DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST
JACKSONVILLE, FL 32212-0030

5090
Ser OPUE3/0498
December 4, 2012

Florida Department of Environmental Protection
Attn: Mr. John Winters
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

BUREAU OF WASTE CLEANUP
RECEIVED

DEC 06 2012

FEDERAL PROGRAMS SECTION

Dear Mr. Winters:

SUBJECT: SUBMITTAL OF THE DRAFT FINAL REMEDIAL INVESTIGATION REPORT FOR SITE 40, BASE-WIDE GROUNDWATER, OPERABLE UNIT 25 AT NAVAL AIR STATION, WHITING FIELD

In accordance with the Federal Facilities Agreement between U.S. Environmental Protection Agency, Region 4, the Florida Department of Environmental Protection for the State of Florida and the Department of the Navy for the Naval Air Station, Whiting Field, Milton, Florida, enclosed is the Draft Final "Remedial Investigation Report for Site 40, Base-wide Groundwater, Operable Unit 25".

Should you require any further details or clarifications, please feel free to contact Mr. Arne Olsen, Remedial Project Manager at (904) 542-6159 or by email: arne.olsen@navy.mil.

Sincerely,

A. E. OLSEN
Integrated Product Team
Gulf Coast
By direction of the
Commanding Officer

Enclosure: Draft Final Remedial Investigation Report for Site 40, Base-wide Groundwater, Operable Unit 25

Copy to:
Mr. Craig Benedikt, US EPA
Mr. Michael Pattison, NASWF PWD
Mr. Rich May, Tetra Tech
Ms. Amy Twitty, CH2M Hill

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62470-08-D-1001

Rev. 1
December 2012

Draft Final
Remedial Investigation Report
for
Site 40, Base-Wide Groundwater

Naval Air Station Whiting Field
Milton, Florida

USEPA Operable Unit 25
USEPA ID Number FL2170023244

Contract Task Order JM40

December 2012

NAVFAC
Naval Facilities Engineering Command
NAVFAC SOUTHEAST
NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH

DRAFT FINAL
REMEDIAL INVESTIGATION REPORT
FOR
SITE 40, BASEWIDE GROUNDWATER

NAS WHITING FIELD
MILTON, FLORIDA

USEPA OPERABLE UNIT 25

USEPA ID NUMBER FL2170023244

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:
Naval Facilities Engineering Command Southeast
NAS Jacksonville Building 103
Jacksonville, Florida 32212**

**Submitted by:
Tetra Tech, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406**

**CONTRACT NUMBER N62470-08-D-1001
CONTRACT TASK ORDER JM40**

DECEMBER 2012

PREPARED UNDER THE DIRECTION OF:

Richard D. May

**RICHARD D. MAY
PROJECT MANAGER
TETRA TECH, INC.
TALLAHASSEE, FLORIDA**

APPROVED FOR SUBMISSION BY:

John Trepanowski

**JOHN TREPANOWSKI
PROGRAM MANAGER
TETRA TECH, INC.
KING OF PRUSSIA, PENNSYLVANIA**

PROFESSIONAL CERTIFICATION

Remedial Investigation Report
Site 40, Base-Wide Groundwater
Naval Air Station Whiting Field
Milton, Florida

This *Remedial Investigation Report, Site 40, Base-Wide Groundwater, Naval Air Station Whiting Field, Milton, Florida*, was prepared under the direction of the undersigned geologist using geologic and hydrogeologic principles standard to the profession at the time the report was prepared. If existing conditions differ from those described, the undersigned geologist should be notified to evaluate the effects, if any, of additional information on the assessment described in this report.

This document was prepared for Site 40 at NAS Whiting Field, Milton, Florida and should not be construed to apply to any other site.

Tetra Tech, Inc.
1558 Village Square Blvd., Suite 2
Tallahassee, FL 32309

Larry Smith, P.G. 07/31/2014
Professional Geologist
State of Florida License Number 0001619

TABLE OF CONTENTS

SECTION **PAGE**

APPENDICES

TABLES

NUMBER

TABLES (CONT.)

FIGURES

NUMBER

FIGURES (CONT.)

ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services, Inc.
ADAF	Age-dependent adjustment factors
AFFF	Aqueous fire-fighting foam
AST	Aboveground storage tank
atm-m^3/mol	Atmosphere per cubic meter per mole
AVGAS	Aviation gasoline
BAT	Bengt-Arne-Tortensson
BCF	Bioconcentration factor
BEHP	Bis(2-ethylhexyl)phthalate
BHC	Benzene hexachloride
bls	Below land surface
BTEX	Benzene, toluene, ethylbenzene, and xylene
°C	Degree Celsius
CAR	Contamination Assessment Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
COC	Contaminant of concern
COPC	Contaminant of potential concern
cPAH	Carcinogenic polynuclear aromatic hydrocarbon
CFS	Cancer slope factor
CSM	Conceptual Site Model
CTE	Central tendency exposure
CTL	Cleanup Target Level
CTO	Contract Task Order
CV	Coefficient of variation
CVOC	Chlorinated volatile organic compound
DCA	Dichloroethane
DCE	Dichloroethene
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved oxygen
DOC	Dissolved organic carbon
DPT	Direct push technology

ACRONYMS AND ABBREVIATIONS (CONTINUED)

EC	Engineering control
EDB	Ethylene dibromide
EDR	Environmental Data Resources
Eh	Reduction potential
EP Tox	Extraction Procedure Toxicity
EPC	Exposure point concentration
ERA	Ecological Risk Assessment
ESV	Ecological Screening Values
EU	Exposure unit
°F	Degree Fahrenheit
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Resources
FID	Flame ionization detector
foc	Fraction of organic carbon
FOD	Frequency of detection
FR	Federal Register
FS	Feasibility Study
FYR	Five Year Review
GAC	Granular activated carbon
GC	Gas chromatograph
GCTL	Groundwater cleanup target level
GIR	General Information Report
HEAST	Health Effects Assessment Summary Tables
HLA	Harding Lawson Associates
HHRA	Human Health Risk Assessment
HHRSE	Human Health Risk Screening Evaluation
HI	Hazard index
HQ	Hazard quotient
HRS	Hazard Ranking System
IAS	Initial Assessment Study
ID	Inside diameter
IDL	Instrument detection limit
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	Incremental lifetime cancer risk
IR	Installation Restoration

ACRONYMS AND ABBREVIATIONS (CONTINUED)

IRA	Interim remedial action
IRIS	Integrated Risk Information System
IUR	Inhalation unit risk
JP	Jet propellant
K_d	Distribution coefficient
K_{oc}	Organic carbon partition coefficient
K_{ow}	Octanol/water partition coefficient
L/kg	Liter per kilogram
LNAPL	Light nonaqueous phase liquid
LOAEL	Lowest Observed Effects Level
LUC	Land use control
µg/dL	Microgram per deciliter
µg/kg	Microgram per kilogram
µg/L	Microgram per liter
µS/cm	Micro Siemen per centimeter
MCL	Maximum Contaminant Level
MCPA	2-methyl-4-chlorophenoxyacetic acid
MI	Mobility index
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
MK	Mann-Kendall
MMRP	Military Munitions Response Program
msl	Mean sea level
MTBE	Methyl tert-butyl-ether
mV	Millivolt
NA	No Action
NACIP	Navy Assessment and Control of Installation Pollutants
NAS	Naval Air Station
NAVFAC SE	Naval Facilities Engineering Command Southeast
Navy	Department of the Navy
NCA	North Central Area
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Non-detect
NFA	No Further Action
NFESC	Naval Facilities Engineering Service Center

ACRONYMS AND ABBREVIATIONS (CONTINUED)

NOAEL	No Observed Effects Level
NPL	National Priorities List
NTU	Nephelometric turbidity unit
NWFWDM	Northwest Florida Water Management District
OLF	Outlying Field
ORP	Oxidation-reduction potential
OU	Operable Unit
OVA	Organic vapor analyzer
OWS	Oil/Water Separator
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PDWS	Primary Drinking Water Standard
PLF	Product Line Dispensing Facility
PLJ	Product line junction
PLP	Product Line Pump Station
ppm	Part per million
PRG	Preliminary remediation goal
PSC	Potential Source of Contamination
PVC	Polyvinyl chloride
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
RAP	Remedial Action Plan
RBC	Risk-Based Concentration
RfC	Reference concentration
RfD	Reference dose
RI	Remedial investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
RSC	Relative Source Contribution
RSL	Regional Screening Level
S	Solubility
SAP	Sampling and Analysis Plan
SAR	Site Assessment Report
SARA	Superfund Amendments and Reauthorization Act
SCA	South Central Area

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SCTL	Soil Cleanup Target Level
SDWS	Secondary Drinking Water Standard
SOP	Standard operating procedure
SOPQAM	Standard Operating Procedures and Quality Assurance Manual
SPLP	Synthetic precipitation leaching procedure
SU	Standard unit
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TCA	Trichloroethane
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total dissolved solid
TEQ	Toxic equivalent
Tetra Tech	Tetra Tech, Inc.
TKN	Total Kjeldahl nitrogen
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TRPH	Total recoverable petroleum hydrocarbons
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground storage tank
UXO	Unexploded ordnance
VOC	Volatile organic compound
VP	Vapor pressure
WWTP	Wastewater treatment plant
yd^3	Cubic yard

EXECUTIVE SUMMARY

A remedial investigation (RI) was conducted at Site 40, Base-Wide Groundwater, Naval Air Station (NAS) Whiting Field in Milton, Florida, by the Department of the Navy (Navy), Naval Facilities Engineering Command Southeast (NAVFC SE) as part of the Department of Defense Installation Restoration (IR) program.

The purpose of this RI Report is to document field activities and present analytical findings of multiple soil and groundwater investigations. These investigations aid in characterizing the nature and extent of toxic and/or hazardous chemicals present in soil and groundwater and presents potential risks to human and ecological receptors.

This RI Report incorporates data collected during three investigation events conducted in 2007, 2008, and concluded in 2011 as well as data previously presented in technical memorandums and underground storage tank (UST) and RI Reports issued from 1993 to 2008. The RI provides information to refine the Conceptual Site Model (CSM) and forms the basis for the development of remedial objectives and alternatives.

This report quantifies the extent, and location of groundwater contamination within four areas: the Northern Area, the North Central Area, the South Central Area and Southern Area. The Northern Area consists of Sites 1, 2, 17, 18, and 38. The North Central Area (NCA), consists of sites 3, 4 (former UST Site 1467), 32, 35, 36, 37, and 41 (former Area of Concern [AOC] 1485C) and UST Sites 1438/1439, 2832, and 2894. The South Central Area (SCA) consists of Sites 5, 6, 7 (former UST Site 1466), 15, 16, 29, 30 and 33. The Southern Area consists of Sites 8, 9, 10, 11, 12, 14, and 31 (Areas A through F).

Site 40, Base-Wide Groundwater, was designated as a single site in order to reduce difficulties encountered where single or mixed plumes underlie multiple sites. Base-Wide Groundwater is a discrete site separated at the water table from surficial sites and their vadose zone soils. The main purpose of this report is to describe the groundwater plumes and their characteristics. However, the Records of Decision (RODs) issued for the sites overlying Site 40 did not address vadose zone soils leaching to groundwater –instead, they deferred the investigation of leaching and potential impacts to groundwater to this RI report.

ES.1 LEACHABILITY AND GROUNDWATER INVESTIGATION SUMMARY

Twenty-four IR sites with signed RODs are located across the facility. These RODs are limited to the vadose zone soils but do not include leaching to groundwater. Rain falling on these sites infiltrates the soil and leaches contaminants from soil to the groundwater. Each ROD states leachate from the vadose zone soil may potentially impact groundwater and will be resolved in the Site 40 RI. Therefore, a major portion of this RI is dedicated to reporting the findings concerning leachate from these various sites and their potential impact on Site 40 groundwater. For this reason, all overlying IR Sites that may contribute leachate to Site 40 groundwater and have been investigated have findings included in this report.

ES.2 GROUNDWATER INVESTIGATION SUMMARY

Northern Area of Site 40

Beta-benzene hexachloride and heptachlor epoxide were detected in groundwater samples at Site 38 in monitoring well WHF-38-MW-2S in exceedance of the Florida Department of Environmental Protection (FDEP) groundwater cleanup target level (GCTL). One pesticide (heptachlor epoxide) and five inorganics (aluminum, arsenic, iron, lead, manganese, and vanadium) exceeded the GCTL groundwater samples at Site 38 located in the Northern Area. The frequent occurrence of inorganics exceeding federal or state criteria reflects regional groundwater conditions not affected by operations at the facility or are likely a secondary response to the groundwater chemistry change caused by organic contamination.

North Central Area of Site 40

Four organics (ethylbenzene, toluene, total xylenes, and naphthalene) and five inorganics (aluminum, iron, lead, manganese, and vanadium) were detected in SPLP leachate in exceedance of GCTLs primarily at Site 41. BTEX, TCE, cis-1,2-DCE, 1,1-DCA, BEHP, aluminum, arsenic iron, lead, manganese, mercury, and vanadium were found in exceedance of GCTLs within the mapped plume located in the NCA. Only ethylbenzene, toluene, total xylenes, aluminum, iron, and lead were found in both SPLP leachate and groundwater indicating a possible association between a soil contaminant source and GCTL exceedance in groundwater.

South Central Area of Site 40

Eight organics (ethylbenzene, 2-methylnaphthalene, toluene, total xylenes, BEHP, naphthalene, dieldrin, and TPH) and six inorganic analytes (aluminum, iron, lead, manganese, mercury, and vanadium) were detected in soil SPLP leachate in exceedance of GCTLs. Benzene, cis-1,2-DCE, ethylbenzene, total xylenes, trans-1,2-DCE, TCE, vinyl chloride, aluminum, arsenic, iron, lead, manganese, and vanadium were found in exceedance of GCTLs within the mapped plume boundary located in the SCA. Only ethylbenzene, total xylenes, aluminum, iron, lead, manganese, and vanadium were found in both SPLP leachate and groundwater indicating an association between a soil contaminant source and GCTL exceedance in groundwater.

Southern Area of Site 40

No organic compounds were found above regulatory limits in soil leachate in the Southern Area. Aluminum and mercury were detected in soil SPLP leachate in exceedance of GCTLs. Vinyl chloride, BEHP, aluminum, iron, and manganese were detected in exceedance of GCTLs in groundwater. Therefore, contaminated soil is a potential source to groundwater for aluminum. The other analytes detected in groundwater listed above may be leaching to groundwater, but the source was not detected.

ES.2 RECOMMENDATION SUMMARY

Human Health Summary

In summary, there is a potential exposure pathway to Site 40 groundwater for both pilot trainees living on the facility and adult base workers. This potential pathway is present because Site 40 groundwater is pumped to the surface from public supply wells for consumption and general use by personnel at the facility. Groundwater is monitored prior to treatment for required pollutants. The analytical results of the monitoring are provided to FDEP for review. The quality of the treated (granular activated carbon [GAC] filtration) water provided to the public is analyzed monthly and the results provided to FDEP.

Potential receptors under future land use are the hypothetical child and adult residents. Although future land use is likely to be the same as current land use, the potential future receptors were evaluated in the baseline human health risk assessment (HHRA), primarily for decision-making purposes.

The contaminants of potential concern (COPCs) for both the NCA and SCA plumes for direct contact to groundwater are:

- Benzene, cis-1,2-dichloroethene, ethylbenzene, toluene, total xylenes, and trichloroethene.

An adult worker or hypothetical resident consuming untreated groundwater from the NCA or SCA plumes may be exposed to contaminants exceeding the USEPAs target acceptable risk range resulting in unacceptable carcinogenic risks. Carcinogenic risks for adult trainees exposed to groundwater from the SCA plumes are within the acceptable risk range established by USEPA.

The individual target organ hazard index (HI) for the adult trainee, adult base worker, and possible future residential receptors exceeded the USEPAs HI of 1 indicating that adverse non-carcinogenic affects are also anticipated from exposure to groundwater from the NCA and/or SCA plumes.

Ecological Summary

In summary, there is no exposure pathway to Site 40 groundwater for ecological receptors. However, groundwater from Site 40 upwells into Clear Creek, Site 39, and its floodplain. Even in this situation, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) in groundwater pose negligible risks to ecological receptors in Clear Creek and its floodplain.

The closest IR sites that may impact Clear Creek as Site 15 and 16 located approximately 500 feet east of the Clear Creek floodplain. Although groundwater beneath NAS Whiting Field is contaminated by various chemicals, the only possible route of exposure for contact with ecological receptors is along Clear Creek and its floodplain. With the above factors in mind, no further evaluation of groundwater-related potential ecological risk is warranted for Site 40.

1.0 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) under contract with the Department of Navy (Navy), Naval Facilities Engineering Command Southeast (NAVFAC SE) conducted a remedial investigation (RI) for Site 40, Base-Wide Groundwater at Naval Air Station (NAS) Whiting Field located in Milton, Florida. This RI Report was prepared for NAVFAC SE under Contract Task Order (CTO) JM40, for the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract Number N62470-08-D-1001. For the purposes of this RI Report, the study area is the boundary of the facility. This RI Report presents the results, in whole or in part, for the Site 40 field investigations conducted from 1993 through 2011. The field work that supports this RI was conducted in accordance with various work plans. The four primary work plans include 1) the RI/Feasibility Study (FS) Work Plan for Sites 07 (an underground storage tank [UST] site), 29, 35, 38, 39, and 40 and Potential Source of Contamination (PSC) 1485C (Tetra Tech, 2000); 2) the Remedial Investigation Work Plan for Base-Wide Groundwater Assessment Activities at Site 40 and Well Abandonment, October 2007 (Tetra Tech, 2007a); 3) the Work Plan for Base-Wide Groundwater Sampling, Membrane Interface Probe Investigation, and Monitoring Well Installation Activities at Site 40, April 2008 (Tetra Tech, 2008a); and 4) Sampling and Analysis Plan (SAP) Remedial Investigation Addendum for Site 40, Base-Wide Groundwater Operable Unit (OU) 25, November 2010 (Tetra Tech, 2010a). The RI Report also includes data from several UST reports submitted to the Florida Department of Environmental Protection (FDEP). The findings from the earlier investigations are described in other sections this report. The data collected from the various field investigations has been compiled and was used to refine the Conceptual Site Model (CSM). This RI also provides an evaluation of potential risks to human and ecological receptors and forms the basis for the potential development of remedial objectives and alternatives comprising an FS.

1.1 PURPOSE OF REPORT

The purpose of the RI and RI Report is to document the nature and extent of contamination and prepare a risk assessment. This is achieved by documenting field activities and presenting analytical results from groundwater investigations of Site 40 and the impact on groundwater of contaminants found in the vadose zone. These groundwater and vadose zone investigations provide sufficient data to characterize the nature and extent of toxic and/or hazardous chemicals present in or leaching to groundwater. This RI Report also documents the impact of UST sites where soils overlying the water table were found to contain petroleum related chemicals that exceed their FDEP Soil Cleanup Target Levels (SCTLs) for leaching to groundwater.

1.2 SITE BACKGROUND

1.2.1 NAS Whiting Field Regulatory Setting

The Navy Installation Restoration (IR) program was designed to identify and abate or control contaminant migration resulting from past operations at naval facilities. The IR program is the Navy response authority under Section 120 of the CERCLA of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and Executive Order 12580. CERCLA requires federal facilities to comply with the act, both procedurally and substantively. NAVFAC SE is the agency responsible for the Navy IR program in the southeastern United States. Therefore, NAVFAC SE has the responsibility to manage NAS Whiting Field from preliminary assessment, site inspection, and RI/FS through the remedial response selection in compliance with the guidelines of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300). Section 105(a)(8)(A) of SARA requires the United States Environmental Protection Agency (USEPA) to develop criteria to set priorities for remedial action for chemicals detected in environmental media based on relative risk to public health and the environment. To meet this requirement, the USEPA has established the Hazard Ranking System (HRS) as Appendix A to the NCP. First promulgated in 1982, the HRS was amended in December 1990, effective March 14, 1991 (55 Federal Register [FR] Number 241:51532-51667), to comply with requirements of Section 105(c) (1) of SARA to increase the accuracy of the assessment of relative risk.

The HRS score for NAS Whiting Field was generated in 1993. The score was sufficient to place NAS Whiting Field on the National Priorities List (NPL). In January 1994, the USEPA placed NAS Whiting Field on a proposed list of sites to be included on the NPL (40 CFR 300; FR, 18 January 1994). On May 31, 1994, NAS Whiting Field was placed on the NPL effective June 30, 1994 (40 CFR 300; FR, 31 May 1994). As a result, this RI for NAS Whiting Field follows the requirements of the NCP and regulatory guidance for conducting RI/FS programs under CERCLA (USEPA, 1989). Also, per CERCLA Section 121(d), the Navy follows as appropriate, Applicable or Relevant and Appropriate Requirements of the State of Florida for IR program activities at NAS Whiting Field.

1.2.2 NAS Whiting Field Facility Description

NAS Whiting Field is located in Santa Rosa County, in Florida’s northwestern coastal area, approximately 5.5 miles north of Milton and 25 miles northeast of Pensacola (see Figure 1-1). Mobile, Alabama is approximately 79 miles west of NAS Whiting Field, and Tallahassee, is roughly 174 miles to the east. NAS Whiting Field is the home of Training Air Wing Five and was constructed in the early 1940s. The facility was commissioned as the Naval Auxiliary Air Station Whiting Field in July 1943 and since then has functioned as a naval aviation training facility. The facility’s mission is to train student naval aviators in the use of basic instruments, formation, and tactical phases of fixed-wing and propeller-driven aircraft and in the basic and advanced portions of helicopter training. NAS Whiting Field is approximately 3,842 acres and consists of two airfields (North and South) separated by various buildings housing supporting operations and staff. The North Field is used for fixed-wing aircraft training, and the South Field is used for helicopter training. Figure 1-2 presents the facility layout and the aerial extent of Site 40, along with monitoring well locations. Figure 1-3 presents the facility surface features, including the North and South Field runways, central mission support areas with administration buildings, hangars, etc. and concrete lined and unlined ditches designed to convey storm water away from the facility to Clear Creek to the west and Coldwater Creek to the east.

Land surrounding NAS Whiting Field consists primarily of agricultural land to the northwest, residential and forested areas to the south and southwest, and forests along the remaining boundaries. The central area of the facility is located on an upland area with elevations ranging from 150 to 190 feet above sea level. The facility is partially bounded to the west by Clear Creek with an average elevation of approximately 40 feet above sea level, which is significantly lower than the upland area. Clear Creek and Big Coldwater Creek are tributaries of the Blackwater River. The Blackwater River discharges to the estuarine waters of the East Bay of the Escambia Bay coastal system. The FDEP classifies both Clear Creek and Big Coldwater Creek as Class III Waters for Recreation-Propagation and Management of Fish and Wildlife. Blackwater River is classified as Outstanding Florida Water. Outstanding Florida Waters are considered to be of exceptional recreational and ecological significance.

NAS Whiting Field is located in the Western Highlands subdivision of the Coastal Plain physiographic province. The facility is located on a plateau characterized by low valleys to the east and west. The western valley has an average drop in elevation of approximately 140 feet is deeply incised by streams and man-made concrete lined ditches terminating at Clear Creek.

1.2.3 NAS Whiting Public Potable Water Description

All potable and industrial water supplies at NAS Whiting field are obtained from the sand-and-gravel aquifer. This aquifer extends from the water table surface to approximate depth of 300 feet below land surface (bls). NAS Whiting provides water to facility personnel from three production wells: W-N4, W-W3, and W-S2. Current average pumping capacities from the facility production wells include: the North Well (W-N4), 340 gallons per minute (gpm); West Well (W-W3), 500 gpm; and the South Well (W-S2) 320 gpm. Water can be pumped from the wells at 300 to 500 gallons per minute by 50 horse power pumps (Figure 1-2).

The North, West, and South Wells are screened from 156 to 230, 179 to 200 and 160 to 202 feet bls, respectively, and are terminated at the bottom of the screened intervals. The top of the screened interval for each well is approximately 50 feet below the surface of the sand-and-gravel aquifer (Table 1-1).

Until 1986, untreated groundwater was pumped from the three wells and distributed across the facility. Based on need, the water was distributed to areas of use or piped into one of four holding tanks for later distribution. The well pumps are controlled manually, turned on or off based on observation of holding tank levels or gallons pumped.

On November 26, 1985, trichloroethene (TCE) was detected at a concentration of 4.0 micrograms per liter (μg/L) in water from the South Well. This is greater than the FDEPs drinking water standard of 3.0 μg/L. Two follow-up sampling events in December 1985 detected TCE and benzene at average concentrations of 3.3 μg/L and 0.7 μg/L, respectively. Subsequent to these detections quarterly sampling was instituted (Navy Letter to FDEP, 28 January 1986). Benzene was detected in the South Well in three of the following four quarterly sampling events exceeding the FDEP primary drinking water standard of 1 μg/l. These findings prompted FDEP to request the closure of the South Well until the concentration of contaminants could be controlled through treatment (FDEP letter to the Navy, 28 August 1986).

In September 1986, FDEP requested the West Well be removed from service after TCE was detected at a concentration of 7.9 μg/L exceeded the FDEP primary drinking water standard of 3 μg/L. The South Well had been resampled during the same time period and benzene was detected at a concentration of 29.6 μg/L (FDEP, 1986). In October 1986, the facility contracted an engineering firm to study the public water distribution system and provide possible solutions (Navy, 1987). In September 1987, FDEP issued a permit for the installation of a granular activated carbon (GAC) absorption system for the West Well as well as a permit allowing NAS Whiting Field employees to operate the GAC system once installed. The Whiting Field water supply system operated from the North Well throughout most of 1987. Testing of the GAC system effluent demonstrated the adequacy of the system. Testing and verification of the treatment system of the West Well began on 3 November, 1987, and was completed 1 December, 1987. Subsequently, the West Well was returned to service with additional treatment by chlorination, pH adjustment, and addition of a sequestering agent to reduce iron precipitation. The South Well underwent the same process and was returned to service in early 1990.

Currently, groundwater is pumped from the three wells into one of two 10,000-gallon GAC tanks where the groundwater is treated prior to distribution across the facility. Distribution is demand-based. Treated water is delivered to the tap for immediate use or into one of four holding tanks for later distribution. The treated water is used for consumption, cleaning, and other typical non-restricted uses.

Untreated influent groundwater is sampled from stop-cock style valves and analyzed for volatile organic compounds (VOCs) and ethylene dibromide (EDB) on a quarterly schedule. To assure the groundwater is treated sufficiently prior to distribution, the GAC-treated effluent water is sampled monthly and analyzed for VOCs and EDB. Biannually water is collected from partial treatment ports located along the side of the GAC tanks representing 45 percent, 56 percent and 67 percent progress through the GAC containment tank. This analysis schedule meets the requirements of FDEP Chapter 62-550, F.A.C., Drinking Water Standards, Monitoring, and Reporting. The Navy is required to report the analytical monitoring results to FDEP, which in turn maintains the results in the OCULUS database. The FDEP supported data base OCULUS (http://wrmedms.dep.state.fl.us/Oculus/) is available for public access.

Analytical results of the untreated influent and treated effluent are provided in Appendix A. Analysis of the data show that the solvent dichloromethane (methylene chloride) was detected exceeding the FDEP criteria of 5.0 µg/L on December 2nd, 2004 from the influent or untreated groundwater samples collected from the North, West, and South Wells at 6.7, 8.5, and 7.4 µg/L respectively. These findings are suspect due to their singular occurrence on one date in three different wells hundreds of feet apart. These detections are likely due to laboratory error rather than an actual increase of this solvent in groundwater. The public drinking water system has not been out of compliance with FDEPs Rule 62-550.500(7) (a) F.A.C. at any other time.

1.2.4 Site 40 Description

Site 40 was designated in 1999 and includes all groundwater underlying the NAS Whiting Field property boundary (see Figure 1-2). Site 40 was created for the ease of addressing the two large commingled groundwater plumes underlying several IR sites in the facility's north and south central areas. In this report, these plumes are addressed as separate individual units. It is likely these plumes have multiple potential source areas.

This is a departure from the typical site where a boundary is established and all soils and groundwater within that boundary are part of the site, with soil and groundwater addressed as one site. Site 40 is differentiated from overlying sites by the water table. A plume within Site 40 may be either within the boundary of an overlying site or have migrated outside of any overlying site boundary. As will be demonstrated, not all designated IR or UST sites leach contaminants to Site 40. The thick vadose zone attenuates contaminants during the infiltration process. Many contaminants do not reach the water table or reach groundwater at such low concentration; they do not pose a risk to human health or environment.

In addition to the IR Sites listed in Table 1-2, UST sites are also listed because these sites may release petroleum compounds that impact the groundwater of Site 40. Sites 4 and 7 have been in both the IR and UST programs. Currently, soils at Sites 4 and 7 are classified as UST sites. The groundwater beneath these sites is a part of Site 40. The UST sites listed below are included in this Site 40 RI Report because they have a potential to leach contaminants affecting the overall condition of Base-Wide Groundwater.

Site:	Description:
• Site 4	North aviation gasoline (AVGAS) Tank Sludge Disposal Area
• Site 7	South AVGAS Tank Sludge Disposal Area
• Product Line	Product Line Junction, Pump Station, and Dispensing Facility
• 1438/1439	AVGAS Tanks 1438 and 1439
• 2832	AVGAS Pipeline, Section E, at Building 2832
• 2394	Building 2894 Pumping Station
• OWS 2993	Oil/Water Separator (OWS)

As a result of previous work, twenty-four sites have been designated with a No Action (NA), No Further Action (NFA), or have land use controls (LUCs) or engineering controls (ECs) and a signed Record of Decision (ROD) (see Table 1-2). The ROD for each of the 24 sites specifies that the leaching of contaminants from soil to groundwater will be addressed by the Site 40 Base-Wide Groundwater Investigation (this report). Sites 3, 4, 5, 6, 7, 30, 32, and 33 are all potential contributors to groundwater contamination from a source or sources overlying Site 40 groundwater plumes that have not been precisely located.

1.2.5 Areas of Investigation

In order to simplify the discussion of Site 40, it has been divided into four study areas; namely the Northern, North Central, South Central, and the Southern Areas (Figure 1-2).

The Northern Area consists of four IR Sites and two Military Munitions Response Program (MMRP) sites:
1) The Northwest Disposal Area, Operable Unit (OU) 01 or Site 1
2) The Northwest Open Disposal Area, OU 02 or Site 2
3) The Crash Crew Training Areas, A and B OUs 16 and 17 or Sites 17 and 18 respectively
4) Former Golf Course Maintenance Building (Bldg. 2877), OU 23 or Site 38,
5) The Former Gunnery Area and,
6) The Skeet Range.

These sites all have RODs for surface soil except the Former Gunnery Area and a Skeet Range, both of which remain under investigation.

The North Central Area (NCA) consists of three IR and eight petroleum sites. The three IR sites include:
1) The Underground Waste Solvent Storage Area, OU 03 or Site 3
2) The North Field Maintenance Hanger, OU 20 or Site 32
3) The Former Pesticide Storage Building 1485C, OU 27 or Site 41.
The IR sites all have RODs.

The eight petroleum-related sites include:
1) The North AVGAS Tank Sludge Disposal Area Site 4 (also previously designated as UST Site 1467),
2) The AVGAS Pipeline-Section E, or Site 2832,
3) Site 2894, Bulk Storage Facility Pump House, (initially referred to as Site 2891)
4) Site 1438/1439 (previously designated UST Site 7),
5) The Oil/Water Separator (OWS Building 2993),
6) The Product Line Dispensing Facility,
7) The Product Line Pump Station, and
8) The Product Line Junction.

The South Central Area (SCA) consists of 10 IR sites and one petroleum site. The IR sites include:
1) The Battery Acid Seepage Pit, OU 05 or Site 5
2) The South Transformer Oil Disposal Area, OU 06 or Site 6
3) The Southwest Landfill, OU 14 or Site 15
4) The Open Disposal and Burning Area, OU 15 or Site 16
5) The Auto Hobby Shop, OU 26 or Site 29
6) The South Field Maintenance Hangar, OU 18 or Site 30
7) The Midfield Maintenance Hangar Site, OU 21 or 33
8) The Public Works Maintenance Facility, OU 22 or Site 35
9) The Auto Repair Booth, Site 36 and,
10) The Paint Spray Booth, Site 37.
The SCA IR sites all have RODs for surface soil except Site 36s and 37 which were closed with no action.

The petroleum-related site is the South AVGAS Tank Sludge Disposal Area, Site 7 which was previously designated as UST Site 1466, and is a soil-only UST site.

The Southern Area consists of seven IR sites and one UST site. The seven IR sites include:
1) The Waste Fuel Disposal Area, OU 08 or Site 9
2) The Southeast Open Disposal Area A, OU 09 or Site 10
3) The Southeast Open Disposal Area B, OU 10 or Site 11
4) The Tetra ethyl Lead Disposal Area, OU 11 or Site 12

5) The Sanitary Landfill, OU 12 or Site 13
6) The Short-Term Sanitary Landfill, OU 13 or Site 14 and,
7) The Sludge Drying Beds and Disposal Areas, OU 19 or Site 31 Areas A through F (six Sites).
The Southern Area IR sites all have RODs for surface soils.

The petroleum-related site is the AVGAS Fuel Spill Area, Site 3054 which was previously designated IR Site 8. Site 3054 is closed. Detailed information is provided in Section 2.4.5.

The Clear Creek Floodplain is designated OU 24 or Site 39 and is located topographically and hydrogeologically downgradient of Site 40. Site 39 receives and is affected by groundwater that discharges from Site 40 to Clear Creek. Site 39 is being addressed by a separate IR and is not discussed in this report.

Two large commingled TCE and benzene, toluene, ethylbenzene, and xylene [BTEX]) groundwater plumes underlie the NCA and SCA and are the result of contaminants from several adjacent or nearby IR and UST sites leaching to groundwater.

1.3 CONCEPTUAL SITE MODEL

Based on interpretation of previously collected data, a CSM was developed for Site 40. The CSM integrates information regarding the physical characteristics of the site, exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify potential exposure routes and receptors to be evaluated in the risk assessment. A well-defined CSM allows for a better understanding of the risk to human and ecological receptors at a site and aids in identifying the need for remediation. If there is a requirement of remediation, the CSM is the basis for defining the Remedial Action Objectives and can be used to expose data gaps.

The CSM is developed over time as additional site-related information is collected. For example, a CSM is typically drafted during RI scoping and is refined as RI data is interpreted. This allows for an iterative refinement of the CMS through time. A more detailed CSM is presented in Section 5.0, Contaminant Fate and Transport, of this RI Report. The following components of the initial Site 40 CSM are described in the following sections and are presented as Figure 1-4.

- Site sources of contamination
- Contaminant release mechanisms
- Transport/migration pathways
- Exposure routes
- Potential receptors

1.3.1 Site 40 Sources of Contamination

Groundwater contamination associated with NAS Whiting Field is the result of past chemical and fuel storage, waste disposal, general maintenance and repair, and/or grounds keeping practices at the facility. Contaminants associated with these activities include waste solvents, paints, paint thinners, oils, hydraulic fluids, polychlorinated biphenyls (PCBs), pesticides, fuel sludge, and various aviation fuels. These materials are found in soils at sites due to spills and leaks as well as at sites where disposal occurred in landfills and at training areas and burn pits in firefighting training areas.

It should be noted that the contaminants contributed by industrial activities at NAS Whiting Field have varied over time and reflect changes in technology and regulatory criteria. Best management practices and compliance with FDEP and USEPA rules and regulations have reduced the amount of hazardous materials being released to the environment.

1.3.2 Contaminant Release Mechanisms

Waste materials were routinely disposed of within designated areas and within specific periods of time. Some of these materials may not have been properly contained within the disposal areas and waste piles. As a result, these contaminants could have been released to underlying soil and leach to groundwater. Additionally, there are several UST sites and associated distribution systems within the North and South Central Areas of the facility where leaks or spills have occurred and where tank sludge was buried in areas adjacent to UST facilities. Lastly, materials such as fuels and maintenance fluids were in inadvertently released at the facility because of accidental spills or equipment failures.

1.3.3 Transport/Migration Pathways

Potential contaminant migration pathways at NAS Whiting Field exist in the form of leaching contaminants from soil to groundwater and the flow of contaminants with the groundwater to surface water bodies. The General Information Report (GIR) (ABB Environmental Services, Inc. [ABB-ES], 1998a, Appendix B) includes shallow and deep aquifer zone water table maps that were produced to illustrate base-wide water table contours. These maps are based on groundwater data collected in multiple water level measuring events that span 1993 and 1994. Because the water level data collected during the time of investigation was similar, only two maps are presented in the GIR. These maps show that groundwater flows in a southerly to southwesterly direction in the western part of the facility towards Clear Creek. In the southern area of the facility, groundwater flow is to the south. Dissolved groundwater plumes beneath NAS Whiting Field flow in a southwesterly direction to recharge Clear Creek and its floodplain, which is Site 39.

1.3.4 Exposure Routes (Human Receptors)

NAS Whiting Field is an active facility and will remain active for the near future. Direct access to Site 40 groundwater, located beneath the active areas, is 100 feet bls or greater. Therefore, it would be a rare event for the average worker or visitor to have direct access to untreated groundwater. A secondary consideration, however, is exposure to treated groundwater that is pumped by water supply wells from areas adjacent to known plumes and is provided for the facility personnel at the tap for unrestricted use. Exposure to treated groundwater is evaluated in the Human Health Risk Assessment (HHRA) found in Section 6.0 of this RI Report. An additional contact point would be the upwelling of groundwater as it discharges to Clear Creek. This scenario has been evaluated in the Site 39 RI (Tetra Tech, 2010b).

1.3.5 Exposure Routes (Ecological Receptors)

Complete biota exposure pathways for Site 40 Base-Wide Groundwater are evaluated in the Ecological Risk Assessment (ERA) section (Section 7.0) of this report, which determined there is no direct exposure pathway to groundwater primarily due to the vadose zone barrier. As an indirect exposure pathway, however, Site 40 groundwater upwells into the Clear Creek floodplain, which is Site 39

1.3.6 Potential Human and Ecological Receptors

Based on current and potential future groundwater use from Site 40, periodic visitors and permanent users of the treated water dispensed by the facility are considered the only potential receptors that might be exposed to contaminated groundwater. The risk would be incurred if a treatment failure incident occurred. Risks under these conditions are evaluated for these receptors in the (HHRA) presented in Section 6.0.

1.4 REPORT ORGANIZATION

The RI Report is organized into nine sections. Section 1.0 presents the purpose and regulatory setting for the RI at NAS Whiting Field. Section 2.0 summarizes the site history, site description, and previous investigations. Section 3.0 presents the investigation methodology utilized to conduct the assessment. Section 4.0 presents the investigative results of the assessment. Section 5.0 describes contaminant fate and transport. Section 6.0 presents the HHRA. Section 7.0 presents the ERA. Section 8.0 provides a summary of the conclusions and recommendations. Section 9.0 presents professional review certification. The following appendices are included:

- Appendix A contains the Public Drinking Water Supply Analytical Results 2002-2005, 2008-2012
- Appendix B contains the General Information Report and other Supplemental Reports
- Appendix C contains the Potable Well Survey Report (EDR)

- Appendix D contains the Well Index, Boring Logs and Water Level Data
- Appendix E contains the Data Validation Reports
- Appendix F contains the Raw analytical Data
- Appendix G contains Tables and Graphs of BTEX and TCE Trends
- Appendix H contains the Leachate Infiltration Study and Data
- Appendix I contains the FDEP April 11, 2001, Letter and Inorganics in Soil Analysis
- Appendix J contains the Human Health Risk Tables
- Appendix K contains the Ecological Risk Files
- Appendix L contains the EPA and FDEP Response To Comments

2.0 STUDY AREA FEATURES AND PREVIOUS INVESTIGATIONS

This section provides a summary of the surface feature characteristics of the terrain overlying Site 40, meteorology, regional and local geology, description of aquifers, and an overview of previous investigations at NAS Whiting Field.

2.1 EXISTING SURFACE FEATURES

NAS Whiting Field is located on a plateau that is approximately 195 feet above mean sea level (msl) and bounded by lower-lying Clear Creek to the west and Big Cold Water Creek to the east. The western boundary of NAS Whiting Field slopes to an elevation of approximately 30 feet above msl at the eastern boundary of Clear Creek. The eastern boundary of NAS Whiting Field slopes very gradually to an elevation of approximately 30 feet above msl at the western boundary of Big Cold Water Creek. Clear Creek and Big Cold Water Creek discharge either directly to Blackwater River or to a tributary of the Blackwater River that discharges to the estuarine waters of the East Bay of the Escambia Bay coastal system (see Figures 1-2 and 1-3).

2.1.1 Northern Area Surface Features

The Northern Area at NAS Whiting Field includes the following surface features: the North Field airplane runways, taxiways, ramps, and adjacent mowed grass areas that cover the majority of the land that comprises this area. Additional features on the eastern side of the Northern Area include the golf course and three shooting ranges (archery range [former skeet range], pistol range, and a closed gunnery range that is now a baseball field). Two closed landfills and two closed fire training area are located on the western margin of the North Field area. Typical land surface cover includes mowed grasses and managed pine forest with a boundary area of unmanaged mixed timber and a boundary fence.

2.1.2 North Central and South Central Areas Surface Features

The Central Area has the majority of the administration and maintenance facilities buildings that typically comprise offices for personnel administering facility operations such as flight training, flight operations (air traffic control tower), three aircraft maintenance hangars, vehicle and base general maintenance, a power generation station no longer in operation, warehouses, shopping center, housing, medical, security, fire station, etc. Other features in the Central Area include recreational areas (baseball, soccer/football fields, and quarter-mile track), parking lots, and mowed grasses. The Central Area is where the three public water supply wells are located (see Figure 2-1).

Fuel and fuel distribution are a major component in the support flight operations. In the past AVGAS was stored in two 218,384-gallon tanks located at Site 1438/1439 located on the eastern side of the industrial area. These tanks and their support systems were phased out in 1980. The distribution pipelines were abandoned in place and tanks 1438 and 1439 were removed in 1985. Prior to removal, AVGAS was distributed from this location to fueling substations at both the North (UST Site 1467 or IR Site 4) and South Fields (UST Site 1466 or IR Site 7) (Figure 2-3). The USTs located at Sites 4 and 7 were removed in 1992. Currently, JP-8 aviation fuel is stored in above ground storage tanks (ASTs) 2890 and 2891, located on the eastern side of the industrial area. Fuel is now distributed to aircraft on the parking ramp by tanker trucks.

2.1.3 Southern Area Surface Features

Structures and features associated with the Southern Area include the South Field runways, taxi ways, ramps, and adjacent mowed grass areas that cover the majority of the land comprising this area. Additional features on the eastern side of the Southern Area are six closed landfills. Surface features on the western side of the Southern Area include two closed landfills, one active fire training area, and a waste water treatment plant that is no longer in operation. Typical land surface cover includes mowed grasses and managed pine forest with a boundary area of unmanaged mixed timber and a boundary fence.

2.2 METEOROLOGY

The climate of northwestern Florida is generally humid and subtropical with warm summers and mild winters. The average summer temperature is 81 degrees Fahrenheit (°F), while the average winter temperature is 54 °F. Historically, average rainfall is approximately 66 inches. The western panhandle of Florida is subject to relatively frequent occurrences of tropical storms during the Hurricane Season (June – November).

Annual mean precipitation in the NAS Whiting Field area from 1987 to 1998 was 67.58 inches with an annual high of 105.48 inches and a low of 41.76 inches of rainfall. Beginning in about 1998, draught conditions began. Since then, the mean annual precipitation in the NAS Whiting Field area from 1999 to 2007 decreased to an average of 25.425 inches with an annual high of approximately 35 inches and a low of approximately 14 inches. As a result of the reduction in rainfall, the water table elevations dropped in ensuing years.

2.3 SOIL TYPES

Nine soil types are present within the boundaries of NAS Whiting Field based on a review of the Soil Survey of Santa Rosa County, Florida (U. S. Department of Agriculture [USDA], 1980). The IR sites are associated with seven of the nine soil types including Troup loamy sand, Lakeland sand, Dothan fine sandy loam, Lucy loamy sand, Orangeburg sandy loam, Bonifay sandy loam, and Bibb-Kingston soil association. A review of the soil types associated with the IR sites indicate the following five dominant soil types: Troup loamy sand, Lakeland sand, Dothan fine sandy loam, Lucy loamy sand, and Bonifay sandy loam. In addition, a review of the individual soil type descriptions indicated similarities in texture and mineral content between the Dothan fine loamy sand, Lucy loamy sand, and Bonifay loamy sand (ABB-ES, 1998a).

2.4 REGIONAL GEOLOGY

NAS Whiting Field lies in the Western Highland subdivision of the Coastal Plain Province. The Coastal Plain is primarily comprised of beds of sand, silt, limestone, and clay that dip gently seaward. The Western Highland consists of a southward-sloping plateau with a surface that has been incised by numerous streams (Marsh, 1966). A more detailed description of the regional geology is contained in Section 1.4.5 of the GIR found in Appendix B of this report.

The local geology as determined by hundreds of soil borings as described in Section 2.4.1 match well with the description of the Citronelle Formation (Marsh, 1966) that is described as lying unconformably over the lower member of the Pensacola Clay. It is likely the upper member of the Pensacola Clay is not present in the area of NAS Whiting Field. At NAS Whiting Field, the Pensacola Clay is a massive layer of dark to light gray clay typically silty with very fine to coarse micaceous quartz sand has been encountered at a depth of approximately 250 feet bls in several borings in the industrial area and is likely present across the facility. Associated carbonized wood and plant material (leaves, reeds, saw grass) have been observed in samples collected from the Pensacola Clay as well as intermittent stratum with abundant mollusk shells. These characteristics are consistent with Marsh's description of the lower member of the Pensacola Clay

2.4.1 Local Geology

A general discussion of the geologic interpretation from the land surface at approximately 185 feet msl to approximately 50 feet below msl or 235 feet bls is presented in subsection 1.4.5 of the GIR (ABB-ES, 1998a). Additional descriptions for this interval are presented in Section Three of the RI/FS Technical Memorandum No. 2 Geologic Assessment (ABB-ES, 1995a). Site-specific geologic information has also been generated during 2000, 2007, and 2010 investigations by the installation of monitoring wells that penetrate this interval.

In brief, the stratigraphy consists principally of lightly colored quartz sand (white to tan to orange to red-orange) that contains lenses, beds, and stringers of silty or sandy clays or a combination of silty sandy clays. Beds can be poorly graded sand beds or stratum (fine- to medium-grained) with interstitial silts and clays as well as silty sand and clay beds or well-structured finning upwards sequences. These sand and clay beds are not usually aerially extensive and are frequently interbedded with silt and clay beds with similar color schemes. The quartz sands grains are typically angular to subangular and are geologically very poorly sorted ranging from very fine- to very coarse-grained.

Sand beds above clays may form indurate limonite-cemented sandstone up to 12 inches thick having the color of iron or rusted iron. This limonite-cemented sandstone type rock is frequently found on and near the land surface and was found at depth in several borings, and also immediately above the Pensacola Clay. The oxidized color scheme continues down to the top of the Pensacola Clay. The lithology and stratification of the material encountered at NAS Whiting Field are consistent with the description of the Citronelle Formation (Marsh, 1966; Scott, 1992; ABB-ES, 1992a; ABB-ES, 1995a) (see Figure 2-2).

The sedimentary patterns described above are typically associated with a fluvial or riverine deposition. As such, sand or clay beds may be continuous over several or tens of acres. Due to the nature of the depositional processes; however, lack of correlation over even short distances indicates these beds were frequently truncated by post deposition erosion during the ongoing fluvial erosional and depositional processes. Clay beds within the Citronelle Formation have been extensive enough to confidently map over small areas but frequently: are discontinuous, not located at consistent depths, and cannot be confidently traced between borings. Therefore, they are not believed to be significant or massive subsurface features (ABB-ES, 1995a).

The upper surface of the Pensacola Clay was thought to have been penetrated during the process of installing two deep wells at Sites 15 and 16 in the mid-1990s; however, the amount of data generated was insufficient to conclusively determine the clay encountered was the Pensacola Clay. Subsequently, two additional deep wells were installed in the late 1990s (WHF-30-MW-3D South Field and WHF-32-MW-3D North Field) again encountered what appeared to be the same clay at a distance of 2000 and 5000 feet (ABB-ES, 1998a).

The installation of an additional 15 deep borings or monitoring wells installed in 2000 that also encountered the clay over a wide area provided sufficient data to allow better definition of the upper surface and conclude the unit was the Pensacola clay. The massive grey fossiliferous clay encountered at NAS Whiting is interpreted as the Pensacola Clay and is typically found from approximately 250 feet bls or 50 to 75 feet below msl at the facility. The Pensacola Clay is of marine origin and is extensive over a large region. The Pensacola Clay underlies all of NAS Whiting Field and is considered a confining unit with very low permeability (Hayes and Barr, 1983). This data was collected from borings penetrating to just below the top and up to 225 feet into the Pensacola Clay (see Figure 1-4).

2.4.2 Aquifers and Hydrogeology

A general discussion of surface water, the aquifer system, and water supply wells at NAS Whiting Field is presented in Subsection 1.4.6 of the GIR (ABB-ES, 1998a). The sand-and-gravel aquifer is the only aquifer studied in the NAS Whiting Field IR program. Virtually all of the groundwater used in Santa Rosa County is drawn from the sand-and-gravel aquifer. In August of 2011, Tetra Tech ordered an Environmental Data Resources (EDR) GeoCheck® Report to determine if public water supply wells were known to be within a two mile radius outside of the facility. The report did not identify public water supply wells within a two mile radius outside of the facility (see Appendix C).

The surficial water-bearing aquifer within Santa Rosa County is primarily comprised of sand, gravel, silt, and clay and is approximately 200 to 350 feet thick near NAS Whiting Field. Often times the clay layers are interbedded within the sand-and-gravel aquifer and act as semi-confining units. Groundwater within the shallow aquifer beneath the industrial area moves laterally in a southwesterly direction until it discharges to Clear Creek, the floodplain, or other surface water features (ABB-ES, 1998a).

Groundwater pH is low in the region as well as at NAS Whiting Field. The pH measured in the background wells in years 1993 and 1996 ranged from 4.86 to 5.78 with a median pH of 5.20. The groundwater pH has a median value of 5.18 with a minimum pH of 4.21 and a maximum pH of 6.18 during the 2000 to 2011 groundwater sampling events, which reflect a large number of wells located base-wide with many sampled with pH measurements collected two to three times. The pH value of Clear Creek, which receives recharge from the larger local area including NAS Whiting Field, had a median value of 5.16 with a minimum pH of 4.34 and a maximum pH of 6.21 (Tetra Tech, 2010a).

