUMMARY OF HAZARD INDICES AND ILCRs FOR SURFACE SOIL AT SITE 27
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker		Future Trespasser	
						HI	ILCR	HI	ILCR
Surface Soil	Incidental Ingestion	Aluminum	0.0084	0.079	ND	0.0030	ND	0.0019	ND
		Arsenic	0.0098	0.091	5.0E-06	0.0035	5.6E-07	0.0023	1.5E-07
		BEQs	ND	ND	7.3E-06	ND	8.2E-07	ND	2.1E-07
		Beryllium*	0.00010	0.0010	2.6E-06	3.7E-05	2.9E-07	0.000024	7.4E-08
		Cadmium	0.0067	0.063	ND	0.0024	ND	0.0016	ND
		Chromium	0.019	0.176	ND	0.0067	ND	0.0044	ND
		Dieldrin	0.0010	0.0090	8.8E-07	0.00034	9.8E-08	0.00022	2.5E-08
		Lead	ND	ND	ND	ND	ND	ND	ND
		Manganese	0.0039	0.036	ND	0.0014	ND	0.0010	ND
		Mercury	0.0060	0.056	ND	0.0021	ND	0.0014	ND
		Silver	0.00051	0.00473	ND	0.00018	ND	0.00012	ND
	Dermal Contact	Aluminum	0.0017	0.0057	ND	0.0012	ND	0.00040	ND
		Arsenic	0.0020	0.0066	5.6E-07	0.0014	2.3E-07	0.00046	3.0E-08
		BEQs	ND	ND	3.3E-06	ND	1.3E-06	ND	1.7E-07
		Beryllium*	0.000021	0.000071	2.9E-07	1.5E-05	1.2E-07	0.000005	1.5E-08
		Cadmium	0.0014	0.0045	ND	0.00098	ND	0.00032	ND
		Chromium	0.0039	0.013	ND	0.0028	ND	0.00089	ND
		Dieldrin	0.00079	0.0026	3.9E-07	0.00056	1.6E-07	0.00018	2.1E-08
		Lead	ND	ND	ND	ND	ND	ND	ND
		Manganese	0.00079	0.0026	ND	0.00056	ND	0.00020	ND
		Mercury	0.0012	0.0041	ND	0.00088	ND	0.00028	ND
		Silver	0.00010	0.00034	ND	0.00007	ND	0.000024	ND
	Inhalation	Chromium	ND	ND	3.5E-07	ND	1.5E-07	ND	1.7E-08
Surface Soil Pathway Sum			0.07	0.6	2E-05	0.0	4E-06	0.02	7E-07

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.
BEQs - Benzo(a)pyrene equivalents.
*- After the Baseline Risk Assessment was finalized, the USEPA considered beryllium as a carcinogen through the inhalation exposure route only.

TABLE 2-27

SUMMARY OF HAZARD INDICES AND ILCRa FOR GROUNDWATER AT SITE 27
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker	
						HI	ILCR
Groundwater	Ingestion	Aldrin	0.0031	0.0071	8.6E-07	0.0011	2.7E-07
		alpha-BHC	ND	ND	7.1E-07	ND	2.3E-07
		Chloroethane	0.0057	0.013	ND	0.0020	ND
		Chloroform	0.0062	0.015	2.1E-07	0.0022	6.7E-08
		Chromium	10	24	ND	4	ND
		1,2-Dichlorobenzene	0.0055	0.013	ND	0.0020	ND
		1,4-Dichlorobenzene	ND	ND	3.1E-06	ND	9.8E-07
		1,1-Dichloroethane	0.043	0.10	ND	0.015	ND
		1,2-Dichloroethane	ND	ND	5.1E-05	ND	1.6E-05
		1,1-Dichloroethene	0.11	0.25	3.2E-04	0.038	1.0E-04
		1,2-Dichloroethene (cis)	0.068	0.16	ND	0.024	ND
		1,2-Dichloroethene (total)	0.12	0.28	ND	0.043	ND
		Dieldrin	0.0030	0.0071	1.3E-06	0.0011	4.3E-07
		Ethylbenzene	0.0045	0.010	ND	0.0016	ND
		bis(2-Ethylhexyl) phthalate	0.013	0.030	2.0E-06	0.0045	6.3E-07
		Heptachlor	0.0001	0.0003	1.4E-07	0.000039	4.3E-08
		Heptachlor epoxide	0.010	0.024	6.7E-07	0.0037	2.1E-07
		Manganese*	0.40	0.93	ND	0.14	ND
		4-Methylphenol	0.14	0.32	ND	0.049	ND
		Naphthalene	0.017	0.039	ND	0.0060	ND
		Pentachlorophenol	0.0014	0.0032	2.7E-06	0.00049	8.7E-07
		Tetrachloroethene	0.038	0.089	1.1E-05	0.014	3.5E-06
		Toluene	0.0020	0.0047	ND	0.00072	ND
		1,1,1-Trichloroethane	0.085	0.20	ND	0.030	ND
		Trichloroethene	0.086	0.20	3.1E-06	0.031	9.9E-07
		Vinyl chloride	ND	ND	1.1E-04	ND	3.7E-05
		Xylene (Total)	0.0019	0.0044	ND	0.00067	ND

TABLE 2-27

SUMMARY OF HAZARD INDICES AND ILCRa FOR GROUNDWATER AT SITE 27
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker HI	Site Worker ILCR
Groundwater (continued)	Inhalation	Chloroethane	0.00079	0.0019	ND	0.00028	ND
		Chloroform	0.0062	0.015	2.8E-06	0.0022	8.8E-07
		1,2-Dichlorobenzene	0.012	0.029	ND	0.0044	ND
		1,4-Dichlorobenzene	0.0010	0.0024	ND	0.00036	ND
		1,1-Dichloroethane	0.030	0.071	ND	0.011	ND
		1,2-Dichloroethane	0.35	0.83	5.1E-05	0.13	6.9E-05
		1,1-Dichloroethene	0.11	0.25	9.3E-05	0.038	3.1E-05
		1,2-Dichloroethene (cis)	0.07	0.16	ND	0.024	ND
		1,2-Dichloroethene (total)	0.12	0.28	ND	0.043	ND
		Ethylbenzene	0.0016	0.0036	ND	0.00056	ND
		Tetrachloroethene	0.038	0.089	4.3E-07	0.014	5.4E-11
		Toluene	0.0035	0.0083	ND	0.0013	ND
		1,1,1-Trichloroethane	0.010	0.024	ND	0.0037	ND
		Trichloroethene	0.086	0.20	1.7E-06	0.031	5.8E-11
		Vinyl chloride	ND	ND	1.8E-05	ND	5.8E-06
		Xylene (Total)	ND	ND	ND	ND	ND
Groundwater Pathway Sum			12	29	7.0E-04	4	3.0E-04

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

TABLE 2-28

SUMMARY OF HAZARD INDICES AND ILCRs AT SITE 27
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)	HI (Trespasser)	ILCR (Trespasser)
Surface Soil	Incidental Ingestion	0.05	0.5	2E-05	0.02	1.8E-06	0.01	5E-07
	Dermal Contact	0.01	0.03	5E-06	0.008	1.9E-06	0.003	2E-07
	Inhalation	NA	NA	3E-07	NA	1.5E-07	NA	2E-08
Groundwater	Ingestion	11	27	5E-04	4	2E-04	NA	NA
	Inhalation	0.8	2	2E-04	0.3	1E-04	NA	NA
Sum for All Pathways		12	29	7E-04	4	3E-04	0.02	7E-07

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

The ingestion and inhalation ILCRs for groundwater are 2 x 10^{-4} and 1 x 10^{-4}, respectively. 1,1-DCE, PCE, and vinyl chloride are the primary contributors to risk to the ingestion pathway. 1,4-dichlorobenzene, 1,1-DCE, and 1,2-DCA are the primary contributors to risk for the inhalation pathway. HI for groundwater for the ingestion pathways is 4, and chromium is the primary contributor to risk.

Hypothetical Future Adolescent Trespassers

There are no unacceptable risks for the hypothetical future adolescent trespassers exposed to surface soil at Site 27.

Future Construction Workers

The maximum concentrations of chemicals in subsurface soil at Site 27 are less than the site-specific construction worker PRGs.

Site 30

The HHRA identified arsenic, beryllium, and BEQs as COCs in soil. Arsenic, cadmium, chromium, benzene, chloroform, 1,1-DCE, 1,4-dichlorobenzene, PCE, and 1,1,1- TCA were identified as COCs in groundwater.

Tables 2-29 through 2-32 summarize the ILCRs and HIs for each COC and each pathway at Site 30.

Hypothetical Future Site Residents

The ingestion and dermal contact ILCRs for hypothetical future site residents due to surface soil at Site 30 are 2 x 10^{-5} and 7 x 10^{-6}, respectively, greater than USEPA's target risk range (1 x 10^{-4} to 1 x 10^{-6}) and FDEP's target risk level (1 x 10^{-6}). Arsenic, BEQs, and beryllium are the primary risk contributors for the ingestion pathway. BEQs are the primary risk contributors for the dermal pathway.

The ingestion and inhalation ILCRs for groundwater west of Murray Road are 1 x 10^{-3} and 4 x 10^{-4}, respectively. Arsenic, benzene, 1,2-DCA, 1,1-DCE, PCE, and vinyl chloride are the primary contributors to risk for the ingestion pathway. Benzene, chloroform, 1,2-DCA, and 1,1-DCE are the primary contributors to risk for the inhalation pathway.

HIs for the adult and child resident for groundwater west of Murray Road for the ingestion pathway are 6 and 14, respectively, greater than the USEPA and FDEP target level of 1. HIs for the adult and child resident for groundwater west of Murray Road for the inhalation pathway are 3 and 8, respectively. Arsenic, cadmium, chromium, and 1,1,1-TCA are the primary contributors to risk for the ingestion pathway. Benzene and 1,2-DCA are the primary contributors to risk for the inhalation pathway.

TABLE 2-29

SUMMARY OF HAZARD INDICES AND ILCRs FOR SURFACE SOIL AT SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker		Future Trespasser	
						HI	ILCR	HI	ILCR
Surface Soil	Incidental Ingestion	Aluminum	0.0075	0.070	ND	0.0027	ND	0.0017	ND
		Aroclor-1242	ND	ND	1.1E-07	ND	1.2E-08	ND	3.1E-09
		Aroclor-1254	0.0020	0.019	9.2E-08	0.00072	1.0E-08	0.00046	2.6E-09
		Aroclor-1260	ND	ND	1.5E-07	ND	1.7E-08	ND	4.3E-09
		Arsenic	0.0052	0.048	2.7E-06	0.0018	3.0E-07	0.0012	7.7E-08
		BEQs	ND	ND	1.5E-05	ND	1.7E-06	ND	4.4E-07
		Beryllium*	0.000045	0.00042	1.1E-06	0.00002	1.2E-07	0.000010	3.2E-08
		Cadmium	0.0037	0.034	ND	0.0013	ND	0.00085	ND
		Chromium	0.015	0.14	ND	0.0053	ND	0.0035	ND
		Dieldrin	0.00015	0.0014	1.4E-07	0.00005	1.5E-08	0.000034	3.9E-09
		Manganese	0.0014	0.013	ND	0.00049	ND	0.00065	ND
	Dermal Contact	Aluminum	0.0015	0.0051	ND	0.0011	ND	0.00036	ND
		Aroclor-1242	ND	ND	4.9E-08	ND	2.0E-08	ND	2.6E-09
		Aroclor-1254	0.0016	0.0054	4.1E-08	0.0012	1.7E-08	0.00038	2.2E-09
		Aroclor-1260	ND	ND	6.6E-08	ND	2.7E-08	ND	3.5E-09
		Arsenic	0.0011	0.0035	3.0E-07	0.00076	1.2E-07	0.00025	1.6E-08
		BEQs	ND	ND	6.9E-06	ND	2.8E-06	ND	3.6E-07
		Beryllium*	0.000009	0.000030	1.2E-07	0.00001	5.0E-08	0.000002	6.5E-09
		Cadmium	0.00075	0.0025	ND	0.00054	ND	0.00017	ND
		Chromium	0.0031	0.010	ND	0.0022	ND	0.00071	ND
		Dieldrin	0.00012	0.00040	6.1E-08	0.00009	2.5E-08	0.000028	3.2E-09
		Manganese	0.00028	0.00093	ND	0.00020	ND	0.00013	ND
	Inhalation	Chromium	ND	ND	2.8E-07	ND	1.2E-07	ND	1.4E-08
Surface Soil Pathway Sum			0.04	0.35	3E-05	0.02	5E-06	0.01	1E-06

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.
BEQs - Benzo(a)pyrene equivalents.
*- After the Baseline Risk Assessment was finalized, the USEPA considered beryllium as a carcinogen through the inhalation exposure route only.

TABLE 2-30

SUMMARY OF HAZARD INDICES AND ILCRs FOR GROUNDWATER WEST OF MURRAY ROAD AT SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker	
						HI	ILCR
Groundwater West of Murray Road	Ingestion	Arsenic	0.65	1.5	1.6E-04	0.23	5.2E-05
		Barium	0.014	0.032	ND	0.0048	ND
		Benzene	ND	ND	2.8E-05	ND	8.9E-06
		Cadmium	1.7	4.0	ND	0.62	ND
		Chloroethane	0.017	0.041	ND	0.0062	ND
		Chloroform	0.043	0.10	1.5E-06	0.015	4.6E-07
		Chromium	1.0	2.4	ND	0.36	ND
		1,2-Dichlorobenzene	0.011	0.027	ND	0.0041	ND
		1,3-Dichlorobenzene	0.0019	0.0045	ND	0.00069	ND
		1,4-Dichlorobenzene	ND	ND	4.2E-06	ND	1.3E-06
		1,1-Dichloroethane	0.190	0.45	ND	0.070	ND
		1,2-Dichloroethane	ND	ND	1.5E-04	ND	4.7E-05
		1,1-Dichloroethene	0.28	0.64	8.2E-04	0.10	2.6E-04
		1,2-Dichloroethene (cis)	0.16	0.36	ND	0.056	ND
		1,2-Dichloroethene (total)	0.24	0.56	ND	0.086	ND
		bis(2-Ethylhexyl) phthalate	0.012	0.028	1.8E-06	0.0042	5.8E-07
		Lead	ND	ND	ND	ND	ND
		Manganese	0.050	0.11	ND	0.017	ND
		4-Methylphenol	0.051	0.12	ND	0.018	ND
		Naphthalene	0.0082	0.019	ND	0.0029	ND
		Pentachlorophenol	0.0013	0.0030	2.5E-06	0.00046	8.1E-07
		Tetrachloroethene	0.27	0.64	7.8E-05	0.10	2.5E-05
		1,1,1-Trichloroethane	1.0	2.3	ND	0.36	ND
		Trichloroethene	0.069	0.16	2.5E-06	0.025	8.0E-07
		Vinyl chloride	ND	ND	1.6E-05	ND	5.2E-06