The median pH values reported above are outside the lower end of the USEPA SDWS range. This condition was noted by the United States Geological Survey (USGS), “Water in the aquifer is usually slightly acidic, with a pH of about 6.0; locally, the water is more acidic (pH 4.5). Dissolved iron concentrations may locally be objectionable; concentrations as large as 4,300 milligrams per liter have been reported” (USGS, 2009).

Typically, as groundwater pH decreases, metals solubility increases. As a result of the lower than normal pH values found in groundwater, for aluminum, arsenic, iron, manganese, and vanadium are at slightly elevated concentrations. These elevated concentrations are likely the direct result of higher solubility than in a typical aquifer. “In the case of heavy metals, the degree to which they are soluble determines their toxicity. Metals tend to be more toxic (available at higher concentrations) at lower pH because they are more soluble" (USGS http://ga.water.usgs.gov/edu/phdiagram.html). There are no sites at NAS Whiting Field that would release these five metals such that they would be found hydrogeologically upgradient and throughout the northern boundary of the facility.

The recognition that these metals (aluminum, arsenic, iron, manganese, and vanadium) are present in both soil and groundwater at concentrations that exceeded regulatory criteria and found across the facility both up and down gradient of know sites indicates they are naturally occurring. These metals are found in areas where facility activities could not have cause an impact by these metals.

2.4.3 Historical Hydrogeological Information

An overview of hydrogeologic information including: horizontal and vertical hydraulic gradient information is presented in subsection 3.2.4, hydraulic conductivity and flow velocities are presented in Subsection 3.2.2 of the GIR (ABB-ES, 1998a). Additionally, several other previous reports listed below provide geologic and hydrologic information:

- GIR (ABB-ES, 1998a)
- Phase I Technical Memorandum No. 2 Hydrogeologic Assessment (ABB-ES, 1992b)
- IR and FS Technical Memorandum No. 2 Geologic Assessment (ABB-ES, 1995a)
- IR and FS Phase II-A Technical Memorandum No. 4 Hydrogeologic Assessment (ABB-ES, 1995b)

The Phase I Technical Memorandum No. 2 Hydrogeologic Assessment (ABB-ES, 1992b) report provides data on the results of a pump test, a series of water table surface and groundwater flow direction maps, and analysis of horizontal and vertical gradients of the surficial aquifer at NAS Whiting Field.

The GIR includes shallow and deep aquifer zone potentiometric maps that were produced to illustrate base-wide groundwater contours. These maps are based on groundwater data collected in multiple water level measuring events that span 1993 and 1994 (ABB-ES, 1998a). The shallow water table map and the deep aquifer zone potentiometric map show groundwater on the western side of the facility flows primarily in a south to southwesterly direction towards Clear Creek. To the east of this area, a ground water divide is found that is oriented northwest/southeast through the eastern edge of the northern industrial area. To the east of the divide groundwater flow is primarily to the southeast toward Big Coldwater Creek. In the southern area of the facility groundwater flow is to the south (ABB-ES, 1998a).

2.4.4 Hydraulic Conductivity

Hydraulic conductivity tests consisted of multiple slug tests of several monitoring wells and a two pumping test at installation production wells.

The slug tests consisted of both rising- and falling-head tests and have been conducted on 15 selected monitoring wells located at 13 different sites across NAS Whiting Field. Two to three slug tests were conducted at each location to provide a statistical average of the estimated radial hydraulic conductivity (K) of the aquifer in the vicinity of a piezometer or monitoring well screened interval. A summary of the slug test data is presented in Table 3-3 of the ABB-ES (1992) report. Individual records of the slug test calculations are provided in Technical Memorandum No. 4 Hydrogeologic Investigation (ABB-ES, 1995b).

A six day pump down test of the southern production well involved obtaining water level information from four groundwater monitoring wells and/or piezometers were conducted in 1991. Monitoring wells WHF-5-OW-1D, WHF-5-PZ-1I, WHF-5-PZ2I, and WHF-5-MW-3I and the south production well were observed during a pump test. Following the termination of the pump down-portion of the test, aquifer recovery data were collected from the five monitoring locations during the seven-day recovery period. The pump test data was evaluated using the leaky aquifer (Hanstush and Jacob, 1955) and delayed drainage (Boulton, 1955) methods to provide estimates of the transmissivity, hydraulic conductivity and storativity of the sand-and-gravel aquifer. Calculated transmissivity values ranged from 10,000 to 20,000 square feet per day. The range of lateral hydraulic conductivity is approximately 100 to 150 feet per day, and storativities ranged from 0.045 to 0.08 (unitless) (ABB-ES, 1992a).

A summary of the pumping test data is presented in Appendix A of the RI Phase I Technical Memorandum No. 2, Hydrogeologic Assessment (ABB-ES, 1992b).

2.4.5 Horizontal and Vertical Groundwater Gradients

Estimated horizontal hydraulic gradients across the facility typically range from 0.0039 foot per foot to 0.0048 foot per foot. With the exception of Sites 29 and 30, horizontal hydraulic gradients for all other sites were within the same order of magnitude. The values at Site 30 were one order of magnitude lower than this range, and the values at Site 29 were one order of magnitude higher. The data used to determine horizontal gradients were collected from wells not influenced by public supply wells. Estimated vertical hydraulic gradients across the facility typically range from 0.0486 to 0.0006 foot per foot. The vertical direction of flow in the upper 100 feet of the sand-and-gravel aquifer is predominantly downward (ABB-ES, 1992b). Upward flow was observed in six well clusters (Sites 5, 6, 14, 15, and 16). Three of the clusters (at Sites 5 and 15) exhibited a reversal of the vertical hydraulic gradients calculated for each of the individual sites. Horizontal and vertical hydraulic gradients described above are detailed in section 3.2.4 of the GIR (ABB-ES, 1998a).

2.5 POTENTIAL SOURCES

Previous base activities generated a variety of wastes related to pilot training, the operation and maintenance of aircraft and ground support equipment, and the station's facility maintenance activities throughout its years of operation as described in Section 1.0. Interviews with facility personnel and reviews of the records indicated that before the 1970s and the establishment of hazardous waste programs, most of the hazardous waste was disposed of at various locations on-site. Waste materials were disposed of either in dumpsters that were emptied into on-site disposal areas or in waste oil bowsers that presumably were used for fire-fighting training. Wastes including waste paints, paint thinners, solvents, waste oil, waste gasoline; hydraulic fluids, AVGAS, tank bottom sludges, PCB transformer fluids, and paint stripping wastewater were potentially dumped into on-site disposal areas. These disposal areas consisted of natural or man-made depressions located within the confines of NAS Whiting Field. In addition to the waste materials routinely disposed of on site in the disposal areas, additional materials were reportedly released on site as the results of accidents or equipment failures. AVGAS and JP-8 were released at multiple locations due to tank and pipe line failures.

Site 40 contaminants that exceed USEPA and FDEP groundwater standards VOCs, SVOCs, pesticides, and metals. Two large commingled groundwater plumes that cover approximately 136 acres were delineated during this Site 40 RI. One major commingled plume is located in the NCA and includes BTEX and TCE. The other mixed plume is located in the SCA and is composed of BTEX and TCE. A smaller separate BTEX plume is located on the east side of the industrial area beneath Site 1438/1439. The two commingled plumes (as defined by groundwater samples collected in 2008) and the plume from Site 1438/1439 (as defined by groundwater samples collected in 2000) are represented on Figure 2-3. Groundwater associated with these three plumes flows primarily in a southwesterly direction.

2.6 PREVIOUS INVESTIGATIONS

Investigation of groundwater at NAS Whiting Field began in 1985 and has continued to the current day. The following list provides an overview of investigative events followed by additional information about each event. It should be noted that various phases of investigation and resultant reports overlap due to the review and rewrite process.

- Initial Assessment Study (IAS), 1985
- Phase I RI, December 1990 to May 1991

- Phase II-A RI, April 1992 to February 1994
- UST Investigations, 1991 to 1994
- Phase II-B RI, August 1996 to June 1997
- Phase II-C RI, August 1996 to June 1998

2.6.1 Initial Assessment Study, 1985

Historical records were reviewed during the IAS (Envirodyne Engineers, Inc., 1985) by conducting a records search. The records search indicated that throughout its years of operation, NAS Whiting Field generated a variety of wastes related to pilot training, the operation and maintenance of aircraft and ground support equipment, and the facility maintenance programs. Wastes, including waste paints, paint thinners, solvents, waste oils, waste gasoline, hydraulic fluids, AVGAS, tank-bottom sludges, PCB transformer fluids, and paint stripping wastewater were potentially dumped into on-site disposal areas. These disposal areas consisted of natural or man-made depressions located within the confines of the facility. Additional materials were reportedly released on-site as the result of accidents or equipment failure.

Based on a review of historical data, aerial photographs, field inspections, and interviews with facility personnel, 15 sites requiring further investigation including sampling and monitoring to confirm the presence or absence of suspected contamination and to further quantify the extent of any environmental problems. The following recommendations were made in the IAS and are relevant to the sites addressed in this RI.

2.6.2 Verification Study, 1985 to 1986

The results of the Verification Study (Geraghty and Miller, 1986) provided an assessment of the physical and chemical conditions at NAS Whiting Field. A brief description of the site assessments performed for Sites 3, 4, and 6 during the Verification Study is presented below.

2.6.2.1 OU 03 – Site 3

At Site 3, a soil boring was drilled and split-spoon core samples were collected at 5-foot intervals to a total depth of 25 feet bls. The only organic analytes detected in the soil samples were phenols at the surface, which were attributed to vegetative matter in the soil. Of the nine metals analyzed, only zinc, chromium, silver, cadmium, and mercury were detected. Zinc, chromium, and cadmium concentrations decreased to nondetectable levels with depth; however, silver and mercury were detected to 25 feet bls.

Additionally two monitoring wells (WHF-3-1 and WHF-3-2) were installed near the USTs at a depth of approximately 153 feet bls. Groundwater samples were analyzed for USEPA priority pollutants. Except for trace concentrations of arsenic and lead, priority pollutants were not detected in the groundwater samples collected from monitoring well WHF-3-2. Three VOCs (1,1,1-trichloroethane [TCA] at 13 µg/L; 1,1,2-TCA at 111 µg/L; and TCE at 18 µg/L] were detected at concentrations that exceeded their federal and state Maximum Contaminant Levels (MCLs) at monitoring well WHF-3-1.

2.6.2.2 OU 04 – Site 4

At Site 4, 28 surface soil samples were collected and mixed to produce one composite sample during the 1986 Verification Study. This sample was split into two parts, and each was analyzed for total lead content and Extraction Procedure Toxicity (EP Tox) for lead. Laboratory analytical results of the extent of soil samples contained total lead concentrations at 15 and 27 milligrams per kilogram (mg/kg). Lead was not detected in the EP Tox test leachate extract above the method detection limit of 0.01 milligram per liter (mg/L).

Monitoring well WHF-4-1 was installed along the southern boundary of the USTs during the 1986 study. This monitoring well was installed in the intermediate zone of the upper sand-and-gravel aquifer at a depth of 152 feet bls. One groundwater sample was collected from this monitoring well and analyzed for BTEX, naphthalene, EDB, and lead. Benzene (17 µg/L) and toluene (10 µg/L) were detected in the groundwater sample. Trace concentrations of lead were detected at concentrations below federal and state drinking water standards.

2.6.2.3 OU 06 – Site 6

At Site 6, 10 composite soil samples (sandy clay) were collected along the flanks of the paved ditch at the site during the 1986 Verification Study. The soil samples were collected from the land surface to a depth of 2 feet bls and analyzed for PCBs. PCBs were not detected at concentrations above the laboratory method detection limit of 0.2 mg/kg.

2.6.3 Phase I Remedial Investigation, December 1990 to May 1992

A phased approach was implemented to conduct RIs at the facility. Phase I of the RI began in December of 1990 to determine the nature and extent of contamination at suspect sites identified during the IAS and Verification Study. Fourteen of the 18 previously identified sites (Sites 1, 2, 3, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18) at the facility were addressed. Five additional sites (Sites 29, 30, 31, 32, and 33) were identified during the RI Phase I activities and later added to the Phase II-A program for investigation. Three of the 18 previously identified sites (Sites 4, 7, and 8 later referred to as UST Sites 1467, 1466, and 3054, respectively) were to be investigated under the UST program. A fourth site, not addressed, investigated under the UST program, was Site 5, which was under a consent order with the Florida Department of Environmental Resources (FDER), now known as the FDEP. No contamination attributable to Sites 2 and 12 was detected during the RI Phase I and NFA were proposed for both sites. Phase I was completed in May 1992 (ABB-ES, 1992a).

As a part of the RI Phase I investigation, piezocone penetrometer subsurface explorations were completed in conjunction with in situ groundwater samples collected using the Bengt-Arne-Torstensson (BAT) sampling technique. A total of 68 groundwater samples were collected from 13 sites and from the areas surrounding water supply wells (W-S2 and W-W3). The groundwater samples were analyzed for USEPA Target Compound List (TCL) VOCs and Target Analyte List (TAL) inorganics. Groundwater results from the BAT sampler were used as a screening tool to identify locations for permanent monitoring wells. The following sub sections describe Phase I activities.

2.6.3.1 Areas Surrounding Production Wells W-S2 and W-W3

Groundwater samples collected from shallow or “water table zones” surrounding the two potable water wells (W-S2 and W-W3) contained various target analytes including BTEX, cis/trans-1,2-dichloroethylene (DCE), 1,2-DCEm and TCE. These analytes were detected at concentrations exceeding their current USEPA and FDEP groundwater criteria in at least two of eight shallow groundwater samples.

BAT sampling results indicated VOCs were not detected in groundwater samples collected from the deep zone of the sand-and-gravel aquifer (180 to 183 feet bls) equivalent to the zone used by the potable supply wells. BAT sampling results indicate inorganic analytes were detected at concentrations similar to background values in both wells.

2.6.3.2 Sites 1, 2, 17, and 18

Sites 1, 2, 17, and 18 are located in the northwestern area of NAS Whiting Field. VOCs were not detected at concentrations exceeding the instrument detection limit (IDL), which was typically 10 μg/L, but occasionally ranged up to 25 μg/L in any BAT groundwater sample collected in areas of Site 1, 2, 17, and 18. Chromium was detected at a concentration exceeding its federal and state MCL of 100 μg/L and 50 μg/L, respectively. Lead was detected at a concentration that exceeded the federal standard of 15 μg/L. The other inorganic analytes detected were at concentrations similar to background values.

2.6.3.3 Sites 9, 10, 11, 12, 13, and 14

Sites 9, 10, 11, 12, 13, and 14 are located in the southeastern area of NAS Whiting Field. None of the groundwater samples contained VOCs at concentrations exceeding the IDL, which was typically 10 μg/L, but occasionally ranged up to 25 μg/L. Concentrations of chromium ranged from 88.5 to 410 μg/L;

however, only one of the samples contained chromium at a concentration exceeding its background value. Concentrations of zinc were detected in each sample at concentrations ranging from 52.4 to 281 µg/L. However, concentrations of zinc were less than its background values.

2.6.3.4 Sites 15 and 16

Sites 15 and 16 are located in the southwest area of NAS Whiting Field. Three VOCs, benzene, toluene, and xylenes, were detected in BAT samples collected from the water table zone at Site 15. VOCs were not detected in BAT samples collected from the water table zone of Site 16. VOCs detected in groundwater samples from the Site 16 deep zone included benzene, toluene, xylenes, and 1,2-dichloroethane (DCA). Benzene and 1,2-DCA exceeded their current USEPA and FDEP regulatory criteria. With the exception of one inorganic analyte aluminum, which was detected in one shallow BAT groundwater sample from Site 15, inorganic analytes were detected at concentrations similar to background values.

Based on the results from BAT groundwater sampling at all the sites, it was determined that additional groundwater investigative activities were warranted during the RI Phase II-A.

2.6.4 Phase II-A RI, April 1992 to March 1994

Based on findings of the Phase I RI, the objective of the Phase II-A RI was to evaluate the presence, nature, and extent of contamination resulting from past discharges from the various sites at NAS Whiting Field. In Phase II-A of the RI, a series of seven technical memoranda summarizing results were generated. The following is list of the technical memoranda issued:

- Phase I Technical Memorandum No. 2 Hydrogeologic Assessment (ABB-ES, 1992b)
- RI and FS Technical Memorandum No. 3 Soils Assessment (ABB-ES, 1992c)
- RI and FS Technical Memorandum No. 2 Geologic Assessment (ABB-ES, 1995a)
- RI and FS Phase II-A Technical Memorandum No. 4 Hydrogeologic Investigation (ABB-ES, 1995b)
- RI and FS Phase II-A Technical Memorandum No. 5 Groundwater Assessment (ABB-ES, 1995c)
- Industrial Area and Groundwater Investigation Interim Report Addendum (Draft) (ABB-ES, 1998b)

The report for the Phase II-A Groundwater Assessment activities was eventually titled the “Remedial Investigation and Feasibility Study Phase II-A Technical Memorandum No. 5 Groundwater Assessment” (ABB-ES, 1995c) and included the analytical results of 14 in situ groundwater samples using the BAT method, installing 76 monitoring wells at 18 sites, and collecting 125 groundwater samples from newly installed and existing monitoring wells for analysis.

The BAT investigation results showed detections of 10 VOCs in the shallow aquifer zone and seven in the deep aquifer zone. Groundwater samples from new and existing monitoring wells throughout the site had detections of VOCs, SVOCs, pesticides, PCBs, and inorganics. Site specific results (including tables) are summarized in Section 4 of the Remedial Investigation and Feasibility Study Phase II-A Technical Memorandum No. 5 Groundwater Assessment (ABB-ES, 1995c). A brief summary of the Phase II-A results is provided below.

Background Locations

Benzene and toluene were detected in 1993 at concentrations of 4 and 13 µg/L, respectively, in a groundwater sample from monitoring well WHF-BKG-MW-3S. The benzene concentration exceeds its current FDEP and USEPA regulatory criteria. Six inorganic analytes were also detected at concentrations exceeding their USEPA and FDEP MCLs. Monitoring well WHF-BKG-3S, however, has since been determined to be perched above the shallow surficial aquifer and, therefore, it has been determined it does not represent upgradient or background groundwater conditions. Additionally, as a result of its perched location, it has been dry the last two times water elevations were measured.

Volatile and semivolatile analytes were not detected in groundwater samples collected from monitoring wells WHF-BKG-MW-1S and WHF-BKG-MW-2S. Beta-benzene hexachloride (the pesticide Lindane) was detected in a groundwater sample for WHF-BKG-MW-2S at a concentration of 0.02 J µg/L, exceeding its USEPA and FDEP regulatory criteria. Bis(2-ethylhexyl)phthalate (BEHP) was detected in a groundwater sample from WHF-BKG-MW-2D at a concentration of 4.0 J µg/L, below the USEPA and FDEP regulatory criteria. The source of the beta-benzene hexachloride is likely the application of the pesticide to agricultural fields located to the north and hydrogeologically upgradient of NAS Whiting Field.

Eighteen inorganic analytes were detected in the background groundwater samples. Comparison of detected inorganic analytes to federal and state MCLs indicated that groundwater samples from monitoring wells WHF-BKG-MW-1S and WHF-BKG-MW-2S contained concentrations of aluminum, chromium, iron, and vanadium at concentrations exceeding the USEPA and FDEP Primary or Secondary MCLs.

Northern Area

Operable Unit (OU) 1 - Site 1, Northwest Disposal Area: VOCs, SVOCs, or PCB compounds were not detected in groundwater samples at concentrations exceeding their USEPA or FDEP regulatory criteria. The pesticide compound beta-benzene hexachloride was detected in groundwater samples collected from shallow and intermediate monitoring wells exceeding its USEPA and FDEP regulatory criteria. Seven inorganic analytes, including aluminum, beryllium, chromium, iron, lead, manganese, and nickel, were detected at concentrations exceeding their USEPA and FDEP regulatory criteria.

OU 2 - Site 2, Northwest Open Disposal Area: One SVOC, BEHP, was detected as a single occurrence in a shallow aquifer groundwater sample at a concentration that exceeded its USEPA and FDEP regulatory criteria. Also, three inorganic analytes aluminum, chromium, and iron were detected at concentrations exceeding their USEPA and FDEP regulatory criteria.

OU 16 - Site 17, Crash Crew Training Area A: Two SVOCs, BEHP, and di-n-octylphthalate, were detected in groundwater samples collected from shallow aquifer zone monitoring wells. BEHP exceeded its USEPA and FDEP regulatory criteria. Beta-benzene hexachloride was the only pesticide detected in the groundwater samples collected from shallow aquifer monitoring wells. Five inorganic analytes, including aluminum, chromium, iron, lead, and manganese, were detected in shallow aquifer zone groundwater samples at concentrations exceeding their USEPA and FDEP regulatory criteria.

OU 17 - Site 18, Crash Crew Training Area B: A single pesticide, 4,4-dichlorodiphenyltrichloroethane (DDT), was detected in groundwater samples from both shallow and intermediate aquifer zone exceeding their USEPA and FDEP regulatory criteria Three inorganic analytes, including aluminum, iron, and manganese, were detected in shallow aquifer zone groundwater samples at concentrations exceeding their USEPA and FDEP regulatory criteria.

North Central Area

OU 3 - Site 3, Underground Waste Solvent Storage Area: 1,2-DCE, TCE, tetrachloroethene (PCE), benzene, toluene, and ethylbenzene were detected in groundwater samples collected from shallow aquifer zone monitoring wells at concentrations that either met or exceeded their current USEPA or FDEP regulatory criteria. Additionally, VOCs were detected in intermediate aquifer zone samples and BEHP was detected in shallow, intermediate, and deep aquifer zone samples. Heptachlor epoxide was detected at a concentration that exceeded current FDEP and USEPA regulatory criteria. Aluminum, cadmium, iron, lead, and manganese were detected in shallow, intermediate, and deep aquifer zone groundwater samples at concentrations exceeding their current FDEP and USEPA regulatory criteria.

OU 4 - Site 4, North AVGAS Tank Sludge Disposal Area: TCE, benzene, toluene, and ethylbenzene were detected in shallow and intermediate aquifer zones groundwater samples collected from at concentrations that either met or exceeded their current USEPA or FDEP regulatory criteria. 1, 2-DCE and BEHP were detected in shallow aquifer zone groundwater samples at concentrations exceeding current USEPA or FDEP regulatory criteria. Pesticides and PCBs were not detected at concentrations exceeding their current FDEP and USEPA regulatory criteria. Aluminum, arsenic, cadmium, iron, lead, and manganese were detected in shallow, intermediate and deep aquifer zone groundwater samples at concentrations exceeding their current FDEP and USEPA regulatory criteria.

OU 20 - Site 32, North Field Maintenance Hangar: 1,2-DCE, TCE, benzene, toluene, and ethylbenzene were detected in shallow aquifer zone groundwater samples at concentrations that either met or exceeded their current USEPA or FDEP regulatory criteria. BEHP was detected in one shallow aquifer zone groundwater sample at concentrations exceeding current USEPA or FDEP regulatory criteria. Pesticides and PCBs were not detected exceeding their current FDEP and USEPA regulatory criteria. Aluminum, antimony, cadmium, chromium, copper, iron, lead, and manganese were detected in shallow, intermediate and deep aquifer zone groundwater samples at concentrations exceeding their current FDEP and USEPA regulatory criteria.

South Central Area

OU 5 - Site 5, Battery Acid Seepage Pit: PCE was the only VOC detected in groundwater samples collected from shallow aquifer zone monitoring wells at concentrations that either met or exceeded its current USEPA or FDEP regulatory criteria. TCE and benzene were detected in intermediate aquifer zone groundwater samples at concentrations that either met or exceeded its current USEPA or FDEP regulatory criteria. BEHP was detected in one shallow aquifer zone groundwater sample at a concentration exceeding its current USEPA or FDEP regulatory criteria. Pesticides and PCBs were not detected exceeding their current FDEP and USEPA regulatory criteria.

Aluminum, antimony, cadmium, chromium, iron, lead, and manganese were detected in shallow aquifer zone groundwater samples at concentrations exceeding their current FDEP and USEPA regulatory criteria. Cadmium was detected in intermediate aquifer zone groundwater samples at concentrations exceeding its current FDEP and USEPA regulatory criteria. Aluminum, cadmium, iron, and manganese were detected in deep aquifer zone groundwater samples exceeding their current FDEP and USEPA regulatory criteria.

OU 6 - Site 6, South Transformer Oil Disposal Area: 1,2-DCE and TCE were detected in two shallow aquifer zone groundwater samples at concentrations that either met or exceeded their current USEPA or FDEP regulatory criteria. BEHP was detected in shallow and deep aquifer zone groundwater samples at concentrations exceeding its current USEPA or FDEP regulatory criteria. PCBs were not detected at concentrations exceeding their current FDEP and USEPA regulatory criteria. Aluminum, cadmium, iron, lead, and manganese were detected in shallow aquifer zone groundwater samples at concentrations exceeding their current FDEP and USEPA regulatory criteria.

OU 7 - Site 7, South AVGAS Tank Sludge Disposal Area: TCE was detected in 10 of 11 shallow aquifer zone groundwater samples at concentrations that either met or exceed its current USEPA or FDEP regulatory criteria. Six VOCs, including vinyl chloride, 1,2-DCE, TCE, benzene, toluene, and ethylbenzene, were detected in shallow aquifer zone groundwater samples at concentrations exceeding their current USEPA or FDEP regulatory criteria. TCE was the only VOC detected in intermediate aquifer zone groundwater samples at concentrations that exceeded its USEPA and FDEP regulatory criteria. SVOCs were not detected in shallow aquifer zone groundwater samples at concentrations that exceeded their USEPA or FDEP regulatory criteria.

Aluminum, antimony, cadmium, chromium, iron, lead, and manganese were detected in shallow aquifer zone groundwater samples at concentrations that exceed their current FDEP and USEPA regulatory criteria.

OU 14 - Site 15, Southwest Landfill: VOCs were not detected in groundwater samples collected from shallow, intermediate, or deep aquifer zones at Site 15 at concentrations that exceed their USEPA or FDEP regulatory criteria. BEHP was detected in a shallow aquifer zone groundwater sample at a concentration that exceeds its USEPA and FDEP regulatory criteria. Four inorganic analytes, including aluminum, cadmium, iron, and manganese, were detected in shallow aquifer zone groundwater samples at concentrations that exceed their USEPA and FDEP regulatory criteria. Cadmium was the only analyte detected in the intermediate and deep aquifer zone groundwater samples at concentrations that exceed its USEPA and FDEP regulatory criteria.

OU 15 - Site 16, Open Disposal and Burning Area: VOCs were not detected in shallow aquifer zone groundwater samples at concentrations exceeding their regulatory criteria. Three VOCs, 1,2-DCE, TCE, and benzene, were detected in intermediate aquifer zone groundwater samples at concentrations that exceed their USEPA and FDEP regulatory criteria. BEHP was detected in shallow and intermediate aquifer zone groundwater samples at Site 16. Only the concentrations detected in the intermediate depth aquifer zone exceeded its USEPA and FDEP regulatory criteria.

Six inorganic analytes including aluminum, beryllium, chromium, iron, lead, and manganese were detected in shallow aquifer zone groundwater samples at concentrations that exceeded their USEPA and FDEP regulatory criteria. Six inorganic analytes, including aluminum, cadmium, chromium, iron, lead, and manganese were detected in intermediate aquifer zone groundwater samples at concentrations that exceeded their USEPA and FDEP regulatory criteria. Four inorganic analytes, including aluminum, cadmium, iron, and manganese was detected in deep aquifer zone groundwater samples at concentrations that exceed their USEPA and FDEP regulatory criteria.

OU 26 - Site 29, Auto Hobby Shop: Two VOCs, acetone and 4-methyl-2-pentanone (methyl isobutyl ketone), were detected in shallow aquifer zone groundwater samples at Site 29. Aluminum, antimony, cadmium, chromium, iron, lead, and manganese were detected in shallow aquifer zone groundwater samples at concentrations exceeding their current FDEP and USEPA regulatory criteria.

OU 18 - Site 30, South Field Maintenance Hangar: Three VOCs, 1,1-DCE, TCE, and benzene, were detected in shallow aquifer zone groundwater samples at concentrations exceeding their USEPA and FDEP regulatory criteria. Six inorganic analytes, including aluminum, cadmium, iron, lead, and manganese were detected in aquifer zone groundwater samples at concentrations exceeding their USEPA and FDEP regulatory criteria.

OU 21 - Site 33, Midfield Maintenance Hangar: TCE was the only VOC detected in each shallow and deep aquifer zone groundwater sample at concentrations that either met or exceeded its current USEPA or FDEP regulatory criteria. 1,2-DCE was detected in one shallow aquifer zone groundwater sample at a concentration that either met or exceeded current USEPA or FDEP regulatory criteria. Aluminum, cadmium, chromium, iron, manganese and thallium were detected in shallow aquifer zone groundwater samples at concentrations exceeding their current FDEP and USEPA regulatory criteria.

Southern Area

OU 08 - Site 9, Waste Fuel Disposal Area: Two inorganic analytes, aluminum and iron, were detected in groundwater samples from the shallow and intermediate aquifer zones at concentrations exceeding their USEPA and FDEP regulatory criteria.

OU 09 - Site 10, Southeast Open Disposal Area A: Two inorganic analytes, aluminum and iron, were detected in shallow aquifer zone groundwater samples at concentrations that exceed their USEPA and FDEP regulatory criteria. The inorganic analytes were also detected in intermediate aquifer zone groundwater samples.

OU 10 - Site 11, Southeast Open Disposal Area B: The VOC acetone was detected in one groundwater sample from an intermediate depth monitoring well. Di-n-octylphthalate was the only SVOC detected in intermediate depth monitoring wells. Four inorganic analytes, including aluminum, iron, lead, and manganese, were detected in shallow aquifer zone groundwater samples at concentrations that exceeded their USEPA and FDEP regulatory criteria. Two inorganic analytes, aluminum and iron, were detected in the intermediate aquifer zone groundwater samples at concentrations that exceeded their FDEP secondary criteria.

OU 11 - Site 12, Tetra ethyl Lead Disposal Area: Cadmium was the only inorganic analyte detected in aquifer zone groundwater samples at concentrations exceeding its USEPA and FDEP regulatory criteria.

OU 12 - Site 13, Sanitary Landfill: Acetone was detected in one of two groundwater samples collected from a shallow monitoring well. One SVOC, BEHP, was detected in shallow aquifer zone groundwater sample at a concentration that exceeded its USEPA and FDEP regulatory criteria. Four inorganic analytes, including aluminum, cadmium, iron, and manganese, were detected in shallow aquifer zone groundwater samples at concentrations that exceed their USEPA and FDEP regulatory criteria. Manganese was the only inorganic analyte detected in intermediate aquifer zone groundwater samples at concentrations that exceeded its USEPA and FDEP regulatory criteria.

OU 13 - Site 14, Short-Term Sanitary Landfill: BEHP was detected in shallow and intermediate aquifer zone groundwater samples at concentrations exceeding its USEPA and FDEP regulatory criteria. Two inorganic analytes, aluminum and magnesium, were detected in shallow aquifer zone groundwater samples at concentrations that exceed their USEPA and FDEP regulatory criteria. None of the inorganic analytes detected in intermediate aquifer zone groundwater samples exceeded regulatory criteria.

2.6.5 UST Investigations, 1991 to 1994

Sites 4, 7, and 8 (referred to as UST Sites 1467, 1466 and 3054, respectively) were investigated under the Navy's UST program and, therefore had not been incorporated in to the Navy's IR program. In July 1992, an agreement was reached among the Navy, USEPA, and FDEP to sample monitoring wells at Sites 4, 7, and 8 and analyze the groundwater samples. Based on analytical the results, a decision would be made regarding whether Sites 4 and 7 should remain in the Navy UST program or transferred into the Navy IR program. The field work was completed in 1993. The results of the investigation were reported in the Jurisdiction Assessment Report (ABB-ES, 1994a). The report concluded that groundwater at Sites 4 and 7 was contaminated with BTEX as well as TCE. The commingled petroleum-related constituents and solvent plumes at Sites 4 and 7 could not be remediated without design considerations for TCE. Based on these findings and conclusions, it was recommended that additional assessment activities at these sites should be conducted as part of the ongoing IR program (ABB-ES, 1994a).

Site 8 was investigated under a separate contamination assessment in July 1993. Results were reported in the Contamination Assessment Report (CAR) Addendum for Site 3054 (IR Site 8), NAS Whiting Field, Milton, Florida (ABB-ES, 1992d; ABB-ES, 1993b). Based on the data, NFA was recommended for the site. In correspondence dated January 20, 1994, the FDEP formally accepted the NFA recommendations for Site 8.

2.6.6 Phase II-A, II-B, and II-C Remedial Investigations, August 1996 to August 1997

Phase II of the RI/FS, as outlined in the NAS Whiting Field Work Plan (Jordan, 1990), consisted of the following elements:

- Potential receptors survey

- Plume delineation
- Water supply well investigation
- Source area characterization

The Phase II-A RI/FS was an extension of the investigation begun in Phase I. The objective of Phase II-A was to perform the additional investigation and site characterization required to determine the nature and extent of contamination at NAS Whiting Field and to support a baseline risk assessment and FS. Five additional sites (Sites 29 through 33) were identified during the Phase I RI and subsequently added to the Phase II-A RI investigation program. A total of 20 sites were investigated in Phase II-A. Phase II-A was also designed to confirm whether a release had occurred or is likely to occur at Sites 1, 9, 10, 11, 13, and 14; previous investigations already indicated that environmental impacts had occurred at sites included in Phase II-A. Identified data gaps identified in Phase II-A were to be addressed during Phases II-B and II-C of the RI/FS.

Field work for Phases IIB and IIC was finished in June 1997 and June 1998, respectively. Data obtained from these assessments was used to evaluate the nature and extent of soil contamination and support feasibility studies, baseline risk assessments, and proposed plans and RODs for nineteen sites. In 1995, because of information obtained in Phase IIA, four more sites were added to the program. In 1996, because of information obtained from Phase IIB, Clear Creek was added as a site. In 1997, groundwater was removed from individual sites and combined into a separate site because the existing data showed groundwater contamination had multiple sources and crossed multiple sites. Making groundwater a separate site was thought to facilitate a better definition of the nature and extent of groundwater contamination and earlier completion of other Response Actions.

The following information is a brief description of Phase II site specific activities and results.

OU 03 - Site 3, Underground Waste Solvent Storage Area: Phase II-A RI/FS activities conducted by ABB-ES at Site 3 included a soil gas survey, soil borings, subsurface soil sampling, monitoring well installation, and groundwater sampling.

The soil gas survey was conducted at locations considered to be potential source areas. The results indicated the presence of the following groups of target organic compounds: BTEX, perchloroethene (or PCE), cycloalkanes, and naphthalenes. The soil gas investigation results are presented in the Soil Gas Survey Technical Report (ABB-ES, 1993b).

Ten soil borings (3SB01 through 3SB10) were drilled, and 33 subsurface soil samples were collected around Building 2941 during Phase II-A. Three VOCs, 10 SVOCs, 7 pesticides, and total petroleum hydrocarbons (TPH) were detected in the subsurface soil samples. TPH was present at 4 of 10 soil boring locations at depths less than 7 feet bls. The maximum detected TPH concentration of 27.8 mg/kg was at soil boring 3SB02 at a depth of 1 to 2 feet bls. Twenty-three inorganic analytes were detected in the subsurface soil samples. Concentrations of organic and inorganic analytes detected in the soil samples are presented in Technical Memorandum No. 3 Soil Assessment (ABB-ES, 1995d).

OU 6 - Site 6, South Transformer Oil Disposal Area: At the completion of the Phase I RI field investigation, recommendations for additional sampling during Phase II-A were identified. Phase II-A activities at Site 6 included a soil gas survey, soil borings, subsurface soil sampling, monitoring well installation, and groundwater sampling.

Soil gas sampling at Site 6 was completed in conjunction with soil gas sampling at Sites 5 and 33, with the focus being on Site 33 because of the associated wastes (i.e., solvents and fuels). Soil gas screening indicated a hot spot at Site 6 with ion counts over 100,000 for cycloalkanes/naphthalenes. The soil gas investigation results are presented in Soil Gas Survey Technical Report (ABB-ES, 1993b).

Four soil borings (6SB-1 through 6SB-4) were completed and 17 subsurface soil samples were collected during Phase II-A. Four VOCs, 19 SVOCs, 3 pesticides, 1 PCB, and TPH were detected in the Phase II-A subsurface soil samples (ABB-ES, 1995b). Twenty-one inorganic analytes were detected in subsurface soil samples. Concentrations of organic and inorganic analytes detected in the soil samples are presented in Technical Memorandum No. 3 Soil Assessment (ABB-ES, 1995b).

OU 18 - Site 30, South Field Maintenance Hangar: At the completion of the Phase I RI field investigation, Site 30 was added to the Phase II-A RI program. Phase II-A activities at Site 30 included a soil gas survey, soil borings and subsurface soil sampling, monitoring well installation, and groundwater sampling.

Fifty-six soil gas samplers were placed on approximately 80-foot centers surrounding Building 1406. Soil gas screening indicated several hot spots with ion counts over 100,000 for BTEX, PCE, TCE, and cycloalkanes/naphthalenes. The soil gas investigation results are presented in Soil Gas Survey Technical Report (ABB-ES, 1993b).

Seven soil borings (30SB01 through 30SB07) were drilled, and 23 subsurface soil samples were collected during Phase II-A. The soil borings were completed at soil gas hot spot areas around abandoned waste oil tanks, Building 1406, and the helicopter wash rack area. Three VOCs, 12 SVOCs, 2 pesticides, and TPH were detected in the Phase II-A subsurface soil samples. Concentrations of organic and inorganic analytes detected in soil are presented in Technical Memorandum No. 3 Soil

Assessment (ABB-ES, 1995d).

In 1994, nine soil borings were completed and soil samples were collected by ABB-ES at the wash rack area as part of a contamination assessment of shallow soils for construction activities. Results of the investigation were presented in a letter report (ABB-ES, 1994a). Five VOCs were detected in field screening soil samples analyzed by a field gas chromatograph (GC). Six VOCs and one SVOC were detected in soil samples analyzed by a fixed-base laboratory.

Six additional soil borings (30B001 through 30B006) were completed at the abandoned waste oil tanks and wash rack locations in May 1996 during Phase II-B. Eight VOCs, 7 SVOCs, and lead were detected in 23 subsurface soil samples (including 4 duplicates) collected from these borings.

Four shallow monitoring wells were installed and sampled during Phase II-A. Three VOCs, 1,1-DCE; TCE; and benzene, were detected at concentrations exceeding the USEPA and FDEP MCLs (ABB-ES, 1995c). SVOCs, pesticides, and PCBs were not detected in the Site 30 groundwater samples. Six inorganic analytes, however, were detected at concentrations exceeding their USEPA and FDEP MCLs. Concentrations of organic and inorganic analytes detected at Site 30 are presented in the RI/FS Phase II-C Work Plan for Sites 3, 4, 30, 32, and 33 (Brown & Root Environmental, 1997).

OU 20 - Site 32, North Field Maintenance Hangar: At the completion of the Phase I RI field investigation, Site 32 was added to the Phase II-A RI program. Phase II-A activities at Site 32 included a soil gas survey, soil borings and subsurface soil sampling, monitoring well installation, and groundwater sampling.

Soil gas samplers were placed on approximately 80-foot centers surrounding Building 1424. Soil gas screening indicated several hot spots with ion counts over 100,000 for BTEX, PCE, TCE, and cycloalkanes/naphthalenes. The soil gas investigation results are presented in Soil Gas Survey Technical Report (ABB-ES, 1993b).

Eight soil borings (32SB01 through 32SB08) were drilled in January 1993 during Phase II-A. The soil borings were completed at soil gas hot spot areas around the abandoned waste oil tanks, Building 1424, and the wash rack area. Three additional soil borings (WRSB01 through WRSBB03) were completed at the abandoned waste oil tanks and wash rack locations in August 1993 during Phase II-A. Fifty-three subsurface soil samples were collected during Phase II-A. Six VOCs, 13 SVOCs, 2 pesticides, 1 PCB, and TPH were detected in the subsurface soil samples. Twenty-three inorganic analytes were detected in the subsurface soil samples. Concentrations of organic and inorganic analytes were detected at boring locations 32SB01 through 32SB08 are presented in Technical Memorandum No. 3, Soil Assessment (ABB-ES, 1995d).

In 1994, 13 shallow soil borings were completed and soil samples were collected at a dry well inlet and a buried fuel trench as part of the assessment of shallow soils in preparation of construction activities. Results of the investigation were presented in a letter report (ABB-ES 1994b). Six VOCs were detected field screening soil samples analyzed by a field GC. Five VOCs and four SVOCs were detected in the soil samples collected for fixed-base analysis.

OU 21 - Site 33, Midfield Maintenance Hangar: At the completion of the Phase I RI field investigation, Site 33 was added to the Phase II-A RI program. Phase II-A activities at Site 33 included a soil gas survey, soil borings and subsurface soil sampling, monitoring well installation, and groundwater sampling.

Forty-four soil gas samplers were placed on approximately 80-foot centers in the area surrounding Building 1454. Sampler density was increased surrounding the aboveground and underground waste oil tanks and in an area south of Building 1454. Soil gas screening indicated several hot spots with ion counts over 10,000 for PCE and over 50,000 for BTEX, TCE, and cycloalkanes/naphthalenes. The soil gas investigation results are presented in Soil Gas Survey Technical Report (ABB-ES, 1993b).

Five soil borings (33SB01 through 33SB05) were completed, and 22 subsurface soil samples were collected during Phase II-A. The soil borings were drilled at soil gas hot spot areas around the abandoned waste oil tanks and Building 1454. Four VOCs, seven SVOCs, six pesticides, and TPH were detected in the Phase II-A subsurface soil samples (ABB-ES, 1995d). The six pesticides were detected in soil samples collected from one boring located in a grass-covered area. Twenty inorganic analytes were also detected in the subsurface soils. None of the metal concentrations analyzed by Toxicity Characteristic Leaching Procedure (TCLP) exceeded their regulatory criteria for characterization of hazardous waste. Concentrations of organic and inorganic analytes detected in the soil sample are presented in Technical Memorandum No. 3, Soil Assessment (ABB-ES, 1995d).

In 1994, 20 shallow soil borings were completed (1 to 8 feet bls, 3 to 4 feet bls, and 16 from 0.5 to 3 feet bls), and soil samples were collected by ABB-ES at the apron located east of Building 1454 as part of a contamination assessment of shallow soils for construction activities. Results of the investigation were presented in a letter report (ABB-ES, 1994a; ABB-ES, 1994b). Two VOCs (benzene and TCE) were detected in field screening soil samples analyzed using a field GC. Three VOCs and one SVOC (di-n-butyl phthalate) were detected in the soil samples collected for fixed-base analysis. Di-n-butyl phthalate is a common laboratory contaminant and was detected in the laboratory blank. Consequently, the detection of di-n-butyl phthalate was not believed to be site derived.

Three additional soil borings (33B001 through 33B003) were drilled along the eastern side of Building 1454 in June 1996 during Phase II-B. Six VOCs and lead were detected in 16 subsurface soil samples (including 2 duplicates) collected from these borings. The highest VOC concentration was of TCE (130 micrograms per kilogram [µg/kg]) in a soil sample collected near the land surface at location 33SB002.

2.6.7 Additional UST Investigations

As described in Section 1.3.4 several UST or petroleum-related releases have adversely impacted groundwater at Site 40. In two cases, IR Sites 4 and 7, BTEX compounds are commingled with chlorinated solvents in groundwater (South AVGAS Storage Tank Farm UST Site 1466 [IR Site 7] and the North AVGAS Storage Tank Farm UST Site 1467 [IR Site 4]). The monitoring wells installed during the UST investigation retained the UST originated monitoring well nomenclature and were used by the subsequent IR Site investigations.

Due to the presence of commingled groundwater plumes newly installed UST groundwater monitoring wells were installed and sampled following USEPA protocols. Initial groundwater sampling includes full suite analysis for TCL and TAL analytes that include BETX and chlorinated solvents. This groundwater analytical data allows additional characterization of Site 40 groundwater. Monitoring wells located at the UST sites include the Oil/Water Separator, the Product Line Dispensing Facility, Site 2894, Site 1438/1439, and Site 2832. Groundwater analytical results from these sites are included in this RI Report with the exception of the results of the most recent work at Sites 4 and 7 which occurred in 2010 and 2012 respectively are not yet final.

2.6.8 Degradation Description of Petroleum Hydrocarbon and Chlorinated Ethenes

The biological degradation processes presented below describe favorable chemical conditions that result in the reduction in the size of a molecule, such as TCE, by one or more atoms and/or remove or add electrons from parent molecules by either biological metabolism or valence changes. These biologically driven reactions alter the substance either within or outside the microbial organism. Typical processes are described below.

2.6.8.1 Degradation Petroleum Hydrocarbon

Biological degradation of petroleum hydrocarbons, such as BTEX, occurs in both aerobic and anaerobic aquifer systems (e.g., USEPA, 1994A; Wiedemeier, 1995). Direct oxidation is the primary mechanism in which hydrocarbons are used as growth substrates yielding energy for microorganisms causing the degradation. Under aerobic conditions, oxygen is used as the terminal electron acceptor and hydrocarbons are oxidized to produce carbon dioxide and water. Typically, denitrification occurs first, followed by manganese reduction, iron reduction, sulfate reduction, and then methanogenesis.

Biodegradation rates under aerobic conditions are typically much faster than those under anaerobic biodegradation; however, oxygen typically depletes rapidly, and there is a potentially larger pool of anaerobic electron acceptors in groundwater. Therefore, anaerobic biodegradation may be the major biodegradation mechanism (Wiedemeier, 1998). Additional research showed that BTEX isomers are anaerobically biodegradable under ambient subsurface conditions using ferric iron, sulfate and/or carbon as terminal electron acceptors. Typically a distinct order of biodegradation occurs but the order varies due to the geochemical conditions found at each site. The most easily biodegradable compounds (toluene, o-xylene, m-xylene) appear to anaerobically biodegrade to a low concentration (10 to 30 ug/L) after which biodegradation stops (USEPA, 1997A).

2.6.8.2 Degradation Chlorinated Ethenes

The following are the three primary biological degradation processes that degrade chlorinated ethenes.

Reductive dechlorination occurs as chlorinated ethenes serve as electron acceptors in which a chlorine atom is removed and replaced by a hydrogen atom. A number of environmental conditions must exist for reductive dechlorination to take place including reducing conditions, sufficient carbon sources acting as electron donors, and sufficient microorganisms are responsible for the dechlorination processes (e.g., dehalococcoides) (USEPA, 2006).

“PCE and TCE are highly oxidized compounds and therefore are most susceptible to reductive dechlorination. In general, reductive dechlorination of PCE or TCE occurs by sequential dechlorination from PCE to TCE to DCE isomers to VC to ethylene. Depending upon environment conditions, this sequence may be interrupted and not go all the way to ethylene (Wiedemeier, 1998). Reductive dechlorination may be performed by bacteria that couple their growth with the dechlorination of the chloroethylene or by bacteria that do not benefit from the dechlorination. In the former case, the process is known as halorespiration or dehalorespiration, and the bacteria are referred to as halorespiring bacteria. In the latter case, the process is a co-metabolic reaction where the growth of the bacteria is supported by the metabolism of other compounds.” (USEPA, 2006).

“During the dechlorination, all three isomers of DCE can theoretically be produced. However, Bouwer (1994) reported that under the influence of biotransformation, *cis*-DCE is a more common intermediate than *trans*-TCE and 1,1-DCE. Compared with PCE and TCE, the dichloroethane isomers and vinyl chloride are not as highly oxidized.

Aerobic cometabolism is an indirect oxidation process where microbiological breakdown of chlorinated ethenes does not provide energy to the organism. In aerobic cometabolism, oxygenase enzymes (such as methane monooxygenase and toluene monooxygenase) are produced when microorganisms degrade compounds such as BTEX, methane, or propane under aerobic conditions. These enzymes are nonspecific and are able to also degrade TCE and other chlorinated compounds with the exception of PCE (Wiedemeier et al., 1998).

"Oxidation usually occurs in the presence of molecular oxygen; however, oxidation of *cis*-DCE and vinyl chloride may also occur under some anaerobic conditions (Bradley and Chapelle, 1998, 2000, 2000a; reviewed in Bradley, 2003). Bradley in Chapelle (2000) showed that vinyl chloride can be oxidized acetate by an interesting class of anaerobic bacteria called the acetogens. They oxidize the organic compound solely as a part of their energy metabolism." (USEPA, 2006).

Direct oxidation occurs where chlorinated ethenes serve as electron donors (energy source) in microbial metabolism. Of the chlorinated ethenes, both DCE and vinyl chloride is the most susceptible to aerobic oxidation under natural groundwater conditions, and the oxidation is more rapid than reductive dechlorination (USGS, 2007). Under anaerobic conditions, there is little evidence for the oxidation of chlorinated compounds using other electron acceptors such as nitrate, iron (III), manganese (IV), or sulfate. Bradley and Chapelle demonstrated that microbes can oxidize vinyl chloride using ferric iron as an electron acceptor (Bradley, 1996).

3.0 FIELD INVESTIGATION

Data presented in this report were generated using several iterations of USEPA and FDEP Standard Operating Procedures (SOPs) and Quality Assurance Plans (QAPs) from the early 1980s to present. Some data collected early in the IR investigations can be considered useful, such as water level data, lithologic descriptions and survey data because current methods or procedures used to collect this type of data have not been updated. Advances have been made in the analytical laboratory, however, and in some aspects of environmental sample collection methods and procedures render older data less precise than more recent data, as well as not reflecting current conditions. Refinements in sampling and analytical processes preclude using older data for anything other than reference or bench marks which have varying degrees of applicability. Additionally, USEPA and FDEP have limits for the useful age of analytical data. For these reasons, the groundwater analytical data representing the BTEX/TCE plumes located in the central areas of the facility are limited to data collected from 2007 to 2010. Groundwater analytical data representing landfill sites located in the peripheral areas of the facility are limited to data collected from 1997 to 2000, the last period groundwater samples were collected from these sites. Only the most recent analytical data has been used to develop the conclusions in this report.

1990s

Early investigation reports (Phase I series, Phase II-A, Phase II-B, and Phase II-C and early UST investigations) describe procedures and methods for installing monitoring wells and collecting soil and groundwater samples in the body of the reports but guidance documents are not referenced within the reports. The RI/FS GIR (ABB-ES, 1998a) was designed to describe existing site conditions (e.g., geography, demography, land use, physiography, topography, climate, soil type, regional geography, regional hydrology) as well as describe procedures and methods used in investigations (e.g., soil gas sampling, geophysical investigation, soil sampling, surface water sediment sampling, monitor well installation, groundwater sampling) and combine the resultant wide range of general data collected prior to 1998 in one volume. The GIR references the USEPA SOPs and Quality Assurance Manual (SOPQAM) (USEPA, 1991A), and the project specific QAP is found in Appendix D of the NAS Whiting Field RI Work Plan, Vol. II (Jordan, 1990). At that time, the FDEP required consultants to produce a company-specific Quality Assurance Project Plan (QAPP) with SOPs.

2000s

The Site 40 RI/FS work plan (Brown & Root, 1997; Tetra Tech, 2000) for field work performed in 2000 and 2001 provided SOPs for field personnel responsibilities, mobilization, sampling methods, monitoring well installation, decontamination procedures, groundwater level measurements, sample management, change in field methods, protocols on corrective actions, waste management, project documentation, and other general information. Field investigation methods performed after November 2001 were in accordance with the USEPA Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (USEPA, 2001 through 2007) that was in effect until February 2007. After that time, it was superseded by the USEPA Region 4 Science and Ecosystem Support Division that provided guidance and SOPs online via the Field Branches Quality System and Technical Procedures. The online SOPs are the current USEPA guidelines. The USEPA also provided guidance via the Ecological Assessment SOPQAM (USEPA, 2002).

Prior to 2004, the FDEP required each environmental company operating in Florida to develop in-house SOPs. These were then reviewed by FDEP to determine if the company would be allowed to conduct field investigations within the state. ABB-ES, the previous Navy CLEAN contractor, and Tetra Tech had SOPs approved by the FDEP. In February 2004, the FDEP issued the Department of Environmental Protection SOPs for Field Activities. This document includes all SOPs required by FDEP for conducting environmental investigations and collecting environmental field samples. These FDEP SOPs were referenced in subsequent work plans, QAPs, and reports.

The Data

Field work performed since the early 1990s has been conducted in compliance with the then current Navy, USEPA Region 4 and/or FDEP requirements, regulations, guidance, and technical standards. When procedures or methods are not provided by governmental and/or regulatory agencies, either the ABB-ES SOPs or the Tetra Tech Corporate Quality Assurance Program Manual dated October 9, 2002, were applied.

Groundwater analytical data presented in this report reflects two areas and periods of sample collection. Groundwater and soil samples collected from the area of the landfills located along Patrol Road were collected from 1997 to 2000. Groundwater samples collected from the areas involving the two large mixed plumes of BTEX and TCE were collected during the 1990s and well as three separate focused rounds of sampling in 2007, 2008, and 2011. Environmental data tables in this RI Report provide the date of the sample collection for each sample. The data set presented in this report consists of 99 groundwater samples, 37 surface soil samples, and 58 subsurface soil samples (all quantities include duplicates). Groundwater data collected under the Phase II-C investigation conducted in 1998 primarily in the NCA are included in the large data set trend analysis section of this report.

The groundwater data set for the perimeter landfills along Patrol Road includes only the most recent validated analytical results for each analyte in every well sampled at NAS Whiting field. In other words, data representing one monitoring well is comprised of the most recent data from the last sampling event or if necessary several sampling events over the course of several years. For example, aluminum was analyzed in 1993, 1996, and in 2000 for the monitoring well WHF-1466-MW-8S; however, only the 2000 data for aluminum is used. If VOCs were not collected from a particular well in 2000 but were in 1996 the VOCs from 1996 would be used.

Fourteen additional groundwater samples and 2 subsurface soil samples collected from Sites 1438/1439, 2832, 2894, the UST Sites OWS 2993, and the Product Line Dispensing Facility were collected under the FDEP UST program and are being utilized to better define Site 40, which includes all groundwater at NAS Whiting Field.

Field and laboratory quality assurance and quality control requirements for the RI activities outlined in the Site 40 RI/FS Work Plan comply with the RI/FS QAPP located in Appendix H of the Site 40 RI/FS Work Plan. Health and safety requirements were in accordance with the RI/FS Health and Safety Plan located in Appendix G of the Site 40 RI/FS Work Plan. Field investigative methods not covered in the documents identified above may be found in the NAS Whiting Field RI/FS GIR (ABB-ES, 1998a).

In 2006, it was determined that three rounds of groundwater samples would be collected to determine if conditions favorable for natural attenuation exist in groundwater at NAS Whiting Field. Each of the three sampling rounds (2007, 2008, and 2011) was considered independently with interim iterative adjustments based on previous findings. Where needed, additional groundwater monitoring wells were installed to address data gaps. The three work plans for each sampling event are as follows: RI Work Plan for Base-wide Groundwater Assessment Activities at Site 40 and Well Abandonment, (Tetra Tech, 2007a); Work Plan for Base-wide Groundwater Sampling, Membrane Interface Probe Investigation, and Monitoring Well Installation, (Tetra Tech, 2008a); and the SAP, Remedial Investigation Addendum for Site 40, Base-Wide Groundwater Operable Unit 25, (Tetra Tech, 2010a) (this work plan was executed in 2011).

3.1 SURFACE AND SUBSURFACE SOIL ASSESSMENT

Surface and subsurface soil samples were typically collected from soil borings created during the installation of new monitoring wells. The subsurface soil samples were analyzed at a fixed-base laboratory for some or all of the following analytes: TAL metals, cyanide, TCL VOCs, TCL SVOCs, pesticides, PCBs, and TPH. If the samples exceeded federal or state regulatory criteria, the same subsurface soil samples were then subjected to either the synthetic precipitation leachate procedure (SPLP) or the TCLP and the derived leachate was analyzed for the same parameters. These sample results were used to establish a relationship between the concentration of target analytes detected in soil samples and SPLP or TCLP leachate results to determine which analytes, if any, were leaching from soils to the groundwater at concentrations that may exceed federal or state groundwater regulatory criteria.

Following a similar process in 2003, additional surface and subsurface soil samples were collected at specific IR Sites where existing historical data indicated exceedances of federal or state groundwater regulatory criteria for leachability. SPLP leachate samples were derived from these soils and analyzed for site-specific analytes to determine the likelihood the soils were acting as a source to the chemicals detected in groundwater samples. Soil sampling locations for Site 40 are shown in Figure 1-2. Site-specific soil samples and their leachates as determined by the SPLP or TCLP were analyzed for the parameters indicated on Table 3-1.

3.2 GEOPHYSICAL ASSESSMENT

Geophysical logs of three borings (WHF-1466-B-21D4, WHF-1466-B-25D4, and WHF-OW-B-3D4) and three monitoring wells (WHF-1467-MW-14D4, WHF-1467-MW-16D4, and WHF-OW-MW-5D4) were conducted at NAS Whiting Field between October 16 and 18, 2002.

The purpose of the geophysical logging was to collect data to assess the lateral and vertical primary lithologies present in the subsurface at the facility and to aid in the determination of the presence and elevation of the upper surface of the Pensacola Clay. The instrument sensors used during logging were temperature, natural gamma, resistivity, and electrical conductivity. The logs of the latter three are provided in Appendix G. Data were collected continuously from the deepest penetration of the geophysical tool to the surface. Borings or monitoring wells selected for logging were based on relative location but primarily on depth sufficient to reach the Pensacola Clay. The geophysical logs were used to differentiate between and correlate major stratigraphic units across the facility. It should be noted, several logs contain anomalous spikes in both resistivity and conductivity at predictable intervals caused by the placement of stainless steel centralizers on the well risers at approximately 40-foot centers.

3.3 HYDROGEOLOGIC ASSESSMENT

A general discussion of the geologic field investigation methods at NAS Whiting Field is presented in Subsections 2.1.3.5, Split-Spoon Soil Sampling, and 2.1.5, Monitoring Well Installation, of the GIR (ABB-ES, 1998a). A brief description of these activities is also presented within this section.

3.4 GROUNDWATER ASSESSMENT

Multiple work plans were written from 1993 to 2010 to assess either site-specific or base-wide groundwater quality. The initial base-wide remedial investigation performed under the RI/FS work plan (Brown & Root, 1997; Tetra Tech, 2000) at Site 40 in 2000, included the installation of 43 monitoring wells. The purpose of this work plan was to guide an investigation to further define the nature and extent of groundwater contamination at Sites 7 (UST Site), 29, 35, 39, and 40 and to provide initial investigations at Sites 5 and 38 and PSC 1485C (now Site 41). The information generated was used as a basis for recommending remedial alternatives that address identifiable risk to human health and the environment. It was thought the resulting data would enable sufficient site characterization and risk evaluation for determination of the appropriate technologies to support the remedy for these sites (Tetra Tech, 2000).

After completion of the field work in 2000, the Site 40 environmental data generated was evaluated. The findings were presented in 2004. Regulators commented that the groundwater evaluation did not address soils leaching to groundwater from overlying sites. Based on ongoing investigations at these overlying sites, it had been determined the sites' soils were likely leaching contaminants to groundwater. This leaching had not been addressed in the Site 40 investigation. However, base-wide groundwater could not be completely evaluated until after soil contamination at each site, including leaching, had been addressed. It was also determined that because Site 40 was now separate from each surface soil site, those sites overlying groundwater could be evaluated and receive a ROD at an accelerated pace if unencumbered by determining if soil contamination was leaching to groundwater.

During the next four years, 2004 to 2008, the majority of the IR Sites were evaluated relative to direct exposure to surface and subsurface soils and RIs produced. By 2008, 19 "soil-only RODs" had been issued for these sites. In each case, the report indicated that, if present, contaminants in the vadose zone that were potentially leaching to groundwater would be addressed in the Site 40 Base-Wide Groundwater RI.

It was determined by the Navy in 2007 that the best path forward for Site 40 would be to collect groundwater data from the two commingled TCE/BTEX plumes over a three year period to determine if analyte concentrations were increasing or decreasing, collect natural attenuation data, and address data gaps. As a result, additional groundwater data was collected in 2008, 2009 and 2011. To address data gaps, additional monitoring wells were installed in 2008 and in 2011 under RI work plans (Work Plan for Base-wide Groundwater Sampling, Membrane Interface Probe Investigation, and Monitoring Well Installation, Tetra Tech 2008; and the SAP, Remedial Investigation Addendum for Site 40, Base-Wide Groundwater Operable Unit 25, (Tetra Tech, 2010a) (this work plan was executed in 2011).

The RI investigation performed under the Phase II-C RI/FS Work Plan included the installation of 35 monitoring wells as listed in Table 3-4 and in the text of the work plan (Brown & Root, 1997; Tetra Tech, 2000). Before or during the execution of the field work, additional monitoring wells were added or deleted to bring the total of installed monitoring wells to 43. The additions and deletions are described in subsection 3.4.2.

All groundwater samples were collected using low flow techniques, in general accordance with the approved work plans. Groundwater samples were collected from each of the new monitoring wells and analyzed for TCL VOCs, TCL SVOCs, TAL metals, cyanide, pesticides, PCBs, TPH, and natural attenuation parameters. The results of the sample analyses are found in various tables within this report as well as in Appendices D, H, and I. Groundwater samples collected from existing monitoring wells were targeted for the analytes that had previously exceeded criteria and/or analyzed for site-specific contaminants and/or TCL VOCs and natural attenuation parameters. Copies of all known monitoring well and boring logs generated for NAS Whiting Field are presented in Appendix G. Monitoring well locations for Site 40 are illustrated on Figure 1-2. Site-specific analytical results are discussed in Section 4.

3.4.1. <u>Water Table Elevation Evaluation</u>

Multiple rounds of water level elevation measurements have been conducted during various phases of RI and UST investigations. This data has been collected from the various RI and UST reports and is provided in Appendix E. The initial groundwater data elevation measurements were collected on November 12, 1990 and the last groundwater elevation measurements were collected on September 12, 2012 for an UST investigation from wells around Site 7.

The initial effort to depict base-wide groundwater contours was developed based on water level elevation measurements collected between September 30 and October 1, 1993. Water level elevation measurements were made at a total of 82 monitoring wells. A second round of water level elevation measurements were collected on February 8 and 9, 1994 and included the previously measured 82 monitoring wells and collection of additional water level elevation data from 47 monitoring wells installed at UST Sites (Figure 2-1). The water level elevation data were used to develop groundwater contour maps, which illustrate groundwater flow direction for the entire facility (not shown on Figure 2-1) as well as the industrial area. Initially, figures were developed to present groundwater contour maps for what were thought to be shallow and deep zones of the sand-and-gravel aquifer. Over time, the weight of evidence showed the sand-and-gravel aquifer at Whiting was uniform with no stratification resulting in shallow and deep zones.

Our contour maps for the first sampling event are similar to the February 1994 contraband and are, therefore, not presented in this report additional information including contour maps of up to geometric surface of the shallow and deep aquifer zones for both water level measurement events are included in the technical memorandum number four, hydrogeologic assessment, NAS Whiting field, (ABB-ES, 1994).

3.4.1 Monitoring Well Installation

Monitoring wells were installed as prescribed by three RI/FS work plans (Tetra Tech, 2000; Tetra Tech, 2008a; and Tetra Tech 2010a). Locations and well depths were selected primarily to resolve data gaps and provide sentinel wells hydraulically down or side gradient of known contaminant plume boundaries.

The installation of several monitoring wells originally scoped in the 2000 RI/FS Work Plan was canceled in the field due to encountering clay at the desired screened interval that would make a monitoring well useless. An example, the installation of wells WHF-1466-MW-9D4, WHF-1466-MW-21D3, WHF-1466-MW-21D4, WHF-1466-MW-24D4, and WHF-1466-MW-25D4 was cancelled because the borings for the wells were completed in the Pensacola Clay and would not produce groundwater for sampling. The installation of monitoring wells WHF-32-MW-12P through WHF-32-MW-17P was cancelled as the targeted perched aquifer in the NCA was not found consistently. The installation of monitoring well WHF-10-MW-3S was cancelled due to the completion of the remedial action for Site 10 (Bechtel, 2000a). Also, the monitoring wells installed at Sites 31, Area E, and 31, Area F, (WHF-31-MW-5S and WHF-31-MW-7S) fulfilled the intent of the cancelled monitoring well WHF-10-MW-3S.

All wells scoped for installation during 2007 were installed as prescribed by the work plan. Three monitoring wells (WHF-1467-MW-38S, WHF-1467-MW-41S, and WHF-1467-MW-43S) originally scoped in the 2010 RI work plan were cancelled in the field due to encountering clay in the intended screened interval and determining the well would not be productive. In two instances, the boring was continued to verify the thickness of the clay unit, exceeded the required depth of the planned well design.

In the 2000 field event, the installation of several wells not originally scoped in the RI/FS work plan were added due to decisions by the Navy after the RI/FS work plan was finalized. Monitoring wells WHF-31-MW-5S through WHF-31-MW-8S (to investigate any possible downgradient movement of groundwater contamination from Site 31: Areas B, D, E, and F) and WHF-14-MW-3S were added. Six shallow or perched monitoring wells were added by the Navy to the originally scoped wells to investigate newly detected releases or to finalize ongoing reports. The installation of monitoring well WHF-PDF-MW-01S supported an UST investigation located south of Site 3. The installation of monitoring well WHF-OWS-MW-01S supported an UST investigation located north of Site 41. The installation of monitoring well WHF-1438-MW-7S supported an UST investigation of Site 1438/1439. The installation of monitoring wells WHF-2832-MW-01S and WHF-2832-MW-02S during the summer of 2002 supported the Site 2832 UST investigation (AVGAS E pipeline).

In the 2000 and 2008 field events, shallow aquifer monitoring wells were installed using hollow-stem augers. Twenty-five monitoring wells were installed into the upper 10 to 15 feet of the surficial aquifer. These monitoring wells were constructed of 2-inch inside diameter (ID), flush-thread polyvinyl chloride

(PVC) with 10-foot 0.01 slot screen in an 8-inch ID borehole. The sand pack was 20-30 size silica sand with a 45-60 fine sand seal. Centralizers were placed at 25-foot centers.

In the 2000 field event, intermediate and deep aquifer zone monitoring wells were installed using mud-rotary techniques. Nine monitoring wells were installed into the intermediate aquifer zone of the surficial aquifer. These intermediate aquifer zone monitoring wells were constructed of 4-inch ID, flush-thread PVC with 10-foot 0.01 slot screen. The sand pack was 20-30 size silica sand with a 45-60 fine sand seal. Centralizers were placed at 25-foot centers. Eleven double-cased monitoring wells were installed where wells exceeded 255 feet bls or when wells were installed in areas where cross contamination was a concern. Initially a 10- to 12-inch ID pilot boring was drilled to the target depth. Next, an 8-inch ID, Schedule 40 PVC casing was assembled from 20-foot segments with stainless-steel screws and emplaced in the open boring. Neat bentonite grout was then tremied under pressure between the outside of the casing and the annulus. The assembly was then undisturbed for a minimum of 48-hours to allow the grout to cure. The boring was advanced using mud-rotary techniques through the bottom of the casing to the selected depth with a 7 7/8-inch mud-rotary bit. A 4-inch ID Schedule 40 PVC screen and riser was then placed to the selected depth. The sand pack consisting of 20-30 size silica sand with a 45-60 fine sand seal was then emplaced via a tremie tube. Centralizers were placed at either 25- or 50-foot centers on the riser as determined by the site geologist.

In the 2011 field event, shallow aquifer monitoring wells were installed using the Roto-sonic system. Four monitoring wells (WHF-1467-MW-39S, WHF-1467-MW-44S, WHF-2894-MW-3I, and WHF-2894-MW-4I) were installed into the upper 10 to 15 feet of the surficial aquifer (the 3I and 4I suffixes on the Site 2894 wells are intermediate relative to other site wells and are in fact shallow aquifer wells). These monitoring wells were constructed of 2-inch ID, flush-thread PVC with 10-foot 0.01 slot screen in an 8-inch ID borehole. The sand pack was 20-30 size silica sand with a 45-60 fine sand seal.

3.4.2 <u>Rationale for New Monitoring Well Locations</u>

The rationale for monitoring well locations at Site 40 is as follows:

During the 2000 event, monitoring wells WHF-1466-MW-17D3, WHF-1467-MW-14D3, WHF-1467-MW-14D4, WHF-1467-MW-16D3, WHF-1466-MW-9D3, and WHF-1466-MW-9D4 were installed at existing shallow aquifer zone monitoring well locations. The intent was to investigate the vertical extent of potential contamination of either the intermediate or deep aquifer zones of the surficial aquifer above the Pensacola Clay near source areas.

Deep aquifer zone monitoring wells WHF-1466-MW-2ID3, WHF-1466-MW-2ID4, WHF-1466-MW-24D3, WHF-1466-MW-24D4, WHF-1466-MW-25D3, WHF-1466-MW-25D4, WHF-15-MW-8D3, WHF-16-MW-7D3, WHF-16-MW-D4, and WHF-13-MW-3D3 were installed at existing shallow aquifer zone monitoring well locations. The intent of these monitoring wells was to investigate potential hydraulic downgradient extent of groundwater contamination and to provide additional locations to determine intermediate and deep aquifer zone groundwater flow directions.

The well pairs WHF-OW-MW-1D3 and WHF-OW-MW-1D4, WHF-OW-MW-3D3 and WHF-OW-MW-3D4, and WHF-OW-MW5D3 and WHF-OW-MW5D4 were installed west of Clear Creek at existing shallow aquifer zone monitoring well locations. The intent was to detect if contamination was present west of Clear Creek in either the intermediate or deep aquifer zones of the shallow surficial aquifer and the potential for plume migration west of Clear Creek.

Monitoring wells WHF-01-MW-5S, WHF-02-MW-4S, WHF-10-MW-3S, and WHF-13-MW-5S were installed to collect site-specific background data from the shallow aquifer zone.

During the 2011 field event, the wells WHF-1467-MW-31I, WHF-1467-MW-35S, WHF-1467-MW-35I, WHF-1467-MW-36S, and WHF-1467-MW-2PR were installed adjacent to shallow aquifer zone monitoring wells to investigate the vertical extent of potential contamination.

Groundwater monitoring wells WHF-2894-MW-3I and WHF-2894-MW-4I were installed to monitor the surficial aquifer shallow zone downgradient of Site 2894 and collect additional geologic information.

3.4.3 Monitoring Well Development

Each of the shallow, intermediate, and deep aquifer zone monitoring wells was developed according to the methods specified in RI/FS work plans (Tetra Tech, 2000, 2007, 2008, 2010a) and the USEPA Region 4 SOPQAM (USEPA, 1991A). During the 2000 field event, monitoring well development was completed using single displacement (Waterra^{TM}) pumps. The Waterra^{TM} was initially used to remove any drilling fluids or cuttings and fine formation materials (e.g., sand, silt, or clay). During the 2007, 2008, and 2011 field events, monitoring well development was completed using a single displacement bladder or (Bennett^{TM}) pump. Monitoring well development was considered complete when the pH, specific conductivity, and temperature measurements had stabilized and the formation water was clear.

3.4.4 Groundwater Sampling

Since 1996, all groundwater sampling events at NAS Whiting Field have been conducted using submersible or bladder pumps at low flow rates typically equal to or less than 1 liter per minute using Teflon™ lined tubing. During the 2000, 2007, 2008, and 2011 sampling events, all monitoring wells were sampled in accordance with the respective RI/FS work plans (Tetra Tech, 2000, 2007, 2008, 2010a), USEPA SOPs, and FDEP SOPs FS 1000 and FS 2200.

Groundwater samples were collected from newly installed monitoring wells a minimum of 24 hours after well development. Water level data was recorded and purge volume calculated. Groundwater was pumped from the top of the water column in shallow wells where possible. Prior to groundwater sample collection, the monitoring well was purged. Both purging and groundwater sampling operations were conducted at low flow rates attempting to achieve turbidity levels of less than 10 nephelometric turbidity units (NTUs). During purging field parameters of pH, temperature, specific conductively, turbidity, oxidation-reduction potential (ORP), and dissolved oxygen (DO) were collected using a field multi-meter. Samples were not collected until all indicator parameters had reached equilibrium and representative groundwater could be sampled. Typically, if all parameters were within 5 percent of their previous value and three volumes had been removed from the monitoring well, sampling occurred; if not, a total of five well volumes were removed prior to sampling. Purging was considered complete if a well purged dry.

Natural attenuation parameters were collected to support an evaluation of the potential for natural attenuation of organic contaminants in groundwater. Groundwater quality parameters were analyzed at a fixed-based laboratory for purposes of evaluating natural attenuation processes include chloride, cyanide, dissolved organic carbon (DOC), hydrogen sulfide, nitrate, nitrite, nitrite/nitrate, reactive sulfide, and sulfate. Additionally, iron, alkalinity, and DO were measured using either a CHEMets^{TM} or Hach DR-890^{TM} spectrophotometer or equivalent.

The sample aliquot for VOC analysis was collected by sampling groundwater at a flow rate of equal to or less than 0.10 liter per minute to minimize agitation of the water in the monitoring well and transferring the contents to a VOC vial.

3.5 EVALUATION OF THE BIODEGRADATION PROCESSES

Evaluation of the biodegradation processes occurring at both the NCA and SCA Plumes (the sites) was conducted using a multiple-lines-of-evidence approach. The primary line of evidence is related to the contaminant and daughter product concentration trends present at the site. Evaluation of this evidence was based on the historical groundwater monitoring results from 1993 through 2011 (see Appendix F and I). It should be noted that this is a larger data set than the 2007 through 2011 data presented in tables and figures in this report. Trend analysis on the 1993 through 2011 data set was performed to evaluate whether concentrations of “parent” contaminant compounds decreased over time and whether the “daughter” compounds are present and reduced subsequently. The secondary line of evidence is related to the geochemical conditions of the groundwater within both the NCA and SCA plumes (see Tables 4-36 and 4-44). Evaluation of this evidence was conducted using the 2011 geochemical and field parameter data to determine whether favorable conditions for biodegradation are present within the plumes.

Biodegradation of petroleum hydrocarbons varies depending on the product; at NAS Whiting Field, it has been AVGAS (a gasoline) and JP-4 through JP-8 (kerosene). Gasoline is primarily composed of relatively volatile hydrocarbons containing 4 to 12 carbon atoms including the BTEX compounds benzene, toluene, ethylbenzene, and xylene. JP-5 jet fuel is a kerosene-based fuel primarily composed of relatively low-volatility hydrocarbons containing 11 to 13 carbon atoms with relatively insignificant (less than 1 percent by weight, mass fraction) BTEX content.

Biodegradation of BTEX compounds to form the final end-product, carbon dioxide, is the process that generally is well understood. The efficiency of the biodegradation is primarily a function of the availability of the various electron-acceptors that may be used in the reactions as well as the presence of appropriate microorganisms and enzymes. Oxygen is by far the most favorable electron-acceptor, and BTEX degradation is relatively fast and efficient in aerobic groundwater. When dissolve oxygen is depleted within the contaminant plume, nitrate is the next most favorable electron acceptor followed by manganese, ferric iron, sulfate, and carbon dioxide. All of these anaerobic biodegradation processes are slower than aerobic processes, and benzene degradation is particularly slow when carbon dioxide is the only available electron acceptor. Manganese is not often considered an important electron acceptor because it is generally not abundant in aquifer sediments. Biodegradation of the various longer chain hydrocarbons that make up JP-5 is less understood, although anaerobic degradation is generally more rapid than anaerobic degradation (USGS, 2005).

3.5.1 Methodology for Trend Analysis

Contaminant concentration trends were evaluated using time plots (i.e., plots of concentrations versus time) and Mann-Kendall (MK) test (statistical analysis of trends) for the 1993 through 2011 data.

Time plots are graphic representations for temporal data that are collected over specific time intervals (e.g., quarterly, semiannually, or annually). A time plot can be prepared by plotting the constituent concentrations against sampling time for individual chemicals in individual wells. Time plots can be used to visually identify large scale and small scale trends over time.

The MK test is a statistical hypothesis test to determine the trend of a time series. A minimum of four data points per location are required to conduct a MK test. The MK test determines if the data are described as a “statistically significant downward” trend, a “statistically significant upward” trend, or “no trend”. No trend means the constituent concentrations fluctuate with time and the evidences/data are insufficient to conclude an upward or a downward trend with certain level of confidence. When analytical results indicate “no trend”, the level of fluctuation was further evaluated to determine if it was low and a stable trend can be claimed. The coefficient of variation (CV) was used for the identification of a stable trend. For the “no trend” cases, the CV of a time series was calculated to measure the data dispersion proportional to its mean. A high CV value indicates a high level of fluctuation. If the CV value is not greater than 1, the trend is identified as “stable” (i.e., the constituent concentrations have relatively minor fluctuations and the trend appears to be “flat” in time). Detailed methodologies of the trend analysis are presented in Appendix G.

The MK test results are summarized in Tables 4-1 and 4-2 and the time plots are both located in Appendix G.

4.0 INVESTIGATIVE RESULTS

The purpose of this section is to present the results of Site 40 Base-Wide leachability and groundwater investigations. These investigations were undertaken to:

1) Determine site-specific background concentrations.
2) Derive facility specific values for leaching.
3) Determine vertical and horizontal extent of contamination.
4) Provide additional control points to refine groundwater flow direction.
5) Determine the effect of naturally occurring attenuation processes on the temporal distribution of contamination.

The data presented herein are supported by geologic and hydrologic information provided in Section 3.0 from the NAS Whiting Field GIR (ABB-ES, 1998a).

The investigation activities conducted in 2000 after the creation of Site 40 included the collection of surface soil, subsurface soil, and groundwater samples as described in the Site 40 RI/FS work plan (Brown & Root, 1997; Tetra Tech, 2000). The rationale for installing and sampling new monitoring wells was to resolve data gaps that were identified after completing previous investigations of individual sites and are described in Section 3.0. During the installation of new monitoring wells soil samples were collected and analyzed using SPLP or TCLP to determine the tendency of soils to leach to groundwater.

In 2006, a review of the available soil and groundwater data indicated additional groundwater samples were needed to determine if, and at what rate, natural attenuation was occurring at the two commingled plume areas. In 2007, 2008, and 2011, groundwater samples and natural attenuation data were collected from in and around the NCA and SCA plumes (see Figure 1-2). During these groundwater sampling events, additional monitoring wells were also installed to address data gaps related to plume boundaries and contamination at deeper aquifer intervals as described in Section 3.0 of this report. This groundwater analytical data is presented in tables in this section. Soil and groundwater sample collection methods and references are described in Section 3.0 of this report. Groundwater analytical results are found in Appendices H and I.

Subsequent to these soil and groundwater investigations and to provide an additional line of evidence to support conclusion drawn from previous sampling, a leachability modeling study was conducted. Surface and subsurface soil data were used to evaluate the potential for contaminants to leach from soil to groundwater using the USEPA SEeasonal SOIL (SESOIL) and VLEACH infiltration modeling software.

A white paper issued in April 2004 describes aluminum, iron, manganese, and vanadium as ubiquitous in the geologic makeup of NAS Whiting Field (Appendix I). The random nature of their concentrations at various depths precludes a defined source area. These inorganics are naturally occurring and are not related to any known IR Site. The apparent random distribution of areas of low pH groundwater and resultant high iron concentrations in groundwater supports this observation. The low pH in groundwater is a natural condition and encountered as problem in adjacent water districts as well. It is the intent of the Navy to recognize the low pH and resultant higher concentrations of inorganics as natural. This requires a redefined acceptable background limit for inorganics in the area. The Navy recognizes the issue is problem encompassing an area larger than Whiting and does not view these ubiquitous inorganics as a contaminant. A letter issued by FDEP on April 11, 2001, removed arsenic as a COC from NAS Whiting Field (FDEP, 20-1) (Appendix I).

The discussion of environmental samples and modeling findings are present on a site-by-site basis for each of the four geographical regions. Following the site-by-site discussion a general discussion of groundwater conditions within each geographic area is provided. A summary of the base-wide groundwater conditions at NAS Whiting Field is provided at the end of Section 4.0.

4.1 AREAS OF INVESTIGATION

In the following discussion of investigation results, each of the four geographic areas is presented individually to reduce the complexity of the information required to describe the extent and character of groundwater contamination. The four geographic areas are the Northern Area, North Central Area, South Central Area and Southern Area. A detailed list of investigated areas is found in subsection 1.2.5. A brief list is as follows: Northern Area consists of Sites 1, 2, 17, 18, and 38, the North Central Area consists of Sites 3, 4 (former UST Site 1467), 32, 35, 36, 37, and 41 (former Building 1485C); UST sites 1438/1439, 2832, and 2894, the South Central Area consists of Sites 5, 6, 7 (former UST Site 1466), 15, 16, 29, 30, and 33), and the Southern Area consists of Sites 8, 9, 10, 11, 12, 14, and 31A through 31F (see Figures 1-2, 4-1).

4.2 COMPONENTS OF INVESTIGATION

The surface soil, subsurface soil, and groundwater at NAS Whiting Field were investigated to determine the:

- Potential for contaminates to leach from soils to groundwater.
- Correlation between leachate potential and groundwater contamination.
- Extent of groundwater contamination at concentrations greater than state and/or federal criteria for Site 40.

- The nature (contaminants, concentrations and temporal variability) of groundwater contamination.

4.2.1 Leachability

The potential for a site to leach contaminants to the groundwater at concentrations sufficient to present a health risk to humans or the environment was evaluated using several lines of evidence. These lines of evidence were: 1) surface and subsurface data, 2) TCLP/SPLP data, 3) leachability modeling data, and 4) groundwater data.

The leachate samples were derived from surface and subsurface soil samples collected at NAS Whiting Field in areas known or suspected to contain analytes above the leachability limits as outlined in the Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C (FDEP, 2005). Additional soil samples were collected coincident with the installation of new monitoring wells. In areas of known soil or groundwater contamination, analyses were restricted to previously detected analytes to determine if these specific analytes were leaching from soil to groundwater. It was also determined that to avoid disturbing any liner and drilling into potentially unsafe areas, additional leachate samples would not be collected from within the boundaries of landfill sites.

TCLP is designed to be the more aggressive of the leaching procedures used when soils contaminated by oily waste are to be analyzed. The procedure is to use an acid rinse (nitric/sulfuric acid to a pH < 2) to aggressively strip analytes from soil and deposit them in the aqueous leachate sample. The TCLP procedure is also associated with a specific abbreviated list of analytes identified to be COPC for oily waste sites.

The SPLP is a less aggressive leaching procedure used during site investigations at NAS Whiting Field. The procedure includes an acetic acid buffer solution that is maintained at a pH of 4.93. The SPLP analysis mimics natural leaching caused by rainwater as it penetrates soil carrying analytes to the water table. It should be noted, as per Chapter 62-777, F.A.C., each metal has a specific regulatory limit for leaching to groundwater. Therefore, either SPLP or TCLP was determined for the soils for each specific site, and concentrations detected in the leachate sample were compared to FDEP regulatory criteria.

The results from the TCLP and SPLP analysis and analysis of groundwater samples were compared to FDEP Groundwater Cleanup Target Levels (GCTLS) from Chapter 62-550, F.A.C., and Chapter 62-777, F.A.C., and USEPA Primary Drinking Water Standards (PDWS) and Secondary Drinking Water Standards (SDWS) from Title 40 CFR Parts 141 and 143.

Two leaching evaluation models were used to simulate infiltration of precipitation through soils and subsequent leaching of contaminants to the groundwater. For contaminants that were detected at concentrations that exceeded the FDEP SCTL, SESOIL was used to perform a leaching evaluation of inorganic constituents and VLEACH was used to perform the leaching evaluation of organic. A complete description of both SESOIL and VLEACH as well as results of the modeling study can be found in Appendix H.

4.3 GROUNDWATER QUALITY INVESTIGATION

Groundwater samples were collected across the facility in support of this investigation as described in Section 3.4. Groundwater quality data collected for this RI Report are compared to background data collected under a previous investigation. A complete background investigation for NAS Whiting Field is presented in the GIR (ABB-ES, 1998a). The background monitoring wells are located north and northeast of the facility (see Figure 1-2). The screened interval of the background wells ranges from 94 to 180 feet bls. The results of the groundwater analyses were compared to FDEP CTLs from Chapter 62-550, F.A.C., and Chapter 62-777, F.A.C. (2005), and USEPA PDWS and SDWS from Title 40 CFR Parts 141 and 143.

4.3.1 BASEWIDE SOIL AND GROUNDWATER QUALITY

The following section provides a description of the influence geologic conditions have on inorganics in soil and background groundwater quality and the groundwater impacts on the North and South Areas.

A technical paper issued in April 2004 “Inorganics in Soil at NAS Whiting Field” (see Appendix I) very briefly describes the likely geologic conditions and mineral chemistry that cause aluminum, iron, manganese, and vanadium to be found at slightly elevated concentrations in soils at all depths at NAS Whiting Field. The paper points out there is no direct evidence of site-related use for these metals at NAS Whiting Field, and the process and procedures at most sites would not likely contribute to the random presence and ubiquitous nature of these inorganic analytes in soils. The slightly elevated concentrations of these inorganics are considered to be an artifact of the regions natural geologic conditions.

The element arsenic substitutes for the same four inorganics and is also found throughout the vadose zone at slightly elevated concentrations above regulatory criteria. A letter issued by FDEP on April 11, 2001, removed arsenic as a COPC from NAS Whiting Field.

Aluminum, arsenic, iron, manganese, and vanadium are found in vadose and phreatic zone soils at concentrations exceeding federal and state SCTLs. As a result, inorganics that occur naturally in soil in both the vadose zone and below the groundwater table tend to be more soluble and mobilize with groundwater flow. As the groundwater flows through regional soils these inorganics are incorporated in the groundwater reflecting regional geochemical conditions rather than the impacts of operations at NAS Whiting Field.

4.3.1.1 Background Groundwater Quality

Seven background groundwater monitoring wells installed in the sand-and-gravel aquifer were hydrogeologically upgradient of the NAS Whiting Field IR Sites (see Figure 1-2). Three of the background wells were shallow water table zone monitoring wells (WHF-BKG-MW-1S, WHF-BKG-MW-2S, and WHF BKG MW-3S) that were installed during the RI Phase II-A sampling program. These monitoring wells are screened across the water table with 15-foot long sections of screen. Because the depth to water at these three locations varies from 60 to 118 feet bls, the depth of the screened interval at these monitoring well locations varies from 65 to 121 feet bls. Monitoring well WHF-BKG-MW-3S, the shallowest well, was later determined to be perched and is not used in the analysis in this report.

Four additional background monitoring wells, two intermediate and two deep, were installed as well clusters adjacent to wells WHF-BKG-MW-1S and WHF-BKG-MW-2S during the RI Phase II-B sampling program. These monitoring wells were installed to monitor intermediate and deep lithologic units in the sand-and-gravel aquifer. An intermediate well was completed 20 to 30 feet deeper than the associated shallow well and a deep well was completed 60 feet deeper than the associated shallow well. Both intermediate and deep monitoring wells (WHF-BKG-MW-1I, WHF-BKG-MW-1D, WHF-BKG-MW-2I, and BKG-MW-2D) were completed with 10-foot sections of screen.

In October 1993, groundwater water samples were collected from monitoring wells WHF-BKG-MW-1S, WHF-BKG-MW-2S, and WHF-BKG-MW-3S and analyzed for TCL VOCs, SVOCs, pesticide/PCBs, and TAL inorganics. In July 1996, groundwater samples from the same monitoring wells were analyzed for TCL VOCs, SVOCs, pesticide/PCBs, and inorganics and general water chemistry parameters alkalinity, chloride, hardness, ammonia, nitrogen, nitrate/nitrite nitrogen, total sulfide, sulfate, total Kjeldahl nitrogen (TKN), total phosphorus, total dissolved solids (TDS), and total organic carbon (TOC) (Tables 4-1 and 4-2).

During the 1996 sampling event, field water quality parameters of the groundwater samples were also measured, including temperature, pH, specific conductance, turbidity, DO, dissolved ferrous-iron, dissolved hydrogen sulfide, and ORP. In addition, monitoring wells that produced groundwater samples with turbidities that exceeded 10 NTUs had an additional filtered groundwater sample collected to evaluate the effect of nondissolved inorganic constituents. The samples were analyzed for TAL inorganic analytes with the exception of cyanide (Table 4-1).

The following sections present the laboratory analytical results of the background groundwater samples collected from NAS Whiting Field. Target analytes detected are presented based on the following three general monitoring zones in the sand-and-gravel aquifer: shallow, intermediate, and deep. Because there is not a continuous confining bed or aquitard, however, each of the monitoring zones was combined for the evaluation and determination of background screening values.

4.3.1.2 Shallow Background Monitoring Wells

Three background groundwater samples were collected on October 14 and 15, 1993, and on July 16 and 17, 1996, from the three shallow monitoring wells (WHF-BKG-MW-1S, WHF-BKG-MW-2S, and WHF BKG MW-3S) during the IR Phase II-A and II-B sampling programs. Shallow monitoring well background locations are shown on Figure 1-2. Tables 4-1 provide summaries of detected analyte concentrations. Groundwater quality parameters measured in the field are provided on Table 4-2.

Two TCL VOCs (benzene and toluene) and one pesticide compound (beta-benzene hexachloride) were detected in background shallow groundwater samples. Organic compounds were only detected during the Phase II-A sampling event. TCL SVOCs or PCB compounds were not detected in shallow background groundwater samples. The two VOCs that were detected at background monitoring well location WHF-BKG-MW-3S, which was later determined to be perched, were not used in the background analysis.

Twenty TAL inorganic analytes, including aluminum, antimony, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, vanadium, zinc, and cyanide were detected in the shallow background groundwater samples. A comparison of the analytical results between the Phase II-A and II-B sampling events indicates a general decrease in the inorganic analyte concentrations. This is likely due to the use of the low-flow purging and sampling methods used during the Phase II-B sampling event.

Three inorganic analytes were detected in shallow background groundwater samples at concentrations exceeding their Florida regulatory criteria. Aluminum was detected at monitoring well locations WHF BKG-MW-1S and WHF-BKG-MW-2S in the Phase II-A event at concentrations of 47,100 and 27,400 µg/L, respectively, which exceed its Florida criteria of 200 µg/L. Iron was detected at monitoring well locations WHF-BKG-MW-1S and WHF-BKG-MW-2S in the Phase II-A event at concentrations of 64,800 and 272,200 µg/L, respectively, which exceeds its Florida criteria of 300 µg/L. Vanadium was detected at monitoring well locations WHF-BKG-MW-1S and WHF-BKG-MW-2S in the Phase II-A event at concentrations of 227 and 176 µg/L, respectively, which exceeds its Florida criteria of 49 µg/L.

Aluminum and iron were not detected in the same shallow wells during the Phase II-B sampling event. Aluminum and iron, however, were detected at intermediate and deeper monitoring well locations WHF BKG-MW-1I and WHF-BKG-MW-2D at concentrations of 420 and 484 µg/L,-for aluminum and 431 and 972 µg/L, for iron exceeding their respective Florida criteria of 200 and 300 µg/L. Aluminum and iron are found in shallow, intermediate and deep monitored levels within the sand-and-gravel aquifer. Also, it should be noted that "dissolved-iron concentrations may locally be objectionable; concentrations as large as 4,300 micrograms per liter have been reported" regionally for the sand and-gravel aquifer (USGS, 2012).

The Phase II-B sampling event incorporated a low-flow purging and sampling methodology to reduce the turbidity of the groundwater samples and collect samples that were representative of the groundwater conditions. As indicated in Table 4-2, the turbidity of the groundwater samples decreased between 101 and 534 percent between the two sampling events. Low turbidity groundwater samples are more representative of the aquifer conditions because inorganic analytes adsorbed to sediment particles are not released into solution when the sample is acidified for sample preservation. Because the low turbidity groundwater samples are more representative of aquifer conditions, only the laboratory analytical results from the Phase II-B sampling event was used to determine background screening values.

Table 4-3 presents background concentrations for general water chemistry parameters from the RI Phase II-B sampling event. Five of 11 water chemistry parameters were detected in the groundwater samples from the shallow monitoring wells including total nitrogen as nitrate plus nitrite, sulfate, TDS, TKN, and TOC.

4.3.1.3 Intermediate Background Monitoring Wells

Two intermediate zone monitoring wells (WHF-BKG-MW-1I and WHF-BKG-MW-2I) were installed and sampled during the RI Phase II-B sampling event on July 16 and 17, 1996 (see Figure 1-2). The low flow purging and sampling methodology was used for sample collection. Table 4-1 provides a summary of the detected analytes.

No VOCs, SVOCs, pesticides, or PCB compounds were detected in the intermediate background groundwater samples.

Fourteen TAL inorganic analytes, including aluminum, barium, cadmium, calcium, chromium, copper, iron, magnesium, manganese, potassium, sodium, vanadium, zinc, and cyanide were detected in the background groundwater samples from intermediate monitoring wells.

Four of 11 water chemistry parameters were detected in groundwater samples from intermediate monitoring wells including: hardness as calcium carbonate, total nitrogen as nitrogen as nitrate, sulfate, and TDS.

4.3.1.4 Deep Background Monitoring Wells

Two deep zone monitoring wells (WHF-BKG-MW-1D and WHF-BKG-MW-2D) were installed and sampled during the RI Phase II-B sampling event on July 16 and July 30, 1996 (see Figure 1-2). Low flow purging and sampling methodology was used for sample collection. Table 4-1 provides summaries of detected analyte concentrations.

No TCL VOC, pesticides, or PCB compounds were detected in the deep background groundwater samples. The TCL SVOC analyte BEHP was detected at 4.0 µg/L in the groundwater sample from monitoring well WHF-BKG-MW-2D. BEHP did not exceed either the state or federal regulatory criteria. BEHP is likely a laboratory artifact.

Fifteen TAL inorganic analytes, including aluminum, barium, beryllium, calcium, chromium, copper, iron, magnesium, manganese, nickel, potassium, sodium, vanadium, zinc, and cyanide were detected in background groundwater samples from deep wells.

Four of 11 groundwater chemistry parameters were detected in groundwater samples from deep wells, including hardness as calcium carbonate (CaCO3), total nitrogen as nitrate plus nitrite, sulfate, and TDS (Table 4-2).

4.3.2 Groundwater Geochemistry

Groundwater samples were collected across the facility to support this investigation as described in Section 3.4. The results of the background groundwater analyses were also compared to FDEP CTLs from Chapter 62-550, F.A.C., and Chapter 62 777, F.A.C., and USEPA PDWS and SDWS from Title 40 CFR Parts 141 and 143. A complete background investigation for NAS Whiting Field is presented in the GIR (ABB-ES, 1998a, Appendix B). The background monitoring wells are located north and northeast of the facility (see Figure 1-2).

Groundwater geochemistry parameters used for evaluating natural attenuation and were analyzed both in the field and at a fixed-base laboratory. Parameters analyzed in the field typically included: pH, conductivity, temperature, turbidity, ORP, hydrogen sulfide and DO. Parameters analyzed at a fixed-base laboratory typically included: DO, alkalinity, ammonia, carbon dioxide, chloride, DOC, nitrate, nitrite, sulfate, sulfide, TKN, TOC, and total phosphorus (see Tables 4-2, 4-3, 4-4 and 4-5).

The pH of groundwater is relevant due to its effect on groundwater organic and inorganic constituent chemistry. As discussed previously, pH in the region as well as at NAS Whiting Field is low. As a result, inorganics that occur naturally in soil in both the vadose zone and below the groundwater table tend to be more soluble and mobilize with groundwater flow. The addition of contaminants to groundwater alters the chemistry again either increasing or decreasing the concentration of inorganics. Understanding the natural state of the pH in groundwater helps in the analysis of the contaminant impact if present.

The pH for groundwater in the sand-and-gravel aquifer is low across the region as well as at NAS Whiting Field. Regulatory limits are between a pH of 6.5 and 8.5. The pH measured in the field at background monitoring well locations in 1993 and 1996 ranged from 4.86 to 5.78 with a median pH of 5.20. The pH of groundwater at NAS Whiting Field has a median value of 5.18 with a minimum pH of 4.21 and a maximum pH of 6.18 for the 2000 to 2011 groundwater sampling events. This reflects the large number of monitoring wells located basewide that have been sampled two to three times. The pH value of Clear Creek, which receives recharge from the larger local area including NAS Whiting Field, had a median value of 5.16 with a minimum pH of 4.34 and a maximum pH of 6.21 (Tetra Tech, 2010a).

The median pH values at NAS Whiting Field are below the lower end of the USEPA SDWS pH range. The low pH is also noted by the USGS to be a regional property, “Water in the aquifer is usually slightly acidic, with a pH of about 6.0; locally, the water is more acidic (pH 4.5). Dissolved iron concentrations may locally be objectionable; concentrations as large as 4,300 milligrams per liter have been reported” (USGS, 2009).

The Northwest Florida Water Management District (NWFWMD) also describes a low regional pH in a published report that states “Existing data suggested parameters with the greatest potential to exceed drinking water standards are pH and iron. Chloride and manganese also show instances of elevated levels, but they seem to occur less frequently than elevated iron and low pH. Low pH and high iron and manganese levels reflect background conditions within the sand-and-gravel aquifer.” “Water quality problems typically encountered with sand-and-gravel aquifer; high iron, low pH, and elevated nitrate conditions. Iron is commonly found at naturally-occurring concentrations that exceed the secondary drinking water standard of 0.3 mg/L” (NWFWMD, 2004).

Typically, as groundwater pH decreases, metals solubility increases. As a result of the low pH values found in groundwater at NAS Whiting Field, aluminum, arsenic, chloride, iron, manganese, and vanadium are typically found at slightly elevated concentrations when compared to groundwater that has a less acidic or neutral pH. These elevated concentrations are likely the direct result of higher solubility than in a typical aquifer. “In the case of heavy metals, the degree to which they are soluble determines their toxicity. Metals tend to be more toxic (available at higher concentrations) at lower pH because they are more soluble" (USGS; http://ga.water.usgs.gov/edu/phdiagram.html). Also, there are no hydrogeologically upgradient sites at NAS Whiting Field that would release these five metals such that they would be found throughout the northern boundary of the facility. A summary of water quality parameters of the groundwater samples measured in the field during the RI Phase II-B sampling are presented in sections of Tables 4-1 and 4-2.

The pH measured in background groundwater samples ranged from 4.73 to 5.6 standard units (SUs), which is in the acidic range. The measured pH values exceed the Florida secondary MCL of 6.5 to 9.5 SUs. Temperature of the background groundwater samples ranged from 23 to 29 degrees Celsius (°C). Specific conductance of the background groundwater samples ranged from 23 to 79 microhoms per centimeter. Background groundwater turbidity ranged from 3 to 171 NTUs. All RI Phase II-A and most of RI Phase II-B groundwater sample turbidity measurements exceeded the State of Florida public water supply treatment techniques criterion of 5 NTUs. Oxidation-reduction potential range from 208 to 362 millivolts (mVs), and DO concentrations ranged from 7.1 to 10.2 mg/L. Dissolved ferrous-iron was detected only in the sample from WHF-BKG-MW-2S, whereas dissolved hydrogen sulfide was not detected in background groundwater samples.

The specific conductance at the shallow monitoring well locations ranged from 26 to 105 microSiemens per centimeter (µS/cm,) and the specific conductance in the background monitoring wells ranged from 15 to 611 µS/cm. There was no clear pattern of increased ion concentration based on this data. Although higher specific conductance levels indicate an increased ion concentration, it does not necessarily indicate that contaminants exist.

The temperature in the shallow monitoring wells ranged from 20.5 to 23.3 °C. These readings are typical of the sand-and-gravel aquifer, which has an average temperature of 22 °C.

The DO readings in the shallow monitoring wells ranged from 7.00 to 12.44 mg/L. No other typical aquifer readings are available.

The ORP readings in the shallow monitoring wells ranged from -98.2 to 193.1 mVs. There was no clear association between ORP readings and contaminant concentrations.

4.4 Northern Area

The Northern Area of Site 40 includes Sites 1, 2, 17, 18, and 38 for the purposes of this report (see Figure 1-2). These sites were sampled at various times for soil and/or groundwater from 1998 to 2000. Earlier in the investigation, full suite USEPA CLP TCL and TAL analyses were performed. During later investigations, only the analytes detected above their background screening level and/or USEPA or

FDEP regulatory criteria in the previous investigations were included for additional analysis. Source areas for the contaminants detected are within the boundaries of the specific sites.

4.4.1 Groundwater Quality – Northern Area

Table 4-2 summarizes the groundwater geochemistry data for the Northern Area shallow groundwater monitoring wells. The field-measured pH values in the Northern Area were below the USEPA SDWS range of 6.5 to 8.5. The pH values ranged from 4.21 to 5.38 and averaged 4.79. These values are similar to NAS Whiting Field's average background pH value of 5.20 and reflect conditions found in the region and are not the result of site activities.