TABLE 2-30

SUMMARY OF HAZARD INDICES AND ILCRs FOR GROUNDWATER WEST OF MURRAY ROAD AT SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker	
						HI	ILCR
Groundwater West of Murray Road (continued)	Inhalation	Benzene	1.0	2.4	2.8E-05	0.37	8.9E-06
		Chloroethane	0.0024	0.0057	ND	0.0009	ND
		Chloroform	0.043	0.10	1.9E-05	0.015	6.1E-06
		1,2-Dichlorobenzene	0.026	0.060	ND	0.0092	ND
		1,3-Dichlorobenzene	0.0019	0.0045	ND	0.00069	ND
		1,4-Dichlorobenzene	0.0014	0.0032	ND	0.00049	ND
		1,1-Dichloroethane	0.14	0.32	ND	0.049	ND
		1,2-Dichloroethane	1.0	2.4	1.5E-04	0.37	4.7E-05
		1,1-Dichloroethene	0.28	0.64	2.4E-04	0.10	7.6E-05
		1,2-Dichloroethene (cis)	0.16	0.36	ND	0.056	ND
		1,2-Dichloroethene (total)	0.24	0.56	ND	0.086	ND
		Tetrachloroethene	0.27	0.64	3.1E-06	0.10	9.8E-07
		1,1,1-Trichloroethane	0.12	0.29	ND	0.044	ND
		Trichloroethene	0.069	0.16	1.4E-06	0.025	4.3E-07
		Vinyl chloride	ND	ND	2.6E-06	ND	8.2E-07
Groundwater Pathway Sum			9	22	1E-03	3	5E-04

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

TABLE 2-31

SUMMARY OF HAZARD INDICES AND ILCRs FOR GROUNDWATER EAST OF MURRAY ROAD AT SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker	
						HI	ILCR
Groundwater East of Murray Road	Ingestion	Arsenic	0.59	1.4	1.5E-04	0.21	4.7E-05
		Barium	0.092	0.21	ND	0.033	ND
		Benzene	ND	ND	1.2E-06	ND	3.9E-07
		2-Butanone	0.041	0.095	ND	0.015	ND
		Cadmium	0.26	0.61	ND	0.093	ND
		Carbon Tetrachloride	0.078	0.18	3.9E-06	0.028	1.3E-06
		Chlorobenzene	0.19	0.45	ND	0.069	ND
		Chloroform	0.0058	0.014	1.9E-07	0.0021	6.2E-08
		Chromium	0.16	0.38	ND	0.059	ND
		1,2-Dichlorobenzene	0.0085	0.020	ND	0.0030	ND
		1,3-Dichlorobenzene	0.0063	0.015	ND	0.0022	ND
		1,4-Dichlorobenzene	ND	ND	2.6E-05	ND	8.4E-06
		1,1-Dichloroethane	0.010	0.023	ND	0.0035	ND
		1,2-Dichloroethane	ND	ND	1.4E-06	ND	4.4E-07
		1,1-Dichloroethene	0.15	0.36	4.6E-04	0.055	1.5E-04
		1,2-Dichloroethene (cis)	0.0082	0.019	ND	0.0029	ND
		1,2-Dichloroethene (total)	0.038	0.088	ND	0.013	ND
		Heptachlor epoxide	0.064	0.14	4.0E-06	0.022	1.3E-06
		Lead	ND	ND	ND	ND	ND
		Manganese	0.22	0.51	ND	0.078	ND
		Methylene chloride	0.0042	0.0099	1.0E-06	0.0015	3.3E-07
		Naphthalene	0.0050	0.012	ND	0.0018	ND
		Tetrachloroethene	0.0037	0.0085	1.0E-06	0.0013	3.3E-07
		1,1,1-Trichloroethane	0.073	0.17	ND	0.026	ND
		Trichloroethene	0.068	0.16	2.5E-06	0.024	7.9E-07
		Vinyl chloride	ND	ND	1.4E-03	ND	4.4E-04

TABLE 2-31

SUMMARY OF HAZARD INDICES AND ILCRs FOR GROUNDWATER EAST OF MURRAY ROAD AT SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2

Medium	Exposure Pathway	Chemical	Future Adult Res. HI	Future Child Res. HI	Future Res. LWA ILCR	Site Worker	
						HI	ILCR
Groundwater East of Murray Road (continued)	Inhalation	Benzene	0.045	0.10	1.2E-06	0.016	3.9E-07
		2-Butanone	0.085	0.20	ND	0.030	ND
		Carbon Tetrachloride	0.096	0.22	1.6E-06	0.034	5.1E-07
		Chlorobenzene	0.67	1.6	ND	0.24	ND
		Chloroform	0.0058	0.014	2.6E-06	0.0021	8.2E-07
		1,2-Dichlorobenzene	0.019	0.045	ND	0.0068	ND
		1,3-Dichlorobenzene	0.0063	0.015	ND	0.0022	ND
		1,4-Dichlorobenzene	0.0087	0.020	ND	0.0031	ND
		1,1-Dichloroethane	0.0069	0.016	ND	0.0025	ND
		1,2-Dichloroethane	0.0097	0.023	1.4E-06	0.0035	4.4E-07
		1,1-Dichloroethene	0.15	0.36	1.3E-04	0.055	4.3E-05
		1,2-Dichloroethene (cis)	0.0082	0.019	ND	0.0029	ND
		1,2-Dichloroethene (total)	0.038	0.088	ND	0.013	ND
		Methylene chloride	9.3E-07	0.0000022	7.2E-10	0.00000033	2.3E-10
		Tetrachloroethene	0.0037	0.085	4.1E-08	0.0013	1.3E-08
		1,1,1-Trichloroethane	0.0090	0.021	ND	0.0032	ND
		Trichloroethene	0.068	0.16	1.3E-06	0.024	4.3E-07
		Vinyl chloride	ND	ND	2.2E-04	ND	7.0E-05
Groundwater Pathway Sum			3	8	2E-03	1	8E-04

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

TABLE 2-32

SUMMARY OF HAZARD INDICES AND ILCRs AT SITE 30
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)	HI (Trespasser)	ILCR (Trespasser)
Surface Soil	Incidental Ingestion	0.03	0.3	2E-05	0.01	2E-06	0.008	6E-07
	Dermal Contact	0.01	0.03	7E-06	0.006	3E-06	0.002	4E-07
	Inhalation	NA	NA	3E-07	NA	1E-07	NA	1E-08
Groundwater	Ingestion	6	14	1E-03	2	4E-04	NA	NA
West of Murray Road	Inhalation	3	8	4E-04	1	1E-04	NA	NA
Groundwater	Ingestion	2	5	2E-03	1	6E-04	NA	NA
East of Murray Road	Inhalation	1	3	4E-04	0	1E-04	NA	NA
Sum all Pathways		13	30	4E-03	5	1E-03	0.01	1E-06

ND - Not determined due to the lack of available risk information.
ILCR - Incremental lifetime cancer risk.
HI - Hazard Index.
LWA - Lifetime weighted average.

The ingestion and inhalation ILCRs for groundwater east of Murray Road are 2 x 10^{-3} and 4 x 10^{-4}, respectively. Arsenic, 1,4-dichlorobenzene, 1,1-DCE, and vinyl chloride are the primary contributors to risk for the ingestion pathway. 1,1-DCE and vinyl chloride are the primary risk contributors for the inhalation pathway.

HIs for the adult and child resident for groundwater east of Murray Road for the ingestion pathway are 2 and 5, respectively. HIs for the adult and child resident for groundwater west of Murray Road for the inhalation pathway are 1 and 3, respectively. Arsenic is the primary contributor to risk for the ingestion pathway. Chlorobenzene is the primary contributor to risk for the inhalation pathway. Using the Lead Uptake/Biokinetics Model, lead was determined not to be a COC for hypothetical future site residents at Site 30.

Hypothetical Future and Current Site Workers

The ingestion and dermal contact ILCRs for hypothetical future and current site workers due to surface soil at Site 30 are 2 x 10^{-6} and 3 x 10^{-6}, respectively. BEQs are the primary risk contributors for these pathways.

The ingestion and inhalation ILCRs for groundwater west of Murray Road are 4 x 10^{-4} and 1 x 10^{-4}, respectively. Arsenic, 1,2-DCA, 1,1-DCE, and PCE are the primary contributors to risk for the ingestion pathway. Benzene, chloroform, 1,2-DCA, and 1,1-DCE are the primary risk contributors for the inhalation pathway.

HIs for groundwater west of Murray Road for the ingestion and inhalation pathways are 2 and 1, respectively. Arsenic, cadmium, chromium, 1,1-DCE, PCE, and 1,1,1-TCA are the primary contributors to risk for the ingestion pathway. Benzene, 1,2-DCA, and PCE are the primary contributors to risk for the inhalation pathway.

The ingestion and inhalation ILCRs for groundwater east of Murray Road are 6 x 10^{-4} and 1 x 10^{-4}, respectively. Arsenic, 1,1-DCE, and vinyl chloride are the primary contributors to risk for the ingestion pathway. 1,1-DCE and vinyl chloride are the primary risk contributors to the inhalation pathway.

HI for groundwater east of Murray Road for the ingestion pathway is 1. Arsenic is the primary contributor for this pathway.

Hypothetical Future Adolescent Trespassers

There are no unacceptable risks for the hypothetical future adolescent trespassers exposed to surface soil at Site 30.

Future Construction Workers

The maximum concentrations of chemicals in subsurface soil at Site 30 are less than the site-specific construction worker PRGs.

2.6.2 Ecological Risk Assessment

The risk to ecological receptors for the six sites included in OU 2 was assessed in the RI Report (Ensafe, 1997). At most of OU 2, no quality habitat is available because most of the area is paved or occupied by buildings. The grass between the roads and buildings could be used by terrestrial receptors such as perching birds and/or small animals, but their occurrence would be temporary. No viable terrestrial community exists at OU 2 except for grass and shrub covered areas at Site 11.

Exposure risk to terrestrial species was determined to be relatively low based on the minimal potential for effects to lower-level species, such as insects and worms. Transfer of contaminants up the food chain was determined not to be a concern because contaminants were not detected at concentrations indicative of accumulation. The low soil concentrations of contaminants as compared to ecological criteria and the limited distribution of contaminants were determined to limit the incidental ingestion risk to acceptable levels for locally foraging birds. No unacceptable risks to ecological receptors were identified in the RI.

2.6.3 Risk Assessment Summary

The concentrations of COCs in surface soil, subsurface soil, and groundwater result in unacceptable risk to human health for current and future site uses, but do not result in unacceptable risks to ecological receptors. Data collected in 1997 were used to evaluate the risks. However, subsequent groundwater sampling was conducted in 1999 and 2003. The aluminum and manganese results in the more recently collected groundwater samples at Sites 11, 27, and 30 are less than the concentrations used in the risk assessment. Aluminum concentrations at Site 11 are less than the NAS Pensacola background RCs. Moreover, the aluminum and manganese concentrations at Sites 11, 27, and 30 are less than the risk-based RSLs. Their contribution to total risk associated with groundwater is insignificant; therefore, they would not be considered COCs at these sites. Overall, the response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

2.7 REMEDIAL ACTION OBJECTIVES

2.7.1 Remedial Action Objectives

RAOs are media-specific goals that define the objective of conducting remedial actions to protect human health and the environment and attain remedial goals in a reasonable time frame. RAOs specify the

media, potential exposure routes and receptors, and acceptable concentrations (i.e., cleanup goals) for a site and provide a general description of what the cleanup will accomplish. RAOs typically serve as the design basis for the remedial alternatives described in Section 2.8.

The following RAOs were established in the FS (Ensafe, 2005b) for soil and groundwater at OU 2:

- Protect human health by eliminating or preventing exposure to contamination in surface soil by COCs that exceed Florida residential and commercial/industrial SCTLs.

- Eliminate a continuing contamination source to groundwater by eliminating COCs in subsurface soil at concentrations that exceed Florida SCTLs for leachability.

- Reduce human health risk from exposure to groundwater by reducing groundwater contamination at OU 2 to meet Florida GCTLs. FDEP GCTLs were used because they are typically more stringent than USEPA Maximum Contaminant Levels (MCLs) or because there are no USEPA MCLs for particular contaminants.

The remedy documented in this ROD is expected to achieve these RAOs.

2.7.2 Cleanup Goals

A cleanup goal is the target concentration to which a COC must be reduced within a particular media of concern to achieve one or more of the established RAOs. Cleanup goals are developed to ensure that contaminant concentrations left on site are protective of human and ecological receptors.

2.7.2.1 Soil Cleanup Goals

The soil cleanup goals are listed in Table 2-33. Under the industrial/restricted use scenario, the soil cleanup goals are the FDEP industrial SCTLs or RCs, whichever is greater. Soil with contaminant concentrations greater than leachability SCTLs will also be remediated.

2.7.2.2 Groundwater Cleanup Goals

The groundwater cleanup goals are listed in Table 2-33 and are the FDEP GCTLs or RCs, whichever is greater. Florida GCTLs were chosen as cleanup goals instead of MCLs because GCTLs are equal to or less than MCLs, and for many constituents, there are no MCLs. Monitoring wells adjacent to wetlands must also meet the MSWCTLs. Additionally, it should be noted that the surface water nearby the area is considered Class III per Surface Water Classifications 62-302.400.

TABLE 2-33

CHEMICAL OF CONCERNS
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FL

Chemical of Concern	SOIL		GROUNDWATER		
	Cleanup Goal (mg/kg)	Health-based Standard Basis	Cleanup Goal (µg/L)	Health-based Standard Basis	MSWCTL[A]
Aldrin	-	-	0.002	FL GCTL	0.00014
Aluminum	NA	FL SCTL (industrial)	-	-	-
Antimony	5	FL SCTL (leachability)	-	-	-
Aroclor 1242	2.6	FL SCTL (industrial)	-	-	-
Aroclor 1254	2.6	FL SCTL (industrial)	-	-	-
Aroclor 1260	2.6	FL SCTL (industrial)	0.5	FL GCTL	0.000045
Arsenic	12	FL SCTL (industrial)	10	FL GCTL	50
Barium	-	-	2000	FL GCTL	NA
Benzene	-	-	1	FL GCTL	71.28
Benzo(a)pyrene Equivalents	0.7	FL SCTL (industrial)	-	-	-
Beryllium	63	FL SCTL (leachability)	4	FL GCTL	0.13
Cadmium	7.5	FL SCTL (leachability)	5	FL GCTL	9.3
Carbon Tetrachloride	-	-	3	FL GCTL	4.42
Chlorobenzene	-	-	100	FL GCTL	17
Chloroform	-	-	70	FL GCTL	470.8
Chromium	38	FL SCTL (leachability)	100	FL GCTL	50
Copper	89000	FL SCTL (industrial)	-	-	-
1,4-Dichlorobenzene	-	-	75	FL GCTL	3
1,1-Dichloroethane	-	-	70	FL GCTL	NA
1,2-Dichloroethane	-	-	3	FL GCTL	37
1,1-Dichloroethene	-	-	7	FL GCTL	3.2
cis-1,2-Dichloroethene	-	-	70	FL GCTL	NA
1,2-Dichloroethene (total)	-	-	70*	*	7000
1,2-Dichloropropane	-	-	5	FL GCTL	14
Dieldrin	2	FL SCTL (leachability)	0.002	FL GCTL	0.00014
Heptachlor epoxide	-	-	0.2	FL GCTL	0.00004
Manganese	43000	FL SCTL (industrial)	-	-	-
Mercury	2.1	FL SCTL (leachability)	2	FL GCTL	0.025
4-Methylphenol	-	-	3.5	FL GCTL	70
Methylene chloride	-	-	5	FL GCTL	1580
Naphthalene	-	-	14	FL GCTL	26
Pentachlorophenol	-	-	1	FL GCTL	7.9
Silver	17	FL SCTL (leachability)	-	-	-
1,1,2,2-Tetrachloroethane	-	-	0.2	FL GCTL	10.8
Tetrachloroethene	-	-	3	FL GCTL	8.85
1,1,1-Trichloroethane	-	-	200	FL GCTL	270
Trichloroethene	-	-	3	FL GCTL	80.7
Vanadium	-	-	49	FL GCTL	NA
Vinyl chloride	-	-	1	FL GCTL	2.4
Zinc	6000	FL SCTL (leachability)	-	-	-

A MSWCTL = Marine Surface Water need to be applied to monitoring wells immediately adjacent to surface water bodies or wetlands. However, for monitoring well adjacent to wetlands or water bodies the more stringent of the FL GCTL or MSWCTL will be used as the cleanup goal.