The specific conductance in the shallow monitoring wells ranged from 26 to 105 µS/cm, and the specific conductance in the background monitoring wells ranged from 15 to 611 µS/cm. There is no clear pattern of increased ion concentration based on this data. Higher specific conductance levels indicate there is an increased ion concentration, but does not necessarily indicate that contaminants are present.

The temperature in the shallow monitoring wells ranged from 20.5 to 23.3 °C. These readings are typical of the sand-and-gravel aquifer which has an average temperature of 22 °C. The DO measurements in the shallow monitoring wells ranged from 7.00 to 12.44 mg/L, which are typical of a surficial zone of the sand-and-gravel aquifer. The ORP readings in the shallow monitoring wells ranged from -98.2 to 193.1 mVs.

Organic compounds were not detected in the 2000 and 2001 sampling events in groundwater samples from Sites 1, 2, 17 and 18 at concentrations exceeding FDEP or USEPA regulatory criteria. One SVOC, BEHP (a common field/laboratory derived contaminant) exceeded its FDEP CTL and USEPA PDWS at Site 38. Three pesticides (beta-BHC, gamma-BHC, and heptachlor epoxide) and one SVOC (BEHP) were the only organics detected in groundwater samples from Site 38 that exceeded regulatory criteria in the Northern Area. Beta-BHC exceeded its FDEP CTL; gamma-BHC and heptachlor epoxide exceeded their FDEP CTL and USEPA PDWS in both the groundwater and the SPLP leachate samples. Therefore, soil contamination may have been a source of pesticides to groundwater. The pesticide detections may also reflect non-site-related anthropogenic activities (e.g., routine historical application of chemicals for pest control on the golf course or from upgradient agricultural use).

Groundwater samples from Sites 1, 2, and 17 contain aluminum and iron at concentrations that exceed their USEPA and FDEP CTLs. Groundwater samples from Site 38 contain aluminum, iron, and manganese at concentrations that exceed their FDEP CTLs and USEPA SDWS, arsenic at concentrations that exceed its FDEP CTL and USEPA PDWS, and vanadium at concentrations that exceed its Florida CTL.

4.4.2 OU 01 – Site 1, Northwest Disposal Area

OU 01, hereafter referred to as Site 1, is a 5-acre parcel located along the northwestern facility boundary (see Figure 1-2). Site 1 is located near the North Air Field and can only be easily accessed by Patrol Road. The site is characterized by a surface depression that gently slopes toward a drainage outlet located along the southwestern site boundary. The site is forested with pine trees that are approximately 30 feet tall. Large concrete pipes, culverts, and concrete rubble are present on the surface of the site. Buried waste is not apparent at the land surface, and there are no indications (e.g., stained soil or stressed vegetation) of past waste disposal practices. Surface water bodies are not present within the site boundaries. Surface water runoff from areas adjacent to Site 1 is intercepted by concrete drainage ditch “E” and is conveyed to Clear Creek. There are no known potable groundwater wells within one-quarter mile of the site (EDR, Appendix C). Groundwater from beneath Site 1 is not currently being used as a source for drinking water.

The historical land use of Site 1 reportedly involved the disposal of refuse, waste paints, thinners, solvent, waste oils, and hydraulic fluids associated with the operation and maintenance of aircraft during the period of 1943 until 1965.

The only human health COC identified at Site 1 was arsenic in surface soil. The ecological COCs identified at Site 1 were arsenic, chromium, and vanadium. In the ROD, a LUC remedy was selected to provide protection of human health from arsenic.

Although arsenic was determined to be a COC, subsequent analysis at NAS Whiting Field indicates the presence of arsenic in soil at Site 1 is within naturally occurring levels found elsewhere on the facility (FDEP, 2001).

The ROD (Harding, Lawson, and Associates [HLA], 1999g) presents the final action for both the surface and subsurface soils at Site 1 and is based on results of the RI and FS completed for surface and subsurface soils for Site 1. The remedy selected for Site 1 is LUCs.

Historical investigations at Site 1 revealed the presence of lead in subsurface soil above the baseline screening level and federal and state regulatory criteria and aluminum and iron in groundwater above their CTLs (HLA, 1998).

Leachate Soil Summary

Soil boring location, WHF-01-SB-5 (01D00510), was selected to be the representative of the analytes detected in the subsurface at Site 1. The soil sample from this location was analyzed for SPLP VOCs, TCLP SVOCs, SPLP TPH, and inorganics (aluminum, iron, and lead). VOCs, SVOCs, and TPH were not detected in the leachate from soil sample 01D00510; therefore SPLP/TCLP was not performed on subsequent soil samples. The leachate from soil sample 01G00501 contained aluminum and iron at concentrations that exceeded FDEP GCTLs and USEPA SDWS. A summary of the SPLP and TLCP leachate data is presented in Table 4-6.

Groundwater Analysis Summary

Previous environmental sampling events in 1993 and 1996 did not detect VOCs, SVOCs, pesticides, or PCBs in groundwater samples collected from monitoring wells at Site 1. Therefore, during the 2000 sampling event, a groundwater sample was only collected from newly installed monitoring well WHF-01-MW-5S and was analyzed for VOCs, SVOCs, pesticides, and PCBs. Organic compounds were not detected in the groundwater sample collected from monitoring well WHF-01-MW-5S. The groundwater sample collected from monitoring well WHF-01-MW-5S were also analyzed for TAL metals and cyanide. The groundwater samples collected from existing monitoring wells WHF-01-MW-2S and WHF-01-MW3S were analyzed for aluminum and iron. These groundwater samples were collected “to determine site-specific background concentrations in the shallow aquifer zone” (Tetra Tech, 2000b). Aluminum was detected at concentrations exceeding its FDEP CTLs and USEPA SDWS, and iron was detected at a concentration exceeding its FDEP CTL. A summary of the analytical results are presented in Table 4-7.

Site 1 Summary

The leachate from Site 1 contained aluminum and iron at concentrations that exceeded FDEP GCTLs and USEPA SDWS. Both aluminum and iron were also detected in groundwater exceeding regulatory criteria. Both inorganics are likely naturally occurring. Site 1 is not impacting groundwater.

4.4.3 OU 02 – Site 2, Northwest Open Disposal Area

OU 2, here after referred to as Site 2, the Northwest Open Disposal Area, is a 12-acre parcel located along the northwestern facility boundary near the North Airfield and was previously used as a barrow pit (see Figure 1-2). As a result, the site is now characterized by a surface depression. At its lowest point, the bottom elevation of this surface depression is approximately 20 feet below the surrounding land surface. The site contains wood debris, pallets, asphalt rubble piles, sheet metal, tires, furniture, and crushed paint cans. Surface water bodies are not present within the site boundaries. There are no potable water supply wells within one-quarter mile of the site, and groundwater beneath the site is not currently being used as a source of drinking water (EDR, 2011 and Appendix C).

Site 2 was used for the disposal of construction and demolition debris during the period from 1976 until 1984. Historical land use comprised wastes disposal of asphalt, wood, tires, furniture, and similar materials not suitable for landfill disposal. Since 1984, the site has been inactive. Site 2 has undergone several phases of investigations since 1985 as described in Table 2-1 of the HLA Report (HLA, 1998b).

The current land use for Site 2 is unlimited us and unrestricted exposure.

A ROD Amendment was completed for Site 2, Northwest Open Disposal Area, in 2008 (Tetra Tech, 2008b) in order to modify the ROD signed in September 1999 (HLA, 1999).

In the September 1999 ROD, a LUCs remedy was selected to provide protection for human health and the environment against the lone constituent of concern (COC), arsenic. However, subsequent soil analysis at NAS Whiting Field indicates the presence of arsenic at elevated concentrations at Site 2 is naturally occurring (FDEP, 2001). A review of historical site activities at Site 2 does not support an anthropogenic source for arsenic at the site. Therefore, arsenic has been dropped as a COC for surface soil at Site 2.

The ROD Amendment was prepared by the Navy, the lead agency, with approval from the USEPA, and concurrence from the Florida Department of Environmental Protection (FDEP), because the LUC remedy at Site 2 was no longer necessary.

Historical investigations at Site 2 revealed the presence of manganese in subsurface soil above background screening levels and federal and state regulatory criteria and aluminum in groundwater above CTLs (HLA, 1998b).

Leachate Soil Summary

Subsurface soil sample 02SLMW04S12 collected at boring location WHF-02-SB-4 (see Figure 1-2) was the representative subsurface soil sample for Site 2. The subsurface soil sample was analyzed for SPLP VOCs, TCLP SVOCs, SPLP pesticides, SPLP PCBs, and SPLP TPH.

Chloroform and methylene chloride were detected in the SPLP leachate from Site 2. Methylene chloride exceeded FDEP leachability to groundwater SCTL. Since these analytes were not detected in the associated soil sample used to derive the SPLP extract, it is likely that both are laboratory contaminants. Methylene chloride is a common laboratory contaminant, as it is used in various SVOC laboratory extraction procedures. Chloroform is likely an anthropogenic additive the laboratory should have filtered from their water supply.

No other VOCs, SVOCs, pesticides, PCBs, or TPH were detected in the subsurface soil sample; therefore, SPLP/TCLP was not performed for these analytes. The leachate from subsurface soil sample 2SB0410 collected at boring location WHF-02-SB-4 (see Figure 1-2) contained aluminum and iron at concentrations exceeding FDEP GCTLs and USEPA SDWS. A summary of the analytical results are presented in Table 4-8.

Groundwater Analysis Summary

Previous environmental sampling events in 1993 and 1996 did not detect VOCs, SVOCs, pesticides, or PCBs in groundwater samples collected from Site 2 monitoring wells. Therefore, during the 2000 sampling event, a groundwater sample was only collected from newly installed monitoring well WHF-02-MW-4S and was analyzed for VOCs, SVOCs, pesticides, and PCBs. Organic compounds were not detected in the groundwater sample collected from monitoring well WHF-02-MW-4S. The groundwater sample collected from monitoring well WHF-02-MW-4S were also analyzed for TAL metals and cyanide. The groundwater sample collected from existing monitoring well WHF-02-MW-1S was analyzed for aluminum. These groundwater samples were collected “to determine site specific background concentrations in the shallow aquifer zone” (Tetra Tech, 2000b). Aluminum was detected at concentrations exceeding its FDEP CTL and USEPA SDWS, and iron was detected at a concentration exceeding its FDEP CTL. A summary of the analytical results are presented in Table 4-9.

Site 2 Summary

The leachate from Site 2 contained aluminum and iron at concentrations that exceeded FDEP GCTLs and USEPA SDWS. Both aluminum and iron were also detected in groundwater exceeding regulatory criteria. Both inorganics are likely naturally occurring. Site 2 is not impacting groundwater.

4.4.4 OU 16 – Site 17, Crash Crew Training Area A

OU 16, hereinafter referred to as Site 17, is a 4-acre parcel located along the northwestern facility boundary of NAS Whiting Field (see Figure 1-2) and can only be easily accessed by the Patrol Road. The site slopes gently towards the southwest. The site is currently covered by two feet of soil fill, which is covered by mowed grass. There are no indications (e.g., stained soil or stressed vegetation) of past fire-fighting training practices. According to the USDA (USDA, 1980), the soil at Site 17 is classified as Troup Loamy Sand. Because the soil at the site is predominantly silty sand, most of the on-site rainfall infiltrates directly into the soil. If surface water runoff occurred, it would flow along the southwestern site boundary to be intercepted by concrete drainage ditch “E”. This ditch is present near the southern boundary of the site and conveys surface water from the North Airfield to Clear Creek, (ABB-ES, 1998a). Surface water bodies are not present within the site boundaries. There are no potable water supply wells within one-quarter mile of Site 17 (EDR, 2011, and Appendix C. Groundwater from beneath Site 17 is not currently being used as a source for drinking water.

The historical land use of Site 17 involved igniting approximately 100 gallons of AVGAS or jet fuel within a shallow depression containing a mock-up airframe and extinguishing the fire with aqueous fire-fighting foam (AFFF). Site 17 operated from 1951 until 1991. Site 17 has undergone several phases of investigations since 1985.

Ethylbenzene, methylene chloride, toluene, trichloroethene, and total xylenes, and one naphthalene exceeded Chapter 62-777 F.A.C., Florida leachability SCTLs. TRPH exceeded chapter 62-777 F.A.C. residential, industrial, and leachability SCTLs. No pesticides or PCBs were detected in the surface soil sample collected from Site 17.

Organic analytes detected in subsurface soil samples consisted of three VOCs, two SVOCs, two pesticides, and two PCBs none of which exceeded Florida state or federal residential or industrial screening criteria. Arsenic was detected in for subsurface soil samples at concentrations that exceeded the state and federal industrial screening criteria.

The current land use for Site 17 is designated recreational under conditions agreed upon by the FDEP (FDEP, 1998) and USEPA.

The human health COCs identified at Site 17 includes barium, copper, and TRPH in surface soil. No ecological COCs were identified at Site 17. There were no exceedances of SCTLs found in the subsurface soil at Site 17. Therefore, based on the COCs identified for the surface soil, the HHRA determined that actual or threatened releases of hazardous substances from this site would present imminent and substantial endangerment to public health or welfare if LUCs were not implemented.

The ROD (Tetra Tech, 2006a) presents the final action for surface and subsurface soils at Site 17 and is based on findings of the RI and completed for surface and subsurface soils for Site 17. The remedy selected for Site 17 is LUCs and includes Five Year Reviews (FYRs) to evaluate the effectiveness of the LUCs.

Leachate Soil Summary

Previous groundwater investigations at Site 17 revealed the presence of aluminum and iron above their federal and state CTLs (HLA, 2000a). During the year 2000 and 2001 sampling events, soil samples were not collected at Site 17. Previous soil results are discussed in the RI for Site 17 (HLA, 2000a).

Leachate Infiltration Modeling Results

During the 1992 Phase II-A investigations, 34 surface soil samples were collected from 0 to 8 inches bls. The sampling locations were biased toward the seven burn pit areas, stained soil areas, and swales associated with overland flow. During the 1993 Phase II-A field investigation, 19 subsurface soil samples were collected from 9 soil borings. Most of the subsurface soil samples were collected from depth intervals of 5 to 7, 10 to 12, 15 to 17, and 20 to 22 feet bls. One soil sample (17SB1-60-62) was collected from a depth of 60 to 62 feet bls and was analyzed only for metals and cyanide.

Based on the analytical results of the 34 surface soil samples, 7 different organic analytes, TRPH, and 3 metals (antimony, cadmium, and total chromium) were found to have maximum detected concentrations exceeding FDEP leachability to groundwater SCTLs (see Table E-4 in Appendix H). For SESOIL modeling, the maximum concentrations of these chemicals were assigned to Layer 1. Two metals (antimony and chromium) were detected exceeding the SCTLs in 2 out of 14 and 4 out of 15 soil samples, respectively, collected from a depth of 2 to 7 feet bls at Site 17. For modeling purposes, the maximum concentrations of these two metals were assigned to Layer 2 (2 to 7 feet bls). Cadmium, which was detected below its SCTL at a concentration of 2.5 mg/kg, was assigned to Layer 2 of the cadmium SESOIL model for Site 17. The concentrations of all other chemicals were assigned values of 0.0 mg/kg for Layers 2, 3, and 4. No chemicals were detected at concentrations exceeding their respective leachability to groundwater SCTLs at depths greater than 7 feet bls. Chromium was detected at 15.9 mg/kg in one sample collected from a depth of 15 to 17 feet bls. This value was assigned to sublayers of the chromium SESOIL model representing 7 to 19 feet bls.

The SESOIL model for antimony showed that antimony takes nearly 197 years to reach its predicted peak concentration of 6.5 µg/L at a 10-foot depth, and then starts decreasing immediately. Because of its higher K_d value (75 liters kilogram [L/kg], Table E-5 in Appendix H), cadmium moves downward even slower than antimony and had a predicted peak concentration of 13 µg/L at a depth of 10 feet. Chromium moves downward more quickly than antimony and cadmium and reached a predicted peak concentration of 500 µg/L in leachate at a depth of 10-foot depth. In addition, concentrations of chromium started declining at this depth in year 52 of the simulation. Because of its lower K_d value (19 L/kg, Table E-5 in Appendix H), total chromium moves downward more quickly than antimony and cadmium and reaches a depth of 27 feet bls after 200 years. None of these three metals infiltrated to a 30-foot depth during the 200 years of simulated migration.

Two SVOCs (naphthalene and 2-methylnaphthalene) and TRPH were detected in surface soil samples, but not in the subsurface soil samples (i.e., > 2 feet bls). During VLEACH simulations, the predicted naphthalene concentration at a 10-foot depth peaked at 23 µg/L at about 90 years through the simulation and decreased thereafter. Predicted TRPH concentrations at a 10-foot depth peaked at 11,000 µg/L near the end of the 200-year simulation. 2-Methylnaphthalene migrates more slowly than naphthalene and TRPH and barely rose above a predicted concentration of 2 μg/L at a 10-foot depth after 200 years of migration. None of these three chemicals infiltrated to 30 feet bls after 200 years of migration (see Table E-8 in Appendix H).

Five VOCs were detected in the surface soils. These analytes have lower K_d values (0.069- to 1.394 L/kg) than the metals, SVOCs, and TRPH discussed above. As a result, these five analytes moved downward through the vadose zone more quickly. Predicted peak concentrations of three of the VOCs (methylene chloride, 2-methylnaphthalene, and TCE) exceeded 1 μg/L at a depth of 30 feet bls (see Table E-8 in Appendix H). However, the peak concentrations of the VOCs at the bottom of the vadose zone (103 feet bls) were all less than 0.2 μg/L. The maximum predicted peak VOC concentration to reach the water table was TCE at a concentration of 0.14 μg/L after 93 years of migration. The TCE concentration at this depth decreased rapidly after year 103. As a result, none of these VOCs had a significant effect on groundwater quality in the uppermost aquifer unit. Diagrams of predicted TCE concentration versus time at depth of 10, 30, and 103 feet bls is presented in Figure E-3 in Appendix H.

Based on the above, the analytes detected in soils at Site 17 are not predicted to exceed federal or state regulatory criteria for leaching to groundwater.

Groundwater Analysis Summary

No SVOCs, pesticides, or PCBs, were detected in groundwater samples collected during Phase II-B. During the 2000 and 2001 sampling events, groundwater samples were not collected at Site 17. Previous groundwater investigations revealed targeted organic analytes were not present at concentrations that exceeded regulatory limits (HLA, 1999c, HLA, 2000a).

During the 2000 and 2001 sampling events, groundwater samples were not collected at Site 17. Previous groundwater investigations at Site 17 revealed the presence of aluminum and iron at concentrations that exceed their FDEP CTLs (HLA, 2000a).

Site 17 Summary

Based on leachate modeling the five VOCs, two SVOCs, TRPH, and three metals analytes detected in soils at Site 17 are not predicted to exceed federal or state regulatory criteria for leaching to groundwater. No SVOCs, pesticides, or PCBs, were detected in groundwater samples. The leachate from Site 17 contained aluminum and iron at concentrations that exceeded FDEP GCTLs and USEPA SDWS. Both aluminum and iron were also detected in groundwater exceeding regulatory criteria. Both inorganics are likely naturally occurring. Site 17 is not impacting groundwater.

4.4.5 OU 17 – Site 18, Crash Crew Training Area B

OU 17, hereinafter referred to as Site 18, is a 5-acre parcel located along the northwestern facility boundary of NAS Whiting Field (see Figure 1-2) and can only be easily accessed by the Patrol Road. The site slopes at a low angle towards the southwest. In, 1999 Site 18 was covered with a minimum of two feet of compacted clean fill and re-vegetated. Administrative controls in the form of LUCs are currently enforced (Bechtel, 2000a). There are no indications (e.g., stained soil or stressed vegetation) of past fire-fighting training practices. According to the Santa Rosa County soil survey (USDA, 1980), the soil at Site 18 is classified as Troup Loamy Sand. The soil surrounding the site is predominantly silty sand, and most of the on-site rainfall infiltrates directly into the soil. Surface water bodies are not present within the site boundaries. There are no potable water supply wells within one-quarter mile of Site 18 (EDR, 2011 and Appendix C). Groundwater from beneath Site 18 is not currently being used as a source for drinking water.

The historical land use of Site 18 involved igniting approximately 110 gallons of JP-5 fuel within burn pits and extinguishing the fire with AFFF. Site 18 operated from 1951 until 1991. Site 18 has undergone several phases of investigations since 1985.

The four human health COCs identified at Site 18 are cPAHs, barium, copper, and TRPH in surface soil. Only TRPH was identified as a COC in the subsurface soil at Site 18. Ecological COCs were not identified at Site 18. Based on the COCs present in the surface and subsurface soil, the HHRA found that actual or threatened releases of hazardous substances from this site would present an imminent and substantial endangerment to public health or welfare if LUCs were not implemented.

The ROD (Tetra Tech, 2006b) presents the final action for surface and subsurface soils at Site 18 and is based on results of the RI and FS completed for surface and subsurface soils for Site 18. The selected remedy at Site 18 is LUCs and includes FYRs to evaluate the effectiveness of the LUCs.

Historical investigations at Site 18 revealed the presence of total xylenes, 2-methylnaphthalene, 4-methylphenol, naphthalene, phenol, and TPH in exceedance of FDEP SCTLs and leachability to groundwater criteria.

Leachate Soil Summary

Soil samples 18SB0609 and 18SB0809 from soil boring locations WHF-18-SB-6 and WHF-18-SB-8, respectively, were selected to representative of the analytes detected in the subsurface at Site 18. The subsurface soil samples were analyzed for SPLP VOCs, SPLP SVOCs, and SPLP TPH. VOCs, SVOCs, and TPH were not detected in the subsurface soil samples; therefore, SPLP was not performed on subsequent soil samples.

The SPLP was performed for aluminum, cobalt, copper, iron, lead, and manganese. Aluminum and iron exceeded their FDEP GCTLs and USEPA SDWS in the leachate from soil sample 18SB0609 collected from soil boring location WHF-18-SB-6. A summary of the SPLP leachate data is presented in Table 4-10.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their federal or state CTLs. During the 1992/1993 Phase II-A field investigations, 47 surface soil samples were collected from the land surface to 1 foot bls. The soil sampling locations were biased toward the 11 burn pit areas, stained soil areas, swales associated with overland flow, and areas exhibiting elevated organic vapor readings. During the 1993 Phase II-A field investigation, 24 subsurface soil samples were collected from 10 soil borings. Nineteen of the subsurface soil samples were collected from depth intervals of 5 to 7, 10 to 12, and 15 to 17 feet bls. The remaining five subsurface soil samples were collected from depth intervals of 20 to 22 feet bls in soil borings 18-SB-02 and WHF-18-SB-06 and from depth intervals of 25 to 27, 35 to 37, and 40 to 42 feet bls in soil boring 18-SB-04. The deepest soil sample was collected from a depth of 40 to 42 feet bls.

Based on the analytical results of the 47 surface soil samples, four different organic analytes (ethylbenzene, methylene chloride, 2-methylnaphthalene, and naphthalene), TRPH, and three metals (antimony, cadmium, and total chromium) were found to have maximum detected concentrations that exceed their Florida leachability to groundwater SCTLs (see Table E-4 in Appendix H).

In the near-surface soils (i.e., 2 to 15 feet bls), total xylenes, 2-methylnaphthalene, 4-methylphenol, phenol, naphthalene, and TRPH were detected with at least one sample each displaying a concentration exceeding their Florida leachability to groundwater SCTLs (see Table E-4 in Appendix H). Two organic analytes (ethylbenzene and methylene chloride) and the three metals detected above in the surface soils were not detected in the near-surface soils. For modeling purposes, the maximum concentrations of the six organics were assigned to Layer 2 (2 to 7 feet bls).

At sampling depths greater than 15 feet, three chemicals (2-methylnaphthalene, chromium, and TRPH) were detected in the subsurface soils at concentrations exceeding their respective leachability to groundwater SCTLs. In addition, naphthalene was detected in two subsurface soil samples at concentrations below its leachability to groundwater SCTL. The concentrations assigned to the transport models at depths greater than 15 feet bls for the other chemicals were set equal to 0 mg/L (see Table E-4 in Appendix H).

The SESOIL model for Site 18 predicts that the 11 chemicals will reach a depth of 10 feet in the vadose zone during 200 years of migration. Out of this group of 11, the three chemicals with the highest K_d values (2-methylnaphthalene, antimony, and cadmium) were not predicted to reach a depth of 30 feet in 200 years. The other eight chemicals, naphthalene, chromium, and TRPH were not predicted to reach the bottom of the vadose zone or the water table in 200 years; because they have intermediate values of K_d.

Five organic analytes, ethylbenzene, methylene chloride, xylene, phenol, and 4-methylphenol did infiltrate to the bottom of the vadose zone and have relatively low K_d values ($\leq$ 2.1 L/kg). Three of these analytes (ethylbenzene, methylene chloride, and xylene) are VOCs and two (phenol and 4-methylphenol) are SVOCs. The maximum predicted concentrations of ethylbenzene, methylene chloride, xylene, and 4-methylphenol analytes at the bottom of the vadose zone were less than 3.0 E-7 µg/L, and the concentrations decreased rapidly after the peak was passed. Although phenol infiltrated to the bottom of the vadose zone at a maximum predicted concentration of 24.0 µg/L, the peak concentration after mixing in groundwater is 7.7 µg/L. This is lower than the FDEP GCTL 10 µg/L (see Table E-8 in Appendix H). Diagrams of predicted phenol concentration versus time at depths of 10, 30, and 87 feet bls is presented in Figure E-4 in Appendix H.

None of the analytes detected in surface and subsurface soil at Site 18 that exceed their federal or state leaching to groundwater CTL are predicted to migrate downward in the soil column at concentrations that would result in an exceedance of their groundwater quality criteria.

Groundwater Analysis Summary

During the 2000 and 2001 sampling events, groundwater samples were not collected at Site 18. Previous groundwater investigations revealed targeted organic or inorganic analytes were not present at concentrations that exceed regulatory limits (HLA, 1999c, HLA, 2000a).

Site 18 Summary

Based on leachate modeling analytes detected in soils at Site 18 are not predicted to exceed federal or state regulatory criteria for leaching to groundwater. No SVOCs, pesticides, or PCBs, were detected in groundwater samples. The leachate from Site 18 contained aluminum and iron at concentrations that exceeded FDEP GCTLs and USEPA SDWS. Both aluminum and iron were also detected in groundwater exceeding regulatory criteria, but both are likely naturally occurring. Site 18 is not impacting groundwater.

4.4.6 OU 23 – Site 38, Former Golf Course Maintenance Building

OU 23, here after referred to as Site 38, Building 2877 or the Former Golf Course Maintenance Building, is located approximately 276 feet west and 860 feet north of the white lattice fence associated with the pistol firing range immediately west of the 7th hole fairway on the NAS Whiting Field Golf Course (see Figure 1-2) and can only be easily accessed by the Patrol Road. Building 2877 was initially the Club House, and the main golf course maintenance work area was at the rear of the building. Golf cart battery reconditioning was reportedly conducted at the rear of the building. The battery acid was drained into a sink inside the building. The sink subsequently drained into a tank consisting of an underground concrete culvert opened at one end. The tank retained approximately 50 gallons of liquid before draining to the subsurface soil. The tank was filled with rock sometime between 1974 and 1979, resulting in the discontinuance of battery acid draining at Site 38 (CH^2M HILL, 2002).

Pesticides, including organophosphates, herbicides, fungicides, chlordane, heptachlor epoxide, and some hydrocarbon pesticides were also stored and handled in Building 2877 during operations. Pesticide storage was discontinued in 1983 when a new pesticide facility was completed. A small parking area approximately 200-foot by 200-foot, located north of the building and across the access road was used to rinse trucks after they were used to spray pesticides. A 200-foot by 200-foot area located southwest of the building was used to fill pesticide containers. Possible wastes associated with the site include battery acid, fuels, solvents, and pesticides.

Building 2877 was demolished in 1993 as part of an upgrading and reconstruction project for the NAS Whiting Field Golf Course. Based on site investigations, the concrete building foundation is believed to still be present; however, it is unknown if the former drainage tank is still present.

Unacceptable human health risks were not identified for Site 38 surface and subsurface soils under a residential land use scenario, and risks to ecological receptors were considered acceptable. Therefore, the ROD for Site 38 documents the selected remedial action as a NFA for surface and subsurface soils (Tetra Tech, 2005a).

A soil removal action was conducted on May 13, 2002, based on the RI conducted by CH2M HILL. Soil confined to two limited areas was found to be contaminated with 4,4'-dichlorodiphenyldichloroethylene (DDE) and 4,4'-DDT exceeding USEPA Region 4 recommended ecological screening values (ESV) and alpha-chlordane, gamma-chlordane, and heptachlor epoxide exceeding the USEPA Region 9 preliminary remediation goals (PRGs) of 1,600 µg/kg, 1,600 µg/kg, and 53 µg/kg, respectively, for residential exposure. TRPH exceeded the FDEP leachability and direct exposure residential standard of 340 mg/kg, and dieldrin exceeded the USEPA Region 4 ESV threshold concentration of 0.5 µg/kg. After the source removal action, none of the targeted chemicals identified as COPCs were detected in either surface or subsurface soils at Site 38. Based on the results of the soil removal, it is not likely that soil at Site 38 is a source for impacts to groundwater by the detected pesticides (CH2M HILL, 2002).

After the interim source removal action, no chemicals were identified as COPCs in either surface or subsurface soils at Site 38.

Leachate Soil Summary

SPLP was performed for SVOCS, TPH, and pesticides. Two pesticides, total chlordane and heptachlor epoxide, were detected in the sample leachate and one of their duplicate samples from Site 38. Total chlordane and heptachlor epoxide exceeded their respective FDEP CTLs and the USEPA PDWS. SPLP was performed for aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. Arsenic, lead, and mercury exceeded FDEP CTLs and USEPA PDWS. Aluminum, iron, and manganese exceeded FDEP CTLs and USEPA SDWS. Vanadium exceeded its FDEP CTL. A summary of the SPLP leachate data is presented in Table 4-11.

Leachate infiltration modeling was not applied to Site 38 because the removal action eliminated the soil that was the source for the analytes that could contribute to groundwater contamination.

Groundwater Analysis Summary

Groundwater samples were collected from four newly installed shallow monitoring wells in 2000. Groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and TPH. One SVOC, BEHP (BEHP is a common field/laboratory derived contaminant) exceeded its FDEP CTL and USEPA PDWS in the groundwater sample collected from monitoring well WHF-38-MW-3S. Three pesticides (beta benzene hexachloride [BHC], gamma-BHC, and heptachlor epoxide) were detected in the groundwater sample collected from groundwater monitoring well WHF-38-MW-2S. Beta-BHC exceeded its FDEP CTL: gamma-BHC and heptachlor epoxide exceeded their FDEP CTLs and USEPA PDWS. None of the other targeted organic compounds were detected in the groundwater samples collected from Site 38.

Groundwater samples collected from monitoring wells at Site 38 were analyzed for TAL metals and cyanide. Arsenic exceeded its FDEP CTL and USEPA PDWS, aluminum, iron, and manganese exceeded their FDEP CTLs and USEPA SDWS. Vanadium exceeded its Florida CTL in groundwater samples collected from the site. All other analytes were either not detected or detected at concentrations below regulatory criteria. A summary of the analytical results are presented in Table 4-12.

Site 38 Summary

Leachate infiltration modeling was not applied to Site 38 because the removal action eliminated the soil that was the source for the analytes that could contribute to groundwater contamination. No SVOCs, pesticides, or PCBs, were detected in groundwater samples. One SVOC, BEHP (BEHP is a common field/laboratory derived contaminant) exceeded its FDEP CTL and USEPA PDWS in the groundwater sample collected from monitoring well WHF-38-MW-3S. Three pesticides (beta benzene hexachloride [BHC], gamma-BHC, and heptachlor epoxide) were detected in the groundwater sample collected from groundwater monitoring well WHF-38-MW-2S. Beta-BHC exceeded its FDEP CTL: gamma-BHC and heptachlor epoxide exceeded their FDEP CTLs and USEPA PDWS. The pesticides detected in groundwater likely reflect years of pesticide application on upgradient farm lands and/or the local applications of pesticides on adjacent golf course greens and fairways.

Arsenic exceeded its FDEP CTL and USEPA PDWS, aluminum, iron, and manganese exceeded their FDEP CTLs and USEPA SDWS in groundwater samples collected from the site. Vanadium exceeded its Florida CTL in groundwater samples collected from the site. Aluminum, iron, and iron were also detected in groundwater exceeding regulatory criteria but are likely naturally occurring. Site 38 is not impacting groundwater.

4.4.7 Impact of Soil Contamination Leaching to Groundwater – Northern Area Summary

SPLP and/or TCLP analysis were performed for the analytes that had an exceedance of the FDEP leachability to groundwater criteria. If an exceedance was not detected, then a representative sample(s) was chosen and SPLP and/or TCLP analysis was performed.

The following provide a summary of the analytes that were detected in TCLP and SPLP leachate samples for the SCA.

- Site 1: aluminum and iron,
- Site 2: chloroform and methylene chloride were detected in the SPLP leachate from Site 2, but are likely artifacts from the laboratory,
- Site 17: only arsenic was detected at Site 17 exceeding regulatory criteria,
- Site 18: aluminum and iron,
- Site 38: total chlordane, heptachlor epoxide, aluminum, arsenic, iron, lead, manganese, and mercury.

Although leachate infiltration modeling was conducted for the chemicals that were previously detected during the RI in soil samples collected from the SCA, none of the chemicals are predicted to migrate to groundwater at concentrations that may result in an adverse impact to groundwater.

4.4.8 Groundwater Contamination – Northern Area Summary

Organic compounds were not detected historically or in the year 2000 and 2001 sampling events in groundwater samples from Sites 1, 2, 17 and 18 at concentrations exceeding FDEP or USEPA regulatory criteria. One SVOC, BEHP (a common field/laboratory derived contaminant) exceeded its FDEP CTL and USEPA PDWS at Site 38. Three pesticides (beta-BHC, gamma-BHC, and heptachlor epoxide) and one SVOC (BEHP) were the only organics detected in groundwater samples from Site 38 that exceeded regulatory criteria in the Northern Area. Beta-BHC exceeded its FDEP CTL; gamma-BHC and heptachlor epoxide exceeded their FDEP CTL and USEPA PDWS in both the groundwater and the SPLP leachate samples. Therefore, soil contamination may have been a source of pesticides to groundwater. The pesticide detections may also reflect non-site-related anthropogenic activities (e.g., routine historical application of chemicals for pest control on the golf course or from upgradient agricultural use).

Groundwater samples from Northern Area Sites 1, 2, and 17 contain aluminum and iron at concentrations that exceed their USEPA and FDEP CTLs. Groundwater samples from Site 38 contain aluminum, iron, and manganese at concentrations that exceed their FDEP CTLs and USEPA SDWS, arsenic at concentrations that exceed its FDEP CTL and USEPA PDWS, and vanadium at concentrations that exceed its Florida CTL. Northern Area sites are not impacting groundwater

4.5 NORTH CENTRAL AREA

The paragraphs below present a brief site history including soil investigations and subsequent remedies and the results of SPLP and groundwater sampling assessment activities for the NCA of Site 40 Base-Wide Groundwater. The NCA of Site 40 includes IR Sites 3, 4 (former UST Site 1467), 32, 35, 36, 37, and 41 and UST Sites 1438/1439, 2832, 2894, OWS Building 2993, and Product Line Facilities (Former Fuel Dispensing Area and Pipe Line Junction) for the purposes of this report. Figure 1-2 depicts the NCA.

In 2007, 22 monitoring wells were sampled for organic analysis, and 21 monitoring wells were sampled or inorganic analysis. In 2008 and 2011, a total of 27 and 34 monitoring wells were sampled respectively for organic and for inorganic analyses. Groundwater samples were collected from shallow, intermediate, and deep monitoring wells located at Sites 3, 4 (former UST Site 1467), 32, 35, 36, 37, and 41 and UST Sites 1438/1439, 2832, and 2894 in the NCA of Site 40. These groundwater samples were collected following SOPs found in the SAP for the respective years listed (Tetra Tech, 2007a, 2008, and 2010a). Sites 3, 4 (former UST Site 1467), and 32 are within, and likely contribute to, the NCA plume and are addressed as a group. Sites 35, 36, 37, and 41, and UST Sites 1438/1439, 2832, and 2894 are not located within the NCA plume boundary and are addressed individually (see Figure 1-2).

4.5.1 <u>Groundwater Quality - NCA</u>

In 2011, seven groundwater quality parameters (see Table 4-3) were measured in 34 of the groundwater samples collected in the NCA. Groundwater geochemistry parameters were used for evaluating natural attenuation and were analyzed both in the field and at a fixed-base laboratory. Parameters analyzed in the field included pH, conductivity, temperature, turbidity, ORP, hydrogen sulfide, and DO. Parameters analyzed at a fixed-base laboratory included DO, alkalinity, ammonia, carbon dioxide, chloride, DOC, nitrate, nitrite, sulfate, sulfide, TKN, TOC, and total phosphorus.

Nineteen samples were collected from shallow aquifer zone monitoring wells where total depths ranged from 73 to 123 feet bls. Thirteen samples were collected from intermediate aquifer zone monitoring wells where total depths ranged from 114 to 156 feet bls. Two samples were collected from deep aquifer zone monitoring wells where total depths ranged from 130 to 185 feet bls.

With the exception of one monitoring well (WHF-03-MW-3I), the pH values were outside the USEPA SDWS range of 6.5 to 8.5. The pH values in the shallow aquifer zone monitoring wells ranged from 4.37 to 6.51. A pH measurement of 11.29 at monitoring wells WHF-32-MW-5S is an anomalous outlier possibly due to instrument calibration drift. An examination of subsequent logs from other monitoring wells did not show similar reading. During the sampling events of 2007 and 2008, the pH values of samples collected from the same monitoring well WHF-32-MW-5S were 4.65 and 5.03, respectively. The pH values in the intermediate aquifer zone monitoring wells ranged from 4.27 to 6.51. The pH in the deep aquifer zone monitoring wells ranged from 5.18 to 6.20. The average values for the shallow, intermediate, and deep aquifer zone monitoring wells were 5.85, 5.22 and 5.69, respectively, indicating the groundwater in the NCA is slightly less acidic than the average backgrounds of 5.20, 5.17, and 5.43, respectively, and as reported by USGS for the sand and gravel aquifer (2009).

The specific conductance in the shallow aquifer zone monitoring wells ranged from 17 to 285 µS/cm, and the specific conductance in the shallow aquifer zone background monitoring wells ranged from 15 to 611 µS/cm. The specific conductance in the intermediate aquifer zone monitoring wells ranged from 22 to 196 µS/cm, and the specific conductance in the intermediate aquifer zone background monitoring wells ranged from 38 to 79 µS/cm. The specific conductance in the deep aquifer zone monitoring wells ranged from 38 to 86 µS/cm, and the specific conductance in the deep aquifer zone background monitoring wells ranged from 30 to 45 µS/cm. There was no clear pattern of increased ion concentration based on this data. Although higher specific conductance levels indicate an increased ion concentration, it does not necessarily indicate that contaminants are present in groundwater.

As discussed in the introduction to this section and specified in Table 4-3, DO measurements were collected using two different methods. In the field, CHEMetsTM kits were used to obtain DO measurements at the well head. Groundwater samples were also submitted to an off-site laboratory for analysis. The DO readings ranged from 0 to 6 mg/L in the shallow aquifer zone monitoring wells, 0 to 5.5 mg/L in the intermediate aquifer zone monitoring wells, and 3.5 to 6 mg/L in the deep aquifer zone monitoring wells. DO values reached 7 mg/L and diminished to less than 1 mg/L within the TCE/BTEX NCA plume where high contaminant concentrations are present. Figure 4-2 depicts the DO isocontours for the NCA using 2011 data.

The ORP readings ranged from -115.2 to 230.8 mVs in the shallow aquifer zone monitoring wells, -63.0 to 247.0 mVs in the intermediate aquifer zone wells, and 103.8 to 131.40 mVs in the deep aquifer zone monitoring wells. Figure 4-3 depicts the ORP isocontours for the NCA using 2011 data.

4.5.2 OU 03 – Site 3, Underground Waste Solvent Storage Area

OU 3, hereafter referred to as Site 3, is composed of two discontinuous areas at the northern and southern ends of Building 2941 and extends south toward Building 2987 in the North Field Industrial Area (see Figure 1-2). The site includes an area where two 500-gallon metal USTs were used from 1980 to April 1984 for the storage of waste solvents and residue generated from paint stripping operations conducted at Building 2941. Site 3 also includes the area where a waste oil UST was located near the southwestern corner of Building 2941. A water supply well exists within one-quarter mile of Site 3. This waste oil UST was used for storage of airframe, power plant, and ground support equipment liquid waste from 1968, and possibly earlier, to 1986. The waste oil USTs was reportedly removed in 1984 (Tetra Tech, 2004a).

Wastes (paint-stripping waste solvents and residue) in the waste solvent USTs were periodically removed for off-base disposal. In April 1984, use of the USTs was discontinued, and the two tanks were removed from the site. During the excavation operations, one of the tanks was punctured by a backhoe, resulting in the spillage of approximately 120 gallons of waste solvent onto the ground. Cleanup operations resulted in the recovery of approximately 50 gallons of the waste solvent, and the removal and disposal of approximately six cubic yards (yd^3) of contaminated soil. These materials were sent off base for disposal. Examination of the USTs revealed holes up to 0.5 inch in diameter apparently caused by the wastes corroding through the metal tanks. The amount of waste solvent released is unknown (Tetra Tech, 1999a).

The HHRA conducted during the RI for Site 3 determined that the actual or threatened releases of hazardous substances detected in surface and subsurface soils did not present a current or future potential threat to public health and welfare. Based on the results of the HHRA for surface and subsurface soils at Site 3, the ROD documented the remedial action selected for Site 3 as NFA for surface and subsurface soils (Tetra Tech, 2004a).

Previous groundwater investigations at Site 3 revealed the presence of PCE, TCE, 1,2-DCE, benzene, ethylbenzene, toluene, BEHP, heptachlor epoxide, aluminum, cadmium, iron, lead, manganese, and mercury in the groundwater (ABB-ES, 1995c) in exceedance of federal and/or state regulatory criteria.

Leachate Analysis Summary

Based on historical data, SPLP was performed for dieldrin at three soil sample locations (WHF-03-SB-01, WHF-03-SS-03 and WHF-03-SB-12) but was not detected in the leachate samples (see Table 4-5). The SPLP was also performed for aluminum, chromium, cobalt, copper, iron, lead and manganese at soil sample locations WHF-03-SB-01 and WHF-03-SB-12. Aluminum (in soil sample location WHF-03-SB-01) was the only analyte detected at concentrations that exceeded its USEPA SDWS criteria (see Table 4-13).

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. Nine surface and 49 subsurface soil samples were collected at Site 3. These samples were analyzed for VOCs, SVOCs, pesticides, TRPH, and inorganics. Of the 58 samples, one surface soil sample from soil boring WHF-03-SB-3 contained chromium at a concentration exceeding its FDEP leachability to groundwater SCTL of 38 mg/kg, and three soil samples contained dieldrin at concentrations exceeding its leachability to groundwater SCTL of 0.002 mg/kg.

Chromium was detected at 42.7 mg/kg in the surface soil sample (i.e., 0 to 2 feet bls) from boring WHF-03-SB-03. This value is slightly greater than its leachability to groundwater SCTL. Samples collected at this boring location at deeper depths, 5 to 7 feet bls and 10 to 12 feet bls, contained chromium at 27 mg/kg and 10 mg/kg, respectively. Thus, it appears that the chromium concentrations are decreasing with depth at concentrations below its leachability to groundwater SCTL at this boring location.

Dieldrin was detected at concentrations exceeding its leachability to groundwater SCTL in soil samples collected from soil borings WHF-03-SB-03 (0.044 mg/kg at 0 to 2 feet bls) and WHF-03-SB-01 (0.026 mg/kg at 5 to 7 feet bls and 0.0098 mg/kg at 0 to 2 feet bls).

The highest detected concentrations of chromium and dieldrin were in samples from borings WHF-03-SB-03 and WHF-03-SB-01. These two borings are located 500 or more feet north of the former USTs, and the highest concentrations were detected in soils samples collected from 0 to 7 feet bls. Therefore, it is unlikely that the chromium and dieldrin detected at these two boring locations are related to the former USTs.

One soil sample from boring WHF-03-SB-03 contained chromium at 42.7 mg/kg, which is slightly above its leachability to groundwater SCTL of 38 mg/kg. Chromium is not considered to pose an adverse risk to groundwater quality because only 1 of 58 samples contained chromium at a concentration slightly exceeding its leachability to groundwater SCTL. Therefore, migration of chromium to groundwater was not simulated.

The elevated dieldrin concentrations were detected in a rectangular area that encompasses soil borings 3SB01 through 3SB03 located at the northern end of Building 2941. This area is roughly 300 feet long in the northern to southern direction (parallel to groundwater flow) and 300 feet wide (perpendicular to groundwater flow). This area is hydraulically upgradient of the former USTs. For modeling purposes, the highest dieldrin concentration was used to represent the entire area.

The results of modeling indicate that dieldrin will reach a depth of approximately 36.5 feet after 200 years. At 200 years, the concentration of dieldrin at a 30-foot depth was 0.0007 µg/L. Even the concentration (0.3 µg/L) of dieldrin in the leachate at 10 feet bls is less than the GCTL of 2 µg/L. Therefore, dieldrin in Site 3 soils is not considered to pose an adverse risk to groundwater now or in the future.

Groundwater Analysis Summary

BTEX and TCE and its daughter products have been detected in groundwater samples collected from Site 3, 4, and 32 beginning in 1992 and reported in the RI/FS Phase I Technical Memorandum No. 5 Groundwater Quality Assessment (ABB-ES, 1992e). Plume maps with isocontours for volatile organic contaminants detected in 2007, 2008, and 2011 are provided in Figures 4-4, 4-5 and 4-6 respectively. Tables 4-14, and 4-15 provide these data in tabular form.

Analytes detected at the NCA plume at concentrations that exceeded FDEP CTLs and USEPA PDWS in 2007, 2008, and 2011 include benzene, BTEX total, cis-1,2-DCE, ethylbenzene, toluene, total xylene, TCE, and vinyl chloride. Total xylene exceeded its FDEP CTL. A summary of the analytical results is presented in Table 4-14. Analytical data from 2007 and 2008 is also presented in Table 4-14, and these analytical results will be discussed collectively with the Mann-Kendall Trend Test Results in Section 4.9.1.

Groundwater samples collected in 2007 and 2008 from Site 3 monitoring wells were selected to further characterize the nature and extent of metals contamination. Arsenic exceeded its FDEP CTL and USEPA PDWS, and aluminum, iron, and manganese exceeded their FDEP CTLs and USEPA SDWS. Mercury exceeded its FDEP CTL and USEPA PDWS in the groundwater samples collected from monitoring well WHF-03-MW-2S in 2007 and 2008. The 2007 groundwater sample from monitoring well WHF-03-MW-3I contained mercury at a concentration exceeding its FDEP CTL and USEPA PDWS, but was less than its regulatory criteria in 2008. In 2007 and 2008, lead exceeded its FDEP CTL and USEPA PDWS in the groundwater samples collected from monitoring wells WHF-03-MW-1S, WHF 03 MW 2I, and WHF-03-MW-7S. In 2007, the groundwater sample from monitoring well WHF-03-MW-7I had a detected lead concentration exceeding its FDEP CTL and USEPA PDWS, but was less than regulatory criteria in 2008. A summary of the analytical results is presented in Table 4-15.

Site 3 Summary

Based on soil sampling followed by laboratory leachate analysis contaminants are leaching from soil and impacting groundwater. Benzene, ethylbenzene, toluene, total xylene, TCE, cis-1,2-DCE, and vinyl chloride have been detected at the NCA plume at concentrations that exceeded FDEP CTLs and USEPA PDWS in 2007, 2008, and 2011. Total xylene exceeded its FDEP CTL. No SVOCs, pesticides, or PCBs, were detected in groundwater samples. Arsenic, aluminum, iron, lead, manganese and mercury exceeded their FDEP CTLs and USEPA SDWS. Arsenic, aluminum, iron, and manganese are likely naturally occurring. Lead and mercury are contaminants. Contaminants, including TCE, BTEX, lead and mercury, that originated in the Site 3 area have leached through the vadose zone producing a contaminant plume. Cis-1,2-DCE and vinyl chloride are likely degradation products of TCE.

4.5.3 OU 04 – Site 4 (Formerly Site 1467), North AVGAS Tank Sludge Disposal Area

OU 04, hereafter referred to as Site 4, is located in the North Field Industrial Area of NAS Whiting Field, (see Figure 1-2). Site 4 initially contained 10 USTs that were used for AVGAS storage. Subsurface fuel lines replenished fuel distributed to points further west and north. Potable water supply wells exist within one-quarter mile of Site 4 (EDR, 2011 and Appendix C). The USTs were installed in 1943 when the facility first began operations. From 1943 to 1968, the nine large AVGAS tanks (23,700-gallon) were cleaned out approximately every four years. The tank bottom sludge, probably containing tetraethyl lead, was buried at shallow depths in the area immediately adjacent to the surrounding tanks. Navy personnel estimated that 1,000 to 2,000 gallons of sludge were disposed of in this manner (Envirodyne Engineers, Inc., 1985).

In November 1991, assessments for petroleum contaminated soil and groundwater were begun at Site 4. Background information provided by NAS Whiting Field personnel included reports of past releases of petroleum and use of solvents to clean the USTs. Preliminary results of the assessment indicated widespread petroleum contamination at Site 1467, and evidence that petroleum and chlorinated hydrocarbon contamination may be commingled at the site (ABB-ES, 1994c).

Removal of the USTs began in 1992 and was completed 1994. The removal included eight 23,700-gallon steel tanks, one 15,000-gallon steel tank, and one 750-gallon tank. The nine larger USTs were used for AVGAS storage. The 750-gallon UST was reportedly used for the storage of contaminated fuel. There are no known records of spills or leaks at Site 4, but petroleum contamination was observed in subsurface soils when the USTs were removed. ABB-ES recommended that additional contamination assessments should be conducted as part of the ongoing IR program (ABB-ES, 1994c).

Later, Site 4 was included in a series of site-specific reports produced by the IR program. In 1999, an RI Report for surface and subsurface soils at Sites 3, 4, 6, 30, 32, and 33 summarized the chemicals detected in surface and subsurface soil samples at Site 4 that included VOCs, SVOCs, and inorganics. Pesticide analytes were only detected in surface soil samples at Site 4. With the exception of the pesticide analytes, these chemicals were most frequently detected and usually at their highest concentrations in soil samples collected from soil borings 4SB01, 4SB03, and 4SB06 located at the former USTs (ABB-ES, 1999).

VOCs were not detected at concentrations that that exceed their regulatory criteria in either surface or subsurface soil samples at Site 4. Benzo(a)pyrene was the only SVOC that exceeded Region III Risk-Based Concentrations (RBCs) or FDEP SCTLs for residential and industrial direct exposure to soil at Site 4. Dieldrin, aluminum, arsenic, and vanadium exceeded the Region III RBCs for residential direct soil exposure. Arsenic and vanadium also exceeded the FDEP SCTL for residential direct exposure to soil. Arsenic was the only analyte other than benzo(a)pyrene to exceed Region III RBCs and FDEP SCTLs for industrial direct exposure to soil (ABB-ES, 1999)

Prior to the issuance of a final soil ROD, the site was transferred to the UST program. It was determined after a review of the sampling results of the RI that the site did not have any contaminants that did not originate from petroleum-related releases.

Previous groundwater investigations at Site 4 revealed the presence of PCE, TCE, chloroform, 1,2-DCE, benzene, ethylbenzene, toluene, BEHP, aluminum, cadmium, iron, lead, and manganese in the groundwater (ABB-ES, 1995c; ABB-ES, 1996) in exceedance of state and/or federal regulatory criteria.

Leachate Soil Summary

Soil boring locations WHF-04-SB-3 (4SB0322) and WHF-04-SB-6 (4SB0620) were selected to be representative of the analytes present in the subsurface at Site 4. The subsurface soil samples collected from theses boring were analyzed for VOCs, SVOCs, aluminum, cobalt, copper, iron, lead, and manganese.

Ethylbenzene, toluene, and total xylenes were detected at concentrations that exceed FDEP GCTLs in the sample leachate from the sample collected at soil sample location WHF-04-SB-6 (see Table 4-16).

Lead in soil sample location WHF-04-SB-6 was the only analyte detected in the sample leachate and did not exceed state and/or federal regulatory criteria (see Table 4-16).

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. Model simulations for seven analytes were performed. Four of these analytes are considered petroleum constituent related (BTEX). The other three analytes were: 4-methylphenol, benzo(a)anthracene, and n-nitroso-di-n-propylamine.

Benzene was detected in 58 out of 136 soil samples collected between 15 and 100 feet bls, with the highest detected concentration of 6,340.0 µg/kg at 88 feet bls. The concentration detected at 88 feet bls may represent contamination that is located at the top of the perched water table surface as LNAPL. The floating product will create a smear zone in the soil near the water table surface. Because the high concentrations of benzene were detected at the water table surface, the maximum detected concentration of benzene in groundwater should appear immediately in the VLEACH simulation, which it did.

Figure E-1 in Appendix H shows the predicted concentration of benzene in the soil leachate at the base of the soil column (89 feet bls) during the first 25 years of a 200 year simulation. As shown in this figure, the peak benzene concentration (11,700 µg/L) occurred in year one and decreased rapidly in years 2 through 4. The concentration increased to about 2,500 µg/L in years 6 through 8. The second peak is caused by the benzene leaching out of soil at 58 to 75 feet bls (soil concentrations were 0.175 and 4.87 µg/kg in three samples). This second peak decreases quickly to less than 1,000 µg/L by about year 12. Note that Table E-1 represents the predicted concentrations of soil leachate and not groundwater. The maximum predicted groundwater concentration occurred in year 1 at 4,230 µg/L, which is about 36 percent of the maximum predicted concentration in soil leachate. The predicted concentration of benzene in groundwater declines after year 1 matching the FDEP and USEPA GCTL of 1 µg/L by year 31.

Ethylbenzene was detected in 2 of 12 soil samples collected between 0 and 15 feet bls (Appendix H, Table E-4); however, the concentration in one of the samples was 2.95 mg/kg. Like benzene, the highest concentration in soil (115 mg/kg) was detected down near the water table surface (89 feet bls). As a consequence, the highest concentration of ethylbenzene in soil leachate at the base of the vadose zone (48,500 µg/L) occurred in year 1. The leachate concentration decreased rapidly after year 1 to less than 5,000 µg/L by year 10. The highest predicted ethylbenzene concentration in groundwater is 14,300 µg/L.

Applying the infiltration model using sources near the ground surface in the vadose zone compared to the JP-5 product perched just feet above the water table is an exercise that shows infiltration would impact groundwater even if JP-5 fuel was not present in pure form at depth. The model does not simulate the leaching of contaminants sourced by LNAPL.

To date, the JP-5 fuel found perched on a clay layer beneath Site 4 has maintained thickness of up to 18 inches in a monitoring well WHF-1466-MW-26P or the replacement WHF-1466-MW-26PR located within the Site 4 area for over 15 years. Since the initial detection of JP-5 in the mid-1990s, it has been detected in 6 new monitoring wells (04-MC-01, 04-MC-03, 04-MC-04, 04-MC-05, 04-MC-06, and 04-MC-12) from 0.20 to 2.04 feet thick (CH^2M Hill, 2012). The JP-5 is perched on groundwater or on clay that retards or delays the fuel's downward movement.

The JP-5 perched on the clay evaporates into the vadose zone soil producing a soil gas cloud or plume. The JP-5 also dissolves into any infiltrating groundwater that is retained for a period beneath the JP-5 by the clay layer. This groundwater is contaminated by contact with JP-5 then likely overflows the edge of the clay layer then infiltrates downward to mix with the surficial groundwater. This large readily available contaminant mass will impact the groundwater for a significant period of time providing a continuing source of petroleum-related constituents to the NCA plume.

Groundwater Analysis Summary

BTEX and TCE and its daughter products have been detected in groundwater samples collected from Site 3, 4, and 32 beginning in 1992 as reported in the RI/FS Phase I Technical Memorandum No. 5 Groundwater Quality Assessment (ABB-ES, 1992e). Plume maps with isocontours for VOCs detected in 2007, 2008, and 2011 are provided in Figures 4-4, 4-5 and 4-6 respectively. Tables 4-14, and 4-15 provide these data in tabular form.

Analytes detected at the NCA plume at concentrations that exceeded FDEP GCTLs and USEPA PDWS in 2007, 2008, and 2011 include benzene, BTEX total, cis-1,2-DCE, ethylbenzene, toluene, total xylenes, TCE, and vinyl chloride. Total xylenes exceeded its FDEP GCTL. A summary of the analytical results is presented in Table 4-14. Analytical data from 2007 and 2008 is also presented in Table 4-37, and these analytical results will be discussed collectively with the Mann-Kendall trend test results in Section 4.9.1.

Groundwater samples collected in 2007 and 2008 from monitoring wells at Site 4 (former UST Site 1467) were analyzed for TAL metals. Lead exceeded its FDEP CTL and USEPA PDWS in groundwater samples collected from monitoring wells WHF-1467-MW-2I, WHF-1467-MW-27S, and WHF 1467 MW 31S in 2007 and 2008. In 2008, the groundwater samples collected from monitoring wells WHF-1467-

MW-36S and WHF 1467-MW-37S contained lead at concentrations exceeding its FDEP CTL and USEPA PDWS. A summary of the analytical results is presented in Table 4-15.

Site 4 Summary

Based on soil sampling followed by laboratory leachate analysis contaminants are leaching from soil and impacting groundwater. Benzene, ethylbenzene, toluene, total xylenes, TCE, cis-1,2-DCE, and vinyl chloride have been detected at the NCA plume at concentrations that exceeded FDEP GCTLs and USEPA PDWS in 2007, 2008, and 2011. Total xylenes exceeded its FDEP GCTL. Lead exceeded its FDEP CTL and USEPA PDWS in groundwater samples collected from Site 4. No SVOCs, pesticides, or PCBs, were detected in groundwater samples. Contaminants, including TCE, BTEX, and lead that originated in the Site 4 area have leached through the vadose zone producing a contaminant plume. Cis-1,2-DCE and vinyl chloride are likely degradation products of TCE.

4.5.4 OU 20 – Site 32, North Field Maintenance Hangar

OU 20, hereafter referred to as Site 32, North Field Maintenance Hangar, is a 3.5-acre parcel located within the North Airfield of NAS Whiting Field (see Figure 1-2). The site includes Buildings 1424 and 2805, an unnumbered storage building, two wash racks, and the former location of four waste oil/kerosene USTs. The site is physically characterized by paved areas and buildings. The site activities are characterized by high vehicle/aircraft traffic. Surface water runoff adjacent to Site 32 is intercepted by concrete drainage ditch or storm sewers and is conveyed west to Clear Creek. There is a potable water supply well installed within one-quarter mile of Site 32 (EDR, 2011, and Appendix C). Groundwater flow beneath Site 32 is toward the west. Because nearly the entire site is paved, essentially no appreciable rainfall infiltrates soil; rather it is channeled into the storm sewer and conveyed to a concrete drainage ditch. This ditch is located at the southern boundary of the site and conveys surface water from the North Airfield west to Clear Creek.

The historical land use of Site 32 involved the operation and maintenance of aircraft during the period of 1943 until the present.

The current land use for Site 32 is industrial under the following condition agreed upon by the FDEP and USEPA:

> Restrict future use of the site to nonresidential activities involving less than full-time human contact with surface and subsurface soil.

The human health COCs identified at Site 32 were TRPH in surface soil and TRPH, benzo(a)pyrene toxic equivalents (TEQs), TCE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene in subsurface soil.

Ecological COCs were not identified at Site 32. The HHRA found that actual or threatened releases of hazardous substances from this site would present an imminent and substantial endangerment to public health, welfare, or the environment if LUCs were not implemented.

The ROD (Tetra Tech, 2004b) presented the final action for both the surface and subsurface soils at Site 32 and was based on results of the RI, FS, and FS Addendum completed for surface and subsurface soils for Site 32. The selected remedy at Site 32 is LUCs and ECs and includes FYRs to evaluate the effectiveness of the LUCs and ECs.

Following the risk assessment using USEPA and FDEP guidelines, several COCs: TRPH in surface soil and TRPH, benzo(a)pyrene TEQs, TCE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene in subsurface soil were identified and, therefore, unacceptable risk was anticipated for exposure to the soil. As a result of these findings, LUCs were selected as the remedy (via 2004 ROD) for surface and subsurface soil at Site 32.

Previous groundwater investigations at Site 32 revealed the presence of TCE, 1,2-DCE, benzene, ethylbenzene, toluene, BEHP, aluminum, antimony, cadmium, chromium, copper, iron, lead, and manganese in the groundwater (ABB-ES, 1995c) in exceedance of state and/or federal regulatory criteria.

Leachate Soil Summary

Soil samples, WHF-32-SB-1 (32SB0107), WHF-32-SB-B2 (32SBB0212), WHF-32-SB-E4 (32SBE0410), WHF-32-SB-N1 (32SBN0110), and WHF-32-SB-S3 (32SBS0310) were selected to be representative of the analytes detected in subsurface soil at Site 32. The subsurface soil samples were analyzed for VOCs, SVOCs, and TPH at soil sample locations (see Figure 1-2).

Ethylbenzene, total xylenes, and naphthalene exceeded FDEP CTLs in the sample leachate in the soil sample collected from boring location WHF-32-SB-B2 (see Table 4-17).

Soil sample location WHF-32-SB-1 contained lead in the sample leachate at a concentration exceeding FDEP and USEPA GCTLs (see Table 4-17).

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or CTLs. The leaching and the vertical migration of ten chemicals were modeled for Site 32 (see Table E-8 in Appendix H). These chemicals were the highest detected concentrations, most frequently detected, and/or detected above their Florida leachability to groundwater SCTLs at the greatest depths. The highest detected concentration of each contaminant was used as the starting concentration in the soil profiles for each leaching model. According to the SESOIL simulations, three of the chemicals (2-methylnaphthalene, naphthalene, and TRPH) do not reach the water table after 200 years of migration. Four of the chemicals (1,2,4-trimethylbenzene, ethylbenzene, toluene, and xylene) did reach the water table aquifer, but not at concentrations high enough to raise their concentrations in groundwater above FDEP GCTLs. Of those four chemicals, the migration of 1,2,4-trimethylbenzene resulted in the maximum predicted concentration in groundwater (1.01 μg/L) to reach 1 percent of the GCTL (10 μg/L).

Of the 10 SESOIL simulations performed for Site 32, three simulations (methylene chloride, PCE, and TCE) predicted that the leaching of chemicals would result in exceedances of GCTLs.

The predicted concentration of PCE in the vadose zone leachate (650 μg/L) and the water table aquifer (430 μg/L) were much higher than predicted maximum concentrations for the other chemicals (see Table E-8 in Appendix H). PCE was only detected in soil samples between 0 and 17 feet bls. According to the SESOIL model, however, the predicted peak PCE concentration reached the water table surface in 38 years and declined thereafter. Like PCE, the TCE detections in soil were found between 0 and 17 feet bls (except for one detection at 85 feet bls). According to the SESOIL model, the predicted maximum TCE concentration in leachate reaches the water table surface in approximately 38 years and declined fairly quickly thereafter. Both PCE and TCE are similar in their distributions in soil and behavior in the SESOIL model runs. Because PCE and TCE were probably used in the 1960s and 1970s at Site 32 and this may be the period of time when spills and releases might have occurred, it has been almost 40 years since releases likely occurred. Therefore, the highest concentrations in soil and groundwater may have already occurred. If this is the case, concentrations in groundwater will likely decline as predicted by the SESOIL model. However, either PCE or TCE may present in silty clays or clay and may leach to groundwater until the concentrations in the contaminated soils decrease.

Overall, the SESOIL models predict that three chemicals (PCE, TCE, and methylene chloride) will be leached from Site 32 soils in sufficient mass and concentrations to cause exceedances of their FDEP GCTLs and USEPA MCLs. According to the SESOIL predictions, however, the concentrations of these chemicals in soil and groundwater should have peaked in the past and should now be declining.

Groundwater Summary

BTEX and TCE and its daughter products have been detected in groundwater samples collected from Site 32 beginning in 1992 as reported in the RI/FS Phase I Technical Memorandum No. 5 Groundwater Quality Assessment (ABB-ES, 1992e). Plume maps with isocontours for volatile organic contaminants detected in 2007, 2008, and 2011 are provided in Figures 4-4, 4-5 and 4-6 respectively. Tables 4-14, and 4-15 provide these data in tabular form.

Analytes detected at the NCA plume at concentrations that exceeded FDEP GCTLs and USEPA PDWS in 2007, 2008, and 2011 include benzene, BTEX total, cis-1,2-DCE, ethylbenzene, toluene, total xylenes, TCE, and vinyl chloride. Total xylenes exceeded its FDEP GCTL. The analytical results will be discussed collectively with the Mann-Kendall trend test results in Section 4.9.1.

Groundwater samples collected in 2007 and 2008 from monitoring wells at Site 32 were analyzed for TAL metals. Lead exceeded its FDEP CTL and USEPA PDWS in the groundwater samples collected from monitoring well WHF-32-MW-1S in 2007 and 2008. In 2007, lead exceeded its FDEP CTL and USEPA PDWS in the groundwater sample collected from monitoring well WHF-32-MW-8I, but was not detected in the groundwater sample collected in 2008. A summary of the analytical results is presented in Table 4-15.

Site 32 Summary

Based on soil sampling followed by laboratory leachate analysis contaminants are leaching from soil and impacting groundwater. Benzene, ethylbenzene, toluene, total xylenes, TCE, and vinyl chloride have been detected at the NCA plume at concentrations that exceeded FDEP GCTLs and USEPA PDWS in 2007, 2008, and 2011. Total xylenes exceeded its FDEP GCTL. Lead exceeded its FDEP CTL and USEPA PDWS in groundwater samples collected from Site 32. No SVOCs, pesticides, or PCBs, were detected in groundwater samples. Contaminants, including TCE, BTEX, and lead that originated in the Site 4 area have leached through the vadose zone producing a contaminant plume. Vinyl chloride is likely a degradation product of TCE.

4.5.5 OU 22 – Site 35, Public Works Maintenance Facility

OU 22, hereafter referred to as Site 35, Public Works Maintenance Facility, is located within the North Airfield of NAS Whiting Field (see Figure 1-2). The site includes Building 1429, former Building 2848 (gas station), an unnumbered vehicle shed, and three former USTs. The site is physically characterized by paved areas and a building with a concrete floor. The site activities are characterized by high vehicle traffic. Because the majority of the site is paved, little rainfall infiltrates and most is channeled into the storm sewers. Surface water runoff flows along the northern site boundary and is intercepted by a concrete drainage ditch. Surface water bodies are not present within the site boundaries. Surface water runoff adjacent to Site 35 is intercepted by concrete drainage ditch or storm sewers. There are potable water supply wells within one-quarter mile of Site 35 (EDR, 2011, and Appendix C). Groundwater from beneath Site 35 is not currently being used as a source for drinking water. The historical land use of Site 35 is for the maintenance of vehicles and equipment, generation of power and heat, storage of fire-fighting equipment, woodworking and metals repair, and offices.

The current land use for Site 35 is designated industrial under the following conditions agreed upon by the FDEP and USEPA:

- Restrict future use of the site to nonresidential activities involving less than full-time human contact, such as warehouse-like facilities, parks, or trails, unless prior written approval is obtained from the USEPA and FDEP. Specifically prohibited residential uses shall include, but are not limited to, any form of housing, childcare facilities, pre-schools, elementary and secondary schools, playgrounds, or full-time adult convalescent or nursing care facilities.

- Prohibit any digging into or other disturbance of concrete/asphalt cover or other areas with contaminated surface and subsurface soils at the site unless prior written approval is obtained from the USEPA and FDEP.

- Prohibit the removal of surface or subsurface soils from the site unless prior written approval is obtained from the USEPA and FDEP.

- Maintain the integrity of the existing concrete/asphalt cover and any other future on-site remedy components including warning signs to be posted along the boundary of the site.

The only human health COC identified at Site 35 is benzo(a)pyrene TEQs in subsurface soil. Human health COCs were not identified in surface soil, as most of the site is covered by concrete and asphalt. Ecological COCs were not identified at Site 35. Therefore, based on the presence of benzo(a)pyrene TEQs in subsurface soil, the HHRA found that actual or threatened releases of hazardous substances from this site would present an imminent and substantial endangerment to public health, welfare, or the environment if LUCs were not implemented.

The ROD (Tetra Tech, 2006c) presents the final action for both the surface and subsurface soils at Site 35 and is based on results of the RI, FS, and FS Addendum completed for surface and subsurface soils for Site 35. The selected remedy at Site 35 is LUCs and ECs and includes FYRs to evaluate the effectiveness of the LUCs and ECs.

Following the risk assessment using USEPA and FDEP guidelines, the COC benzo(a)pyrene TEQs were identified and, therefore, unacceptable risk was anticipated for exposure to the soil. As a result of these findings, LUCs were selected as the remedy (via 2006 ROD) for surface and subsurface soil at Site 35.

Previous groundwater investigations at Site 35 revealed that BEHP, aluminum, iron and manganese at concentrations that exceeded their FDEP CTLs (HLA, 1999d).

Leachate Soil Summary

Soil samples were analyzed, however, using the TCLP in 2000 and SPLP in 2001. The TCLP analysis was for only metals for subsurface soil samples from boring locations WHF-35-SB-10, WHF-35-SB-11, WHF-35-SB-12, and WHF-35-SB-13. In 2001, the SPLP was conducted for subsurface soil samples collected from boring locations WHF-35-SB-11, WHF-35-SB-12, and WHF-35-SB-13. The SPLP extract from these samples was analyzed only for VOCs. A summary of the SPLP leachate data is presented in Table 4-18.

Acetone was the only VOC detected and did not exceed its federal or state CTLs in the sample leachate for the subsurface soil sample from boring location WHF-35-SB-11 (see Table 4-18).

The leachate from samples WHF-35-SB-10, WHF-35-SB-11, WHF-35-SB-12, and WHF-35-SB-13 was analyzed by TCLP in 2000 for arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. None of the analytes were detected in the leachate from the subsurface soil samples (see Table 4-18).

Groundwater Summary

Current groundwater sampling was not conducted at Site 35, 36, or 37. Previous groundwater results are discussed in Sections 4.5.5, 4.5.6, and 4.5.7 of this report and in the investigation report for Sites 35, 36, and 37 (HLA, 1999d).

In 1997, groundwater samples collected from Site 35 were analyzed for VOCs, SVOCs, pesticides, and PCBs. The VOC 1,1-DCA and SVOC BEHP were detected at concentrations that exceeded their FDEP CTLs. 1,1-DCA was detected in a groundwater sample and it's duplicate from monitoring well WHF-35-MW-1S at estimated concentrations of 6 J and 7 J µg/L, respectively. The duplicate sample equals the federal and state CTL. BEHP was detected in one groundwater sample from monitoring well WHF-35-MW-2S at an estimated concentration of 9 J µg/L, which exceeds its FDEP CTL of 6 µg/L (ABB-ES, 1998c). Groundwater samples were not collected in subsequent sampling events. A summary of the analytical results is presented in Table 4-19.

Site 35 Summary

Based on leachate modeling analytes detected in soils at Site 35 are not predicted to exceed federal or state regulatory criteria for leaching to groundwater. The VOC 1,1-DCA and SVOC BEHP were detected at concentrations that slightly exceeded their FDEP CTLs.

4.5.6 Site 36, Auto Repair Booth

Site 36, Building 1440A, the Auto Repair Booth (see Figure 1-2), received NFA designation in February 1999 prior to the designation of OUs in 1994. The site consists of a single service bay with a lubrication rack sump for working under vehicles. The drain for the lubrication rack was plugged more than 10 years ago (circa 1989). The drain originally emptied into a concrete sump, which was connected to the storm sewer system. One aboveground waste oil tank is located on the eastern side of Building 1440A. Current conditions at the site indicate the waste oil tank may have previously been located on the western side of the building and was filled through a funnel system through the wall of the building. In addition, the southwestern corner of the building may have previously contained a fuel pump island and an UST that was used as a fuel tank. Site 36 is within one-quarter mile of a potable water supply well (EDR, 2011 and Appendix C). Possible waste associate with Building 1448 include oil, grease, fuel, and solvents (HLA, 1999d).

Previous groundwater investigations at Site 36 revealed the presence of TCE at concentrations that exceed its FDEP CTL (HLA, 1999d). Methylene chloride was not detected in groundwater samples.

Because of the site's NFA designation, the collection of subsurface soil samples for analysis by the SPLP have not been collected. It is likely that the detections of TCE in groundwater are the result of the site being hydraulically side gradient to the NCA Plume.

Soil Summary

Previous soil sampling analytical results indicate that, with the exception of methylene chloride, analytes have not been detected at concentrations that exceed their federal and state leachability to groundwater criteria, leachability models were not applied. In addition, methylene chloride was not detected in groundwater samples.

Groundwater Summary

In 1997, groundwater samples collected from Site 36 were analyzed for VOCs, SVOCs, pesticides, and PCBs. One VOC, TCE was detected in groundwater samples at concentrations that exceed the federal and state CTLs of 5 and 3 µg/L, respectively. TCE was detected in groundwater samples from monitoring wells WHF-36-MW-1S and WHF-36-MW-1I at estimated concentrations of 16 J and 17 J µg/L, respectively, which exceeds its federal and state CTLs (ABB-ES, 1998c). Groundwater samples were not collected in subsequent sampling events. A summary of the analytical results is presented in Table 4- 19.

Site 36 Summary

Based on leachate modeling analytes detected in soils at Site 36 are not predicted to exceed federal or state regulatory criteria for leaching to groundwater. TCE was detected at concentrations that slightly exceeded its' federal and FDEP CTLs.

4.5.7 Site 37, Spray Paint Booth

Site 37, Building 1486, received a NFA designation before OU numbers were issued. The site was constructed in 1944 and includes a furniture shop and paint spray booth. The paint spray reportedly contained a "waterfall recirculation system". The system worked as follows: objects are painted with a spray gun underneath the hood, the fumes from this operation were captured in the hood and combined with water, and then the water was discharged to the sanitary sewer system. Site 37 is within one quarter mile of potable water supply wells (EDR, 2011 and Appendix C). Possible waste associate with Building 1486 include paint and solvents (HLA, 1999d).

Soil Summary

Previous soil sampling analytical results indicate that, with the exception of methylene chloride, analytes have not been detected at concentrations that exceed their federal and state leachability to groundwater criteria, leachability models were not applied. In addition, methylene chloride was not detected in groundwater samples.

Groundwater Summary

In 1997, groundwater samples collected from Site 37 were analyzed for VOCs, SVOCs, pesticides, and PCBs. Three VOCs 1,1-DCA, TCE, and benzene were detected in groundwater samples at concentrations that equaled or exceeded either federal or state CTLs. 1,1 DCA was detected in a groundwater sample from monitoring well WHF-37-MW-1I at an estimated concentration of 7 J µg/L. TCE was detected in groundwater samples from two monitoring wells, WHF-37-MW-1S and WHF 37 MW 1I, at concentrations of 5 and 3 µg/L, respectively that equaled or exceeded the state and federal regulatory criteria of 3 and 5 µg/L, respectively. Benzene was detected in one groundwater sample from WHF-37-MW-01I at a concentration of 3 µg/L that exceeds the FDEP CTL of 1 µg/L, but is less than the federal CTL of 5 µg/L (ABB-ES, 1998c). Groundwater samples were not collected in subsequent sampling events (HLA, 1999d). A summary of the analytical results is presented in Table 4-19.

Site 37 Summary

In 1997, three VOCs 1,1-DCA, TCE, and benzene were detected in groundwater samples at concentrations that equaled or slightly exceeded either federal or state CTLs.

4.5.8 OU 27 – Site 41, Former Pesticide Storage Building 1485C

OU 27, hereafter referred to as Site 41, occupies approximately 23,000 square feet in the central industrial area of NAS Whiting Field (see Figure 1-2). Former Building 1485C was located within the Base Operating Services Compound northwest of the eastern termination of Yorktown Street and was used during an undetermined period of time for storage of ground maintenance equipment and limited amounts of pesticides. The site was in use since the early 1960s. The storage building caught fire in the late 1980s and was completely destroyed. Following the fire, cleanup activities at the site included the removal of all building materials, the concrete slab flooring, and an unknown quantity of soil. The depth of the removal and the disposal history of the excavated materials are unknown (Tetra Tech, 2008c).

Site 41 is located in the industrial area of the base, and facility maintenance workers are currently the main site users and are expected to be for the foreseeable future. Site 41 is within one quarter mile of potable water supply wells (EDR, 2011 and Appendix C). On-site wildlife may temporarily use Site 41, but due to lack of suitable cover, wildlife habitat is limited and use is assumed to be infrequent. Industrial/commercial-type use of the site is expected to continue for the foreseeable future.

Several iterative sampling events were conducted for the RI from 2000 to 2004 during which a total of 53 surface soil and 67 subsurface soil samples were collected and analyzed for various parameters. Analytical results were compared to FDEP SCTLs (FDEP, 2005), NAS Whiting Field background screening values for inorganics only, and USEPA Regional Soil Screening Levels (USEPA, 2011) to determine if contaminants in soil samples exceed regulatory criteria.

The previous investigations at Site 41 (formerly PSC 1485C) revealed the presence of dieldrin, aluminum, cobalt, copper, iron, lead, manganese, and zinc in surface soil and aluminum, cobalt, copper, iron, lead, and manganese in subsurface soil (Tetra Tech, 2005b).

The HHRA used USEPA and FDEP guidelines and identified several COCs (including dieldrin and cPAHs) that presented an unacceptable risk for exposure to soil at the Site 41. Based on these findings, soil excavation and disposal was selected as the remedy (Tetra Tech, 2011) for surface and subsurface soil at Site 41.

Leachate Soil Summary

Soil samples WHF-1438C-SS-1, WHF-1438C-SS-2, WHF-1438C-SS-3, WHF-1438C-SS-4, WHF-1438C-SS-5, and WHF-1438C-SS-6 were selected to be the representative of the analytes present in surface and subsurface soil at Site 41 and were analyzed for SVOCs, pesticides TPH, and inorganics. Subsurface soil samples WHF-1438C-SB-5, WHF-1438C-SB-6, WHF-1438C-SB-7, and WHF-1438C-SB-8 were also analyzed for pesticides and inorganics (see Figure 1-2).

SVOCs, TPH, and pesticides were not detected in the SPLP leachate in for the surface soil samples, and pesticides were not detected in the leachate for the subsurface soil samples. A summary of the TCLP leachate data for surface soils is presented in Table 4-20. A summary of SPLP leachate data for subsurface soil is presented in Table 4-21.

Aluminum, iron, and manganese were detected in the leachate for soil sample locations WHF-1438C-SS-1, WHF-1438C-SS-2, WHF-1438C-SS-3, WHF-1438C-SS-4, WHF-1438C-SS-5, and WHF-1438C-SS-6 at concentrations exceeding their FDEP CTLs and USEPA SDWS. Lead was detected in the leachate for soil sample locations WHF-1438C-SS-1, WHF-WHF-1438C-SS-4, WHF-1438C-SS-5, and WHF-1438C-SS-6 at concentration exceeding its FDEP CTLs and USEPA PDWS. Vanadium was detected in the leachate for soil samples at locations WHF-1438C-SS-1, WHF-1438C-SS-2, WHF-1438C-SS-5, and WHF-1438C-SS-6 at concentrations exceeding the FDEP CTL. A summary of the SPLP inorganic data is presented in Tables 4-20 and 4-21.

Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. VLEACH modeling was applied to one (dieldrin) of five other organic chemicals (benzo(a)anthracene, benzo(b)fluoranthene, carbazole, 4-nitroaniline, and TRPH) that were detected in soil samples collected from Site 41 that exceeded their respective leachability to groundwater SCTLs one or more times (see Table E-4 in Appendix H). Benzo(a)anthracene, benzo(b)fluoranthene, carbazole, and 4-nitroaniline were each detected in one sample and exceeded their leachability to groundwater SCTLs. TRPH exceeded its leachability to groundwater SCTL in two samples. Benzo(a)anthracene, benzo(b)fluoranthene, carbazole, 4-nitroaniline, and TRPH were not found in sufficient mass or concentrations to pose a risk to groundwater based on the VLEACH simulations that were performed at other sites. Therefore, the only organic chemical modeled for Site 41 using VLEACH was dieldrin.

Antimony was detected in many soil samples, but only one sample (10.7 mg/kg) exceeded its leachability to groundwater SCTL of 5.4 mg/kg. Chromium was detected in only one sample and exceeded its leachability to groundwater SCTL. VLEACH modeling was not conducted for antimony and chromium because it is likely that they are not present in sufficient mass or concentration that they could leach from the soil, migrate downward 115 feet to the water table surface, and cause a measurable impact to groundwater quality.

Dieldrin was detected in 37 out of 64 soil samples collected at Site 41 (see Table E-4 in Appendix H), and 28 of these samples exceeded the SCTL of 0.002 mg/kg. The highest detected concentration (0.94 mg/kg) of dieldrin in soil was in a subsurface soil sample collected from 2 to 3 feet bls. The leaching and migration of dieldrin was simulated in a VLEACH model using the maximum detected dieldrin concentration as the starting concentration in the simulation. The SESOIL model predicted that dieldrin would reach a total depth of only 35.5 feet bls after 200 years of leaching, and the maximum concentration in pore water leachate at 30 feet bls was only 10^{-3} µg/L (see Table E-8 in Appendix H).

Therefore, the leaching and migration of dieldrin is not significant and should pose no adverse risk to groundwater at Site 41.

Groundwater Summary

In 2000, a groundwater sample was collected from monitoring well WHF-1485C-MW-1S (located at Site 41) and analyzed for VOCs, SVOCs, pesticides, PCBs, and TPH. Only one analyte, BEHP (a common field/laboratory derived contaminant), was detected at a concentration that exceeded its FDEP CTL and USEPA PDWS. Groundwater samples collected in 2000 from monitoring wells at Site 41 were analyzed for TAL metals and cyanide. Aluminum and iron were detected in excess their respective FDEP CTLs and USEPA SDWS. A summary of the analytical results is presented in Table 4-22.

Site 41 Summary

In 1997, three VOCs 1,1-DCA, TCE, and benzene were detected in groundwater samples at concentrations that equaled or slightly exceeded either federal or state CTLs. No additional groundwater samples were collected.

4.5.9 Impact of Soil Contamination Leaching to Groundwater – North Central Area Summary

SPLP and/or TCLP analysis were performed for the analytes that had an exceedance of FDEP leachability to groundwater criteria. If an exceedance was not detected, then a representative sample was chosen, and SPLP and/or TCLP analysis was performed. The following provides a summary of the analytes that were detected in TCLP and SPLP leachate samples for the North Central Area.

- Site 3: aluminum
- Site 4 (formerly Site 1467): ethylbenzene, toluene, and total xylenes
- Site 32: ethylbenzene, total xylenes, naphthalene, and lead
- Site 35: analytes in the SPLP extract did not exceed leachability to groundwater criteria
- Sites 36 and 37: none
- Site 41: aluminum, iron, manganese, lead and vanadium

Leachate infiltration modeling was conducted for the chemicals that were previously detected during the RI in soil samples collected from the NCA. The following provides a summary of the chemicals by site that are predicted to migrate to groundwater at concentrations that may result in an adverse impact to groundwater.

- Site 4 (formerly Site 1467): Benzene and ethylbenzene are predicted to migrate through soil to groundwater; however, Site 4 also has JP-5 perched on a clay layer above the surficial aquifer.

The SESOIL model does not simulate the leaching of contaminants sourced by LNAPL. Perched JP-5 fuel or contaminated groundwater is likely migrating from the perched location to groundwater becoming a continuing source of petroleum-related constituents to groundwater.

- Site 32: PCE, TCE, and methylene chloride were predicted to leach to the groundwater at concentrations exceeding their GCTLs; however, according to the SESOIL predictions, the concentrations of these chemicals in soil and groundwater should have peaked in the past and should now be declining or about to decline.

4.6 NORTH CENTRAL AREA UST SITES

4.6.1 Site 1438/1439

Site 1438/1439 is located on the western side of the NCA (see Figure 1-2). Tanks 1438 and 1439 were installed in 1943. The two storage tanks were constructed partially below ground surface and covered with fill dirt to form two large mounds. Each tank had a capacity to store 218,384 gallons of AVGAS. Fuel for flight operations was transported to the site by tanker truck and railroad car and offloaded at concrete valve pits located adjacent to the truck stand and railroad tracks south of the pump house. Fuel was pumped from the valve pits via underground pipelines to Tanks 1438 and 1439. Fuel stored in Tanks 1438 and 1439 was then pumped through underground pipelines from the pump house to the northern and southern airfield fueling stations. The tanks were decommissioned in 1980, at which time they were filled with water.

In 1985, Tank 1438, Tank 1439, and the pump house were demolished. According to the NAS Whiting Field Public Works Center, Tank 1438 was demolished and removed from the site. Tank 1439, however, was collapsed and abandoned in place. During demolition, free product was discovered in the excavation pit. The fuel transmission pipelines running to both the northern and southern airfields were reportedly abandoned in place and filled with concrete. A Storage Tank Closure Report was not filed with the State of Florida when Tank 1438, Tank 1439, and the pump house were demolished (HLA, 2000e).

A site investigation was completed in 1998 by ABB-ES. From April 7 to April 29, 1997, 28 soil borings were advanced to the water table (approximately 110 feet bls) to supplement a Terra-Probe soil assessment conducted during the 1994 preliminary contamination assessment (ABB-ES, 1998d). Soil samples were collected at 2-foot intervals from the land surface to 108 feet bls from a central location at the site to complete a lithological description of the site sediments. Soil samples from the majority of the borings were collected continuously to 20 feet bls, and then at 5-feet intervals thereafter until the water table was encountered. Samples were screened using an organic vapor analyzer (OVA) equipped with a flame ionization detector (FID) in accordance with Chapter 62-770, F.A.C., requirements. In addition, five soil samples were collected, sent to a fixed-based laboratory, and analyzed for natural attenuation parameters (HLA, 2000e).

In December 1999, the Navy and FDEP decided that additional soil borings were necessary. HLA advanced 12 additional soil borings in January 2000. Soil was screened using an OVA equipped with a FID to select soil samples for laboratory analysis; 31 soil samples were collected. A Supplemental Assessment Results letter report, dated April 14, 2000, described the findings of this investigation. Subsequently, the Navy suggested NFA at the site. The FDEP, however, requested more sampling at the site to determine if a Remedial Action Plan (RAP) was necessary.

On October 2, 2000, Harding ESE (formerly HLA) returned to the site and advanced three additional soil borings and based on the findings of this investigation it was recommended that a RAP be completed for the site (Harding ESE, 2000).

Tetra Tech performed a treatability study at the site in November 2001 to determine the effectiveness of in-situ remediation technologies. Two injection wells and six monitoring points were installed at the site. Soil permeability tests were performed at Site 1438/1439.

A RAP was issued for the site in May 2002 (Tetra Tech, 2002a). The RAP was approved by the FDEP in 2002. The RAP was executed from October 2004 through September 2005 and a Draft Remedial Action Completion Report was issued in November 2005. The report indicated that during the system operational period, contaminant concentrations decreased significantly, but when the system was down for a month upon start-up, influent concentrations increased dramatically and remained high during one month of operation indicating a substantial residual contaminant mass may be present. It was recommended the system operate for an additional year.

Site 1438/1439 is within one-quarter mile of potable groundwater well W-S2 located approximately 900 feet to the southwest. The exiting site monitoring wells were sampled in January of 2011. The results of that sampling round are found in this report. Previous groundwater investigations at Site 1438/1439 revealed the presence of BTEX, naphthalene, and 1,2-EDB at concentrations exceeding FDEP CTLs (ABB-ES, 1998d).

Leachate Soil Summary

Soil sample location WHF-1438-SB-7 was sampled in 2000 and 2001 at depths of 17 to 19 feet bls and 19 to 21 feet bls, respectively (see Figure 1-2). The soil samples WHF-1438-SS-7 (1438D00717) and WHF-1438-SB-7 (1438SB00721) from Site 1438/1439 were analyzed for SPLP for VOCs, SVOCs, and

TPH and inorganics, pesticides, and PCBs by TCLP. A summary of the SPLP/TCLP data is presented in Table 4-23.

SPLP was performed, and the leachate from one sample collected in 2001 was analyzed for aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, selenium, and silver. Aluminum was detected at a concentration that exceeded its FDEP CTL and USEPA SDWS (see Table 4-23).

Groundwater Summary

Seven monitoring wells were installed in the shallow aquifer zone surficial aquifer (see Figure 1-2). Groundwater samples collected in 1997 from these monitoring wells were analyzed for purgeable aromatic hydrocarbons using USEPA Method 602, PAHs using USEPA Method 610, TPRH using the Florida Residual Petroleum Organic Method, EDB using USEPA Method 504, and lead using USEPA Method 239.2. Five VOCs were detected: benzene, toluene, ethylbenzene, total xylenes, and methyl tert butyl-ether (MTBE) (Figure 2-3). Three PAHs (naphthalene, 1 methyl naphthalene, and 2-methyl naphthalene) were detected. TRPH, EDB, and lead were also detected.

Benzene was detected exceeding its FDEP CTL in groundwater samples from five of eight monitoring wells. Toluene exceeded its FDEP CTL in one of eight monitoring wells. Ethylbenzene and total xylenes exceeded FDEP CTLs in two of eight monitoring wells (see Table 4-24).

In September 1997, three soil samples (U7B03505, U7B32A05, and U7B02605) were collected in areas of high, medium, and low OVA readings. These three soil samples were analyzed to determine if the petroleum-related constituents could potentially leach to groundwater. The analytical results indicated that none of the compounds detected in the soil samples exceeded the FDEP leachability to groundwater SCTLs per Chapter 62-770, F.A.C. The SPLP data suggests that the soil at the site is not a continuing source for petroleum-related constituents leaching to groundwater at concentrations that would result in groundwater contamination.

The groundwater sample collected in 2001 from monitoring well WHF-1438-MW-7S was analyzed for lead, and lead was not detected in the groundwater sample. In 2010, groundwater samples collected from monitoring wells WHF-1438-MW-2S, WHF 1438 MW 2D, WHF-1438-MW-3S, WHF-1438-MW-5S, WHF-1438-6S, and WHF-1438-7S were analyzed for BTEX. Benzene was only analyte that exceeded its FDEP CTL and USEPA PDWS in the groundwater sample collected from monitoring well WHF-1438-MW-2S (Figure 2-1). This indicates the entire plume has been reduced to a benzene detection in one well. A summary of the analytical results is presented in Table 4-24.

Site 1438/1439 Summary

Based on soil sampling followed by laboratory SPLP analysis aluminum is leaching from soil and impacting groundwater. The site has impacted groundwater as revealed by a large plume detected in the 1997 groundwater sampling event. However, the soil gas remediation systems has reduced the plume to benzene detected in groundwater exceeding the FDEP CTL and USEPA PDWS in one well.

4.6.2 Site 2832, AVGAS Pipeline Section E

Site 2832, AVGAS Pipeline Section E, is an active UST site located on the eastern side of the NCA. Site 2894 was investigated in the early 1990s to evaluate soil and groundwater conditions after the detection of an apparent pipeline leak. An investigation using direct push technology (DPT) found contaminants in surface soil at concentrations exceeding their leachability to groundwater SCTLs. Free-phase petroleum product was also found to occur at a perched water table approximately 30 feet bls (70 feet above the surficial zone of the sand-and-gravel aquifer). Petroleum-related constituents detected in perched groundwater consisted of VOCs, polynuclear aromatic hydrocarbons (PAHs), EDB, and TPHs and exceeded their FDEP GCTLs per Chapter 62-770, F.A.C. These contaminants were not detected in soils at depths greater than 10 feet below the perched water table nor at two hydraulically downgradient monitoring wells completed in the surficial zone of the sand-and-gravel aquifer, which is found at approximately 110 feet bls. The Site Assessment Report (SAR) (Tetra Tech, 2003) recommended the RAP include a monitoring program for the shallow surficial aquifer to verify it has not been impacted.

A soil removal was initiated in 2009 in accordance with the RAP but not completed. Based on historical groundwater data and the elimination of the majority of the soil that was a source of the petroleum-related constituents to perched groundwater at Site 2832; petroleum related contaminants are likely no longer leaching from soil to perched groundwater at the site. Site 40 has never been impacted by Site 2832.

Groundwater Summary

In May 2002, groundwater samples were collected from monitoring wells WHF-2832-MW-1S and WHF 2832-MW-2S screened in the perched zone at approximately 20 feet bls. These samples were analyzed for VOCs, SVOCs, PAHS, pesticides, PCBs, and TPH. One SVOC, BEHP, was detected in the groundwater samples in excess of its FDEP CTL and USEPA PDWS. Groundwater samples collected in 2002 from monitoring wells WHF-2832-MW-1S and WHF 2832 MW 2S were analyzed for TAL metals and cyanide. Aluminum, iron, and manganese exceeded their respective FDEP CTL and USEPA SDWS in the groundwater sample collected from monitoring well WHF 2832 MW 1S. Aluminum exceeded in the Florida CTL and USEPA SDWS in the groundwater sample collected from monitoring well WHF-2832-MW-2S.

Two additional groundwater monitoring wells (WHF-2832-MW-3S and WHF-2832-MW-4S) screened across the water table of Site 40 were installed in September of 2002 and sampled in October 2002. The groundwater samples collected from these wells was analyzed for VOCs, PAHs, lead, and TPH. None of the organic compounds detected in the groundwater samples collected in October 2002 exceeded their federal or state regulatory criteria. A summary of the analytical data is presented in Table 4-25.

Site 2832 AVGAS Pipeline Section E Summary

Groundwater investigated at Site 2832 is perched at approximately 20 feet bls and does not impact Site 40 groundwater where the water table is approximately 100 ft bls. Site 2832 dose not impact Site 40.

4.6.3 Site 2894

Site 2894 is located on the southeastern side of the NCA. Site 2894 is a bulk fuel storage facility that includes Building 2894 (pump house), two aboveground storage tanks (ASTs), a truck fill stand, and associated active and abandoned product transfer lines. Building 2894 is a pump house used to transfer JP-5 fuel from tanker trucks to ASTs 2891 and 2892. Building 2894 is located east of ASTs 2891 and 2892 in the northeastern section of the industrial area at NAS Whiting Field (see Figure 1-2). Topography, the site is generally flat in the area of the truck stand and Building 2894; however, there is a relatively steep hillside north and east of the truck stand area that is truncated by concrete drainage ditches at the base of the approximate 30 foot hill. West of Building 2894, the ground slopes gently toward the concrete spill containment area surrounding ASTs 2891 and 2892 (see Figure 1-2).

JP-5 fueling operations have been conducted at the site since the 1960s. A railroad line was used to deliver fuel to the system until the mid-1970s. JP-5 was offloaded from the railcars via a pipeline adjacent to the railroad line and pumped into ASTs 2891 and 2892. The railroad line was eventually removed, associated transfer piping and fuel fill ports were abandoned in place, and fuel has since been delivered to the site by tanker truck. JP-5 was transferred from tanker trucks to ASTs 2891 and 2892 through the Building 2894 pumping station.

Tanks 2891 and 2892 are two 230,000-gallon bare steel ASTs that were constructed in 1961. The tanks have secondary spill containment consisting of a concrete base and berm. The spill containment area is surrounded by chain-link fencing and lockable gates to discourage unwarranted entry. The truck stand is also bermed and has drains that flow into the AST spill containment area in the event of a release. The contents of ASTs 2891 and 2892 are inventoried daily, and these records are contained in the facility Spill Prevention, Control, and Countermeasure Plan.

On the morning of April 5, 1991, facility personnel working at the Building 2894 pump house reported a fuel release to the facility Environmental Coordinator. JP-5 was discovered leaking from an underground pipeline between Building 2894 and the truck stand used to offload fuel from tanker trucks to ASTs 2891 and 2892. Facility personnel estimated that approximately 25 gallons of JP-5 were released into the soil in the vicinity of the pump house.

On the day the leak was discovered, approximately two cubic yards of fuel-saturated soil was excavated from the area of the release. The underground pipeline was flushed with water, abandoned in place, and replaced with a new aboveground pipeline, which is currently in use.

A CAR was prepared for the site by ABB-ES in 1993. The CAR described the extent of petroleum impact at the site and recommended preparation of a RAP. The RAP for Site 2894 was submitted in 1995 (ABB-ES, 1995e) and recommended the installation of two separate remediation systems at Site 2984, one to treat shallow soils (0 to 15 feet bls) and one to treat deep soils (25 to 80 feet bls). An air injection bioventing system was recommended for remediation of the shallow soils, and a barometric pumping system was recommended for remediation of the deep soils. The bioventing system consisted of five injection wells and four monitoring points. The barometric pumping system consisted of five air inlet wells and 15 pumping wells. The two systems were installed and began operation in November 1997.

The first annual report for system monitoring at Site 2894 was submitted to FDEP in December 1997. Quarterly monitoring and sampling of the system was conducted during the first year of operation by ABB-ES. Semiannual monitoring and sampling of the system were approved by FDEP after their review of the first annual system observation report. Semiannual monitoring was performed by Dames and Moore in 1998 and 1999.

In August 1999, a soil assessment was conducted to evaluate the progress of remediation of the shallow soils. On November 9, 1999, a Closure Assessment Soil Sampling Report for the bio-venting (shallow soil) treatment system was submitted to FDEP by Dames and Moore. The report concluded that NFA status should be granted for shallow soils at Site 2894 based on the results of the soil sampling. The report proposed that remediation of the shallow soils should be discontinued by the end of 1999. The FDEP subsequently reviewed the CAR and issued an approval letter for the report on December 30, 1999. The FDEP approval letter concurred with the recommendation to discontinue operation of the bioventing (shallow soil) portion of the remedial system and with the recommendation that the barometric pumping system (deep soil) should continue to operate to remediate deeper soils at the site.

Semiannual monitoring was continued by Tetra Tech in 2001 and 2002. Monitoring reports were submitted in May 2002 and September 2002. The September 2002 letter report recommended continued operation and monitoring of the barometric pumping system to remediate the deep soil. On February 24, 2003, the

FDEP issued a response to the September 2002 report, concurring with the recommendation to continue semiannual operation and monitoring of the barometric pumping system at Site 2894 (Tetra Tech, 2002b).

On March 25, 2004, while performing semiannual groundwater sampling at Site 2894, Aerostar Environmental Services, Inc. gauged approximately three inches of floating nonaqueous phase liquid with an oil/water interface probe at monitoring well WHF-2894-MW-7. The depth-to-product measurement was 77.25 feet. Groundwater in this area of NAS Whiting Field is not typically encountered at this shallow depth; however, localized intermittent perched water-bearing lenses are frequently encountered at similar elevations.

Based on these findings, Tetra Tech was contracted by NAVFAC SE to perform an assessment and submit a SAR for Site 2894. Tetra Tech performed site assessment activities during May and June 2005. The sections below present the background information, data compilation, results, conclusions, and recommendations associated with the SAR.

- Excessive soil contamination is present on both the eastern and western sides of WHF-2894-MW-7 at depths of 6 to 28 feet bls. Although the screening results indicate soil was not contaminated adjacent to WHF-2894-MW-7 at 75 feet bls, free-phase product was observed in monitoring well WHF-2894-MW-7. Monitoring well WHF-2894-MW-7 penetrates the upper clay and may act as a vertical conduit and potentially channel free product to the previously uncontaminated water table at 75 feet bls.

- Results of fixed-base laboratory analysis of soil sample WHF-2894-SLB0318 collected at a depth of 18 feet bls indicated that contaminated soil was not present as defined by Chapter 62-770.200(7), F.A.C. Based on the analytical results, petroleum-related contaminants do not appear to be leaching from the soil at this location and depth interval.

In December of 2010, monitoring wells WHF-2894-MW-3I and WHF-2894-MW-4I were installed to the shallow surficial aquifer zone (Site 40). Both wells were sampled in 2011 for BTEX and TCE neither of which were detected.

Groundwater Summary

In 1998, groundwater samples collected from monitoring wells WHF-2894-MW-2S and WHF-2894-MW-3S were analyzed for TAL metals. In 1998, a groundwater sample collected from monitoring well WHF-2894-MW-3S (a perched well) was analyzed for VOCs, SVOCs, and TPH. Dibenzo(a,h)anthracene and indeno(1,2,3-c,d)pyrene exceeded their FDEP CTLs. Aluminum and iron exceeded their respective FDEP CTL and USEPA SDWS in the groundwater sample collected from monitoring well WHF-2894-MW-3S.