* Based on cis-1,2-dichloroethene

\- Not considered a Chemical Of Concern for the specified media

FL = Florida
GCTL = Groundwater Cleanup Target Levels
SCTL = Soil Cleanup Target Levels

mg/kl = milligram per kilogram
µg/L= microgram per Liters

2.8 DESCRIPTION OF ALTERNATIVES

This section provides a narrative of each alternative evaluated for the remediation of soil and groundwater at OU 2. For further information on the remedial alternatives, refer to the FS (EnSafe, 2005b). Section 2.9 summarizes the comparative analysis of alternatives that is documented in the FS.

2.8.1 Soil Alternatives

Five remedial alternatives for OU 2 soil were analyzed in the FS. Each alternative was considered with respect to the nine criteria outlined in the NCP at 40 CFR 300.430(e)(9)(iii). These criteria are categorized as threshold, primary balancing, and modifying and are further explained in Table 2-34. These alternatives are summarized in this section.

2.8.1.1 Soil Alternative S-1: No Action

This alternative is required by the NCP as a baseline for comparison with other alternatives. Under this alternative, no response action would be conducted to reduce the volume, mobility, or toxicity of contaminated soil, and no controls would be initiated to restrict future land use or exposure to contaminated media. Soil with the potential to leach contaminants to groundwater at unacceptable concentrations would be left on site.

This alternative would not protect human health because risks from exposure to contaminated soil would continue to exist. This alternative would not achieve the RAOs for soil or comply with ARARs. There would be no reductions of contaminant mobility, and reduction in toxicity and volume would occur only through long-term natural attenuation and would not be monitored. Because no remedial action would take place, this alternative would not result in any short-term risks. Because there is no action, there are no implementation considerations. There would be no cost associated with this alternative.

2.8.1.2 Soil Alternative S-2: Land Use Controls

Although this alternative would be limited to LUCs, it would allow site risks to be managed consistent with both USEPA risk guidance and the State of Florida's Risk Management Option Level II under Chapter 62-780(2), F.A.C. LUCs would be developed and implemented by NAS Pensacola with concurrence from the regulatory agencies. A LUC RD would be prepared in accordance with the NAS Pensacola Base Master Plan and FFA. Institutional controls would be implemented and enforced to restrict the property use to nonresidential. Prohibited uses of the property under these criteria would include, but not be limited to, any form of housing, child-care facilities, any kind of school including preschools, elementary schools, and secondary schools, playgrounds, and adult convalescent or nursing care facilities. The excavation, disturbance, or removal of soil, existing asphalt, concrete or buildings from the site would be

TABLE 2-34

**EXPLANATION OF DETAILED ANALYSIS CRITERIA
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA**

Criterion	Description
Threshold	**Overall Protection of Human Health and the Environment.** Addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering methods, and/or institutional controls. **Compliance with ARARs.** CERCLA Section 121(d) and NCP §300.430(f)(1)(II)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4). This criterion addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes or provides a basis for invoking a waiver.
Primary Balancing	**Long-Term Effectiveness and Permanence.** Refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time after cleanup levels have been met. Also includes consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls. **Reduction of Contaminant Toxicity, Mobility, and Volume Through Treatment**. Refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. **Short-Term Effectiveness.** Addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved. **Implementability**. Addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other government entities are also considered. **Cost.** The benefits of implementing a particular alternative are weighed against the cost of implementation.
Modifying	**State/Support Agency Acceptance.** The final Feasibility Study and the Proposed Plan, which are placed in the Administrative Record file, represent a consensus by the Navy, USEPA, and FDEP. **Community Acceptance.** The Navy assesses community acceptance of the preferred alternative by giving the public an opportunity to comment on the remedy selection process and the preferred alternative and then responds to those comments.

prohibited unless prior written approval is obtained from the facility's Environmental Coordinator. The Navy would be responsible for implementing, maintaining, reporting on, and enforcing the LUCs. This option would require annual inspections to confirm compliance with the LUC agreement. The alternative would provide long-term effectiveness by restricting future use and access.

LUCs would be implemented to limit land use to industrial/commercial activitie. Maintenance of the LUCs would be addressed in a LUC RD to be submitted to USEPA and FDEP for review and comment. The LUCs will be maintained until concentrations in soil are at levels that allow for unrestricted use and unlimited exposure. The LUC boundaries are shown on Figure 2-6.

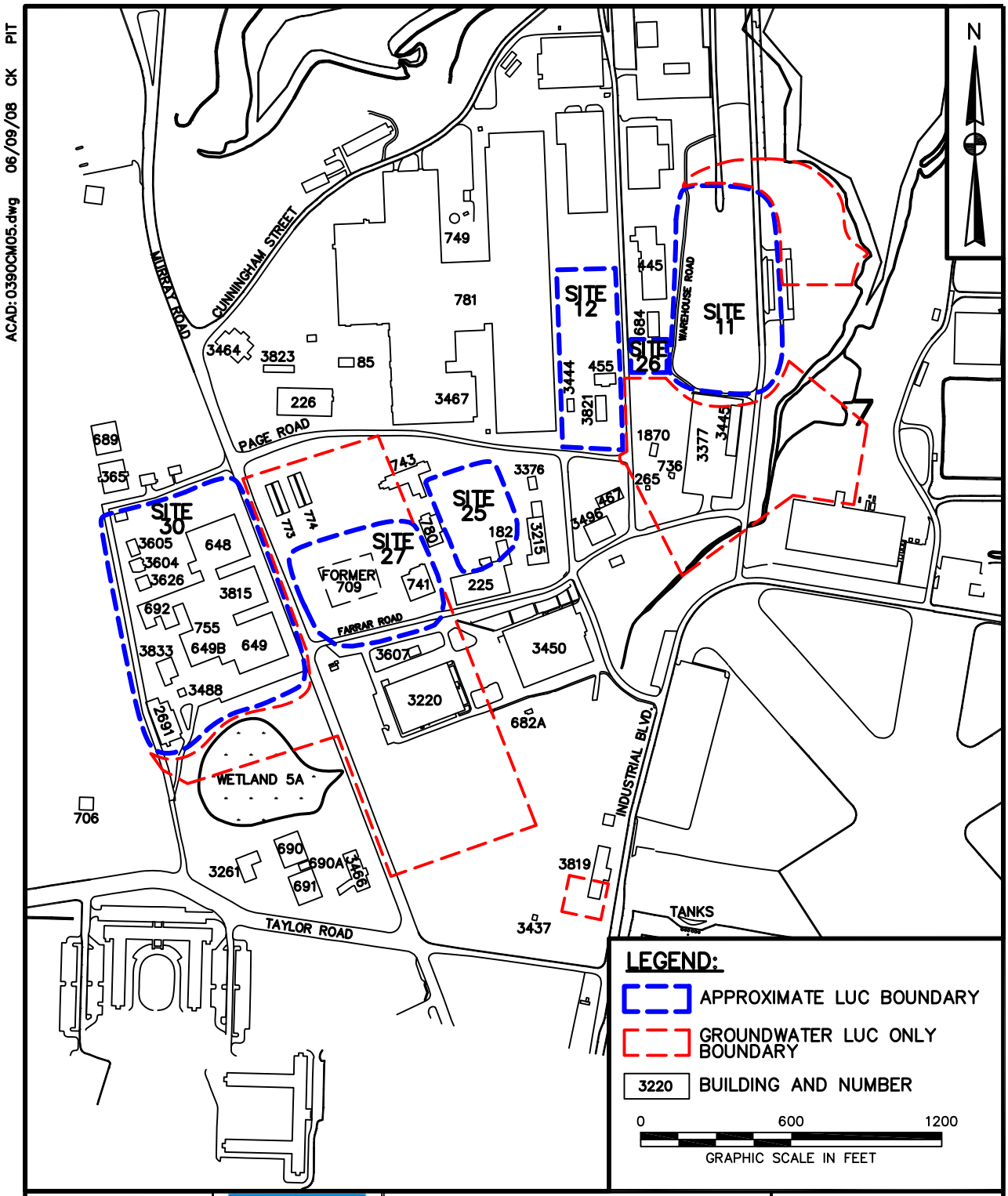
This alternative would protect human health because LUCs would reduce the risk from direct exposure by restricting future use and access. There would be no reduction of contaminant toxicity, mobility, or volume through active treatment. This alternative would not achieve the RAOs, and contaminant concentrations would continue to be greater than industrial and leachability SCTLs. There would be minimal short-term risks associated with the performance inspection activities, which would be addressed through appropriate health and safety procedures. The LUCs would be maintained until concentrations in soil are at levels that allow for unrestricted use and unlimited exposure. The LUC RD could be developed and implemented in less than 1 year. LUCs are assumed to be required for 30 years. The estimated cost of the initial implementation of the LUC alternative is $22,000. The 30-year net present worth (NPW) of this alternative, using a 6 percent interest rate, is $77,000.

2.8.1.3 Soil Alternative S-3: Soil and Asphalt Capping and LUCs

Covering or capping of the site surface reduces the risk of exposure to contaminated soil, thus eliminating the direct exposure pathway. When constructed as low-permeability covers, caps also reduce the flow of water and reduce the risk of rain and surface water carrying any contamination downward into the groundwater.

This alternative would involve the construction of 22-inch thick asphalt covers (including 4 inches of asphalt, underlain by 12 inches of a base rock, a geotextile drainage fabric, and 6-inch of leveling fill material) in four areas (two at Site 12 and one each at Sites 25 and 27 for a total of 8.7 acres) and 2-foot-thick soil covers in four areas (two each at Sites 11 and 30 for a total of 4.8 acres). The covers would reduce exposure to contaminated soil, thus eliminating the unacceptable human health risks associated with the direct exposure pathway. The asphalt covers would also reduce the flow of water and reduce the risk of rain and surface water carrying any contamination downward into the groundwater.

Although the proposed asphalt and soil caps would protect against exposure to most soil with concentrations in excess of commercial/industrial direct exposure and leachability SCTL, several isolated areas of soil exceedances occur near Sites 27 and 30. These exceedances would be addressed by



DRAWN BY CK	DATE 6/09/08	LUC BOUNDARIES OPERABLE UNIT 2 RECORD OF DECISION NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0390
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2–6 / REV. 0

FORM CADD NO. SDIV-AV.DWG - REV 1 - 9/10/98

excavating the top 2 feet of soil from these locations and consolidating it under the Site 27 asphalt cap. The total estimated excavation volume is 950 yd^3. Excavated areas would be covered with clean fill to the previous elevation. Because contamination would be left on site at levels that preclude unrestricted use and unlimited exposure, this alternative would require implementation of LUCs (as described in Alternative S-2) and regular inspection and maintenance of the soil covers.

This alternative would protect human health because LUCs would reduce the risk from direct exposure by preventing exposure under residential scenarios, and covers would prevent exposure to soil with contaminant concentrations greater than industrial SCTLs. There would be no reduction of contaminant toxicity, mobility, or volume through active treatment. This alternative would achieve the RAOs within approximately 1 year, and ARARs for SCTLs would be met by eliminating the exposure route with the caps and covers, although contaminant concentrations would still be greater than residential SCTLs. There would be minimal short-term risks associated with excavation, grading, and performance inspection activities, which would be addressed through appropriate health and safety procedures. The LUCs would be maintained until concentrations in soil are at levels that allow for unrestricted use and unlimited exposure. Although construction and LUCs development and implementation would be completed in 1 year, LUCs and operation and maintenance (O&M), such as cover maintenance and inspection are assumed to be required for 30 years. The estimated initial cost of the soil and asphalt capping and LUC alternative is $2,682,000. The 30-year NPW of this alternative, using a 6 percent interest rate, is $2,736,000.

2.8.1.4 Soil Alternative S-4: Phytoremediation Covers, Asphalt Capping, and LUCs

This alternative would involve the installation of covers and asphalt capping and is identical to Alternative S-3 Soil and Asphalt Capping and LUCs, however, phytoremediation covers would be used in place of soil covers. The asphalt covers would still be used as described in Alternative S-3. Phytoremediation is a process that uses plants to remove, transfer, stabilize, and/or degrade contaminants in soil using a vegetative cover system. Phytoremediation covers are vegetative and soil covers that are designed as long-term, self-sustaining systems of plants growing in and/or over materials that pose environmental risk. A vegetative cover generally requires minimal maintenance. Phytoremediation covers consist of soil and plants to minimize infiltration of water and to aid in the degradation of underlying waste. Risk reduction relies on the degradation of contaminants, isolation of contaminants to prevent human or wildlife exposure, and reduction of leachate formation and movement.

Because contamination would be left on site at levels that preclude unrestricted use and unlimited exposure, this alternative would require implementation of LUCs (as described in Alternative S-2), regular inspections to maintain the asphalt caps and vegetative cover, and plant maintenance such as mowing, weeding, and trimming.

Although phytoremediation would not immediately reduce the volume or toxicity of wastes, it may be sufficient to reduce contamination by removal, transfer, stabilization, and/or degradation to levels less than the commercial/industrial direct exposure and leachability SCTLs. The phytoremediation cover also reduces direct contact with contaminated soil. Asphalt capping would not reduce the volume or toxicity of wastes but it would provide reliable protection against direct exposure to contaminated soil.

This alternative would protect human health because LUCs would reduce the risk from direct exposure by preventing exposure under residential scenarios, and caps and cover would prevent exposure to soil with contaminant concentrations greater than industrial SCTLs. There would be no reduction of contaminant toxicity, mobility, or volume through active treatment. This alternative would achieve the RAOs within 1 year, and ARARs for SCTLs would be met by eliminating the exposure route with the caps and cover, although contaminant concentrations would still be greater than residential SCTLs. There would be minimal short-term risks associated with the performance of excavation, grading, planting, and inspection activities, which would be addressed through appropriate health and safety procedures. The LUCs would be maintained until concentrations in soil are at levels that allow for unrestricted use and unlimited exposure. Although construction and LUC development and implementation would be completed in 1 year, LUCs and O&M, such as phytoremediation cover and asphalt cover maintenance and inspection are assumed to be required for 30 years. The estimated initial cost of the phytoremediation covers, asphalt capping, and LUCs alternative is $2,137,000. The 30-year NPW of this alternative, using a 6 percent interest rate, is $2,445,000.

2.8.1.5 Soil Alternative S-5: Excavation and Offsite Disposal and LUCs

This alternative would involve excavating contaminated soil such that the average soil contaminant concentrations based on the 95 percent upper confidence limit would meet the State of Florida industrial SCTLs. Vadose zone soil with contaminant concentrations that exceed the State of Florida leachability SCTLs will be also be excavated. Where contamination is contiguous, large areas will be excavated. In cases where soil contamination is isolated, small excavations would be performed in 40-foot by 40-foot sections. The proposed areas of soil removal would be excavated to 2 feet bls, and subsurface soil contamination (noted in the following paragraph) would not be addressed. The excavated soil (18,252 yd^3) is assumed to require disposal as hazardous waste.

Subsurface SCTLs were only exceeded or equaled in three locations. In the first instance, the sample depth was 20 feet bls and below the water table, and thus would be addressed as part of the groundwater cleanup. In the second instance, the total chromium concentration in a subsurface soil sample from Site 11 was 48 micrograms per kilogram (µg/kg), which exceeded the hexavalent chromium leachability SCTL of 38 µg/kg. Because the sample analysis did not differentiate between hexavalent chromium and total chromium, and because most of the chromium presumably exists as trivalent chromium, this chromium result was excluded from consideration for excavation. In the third instance, the concentration of PCE

was 30 µg/kg, which was equal to (but not exceeding) the leachability SCTL of 30 µg/kg; this sample was also excluded from excavation considerations.