In 2001, groundwater samples were collected from monitoring wells WHF-2894-MW-2S, WHF-2894-MW-3S, WHF-2894-MW-5S, and WHF-2894-MW-7S (all perched wells) and analyzed for VOCs and PAHs. None of the targeted analytes were detected. A summary of the analytical results is presented in Table 4-26

In 2002, groundwater samples were collected from monitoring wells WHF-2894-MW-2S, WHF-2894-MW-3S, WHF-2894-MW-5S and WHF-2894-MW-7S (all perched wells) and analyzed for VOCs and SVOCs. 1,2-Dibromoethane, toluene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected, but at concentrations less than their FDEP CTLs.

On March 25, 2004, three inches of floating product was detected in the perched groundwater monitoring well WHF-2894-MW-7S. The fuel level has been monitored at least annually in well WHF-2894-MW-7S since initially detected. As a result of the fuel detected at the site, an investigation was completed with a SAR issued in June 2007 recommending additional investigation.

In December 2010, monitoring wells WHF-2894-MW-3I and WHF-2894-MW-4I were installed through a clay layer and screened in the shallow surficial aquifer in the direction believed to be hydrogeologically downgradient of monitoring well WHF-2894-MW-7P (newly designated with P suffix to denote perched [previously designated S]). In 2011, groundwater samples were collected from the two newly installed monitoring wells, which were screened across the groundwater table, and analyzed for BTEX. Toluene was detected at a concentration below its FDEP and USEPA CTLs.

Site 2894 Summary

Groundwater contamination investigated at Site 2894 is perched at approximately 80 feet bls and likely impacts Site 40 groundwater at approximately 100 feet bls by vertical migration to the water table. The site remains under investigation.

4.6.4 Oil/Water Separator Building 2993

Tank System 2993A consisted of an oil/water separator (OWS), a 500-gallon UST used to store jet fuel, and a sludge tank as shown on Figure 1-2. The OWS provided secondary containment for overfills occurring at the 500-gallon UST and also received the rainfall collected in a storm water collection sump from runoff from a nearby fuel truck parking area (Tetra Tech, 2001).

Tank System 2993A was located approximately 200 feet east of Building 2993 in a grassy area that slopes to the east. To the west of the site is an asphalt covered parking area extending approximately 200 feet west to Building 2993, the Fuel Contractor's office. Immediately adjacent to the site, along the edge of the asphalt parking area, is a one-story metal building set on a concrete slab. This structure is used as a drive through truck maintenance bay. Approximately 400 feet to the northwest of the site are two 230,000-gallon aboveground jet fuel tanks within concrete containment and two small storage buildings comprising Site 2894. To the north of the site is a grassy area that extends approximately 1,000 feet to the North Field ramps and runways. To the east and southeast of the site for over one-quarter mile is grassy vacant land (Tetra Tech, 2001).

In December 1996, the OWS, sludge tank and 500 gallon UST associated with Tank System 2993 were removed. During removal of the tank system, an Initial Remedial Action (IRA) was conducted to remove "excessively contaminated soil" in the area of the OWS. Approximately 34 cy^3 of soil were removed from an excavation approximately 10 feet by 15 feet by 6 feet in depth (Tetra Tech, 2001).

In May 1995, a CAR was initiated to investigate the areal extent of petroleum hydrocarbons in the groundwater and soil in the vicinity of the OWS system (W. Grady Swan, Inc. Project Number WGS95-0094). A soil vapor assessment was completed by advancing 21 soil borings (borings 1 to 21) to 5 feet bls and 1 deep borings, borings 22 and 23 to 31 feet bls and 45 feet bls, respectively, in the vicinity of the OWS. Soil vapor readings collected from soil samples indicated that "excessively contaminated soil" as defined in Chapter 62-770, F.A.C., for kerosene-type fuel releases was present. The "excessively contaminated soil" was identified from the land surface to approximately 5 feet bls within an area radiating outward 10 to 15 feet from the OWS, and to a depth of 20 to 35 feet bls within and immediately adjacent to the OWS.

To confirm the vertical extent of petroleum constituents in the soil (as defined by OVA data), samples were collected from borings 22 and 23 at depths of 29 to 31 feet bls and 45 feet bls, respectively. These subsurface soil samples were analyzed for volatile organic halocarbons, volatile organic aromatics, and PAHs. The results of the soil laboratory analysis indicated the targeted analytes were below their laboratory method detection limits (Tetra Tech, 2001).

The CAR identified an intermittent perched aquifer at approximately 4 to 10 feet bls beneath the site. Five monitoring wells were installed by hand auger during the CAR in May 1995 to determine the groundwater flow direction, hydraulic gradient, and the horizontal extent of groundwater contamination in the perched aquifer. On June 2, 1995, groundwater samples were collected from monitoring wells MW-1, MW-4, MW-5, and the southwestern compliance well for Kerosene Analytical Group parameters. The analytical results indicate that the perched aquifer was contaminated with dissolved hydrocarbons above their criteria established per Chapter 62-770, F.A.C., at the source location (MW-4) (Tetra Tech, 2001).

The CAR concluded that a thin, localized perched aquifer underlies the area of the OWS. The perched aquifer is located near land surface and contains groundwater only sporadically, primarily following heavy rainfall. During the initial sampling event, all of the monitoring wells, with the exception of one, contained less than 1 foot of water. During the second sampling event, three of the monitoring wells were dry and the other two contained less than 0.1 foot of water.

The CAR identified the source of contamination to be storm water discharges from the Fuel Truck Parking Area to the leaking OWS.

During the DPT investigation of the closed OWS, soils exhibiting an OVA response of greater than 50 parts per million (ppm) were encountered in soil borings OWS-SB-01 (780 ppm), OWS-SB-05 (>5000 ppm), OWS-SB-08 (400 ppm), OWS-SB-10 (200 ppm), and OWS-SB-12 (150 ppm). These data indicate that “excessively contaminated soil” is present in the vicinity of these soil borings. The “excessively contaminated soil” extends to a depth of approximately 22 feet bls in the immediate vicinity of the former OWS and sludge tank, (OWS-SB-01 and OWS-SB-05) and along the former runoff drain from the parking lot (OWS-SB-10). Elsewhere at the site the “excessively contaminated soil” is limited to the upper 10 to 15 feet of the vadose zone. Soil vapor screening results for the OWS are presented in Table 2-1 and soil vapor concentrations are depicted on Figure 3-1 of the Tetra Tech, 2001 report.

The results of the laboratory analysis confirm that petroleum-related analytes are present in the vadose zone soil at the site. The highest concentration of petroleum constituents was detected in the soil sample collected from OWS-SB-01. This sample had a TPH concentration of 3,800 mg/kg and a naphthalene concentration of 3,100 mg/kg. Concentrations above FDEP target levels were also reported for 1-methylnaphthalene and 2-methylnaphthalene. Laboratory analytical results for soil samples collected at the OWS are summarized on Table 3-1 of the 2001 Tetra Tech, report.

Site 2993 Summary

Groundwater investigated at Site 2993 is perched at approximately 20 feet bls and is ephemeral and does not impact Site 40 groundwater at approximately 100 feet bls.

4.6.5 Product Line Junction

The product pipeline junction investigated includes a portion of the system of pipelines formerly affiliated with two ASTs identified as Tank Number 2891 and Tank Number 2892. The product line was used to transport jet fuel stored in the ASTs to the dispensing facility. The product line begins at the pump station facility located on Hornet Street and extends in a southwesterly direction along the southern side of Hornet Street under Saratoga Street to an abandoned dispensing facility located southwest of the junction of Hornet and Enterprise Streets (Tetra Tech, 2001).

The product pipeline from the pump station to the dispensing facility consists of 10-inch diameter metal pipe approximately 1,315 feet in length. The product line maintains a consistent below grade depth of approximately three feet except for an aboveground junction located at the southeast corner of Hornet Street and Saratoga Street and an exposed portion near the pump station facility. The piping is located within a relatively flat grassy area. A site plan depicting the area of the product line investigation is provided as Figure 1-4 of the 2001 Tetra Tech, report.

On March 27, 1996, a closure assessment was performed after which the product pipeline system was taken out of service through in-place closure (Jim Stidham and Associates, Inc., 1996).

The site investigation was limited to the areas of the product line junction (PLJ) where “excessively contaminated soil” was detected during the product line closure assessment. Review of the data from the preliminary investigation and evaluation of historical data from previous investigations suggests the contaminant plume detected at the PLJ is commingled with the North Field Industrial Area petroleum plume now known as the NCA plume. Therefore, no further investigation was performed at the PLJ and any additional assessment for that location is to be addressed under the IR program. No data from the PLJ is included in this report (Tetra Tech, 2001). Data from all previous PLJ investigations have been available for investigation planning of the North Field Industrial Area petroleum plume.

Product Line Junction Summary

The contaminant plume detected at the PLJ is commingled with the NCA plume and is considered part of that larger plume.

4.6.6 Product Line Dispensing Facility

During the DPT investigation at the former Product Line Dispensing Facility (PDF), soils exhibiting an OVA response of greater than 50 ppm were encountered in soil borings PDF-SB-06 (310 ppm), PDF-SB-09 (>5000 ppm), and PDF-SB-12 (380 ppm). These data indicate that “excessively contaminated soil” is present in the vicinity of these soil borings. The “excessively contaminated soil” extends to a depth of approximately 19 feet along the southern and eastern edge of the former dispenser island pad, (PDF-SB-06 and PDF-SB-09). Elsewhere at the site, the “excessively contaminated soil” is limited to the upper 10 to 15 feet of the vadose zone. Soil vapor screening results for the PDF are presented in Table 2-2 and soil vapor concentrations are depicted on Figure 3-2 of the 2001 Tetra Tech, report.

The results of the laboratory analysis confirm that petroleum-related analytes are present in the vadose zone soil at the site. The highest detected concentration of petroleum-related constituents was in the soil sample collected from boring location PDF-SB-06. This soil sample had a TPH concentration of 20 mg/kg and a total volatile organic aromatic concentration of 6.9 mg/kg. Laboratory analytical results for soil samples collected at the PDF are summarized on Table 3-1 of the 2001 Tetra Tech, report.

Product Line Dispensing Facility Summary

The contaminant plume detected at the PDF is commingled with the NCA plume and is considered part of that larger plume.

4.6.7 Impact of Soil Contamination Leaching to Groundwater - North Central Area UST Summary

SPLP and/or TCLP analysis were performed for the analytes that had an exceedance of the Florida leachability to groundwater criteria. If an exceedance was not detected, then a representative sample(s) was chosen and SPLP and/or TCLP analysis was performed. The following provide a summary of the analytes that were detected in TCLP and SPLP leachate samples for the North Central Area USTs.

- UST Site 1438/1439: aluminum.
- Site 2832: soil removal completed and eliminated majority of the soil that was source of the petroleum-related constituents.
- Site 2894: SPLP test were not conducted as part of the investigation.
- OWS Building 2993: SPLP test were not conducted as part of the investigation.
- Product Line Junction: SPLP test were not conducted as part of the investigation.
- Product Line Dispensing Facilities: SPLP test were not conducted as part of the investigation.

Leachate infiltration modeling was not frequently conducted for the chemicals that were previously detected during the assessment of the North Central Area petroleum sites.

4.6.8 SUMMARY OF GROUNDWATER CONTAMINATION NORTH CENTRAL AREA

The following organic compounds exceeded either their USEPA and/or FDEP regulatory criteria for groundwater samples collected from within the NCA:

- Site 3: BTEX, TCE, cis-1,2-DCE, and vinyl chloride.
- Site 35: 1,1-DCA and BEHP.
- Site 36: TCE.
- Site 37: 1,1-DCA, TCE, and benzene.

- Site 41: BEHP.
- UST Site 1438/1439: BTEX, MTBE, naphthalene, 1-methyl naphthalene, 2-methyl naphthalene, TRPH and EDB.
- UST Site 2832: BEHP.
- UST Site 2894: In 1998, dibenzo(a,h)anthracene and indeno(1,2,3-c,d)pyrene exceeded their FDEP CTLs in samples from a perched well, but were not detected in subsequent samples. Free-phase product was detected in one monitoring well with a perched groundwater source.

The following inorganic analytes were detected above the federal and/or state regulatory criteria in the groundwater within the NCA:

- Site 3: analyzed for TAL metals: arsenic, aluminum, iron, manganese, mercury and lead detected.
- Site 4: analyzed for TAL metals: only lead detected.
- Site 32: analyzed for TAL metals: only lead detected.
- Site 41: analyzed for TAL metals and cyanide: only aluminum and iron detected.
- Site 1438/1439: only analyzed for lead, no detections.
- UST Site 2832: analyzed for TAL metals and cyanide: aluminum, iron, and manganese detected.
- UST Site 2894: analyzed for TAL metals: aluminum and iron detected.

4.7 SOUTH CENTRAL AREA

The paragraphs below present a brief site history and the results of the soil SPLP sampling activities for the SCA of Site 40, Base-Wide Groundwater at NAS Whiting Field. The SCA of Site 40 includes Sites 5, 6, 7 (former UST Site 1466), 15, 16, 29, 30, and 33 for the purposes of this report (see Figure 1-2).

In 2007, 37 monitoring wells were sampled for select organic constituents. Analyses for inorganic constituents were not performed because no new monitoring wells were installed in the SCA. In 2008 and 2011, a total of 37 and 42 monitoring wells were sampled for select organic constituents. Groundwater samples were collected from shallow, intermediate, and deep monitoring wells located at Sites 5, 6, 7 (former UST Site 1466), 15, 16, 29, 30, and 33. Sites 5, 6, 7, 30, and 33 are within the SCA plume boundaries and will be discussed as an associated group. Sites 15 and 16 are downgradient of the suspected source area and while not contributing to the plume contamination likely reflect the terminal end of the plume; therefore, they will be discussed individually. Figure 1-2 shows the locations of these sites and monitoring wells.

4.7.1 Groundwater Quality - SCA

In 2011, eight groundwater quality parameters (Table 4-4) were measured in 37 of the groundwater samples collected in the SCA. Groundwater geochemistry parameters used for evaluating natural attenuation and were analyzed both in the field and at a fixed-base laboratory. Parameters analyzed in the field included pH, conductivity, temperature, turbidity, ORP, hydrogen sulfide, and DO. Parameters analyzed at a fixed-base laboratory included DO, alkalinity, ammonia, carbon dioxide, chloride, DOC, nitrate, nitrite, sulfate, sulfide, TKN, TOC, and total phosphorus.

Twenty groundwater samples were collected from shallow aquifer zone monitoring wells that are screened from 195 to 210 feet bls. Thirteen samples were collected from intermediate aquifer zone monitoring wells that have total depths ranging from 150 to 160 feet bls. Nine samples were collected from deep aquifer zone monitoring wells that have total depths ranging from 180 to 190 feet bls.

All pH values were outside the USEPA SDWS range of 6.5 to 8.5. The pH values in the shallow aquifer zone monitoring wells ranged from 4.13 to 6.02, pH values in the intermediate aquifer zone monitoring wells ranged from 4.50 to 6.10, and pH values in the deep aquifer zone monitoring wells ranged from 4.46 to 5.79. The average values for the shallow, intermediate, and deep aquifer zone monitoring wells were 4.90, 4.96, and 4.79, respectively.

The specific conductance in the shallow aquifer zone monitoring wells ranged from 23 to 282 µS/cm, and the specific conductance in the shallow aquifer zone background monitoring wells in the ranged from 15 to 611 µS/cm. The specific conductance in the intermediate aquifer zone monitoring wells ranged from 21 to 311 µS/cm, and the specific conductance in the intermediate aquifer zone background monitoring wells ranged from 38 to 79 µS/cm. The specific conductance in the deep aquifer zone monitoring wells ranged from 23 to 77 µS/cm, and the specific conductance in the deep aquifer zone background monitoring wells ranged from 30 to 45 µS/cm.

The temperature ranged from 18.66 to 23.01 °C in the shallow aquifer zone monitoring wells, 19.94 to 23.35 °C in the intermediate aquifer zone monitoring wells and 20.33 to 21.73 °C in the deep aquifer zone monitoring wells. These readings are typical of the sand-and-gravel aquifer which has an average temperature of 22 °C.

As discussed in the introduction to this section and specified in Table 4-4, DO measurements were collected using three different methods. The DO readings collected via CHEMetsTM ranged from 0.20 to 6.50 mg/L in the shallow aquifer zone monitoring wells, 0.20 to 3.50 in the intermediate aquifer zone monitoring wells, and 1.00 to 4.50 in the deep aquifer zone monitoring wells. These DO measurements reached values in excess of 7 mg/L and diminished to less than 1 mg/L within the plume where high contaminant concentrations are present. Figure 4-7 depicts the DO and iron isocontours for the SCA using 2011 data.

The ORP readings ranged from -10.3 to 272.7 mVs in the shallow aquifer zone monitoring wells, -46.0 to 254.7 mVs in the intermediate aquifer zone monitoring wells, and 170.4 to 253.3 mVs in the deep aquifer zone monitoring wells. Figure 4-8 presents the ORP isocontours of the SCA. The isocontours show a reduced area directly beneath Site 7 the surrounding areas with a few exceptions are not impacted by reducing conditions. The tendency is for reducing conditions in the areas of highest contaminant concentrations. Wells with little or no contaminants present on the periphery of the plume tend to have an ORP in the +200 range. At the leading edge of the plume where contaminants are present in the intermediate zone, reducing conditions can be found but the deeper aquifer zone is positive.

Ferrous iron measurements collected from shallow aquifer zone groundwater samples from monitoring wells ranged from non-detect (ND) to 3.3 mg/L. Six of the 15 shallow aquifer zone monitoring wells that were sampled had ferrous iron measurements in exceedance of its GCTL and the SDWS, both of which are 0.3 mg/L. Two ferrous iron measurements were collected from the SCA intermediate aquifer zone monitoring wells. Only the groundwater sample collected from monitoring well WHF-07-MW-1I contained ferrous iron at 3.30 mg/L which exceeds its GCTL and the SDWS. Only one groundwater sample collected from a deep aquifer zone monitoring well (WHF 1466-MW-8D3) contained ferrous iron at a concentration (0.71 mg/L) that exceeded its GCTL and SDWS.

Ferrous iron measurements collected from groundwater samples located outside the boundary of the delineated plume indicate ferrous iron concentration was less than 1 mg/L to ND. Ferrous iron readings within the plume increased to values over 3 mg/L where high contaminant concentrations were present. Figure 4-7 depicts the ferrous iron isocontours for the SCA using 1998 and 2000 data.

Sites 5, 6, and 33 are located in a cluster, therefore, the Site 5 and 6 groundwater results will be presented in conjunction with those of Site 33.

4.7.2 OU 05 – Site 5, Battery Acid Seepage Pit

OU 5, Site 5, the Battery Acid Seepage Pit, consists of Building 1478 and the surrounding land and is located north of the Midfield Maintenance Hangar, Building 1454 (see Figure 1-2). Site 5 was the battery maintenance building where battery waste acid and electrolyte solutions were disposed of and replaced from 1967 until 1984.

Waste electrolytic solutions were mixed with sodium bicarbonate and tap water and then poured down a sink drain in Building 1454. From the sink the waste electrolyte solution was discharged via piping to a dry well. The well consisting of a section of 60-inch-diameter concrete culvert set vertically in the ground and filled with gravel located west of Building 1454. Annually, an estimated 180 gallons of waste electrolyte solution was discharged to the dry well. During the period of operation, an estimated total of 3,060 gallons of solution was disposed of in this manner. The drain was disconnected from the dry well in 1984 and connected to the sanitary sewer (Envirodyne Engineers, Inc., 1985).

A potable water supply well operated by the Navy, designated the South Production Well (W-S2), is located within 50 feet of Site 5 (Figure 2-1) (EDR, 2011, and Appendix C). Groundwater beneath Site 5 is currently being used as a source for drinking water. This groundwater, like all groundwater produced at Whiting, is filtered through granular activated carbon prior to use and tested on a monthly basis for VOCs.

History

As described in the RI Report for Sites 5, 7, 29, 35, and 38 (Tetra Tech, 2005c), on February 9, 1984, the FDER (now known as the FDEP) conducted a hazardous waste compliance inspection at NAS Whiting Field. Shortly thereafter, the FDER issued a warning notice to the Navy regarding the battery electrolyte and/or wastes constituents and disposal of hazardous waste. The current land use at Site 5 is industrial and is not expected to change in the foreseeable future (Tetra Tech, 2005c).

Four monitoring wells were installed at soil boring locations and completed with maximum depths ranging from 142 feet to 147 feet bls. On August 10, 1985, groundwater samples were collected from the monitoring wells and analyzed for PDWS contaminants, SDWS contaminants, USEPA priority pollutants, and aluminum. The monitoring wells were resampled on November 1, 1985, and analyzed for USEPA priority pollutants. The analytical results for the groundwater samples indicated benzene was the only analyte detected at concentrations exceeding the PDWS (Geraghty and Miller, 1986). Subsequent letters between the Navy and regulatory agencies reveal that on November 26, 1985, TCE was detected at 4.0 µg/L in the South Well exceeding FDEPs drinking water standard of 3.0 µg/L. Two follow-up sampling events in December 1985 detected TCE for an average of 3.3 µg/L and benzene averaging 0.7 µg/L.

The conclusions of the 1985 detection and monitoring program were: that groundwater and soils in the vicinity of the battery shop had not been adversely impacted by metals or other contaminants associated with past discharges to the dry well. However, organic analytes, particularly benzene, was detected at concentrations slightly above the PDWS in groundwater samples from two monitoring wells. The source of benzene in the groundwater was unknown. TCE was detected at a concentration exceeding the PDWS in a groundwater sample from the facility supply well W-S2. Periodic groundwater sampling for a period of one year was recommended (Geraghty and Miller, 1986). Subsequent to these detections quarterly sampling was instituted (Navy Letter to FDEP, 28 January 1986). Benzene was subsequently detected in the South Well (W-S2) in three of the following four quarterly sampling events exceeding the

FDEP primary drinking water standard of 1 µg/L . These findings prompted FDEP to request the closure of that well until the exceedances could be controlled through treatment (FDEP letter to the Navy, 28 August 1986) (Ref. this report, Section 1.2.3).

Unacceptable human health risks were not identified for Site 5 surface and subsurface soils, based on a residential land use scenario. Risks to ecological receptors were also acceptable. The ROD documents the selected remedial action for Site 5 as NA for surface and subsurface soils (Tetra Tech, 2005c).

Leachate Soil Summary

Soil samples WHF-05A-SS-2 (05SS0202) and WHF-05A-SS-4 (05SS0402) were selected to be representative of analytes detected in surface soil samples at Site 5. The samples were analyzed by the SPLP for pesticides, PCBs, and inorganics. The leachate for soil sample 05SS0402 contained the pesticide dieldrin at a concentration that exceeded its FDEP CTL. The leachate from surface soil samples WHF-05A-SS-2 (05SS0202) and WHF-05A-SS-4 (05SS0402) contained aluminum, cobalt, copper, iron, lead, manganese, and zinc. Aluminum and iron were detected at concentrations exceeding FDEP GCTLs and USEPA SDWS. Lead exceeded its FDEP CTL and USEPA PDWS. A summary of the SPLP data is presented in Table 4-27.

Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. Dieldrin at Site 5 was not simulated. Dieldrin was the only organic chemical to be detected in excess the SCTL at Site 5. It was detected in three out of six samples, with 1.72 mg/kg being the highest concentration detected. Dieldrin transport through soil has been has been modeled for several other sites (e.g., Sites 3, 11, and 16), where dieldrin was detected in samples collected from greater than two feet deep. In each case, dieldrin was not predicted to reach the water table, nor was it predicted to cause an impact to groundwater.

Groundwater Summary

Sites 5 (Battery Acid Seepage Pit), 6 (South Transformer Oil Disposal Area), 7 (Former UST Site 1466) (South AVGAS Tank Sludge Disposal Area), Site 30 (South Field Maintenance Hangar) and Site 33 (Midfield Maintenance Hangar) are located in a very small area (Figure 2-3). The groundwater summary is all inclusive and located in subsection 4.7.4.

4.7.3 OU 06 – Site 6, South Transformer Oil Disposal Area

OU 06, hereinafter referred to as Site 6, is a parcel of land approximately 1.1 acres located southeast of the Midfield Maintenance Hangar, Building 1454. From the 1940s until 1964, transformer fluids were reportedly drained into the grassed ditch southeast of Building 1454. A potable water supply well operated by the Navy is within 50 feet of Site 5 (EDR, 2011, and Appendix C). Groundwater beneath Site 6 is currently being used as a source for drinking water. The groundwater produced by water supply well W-S2 is filtered through granular activated carbon prior to use and tested on a monthly basis for VOCs.

Elevated concentrations of organic and inorganic analytes were identified in the RI at the site as presented in Section 2.5 of the Site 6 RI. The source of inorganic analytes (aluminum, iron, and vanadium) present at Site 6 is not known, as there are no documented uses of these constituents at the site. Organic compounds have been detected and are most prevalent in shallow soil at the area adjacent to the Midfield Hangar apron. Runoff from the apron is directed to this area; therefore, the most likely source of the organic compounds is from activities at the hangar, as well as the past discharge of transformer oil to the ditch.

Unacceptable human health risks were not identified for Site 6 surface and subsurface soils. Risks to ecological receptors were also acceptable. Based on the results of the HHRA for surface and subsurface soils at Site 6, the ROD documented the selected the remedial action for Site 6 as NFA for surface and subsurface soils (Tetra Tech, 2004c).

Previous groundwater investigations at Site 6 indicate that TCE, 1,1-DCE, BEHP, dieldrin, aluminum, cadmium, iron, lead, and manganese are present in groundwater at concentrations exceeding the FDEP GCTLs (ABB-ES, 1995c).

Based on the presence of benzo(a)pyrene and TPH at concentrations exceeding their industrial direct exposure SCTLs and their delineation during recent investigations**,** two areas each measuring 10 feet by 10 feet and approximately 5 feet deep was excavated at Phase II-A sample locations 6SB03 and 6SB04. The combined soil volume from the two areas excavated was approximately 37 yd^3 (approximately 52.7 tons). Because the horizontal and vertical extent of the contamination was predetermined, confirmation samples were not collected from the sidewalls or bottom of the excavation at Site 6 (CH^{2}M Hill, 2002).

Leachate Soil Summary

Based on previously existing data, the SPLP was performed for dieldrin and TCE on two subsurface soil samples (6SB0107 and 6SB0217) collected from locations WHF-06-SB-1, WHF-06-SB-2. Neither analyte was detected in the sample leachate. SPLP was performed for aluminum, chromium, copper, iron, lead, and manganese. None of the analytes were detected in the sample leachate. A summary of the SPLP data is presented in Table 4-28.

Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. Six chemicals (TCE, TRPH, benzo(a)anthracene, carbazole, chromium, and dieldrin) were detected in Site 6 soils, which had at least one exceedance of the SCTLs (see Table E-4 in Appendix H). Benzo(a)anthracene was detected in two out of five surface soils and one out of 14 subsurface soils. The SCTL was exceeded in only one sample and the detected concentration (1.65 mg/kg) was barely above the SCTL of 0.8 mg/kg (see Table E-4 in Appendix H). Therefore, simulation of the migration of benzo(a)anthracene was not performed. Likewise, there was only one sample result exceeding the leachability to groundwater SCTL for carbazole, three for dieldrin, one for TRPH, and one for TCE. Simulations of migration through soils for these chemicals were not performed because they were not found in sufficient mass or concentrations to pose a risk to groundwater based on the VLEACH simulations that were performed at other similar sites. Therefore the concentrations of TCE, TRPH, benzo(a)anthracene, carbazole, chromium, and dieldrin detected in soils at Site 6 would not result in adverse impacts to groundwater.

Chromium was detected in more samples and at greater depths at Site 6 than were the organic chemicals mentioned above. Of the 21 soil samples analyzed for chromium at Site 6, only one sample from 0 to 2 feet bls and one sample from 15 to 17 feet bls exhibited chromium concentrations exceeding its leachability to groundwater SCTL of 38 mg/kg. The simulation of chromium migrating through the soil column using the VLEACH model resulted in a maximum leachate concentration at the base of the soil column of 414 µg/L and a maximum concentration of 331 µg/L in the aquifer. This concentration in the aquifer is only slightly less than the leachate concentration; therefore, in all likelihood the concentration in the aquifer would be much less that 331 µg/L (i.e., dilution and dispersion in the aquifer would most likely result in lesser concentrations). The potential exceedance of the GCTL for chromium at Site 6 is highlighted on Table E-8 in Appendix H.

Groundwater Summary

Sites 5 (Battery Acid Seepage Pit), 6 (South Transformer Oil Disposal Area), 7 (Former UST Site 1466) (South AVGAS Tank Sludge Disposal Area), Site 30 (South Field Maintenance Hangar) and Site 33 (Midfield Maintenance Hangar) are located in a very small area (Figure 2-3). The groundwater summary is all inclusive and located in subsection 4.7.4.

4.7.4 OU 21 – Site 33, Midfield Maintenance Hangar

OU 21, hereinafter referred to as Site 33, is a 2.5 acre parcel located within the North Airfield of NAS Whiting Field (see Figure 1-2). The site includes Building 1454, a maintenance hangar, an unnumbered storage building, and a former waste oil/kerosene UST. Over 50 percent of the site is covered with impervious surfaces such as paved areas and buildings with the remaining area consisting of grass. Site

5 is located on the northern boundary, and Site 6 is located on the southeastern boundary. The site activities are characterized by aircraft maintenance and vehicle/aircraft traffic (ABB-ES, 1999).

Because the majority of the site is paved, little rainfall infiltrates soils and most is channeled into the storm sewers. Surface water runoff flows to the northern edge of the pavement and infiltrates into a grassy area. Surface water from the remainder of the site is channeled to a concrete drainage ditch which conveys the surface water runoff east to Big Coldwater Creek. Potable water supply well W-S2 is located within 50 feet of the northern boundary of Site 33 (EDR, 2011 and Appendix C). Groundwater from beneath Site 33 is currently being used as a source for drinking water and is treated by a granular activated carbon system and distributed throughout the facility for unrestricted use. The water produced by the water supply well is tested monthly for VOCs.

The historical land use of Site 33 involved the operation and maintenance of aircraft during the period of 1943 until the early 1970s when the Ground Support Equipment Shop replaced the maintenance of aircraft. The Ground Support Equipment Shop currently occupies Site 33.

The current land use for Site 33 is designated industrial under the following conditions agreed upon by the FDEP and USEPA: Restrict future use of the site to nonresidential activities involving less than full-time human contact with surface and subsurface soil.

Human health COCs were not identified for surface soils, but were identified for subsurface soil. The human health COC identified at Site 33 for subsurface soil was TRPH. Ecological COCs were not identified at Site 33. Therefore, the HHRA determined that actual or threatened releases of hazardous substances from this site would present an imminent and substantial endangerment to public health, welfare, or the environment if LUCs were not implemented (Tetra Tech, 2004d).

The ROD (Tetra Tech, 2004d) presents the final action for both the surface and subsurface soils at Site 33 and is based on results of the RI, FS, and FS Addendum completed for surface and subsurface soils for Site 33. The selected remedy at Site 33 is LUCs and ECs and includes FYRs to evaluate the effectiveness of the LUCs and ECs.

Previous groundwater investigations at Site 33 revealed the presence of TCE, 1,1 DCE, benzene, ethylbenzene, toluene, aluminum, antimony, cadmium, iron, lead, and manganese at concentrations exceeding FDEP CTLs (ABB-ES, 1995c).

Leachate Soil Summary

Subsurface soil samples WHF-33-SB-2 (33SB0207) and WHF-33-SB-5 (33SB0510) were selected to be the representative of the analytes detected in subsurface soil samples at Site 33 and were analyzed for ethylbenzene, total xylenes, dieldrin, TPH, aluminum, chromium, cobalt, copper, iron, lead, and manganese.

None of the targeted organic analytes were detected in the leachate of the SPLP samples. The leachate from soil sample WHF-33-SB-2 (33SB0207) contained aluminum, chromium, cobalt, copper, iron, lead, and manganese. Aluminum and iron were detected at concentrations that exceeded their FDEP CTLs and USEPA SDWS in the leachate of the SPLP samples (Table 4-29).

Leachate Infiltration Modeling Results

Six chemicals were previously detected during the RI at Site 33 at concentrations that exceeded their respective leachability to groundwater SCTLs (see Table E-4 in Appendix H). Chromium, dieldrin, and ethylbenzene were each detected in only one sample at concentrations that exceeded their leachability to groundwater SCTLs. Xylene was detected in two samples at concentrations that exceeded its leachability to groundwater SCTL. TCE was detected in six samples (four of which were surface soil samples) at concentrations that exceeded its leachability to groundwater SCTL. The highest detected TCE concentration was 0.130 mg/kg. Therefore, these six chemicals detected in soil samples were not found in sufficient mass or concentrations to pose a risk to groundwater based on the VLEACH simulations that were performed at other similar sites.

TRPH was detected in Site 33 soils at high frequencies of occurrence at concentrations that exceeded its leachability to groundwater SCTL (see Table E-4 in Appendix H). The highest detected concentrations of TRPH in soil were assigned to the starting soil profile in VLEACH, and the simulation was run for a period of 200 years. The concentration reaching the base of the vadose zone peaked after 190 to 200 years of migration and the peak leachate concentration was 3,620 µg/L, which is less than the GCTL of 5,000 µg/L (see Table E-8 in Appendix H). The maximum predicted TRPH concentration (1,943 µg/L) in groundwater less than its GCTL. Therefore, it is not likely that TRPH will not adversely impact groundwater at Site 33.

Groundwater Summary

The groundwater samples collected in 2011 from Sites 5, 6, and 33 were analyzed for VOCs to confirm historical findings and further characterize and delineate previously detected contaminants. The VOCs detected in 2011 include benzene, cis-1,2-DCE, ethylbenzene, toluene, and TCE at concentrations that exceed their FDEP CTLs and USEPA PDWSs and total xylenes at concentrations that exceed its FDEP CTL. A summary of the organic analytical results is presented in Table 4-30. Plume maps with isocontours for volatile organic contaminants detected in 2007, 2008, and 2011 are provided in Figures 4-9, 4-10 and 4-11, respectively. Analytical data from 2007 and 2008 is also presented in Table 4-30 and will be discussed along with the Mann-Kendall trend test results in Section 4.9.2. Groundwater samples were collected in 2007 from monitoring wells WHF-05-MW-3I and WHF-05-MW-10I and analyzed for TAL metals. Aluminum and iron were detected above their respective FDEP CTLs and USEPA SDWS. A summary of the inorganic analytical results is presented in Table 4-31.

Groundwater samples were collected in 2007 from monitoring wells WHF-06-MW-1S and WHF 06 MW3D and analyzed for TAL metals. Aluminum and iron were detected above their respective FDEP CTLs and USEPA SDWS. A summary of the analytical results is presented in Table 4-31.

Sites 5, 6, and 33 Summary

Based on soil sampling followed by laboratory leachate analysis contaminants are not leaching from soil and impacting groundwater. However, TCE, 1,1 DCE, benzene, ethylbenzene, toluene aluminum, antimony, cadmium, iron, lead, and manganese have been found and/or are currently present in groundwater at concentrations exceeding the FDEP GCTLs. No SVOCs, pesticides, or PCBs, were detected in groundwater samples. Cis-1,2-DCE is likely a degradation products of TCE. Sites 5, 6, and 33 are impacting groundwater as demonstrated by the SCA plume located beneath the three sites.

4.7.5 OU 07 – Site 7, South AVGAS Tank Sludge Disposal Area (Former UST Site 1466)

OU 07, hereinafter referred to as Site 7, is located on the southwestern side of the South Field Industrial Area, about 400 feet west-northwest of the South Field Maintenance Hangar (Building 1406, Site 30). Site 7 (previously known as UST Site 1466) once contained the South Fuel Farm including eight 23,700-gallon and two 15,000-gallon steel USTs (ABB-ES, 1994). The eight large USTs were used to store AVGAS, and the two smaller USTs were used to store aviation lubricants between 1943 to the late 1970s. The AVGAS USTs were cleaned out approximately every four years. The tank bottom sludge (probably containing tetraethyl lead) was buried at shallow depths in nearby areas (ABB-ES, 1994c). Navy personnel estimate that 1,000 to 2,000 gallons of sludge were disposed of in this manner. In 1991, ABB-ES initiated a contaminant assessment of Site 7, which included soil borings and the installation of 20 shallow and 3 deep monitoring wells (ABB-ES, 1994c). All of the USTs and the associated piping in the South Fuel Farm were removed in 1992.

At Site 7, a plume of BTEX was delineated in groundwater, which started at the USTs and extended south-southwest for at least 1600 feet. The highest concentrations of BTEX in the groundwater plume were detected in 1993 from monitoring well WHF-1466-MW-18S, which was located directly adjacent to one of the former USTs on the southeastern side of the Fuel Farm. The concentrations in 1993 groundwater sample for benzene, toluene, ethylbenzene, and xylene from monitoring well WHF-1466-MW-18S were 14, 11, 2.3, and 12 mg/L, respectively.

Previous investigation of groundwater at Site 7 indicate that TCE, vinyl chloride, 1,2-DCE, benzene, ethylbenzene, toluene, aluminum, antimony, cadmium, iron, lead, and manganese were present at concentrations that exceed their FDEP CTLs (ABB-ES, 1995c).

Leachate Soil Summary

The SPLP was performed on surface soil samples for SVOCs and TPH, and subsurface soils for VOCs, SVOCs, and TPH. None of the targeted analytes for surface soil samples was detected in their SPLP leachates. The leachates for the subsurface soil samples contained ethylbenzene, total xylenes, 2-methylnaphthalene, naphthalene, and TPH at concentrations that exceed their respective Florida groundwater CTLs.

Aluminum, iron, lead, manganese, and vanadium were detected at concentrations that exceed their FDEP CTLs and USEPA SDWS in the surface soil leachate. The subsurface soil samples did not contain inorganic analytes in the leachate at concentrations that exceed their FDEP CTLs and USEPA SDWS. A summary of the SPLP inorganic data is presented in Tables 4-32 and 4-33.

Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. A total of seven chemicals (benzene, benzo(a)anthracene, benzo(a)pyrene, ethylbenzene, selenium, toluene, and total xylenes) were detected in Site 7 soils, which had at least one exceedance of the SCTLs (see Table E-4 in Appendix H). Benzo(a)anthracene was detected in one out of eight surface soils (at 0.375 mg/kg) and one out of 10 subsurface soils (at 2.44 mg/kg). The SCTL was exceeded in only one sample, and the concentration detected (2.44 mg/kg) was barely in excess of the SCTL of 0.8 mg/kg (see Table E-4 in Appendix H). Therefore, simulation of benzo(a)anthracene migration was not performed. Likewise, there was only one sample result exceeding the SCTL for benzo(a)pyrene and two for selenium. Simulations of their migration through soils using VLEACH was not performed because their detections were very few, the exceedances of SCTLs were very few, and the simulation of migration for these chemicals at other sites indicate that the concentrations detected in soils at Site 7 would not result in adverse impacts to groundwater.

Soil leaching simulations were performed for four chemicals (benzene, ethylbenzene, toluene, and xylene) that were detected at high concentrations in Site 7 soils that were deep in the soil profile. These four chemicals have also been detected in Site 7 groundwater at relatively high concentrations.

Benzene was not detected in nine soil samples collected from 0 to 18 feet bls, but was detected in two samples from 18 to 20 feet bls and in five samples from 120 to 130 feet bls (near the water table surface). This suggests that the benzene detected in the soils near the water table surface originate from free-phase floating product and not from downward movement from the ground surface, or that downward infiltration has occurred and the majority of the contaminants are now near the water table. When the leaching and migration of benzene through the vadose zone was simulated, the highest concentrations of benzene in leachate at the bottom of the soil column and in the groundwater were observed in year 1 of the simulation, as would be expected since the bulk of the benzene mass was already at the water table at the beginning of the simulation. The highest predicted benzene concentrations in leachate at the base of the soil column and in groundwater occurred in year 1 and were 1,412 and 1,410 µg/L, respectively. These concentrations decreased rapidly (about 90 percent decrease) in the first ten years of simulation. Benzene has been detected in Site 7 soils at concentrations that are predicted by the VLEACH model to exceed its FDEP CTL and USEPA MCLs (see Table E-8 in Appendix H).

The distribution of toluene in the soil column was similar to benzene. One out of ten samples collected between 0 and 15 feet bls contained toluene at a concentration that barely exceeded its leachability to groundwater SCTL of 0.5 mg/kg (see Table E-4 in Appendix H). The majority of higher toluene concentrations (e.g., 3.4 to 34 mg/kg) were detected in soil samples that were collected at depths of 120 to 130 feet bls (i.e., at the water table surface). The VLEACH simulation of toluene leaching and migration predicted that the maximum toluene concentrations in leachate and groundwater (13,400 and 69 µg/L, respectively) occurred in year 1 and decreased rapidly thereafter. The simulation did predict the concentration of toluene in groundwater would exceed the FDEP GCTL of 40.0 µg/L and the USEPA MCL of 1,000 µg/L. This suggests toluene detected in the soils near the water table surface either originate from free-phase floating product near the same depth and not from downward movement from the ground surface or the mass of toluene has infiltrated from the near surface soils to depth.

Ethylbenzene was detected in two out of eight surface soil samples and 16 of 38 subsurface soil samples (below 15 feet deep). Unlike benzene and toluene, ethylbenzene was detected in approximately 40 percent of the soil samples throughout the soil column, and 27 percent of the samples exceeded the SCTL of 0.8 mg/kg. The simulation of ethylbenzene migration predicted that the highest concentrations in the soil leachate at the base of the soil column and in groundwater (2,690 and 144 µg/L, respectively) occurred in year 1 and decreased rapidly thereafter. By year 10, the concentrations were roughly 10 percent of the predicted values in year 1. Ethylbenzene has been detected in Site 7 soils at concentrations that are predicted by the VLEACH model to exceed its FDEP CTL and USEPA MCLs (see Table E-8 in Appendix H).

Xylene was detected in one of seven soil samples collected between 0 and 15 feet bls and 21 of 38 samples collected from below 15 feet bls. Xylene was similar in distribution to ethylbenzene, as it also was detected throughout the soil column. The highest detected concentration of xylene in soil (21.4 mg/kg) was in a sample collected from 125 feet deep (at the water table surface). The VLEACH model predicted that maximum concentrations of xylene in soil column leachate and groundwater (11,900 and 533 µg/L, respectively) occurred in year 1 of the simulation (see Table E-8 in Appendix H), and decreased rapidly thereafter. Xylenes have been detected in Site 7 soils at concentrations that are predicted by the VLEACH model to exceed its FDEP CTL and USEPA MCLs (see Table E-8 in Appendix H).

Groundwater Summary

The groundwater samples collected in 2011 from Sites 7 (former UST Site 1466), were analyzed for VOCs to confirm historical findings and further characterize and delineate previously detected contaminants. The VOCs detected in 2011 include benzene, cis-1,2-DCE, ethylbenzene, toluene, and TCE at concentrations that exceed their FDEP CTLs and USEPA PDWSs and total xylenes at concentrations that exceed its FDEP CTL. A summary of the analytical results is presented in Table 4-30. Plume maps with isocontours for volatile organic contaminants detected in 2007, 2008, and 2011 are provided in Figures 4-9, 4-10 and 4-11, respectively. Analytical data from 2007 and 2008 is also presented in Table 4-30 and will be discussed along with the Mann-Kendall trend test results in Section 4.9.2.

During 2007 to 2008, groundwater samples were collected from fifteen monitoring wells and analyzed for TAL metals. Arsenic, aluminum, iron, manganese, and vanadium were detected at concentrations above regulatory criteria. Lead was detected above its FDEP CTL and USEPA PDWS in the groundwater samples collected from monitoring wells WHF 07-MW-1I, WHF-1466-MW-15S and WHF-1466-MW-27S. A summary of the analytical results is presented in Table 4-31.

Site 7 Summary

Based on soil sampling followed by laboratory leachate analysis contaminants are leaching from soil and impacting groundwater. Ethylbenzene, total xylenes, 2-methylnaphthalene, naphthalene, and TPH were leached from subsurface soil at concentrations that exceed their respective state groundwater CTLs. Benzene, ethylbenzene, toluene, and xylenes are predicted based on modeling to impact the water table at concentrations that exceeded FDEP GCTLs and USEPA PDWS. Arsenic, aluminum, iron, manganese, and vanadium were detected at concentrations above regulatory criteria. Lead exceeded its FDEP CTL and USEPA PDWS in groundwater samples collected from Site 7. No SVOCs, pesticides, or PCBs, were detected in groundwater samples. Contaminants, including BTEX, and lead that originated in the Site 7 area have leached through the vadose zone producing a contaminant plume. TCE, found only in groundwater at Site 7, is likely migrating from up-gradient sites.

4.7.6 OU 14 – Site 15, Southwest Landfill

OU 14, hereinafter referred to as Site 15, is a 21-acre parcel located along the southwestern facility boundary of NAS Whiting Field (see Figure 1-2). Site 15 is located west of the South Air Field and can only be easily accessed by the Patrol Road. The site is currently forested with scrub oak shrubs and pine trees approximately 25 feet high and slopes towards Clear Creek located approximately 1,200 to the southwest. According to the Santa Rosa County Soil survey (USDA, 1980), the soil at Site 15 is classified as Troup Loamy Sand. There is no evidence of a clay soil cap over the site area. Because the soil at the site is predominantly silty sand, most rainfall infiltrates directly into the sites soil, and there is no evidence of surface water runoff (ABB-ES, 1998a). Surface water bodies are not present within the site boundaries. Buried waste is not exposed at the land surface, and there are no indications (e.g., stained soil or stressed vegetation) of past waste disposal practices. There are no potable water supply wells within one-quarter mile of Site 15 (EDR, 2011 and Appendix C). Groundwater from beneath Site 15 is not currently being used as a source for drinking water.

The historical land use of Site 15 was an operational landfill from 1965 to 1979 and consisted of approximately seven trenches oriented north to northeast. These trenches covered approximately 15 to 21 acres of the site. The landfill reportedly received the majority of wastes generated at the base, potentially including general refuse, waste paints, oils, solvents, thinner, hydraulic fluid, bagged asbestos, and potentially PCB-contaminated transformer oil. Site 15 has undergone several phases of investigations since 1985.

The only human health COC identified at Site 15 was Aroclor-1242 in subsurface soil. No ecological COCs were identified at Site 15. The primary contributor to the sublethal risk was Aroclor-1242 in the subsurface soil. There were no exceedances found in the surface soil at Site 15. Therefore, the risk assessments found that actual or threatened releases of hazardous substances from this site would present an imminent and substantial endangerment to public health or welfare if LUCs were not implemented. The ROD (Tetra Tech, 2006d) presents the final action for subsurface soils at Site 15 and is based on results of the RI and FS completed for surface and subsurface soils for Site 15 (Tetra Tech, 1998). The selected remedy at Site 15 is LUCs and includes FYRs to evaluate the effectiveness of the LUCs.

Previous investigations (Phases II-A and II-B) at Site 15 revealed the presence of 1,1-DCE, benzene, TCE, 4,4’-DDT, aluminum, antimony, iron, manganese, and thallium in groundwater exceeding FDEP CTLs (HLA, 1999e).

Leachate Soil Summary

Based on historical data, SPLP was performed for the SVOCs 3,4-methylphenol and phenol on two soil samples (15SB0212 and 15SB0612) at boring locations WHF-15-SB-2 and WHF-15-SB-6. Neither analyte was detected in the soil sample leachate. SPLP was performed for aluminum, cobalt, copper, iron, lead, and manganese on two soil samples (15SB0212 and 15SB0612) at boring locations WHF-15-SB-2 and WHF-15-SB-6. Only aluminum was detected at concentrations that exceed its FDEP CTL and USEPA SDWS in the leachate for the soil samples. A summary of the SPLP data is presented in Table 4-34.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. During the Phase II-A investigation, five subsurface soil samples were collected from five different test pits at depths ranging from 5 to 12 feet bls. Phenol and 4-methylphenol were detected in one sample each at concentrations exceeding their FDEP leachability to groundwater SCTLs. Phenol was detected at 0.053 mg/kg in test pit TP-15-02, and 4-methylphenol was detected at 0.077 mg/kg in test pit TP-15-06. The single detection of phenol marginally exceeds the FDEP leachability to groundwater SCTL of 0.050 mg/kg. For the VLEACH modeling, the maximum concentration of phenol and 4-methylphenol were assigned to layer 2 (depth interval = 7-12 feet bls,) (see Table E-6 in Appendix H). Concentrations of these two analytes were set equal to zero in the other three layers. The affected soil area was estimated to be 500 feet by 500 feet (see Table E-1 in Appendix H) encompassing both test pits where the two contaminants were detected, plus the intervening area and areas to the east and west.

The VLEACH modeling predicted phenol will move downward from 12 feet to 31 feet bls in a relatively short time (38 years). The predicted concentration at 10 feet bls is initially high (148 μg/L in year 1), but decreased rapidly in years 2 and 3 and was nearly depleted by year 4. A phenol concentration peak reached 30 feet bls and the bottom of the vadose zone (31 feet bls) after 36 years of migration, but the concentration was only 0.23 μg/L (see Table E-8 in Appendix H). After mixing with groundwater, the phenol concentration in groundwater peaked at 0.0095 μg/L after 39 years of migration. Hence, the predicted impact to groundwater quality in the water-table aquifer is negligible. 4-Methylphenol also reaches the bottom of the vadose zone, but the arrival time is much slower (74 years), and the predicted concentration never exceeds $1.0E^{-7}$ μg/L (see Table E-8 in Appendix H). Therefore, it is not likely that phenol and 4-methylphenol will adversely impact groundwater at Site 15.

Groundwater Summary

Groundwater samples were collected in 2007, 2008 and 2011 from 12 monitoring wells at Site 15 and analyzed for select VOCs. TCE was detected in exceedance of its FDEP CTL and USEPA PDWS in groundwater samples collected from monitoring wells WHF-15-MW-5I, WHF-15-MW-5D, WHF-15-MW-8I, and WHF-15-MW-8D. Groundwater samples were collected in 2007 from eight monitoring wells at Site 15 and analyzed for TAL metals. Aluminum, iron, and manganese were detected in excess of their regulatory criteria. A summary of the analytical results is presented in Tables 4-30 and 4-31.

Site 15 Summary

Based on leachate analysis, only aluminum is leaching from soil and impacting groundwater. TCE was detected in exceedance of its FDEP CTL and USEPA PDWS in intermediate and deep groundwater samples and is likely migrating beneath Site 15 from up gradient sites.

4.7.7 OU 15 – Site 16, Open Disposal and Burning Area

OU 15, hereinafter referred to as Site 16, is a roughly rectangular, 12-acre parcel located along the southwestern facility boundary of NAS Whiting Field (see Figure 1-2). The site is located west of the South Air Field and can only be easily accessed by the Patrol Road. The site is currently forested with scrub oak shrubs and pine trees approximately 25 feet high and slopes towards the southwest. Clear Creek is located approximately 400 feet to the west. According to the Santa Rosa County Soil survey (USDA, 1980), the soil at Site 16 is classified as Troup Loamy Sand. There is no evidence of a clay soil cap over the site area. Because the soil at the site is predominantly silty sand, most rainfall infiltrates directly into the site soil, as there is no evidence of surface water runoff (ABB-ES, 1998a). Surface water bodies are not presently found within the site boundaries; however, in the 1990s, there was a mapped area termed “the bog” west of the site. Buried waste is not exposed at the land surface and there are no indications (e.g., stained soil or stressed vegetation) of past waste disposal practices. There are no potable water supply wells within one-quarter mile of Site 16 (EDR, 2011 and Appendix C). Groundwater from beneath Site 16 is not currently being used as a source for drinking water. Groundwater beneath Site 16 flows to the southwest and upwells into the Clear Creek floodplain Site 39.

The historical land use of Site 16 was the primary sanitary landfill for NAS Whiting field during the period of 1943 until 1965. To reduce volume, solid wastes were routinely burned using diesel fuel as an accelerant. Site 16 has undergone several phases of investigations since 1985.

The four human health COCs identified at Site 16 are cPAHs, barium, copper, and lead in surface soils and barium, copper, and lead in subsurface soils. No ecological COCs were identified at Site 16. The primary contributor to the sublethal risk in the subsurface soil was the suspected buried waste and debris. Therefore, the risk assessments found that actual or threatened releases of hazardous substances from this site would present an imminent and substantial endangerment to public health or welfare if LUCs were not implemented.

The ROD (Tetra Tech, 2008d) presents the final action for surface and surface soils at Site 16 and is based on results of the RI and FS completed surface soils for Site 16. The selected remedy at Site 16 is LUCs and includes FYRs to evaluate the effectiveness of the LUCs.

Previous investigations (Phases II-A and II-B) at Site 16 revealed the presence of 1,2-DCA, TCE, benzene, BEHP, 4,4'-DDT, aluminum, antimony, beryllium, cadmium, chromium, iron, lead, manganese, and vanadium in groundwater exceeding their FDEP CTLs (HLA, 2000b).

Based on the presence of benzo(a)pyrene and PAHs at Phase II-B surface soil sampling locations exceeding USEPA Region IX residential RPGs the decision was made to remove the soil around the area of exceedance. An area that measured 45 feet by 20 feet and approximately 2 feet deep was excavated. Approximately 67 cubic yards (95.37 tons) of nonhazardous soil were removed. Prior to completing the backfill, two subsurface soil samples were collected at the bottom of the excavation area and analyzed for PAHs. The results revealed the soil was above the leachability criteria for subsurface soil and that benzo(a)pyrene concentrations in one of the excavation samples slightly exceeded residential, direct exposure (CH^2M Hill, 2002).

Leachate Soil Summary

Prior to completing the backfill, two subsurface soil samples were collected at the bottom of the excavation area and analyzed for PAHs. The results revealed the soil was above the leachability criteria for subsurface soil and that benzo(a)pyrene concentrations in one of the excavation samples slightly exceeded residential, direct exposure (CH^2M Hill, 2002). The excavation was back filled with clean soil.

The leachate from sample 16SS1002 collected form location WHF-16-SS-10 was analyzed for aluminum, antimony, cadmium, cobalt, iron, lead, and manganese. Aluminum and iron were detected at concentrations exceeding their FDEP CTLs and USEPA SDWS in the soil sample leachate. Antimony, cadmium, and cobalt were not detected. A summary of the SPLP data is presented in Table 4-35.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. During the Phase II-A investigation, five subsurface soil samples were collected from five different test pits at depths ranging from 2 to 10.5 feet bls. Dieldrin was detected in one of these samples, and antimony and cadmium were detected in two samples at concentrations exceeding FDEP SCTLs. The maximum concentrations of these three chemicals were 0.15, 6.7, and 9.0 mg/kg, respectively (see Table E-4 in Appendix H). For the SESOIL modeling, the maximum surface soil concentrations of the four chemicals were assigned to layer 1 (depth interval = 0-2 feet bls) (see Table E-6 in Appendix H). The maximum concentrations of each chemical detected in subsurface soil samples were assigned to layers 2 and 3, as appropriate. The affected soil area was estimated to be 300 feet by 800 feet (see Table E-1 in Appendix H), encompassing all of the surface and subsurface sampling locations where contaminants were detected exceeding the SCTLs.

The VLEACH modeling predicted most of the methylene chloride mass will move down to the water table surface (12 feet bls) in the first two years of migration. The maximum concentration of methylene chloride in leachate expected to reach the water table is 317 µg/L in year 1 (see Table E-8 in Appendix H), but decreased rapidly in year 2 and was nearly depleted by year 3. After mixing with groundwater, the methylene chloride concentration in groundwater peaked at 24.3 µg/L after one year of migration. The methylene chloride concentration decreased rapidly in succeeding years. Because the methylene chloride leaches out of the soil so quickly and because the landfill operations ended so long ago, it is not likely much methylene chloride is currently present in the soil. Also, methylene chloride was detected in only one soil sample out of 24 soil samples analyzed. Since methylene chloride is a common lab contaminant, the single detection of methylene chloride may be a false positive result.

The VLEACH modeling predicted there would be extremely slow movement of dieldrin. Dieldrin would not reach the 10-foot depth marker or the water table in 200 years of infiltration. Therefore, it is not likely that dieldrin will adversely impact groundwater at Site 16.

Groundwater Summary

Groundwater samples were collected in 2007, 2008 and 2011 from five monitoring wells at Site 16 and analyzed for select VOCs. Benzene was detected in 2007 and 2008 at concentrations that exceeded its FDEP CTL and USEPA PDWS in the groundwater samples collected from monitoring wells WHF 16 MW 2I; however, benzene was not detected in 2011. Benzene was detected at concentrations that exceed its FDEP CTL in groundwater samples collected from monitoring well WHF-16-MW-3I in 2007 and 2008, monitoring well WHF-16-MW-4II in 2008 and monitoring well WHF-16-MW-7I in 2007, 2008, and 2011. Benzene was not detected in the groundwater samples collected in 2011 from monitoring wells WHF-16-MW-3I and WHF-16-MW-4II.

TCE was detected in 2007 at concentrations that exceed its FDEP CTL and USEPA PDWS in a groundwater sample collected from monitoring well WHF-16-MW-21; in 2008 TCE exceeded its FDEP CTL; and in 2011 TCE was below its FDEP and USEPA CTLs. In 2007 and 2008, TCE was detected exceeding its FDEP CTL and USEPA PDWS in groundwater samples collected from monitoring well WHF

16-MW-4II; in 2011 TCE exceeded its FDEP CTL. A summary of the analytical data is presented in Table 4-30.

Groundwater samples were collected in 2007 from seven monitoring wells at Site 16 and analyzed for TAL metals. Aluminum, iron, and manganese were detected in excess of their regulatory criteria. A summary of the analytical results is presented in Table 4-31.

Site 16 Summary

Based on leachate analysis, only aluminum and iron are leaching from soil and impacting groundwater. Benzene and TCE were detected in exceedance of their FDEP CTL and/or USEPA PDWS in intermediate and deep groundwater samples that are likely migrating to Site 16 from up-gradient sites.

4.7.8 OU 26 – Site 29, Auto Hobby Shop

OU 26, hereinafter referred to as Site 29, the Auto Hobby Shop, is located in the area surrounding Buildings 1404 and 2975 (see Figure 1-2). A steel UST was installed in the 1940s for storage of waste motor oil generated from vehicle maintenance operations conducted at the Auto Hobby Shop. The UST was located southeast of Building 1404 and west of Building 2975. The UST was initially abandoned in place in 1986 and later removed from the site in 1998 (Bechtel, 2000b). Another UST that was used for storage of heating oil specifically for Building 1404 and presumably installed in the mid-1940s was located in the parking area between Buildings 1404 and 2975. This UST was also removed in 1998.

Building 1404 has been used since the 1940s for base personnel vehicle repairs, woodworking, and hobby activities. Building 2975 is used for vehicle and supply storage. The waste oil UST was used for disposal of waste motor oil and possibly solvents and paints from the 1940s until 1986. In 1986, the waste oil UST was abandoned in place by filling it with sand. This apparently occurred before the UST was included in the formal tank management program at the facility. It is unknown if the UST contents were removed as part of the abandonment. Following abandonment, an aboveground waste oil tank was placed at the location for continued disposal activities. The heating oil UST is believed to have been used for heating oil only and no records of other materials being placed in the tank exist.

Six surface soil borings and five subsurface soil borings were advanced at Site 29 near the former waste oil UST location, and five additional subsurface soil borings were advanced at the former heating oil UST location for the purpose of investigating possible contamination. The subsurface samples were screened for organic vapors by FID. Organic vapors were not detected; therefore, subsurface soil samples were not collected for laboratory analysis. Six surface soil samples were collected in 2000 and analyzed for SPLP VOCs, SVOCs, inorganics, and TRPH.

Unacceptable human health risks have not been identified for Site 29 surface and subsurface soils under a residential land use scenario. Risks to ecological receptors are acceptable. Therefore, the ROD for Site 29 documents the selected remedial action as a NA for surface and subsurface soils (Tetra Tech, 2005e).

Leachate Soil Summary

Soil samples, WHF-29-SS-1 (29D00101), WHF-29-SS-2 (29D00201), WHF-29-SS-3 (29D00301), WHF-29-SS-4 (29D00401), WHF-29-SS-5 (29D00501), and WHF-29-SS-6 (29D00601), were selected to be the representative of the analytes detected in surface soil at Site 29 and were analyzed by the SPLP for VOCs, SVOCs, TPH, and inorganics.

Acetone was the only VOC detected and did not exceed its FDEP or USEPA regulatory criteria for groundwater. SVOCs and TPH were not detected in the leachate of the SPLP sample.

Aluminum, iron, and lead exceeded FDEP CTLs and USEPA SDWS in the leachate of the SPLP sample. Vanadium exceeded its FDEP CTL in the leachate of the SPLP sample. A summary of SPLP data is presented in Table 4-36.

Leachate Infiltration Modeling Results

Ten different chemicals were detected previously during the RI in soils samples collected from Site 29 at concentrations exceeding their respective leaching to groundwater SCTLs (see Table E-4 in Appendix H). Antimony was detected only once in 20 surface and subsurface soil samples; it was detected at a depth of 12 to 14 feet bls in 29SB02. Since the detected value (11.5 mg/kg) only slightly exceeded its leachability to groundwater SCTL (5.4 mg/kg), the leaching and migration of antimony was not simulated. Likewise, TCE, ethylbenzene, naphthalene, and dieldrin were detected in only one surface or near-surface sample (i.e., 0 to 15 feet bls) (see Table E-4 in Appendix H) exceeding their leachability to groundwater SCTL; therefore, their migration through the vadose zone was not simulated.

Benzene was detected in five out of 16 surface soil samples and one of six near-surface soil samples (see Table E-4 in Appendix H); however, only three of these samples exceeded its leachability to groundwater SCTL of 0.007 mg/kg. Chromium was detected in 25 soil samples; however, its leachability to groundwater SCTL (38 mg/kg) was exceeded in only two of the samples. Toluene was detected in three surface samples and one near-surface sample; however, only one of the surface soil samples contained toluene at a concentration exceeding its leaching to groundwater SCTL. Xylenes were detected exceeding its leachability to groundwater SCTL in two of 16 surface soil samples; but not in subsurface soil samples. Therefore, these nine chemicals detected in soil samples were not found in sufficient mass or concentrations to pose a risk to groundwater based on the VLEACH simulations that were performed at other similar sites.

TRPH was exceeded its' SCTL (340 mg/kg) in five of 15 surface soil samples, but not in 10 near-surface and subsurface soil samples. The TRPH concentrations in five surface samples were relatively high (370 to 14,000 mg/kg); therefore, a simulation of TRPH leaching and migration for Site 29 was performed. The TRPH concentrations in soil at 0 to 5, 5 to 10, 10 to 14, and 14 to 17 feet bls were set to 14,000, 16.4, 2.2, and 4.2 mg/kg, respectively, which correspond to the highest concentrations of TRPH detected in soil at those depth intervals. The VLEACH model predicted that TRPH would reach a depth of only 85 feet bls after 200 years (note: the total thickness of the vadose zone is 127 feet). The highest concentration of TRPH in soil leachate at a depth of 30 feet bls was 18,000 µg/L, which is three times higher than the GCTL of 5,000 µg/L. The VLEACH model, however, predicts that TRPH will not reach the water table surface (approximately 127 feet bls) in 200 years at a concentrations that would cause an exceedance of its GCTL (5,000 µg/L). Therefore, it is not likely that TRPH will adversely impact groundwater at Site 29.

Groundwater Summary

Groundwater samples were collected in 1993 from two monitoring wells at Site 29 and analyzed for TAL metals. Aluminum, antimony, cadmium, chromium, cobalt, iron, lead, manganese, mercury, and vanadium were detected in excess of their regulatory criteria.

Site 29 Summary

Based on leachate analysis, only aluminum, iron, and lead are leaching from soil and impacting groundwater. However, aluminum, antimony, cadmium, chromium, cobalt, iron, lead, manganese, mercury, and vanadium were detected in excess of their regulatory criteria. Aluminum, iron, manganese, and vanadium are likely naturally occurring. Antimony, cadmium, chromium, cobalt, and lead are impacting groundwater but from no known source.

4.7.9 OU 18 – Site 30, South Field Maintenance Hangar

OU 18, hereinafter referred to as Site 30, is a 4.3-acre parcel located at the South Field Industrial Area of NAS Whiting Field (see Figure 1-2). The site includes Buildings 1406, 3042, and 3024; two aircraft wash racks; and four former waste oil/kerosene USTs. The site consists of paved areas and buildings that are surrounded by small areas of grass. Site activity is primarily aircraft maintenance and washing which is characterized by high vehicle/aircraft traffic. The historical land use of Site 30 involved the operation and maintenance of aircraft from 1943 until the present. Because the majority of the site surface is paved, most of the on-site rainfall does not infiltrate soils and is channeled into the storm water sewer system.

Surface water runoff is intercepted by a concrete drainage ditch that conveys surface water from the South Airfield to Clear Creek. Surface water bodies are not present within the site boundaries.

There are no potable water supply wells within one-quarter mile of Site 30 (EDR, 2011 and Appendix C). The closest potable water supply well is W-S2, located 1,400 feet hydraulically upgradient to the north. Groundwater beneath Site 30 is not currently being used as drinking water.

The human health COCs identified at Site 30 was TRPH in surface soil and TRPH and benzo(a)pyrene TEQs in subsurface soil. Ecological COCs were not identified at Site 30. Therefore, the risk assessments found that actual or threatened releases of hazardous substances from this site would present an imminent and substantial endangerment to public health and welfare. The ROD (Tetra Tech, 2004e) presents the final action for both the surface and subsurface soils at Site 30 and is based on results of the RI, FS, and FS Addendum completed for surface and subsurface soils for Site 30. The selected remedy at Site 30 is LUCs and ECs and includes FYRs to evaluate the effectiveness of the LUCs and ECs.

Previous groundwater investigations at Site 30 revealed the presence of 1,1-DCE, TCE, benzene, aluminum, cadmium, iron, lead, and manganese in groundwater at concentrations exceeding their FDEP CTLs (ABB-ES, 1995c).

Leachate Soil Summary

Soil samples WHF-30-SB-1 (30SB0107), WHF-30-SB-2 (30SB0202), WHF-30-SB-B1 (30SB0119), WHF-30-SB-E2 (30SB0207), and WHF-30-SB-N3 (30SB0309), were selected to be the representative of analytes detected in subsurface soil samples at Site 30 and were analyzed by the SPLP for VOCs, SVOCs, PAHs, TPH, and inorganics. None of the targeted analytes were detected in the leachate of the SPLP samples. A summary of the SPLP data is presented in Table 4-37.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. Eleven chemicals were previously detected during the RI in soil samples collected from Site 30 that exceeded their respective leachability to groundwater SCTLs (see Table E-4 in Appendix H). 1-Methylnaphthalene was in excess its leachability to groundwater SCTL in three subsurface (2 to 15 feet bls) soil samples. 4-Methylphenol, benzo(a)anthracene, chromium, isopropylbenzene, n-nitrosodiphenylamine, pentachlorophenol, and xylene were detected in excess of their leachability to groundwater SCTLs in only one or two samples each, and the maximum detected concentrations barely exceeded their leachability to groundwater SCTLs (see Table E-4 in Appendix H). Therefore, the eight chemicals detected in soil samples were not found in sufficient mass or concentrations to pose a risk to groundwater based on the VLEACH simulations that were performed at other similar sites.

Three chemicals (2-methylnaphthalene, naphthalene, and TRPH) were detected in Site 30 soils at high frequencies of occurrence and at concentrations exceeding their leachability to groundwater SCTLs. 2-Methylnaphthalene was detected in 13 of 58 soil samples at concentrations three times its leachability to groundwater SCTL of 8.5 mg/kg (see Table E-4 in Appendix H). A VLEACH simulation of leaching and migration of 2-methylnaphthalene predicted that 2-methylnaphthalene will not reach the base of the vadose zone in 200 years. Simulations for naphthalene and TRPH also predicted that these chemicals will leach downward through the soil column, but will not pass through a clay layer at 120 to 160 feet bls. Therefore, it is not likely that 2-methylnaphthalene, naphthalene, and TRPH will adversely impact groundwater at Site 30.

Groundwater Summary

Groundwater samples were collected in 2007 from two monitoring wells at Site 30 and analyzed for TAL metals. Aluminum, iron, and manganese were detected in excess of their regulatory criteria but are likely naturally occurring at the concentrations detected. A summary of the analytical results is presented in Table 4-31.

Site 30 Summary

Subsurface soils were analyzed by SPLP for VOCs, SVOCs, PAHs, TPH, and inorganics but none were detected. Other historically detected chemicals were 1-methylnaphthalene, 2-methylnaphthalene, 4-methylphenol, benzo(a)anthracene, chromium, isopropylbenzene, naphthalene, n-nitrosodiphenylamine, pentachlorophenol, TRPH, and xylene but the VLEACH model predicted none had sufficient mass to leach to groundwater at concentrations to impact groundwater.

4.7.10 <u>OU 24 - Site 39, Clear Creek Floodplain</u>

OU 24, hereinafter referred to as Site 39, is a 2.5 acre parcel located within the North Airfield of NAS Whiting Field (see Figure 1-2). Site 39 includes both Clear Creek and the Clear Creek floodplain. The northern boundary of Site 39 is located approximately 350 feet north of where “A” Ditch intersects Clear Creek. The southern boundary of Site 39 is located approximately 1,200 feet south of “A” Ditch. Site 39 is approximately 1,200 feet in length and 300 to 400 feet wide. The Site 39 RI study area boundary encompasses Site 39 and matches the width of the flood plain and is approximately 9,000 feet in length (see Figure 1-2). The western and eastern boundaries of the study area match the flood plain except where the floodplain is not present south of “M” Ditch (Tetra Tech, 2010b).

The Site 39 RI was submitted to federal and state regulatory agencies in 2010 and is currently under review. The RI states that Site 40 groundwater upwells into Clear Creek and analytes are detected above both federal and state regulatory criteria.

4.7.11 Impact of Soil Contamination Leaching to Groundwater - South Central Area Summary

SPLP and/or TCLP analysis were performed for the analytes that had an exceedance of the FDEP leachability to groundwater criteria. If an exceedance was not detected, then a representative sample(s) was chosen and SPLP and/or TCLP analysis was performed. The following provide a summary of the analytes that were detected in TCLP and SPLP leachate samples for the SCA.

- Site 5: dieldrin, aluminum, and iron
- Site 6: analytes in SPLP extract did not exceed leachability to groundwater criteria
- Site 7: ethylbenzene, total xylenes, 2-methylnaphthalene, naphthalene, and TPH
- Site 15: aluminum
- Site 16: aluminum and iron
- Site 29: aluminum, iron, lead, and vanadium
- Site 30: analytes in SPLP extract did not exceed leachability to groundwater criteria
- Site 33: aluminum and iron,
- Site 39: is being evaluated in a RI separate from Site 40.

Leachate infiltration modeling was conducted for the chemicals that were previously detected during the RI in soil samples collected from the SCA. Benzene, ethylbenzene, and xylenes are predicted to migrate to groundwater at concentrations that may result in an adverse impact to groundwater.

4.7.12 South Central Area Groundwater Contamination Summary

The following organic compounds were detected in the groundwater samples collected within the SCA at concentrations that exceed either their respective FDEP CTLs and/or USEPA PDWS:

- Site 5, 6, 7, 30 and 33: TCE, cis-1,2-DCE BTEX,
- Site 15: TCE,
- Site 16: benzene and TCE.

The following inorganic analytes were found above either USEPA and/or FDEP regulatory criteria in the groundwater within the SCA:

- Site 5: aluminum and iron,

- Site 6: aluminum and iron,
- Site 7: aluminum, arsenic, iron, lead, manganese, and vanadium,
- Site 15: aluminum, iron, and manganese,
- Site 16: aluminum, iron, and manganese,
- Site 29: aluminum, antimony, cadmium, chromium, cobalt, iron, lead, manganese, mercury, and vanadium,
- Site 30: aluminum, iron, and manganese,
- Site 33: aluminum, iron, and lead.

4.8 SOUTHERN AREA

The Southern Area of Site 40 includes Sites 9, 10, 11, 12, 13, 14, and 31A through F for the purposes of this report (see Figure 1-2). These sites were sampled at various times for soil and/or groundwater from 1998 to 2000. Earlier in the investigation, full suite USEPA CLP TCL and TAL analyses were performed. During later investigations, only analytes previously detected above their background screening level and/or USEPA or FDEP regulatory criteria in the previous investigations were included for additional analyses. Source areas for the contaminants detected are within the boundaries of the specific sites.

4.8.1 Groundwater Quality – SOUTHERN AREA

In 2000, eight groundwater quality parameters (Table 4-5) were measured in 29 of the groundwater samples collected in the SA. Groundwater geochemistry parameters used for evaluating natural attenuation and were analyzed both in the field and at a fixed-base laboratory. Parameters analyzed in the field included pH, conductivity, temperature, turbidity, ORP, hydrogen sulfide, and DO. Parameters analyzed at a fixed-base laboratory included DO, alkalinity, ammonia, carbon dioxide, chloride, DOC, nitrate, nitrite, sulfate, sulfide, TKN, TOC, and total phosphorus.

Twenty-nine groundwater samples were collected from monitoring wells at Sites 9, 11, 13, 14, 15, 16, 31B, 31D, 31E, and 31F. Groundwater samples were not collected from Sites 8, 12, 31A, or 31C because these sites were previously closed (i.e., Site 8) or are monitored by wells located at adjacent sites. Sixteen groundwater samples were collected from shallow wells whose total depths range from 41 to 124.35 feet bls. Four groundwater samples were collected from intermediate wells whose total depths ranged from 93 to 153.2 feet bls. Nine groundwater samples were collected from deep wells whose total depths range from 115 to 123 feet bls. The 29 monitoring wells were sampled in the summer of 2000 as part of the RI. Table 4-5 summarizes the groundwater quality and monitored natural attenuation data for the Southern Area shallow, intermediate, and deep groundwater monitoring wells.

Four of the pH measurements collected from groundwater samples in the Southern Area (two from shallow monitoring wells, one from an intermediate monitoring well, and one from a deep monitoring well) were within the USEPA SDWS range of 6.5 to 8.5 (Table 4-5). The pH values in the shallow monitoring wells ranged from 4.16 to 11.02, pH values in the intermediate monitoring wells ranged from 5.06 to 6.18, and pH values in the deep monitoring wells ranged from 4.86 to 8.66. The average values for the shallow, intermediate, and deep monitoring wells were 6.42, 6.18, and 6.02, respectively.

The specific conductance for shallow aquifer zone monitoring wells ranged from 17 to 73 μS/cm, and the specific conductance for the shallow aquifer zone background monitoring wells ranged from 15 to 611 μS/cm. The specific conductance for the intermediate aquifer zone monitoring wells ranged from 19 to 1280 μS/cm, and the specific conductance for the intermediate aquifer zone background monitoring wells ranged from 38 to 79 μS/cm. The specific conductance for the deep aquifer zone monitoring wells ranged from 15 to 187 μS/cm, and the specific conductance for the deep aquifer zone background monitoring wells ranged from 30 to 45 μS/cm (Table 4-1).

The temperature ranged from 15.8 to 24.2 °C in the shallow aquifer zone monitoring wells, 20.9 to 25.3 °C in the intermediate aquifer zone monitoring wells, and 15.7 to 23.0 °C in the deep aquifer zone monitoring wells. These readings are typical of the sand-and-gravel aquifer, which has an average temperature of 22°C.

The DO readings ranged from 2.08 to 8.98 mg/L in the shallow aquifer zone monitoring wells, 2.40 to 7.42 in the intermediate aquifer zone monitoring wells, and 2.63 to 9.51 in the deep aquifer zone monitoring wells.

The ORP readings ranged from 143.5 to 164.9 mVs in the shallow aquifer zone monitoring wells and 66.00 to 136.7 mVs in the deep aquifer zone monitoring wells. ORP was not measured in the intermediate aquifer zone monitoring wells (Table 4-5).

4.8.2 OU 08 – Site 9, Waste Fuel Disposal Pit

OU 08, hereinafter referred to as Site 9, is a two-acre parcel located along the eastern facility boundary near the South Air Field at NAS Whiting Field (see Figure 1-2). Site 9 was used for the disposal of an undetermined amount of waste aviation fuel. During the 1950s and 1960s, waste fuel (i.e., aviation fuel) containing tetraethyl lead was reportedly disposed of in the northern portion of Site 9. Reportedly, a tanker truck was used to transport waste fuel to an unlined disposal pit where it was drained. Based on anecdotal information, approximately 200 to 300 gallons of waste fuel were disposed of at the site per trip. The total quantity of fuel disposed of at the site is unknown. Furthermore, the precise location of the disposal pit is unknown; however, at the approximate location of the suspected disposal pit, an ephemeral pond is apparent during periods of heavy rainfall. There has not been any active disposal at the site since the 1960s. There are no known potable water supply wells within one-quarter mile of Site 9 (EDR, 2011 and Appendix C). Groundwater beneath Site 9 is not currently being used as a source for drinking water. The groundwater at Site 9 flows southeast toward Clear Creek.

Past disposal of hazardous waste (described above) at Site 9, although acceptable at the time, had the potential to cause long-term problems through the release of hazardous constituents into the soil and groundwater. As part of the IR Program and the Navy Assessment and Control of Installation Pollutants (NACIP), Site 9 was included in the IAS (Envirodyne Engineers, Inc., 1985) for NAS Whiting Field.

Two SVOCs and 18 inorganic analytes were detected in the surface soil at Site 9 as presented in Section 2.5 of the IAS. The individual inorganic constituents, arsenic, aluminum, iron, and vanadium detected at the site have no direct evidence of site-related use at Site 9, and the procedures at this site did not likely contribute to the presence of these inorganics in surface soil.

Unacceptable human health risks were not identified for Site 9 surface and subsurface soils under a residential land use scenario. Risks to ecological receptors were determined to be acceptable. Therefore, the ROD for Site 9 documents the selected remedial action as a NFA for surface and subsurface soils (Tetra Tech, 2005f).

Previous groundwater investigations (Phases II-A and II-B) at Site 9 revealed the presence of aluminum and iron above FDEP CTLs (HLA, 1999f).

Leachate Soil Summary

During the 2000 and 2001 sampling events, no soil samples were collected at Site 9.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. Surface soil samples were collected from a depth interval of 0 to 1 foot bls at five different locations distributed around Site 9 during the RI Phase II-B. Soil data were compared against state SCTLs and proposed SCTLs (leachability to groundwater); two samples had exceedances (sample location 09S002 had 8.3 mg/kg of antimony and sample location 09S001 had 46.2 mg/kg of chromium). The concentrations of antimony and chromium in these two samples exceeded their FDEP leachability to groundwater SCTLs at 5.0 mg/kg and 38 mg/kg, respectively (see Table E-4 in Appendix H). The two metals were detected at concentrations that barely exceeded their respective SCTLs, and the exceedances only occurred in 20 percent of the samples. In addition, sample locations 09S001 and 09S002 are more than 100 feet southwest and west, respectively, of the suspected disposal area. Therefore, these metal concentrations may not be related to historical waste fuel disposal and may simply reflect natural concentrations in soil.

Subsurface soil samples were not collected during the Phase II-B investigation. For modeling, the highest detected concentrations of antimony and chromium (8.3 and 46.2 mg/kg, respectively) were assigned as representative starting concentrations for Layer 1 of the model (0 to 7 feet bls). Concentrations in the other layers were set equal to 0 mg/kg.

The two metals were detected in surface soil samples 09S001 and 09S002 (HLA, 1999f, Figure 3-2). The area encompassing these two samples is not large. For modeling purposes, a conservative estimate for the area of contamination was 240 feet parallel to the groundwater flow direction and 320 feet perpendicular to groundwater flow (see Table E-1 in Appendix H). This rectangular area encompasses all five of the Phase II-B soil samples and the ephemeral pond. Overall, the actual levels of contamination in the soil were minor in terms of concentrations, areal extent, and depth. In the model simulations, the maximum detected concentrations of antimony and chromium were assigned to a fairly large area that was 7 feet thick.

The results of modeling for Site 9 showed the following:

- Antimony only infiltrates a maximum depth of 10 feet bls after 200 years of migration because of its low solubility and a relatively high K_d value.

- Chromium leached to a maximum depth of 12 feet in 200 years.

Based on the modeling results, the analytes detected in soils at Site 9 are not predicted to adversely affect groundwater beneath Site 9.

Groundwater Summary

A review of the site history shows targeted organic analytes were not detected in previous groundwater investigations (Phases II-A and II-B) at Site 9; therefore, groundwater samples were not collected for analysis of organics (HLA, 1999f).

In 2000, groundwater samples were collected from monitoring wells WHF-09-MW-3S and WHF-09-MW - 2S and analyzed for inorganics based on historical data. Aluminum was detected in groundwater samples from monitoring wells WHF-09-MW-2S and WHF-09-MW-3S at concentrations of 4,180 and 2,860 µg/L, respectively, exceeding its FDEP CTL and USEPA SDWS. None of the other targeted analytes were detected. A summary of the analytical results is presented in Table 4-38.

Site 9 Summary

During the 2000 and 2001 sampling events, no soil samples were collected at Site 9. Soil modeling of detected analytes in soil predicted no analytes would impact groundwater. Aluminum was detected in groundwater exceeding its' FDEP CTL and USEPA SDWS, but is likely naturally occurring.

4.8.3 OU 09 – Site 10, Southeast Open Disposal Area A

OU 09, hereinafter referred to as Site 10, is a 4-acre parcel located along the southeastern facility boundary of NAS Whiting Field (see Figure 1-2). Site 10 is located east of the South Air Field and can only be easily accessed by the Patrol Road. The site is characterized by a gently sloping terrain toward the northern site boundary. The site is currently forested with pine trees approximately 15 feet high. Buried waste is not exposed at the land surface, and there are no indications (e.g., stained soil or stressed vegetation) of past waste disposal practices. There is a soil cover over the site area. Because the soil at the site is predominantly silty sand, most of the onsite rainfall infiltrates directly into the soil. Any surface water runoff flows north and infiltrates surface soils adjacent to the site. Surface water bodies are not present within the site boundaries. There are no potable water supply wells within one-quarter mile of Site 10 (EDR, 2011 and Appendix C). Groundwater beneath Site 10 is encountered approximately 85 feet bls and flows toward the southeast. Groundwater at Site 10 is not currently being used as a source for drinking water.

The historical land use of Site 10 was a construction debris landfill for NAS Whiting Field during the period of 1965 until 1973. Site 10 has undergone several phases of investigations since 1985 (ABB-ES, 1992c).

The current land use for Site 10 is designated recreational under the following conditions agreed upon by the FDEP and USEPA:

- ECs in place in the form of the existing soil cover at the site
- Prohibiting the digging into or disturbing existing soil cover at the site
- Posted warning signs
- Implement LUCs to address contaminants in soil at concentrations in excess of residential standards. Implementation plans to prohibit residential use of the property.

The three human health COCs identified at Site 10 are cPAHs, barium, and TRPH in surface soil. Ecological COCs were not identified at Site 10. The primary contributor to the unacceptable risk in surface soil is the suspected buried waste and debris. There were no exceedances of regulatory criteria for subsurface soil at Site 10. The HHRA determined that actual or threatened releases of hazardous substances from surface soils at this site would present an imminent and substantial endangerment to public health or welfare. The ROD (Tetra Tech, 2007b) presented the final action for surface soils at

Site 10 and is based on results of the RI and FS completed surface soils for Site 10. The remedy selected at Site 10 is LUC (ECs and ICs) and includes FYRs to evaluate the effectiveness of the LUCs.

Previous groundwater investigations (Phases II-A and II-B) at Site 10 revealed the presence of aluminum and iron above FDEP CTLs (HLA, 1999f).

Leachate Soil Summary

Based on historical data, SPLP was performed for dieldrin for soil sample location WHF-10-SB-02 (see Figure 1-2). Dieldrin was not detected in the leachate sample. SPLP was also performed for aluminum, iron, and manganese at soil sample location WHF-10-SB-02. Aluminum exceeded its USEPA SDWS in the leachate sample. A summary of the SPLP data is presented in Table 4-39.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. At Site 10, dieldrin was detected in one surface soil sample (location 10S004) and one near-surface soil sample (location 10SS02) at concentrations of 0.019 and 0.005 mg/kg, respectively, slightly exceeding the FDEP leachability to groundwater SCTL (see Table E-4 in Appendix H). TRPH was detected in one surface soil sample (location 10S003) at a concentration of 666 mg/kg, slightly exceeding the FDEP leachability to groundwater SCTL (see Table E-4 in Appendix H). Antimony was not detected in any of the 11 surface soil samples; however, it was detected in one near-surface soil sample collected from test pit TP-10-02. Chromium was also detected exceeding its leachability to groundwater SCTL in only one near-surface sample (4 to 5 feet bls) collected from test pit TP-10-02 (HLA, 1999f, Figure 3-2).

All of the contaminants that exceeded leachability to groundwater SCTLs at Site 10 were from soil samples collected at the northern part of the site (sample locations 10-SL-04, 10S003, 10S004, and TP-10-02). For modeling purposes, however, the area of contamination was set equal to a rectangle of 160 feet by 320 feet, encompassing most of the shaded landfill area shown in Figure 3-2 of the Site 10 RI (HLA, 1999f).

Overall, the actual levels of contamination in the soil were minor in terms of concentrations detected, areal extent, and depth. The area of contamination was limited and elevated levels of contaminants were detected in only a few samples (one to two samples per contaminant). For modeling, however, the highest detected concentrations of dieldrin, TRPH, antimony, and chromium (19.2, 666, 7.9, and 207 mg/kg, respectively) were assigned as representative starting concentrations for Layer 1 (i.e., 0 to 7 feet bls) over the entire areal extent of the model. Concentrations in other layers were set equal to 0 mg/kg.

The results of the VLEACH modeling for Site 10 (see Table E-8 in Appendix H) showed the following:

- Dieldrin only reached 8 feet bls after 200 years of migration.
- Antimony reached a maximum depth of 10 feet bls after 200 years. The maximum leachate concentration attained at a depth of 10 feet bls was 5.3 µg/L.
- In model year 102, chromium in leachate reached a maximum concentration of 350 µg/L at 10 feet bls. By model year 200, chromium contamination reached a maximum depth of 14.2 feet bls.
- TRPH in leachate at 10-foot depth reached a peak concentration of 3,500 µg/L in model year 51. TRPH reached a maximum depth of 21.9 feet after 200 years of migration.

The representative depth to groundwater is 79.69 feet (see Table E-1 in Appendix H).

Based on the modeling results, the analytes detected in soils at Site 10 are not predicted to adversely affect groundwater at the site.

Groundwater Summary

A review of the site history shows targeted organic analytes were not detected in previous groundwater investigations (Phases II-A and II-B) at Site 10; therefore, groundwater samples were not collected for analysis of organics. Previous investigations revealed the presence of aluminum and iron in excess of CTLs (HLA, 1999f).

Site 10 Summary

Aluminum exceeded its USEPA SDWS in the leachate sample at Site 10. Soil modeling of detected analytes in soil predicted no analytes would impact groundwater. Aluminum and iron were detected in groundwater exceeding their FDEP CTL and USEPA SDWS, but is likely they are naturally occurring.

4.8.4 OU 10 – Site 11, Southeast Open Disposal Area B

OU 10, hereinafter referred to as Site 11, is a 3-acre parcel located along the southeastern facility boundary of NAS Whiting Field (see Figure 1-2). Site 11 is located east of the South Air Field and can only be easily accessed by the Patrol Road. The site is characterized by a gently sloping terrain toward northern site boundary. The site is currently forested with scrub oak trees approximately 25 feet high. Buried waste is not exposed at the land surface, and there are no indications (e.g., stained soil or stressed vegetation) of past waste disposal practices.

When disposal operations were discontinued in 1970, a final permeable native soil covering was placed over the site, and pine trees were planted. Because the soil at the site is predominantly silty sand, most of the onsite rainfall infiltrates directly into the soil. Any surface water runoff flows north and infiltrates into surface soils adjacent to the site. Surface water bodies are not present within the site boundaries. There are no potable water supply wells within one-quarter mile of Site 11 (EDR, 2011 and Appendix C). Groundwater from beneath Site 11 is approximately 64.5 feet bls and flows toward the southeast. Groundwater at Site 11 is not currently being used as a source for drinking water.

The historical land use of Site 11 was as a borrow pit for open disposal during the period of 1943 until 1970. The current land use for Site 11 is designated as recreational under the following conditions agreed upon by the FDEP and USEPA:

- Prohibition of future residential development of the site
- Prohibition of excavation and/or removal of soil off site
- Posting of warning signs

The two human health COCs identified at Site 11 are dieldrin and lead in surface soil. Ecological COCs were not identified at Site 11. The primary contributor to the unacceptable risk in the surface soil was the suspected buried waste and debris. There were no exceedances of regulatory criteria for subsurface soil at Site 11. The HHRA determined that actual or threatened releases of hazardous substances from this site would present an imminent and substantial endangerment to public health or welfare. The ROD (Tetra Tech, 2007c) presents the final action for surface soils at Site 11 and is based on results of the RI and FS completed surface soils for Site 11. The selected remedy at Site 11 is LUCs and includes FYRs to evaluate the effectiveness of the LUCs.

Previous groundwater investigations (Phases II-A and II-B) at Site 11 revealed the presence of vinyl chloride, benzene, BEHP, aluminum, iron, lead, manganese, and vanadium exceeding their FDEP CTLs (HLA, 2000d).

Leachate Soil Summary

Based on historical data, SPLP was performed for dieldrin on soil sample location WHF-11-SB-03 (see Figure 1-2). Dieldrin was not detected in the leachate sample. SPLP was also performed for aluminum, cobalt, copper, iron, lead, and manganese. Iron was detected in the leachate sample, but did not exceed regulatory criteria. A summary of the SPLP data is presented in Table 4-40.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. The surface soil dataset includes four samples collected during the 1992 Phase II-A investigation, 13 samples collected during the 1996 Phase II-B investigation, and 38 samples collected during the 1999 removal action. Only dieldrin was detected at concentrations exceeding its SCTL. Dieldrin was detected in 12 of the 14 soil samples analyzed for pesticides. Of these samples, 11 had concentrations exceeding the FDEP SCTL of 0.004 mg/kg. The maximum detected concentration was 0.210 mg/kg at sample location 11-SL-02. Three near-surface soil samples were collected from test pits at depths of 5 to 6 feet bls. Dieldrin was detected in all three samples, and concentrations ranged from 0.002 to 0.033 mg/kg (see Table E-4 in Appendix H).

The area encompassing the soil samples is approximately 400 feet in the direction parallel to groundwater flow and 300 feet in the direction perpendicular to groundwater flow (see Table E-1 in Appendix H). For VLEACH modeling, the maximum dieldrin concentration detected in any sample (0.210 mg/kg) was assigned to the uppermost soil layer (i.e., 0 to 10 feet bls). Thus, the maximum concentration was assigned to a large area and to a relatively thick portion of the vadose zone soils. Concentrations in other layers were set equal to 0 mg/kg.

The VLEACH model for Site 11 predicted the concentration of dieldrin in leachate at 10-foot depth peaks at 10.2 µg/L after 25 years, and declines thereafter. Dieldrin reached a maximum depth of 27.5 feet after 200 years of migration. Therefore, dieldrin would not impact groundwater at a depth of about 64.5 feet bls.

Based on the modeling results, the concentrations of dieldrin detected in soils at Site 11 are not predicted to adversely affect groundwater beneath the site.

Groundwater Summary

Based results of earlier groundwater investigations (Phases II-A and II-B), vinyl chloride, benzene, BEHP, aluminum, iron, lead, manganese, and vanadium were detected at concentrations exceeding their FDEP CTLs (HLA, 2000d). Therefore, groundwater samples were collected from three monitoring wells at Site 11. The groundwater sample collected from monitoring well WHF-11-MW-1S was analyzed for VOCs, and groundwater samples collected from monitoring wells WHF-11-MW-3S and WHF-11-MW-2I were analyzed for SVOCs and the three wells were analyzed for select metals based on the previous results.

The groundwater sample collected from monitoring well WHF-11-MW-1S contained vinyl chloride at a concentration of 1.1 µg/L slightly higher than the FDEP CTL of 1.0 µg/L. The groundwater sample collected from monitoring well WHF-11-MW-2I contained BEHP (a common field and laboratory derived contaminant) at 12 µg/L exceeding its FDEP CTL and USEPA PDWS of 0.6 µg/L. Aluminum exceeded its FDEP CTLs and USEPA SDWS in groundwater samples from monitoring wells WHF-11-MW-3S and WHF-11-MW-2I. Iron exceeded its FDEP CTLs and USEPA SDWS in groundwater samples from monitoring wells WHF-11-MW-1S and WHF-11-MW-3. Manganese was detected in a groundwater sample from monitoring well WHF-11-MW-4S, but did not exceed any regulatory criteria. A summary of the analytical results is presented in Table 4-41.

Site 11 Summary

No analytes exceeded regulatory criteria in the leachate samples at Site 11. Soil modeling of detected analytes in soil predicted no analytes would impact groundwater.

4.8.5 OU 11 – Site 12, Tetraethyl Lead Disposal Area

OU 11, hereinafter referred to as Site 12, is less than 0.1 acre and is located in the southeastern section of the facility (see Figure 1-2). The disposal area consists of six earth-covered sludge mounds within a fenced area of approximately 100 feet by 25 feet. The mounds range from approximately three to five feet high and five to ten feet in diameter. Site 12 was used as a disposal area for the disposal of an undetermined amount of AVGAS tank bottom sludge waste (Tetra Tech, 1999b).

Each sludge pile reportedly contained 200 to 400 gallons of sludge generated from cleaning the northern and southern aqua system fuel storage tanks and fuel filters. The piles are reported to be contaminated with tetraethyl lead, a component of AVGAS. The sludge was stockpiled at its current location in May 1968. The water table is approximately 75 feet bls and groundwater flows toward the southeast. There are no potable water supply wells within one-quarter mile of Site 12 (EDR, 2011 and Appendix C) (Tetra Tech, 1999b).

Past disposal of hazardous waste (described above) at Site 12, although acceptable at the time, had the potential to cause long-term problems through the release of hazardous constituents into the soil and groundwater. As part of the IR Program and the NACIP, Site 12 was included in the IAS (Envirodyne Engineers, Inc., 1985) for NAS Whiting Field.

Four SVOCs, one pesticide, and 20 inorganic analytes were detected in the surface soil and one VOC, one SVOC, and 20 inorganic analytes were detected in the subsurface soil at Site 12. The individual inorganic constituents, arsenic, aluminum, iron, manganese, and vanadium detected at the site have no direct evidence of site-related use at Site 12, and the materials disposed of at this site are not likely contribute to the presence of these inorganics in surface soil.

Unacceptable human health risks were not identified for Site 12 surface and subsurface soils under a residential land use scenario, and risks to ecological receptors are considered acceptable. Therefore, the ROD for Site 12 documents the selected remedial action as a NFA for surface and subsurface soils (Tetra Tech, 2005g).

Previous groundwater investigations (Phases II-A and II-B) at Site 12 revealed the presence of aluminum and cadmium in groundwater exceeding their FDEP CTLs (HLA, 1999g).

Leachate Soil Summary

During the 2000 and 2001 sampling events, no soil samples were collected at Site 12.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. Only one chemical, dieldrin, was detected in the three soil samples exceeding its FDEP leachability to groundwater SCTL. Two of the three samples contained dieldrin at concentrations that exceeding its leachability to groundwater SCTL of 0.004 mg/kg. The maximum detected concentration was 0.013 mg/kg (see Table E-4 in Appendix H). Dieldrin was not analyzed for in the subsurface samples collected from below 2 feet bls. In VLEACH, the maximum detected dieldrin concentration (0.013 mg/kg) was assigned to Layer 1, and a concentration of 0 mg/kg was assigned to the other three layers.

The VLEACH modeling for Site 12 predicted the concentration of dieldrin in leachate at 10 feet bls to peak at 0.16 µg/L after about 75 years, and declined thereafter. The maximum depth dieldrin infiltrated was 20.4 feet after 200 years (see Table E-8 in Appendix H). The depth to water is about 75 feet bls.

Based on the modeling results, the concentrations of dieldrin detected in soils at Site 12 are not predicted to adversely affect groundwater beneath the site.

Groundwater Summary

A review of the site history (Phases II-A and II-B) indicates that targeted organic analytes have not been detected in groundwater samples previously collected at Site 10; therefore, groundwater samples were not collected for organics. Previous investigations revealed the presence of aluminum and cadmium in excess of FDEP GCTLs (HLA, 1999g).

Site 12 Summary

During the 2000 and 2001 sampling events, no soil samples were collected at Site 12. Soil modeling of detected analytes in soil predicted no analytes would impact groundwater. Aluminum was detected in groundwater exceeding its' FDEP CTL and USEPA SDWS, but is likely naturally occurring.

4.8.6 OU 12 – Site 13, Sanitary Landfill

OU 12, hereinafter referred to as Site 13, is a 4-acre parcel located along the eastern facility boundary of NAS Whiting Field (see Figure 1-2). Site 13 is located east of the South Air Field and can only be easily accessed by the Patrol Road. The site is characterized by a gently sloping terrain toward the southern site boundary. The site is currently forested with scrub oak trees approximately 25 feet high. Buried waste is not exposed at the land surface, and there are no indications (e.g., stained soil or stressed vegetation) of past waste disposal practices. Surface water bodies are not present within the site boundaries. There are no potable water supply wells within one-quarter mile of Site 13 (EDR, 2011, and Appendix C). The depth to groundwater at Site 13 is approximately 90 feet bls and flows toward the southeast. Groundwater from Site 13 is not currently being used as a source for drinking water.

There is no evidence of a clay soil cover over the site area. Because the soil at the site is predominantly silty sand, most of the on-site rainfall infiltrates directly into the soil. Any surface water runoff would flow south and infiltrate surface soils adjacent to the site or flow into Big Coldwater Creek.

The historical land use of Site 13 was as the primary sanitary landfill for NAS Whiting Field during the period of 1979 until 1984.

The current land use for Site 13 is nonresidential/recreational (parks and/or trails) under the following conditions agreed upon by the FDEP (FDEP, 1998) and USEPA:

- Development and implementation of LUCs prohibiting future residential development of the site,
- LUCs prohibiting the digging into or removal of soil off-site, and
- Posted warning signs.

The only human health COC identified at Site 13 was mercury in subsurface soil. Ecological COCs were not identified at Site 13. The primary contributor to unacceptable risk in the surface soil was the suspected buried waste and debris. Following the risk assessments, no constituents were identified as COCs exceeding USEPA risk based standards in surface or subsurface soils; however, mercury in subsurface soil, was found to exceed the FDEP residential SCTL specifically developed for this risk assessment as allowed in the FDEP regulations and guidelines.

The ROD (Tetra Tech, 2006e) presents the final action for surface and subsurface soils at Site 13 and is based on results of the RI and FS completed subsurface soils for Site 13. The selected remedy at Site 13 is LUCs and includes FYRs to evaluate the effectiveness of the LUCs.

Previous groundwater investigations (Phases II-A and II-B) at Site 13 revealed the presence of PCE, TCE, aluminum, iron, and manganese exceeding FDEP CTLs (HLA, 1999h).

Leachate Soil Summary

SPLP was performed for two SVOCs, phenol, and 3,4-methylphenol on soil sample WHF-13-SB-05 (see Figure 1-2). No analyte was detected in the leachate sample. SPLP was also performed for aluminum, cobalt, copper, iron, lead, manganese, and mercury. Aluminum exceeded its USEPA SDWS, and mercury exceeded its FDEP CTL and USEPA PDWS. A summary of the SPLP data is presented in Table 4-42.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. 4-Methylphenol, phenol, and mercury exceeded their FDEP leachability to groundwater criteria, and their potential to leach to groundwater was modeled. The modeling for Site 13 is summarized in Table E-8 in Appendix H.

The model results for 4-methylphenol predicts a concentration of 120 µg/L at a depth of 10 feet bls during year 1 of migration, but dropped to near zero in year 2 (see Figure E-2 in Appendix H). The peak 4-methylphenol concentration in leachate at 30-feet deep was 70 µg/L and occurred in years 13 and 14 (see Figure E-2 in Appendix H). The 4-methylphenol concentration that infiltrated to the bottom of the vadose zone (55 feet bls), however, was only $1.0E^{-7}$ µg/L, after 72 years of migration. The reasons why 4-methylphenol migrated through the vadose zone relatively quickly was due to its high solubility and its low K_d value (see Table E-5 in Appendix H). The starting mass of 4-methylphenol in the shallow soils, however, was insufficient to enable a significant amount to reach the bottom of the vadose zone or water table.

Phenol is more soluble and less sorptive than 4-methylphenol (see Table E-5 in Appendix H). As a result, the model predicts phenol will leach out of the surface soils quickly and infiltrate more quickly than 4-methylphenol. In year 1, nearly all of the phenol has leached out of the uppermost 10 feet of soil. A slug of phenol infiltrates to the 30-foot depth in years 5 through 7 (maximum concentration = 220 µg/L), and decreases quickly thereafter. Phenol reaches the bottom of the vadose zone (55 feet bls) in 38 years, but the leachate concentration is insignificant ($3.0E^{-12}$ µg/L).

Mercury migrated slowly (3.4 feet in 200 years) and reached a maximum depth of only 15.4 feet bls.