Because contamination would be left on site at levels that preclude unrestricted use and unlimited exposure, this alternative would require implementation of LUCs (as described in Alternative S-2).

This alternative would protect human health because LUCs would reduce the risk from direct exposure by preventing exposure under residential scenarios, and contaminated soil would be removed so that the OU would meet industrial SCTLs. There would be no reduction of contaminant toxicity, mobility, or volume through active treatment, although a significant volume of contaminated soil would be removed. This alternative would achieve the RAOs in 1 year, and ARARs for SCTLs would be met by eliminating the exposure route with excavation and disposal of contaminated soil, although contaminant concentrations would still be greater than residential SCTLs. There would be minimal short-term risks associated with excavation, grading, and performance inspection activities, which would be addressed through appropriate health and safety procedures. The LUCs would be maintained until concentrations in soil are at levels that allow for unrestricted use and unlimited exposure. Although construction and LUC development and implementation would be completed in 1 year, LUCs are assumed to be required for 30 years. The estimated initial cost of the excavation, offsite disposal and LUC alternative is $5,071,000. The 30-year NPW of this alternative, using a 6 percent interest rate, is $5,126,000.

2.8.1.6 Common Elements and Distinguishing Features of Soil Alternatives

All of the alternatives (excluding the No Action alternative) include LUCs. After implementation of each alternative, contaminant concentrations would be greater than those that allow for residential uses, which would require LUCs in order to restrict residential uses.

In Alternative S-4, some contaminant reduction may occur through treatment by phytoremediation. Alternative S-5 also provides for contaminant reduction through excavation and disposal rather than treatment. Alternative S-2 has the lowest NPW, and Alternative S-5 has the highest NPW.

2.8.1.7 Expected Outcomes of Soil Alternatives

All of the alternatives (except the No Action Alternative) would allow for site use for industrial and commercial purposes, such as painting and maintenance. Residential, agricultural, and recreational activities would be prohibited. The capping systems in Alternatives S-3 and S-4 would limit uses that could damage the cover systems or affect tree growth. Controls on exposure to contaminants in soil would be achieved in 1 year for all of the alternatives (except the No Action Alternative) allowing for industrial and commercial uses of the sites.

2.8.2 Groundwater Alternatives

Seven remedial alternatives for OU 2 groundwater were analyzed in the FS. Each alternative was considered with respect to the nine criteria outlined in the NCP at 40 CFR 300.430(e)(9)(iii). These criteria are categorized as threshold, primary balancing, and modifying, and are further explained in Table 2-34. These alternatives are summarized in this section.

2.8.2.1 Groundwater Alternative GW-1: No Action

This alternative is required by the NCP as a baseline for comparison with other alternatives. Under this alternative, no action would be taken to treat or prevent potential exposure to contaminated groundwater or to reduce volume, toxicity, or mobility of contaminants. This alternative would not include any LUCs; thus, future site use would be uncontrolled and there would be no restrictions on groundwater use.

This alternative would not protect human health because risks from direct exposure to contaminated groundwater would continue to exist. This alternative would not achieve the RAOs for groundwater or comply with ARARs. There would be no reduction of contaminant mobility, and reduction in toxicity and volume would occur only through long-term natural attenuation and would not be monitored. Because no remedial action would take place, this alternative would not result in any short-term risks. Because there is no action, there are no implementation considerations. There would be no cost associated with this alternative.

2.8.2.2 Groundwater Alternative GW-2: LUCs and Monitoring

This alternative would include evaluation of groundwater to determine whether alternative GCTLs are appropriate for OU 2 groundwater.

As part of this alternative, the groundwater/surface water interface (GSI) would be investigated to obtain additional information and details concerning the hydraulic interaction between groundwater and surface water to optimize the extent of the areas which would require LUCs. The GSI would be completed in two phases. Phase I would be an investigation of groundwater contamination at Sites 11 and 30 and installation of nested monitoring wells. Groundwater samples from these new nested monitoring wells would be used to evaluate MNA processes in groundwater upgradient of nearby wetlands. Based on Phase I results, the Phase II GSI would be conducted in areas of groundwater discharge into the wetlands and investigate flow patterns and the interface between groundwater and surface water.

The establishment of alternative GCTLs is appropriate as long as groundwater does not and will not adversely affect surface water. The GSI would be used to establish these alternative GCTLs. In addition, outside of the area for which LUCs are required, groundwater would need to comply with GCTLs.

NAS Pensacola currently operates as an industrial facility and is expected to remain an active military base for the foreseeable future. Continued commercial/industrial status could be maintained using LUCs to control site access and property use. The LUCs would need to specifically prohibit use of groundwater for potable purposes (drinking, washing, cooking, cleaning, and turf irrigation) and prevent unacceptable occupational exposure to groundwater. In the event that the property ownership is transferred and onsite contamination remains in excess of applicable requirements, the Navy would be required to apply a deed restriction to OU 2 to prohibit residential property uses and restrict groundwater usage. The LUC portion of the alternative would provide long-term protection by restricting future use and access.

Maintenance of LUCs would be addressed in an LUC RD to be submitted to USEPA and FDEP for review and comment. The LUCs would be maintained until concentrations in soil are at levels that allow for unrestricted use and unlimited exposure. An LUC RD would be prepared as the land use component of the RD. The LUC RD would be enforced under the NAS Pensacola Base Master Plan, and the Navy would be responsible for implementing, maintaining, reporting on, and enforcing the LUCs.

This alternative would protect human health because LUCs would reduce the risk from direct exposure by restricting use of the aquifer. Monitoring at the LUC boundaries and GSI would verify that COCs are not migrating and may incidentally indicate whether natural attenuation is occurring. There would be no reduction of contaminant toxicity, mobility, or volume through active treatment, but contaminant toxicity and volume may be reduced through natural attenuation. This alternative would achieve the RAOs and comply with location- and action-specific ARARs and guidance to be considered (TBC). Eventual compliance with chemical-specific ARARs would be achieved through long-term natural attenuation and would be confirmed by groundwater monitoring. There would be minimal short-term risks associated with the performance of groundwater monitoring and LUC inspection activities, which would be addressed through appropriate health and safety procedures. The activities for this alternative would be easy to implement.

The costs associated with LUCs for groundwater are included in the costs for soil remedial alternatives and therefore no separate LUC costs are included in the cost estimates for groundwater alternatives. The groundwater LUC alternative would also include quarterly sampling of six groundwater wells to comply with Risk Management Option II Criteria until no further action (NFA) status is achieved. The LUCs could be developed and implemented in less than 1 year. LUCs and monitoring are assumed to be required for 30 years. The estimated cost of the GSI is $155,000, and the estimated cost to develop alternative GCTLs is $14,000. The annual cost of monitoring is $55,000. The 30-year NPW of this alternative, using a 6 percent interest rate, is $1,175,000.

2.8.2.3 Groundwater Alternative GW-3: MNA and LUCs

This alternative would include natural attenuation, LUCs, and groundwater monitoring. Concentrations of many COCs may decrease by natural processes including dispersion and dilution through aquifer movement, volatilization, biodegradation, adsorption on soil particles, and chemical reactions with subsurface materials. The predominant GCTL exceedances are VOCs at Sites 11 and 30. Several of the OU 2 monitoring wells were sampled for MNA parameters in 2003. OU 2 groundwater generally exists under iron- and sulfate-reducing conditions, which are favorable for reductive dechlorination of the identified VOCs.

Most detected SVOCs exceeded GCTLs by less than an order of magnitude, which means that degradation may be achievable through passive processes. Additionally, naphthalene and methylnaphthalene are the predominant SVOCs that exceed GCTLs, and these SVOCs are generally amenable to biodegradation.

There are relatively few GCTL exceedances of metals such as barium, cadmium, chromium, and lead; none of these metals exceed GCTLs by more than a factor of three. The concentrations of these metals may be naturally attenuated. Iron and manganese are the only other metals to exceed GCTLs. These metals are naturally occurring and may not be indicative of site-related contamination. The high concentrations of iron and manganese also suggest that there are strong reducing conditions in groundwater at Sites 11 and 30, which is expected to be favorable for chlorinated ethene and chromium reduction.

In addition, similar to Alternative GW-2, GSI would be preformed to obtain additional information and details concerning the hydraulic interaction between groundwater and surface water to optimize the extent of the areas which would require LUCs. The GSI would be completed in two phases. Phase I would be an investigation of groundwater contamination at Sites 11 and 30 and installation of nested monitoring wells. Groundwater samples from these new nested monitoring wells would be used to evaluate MNA processes in groundwater upgradient of nearby wetlands, per F.A.C 62-780.690 (3) and (8). Based on Phase I results, the Phase II GSI would be conducted in areas of groundwater discharge into the wetlands and investigate flow patterns and the interface between groundwater and surface water. If necessary additional downgradient sentry wells will be installed to continuously monitor the groundwater to surface water exchange.

The establishment of alternative GCTLs is appropriate as long as groundwater does not and will not adversely affect surface water. The GSI would be used to establish these alternative GCTLs. In addition, outside of the area for which LUCs are required, groundwater would need to comply with GCTLs.

This alternative would require completion of a monitoring plan proposing a source area and point of compliance monitoring locations as well as monitoring frequency. The monitoring would continue until NFA status is achieved. In addition, annual monitoring of groundwater would be undertaken to measure progress towards achieving the RAOs for this media at OU 2.

Until the RAOs are achieved, LUCs described in Alternative GW-2 would be in place to restrict potable uses of groundwater and prevent unacceptable occupational exposure to groundwater. Also, remedial performance would be evaluated to measure progress toward achieving the RAOs.

This alternative would protect human health because LUCs would reduce the risk from direct exposure by restricting use of the aquifer until natural attenuation reduces COC concentrations to cleanup goals. Monitoring would verify the progress of natural attenuation and verify whether COCs are migrating. There would be no reduction of contaminant toxicity, mobility, or volume through active treatment, but contaminant toxicity and volume would be reduced through natural attenuation. This alternative would achieve the RAOs and comply with location- and action-specific ARARs. Eventual compliance with chemical-specific ARARs would be achieved through long-term natural attenuation and would be confirmed by groundwater monitoring. There would be minimal short-term risks associated with the performance of groundwater monitoring and LUC inspection activities, which would be addressed through appropriate health and safety procedures. The activities for this alternative would be easy to implement.

The MNA portion of the alternative includes the GSI and installation of additional point of compliance monitoring wells. The costs associated with LUCs for groundwater are included in the costs for soil remedial alternatives and therefore no separate LUC costs are included in the cost estimates for groundwater alternatives. The monitoring plan and LUCs could be developed and implemented in less than 1 year. LUCs and monitoring are assumed to be required for 30 years. The estimated cost of the GSI is $155,000, and the estimated cost of the additional point of compliance wells is $15,000. The annual cost of MNA sampling is $23,000. The 30-year NPW of this alternative, using a 6 percent interest rate, is $1,599,000.

2.8.2.4 Alternative GW-4: Riparian Corridors and LUCs

This alternative would include riparian corridors, groundwater monitoring, and LUCs. A riparian corridor is a type of phytoremediation generally applied along streams and river banks to control and remediate groundwater contamination moving into the surface water. Phytoremediation is a process that uses plants to remove, transfer, stabilize, and/or degrade contaminants in soil using a vegetative cover system.

The riparian corridors at OU 2 would be constructed by planting certain fast-growing trees, such as poplars, in closely spaced trenched rows. A typical riparian corridor consists of a triple row of trees and has a minimum width of 30 feet.

The riparian corridors alternative would not directly reduce or eliminate GCTL exceedances in the industrial, developed areas of OU 2, such as in the southeastern corner of the Building 649 complex. In these areas, groundwater contamination would be permitted to naturally attenuate. Riparian corridors would be planted along the banks of the wetlands adjacent to Sites 11 and 30 and would not be anticipated to interfere with utilities or ongoing activities. Each riparian corridor would consist of a triple row of trees, approximately 30 feet wide. The total length of the riparian corridors would be 3,240 feet. Surface water would be protected by the riparian corridor by transpiration of the groundwater through the trees, which would remove and treat groundwater and potentially limit infiltration of groundwater to surface water.

The riparian corridors alternative would include periodic post-active remediation monitoring, including periodic sampling of ten monitoring wells. The monitoring activities would be performed quarterly or at approved intervals, and samples would be analyzed for contaminants present before the start of active remediation. The monitoring wells would be selected based on metals, VOC, and SVOC GCTL exceedances. Long-term monitoring and inspection and maintenance of the trees would be conducted for 30 years. Contaminants would also undergo natural attenuation, as described in Alternative GW-3.

Riparian corridors are not immediately effective. Although poplars are fast-growing trees, it is estimated that they would take a year to become established. Thus, the effectiveness of the riparian corridors would be expected to increase with time. Because the riparian corridors would be constructed in areas of no or very low contamination, short-term exposure of site workers would be limited.

Until the RAOs are achieved, LUCs as described in Alternative GW-2 would be in place to specifically restrict potable uses of the groundwater and prevent unacceptable occupational exposure to groundwater. Remedial performance would be evaluated to measure progress toward the RAOs.

This alternative would protect human health because LUCs would reduce the risk from direct exposure by restricting use of the aquifer until phytoremediation and natural attenuation reduce COC concentrations to cleanup goals. Monitoring would verify the effects of phytoremediation and natural attenuation and verify that COCs are not migrating. There would be no reduction of contaminant toxicity, mobility, or volume through active treatment, but contaminant toxicity and volume would be reduced through phytoremediation and natural attenuation, as verified by monitoring. This alternative would achieve the RAOs and comply with location- and action-specific ARARs. Eventual compliance with chemical-specific ARARs would be achieved through phytoremediation and long-term natural attenuation. There would be minimal short-term risks associated with the performance of groundwater monitoring and LUC inspection activities, which would be addressed through appropriate health and safety procedures. The activities for this alternative would be easy to implement.

The riparian corridors alternative includes a GSI and performance monitoring for 30 years. The costs associated with LUCs for groundwater are included in the costs for soil remedial alternatives and therefore no separate LUC costs are included in the cost estimates for groundwater alternatives. Although construction would be completed in 1 year, LUCs and O&M activities are assumed to be required for 30 years. The first-year cost of the riparian corridors alternative is $414,000, which includes the GSI, design, construction, first-year operation, and performance sampling. The construction and LUCs could be developed and implemented in less than 1 year. Performance sampling could continue for 30 years. The 30-year NPW of this alternative, using a 6 percent interest rate, is $2,061,000.

2.8.2.5 Alternative GW-5: Permeable Reactive Barrier, Riparian Corridors, and LUCs

This alternative includes the construction of a permeable reactive barrier (PRB), riparian corridors, monitoring, and LUCs. Alternative GW-5 is identical to Alternative GW-4 but also includes a PRB to treat the chlorinated solvent plume extending from the southeastern corner of the Building 649 complex.

Zero-valent iron (ZVI) PRBs are typically applied to remediate dilute plumes of chlorinated solvents, similar to the Building 649 plume. As they pass though the ZVI PRB, chlorinated solvents undergo reductive dechlorination as the ZVI is oxidized. Using this method, TCE degrades to DCE isomers, which may then degrade to vinyl chloride and ethene. At OU 2, a PRB would be constructed across the entire downgradient edge of contaminated zone and extend downward to the underlying confining zone.

Although PRBs are effective at reducing the concentrations of many of the OU 2 COCs, they produce undesirable groundwater quality immediately downgradient of the PRB. The undesirable effects include increased pH, decreased dissolved oxygen, and ferrous iron leaching in the groundwater immediately downgradient of the PRB.

A PRB would provide an additional level of effectiveness compared to riparian corridors alone. The PRB would actually treat contaminated groundwater and therefore quickly reduce the human health risks associated with the Building 649 plume and would provide an additional level of protection for surface waters to which site groundwater discharges, compared to riparian corridors alone.

Until the RAOs are achieved, the LUCs described in Alternative GW-2 would be in place to specifically restrict potable uses of the groundwater and prevent unacceptable occupational exposure to groundwater. Additionally, remedial performance would be evaluated annually to measure progress toward the RAOs.

This alternative would protect human health because LUCs would reduce the risk from direct exposure by restricting use of the aquifer until the PRB, phytoremediation, and natural attenuation reduce COC concentrations to cleanup goals. Monitoring would verify the effects of PRB, phytoremediation, and

natural attenuation and verify that COCs are not migrating. There would be reductions in contaminant toxicity, mobility, and volume through active treatment by the PRB, and contaminant toxicity and volume would also be reduced through phytoremediation and natural attenuation. This alternative would achieve the RAOs and comply with location- and action-specific ARARs. Eventual compliance with chemical-specific ARARs would be achieved through the PRB, phytoremediation corridor, and long-term natural attenuation. Although construction of the PRB would result in short-term risks to site construction workers, these risks would be minimized through the use of appropriate health and safety procedures. There would also be minimal short-term risks associated with the performance of groundwater monitoring and LUC inspection activities, which would be addressed through appropriate health and safety procedures. Most of the activities for this alternative are easy to implement, but the construction of the PRB would be somewhat difficult to implement.

The PRB and riparian corridors alternative includes a GSI and performance monitoring for 30 years. The costs associated with LUCs for groundwater are included in the costs for soil remedial alternatives and therefore no separate LUC costs are included in the cost estimates for groundwater alternatives. Although construction and LUC development and implementation would be completed in 1 year, LUCs are assumed to be required for 30 years. The first-year cost of the PRB and riparian corridors alternative is $2,816,000, which includes the GSI; design, construction, first-year operation, and performance sampling of the PRB and riparian corridors; and groundwater sampling. Performance sampling could continue for 30 years. The 30-year NPW of this alternative, using a 6 percent interest rate, is $4,930,000.

2.8.2.6 Alternative GW-6: Groundwater Pumping and Discharge to Federally Owned Treatment Works

Alternative GW-6 consists of installing extraction wells and groundwater extraction pumps, and transporting the contaminated groundwater to a waste water treatment plant (WWTP). Groundwater pumping is a conventional method for containment or removal of contaminated groundwater from a site. Extraction wells are installed near contaminant hotspots to remove groundwater contamination. Pumping also has the capability of hydraulically containing groundwater contamination, which may prevent the seepage of contaminated groundwater into adjacent surface waters. Extracted groundwater is then treated and disposed of a WWTP.

The OU 2 extraction well network would consist of 13 extraction wells on the downgradient perimeter of OU 2 to address groundwater discharging to Bayou Grande and nearby wetlands, and three extraction wells to treat the VOC source area near the Building 649 complex. Each well would be approximately 25 feet deep and pumped at a rate of 70 gallons per minute (gpm).

The groundwater pumping alternative would be effective in containment shortly after startup and removal of contamination and would therefore be protective of human health. The proposed extraction wells adjacent to the wetlands would prevent contaminated groundwater from discharging to the wetlands and would thus be protective of surface water. The performance of the pumping system would be evaluated at a minimum of once a year to measure progress toward the RAOs. This evaluation would include the spatial and temporal analyses of groundwater data to assess whether there are increasing, decreasing, or stationary trends in the concentrations of groundwater contaminants. This evaluation would be used to recommend continuation, increases, or decreases in the number of samples and types of analyses required to evaluate the protectiveness of the groundwater pumping in subsequent 5-Year Reviews.

Until the RAOs are attained, LUCs described in Alternative GW-2 would be in place to restrict potable uses of groundwater and prevent unacceptable occupational exposure to groundwater. Remedial performance would be evaluated to measure progress toward the RAOs.

This alternative would protect human health because groundwater extraction would reduce COC concentrations to cleanup goals. Monitoring would verify the effects of pumping. There would be reductions of contaminant toxicity, mobility, and volume through active treatment at the FOTW. This alternative would achieve the RAOs and comply with location- and action-specific ARARs in 1 year. Eventual compliance with chemical-specific ARARs would be achieved. Although construction of the extraction wells and pumping system would result in short-term risks to site construction workers, these risks would be minimized through the use of appropriate health and safety procedures. There would also be minimal short-term risks associated with the performance of groundwater monitoring and maintenance activities, which would also be addressed through appropriate health and safety procedures. The activities for this alternative, particularly the construction of the pumping and piping system, would be somewhat difficult to implement.

The groundwater pumping and discharge to a FOTW alternative includes a GSI. The first-year cost of the groundwater pumping and discharge to an FOTW alternative is $1,154,000, which includes the GSI, O&M, compliance sampling, and groundwater monitoring. The construction and monitoring program could be developed and implemented in less than 1 year. The O&M, compliance sampling and long-term monitoring would continue for 30 years. The 30-year NPW of this alternative using a 6 percent interest rate is $3,502,000.

2.8.2.7 Alternative GW-7: Groundwater Pumping, Treatment, and Discharge to Wetlands

Alternative GW-7 would consist of installing extraction wells, groundwater extraction pumps, and a groundwater treatment system and discharging the treated water to the wetlands near OU 2. The groundwater pumping scenario in Alternative GW-7 is identical to Alternative GW-6. Extracted groundwater would be primarily contaminated with VOCs but may also need treatment for SVOCs and

metals. The treatment scenario developed in this alternative would include air stripping as primary treatment and granular activated carbon (GAC) adsorption as secondary treatment. Air stripping is a conventional method for removing chlorinated solvents and petroleum-related VOCs from extracted groundwater. Air stripping would also have limited effectiveness for SVOCs and metals removal. However, liquid-phase GAC adsorption would be required as secondary treatment to remove residual SVOCs, VOCs, and metals from the waste stream. After primary treatment, extracted groundwater would be routed through sequential GAC adsorption canisters, and water quality would be routinely monitored from a sample port between the GAC canisters and the final discharge. After primary and secondary treatment, the treated groundwater would be discharged to the adjacent wetlands. The discharged water would have to meet the administrative requirements of a National Pollution Discharge Elimination System (NPDES) permit.

The groundwater pumping alternative would be immediately effective in containment and removal of contamination and would therefore be protective of human health. The proposed extraction wells adjacent to the wetlands would prevent contaminated groundwater from discharging to the wetlands and would thus be protective of surface water. The local water balance would be maintained because the groundwater would be returned to the wetlands, where the groundwater normally flows.

The remedial system would be evaluated at the minimum on an annual basis to assess progress toward reaching RAOs. This evaluation would include the spatial and temporal analyses of groundwater data to assess whether there are increasing, decreasing, or stationary trends in the concentrations of groundwater contaminants. This evaluation would be used to recommend continuation, increases, or decreases in the number of samples and types of analyses required to re-evaluate the groundwater pumping alternative in 5-year reviews.

Until the RAOs are attained, LUCs described in Alternative GW-2 would be in place to restrict potable uses of groundwater and prevent unacceptable occupational exposure to groundwater. Remedial performance would be evaluated annually to measure progress toward the RAOs.

This alternative would protect human health because groundwater extraction would reduce COC concentrations to cleanup goals. Monitoring would verify the effects of pumping. There would be reductions of contaminant toxicity, mobility, and volume through active treatment. This alternative would achieve the RAOs and comply with location- and action-specific ARARs within 1 year. Eventual compliance with chemical-specific ARARs would be achieved through air stripping and GAC treatment. Although the construction of extraction wells, pumping, and the treatment system would result in short-term risks to site construction workers, these risks would be minimized through the use of appropriate health and safety procedures. There would also be minimal short-term risks associated with the performance of groundwater monitoring and maintenance activities, which would also be addressed

through appropriate health and safety procedures. The activities for this alternative, particularly the construction of the pumping, piping, and treatment system, would be somewhat difficult to implement.

The groundwater pumping and discharge to wetlands alternative includes a GSI. The first-year cost of the groundwater pumping and discharge to wetlands alternative is $2,522,000, which includes the GSI; design, construction, O&M, and compliance sampling; and groundwater monitoring. The construction and monitoring program could be developed and implemented in less than 1 year. O&M, compliance sampling, and long-term monitoring would continue for 30 years. The 30-year NPW of this alternative, using a 6 percent interest rate, is $12,683,000.

2.8.2.8 Common Elements and Distinguishing Features

All of the alternatives (excluding the No Action alternative) include LUCs, a GSI, and long-term monitoring. For each alternative, contaminant concentrations would remain greater than GCTLs until natural attenuation and/or treatment is complete. During that time, LUCs would be needed to prevent groundwater use. Alternatives GW-2, GW-3, GW-4, and GW-5 rely on passive approaches. Alternatives GW-6 and GW-7 use active methods for groundwater extraction.

Alternatives GW-6 and GW-7 both use groundwater extraction methods that require additional evaluation by the Navy because of the uncertain effectiveness of the technology. Alternatives GW-6 and GW-7 also require significant long-term O&M. Alternative GW-3 has the lowest NPW, and Alternative GW-7 has the highest NPW.

2.8.2.9 Expected Outcomes

In all of the alternatives (except the No Action Alternative), groundwater would eventually meet GCTLs. The shallow groundwater is not currently a significant resource for drinking water, cooling water, or irrigation water. Therefore, the site uses would not be changed by the remediation of the groundwater. GCTLs would not be met for at least 30 years. The surface structures associated with the various alternatives (for example, riparian corridors in Alternatives GW-4 and GW-5 and pumping facilities in Alternatives GW-6 and GW-7) would limit the amount of land available for other uses. Because contaminants would be present at concentrations that prevent unrestricted use, OU 2 could only be used for industrial and/or commercial activities. Long-term activities, such as monitoring, would be required for 30 years for all alternatives (except the No Action Alternative).

2.9 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section summarizes the comparisons of each of the soil and groundwater remedial alternatives with respect to the nine criteria outlined in the NCP at 40 CFR 300.430(e)(9)(iii). These criteria are

categorized as threshold, primary balancing, and modifying and are further explained in Table 2-34. A detailed analysis was performed for each alternative using the nine criteria to select a site remedy. Tables 2-35 and 2-36 summarize the comparison of these analyses for soil and groundwater, respectively. Further information on the detailed comparison of alternatives is presented in the OU 2 FS Report (Ensafe, 2005b).

2.9.1 Comparison of Soil Remediation Alternatives by Category

The following remedial alternatives for soil are compared in this section:

- Alternative S-1: No Action
- Alternative S-2: Land Use Controls
- Alternative S-3: Soil and Asphalt Capping and LUCs
- Alternative S-4: Phytoremediation Covers, Asphalt Capping, and LUCs
- Alternative S-5: Excavation and Offsite Disposal and LUCs

2.9.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Alternative S-1 would not provide protection of human health and the environment. Risks from contaminated soil would continue to exist, as no response action would be conducted to reduce the volume, mobility, or toxicity of contaminated soil, and no controls would be initiated to restrict future land use or exposure to contaminated media.

Alternative S-2 would be protective of human health, but includes no further protection of environmental receptors. LUCs would protect site workers by facilitating contaminant notification. Risks from direct exposure would also be reduced by preventing exposure under residential scenarios. Soil with contaminant concentrations greater than leachability STCLs could still be a source of groundwater contamination.

Alternative S-3 would be protective of human health and the environment. In addition to LUCs, asphalt and soil covers would be used to reduce exposure to contaminated soil, thus eliminating the direct exposure pathway. Asphalt covers would also reduce the flow of water and reduce the risk of rain and surface water carrying any contamination downward into the groundwater, thereby providing protection to human health and the environment.

TABLE 2-35

COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES FOR SOIL CONTAMINATION
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2

Evaluation Criterion	Alternative S-1: No Action	Alternative S-2: Land Use Controls	Alternative S-3: Soil and Asphalt Capping and LUCs	Alternative S-4: Phytoremediation Covers, Asphalt Capping, and LUCs	Alternative S-5: Excavation and Offsite Disposal and LUCs
Threshold Criteria					
Overall Protection of Human Health and the Environment	No protection. Contaminants at concentrations greater than residential direct exposure and groundwater-based leachability SCTLs would remain.	Protects site workers by facilitating contaminant notification and provides protection to potential future residents. Contaminants at concentrations greater than industrial direct exposure and groundwater-based leachability SCTLs would remain.	Surface capping reduces risk of exposure, thus eliminating direct exposure pathway. When constructed as low permeability covers, they reduce infiltration, which permits higher leachability-based SCTLs to be calculated. Asphalt caps would not interfere with the industrial usage of the site and would be constructed in current locations used for light and heavy vehicle parking/storage.	For phytoremediation covers, contaminants would be treated by rhizodegradation and phytotransformation processes, removed by phytoextraction, or controlled by phytostabilization and hydraulic control. The treatment and removal mechanisms would be sufficient to reduce contamination to less than industrial direct exposure and leachability-based SCTLs. Hydraulic control holds the moisture in place so that evapotranspiration processes limit infiltration.	Soils that exceed industrial direct exposure and leachability-based SCTLs would be excavated and disposed off site.
Compliance with ARARs	Not compliant with applicable portions of Chapters 62-777 and 62-780, F.A.C.	Not compliant with applicable portions of Chapters 62-777 and 62-780, F.A.C.	Compliant with applicable portions of Chapters 62-777 and 62-780, F.A.C. Would comply with action-specific ARARs related to cap construction, storm water discharge and occupational exposures.	Compliant with Chapters applicable portions of 62-777 and 62-780, F.A.C. Would comply with action-specific ARARs related to cap construction, storm water discharge and occupational exposures.	Compliant with Chapters applicable portions of 62-777 and 62-780, F.A.C. Would comply with action-specific ARARs related to hazardous waste generation, transport, and disposal; storm water discharge; and occupational exposures.
Balancing Criteria					
Long-Term Effectiveness and Permanence	Provides no long-term protection from occupational exposure or potential future residential exposure, and does not limit contaminant leaching to groundwater.	Restricts site use and access to industrial usage, but some contaminant concentrations would remain at levels above the State of Florida industrial and leachability SCTLs.	Long-term effectiveness and permanence depends on site use and structural durability of the caps. Although asphalt caps are prone to damage by inappropriate usage, geotechnical instability, weathering, and vegetative perturbation, these can be minimized through proper design and construction. Although soil caps are prone to damage by erosion, geotechnical instability, and vegetative perturbation, these can be minimized through proper design and construction.	Phytoremediation covers are a treatment remedy and may reduce contamination levels to SCTLs. The permanence of low-permeability soil reduces the infiltration and leaching of contaminants. The permanence of the phytoremediation treatment and removal processes is dependent on the adaptability and permanence of the phytoremediation vegetation.	Excavation and offsite disposal has long-term effectiveness and permanence as a remediation technology because contamination is removed from the site. Excavation may be less effective than a capping alternative however because all contamination may not be removed using localized excavations, which is biased towards sampled locations.
Reduction of Toxicity, Mobility, or Volume through Treatment	Limited to natural attenuation processes.	Limited to natural attenuation processes.	Surface capping is a control technology that does not reduce the volume or toxicity of waste. Surface capping provides reliable protection against the direct exposure to contaminated soil. Low-permeability covers also reduce infiltration, which permits higher leachability-based CTLs to be calculated.	Phytoremediation covers may reduce the toxicity, mobility, and volume of soil contamination, and may incorporate the processes of hydraulic control, phytodegradation, rhizodegradation, phytovolatilization, and perhaps phytoextraction. The degree of treatment, removal, and control is uncertain.	Although excavation and offsite disposal removes soil contamination, treatment processes are not incorporated.

TABLE 2-35

COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES FOR SOIL CONTAMINATION
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2

Evaluation Criterion	Alternative S-1: No Action	Alternative S-2: Land Use Controls	Alternative S-3: Soil and Asphalt Capping and LUCs	Alternative S-4: Phytoremediation Covers, Asphalt Capping, and LUCs	Alternative S-5: Excavation and Offsite Disposal and LUCs
Balancing Criteria (continued)					
Short-Term Effectiveness	Provides no short-term protection from occupational exposure and does not limit contaminant leaching to groundwater.	Restricts site use and access to industrial usage, but provides no short-term protection from occupational exposure and does not limit contaminant leaching to groundwater.	Asphalt caps have immediate effectiveness at reducing direct exposure and infiltration. Soil caps have immediate effectiveness at reducing direct exposure and infiltration.	When constructed with lower-permeability soil, phytoremediation covers have short-term effectiveness at reducing contaminant leaching. Irrigation of the covers and application of nutrients may biostimulate indigenous microbes, which are capable of bioremediation. Phytoremediation processes become more effective as the vegetation becomes more established.	Excavation and offsite disposal are immediately protective of human health and the environmental because contaminated soil is removed from the site. Excavation may be less effective than a capping alternative however because all contamination may not be removed using localized excavation, which is biased towards sampled locations.
Implement-ability	No technical or administrative concerns.	NAS Pensacola currently operates as an industrial facility and is not proposed for closure. Thus, LUCs may be used to restrict site use. Deed restriction would be required before property transfer.	NAS Pensacola currently operates as an industrial facility and is not proposed for closure. Thus, LUCs may be used to restrict site use. Deed restriction would be required before property transfer. The construction of soil and asphalt covers is technically feasible, and the designated areas are amenable to the specified capping materials. Before the full-scale design and concurrent with construction activities, confirmation samples are needed to verify that contaminated soil is properly addressed. All covers would require periodic inspections. There are no concerns related to the availability of services and materials. Soil caps require regular maintenance to minimize cap erosion, and additional construction may be necessary if sufficient erosion of the cap is observed.	NAS Pensacola currently operates as an industrial facility and is not proposed for closure. Thus, LUCs may be used to restrict site use. Deed restriction would be required before property transfer. The construction of soil, asphalt, and phytoremediation covers is technically feasible, and the designated areas are amenable to the specified capping materials. Before the full-scale design and concurrent with construction activities, confirmation samples are needed to verify that contaminated soil is properly addressed. All covers would require periodic inspections. There are no concerns related to the availability of services and materials. Phytoremediation covers require regular maintenance to maintain a vegetative presence and possibly to harvest plants designed for phytoextraction.	NAS Pensacola currently operates as an industrial facility and is not proposed for closure. Thus, LUCs may be used to restrict site use. Deed restriction would be required before property transfer. Excavation and offsite disposal is technically and administratively feasible at OU 2. Excavation is performed frequently and is a reliable method to remove contaminated soil within given boundaries. Landfill capacity is anticipated to be sufficient for the excavated soil volume.
Cost	$0	The land use controls cost is $22,000, and the 30-year NPW is $77,000.	First year cost is $2,682,000, and the 30-year NPW is $2,736,000.	First year cost is $2,137,000. The 30-year NPW is $2,445,000.	First year cost is $5,071,000 and the 30-year NPW is $5,126,000.

Modifying Criteria

Support Agency Acceptance	FDEP will have opportunity to comment.
Community Acceptance	Determined after public comment period.

LUC – Land use controls.
CTL – Cleanup Target Level.
SCTL – Soil Cleanup Target Level.
ARAR - Applicable or relevant and appropriate requirement.
F.A.C. – Florida Administrative Code.
LDR – Land disposal restriction.

TABLE 2-36

COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES FOR GROUNDWATER
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 3

Evaluation Criterion	Alternative GW-1: No Action	Alternative GW-2: LUCs and Monitoring	Alternative GW-3: MNA and LUCs	Alternative GW-4: Riparian Corridors and LUCs	Alternative GW-5: PRB and Riparian Corridors and LUCs	Alternative GW-6: Groundwater Pumping and Discharge to FOTW	Alternative GW-7: Groundwater Pumping, Treatment, and Discharge to Wetlands
Threshold Criteria							
Overall Protection of Human Health and the Environment	No protection; Numerous GCTL exceedances would remain, and groundwater may leach to surface water at concentrations exceeding Class III surface water criteria.	Provides no additional effectiveness compared to current use, but LUCs restrict groundwater use. Sentinel monitoring wells would be installed at GSI to monitor groundwater leaching to surface water.	Provides no additional effectiveness compared to current use, but LUCs restrict groundwater use. MNA tracks natural attenuation processes. Sentinel monitoring wells would be installed at GSI to monitor groundwater leaching to surface water.	Riparian corridors would have some effectiveness at treating, removing, and controlling groundwater contaminants migrating into adjacent wetlands. LUCs restrict groundwater use.	Riparian corridors are as described in GW-4. The PRB would passively treat the chlorinated solvent plume near Building 649 complex. LUCs restrict groundwater use.	Groundwater pumping is effective for the containment, removal, and treatment of contaminated groundwater. The 13 extraction wells along the wetlands would prevent contaminated groundwater from discharging to the wetlands. The three extraction wells proposed in the Building 649 complex would be used to remove source area contamination.	Groundwater pumping is effective for the containment, removal, and treatment of contaminated groundwater. The 13 extraction wells along the wetlands would prevent contaminated groundwater from discharging to the wetlands. The three extraction wells proposed in the Building 649 complex would be used to remove source area contamination. Discharging treated groundwater to the wetlands would maintain water balance.
Compliance with ARARs	Not compliant with applicable portions of Chapters 62-777 and 62-780, F.A.C.	Compliant with Chapters 62-777 and 62-780, F.A.C.	Compliant with Chapters 62-777 and 62-780, F.A.C.	Compliant with Chapters 62-777 and 62-780, F.A.C. Action-specific ARARs related to storm water discharge and occupational exposures would be met.	Compliant with Chapters 62-777 and 62-780, F.A.C. Action-specific ARARs related to storm water discharge and occupational exposures would be met. Action-specific ARARs associated with the PRB and related to hazardous waste generation, transport, and disposal would be met.	Compliant with Chapters 62-777 and 62-780, F.A.C. Invokes action-specific ARARs related to hazardous waste generation, transport, and disposal and occupational exposures. Action-specific ARARs related to pre-treatment standards would be met.	Compliant with Chapters 62-777 and 62-780, F.A.C. Invokes action-specific ARARs related to hazardous waste generation, transport, and disposal and occupational exposures. Action-specific ARARs related to air permitting and NPDES discharge would be met.
Balancing Criteria							
Long-Term Effectiveness and Permanence	Provides no long-term protection to adjacent wetlands.	Long-term protection provided by LUCs and a network of sentinel monitoring wells.	Natural attenuation would be effective for groundwater contamination. Surface water is protected by a network of sentinel monitoring wells.	Riparian corridors would achieve long-term effectiveness and permanence with little oversight. Permanence is limited by the approximate 20 year lifespan of the poplar trees.	Riparian corridors would achieve long-term effectiveness and permanence with little oversight. Permanence is limited by the approximate 20-year lifespan of the poplar trees. PRBs may have limited long-term effectiveness due to the loss of reactivity and permeability.	Although contaminant mass is removed, it may be difficult to reduce contamination to below GCTLs. Contamination may rebound when pumping stops.	Although contaminant mass is removed, it may be difficult to reduce contamination to below GCTLs. Contamination may rebound when pumping stops

TABLE 2-36

COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES FOR GROUNDWATER
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 3

Evaluation Criterion	Alternative GW-1: No Action	Alternative GW-2: LUCs and Monitoring	Alternative GW-3: MNA and LUCs	Alternative GW-4: Riparian Corridors and LUCs	Alternative GW-5: PRB and Riparian Corridors and LUCs	Alternative GW-6: Groundwater Pumping and Discharge to FOTW	Alternative GW-7: Groundwater Pumping, Treatment, and Discharge to Wetlands
Balancing Criteria (continued)							
Reduction of Toxicity, Mobility, or Volume Through Treatment	Limited to natural attenuation processes.	Limited to natural attenuation processes.	Limited to natural attenuation processes.	Although riparian corridors incorporate phytoremediation processes of hydraulic control, phytodegradation, rhizodegradation, phytovolatilization, and phytoextraction, the degree of treatment, removal, and control is uncertain.	Although riparian corridors incorporate phytoremediation processes of hydraulic control, phytodegradation, rhizodegradation, phytovolatilization, and phytoextraction, the degree of treatment, removal, and control is uncertain. PRB degrades chlorinated solvents and precipitate metals in groundwater.	Groundwater pumping removes contaminant mass from the aquifer. Treatment is accomplished through the FOTW.	Groundwater pumping removes contaminant mass from the aquifer. Treatment is accomplished through air stripping and GAC processes.
Short-Term Effectiveness	Provides no short-term protection to adjacent wetlands.	Short-term protection provided by LUCs and a network of sentinel monitoring wells.	Provides no short-term protection to groundwater, but surface water is protected by a network of sentinel monitoring wells.	Short-term effectiveness at protecting adjacent surface water is limited for 1 to 2 years while trees become established. Nutrient application incidentally biostimulates microbial population in the interim, which may facilitate contaminant biodegradation.	Short-term effectiveness at protecting adjacent surface water is limited for 1 to 2 years while trees become established. Nutrient application incidentally biostimulates microbial population in the interim, which may facilitate contaminant biodegradation. PRBs are immediately effect for passing groundwater, which provides protection until the riparian corridor becomes effective.	Groundwater pumping has short-term effectiveness for hydraulic control of groundwater contamination. As pumping continues, an increasing mass of contamination is removed from the aquifer.	Groundwater pumping has short-term effectiveness for hydraulic control of groundwater contamination. As pumping continues, an increasing mass of contamination is removed from the aquifer.

TABLE 2-36

COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES FOR GROUNDWATER
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 3 OF 3

Evaluation Criterion	Alternative GW-1: No Action	Alternative GW-2: LUCs and Monitoring	Alternative GW-3: MNA and LUCs	Alternative GW-4: Riparian Corridors and LUCs	Alternative GW-5: PRB and Riparian Corridors and LUCs	Alternative GW-6: Groundwater Pumping and Discharge to FOTW	Alternative GW-7: Groundwater Pumping, Treatment, and Discharge to Wetlands
Implement-ability	No technical or administrative concerns.	NAS Pensacola currently operates as an industrial facility and is not proposed for closure. Thus, LUCs may be used to restrict site use. Deed restriction is required upon property transfer.	Requires an MNA monitoring plan and submission of annual evaluation report to FDEP and USEPA.	Riparian corridors are technically and administratively feasible and are located in areas that are readily accessible and have limited development potential. Pilot testing may be necessary to identify best species and nutrient requirements. There are no concerns related to available of services and materials.	Riparian corridors are technically and administratively feasible and are located in areas that are readily accessible and have limited development potential. Pilot testing may be necessary to identify best species and nutrient requirements. No concerns related to available of services and materials. A PRB is technically and administratively feasible, but issues may arise related to road closure and repaving, utility locations, storm water management, and construction method. There are no concerns related to availability of services and materials.	The construction of the 16 extraction wells, 3,000 feet of subsurface conveyance pipe, and 2 lift stations is technically feasible. The Navy is predisposed against the installation of new pump-and-treat systems, and an additional level of scrutiny is required. It is not known whether the quality and quantity of groundwater exceeds the pre-treatment standards and capacity of the FOTW. May also impact water budget of adjacent wetlands.	The construction of the 16 extraction wells, 3,000 feet of subsurface conveyance pipe, and 2 lift stations is technically feasible. The Navy is predisposed against the installation of new pump-and-treat systems, and an additional level of scrutiny is required. A large capacity air stripping and GAC treatment system is required for the 1,120 gpm flow, and O&M costs are high.
Cost	$0	GSI investigation is $158,000 and the focused risk assessment is $14,000. The 30-year NPW is $1,175,000.	Includes long-term monitoring and GSI investigation. Annual cost of MNA sampling is $23,000, and the 30-year NPW is $1,599,000.	First year cost is $414,000, and the 30-year NPW is $2,061,000.	First year cost is $2,816,000, and the 30-year NPW is $4,930,000.	First year cost is $1,154,000, and the 30-year NPW is $3,502,000.	First year cost is $2,522,000, and the 30-year NPW is $12,683,000.
Modifying Criteria							
Support Agency Acceptance	FDEP will have opportunity to comment.						
Community Acceptance	Determined after public comment period.						

LUC – Land use controls.
CTL – Cleanup Target Level.
GCTL – Groundwater Cleanup Target Level.
ARAR - Applicable or relevant and appropriate requirement.
F.A.C. – Florida Administrative Code.
LDR – Land disposal restriction.
GSI – Groundwater/surface water interface.
MNA – Monitored natural attenuation.
PRB – Permeable reactive barrier.
FOTW – Federally-owned treatment works.
gpm – gallons per minute.
O&M – Operation and maintenance.

Alternative S-4 would be similarly protective of human health and the environment as Alternative S-3. LUCs would protect site workers and reduce risk from direct exposure under residential scenarios, while asphalt covers would be utilized to reduce exposure to contaminated soil and reduce the risk of rain and surface water carrying any contamination downward into the groundwater. Phytoremediation covers would be utilized to reduce exposure to contaminated soil, minimize infiltration of water, and facilitate degradation of underlying contaminants in the soil.

Alternative S-5 would provide the best protection of human health and the environment, as soils that exceed industrial direct exposure and leachability SCTLs would be excavated and disposed off site. LUCs would also be implemented to protect site workers and to reduce risk from direct exposure under residential scenarios.

2.9.1.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP §300.430(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility sitting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Alternative S-1 would not comply with chemical-specific ARARs, including applicable portions of Chapter 62-777, F.A.C. However, ARARs analysis is not applicable to Alternative S-1, as no action would be performed. Alternative S-2 would not be compliant with ARARs, specifically applicable portions of Chapters 62-777 and 62-780, F.A.C. Alternatives S-3 and S-4 would be compliant with all ARARs, including applicable portions of Chapters 62-777 and 62-780, F.A.C. and action-specific ARARs related to cap construction and storm water discharge. Alternative S-5 would also be compliant with all ARARs,

including applicable portions of Chapters 62-777 and 62-780, F.A.C. and action-specific ARARs related to storm water discharge and hazardous waste generation, transportation, and disposal.

2.9.1.3 Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time after completion of all remedial activities. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

Alternative S-1 would provide no long-term effectiveness and permanence because contaminated soil would remain on site. There would be no long-term protection from occupational exposure or potential future residential exposure, and no measures would be implemented to limit contaminant leaching to groundwater.

Alternative S-2 would provide moderate long-term effectiveness and permanence. LUCs would restrict site use and access, and would be maintained until concentrations in soil are at levels that allow for unrestricted use and unlimited exposure. However, Alternative S-2 would not include any additional provisions to prevent rain or surface water infiltration.

Alternatives S-3 and S-4 provide more long-term effectiveness and permanence than Alternative S-2, as LUCs would be combined with surface covers to prevent infiltration and minimize exposure to contaminated soils. The long-term effectiveness and permanence of these alternatives would be contingent on the proper design, construction, and maintenance of the cover components. The phytoremediation covers included in Alternative S-4 are considered treatment remedies and would help to reduce contamination levels to SCTLs in the long-term.

Alternative S-5 would provide the best long-term effectiveness and permanence because soils that exceed industrial direct exposure and leachability SCTLs would be excavated and disposed off site.

2.9.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives S-1, S-2, and S-3 would not reduce the toxicity, mobility, or volume of contaminated soil because no treatment would occur. Alternative S-4 would provide some reduction in the toxicity, mobility, and volume of soil contamination through phytoremediation. Alternative S-5 reduces soil contamination through excavation and offsite disposal but does not incorporate treatment processes.

2.9.1.5 Short-term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternatives S-3, S-4, and S-5 would produce short-term risks associated with excavation, grading, and performance inspection activities, however, these risks would be addressed through appropriate health and safety procedures.

Alternative S-1 would not result in risks to site workers or adversely impact the surrounding community because no remedial activities would be performed. Alternative S-2 would restrict site use and access, but would provide no short-term protection from occupational exposure and would not limit contaminant leaching to groundwater. Alternatives S-3, S-4, and S-5 would all provide immediate effectiveness at reducing direct exposure and infiltration.

2.9.1.6 Implementation

Implementation addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Each of the soil alternatives is implementable, as the necessary resources, equipment, and materials are available for all of the proposed tasks. The ease of implementation decreases as the alternatives require more construction/excavation activities.

Alternative S-1 would be the easiest to implement because no action would occur. Alternative S-2 would be easier to implement than Alternatives S-3, S-4, and S-5 because these alternatives include the components of Alternative S-2 but also have additional construction components. Alternative S-3 would likely be easier to implement than Alternative S-4 because Alternative S-4 would require more resources in order to install and maintain the phytoremediation cover. Alternative S-5 would be the most difficult to implement due to the amount of resources required to complete the excavation and offsite disposal components.

2.9.1.7 Cost

The first year cost and 30-year NPW of the soil alternatives are as follows:

Alternative	First Year Cost ($)	30-Year NPW ($)
S-1	0	0
S-2	22,000	77,000
S-3	2,682,000	2,736,000
S-4	2,137,000	2,445,000
S-5	5,071,000	5,126,000

2.9.1.8 State Agency Acceptance

FDEP agrees with the analysis of the alternatives and supports Alternative S-5: Excavation and off site disposal with LUCs**.**

2.9.1.9 Community Acceptance

During the public comment period, no comments were received.

2.9.2 Comparison of Groundwater Remediation Alternatives by Category

The following remedial alternatives for groundwater are being compared in this section:

- Alternative GW-1: No Action
- Alternative GW-2: LUCs and Monitoring
- Alternative GW-3: MNA and LUCs
- Alternative GW-4: Riparian Corridors and LUCs
- Alternative GW-5: Permeable Reactive Barrier, Riparian Corridors, and LUCs
- Alternative GW-6: Groundwater Pumping with Discharge to Federally Owned Treatment Works
- Alternative GW-7: Groundwater Pumping, Treatment, and Discharge to Wetlands

2.9.2.1 Overall Protection of Health and Environment

Alternative GW-1 would provide no protection of human health or the environment. Numerous GCTL exceedances would remain, and groundwater may flow to surface water at concentrations exceeding Class III surface water criteria.

Alternatives GW-2 and GW-3 would be protective of human health, but include no further protection of environmental receptors. Under these alternatives, LUCs would be implemented that would reduce the risk from direct exposure by restricting use of the OU 2 aquifer.

Alternative GW-4 would be protective of human health and would provide limited protection of the environment. In addition to LUCs, riparian corridors would be planted along the banks of the wetlands near Sites 11 and 30 to protect surface water receptors by treating and removing groundwater contamination and by limiting the infiltration of groundwater into surface water via transpiration.

Alternative GW-5 would be more protective of human health and the environment than Alternative GW-4. In addition to the LUC and riparian corridor components of Alternative GW-4, a PRB would be installed as part of this alternative. The PRB would be installed to treat the chlorinated solvent plume extending from the southeastern corner of the Building 649 complex, providing an additional level of protection for receiving surface waters.

Alternative GW-6 would be more protective of human health and the environment than Alternative GW-5. A groundwater extraction system would be installed under this alternative, providing containment and removal of contaminated site groundwater. LUCs would also be implemented to reduce the risk of exposure to contaminated groundwater.

Alternative GW-7 would be most protective of human health and the environment. This alternative would incorporate the same LUCs and extraction system as Alternative GW-6, but would also include an onsite groundwater treatment component. The treatment component would allow treated groundwater to be discharged into nearby wetlands, thereby helping to maintain the local water balance.

2.9.2.2 Compliance with ARARs

All of the alternatives, with the exception of GW-1, would be compliant with ARARs. Alternatives GW-4 and GW-5 would comply with action-specific ARARs related to storm water discharge, and Alternatives GW-5, GW-6, and GW-7 would comply with action-specific ARARs related to hazardous waste generation, transportation, and disposal. In addition, Alternative GW-6 would comply with action-specific ARARs related to pre-treatment standards, and Alternative GW-7 would comply with action-specific ARARs related to air and NPDES permitting.

All of the alternatives would eventually comply with chemical-specific ARARs through natural attenuation. Alternatives that utilize active treatment approaches, such as Alternatives GW-6 and GW-7, would comply with chemical-specific ARARs more quickly than alternatives relying solely on natural attenuation.

2.9.2.3 Long-term Effectiveness and Permanence

Alternative GW-1 would provide no long-term effectiveness or permanence because no action would be taken to treat or prevent potential exposure to contaminated groundwater.

Alternatives GW-2 through GW-7 would all provide long-term effectiveness and permanence. Each of these alternatives include LUCs that would effectively prohibit the use of groundwater for potable purposes and prevent unacceptable occupational exposures. In the event that the property is transferred and onsite contamination remains in excess of applicable requirements, the Navy would be required to apply a deed restriction to OU 2 to prohibit residential property uses and restrict groundwater usage. These alternatives also include monitoring components to determine if COCs are migrating offsite and for assessing natural attenuation.

Alternatives GW-4 and GW-5 would provide more long-term effectiveness and permanence than Alternatives GW-2 and GW-3 because, under these alternatives, riparian corridors would be installed to protect surface water receptors. The long-term effectiveness and permanence of these alternatives would be contingent on the proper design, construction, and maintenance of the riparian corridors. The permanence of the corridors would be limited by the lifespan of the proposed plants, which is approximately 20 years for poplar trees. Because Alternative GW-5 includes an additional PRB component, it would provide more long-term effectiveness than Alternative GW-4. However, the permanence of the PRB component would be limited due to typical losses in barrier reactivity and permeability.

Alternatives GW-6 and GW-7 would provide long-term effectiveness and permanence similar to Alternative GW-5. Although these methods would provide the means for contaminant mass removal, it may be difficult to reduce contamination to levels below GCTLs. Also, contamination may rebound when pumping is discontinued. Operation of the groundwater extraction components of these alternatives would continue for a period of 30 years, and evaluations would be performed at least annually to assess system performance.

2.9.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives GW-1, GW-2, GW-3, GW-4 would not reduce the toxicity, mobility, or volume of contaminated groundwater through treatment and would be limited to reductions through natural attenuation, with some additional reductions in toxicity and volume via phytoremediation under Alternative GW-4.

Alternative GW-5 would provide for a greater reduction in toxicity, mobility, and volume than Alternative GW-4 because the PRB treatment component would treat chlorinated compounds. Alternatives GW-6 and GW-7 would provide the greatest reduction in toxicity, mobility, and volume through treatment because extracted groundwater would be treated at an FOTW (GW-6) or an onsite treatment system (GW-7).

2.9.2.5 Short-term Effectiveness

Except for Alternative GW-1, each of the groundwater alternatives would produce short-term risks associated with monitoring, inspection, and/or construction activities. These short-term risks would be addressed through appropriate health and safety procedures.

Alternative GW-1 would not result in risks to site workers or adversely impact the surrounding community because no remedial activities would be performed. The riparian corridors in Alternatives GW-4 and GW-5 are not immediately effective because the poplar trees would need at least a year to become established. The PRB component of GW-5 would be effective immediately upon installation. Alternatives GW-6 and GW-7 would be immediately effective at containing and removing contamination.

2.9.2.6 Implementability

Each of the groundwater alternatives is implementable because the necessary resources, equipment, and materials are available for all of the proposed tasks. The ease of implementation decreases as the alternatives include more construction/treatment activities.

Alternative GW-1 would be the easiest to implement because no action would occur. Alternatives GW-2, GW-3, and GW-4 would all be relatively easy to implement, and Alternatives GW-5, GW-6, and GW-7 would be somewhat difficult to implement. Of the difficult alternatives, Alternative GW-7 would be most difficult and require the most resources because a new treatment system would have to be constructed and operated.

2.9.2.7 Cost

The first year cost and 30-year NPW of the groundwater alternatives are as follows:

Alternative	First Year Cost ($)	30-Year NPW ($)
GW-1	0	0
GW-2	214,000	1,175,000
GW-3	239,000	1,599,000
GW-4	414,000	2,061,000
GW-5	2,816,000	4,930,000
GW-6	1,154,000	3,502,000
GW-7	2,522,000	12,683,000

2.9.2.8 State Agency Acceptance

FDEP agrees with the analysis of the alternatives and supports Alternatives GW-3 monitored natural attenuation and LUCs**.**

2.9.2.9 Community Acceptance

During the public comment period, no comments were received.

2.10 PRINCIPAL THREAT WASTE

The NCP at 40 CFR 300.430(a)(1)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained that or would present a significant risk to human health or the environment should exposure occur. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or act as a source for direct exposure. No high-concentration source material was identified at OU 2. Thus, there are no areas of contamination within OU 2 that are considered principal threat wastes.

2.11 SELECTED REMEDY

2.11.1 Summary of Rationale for Remedy Selection

The goals of the selected remedy for soil and groundwater are to protect human health and the environment by eliminating, reducing, or controlling hazards posed by the sites and to meet ARARs. Based on consideration of the requirements of CERCLA, the NCP, the detailed analysis of alternatives, and any comments received from USEPA, FDEP, and the public, the remedy selected to address contamination at OU 2 includes Soil Alternative S-5, Excavation and Offsite Disposal with LUCs, and Groundwater Alternative GW-3, MNA and LUCs.

This remedy was selected for the following reasons:

- After the removal of areas of soil identified for excavation, detected concentrations remaining in soil will no longer present an unacceptable threat to human health or the environment assuming that only nonresidential uses of the sites are permitted. Surface soil areas identified as exceeding State of Florida SCTLs will be removed and replaced with clean fill to prevent unacceptable exposure.

- Although contamination is present in groundwater at concentrations greater than FDEP GCTLs, detected concentrations are relatively low and do not present an unacceptable threat to human health or the environment under the groundwater use restrictions to be implemented as part of the selected remedy.

- The contaminant plume is small and confined to the shallow aquifer.

2.11.2 Remedy Description

The soil and groundwater remedy is illustrated on Figures 2-4 through 2-6 and consists of four major components: (1) natural attenuation of contaminated groundwater, (2) removal of selected soil areas, (3) LUCs, and (4) groundwater monitoring.

2.11.2.1 Component 1: Natural Attenuation of Contaminated Groundwater

Natural attenuation will rely on naturally occurring processes within the surficial aquifer to reduce contaminant concentrations in groundwater. Hydraulic dispersion through aquifer movement, adsorption on soil particles, and biodegradation will be the main attenuation processes. Surficial aquifer conditions will be periodically monitored to ensure that contaminant concentrations are being adequately reduced through natural processes.

2.11.2.2 Component 2: Excavation and Offsite Disposal of Contaminated Soil

This alternative would involve excavating contaminated soil such that the average soil contaminant concentrations based on the 95 percent upper confidence limit meet the State of Florida industrial SCTLs. Vadose zone soil with contaminant concentrations that exceed leachability SCTLs will be also be excavated. During the preparation of the Remedial Design, the existing data will be evaluated pertinent to USEPA and FDEP guidelines for calculating 95 percent UCLs (Chapter 62-780.680 F.A.C.) and other risk-based corrective action (RBCA) criteria. Additional samples will be collected and analyzed as needed to determine excavation limits as part of the Remedial Design. Figure 2-4 shows the areas to be evaluated for excavation. In cases were soil contamination is isolated, smaller excavations may be performed in 40-feet by 40-feet sections. The area of contaminated soil that will be evaluated for excavation covers approximately 246,400 square feet. Excavations will be advanced to a depth of 2 feet bls. The estimated maximum volume of soil to be excavated and disposed is 18,250 yd^3. For costing purposes, the excavated soil is assumed to require disposal as hazardous waste. Hazardous waste will be treated off-site as needed to meet Land Disposal Restriction criteria.

2.11.2.3 Component 3: Land Use Controls

Following soil excavation, soil and groundwater contamination will remain at OU 2 at concentrations that preclude unrestricted use and unlimited exposure; therefore, the remedy includes LUCs to prevent unacceptable exposure to residual contaminated soil and groundwater. The boundaries of OU 2 and the area to be covered by the LUCs are shown on Figure 2-6. Consistent with the RAOs developed for the OU, the specific performance objectives for the LUCs to be implemented at OU 2 are as follows:

- Prohibit reuse of the site for residential uses including, but not limited to, any form of housing, child-care facilities, any kind of school including preschools, elementary schools, and secondary schools, playgrounds, and adult convalescent or nursing care facilities.

- Prohibit the excavation, disturbance, and removal of soil unless prior written approval is obtained from the facility's Environmental Coordinator.

- Prohibit potable uses of groundwater from the surficial aquifer underlying the site, including, but not limited to, drinking, washing, cooking, cleaning, and turf irrigation, without prior written approval from the Navy, USEPA, and FDEP.

- Prevent unacceptable occupational exposure to contaminated groundwater in the surficial aquifer by requiring the use of personal protective equipment (PPE) and monitoring equipment for excavations that may encounter groundwater.

- Maintain the integrity of any existing or future monitoring or remediation system(s).

Any time that part of OU 2 is considered for an alternative use, a site approval process will be initiated through the NAS Pensacola Environmental Office. Similarly, for any intrusive activities that are planned within OU 2, the Dig Permit process will be initiated through the NAS Pensacola Environmental Coordinator. The restricted area will be delineated and the restriction will be described in the NAS Pensacola Site Management Plan. Enforcement will be achieved through NAS Pensacola's site approval and Dig Permit processes. The site use and Dig Permits must be approved by the NAS Pensacola Environmental Office before any intrusive or construction activities are performed. Re-evaluation will be required for any significant land use changes. The RD will outline implementation actions for the LUCs.

In the event that property ownership of all or part of the OU is transferred and onsite contaminant concentrations remain greater than levels that allow for unrestricted use and unlimited exposure, the Navy will do the following:

- Execute a deed of conveyance at the time of property transfer that prohibits residential uses of the site unless prior written approval is obtained from the Navy, USEPA, and FDEP. The deed will also prohibit interference with the integrity of any existing or future groundwater monitoring or remediation system(s) without prior Navy, USEPA, and FDEP approval.

- Notice of the Navy's application of LUCs to the site via the deed of conveyance will be provided to those local regulatory agencies including but not limited to local state agencies and management districts that could assist the Navy with their future enforcement.

The LUCs will be implemented and maintained by the Navy until the concentrations of hazardous substances in soil and groundwater have been reduced to levels that allow for unrestricted use and unlimited exposure. Until the RAOs are attained, LUCs need to be in place to specifically restrict potable water groundwater use and prevent unacceptable occupational exposure to groundwater. Remedial performance will be evaluated annually to measure the progress toward the RAOs, and the LUCs will remain in place until the RAOs are achieved. The Navy or any subsequent owners shall not modify, delete, or terminate any LUC without USEPA and FDEP concurrence.

The Navy is responsible for implementing, maintaining, reporting on, and enforcing the LUCs described in this ROD. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity. Should any LUC remedy fail, the Navy will ensure that appropriate actions are taken to re-establish the remedy's protectiveness and may initiate legal action to either compel action by a third party(ies) and/or to recover the Navy's costs for remedying any discovered LUC violation(s).

The LUC implementation actions including monitoring and enforcement requirements will be provided in a LUC RD that will be prepared by the Navy as the LUC component of the overall RD. Within 90 days of ROD signature, the Navy shall prepare and submit to USEPA and FDEP for review and approval (pursuant to those Primary Document review procedures stipulated in the FFA) the LUC RD for OU 2 that shall contain implementation and maintenance actions, including periodic inspections. The Navy will maintain, monitor, and enforce the LUCs according to the LUC RD. LUCs will be developed in accordance with the principles and procedures for specifying, monitoring, and enforcement of land use controls and other post-ROD actions, per letter dated October 2, 2003 from Raymond F. DuBois, Deputy Under Secretary of Defense (Installations and Environment), to Hon. Marianne Lamont Horinko, Acting Administrator, USEPA. Implementation of this remedy will therefore require a survey of the site, annual visual inspections, and a 5-year review with report preparation.

2.11.2.4 Component 4: Long-Term Monitoring

Long-term monitoring consists of the periodic collection and analysis of groundwater samples to evaluate whether contaminant migration is occurring within the surficial aquifer. Long-term monitoring will also be used to assess natural attenuation of groundwater contamination.

Groundwater samples will be collected from 10 existing monitoring wells and analyzed for VOCs, SVOCs, and metals. Sampling frequency will be semi-annual for the first 3 years and annual thereafter. The number of wells to be sampled, parameters to be analyzed, and sampling frequency may change over time depending on sample results and with approval by the Navy, USEPA, and FDEP.

If the results of two consecutive groundwater sampling events indicate that the cleanup levels have been met, the site will be considered remediated for groundwater, and USEPA and FDEP concurrence for NFA at the site would then be requested.

2.11.3 Contingency Remedy

If results show that (1) the implemented excavation, LUCs, and/or natural attenuation have failed to prevent unacceptable risks from exposure to onsite soil and/or groundwater contamination; (2) contaminated groundwater has migrated to an unacceptable degree; or (3) contamination in groundwater is not attenuating as expected, then additional active remedial measures may be evaluated and implemented as detailed in Tables 2-35 and 2-36.

2.11.4 Summary of Estimated Remedy Costs

The estimated capital cost and 30-year NPW of the capital, LUCs, and O&M costs of the selected remedy are as follows:

Soil Alternative S-5: Excavation and Offsite Disposal with LUCs

- Capital cost: $5,071,000
- 30-Year NPW of capital, LUC, and O&M costs: $5,126,000

Groundwater Alternative GW-3: MNA with LUCs

- Capital cost: $170,000
- 30-Year NPW of capital, LUC, and O&M costs: $1,599,000

The NPW is based on an annual discount rate of 6 percent. The above estimates exclude duplicated cost items (such as LUC preparation) included in both the soil and groundwater alternatives estimates.

2.11.5 Expected Outcomes of the Selected Remedy

The expected outcomes of the selected remedy may be summarized as follows:

- Upon completion of the soil removal, OU 2 will be environmentally safe for its intended industrial use as long as the soil and groundwater LUCs are in place and observed.

- Groundwater cleanup goals will be attained in more than 30 years, and the surficial aquifer will become available for unrestricted use, although the surficial aquifer is not likely to be used because water is already provided to the area from an off-site source.

2.12 STATUTORY DETERMINATIONS

Under CERCLA Section 121 and the NCP, the selected remedy must be protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), be cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The following sections discuss how the selected remedy meets these statutory requirements.

2.12.1 Protection of Human Health and the Environment

The selected remedy, Soil Alternative S-5 and Groundwater Alternative GW-3, will protect human health and the environment. LUCs will prevent future residential development of the site. Removal actions at selected areas will eliminate risk due to soil contamination in excess of industrial criteria. The reduced frequency of exposure and potential pathways associated with industrial land use results in a reduced potential intake of soil COCs, and consequently reduced risks to human health. LUCs will also prohibit use of groundwater from the surficial aquifer beneath the site. Consequently, there will continue to be no exposure to contaminated groundwater.

2.12.2 Compliance with Applicable or Relevant and Appropriate Requirements

CERCLA Section 121(d) specifies in part that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or obtain a waiver [see also 40 CFR 300.430(f)(1)(ii)(B)]. ARARs include only federal and state environmental or facility siting laws/regulations and do not include

occupational safety or worker protection requirements. In addition, per 40 CFR 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (TBC criteria).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, although not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

In accordance with 40 CFR 300.400(g), the Navy, FDEP, and USEPA have identified the specific ARARs for the selected remedy. The selected remedy is expected to comply with all ARARs related to implementing the selected action. Tables 2-37 and 2-38 list the chemical-specific and action-specific ARARs that will be considered in the implementation of the selected remedy.

2.12.3 Cost-Effectiveness

The selected remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." [NCP §300.430(f)(1)(ii)(D)]. This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs, and hence this alternative represents a reasonable value for the money spent.

The estimated 30-year NPW of the selected soil and groundwater remedy is $6,725,000.

TABLE 2-37

SUMMARY OF CHEMICAL-SPECIFIC ARARs FOR SELECTED REMEDY
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Requirement Synopsis	Application
State Requirements				
Florida Groundwater Classes, Standard and Exemptions	Chapter 62-520, Florida Administrative Code (F.A.C.)	Applicable	This rule designates the groundwater of the State into five classes and establishes minimum "free from" criteria. This rule also specifies that Classes I and II must meet the primary drinking water standards listed in Chapter 62-550.	This rule was used to classify groundwater and establish cleanup goals for groundwater. Groundwater at this site is considered a potential source of drinking water (G-2).
Surface Water Quality Standards	Chapter 62-302.530, F.A.C.	Relevant and Appropriate	Establishes water quality standards for all waters of the state.	Groundwater may affect adjacent surface waters.
Drinking Water Standards, Monitoring, and Reporting	Chapter 62-550.310(4)(b), F.A.C.	Relevant and Appropriate	Establishes primary drinking water standards including maximum contaminant levels for public water supply systems.	The surficial zone of the sand and gravel aquifer currently has no beneficial use, and the adjacent surface waters are classified as Class III surface water, per Chapter 62-302, F.A.C. Nevertheless, primary drinking water standards are invoked for some COCs in Chapter 62-777.
Contaminant Cleanup Target Levels	Chapter 62-777.170(1)(a), (1)(b), and (2)(a), F.A.C. in tables 1 and 2.	Relevant and Appropriate	Establishes remediation targets for various soil and groundwater exposure scenarios; provides standards for assessing potential cross-media transfer.	Use to determine specific cleanup levels for COCs in soil and groundwater in tables 1 and 2 of 62-777.

CFR – Code of Federal Regulations.
COC – Chemical of concern.
F.A.C. – Florida Administrative Code.
PCB – Polychlorinated biphenyl.

TABLE 2-38

SUMMARY OF ACTION-SPECIFIC ARARs FOR SELECTED REMEDY
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2

Requirement	Citation	Status	Requirement Synopsis	Application
Federal Requirements				
RCRA Identification of Hazardous Waste	40 Code of Federal Regulations (CFR) Part 261.11 and 264.13(a)(1)	Applicable	Requires characterization of solid waste and additional characterization of waste determined to be hazardous. Part 261.11 requires determination of whether solid waste is hazardous. Part 264.13(a)(1) requires a detailed chemical and physical analysis of a representative sample of the waste to determine treatment, storage, and disposal requirements.	The remedial action will generate solid waste (contaminated soil) that must be characterized for disposal.
RCRA Land Disposal Restrictions (LDRs)	40 CFR §268.49	Applicable	This regulation prohibits the land disposal of untreated hazardous wastes and provides standards for contaminated soil that is considered hazardous waste.	If excavated soil is hazardous, they must comply with LDRs.
State Requirements				
Florida General Pollutant Emission Limitation Standards	Chapter 62-296.320, Florida Administrative Code (F.A.C.)	Applicable	Establishes requirements for generation of unconfined emissions of particulate matter from any activity.	Requires reasonable precautions such as application of water or other dust suppressants to control emission from construction and land clearing activities.
Florida Water Well Permitting and Construction Requirements	Chapter 62-532.500, F.A.C.	Applicable	Establishes minimum standards for the location, construction, repair, and abandonment of water wells.	The requirements for permitting for the construction, repair, and abandonment of monitoring wells will be met.
Florida Hazardous Waste – Requirements for Remedial Action	Chapter 62-730.225 (3) F.A.C.	Applicable	Requires warning signs at the sites suspected or confirmed to be contaminated with hazardous waste.	This requirement will be met.

TABLE 2-38

SUMMARY OF ACTION-SPECIFIC ARARs FOR SELECTED REMEDY
OPERABLE UNIT 2
RECORD OF DECISION
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2

Requirement	Citation	Status	Requirement Synopsis	Application
Florida Natural Attenuation with Monitoring Regulation	Chapter 62-780.690(8)(a) thru (c), F.A.C	Relevant and Appropriate	Specifies minimum number of wells and sampling frequency for conducting groundwater monitoring as part of a natural attenuation remedy.	The requirements associated with implementation of groundwater monitoring will be met.[1]

CFR – Code of Federal Regulations.
COC – Chemical of concern.
F.A.C. – Florida Administrative Code.
LDR - Land Disposal Restriction
PCB – Polychlorinated biphenyl.

[1] The designated number of wells, sampling time frames/frequency, and specific parameters for analyses will be provided in a Monitoring Plan that is included in a post-ROD document (e.g. Remedial Design or Remedial Action Work Plan) that is approved by the EPA and FDEP.

2.12.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The Navy and USEPA, in conjunction with FDEP, have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at OU 2. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Navy and USEPA, in conjunction with FDEP, have determined that the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria while also considering the statutory preference for treatment as a principal element and bias against offsite treatment and disposal and considering state and community acceptance. Groundwater treatment alternatives were not selected because the NPWs were much greater than the NPW of the selected remedy. Groundwater treatment alternatives did not provide a significantly greater level of protection compared to the selected remedy.

2.12.5 Preference for Treatment as a Principal Element

The selected remedy does not provide for treatment as a principal element; however, no source materials constituting principal threats are present at the site, and reductions in soil and groundwater contaminant concentrations are expected over time due to dilution and biological, dispersion, advection, and adsorption processes.

2.12.6 Five-Year Review Requirement

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, in accordance with Section 121(c) of CERCLA and NCP §300.430(f)(5)(iii)(c), a statutory review will be conducted within five years of initiation of the remedial action and every five years thereafter until unrestricted use and unlimited exposure can be permitted, to ensure that the remedy continues to be protective of human health and the environment.

2.13 DOCUMENTATION OF SIGNIFICANT CHANGES

The public was provided an opportunity to review and comment on the OU 2 Proposed Plan (TtNUS, 2008). A Public Notice was published in the Pensacola News Journal on **May 11, 2008** informing the public that the Proposed Plan was available for review at the NAS Pensacola Information Repositories and requested that all comments be submitted to the Navy by **June 25, 2008**. CERCLA Section 117(b) requires an explanation of significant changes from the selected remedy presented in the Proposed Plan that was published for public comment. No comments were received from the public during the comment period; therefore, no significant changes to the remedy resulting from public comments, as originally identified in the Proposed Plan, were necessary or appropriate.

However, following the public comment period, the Navy proposed an alternative method for determining the extent of soil using the 95-percent UCL following FDEP regulations and guidance (Chapter 62-780.680 F.A.C.). This alternative calculation will yield an excavation that is still protective of human health and the environment, but will result in a smaller volume of soil to the excavated and disposed. The calculation and excavation limits will be developed during the preparation of the remedial design.

REFERENCES

ABB (ABB Environmental Services, Inc.), 1991. Site Inspection Report, Cold Storage Facility, Naval Air Station, Pensacola, Florida.

ABB, 1993. Contaminant Assessment Report, Site 3450S, Naval Aviation Depot, Naval Air Station, Pensacola, Florida.

Ensafe (Ensafe, Inc.), 1997. Remedial Investigation Report, Operable Unit 2, Naval Air Station Pensacola, Pensacola, Florida. Prepared for Naval Facilities Engineering Command Engineering Field Division South, North Charleston, South Carolina. October.

Ensafe, 2005a. Remedial Investigation Addendum, Operable Unit 2, Naval Air Station Pensacola, Pensacola, Florida. Prepared for Naval Facilities Engineering Command Engineering Field Division South, North Charleston, South Carolina. April.

Ensafe, 2005b. Feasibility Study Report, Operable Unit 2, Naval Air Station Pensacola, Pensacola, Florida. Prepared for Naval Facilities Engineering Command Engineering Field Division South, North Charleston, South Carolina. December.

E&E (Ecology & Environment, Inc.), 1991a. Interim Data Report, Contamination Assessment/Remediation Activities Investigation North Chavelier Disposal Area (Site 11), Naval Air Station, Pensacola, Florida.

E&E, 1991b. Interim Data Report, Contamination Assessment/Remediation Activities Investigation Scrap Bins (Site 12), Naval Air Station, Pensacola, Florida, Ecology & Environment, Inc., Pensacola, FL.

E&E, 1991c. Interim Data Report, Contamination Assessment/Remediation Activities Investigation Supply Department Outside Storage Area (Site 26), Naval Air Station, Pensacola, Florida.

E&E, 1992a. Interim Data Report, Contamination Assessment/Remediation Activities Investigation — Radium Spill Area (Site 25), Naval Air Station, Pensacola, Florida, Ecology & Environment, Inc., Pensacola, FL.

E&E, 1992b. Interim Data Report, Contamination Assessment/Remediation Activities Investigation — Radium Dial Shop (Site 27), Naval Air Station, Pensacola, Florida.

REFERENCES

G&M (Geraghty & Miller, Inc.), 1984. Verification Study, Assessment of Potential Groundwater Pollution at Naval Air Station, Pensacola, Florida.

G&M, 1986. Characterization Study, Assessment of Potential Groundwater Pollution at Naval Air Station, Pensacola, Florida.

NEESA (Naval Environmental and Engineering Support Activity), 1983. Initial Assessment Study of Naval Air Station Pensacola, Pensacola, Florida. (NEESA 13 015).

TtNUS (Tetra Tech NUS, Inc.), 2008. Proposed Plan for Operable Unit 2, Naval Air Station Pensacola, Pensacola, Florida. Prepared for Naval Facilities Engineering Command Engineering Field Division South, North Charleston, South Carolina. January.

USEPA (United States Environmental Protection Agency), 1992. Field Investigation, Naval Air Station, Pensacola, Florida. USEPA Region IV, Athens, Georgia.

USEPA, 1999. A Guide for Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, EPA 540-R-98-031, OSWER 9200.1-23P. July

APPENDIX A

RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY

Public notice of the availability of the Proposed Plan was placed in the Pensacola News Journal on May 11, 2008. A 45-day public comment period was held from May 12, 2008 to June 25, 2008. Provisions for the public to request a public meeting to discuss the Proposed Plan were also described in the public notice. No comments were received during the 45-day comment period.