Based on the modeling results, the concentrations of 4-methylphenol, phenol, and mercury detected in soils at Site 13 are not predicted to adversely affect groundwater beneath the site.

Groundwater Summary

Previous groundwater investigations (Phases II-A and II-B) at Site 13 revealed the presence of tetrachloroethene, TCE, aluminum, iron, and manganese exceeding their FDEP CTLs (HLA, 1999h). Groundwater samples collected in 2000 and 2001 from new monitoring wells WHF-13-MW-3S, WHF-13-MW-3D3, WHF-13-MW-4S, and WHF-13-MW-5S, respectively, were analyzed for VOCs, SVOCs, PAHs, pesticides, and PCBs. In addition, the groundwater sample from monitoring well WHF-13-MW-5S was analyzed for TPH. BEHP and TPH were detected in groundwater sample from monitoring well WHF-13-MW-5S at concentrations lower than their respective USEPA and FDEP CTLs.

The groundwater samples collected from monitoring wells WHF-13-MW-3D and WHF-13-MW-5S were also analyzed for TAL metals and cyanide. The groundwater samples collected from the six other monitoring wells were analyzed for select metals. Aluminum, iron, and manganese were detected at concentrations exceeding FDEP CTLs and USEPA SDWS. A summary of the analytical results is presented in Table 4-43.

Site 13 Summary

Soil modeling of detected analytes in soil predicted no analytes would impact groundwater. Aluminum, iron, and manganese were detected at concentrations exceeding FDEP CTLs and USEPA SDWS but are likely naturally occurring. Site 13 is not impacting Site 40.

4.8.7 OU 13 – Site 14, Short Term Sanitary Landfill

OU 13, hereinafter referred to as Site 14, is approximately three acres and is located near the southeastern boundary of NAS Whiting Field (see Figure 1-2). Site 14 was the primary sanitary landfill at NAS Whiting Field for six to nine months during the latter part of 1978 and the early part of 1979. Landfilling operations ceased in this area in early 1979 because the high clay content of the soil resulted in the ponding of rainwater throughout the site. The disposal area was subsequently covered with soil, and pine trees were planted. There are no potable water supply wells within one-quarter mile of Site 14 (EDR, 2011 and Appendix C) (HLA, 1999i).

Past disposal of hazardous waste (described above) at Site 14, although acceptable at the time, had the potential to cause long-term problems through the release of hazardous constituents into the soil and groundwater.

Two VOCs, two SVOCs, 19 inorganic compounds were detected in the surface soil and four VOCs, three SVOCs, and 19 inorganic compounds were detected in the subsurface soil at Site 14. The individual inorganic constituents (arsenic, aluminum, iron, manganese, and vanadium) detected at the site have no direct evidence of site-related use at Site 14, and the disposal practices at this site are not likely to have contributed to the presence of these inorganics in surface soil (HLA, 1999i).

Unacceptable human health risks were not identified for Site 14 surface and subsurface soils under a residential land use scenario, and risks to ecological receptors were determined to be acceptable. Therefore, the ROD for Site 14 documents the selected remedial action as a NFA for surface and subsurface soils (Tetra Tech, 2006f).

Previous groundwater investigations (Phases II-A and II-B) at Site 14 revealed the presence of aluminum and iron exceeding Florida FDEP (HLA, 1999i).

Leachate Soil Summary

SPLP was performed for VOCs, pesticides and PCBs at soil sample location WHF-14-SB-03 (see Figure 1-2). Methylene chloride was detected at concentrations that exceeded its FDEP CTL and USEPA PDWS. Methylene chloride is a common laboratory contaminant and is likely an artifact of laboratory cross contamination. SPLP was performed for aluminum, cadmium, cobalt, copper, iron lead and manganese at soil sample location WHF-14-SB-02 (see Figure 1-2). Iron and manganese were detected in the SPLP leachate sample at concentrations below regulatory criteria. A summary of the SPLP data is presented in Table 4-44.

Leachate Infiltration Modeling Results

Chemicals that were previously detected during the RI were modeled to assess whether they could leach to groundwater at concentrations that would exceed their state or federal CTLs. Xylenes and 4-methylphenol exceeded their FDEP leachability to groundwater criteria, and their potential to leach to groundwater was modeled.

The modeling for Site 14 predicted that the peak xylene concentrations in leachate will infiltrate approximately 30 feet bls in three years and will reach the bottom of the vadose zone (99 feet bls) in 23 years. The relatively rapid downward migration of xylene is due to the low K_d value (1.394 L/kg) of this analyte (see Table E-5 in Appendix H). The peak concentrations of xylene reaching 30 feet and 99 feet bls, however, is relatively low (38 and 1.0E-8 mg/L, respectively). This is partially due to smearing and spreading of xylene over the entire thickness (99 feet) of the vadose zone, thereby attenuating by orders of magnitude the rate of mass infiltrating to the bottom of the soil column. In addition, xylene has a relatively high biodegradation rate (0.016 days^{-1}). Thus, a significant portion of the mass degrades before it reaches the uppermost aquifer. The maximum concentration of xylene expected in groundwater is 1.0E-16 µg/L and is not detectable by standard analytical procedures.

The modeling predicted that the peak 4-methylphenol concentrations will infiltrate to 30 feet bls in 1 year and will reach the bottom of the vadose zone (99 feet bls) also in 12 years. The relatively rapid downward migration of 4-methylphenol is due to a low K_d value (0.49 L/kg) of this analyte (see Table E-5 in Appendix H). The peak concentrations of 4-methylphenol infiltrating to 30 and 99 feet bls, however, is relatively low (31 and 2.9E-03 µg/L, respectively). This is partially due to the smearing and spreading of 4-methylphenol over the entire thickness of the vadose zone, thereby attenuating by orders of magnitude the rate of mass reaching the bottom of the soil column. In addition, 4-methylphenol has a relatively high biodegradation rate (0.0037 days^{-1}). Thus, a significant portion of the mass degrades before it reaches the uppermost aquifer. The maximum concentration of 4-methylphenol expected in groundwater is 3.0E-16 µg/L. This low level of 4-methylphenol concentration is not currently detectable by standard analytical procedures.

Based on the modeling results, the concentrations of xylene and 4-methylphenol detected in soils at Site 14 are not predicted to adversely affect groundwater at the site.

Groundwater Summary

Previous groundwater investigations (Phases II-A and II-B) at Site 14 did not revealed the presence of targeted organic analytes exceeding their regulatory criteria from shallow monitoring well WHF-14-MW-2S or the intermediate monitoring well WHF-14-MW-1I (HLA, 1999i). An additional monitoring well, WHF-14 -MW-3S, was installed, and a groundwater sample was collected in 2000. The groundwater sample from monitoring WHF-14-MW-3S and was analyzed for VOCs, SVOCs, pesticides, and PCBs. None of the targeted analytes were detected in the groundwater sample.

Previous groundwater investigations at Site 14 revealed the presence of aluminum and iron exceeding FDEP CTLs (HLA, 1999i). In 2000, a groundwater sample collected from monitoring well WHF-14-MW-3S was analyzed for TAL metals and cyanide, and a groundwater sample collected from monitoring well WHF-14-MW-1I was analyzed only for arsenic, which was not detected. The groundwater sample from monitoring well WHF-14-MW-3S contained aluminum and iron at concentrations exceeding FDEP CTLs and USEPA SDWS. A summary of the analytical results is presented in Table 4-45.

Site 14 Summary

Soil modeling of detected analytes in soil predicted no analytes would impact groundwater. Aluminum, iron, and manganese were detected at concentrations exceeding FDEP CTLs and USEPA SDWS but are likely naturally occurring. Site 14 is not impacting Site 40.

4.8.8 OU 19 – Site 31, Sludge Drying Beds and Disposal Area A through F

OU 19, hereinafter referred to as Site 31, includes six areas totaling approximately 13.4 acres (see Figure 1-2). Area 31A, the sludge drying beds near the wastewater treatment plant WWTP; Areas 31B, 31C, and Area 31D, three disposal areas along the Patrol Road near the southwestern end of a runway; and Areas 31E and 31F, two sludge disposal areas along the Patrol Road, at the northeast of the same runway.

Aircraft cleaning compounds, photo processing chemicals, and silver sludge from the photographic laboratory were discharged to the sanitary sewer from 1940 to 1984 potentially accumulating in the sludge at the facility WWTP. Site 31 is one of five sites identified during Phase I of the RI and was subsequently added to the Phase II-A and II-B RI program for investigation. Site 31 is comprised of six areas used for drying and disposal of sludge generated at the wastewater treatment plant. From 1940 until 1990, liquid sludge was dried at Area 31A, and the resulting solids were later spread at Areas 31B, 31C, and 31D. Liquid sludge was also periodically sprayed from a tanker truck over the areas 31B, 31C, 31D, 31E, and 31F. There are no potable water supply wells within one-quarter mile of Site 31 (EDR, 2011 and Appendix C) (HLA, 2001).

Area 31A is a sludge drying bed unit 92 feet long by 80 feet wide located at the WWTP. The unit consists of four sludge drying beds surrounded by a concrete base and containment walls extending to a depth of 2.5 to 3 feet bls. The area is approximately 0.2 acre. The sludge drying beds were taken out of service in 1990. Sludge from the WWTP may have contained hazardous substances such as methylene chloride and heavy metals from industrial effluent.

Areas 31B, 31C, and 31D are mowed grassy areas totaling 6.3 acres and located in an area of surface water control berms on the southwestern slopes of the South Air Field. A rubble pile containing concrete, asphalt, and metal rubble from former facility operations is located at the southwestern corner of Area 31C. Dried sludge was periodically removed from Area 31A and disposed of at Areas 31B, 31C, and 31D. Spray applications of liquid sludge were also applied to the areas by tanker trucks. Areas 31E and 31F are locations where liquid sludge was formerly applied to the land surface northeast of Runway 5/23, on the east and west side of Patrol Road. The extent of Areas 31E and 31F is approximately 6.9 acres (HLA, 2001).

Elevated concentrations of organic and inorganic analytes were identified during the RI. The source of elevated inorganic analytes (arsenic, barium, and chromium) present at Site 31 is not known, as there are no documented uses of these analytes at the facility (HLA, 2001).

Based on additional review of inorganic data from the facility and surrounding area in April 2001, it was determined the observed arsenic values represent naturally occurring levels (FDEP, 2001, Appendix H). Because the identified human health risks associated with arsenic are now considered to be due to naturally occurring levels, remediation of arsenic in surface and subsurface soil is not required at Site 31.

Actual or threatened releases of hazardous substances from Site 31 were addressed by implementing the IRA; no longer present a current or future potential threat to public health and welfare. Human health risks for Site 31 surface soil were acceptable when compared to USEPA carcinogenic risk criteria for all receptors. The noncarcinogenic risks were below the USEPA and FDEP target hazard index (HI) for all receptors except the hypothetical child resident (Tetra Tech, 2002c).

Therefore, the selected remedial action for Site 31 is NFA for soil. NFA for the soil consists of no treatment, containment, or restricted access.

- Previous surface and subsurface soil investigations at Sites 31A, 31B, 31C, and 31D resulted in a recommendation of an NFA.

- Previous groundwater investigations only occurred at Site 31C. These investigations did not reveal the presence of any groundwater contaminants (HLA, 2001). Previously, no monitoring wells had ever been installed downgradient of Sites 31B and 31D; therefore, it was decided these monitoring wells should be installed to determine if groundwater has been impacted due to activities at sites 31B (WHF-31-MW-6S) and 31D (WHF-31-MW-8S).

- Previous surface soil investigations at Sites 31E and 31F resulted in a recommendation of NFA of Site 31 soils. As a result, it was determined subsurface soil and groundwater at these sites would not be impacted and they were, therefore, not investigated (HLA, 2001).

Groundwater Summary

Sludge Drying Beds and Disposal Areas B and D: Previous groundwater investigations (Phases II-A and II-B) at Site 31 C did not reveal the presence of targeted organic analytes (HLA, 2001). Monitoring wells had not been installed hydraulically downgradient of Sites 31B and 31D; therefore, it was determined monitoring wells should be installed to investigate the potential for impacts to groundwater due to activities at these sites. Monitoring well WHF-31-MW-6S was installed at Site 31B and monitoring well WHF-31-MW-8S was installed at Site 31D.

Groundwater samples collected from monitoring wells WHF-31-MW-6S (Site 31B) and WHF-31-MW-8S (Site 31D) were analyzed for VOCs, SVOCs, pesticides, and PCBs. BEHP and diethyl phthalate were detected in the groundwater sample collected from monitoring well WHF-31-MW-6S. BEHP exceeded its FDEP CTL and USEPA PDWS; diethyl phthalate was detected at a concentration less than the FDEP GCTL of 5,600 µg/L. Groundwater samples collected from monitoring wells WHF-31-MW-6S (Site 31B) and WHF-31-MW-8S (Site 31D) and analyzed for TAL metals and cyanide. Aluminum and iron were detected at concentrations exceeding FDEP CTLs and USEPA SDWS. A summary of the analytical results is presented in Table 4-46.

<u>Sludge Drying Beds and Disposal Areas E and F:</u> Groundwater samples collected from monitoring wells WHF-31-MW-5S (Site 31E) and WHF-31-MW-7S (Site 31F) were analyzed for VOCs, SVOCs, pesticides, PCBs, TAL metals and cyanide. None of the organic targeted analytes were detected in the groundwater samples. Monitoring wells WHF-31-MW-5S (Site 31E) and WHF-31-MW-7S (Site 31F) contained aluminum and iron at concentrations exceeding FDEP CTLs and USEPA SDWS. A summary of the analytical results is presented in Table 4-47.

Site 31 Summary

BEHP was detected in groundwater exceeding its' FDEP CTL and USEPA PDWS. BEHP is a common plasticizer and may either be a field or laboratory contaminant. Aluminum and iron were detected at concentrations exceeding FDEP CTLs and USEPA SDWS but are likely naturally occurring. Site 31 is not impacting Site 40.

4.8.9 Impact of Soil Contamination Leaching to Groundwater - Southern Area Summary

SPLP and/or TCLP analysis were performed for the analytes that had an exceedance of the FDEP leachability to groundwater criteria. If an exceedance was not detected, then a representative sample was chosen, and SPLP and/or TCLP analysis was performed. The following provide a summary of the analytes that were detected in TCLP and SPLP leachate samples for the Southern Area.

- Site 9: soil samples for SPLP analysis not collected,
- Site 10: aluminum,
- Site 11: analytes in SPLP extract did not exceed leachability to groundwater criteria,
- Site 12: soil samples for SPLP analysis not collected,
- Site 13: aluminum and mercury,

- Site 14: methylene chloride was detected at concentrations exceeding its FDEP CTL and USEPA PDWS, however, methylene chloride is a common laboratory artifact, and
- Sites 31 A through F: soil samples for SPLP analysis were not collected.

4.8.10 Groundwater - Southern Area Summary

Aluminum was detected at each site at concentrations that exceeded its FDEP and USEPA CTL. Iron was detected at Sites 10, 11, 13, 14 and 31 at concentrations that exceeded its FDEP and USEPA CTL. Manganese was detected at Sites 11 and 13 at concentrations that exceeded its FDEP and USEPA CTL. Cadmium was detected at Site 12 at a concentration that exceeded its FDEP and USEPA CTL. Vanadium was detected at Site 11 at a concentration that exceeded its FDEP CTL. Of these analytes, only aluminum was detected in leachate above regulatory limits and possibly impacted groundwater through leaching.

4.9 BIODEGRATION

As presented previously, based on the evaluation of leachability to groundwater by SPLP and TCLP analysis and infiltration modeling, IR and USTs sites within the NCA and SCA are contributing contaminants to Site 40 through leaching of contaminants from soil to groundwater. Sites contributing organic contaminants from soil to groundwater are: 3, 4, 32, 2894, and Product Line Junction in the NCA; and Sites 5, 6, and 7 in the SCA. Conversely, the same evaluations indicate Sites 35, 36, 37, 41, 2832 AVGAS Pipeline Section E, the Oil/ Water Separator Building 2993, and the Line Dispensing Facility have no impact on the NCA plume of Site 40 Base-Wide Groundwater. Also, Sites 15, 16, 29, 30, and 33 Facility have no impact on the SCA plume of Site 40 Base-Wide Groundwater. Figures 4-12, 4-16, 4-17, 4-17A, 4-20, and 4-20A show two cross-sections of groundwater contamination oriented from north to south across the NCA and SCA plumes. Figure 2-3 shows the location of the cross-sections.

Based on the evaluation of leachability of contaminants in soil to groundwater by SPLP and TCLP analysis and infiltration modeling, IR and USTs sites in the NA and SA are not found to be contributing contaminants to Site 40 Base-Wide Groundwater. These sites are primarily landfill or fire-fighting training areas (Sites 1, 2, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 31) located along the periphery of the facility in the North and South Areas. The SPLP and TCLP analytical and infiltration modeling results are supported by the absence of plumes at these periphery landfill or firefighting sites. Site 38 located at the Golf Course maybe impacted by Golf Course operations or more likely by contaminants migrating beneath the site from upgradient agricultural sources.

4.9.1 Biodegradation in the North Central Area Plume

The interpreted source areas for the NCA plume are Sites 3, 4, and 32 (see Figures 4-4 through 4-6, 2007, 2008, and 2011, respectively). The TCE plume has an elongated form what appears to originate beneath Site 32 with an apparent secondary source area found at the southern end of Site 3. Site 4 was an UST complex and is a source of BTEX contamination to soil and groundwater. The elongation of the plume from Site 32 toward Clear Creek depicts the groundwater flow pathway and resulting distribution of contamination. Biodegradation of the contaminants in the NCA plume is described below.

BTEX

The NCA BTEX plume is illustrated on Figure 4-6 based on the 2011 monitoring results. As shown, the highest BTEX concentrations in the plume appear to be limited to two areas. The BTEX concentrations in these areas were as high as 46,360 µg/L in 2011; however, a significant concentration gradient was also observed where four orders of magnitude reduction in concentrations was observed in the downgradient and side gradient area. It is also noted that the BTEX contamination is primarily limited to the shallow zone of the aquifer in these two areas as indicated by the data from shallow, intermediate, and deep aquifer zone monitoring well clusters (Figure 4-12). The downgradient leading edge of the plume, however, is in the deeper intermediate aquifer zone monitoring wells. The lower concentrations are likely due to down gradient migration causing dispersion and allowing time and opportunity for biological degradation.

The MK test results (see Appendix G Table 4-2) from the most recent data set sampled from 2000 to 2011 suggest that a stable trend of BTEX concentrations was observed at most of the monitoring wells shown on Figure 4-12. Statistically significant upward trends were found in three monitoring wells locations; monitoring wells WHF-03-MW-1S and WHF-1467-MW-27S exhibited upward trends for ethylbenzene and xylene, and monitoring well WHF-03-MW-7S exhibited upward trends for benzene and ethylbenzene. These monitoring well are all located in the source areas. A statistically significant upward trend, derived from the 1993 to 2011 data set, was only identified at monitoring well locations WHF-03-MW-1S and WHF-32-MW-9I. Shallow aquifer zone monitoring well WHF-03-MW-1S is located in a likely source area, and intermediate aquifer zone monitoring well WHF-32-MW-9I is located in the downgradient area (see Appendix G figures).

A statistically significant upward trend derived from the 1993 to 2011 data set was found in three monitoring wells locations. Monitoring wells WHF-03-MW-1S and WHF-1467-MW-27S exhibited upward trends for ethylbenzene and xylene, and monitoring well WHF-03-MW-7S exhibited upward trends for benzene and ethylbenzene. These wells are all located in the source area (see Appendix G Tables 4-1).

The geochemical and field parameters for the NCA plume are summarized in Table 4-36, and DO and iron and ORP isocontours are illustrated on Figures 4-2 and 4-3, respectively. In the two source areas, electron acceptors such as nitrate and sulfate were typically not detected (a trace amount of DO was detected; see the discussion for chlorinated ethenes later in this section). Elevated methane concentrations (up to 8,960 µg/L) were detected in groundwater samples from many wells (see Figure 4-13) indicating that biodegradation of BTEX has depleted most electron acceptors with higher ORP. As a result, the current oxidation-reduction condition in the two source areas is controlled predominantly by methanogenesis. Under these conditions, BTEX compounds are fermented and the by-products (acetate and hydrogen) are used as substrate to produce methane, carbon dioxide (see Figure 4-14), and water. As a degradation product, carbon dioxide was detected in elevated concentrations in the source area, confirming the occurrence of methanogenic biodegradation (see Table 4-36). The elevated methane and carbon dioxide concentrations are fairly consistent within the BTEX source areas, indicating oxidation-reduction reactions are controlled by the degradation of BTEX compounds.

In the downgradient area, with nitrate and sulfate detected at very low concentrations and relatively higher DO and ORP values, the oxidation-reduction condition may be oxic.

In summary, biological degradation of BTEX is occurring in the NCA plume as evidenced by the elevated concentrations of degradation products. The degradation of BTEX has depleted electron acceptors with higher ORPs, and the current predominant oxidation-reduction condition in the source area is methanogenic. A significant BTEX concentration gradient is observed between the sources and downgradient area where conditions may be oxic. Shallow wells tend to have higher concentrations of DO, likely due to receiving oxygen from infiltrating rain water. The stable trend of BTEX observed in the majority of the monitoring wells is caused by the low degradation rate and methanogenic conditions.

Chlorinated Ethenes

Chlorinated ethenes are commingled with the BTEX compounds in some areas (see Figure 4-6). Figure 4-6 shows the TCE plume has two source areas that are partially collocated with the BTEX plume, but occupies smaller areas. The highest TCE concentration in 2001 was 376 µg/L. The concentration gradients appear to decrease over a short distance from the suspect source areas to the downgradient area.

Reductive dechlorination of chlorinated ethenes produces sequential by-products including cis-1,2-DCE and vinyl chloride. Cis-1,2-DCE was detected in groundwater sampled from many of the monitoring wells; however, vinyl chloride, the end product of the degradation of TCE, was not detected in any of the groundwater samples. Vinyl chloride may be rarely detected because it is undergoing oxidative dechlorination at a rapid rate. Ethene, the final product of TCE reductive dechlorination, was detected in groundwater samples from four of 21 monitoring wells (WHF-03-MW-1S, WHF-03-MW-4S, WHF-32-MW-1S, and WHF-03-MW-3I) all centrally located within the center of the NCA TCE contamination.

Chloride, which is also a product of the breakdown of chlorinated ethenes, was detected in groundwater samples from each monitoring well in the NCA plume (see Figure 4-15), but was not detected in background groundwater samples. The highest chloride concentrations were detected in groundwater samples from the two source areas, indicating stronger biodegradation.

The MK test results (see Appendix G Table 4-2) from the most recent data set sampled from 2000 to 2011 suggest that a stable trend of TCE concentrations was observed at most of the monitoring wells shown on Figure 4-16, and that TCE concentrations in the source areas are stable with no significantly upward or downward trends. A statistically significant upward trend (see Appendix G Table 4-1) derived from the 1993 to 2011 data set was only identified at one monitoring well location, WHF-32-MW-9I, which is located downgradient of the source area. Since 2007, TCE detections in groundwater samples from the periphery of the NCA plume screened across the shallow surficial aquifer has not exceeded the TCE MCL. However, at monitoring well location WHF-32-MW-9I screened lower in the aquifer a significant upward trend for TCE (and BTEX) was identified. This may correlate with the NCA plume migrating downward in the aquifer with greater distance from the source area as noted with BTEX contaminants.

As discussed previously, the oxidation-reduction condition in the aquifer is controlled at least in part by the biodegradation of BTEX compounds. Biodegradation of TCE is primarily through reductive dechlorination in the BTEX source areas where strong reducing conditions were observed resulting in methanogenic processes in the area. TOC in the aquifer is very low (see Table 4-36), indicating the only consistent carbon sources available for reductive dechlorination are BTEX compounds.

While methanogenesis is the predominant oxidation-reduction condition in the BTEX source areas, trace amount of DO was detected in groundwater samples from many of the source area monitoring wells; this is consistent with the ORP values and historical DO measurements. The absence of vinyl chloride may be explained by the presence of trace DO concentrations, where vinyl chloride may rapidly oxidized under hypoxic conditions (initial DO concentrations were about 0.1 mg/L) (Bradley, 2011).

In summary, reductive dechlorination is the primary biodegradation process occurring in the central area of the NCA plume. The majority of the wells where TCE was detected exceeding the MCLs are located within the BTEX source areas where the strong reducing condition favor reductive dechlorination.

4.9.2 Biodegradation in the South Central Area Plume

Sites 5 and 33 are the interpreted source for TCE in the SCA plume (see Figures 4-9 through 4-11 representing data from 2007, 2008, and 2011, respectively). The SCA TCE plume has an elongated form that originates beneath Sites 5 and 33 and terminates at the western boundary of the facility in the Clear Creek area. The source areas for BTEX within the SCA plume are Sites 7 and 33. The elongation of the plume from Site 33 toward Clear Creek depicts the groundwater flow pathway and resulting distribution of contamination. Biodegradation of the contaminants in the SCA plume is described below.

BTEX

Figure 4-11 shows the SCA BTEX plume is located beneath Site 7 and is smaller in area relative to the footprint of chlorinated ethenes. The highest detected concentrations of BTEX are at shallow aquifer zone monitoring wells WHF-1466-MW-27S and WHF-1466-MW-18S and intermediate aquifer zone monitoring well WHF-07-MW-1I. BTEX concentrations appear to decrease significantly over a few hundred feet from these monitoring well locations.

BTEX concentrations exceeding USEPA MCLs or FDEP CTLs were not observed at most monitoring wells located downgradient of the source area (see Figures 4-17 and 4-17A). Significant upward trends were not identified. The MK test results (see Appendix G Table 4-2) from the most recent smaller data set sampled from 2000 to 2011 shows most wells have a stable trend of BTEX concentrations in the source area. A significant downward trend is present in monitoring well WHF-15-MW-5D. Statistically significant downward BTEX trends were found at monitoring well locations WHF-03-MW-3S, WHF-30-MW-4S, and WHF-7-MW-1I.

The geochemical and field data from the 2011 sampling event of the SCA plume are summarized in Table 4-44. Elevated methane concentrations were observed in the BTEX source area. With low concentrations of other electron acceptors (e.g., nitrate, sulfate), the predominant oxidation-reduction condition in this source area is likely methanogenesis (see Figure 4-18). The spatial distribution of methane, carbon dioxide (see Figure 4-19), and DO and iron (see Figure 4-7) is consistent with the footprint of the BTEX plume, indicating the oxidation-reduction condition is controlled by the degradation of BTEX compounds in the source area (see Figure 4-8). Downgradient of the source area, the DO concentrations and ORP values increase, indicating oxic conditions are present. As a degradation product, elevated carbon dioxide concentrations were observed to be highest in the source area (see Figure 4-19). Similar to the NCA plume, DO concentrations were observed to be very low in the source area intermediate and deep aquifer zone monitoring wells, but slightly higher in the shallow aquifer zone monitoring wells samples (likely from oxygenated precipitation reaching the surface of the groundwater).

In summary, biological degradation of BTEX is occurring in the SCA plume as evidenced by elevated concentrations of BTEX degradation products. Biodegradation of BTEX has depleted most of the electron acceptors with higher ORPs in the source area. Currently, the predominant redox condition in the source area is methanogenesis. The BTEX concentrations drop rapidly with increased distance downgradient from the source and are below the CTLs in distal downgradient wells.

Chlorinated Ethenes

TCE was detected in groundwater samples collected from many of the monitoring wells located within the SCA plume (see Figures 4-9 through 4-11). Two source areas are present with relatively high TCE concentrations; the highest TCE concentration (522 µg/L) was in a groundwater sample from shallow aquifer zone monitoring well WHF-1466-MW-25S in 2011. The TCE source area appears to be in the northern area of the plume. The flow path for the SCA TCE plume encounters a BTEX source area and plume beneath Site 7.

The MK test results (see Appendix G Table 4-1) derived from the 1993 to 2011 data set showed that a significant downward or stable TCE concentration trend was observed for most groundwater samples. In the northern source area, where TCE concentrations exceeding 100 µg/L are found, a significant downward trend is observed at monitoring well locations WHF-06-MW3D and WHF-06-MW1S. Monitoring well WHF-33-MW-3S has a stable trend. In the Site 7 area where the PCE and BTEX plumes are commingled, there is insufficient data for a MK test for the shallow aquifer zone monitoring well location with the highest TCE concentration (522 µg/L in monitoring well WHF-1466-MW-25S); however, shallow aquifer zone downgradient monitoring wells WHF-30-MW-4S, WHF-1466-MW-13S, and WHF-30-MW-3S have a significant downward trend. Near Clear Creek, a significant downward trend was observed at intermediate and deep monitoring wells WHF-15-MW-5I and WHF-15-MW-5D. TCE has not been detected at concentrations exceeding its federal or state MCLs in the groundwater samples from shallow aquifer zone monitoring well WHF-15-MW-5S since 2007. A significant upward trend for TCE is not apparent for the 1993 to 2011 data set in the SCA plume.

The most recent data set sampled from 2000 to 2011 (see Appendix G Table 4-2) suggest that a significant downward trend of TCE concentrations was observed at most of the monitoring wells shown on Figure 4-20 and 4-20A. TCE concentrations in the source areas are stable with no significant upward trends. Monitoring well WHF-1466-MW-1S showed a significant downward trend. Near Clear Creek, monitoring well WHF-15-MW-8D had a downward trend, and all other monitoring wells were stable or had insufficient data to establish a trend. The leading edge of the SCA plume appears to be migrating deeper in the aquifer with distance from the source area as noted with BTEX contaminants.

Cis-1,2-DCE was detected in groundwater samples collected from many of the monitoring wells. The even distribution of low cis-1,2-DCE concentrations appears to be associated with higher concentrations of TCE suggesting that biodegradation of TCE to cis-1,2-DCE is occurring. Vinyl chloride was not detected in any groundwater sample. Ethene was only detected in one groundwater sample from intermediate aquifer zone monitoring well WHF-07-MW-1I where low concentrations of TCE were detected historically; ethane was not present in the sample collected in 2011. Chloride (see Figure 4-21) was detected in the groundwater samples collected from each monitoring well, with higher concentrations detected at monitoring well locations within the BTEX source area.

As presented previously, oxidation-reduction conditions in the BTEX source area are driven by the biodegradation of BTEX compounds. As a result, methanogenic conditions currently dominate. Outside of the BTEX source area, oxidation-reduction conditions are likely iron reducing in the northern most TCE source area (where very low BTEX concentrations are present), based on the presence of cis-1,2-DCE and the absence of DO and sulfide (hydrogen data not available). In the area downgradient of the BTEX source zone, the oxidation-reduction conditions are likely iron reducing to oxic. The TOC values were overall very low. Relatively higher TOC values were detected in the BTEX source area, consistent with the BTEX concentrations increasing TOC availability. Outside of the BTEX source area, TOC values were less than its detection limit in groundwater samples from many of the monitoring wells, indicating the lack of natural carbon sources.

In summary, the geochemical conditions in the SCA plume are less favorable for reductive dechlorination than in the NCA plume. This is due to the relatively limited areal extent of BTEX compounds that serve as the only carbon source. The lack of a carbon source leads to the observed reducing conditions. The significant downward trend of TCE and the presence of cis-1,2-DCE at many of the monitoring well locations indicate reductive dechlorination from TCE to cis-1,2-DCE is occurring at these monitoring well locations. The absence of vinyl chloride is likely caused by 1) the rapid mineralization in the BTEX source area with the small amount of DO available and 2) the slow reduction from cis-1,2-DCE to vinyl chloride outside of the BTEX source area may be due to less favorable oxidation-reduction conditions and the lack of sufficient carbon sources or oxidative dechlorination of cis-1,2-DCE to vinyl chloride which may have a very slow rate.

5.0 CONTAMINANT FATE AND TRANSPORT

This section contains information on the chemical properties and degradation potential of site contaminants, environmental conditions of the site, and hydrological considerations that have a possible impact on contaminant fate and transport. The movement of contaminants in the environment is controlled by certain properties of the contaminant and the availability of suitable pathways for contaminant movement. Knowledge of a contaminant's chemical properties as it relates to its migration and persistence in the environmental is important when evaluating its potential to elicit adverse effects for human and/or ecological receptors. Of particular importance is to use this knowledge to evaluate a contaminant’s behavior in an environmental medium and its potential to migrate from a release area and persist in one or more environmental media.

The fate and transport discussion for this report is limited to the groups of chemicals detected in groundwater during the Site 40 sampling events at concentrations greater than the screening and regulatory criteria (as presented in Section 4.0) established by the USEPA and FDEP. Because Site 40 specifically addresses base-wide groundwater contaminants while other investigations at NAS Whiting Field address the other environmental media (i.e., surface and subsurface soil and surface water), this section only addresses the fate and transport of contaminants into and out of groundwater.

5.1 POTENTIAL ROUTES OF MIGRATION

The movement of contaminants in the environment is controlled by the source, nature and extent of the contaminants, and the availability of suitable pathways for contaminant movement.

5.1.1 Potential Contaminant Sources

A review of past waste disposal practices at NAS Whiting Field has identified multiple sites located within Site 40 that are potential groundwater contaminant sources (see Table 5-1 and Figure 1-2).

Ongoing monitoring of groundwater at Site 40 has identified two organic groundwater plumes beneath the industrialized areas of the facility with contaminants at concentrations that exceed USEPA MCLs and FDEP MCLs/GCTLs. Both plumes are associated with chlorinated solvents including TCE and associated daughter products including cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride and are comingled with petroleum-related constituents including BTEX.

5.1.2 Preliminary Site Conceptual Model

The preliminary CSM was developed to evaluate the relationships between the potential contaminant sources at Site 40, affected media, and contaminant migration pathways.

Based on the evidence of past waste disposed practices and various industrial activities at IR and UST sites that overlie Site 40, the primary sources for contaminants are industrial solvents and petroleum-related constituents. These contaminants are liquids that once spilled or leaked in sufficient quantities can migrate via infiltration through the vadose zone to the water table. In some instances, it is likely these contaminants were mixed by cleanup processes prior to burial in soils as a past form of industrial cleanup and disposal of waste that was considered acceptable at that time.

5.1.3 Potential Pathways for Contaminant Migration

Based on the evaluation of existing conditions at Site 40, the following potential contaminant transport pathways exist:

- Leaching of contaminants in soil to groundwater
- Migration of contaminants in groundwater
- Extraction of groundwater for drinking water use
- Upwelling/discharge of groundwater into surface water

5.1.3.1 Leaching of Soil Contaminants to Groundwater

Contaminants that adhered to soil particles or have accumulated in pore spaces can be remobilized and transported to groundwater because of infiltration or precipitation. The rate and extent of this leaching are influenced by the following:

- Depth of the water table
- Rate and amount of precipitation
- Rate of rainfall infiltration through the vadose zone
- Physical and chemical properties of the soil
- Physical and chemical properties of the contaminant

The mobility of chemicals at Site 40 can be influenced by the high rates of precipitation in the site area, which allows for a higher rate of infiltration. Some of the contaminants identified for Site 40 (BTEX and TCE), however, generally have physical and chemical properties that result in low mobility and persistence in the environment.

5.1.3.2 Migration of Groundwater Contaminants

Contaminants can migrate as immiscible liquid or in a dissolved phase. An immiscible liquid contaminant present in water such as TCE will infiltrate downward because it has a higher specific gravity than water. Subsurface transport of immiscible contaminants is governed by a set of factors different from those of dissolved contaminants. However, the Site 40 groundwater data does not provide evidence of undiluted chlorinated solvent contaminants at concentrations exceeding water solubility levels.

Free-phase petroleum product (JP-5 fuel), is found at Site 4 perched on clay layers (CH^2MHill, 2012) and at Site 2894. The lack of direct contact of the product with the groundwater of the sand-and-gravel aquifer prevents the product from migrating with groundwater flow. VOCs, such as TCE and associated daughter products, and BTEX compounds were typically detected in groundwater at concentrations below their water solubilities. Therefore, the migration of contaminants in groundwater at Site 40 is controlled by factors that govern the movement of dissolved contaminants.

Three general processes govern the migration of dissolved constituents in groundwater: advection, dispersion, and retardation. Advection is a process by which solutes are carried by groundwater movement. Dispersion is a mixing of contaminated and uncontaminated water during advection. Retardation is a slowing of contaminant migration caused by the reaction of the solute with the aquifer soil.

Contaminant concentrations may be affected by one or more mechanisms during transport. Volatilization or chemical precipitation may physically transform contaminants. Contaminants may be chemically transformed through photolysis, hydrolysis, or oxidation/reduction. Contaminants may also be biologically transformed by biodegradation.

5.1.3.3 Extraction of Groundwater for Drinking Water Use

There are two migration route end points for groundwater from the source area(s). The first is the facility water distribution system, which consists of three public water supply wells located at NAS Whiting Field. These water supply wells provide potable water for general use by facility personnel that includes drinking and bathing at various buildings such as the Combined Bachelors Quarters where pilot trainee’s and their families board for the duration of pilot training. This local water supply is treated by a GAC system maintained by the Navy and monitored on a monthly basis for BTEX and TCE since 1986. Monthly influent and effluent testing is conducted to ensure that water provided to facility personnel meets FDEP and USEPA drinking water criteria.

5.1.3.4 Upwelling of Groundwater into Surface Water

The migration route end point occurs at Clear Creek where SCA plume migrates hydraulically downgradient in groundwater with the natural flow and upwell/discharges into Clear Creek and its floodplain.

5.1.4 Potential Exposure Routes and Receptors

The current land use patterns at NAS Whiting Field are well established, thereby reducing the uncertainty associated with land use assumptions. Access to NAS Whiting Field is restricted to military personnel, civilian employees, and authorized visitors. The facility is surrounded by a boundary fence and signs posted on the fence warn that trespassing is not permitted. People entering the facility must pass through staffed, secure entrance gates. The use of facility-operated public water supply wells that provide on-site treated water will continue. The current and future uses will be the same.

The two receptors are on-facility residents and construction workers. Residential receptors are assumed to use groundwater for domestic purposes (e.g., bathing, showering, washing dishes), which may result in dermal exposure and inhalation of volatiles if the GAC were not in place. Ingestion of groundwater may result in the intake of groundwater COPCs. It is also possible, under future land use conditions where excavations are present at NAS Whiting Field, for construction workers and site occupational workers to be dermally exposed to contaminated soil. For construction workers and on-site occupational workers, exposure to constituents via inhalation is expected to be minimal in areas outside of the boundaries of Site 4.

At Site 40, there is no complete exposure pathway for ecological receptors. Exposure of ecological receptors to groundwater that upwells/discharges into Clear Creek is addressed in the Draft Site 39 RI, which is currently under review (Tetra Tech, 2010b).

5.2 CHEMICAL AND PHYSICAL FACTORS AFFECTING SITE CONTAMINANT MOBILITY

The following properties can be used to evaluate the potential environmental mobility and fate of contaminants:

- Specific gravity
- Vapor pressure
- Water solubility
- Octanol/water partition coefficient (K_{ow})
- Organic carbon partition coefficient (K_{oc})

- Henry's Law constant
- Bioconcentration factor (BCF)
- Mobility index (MI)

Table 5-1 presents the fate and transport parameters of the organic compounds detected at Site 40 relative to their physical and chemical properties.

5.2.1 Specific Gravity

Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. Specific gravity is used to determine whether a chemical will have a tendency to float or sink in water when present as a pure chemical or at very high concentrations. Nonaqueous phase chemicals with specific gravities greater than 1 will tend to sink in water, and chemicals with specific gravities less than 1 will tend to float at the top of the water table. For the groups of chemicals detected at Site 40, chlorinated VOCs (i.e., TCE and daughter products) generally have specific gravities greater than 1, and petroleum-related compounds (i.e., BTEX) generally have specific gravities less than 1.

5.2.2 Vapor Pressure

Vapor pressure provides an indication of the rate at which a chemical volatilizes from both soil and water. It is of primary importance at environmental interfaces such as surface soil/air and surface water/air. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization is a significant loss process for VOCs in surface water or surface soil and is of primary importance at environmental interfaces such as surface soil/air and surface water/air. Volatilization is not as important when evaluating contaminated groundwater and subsurface soils that are not exposed to the atmosphere. Vapor pressures for petroleum-related VOCs and chlorinated VOCs are typically one or more orders of magnitude higher than vapor pressures for PAHs (which are petroleum-related constituents), and volatilization is not significant for inorganics (or metals) other than mercury.

5.2.3 Water Solubility

The rate at which a chemical may be leached from a solid matrix (e.g., soil or waste deposit) by infiltrating precipitation is proportional to its water solubility. More soluble chemicals are more readily leached than less soluble chemicals. The water solubilities presented in Table 5-1 indicate that TCE is slightly more soluble than PAHs, which are not especially water-soluble.

5.2.4 Octanol/Water Partition Coefficient

The K_{ow} is a measure of the equilibrium partitioning of chemicals between octanol and water. A linear relationship between the K_{ow} and the uptake of chemicals by fatty tissues of animal and human receptors (the BCF) has been established (Lyman et al., 1990). K_{ow} values are also useful in characterizing the sorption of compounds by organic soils where experimental values are not available. PAHs are more likely to partition to fatty tissues than the more soluble VOCs. The K_{ow} is also used to estimate BCFs in aquatic organisms.

5.2.5 Organic Carbon Partition Coefficient

The K_{oc} indicates the tendency of a chemical to adhere to soil particles containing organic carbon. Chemicals with high K_{oc} values generally have low water solubilities and vice versa. K_{oc} may be used to infer the relative rates at which more mobile chemicals (monocyclic aromatics and halogenated aliphatics) partition to groundwater. Most PAHs are relatively immobile in soil and are preferentially bound to the soil. These compounds are not as likely to be transported in the dissolved phase by groundwater to the same extent as compounds with higher water solubilities.

5.2.6 Henry's Law Constant

Both vapor pressure and water solubility are of use in determining volatilization rates from surface water bodies and groundwater. The ratio of these two parameters, the Henry's Law constant, is used to calculate the equilibrium chemical concentrations in the vapor (air) phase versus the liquid (water) phase for the dilute solutions commonly encountered in environmental settings. In general, chemicals having a Henry's Law constant of less than 1×10^{-5} atmosphere cubic meters per mole (atm-m^3/mol) should volatilize very little and be present only in minute amounts in the atmosphere or soil gas. For chemicals with Henry's Law constants greater than 5×10^{-3} atm-m^3/mol, volatilization and diffusion in soil gas could be significant.

5.2.7 Bioconcentration Factor

The BCF represents the ratio of aquatic animal tissue concentration to water concentration. The ratio is both contaminant- and species-specific. When site-specific values are not measured, literature values are used or BCFs are derived from K_{ow} values. Many PAHs will bioconcentrate in aquatic animal tissue at levels three to five orders of magnitude greater than those concentrations found in the water in which the organisms reside, whereas petroleum-related VOCs and TCE and associated daughter products do not bioconcentrate to any significant degree.

5.2.8 Soil-Water Distribution Coefficient

The soil-water K_d is a measure of the equilibrium distribution of a chemical or ion in soil/water systems. The distribution of organic chemicals is a function of both the K_{oc} and the f_{oc} in the soil:

$$K_d = K_{oc} * f_{oc}$$

The degree to which organic chemicals sorb to soil is an important consideration when assessing migration potential. If a chemical tends to sorb strongly to soil, there is much less probability that the chemical will reach groundwater and affect groundwater quality. For an ion (e.g., metal), the K_d is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. K_d values for inorganics vary over several orders of magnitude because the K_d is dependent on the size and charge of the ion and the soil properties governing exchange sites on soil surfaces. Coulomb's Law predicts that the ion with the smallest hydrated radius and the largest charge will be preferentially accumulated over ions with larger radii and smaller charges.

5.2.9 Mobility Index

The MI is a quantitative assessment of chemical mobility in the environment based on the water solubility (S), vapor pressure (VP), and the K_{oc} of a given material (Laskowski et al., 1983) as follows:

$$MI = \log((S*VP)/K_{oc})$$

The MI for a given chemical is evaluated using the following scale (Ford and Gurba, 1984):

Relative MI	Mobility Description
> 5	extremely mobile
0 to 5	very mobile
-5 to 0	slightly mobile
-10 to -5	immobile
< -10	very immobile

Of the organic chemicals detected in groundwater at Site 40, chlorinated solvents and BTEX compounds generally have a MI close to 5 and are considered very mobile (please refer to Table 5-1).

5.2.10 Inorganic Site Contaminants

The solubility and mobility of inorganics are strongly influenced by their valence state(s) and mineral forms present in soils (e.g., silicates, hydroxides, oxides, carbonates, etc.). The solubility of a metal also depends on pH, oxidation reduction potential (Eh), temperature, and other ionic species in solution (the Debye-Huckel theory). Nearly all inorganics are more soluble at lower water pH values less than 5.0; the pH of groundwater at Site 40 is mildly acidic ranging from 4.3 to 6.5. Iron, manganese, and chromium are inorganics that have more than one valence state and are more soluble in the reduced valence states. As a result, these inorganics are more soluble under reducing conditions. The solubility products reported in the literature vary with the type of chemical complex formed, but for example, cadmium and copper complexes are generally more soluble than lead and nickel complexes.

The K_d for inorganic constituents is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. The K_d values for inorganics vary over several orders of magnitude because the K_d is dependent on the size and charge of the ion and the soil properties governing exchange sites on soil surfaces. Approximate K_d values for the inorganic site contaminants are presented in Table 5-3. The average pH of the near-surface soils (average = 5.5) is slightly less than the average pH measured in groundwater samples (average = 6.2). As shown in Table 5-2, the K_d values increase slightly when the pH value increases from 5.5 to 6.2. Overall, iron, barium, and antimony have lower K_d values and hence have greater mobilities. Aluminum, chromium, vanadium, and selenium generally have much higher K_d values and lesser mobilities.

5.3 CHEMICAL PERSISTENCE AND DEGRADATION PROCESSES

The persistence of contaminants after they are released to the environment is controlled by the susceptibility of the contaminants to certain chemical and biological processes that may degrade the contaminants and reduce their remaining mass.

The predominant VOCs detected at Site 40 are halogenated aliphatics including TCE and associated daughter products and monocyclic aromatics (BTEX). These VOCs are generally volatile at normal temperatures and are typically considered to be fairly soluble in water with a low capacity for retention by soil organic carbon, and are detected in groundwater at Site 40. The high volatility and water solubility of these VOCs dominate their fate in the environment. These chemicals may migrate through the soil column after being released by a spill event or by subsurface waste burial as infiltrating precipitation solubilizes them. Some fraction of these chemicals is retained by the soil, but most will migrate downward to the water table. Upon reaching the water table, migration occurs primarily in the direction of the horizontal hydraulic gradient.

Under certain conditions, volatilization is a significant fate process for these compounds. Volatilization is only significant at the air-soil or air-water interface. Compounds may volatilize rapidly to the atmosphere from the first foot or two of soil due to low soil adsorption, but at greater depths volatilization would be non-existent. Adsorption is not considered an important fate for these types of compounds when compared to more hydrophobic compounds. BCFs indicate that these compounds should not bioaccumulate.

5.3.1 Halogenated Aliphatics

Compounds with specific gravities greater than that of water (e.g., chlorinated volatile organic compounds [CVOCs] such as PCE, TCE, and related solvents) are often used in various industrial applications such as degreasing. If a large enough volume release of these solvents occurs, these chemicals may migrate as a bulk liquid past the water table and sink into the aquifer. As stated previously, there is no indication this has happed at NAS Whiting Field.

In general, CVOCs are subject to reductive dechlorination in anerobic environments which is the common mechanism for biotransformation of a parent compound such as TCE. This process is an elimination reaction that results in the formation of an ethene from a saturated halogenated compound. Research indicates that microbial degradation of highly chlorinated ethanes is often limited in situ due to low electron donor supply, high electron donor competition and various other factors such as the abundance of microflora, nutrient availability, soil reaction (pH), temperature, etc. (USGS, 2010).

CVOCs are also subject to microbial oxidative mechanisms in aerobic environments which is likely the common mechanism for biotransformation of a parent compound such as DCE and VC. Aerobic cometabolism and aerobic oxidation of these CVOCs can be substantial at the fringe or discharge point of the contaminant plume the potential increases with increasingly oxidizing groundwater (USGS, 2010).

Reductive dechlorination, aerobic cometabolism and aerobic oxidation are taking place in the plumes at NAS Whiting Field.

5.3.2 Monocyclic Aromatics

BTEX compounds have specific gravities less than that of water and are typically found in fuels; if a large enough fuel spills occurs, these compounds may move through the soil column as a bulk liquid until they reach the water table. There, instead of going into solution, the majority of the release may remain as a discrete fuel layer on the water table surface with some of the material going into solution at the water/fuel interface.

Monocyclic aromatic compounds are not considered to be persistent in the environment, particularly in comparison with chemicals such as PCBs and pesticides. Monocyclic aromatics are subject to degradation via the action of both soil and aquatic microorganisms. The biodegradation of these compounds in the soil matrix is dependent on the abundance of microflora, macronutrient availability, soil reaction (pH), temperature, etc. These compounds are amenable to microbial degradation, and it is anticipated that degradation will occur at Site 40 although macronutrient availability is not known. Additional environmental degradation processes such as hydrolysis and photolysis are considered to be insignificant fate mechanisms for monocyclic aromatics in aquatic systems (USEPA, 1982).

5.3.3 Inorganics

Inorganics are highly persistent environmental contaminants. They do not biodegrade, photolyze, hydrolyze, etc. The major fate mechanisms for inorganics are adsorption to the soil matrix (as opposed to being part of the soil structure) and bioaccumulation.

The mobility of inorganics is influenced primarily by their physical and chemical properties in combination with the physical and chemical characteristics of the soil matrix. Factors that assist in predicting the mobility of inorganic species are soil/pore water pH, soil/pore water Eh, and cation exchange capacity. The mobility of inorganics generally increases with decreasing soil pH and cation exchange capacity.

5.4 CONTAMINANT MIGRATION

Transport of contaminants after they are released to the environment is controlled by the following:

- Nature and extent of contamination
- Physical properties of the contaminants
- Potential migration pathways

These factors determine whether the contaminant partitions to more mobile media (air or water) or less mobile media (soil or sediment particles).

The source media typically consist of contaminated subsurface soil from approximately 15 feet bls to the water table ranging from approximately 100 feet bls at IR and UST in the central areas of the facility to approximately 5 feet bls at sites near Clear Creek that are under investigation at NAS Whiting Field. Petroleum-related constituents are found at all UST sites under consideration. TCE is present in groundwater underlying Site 4, but a source in the vadose zone has not been located. At Sites 4 and 2894, free-phase petroleum product has been detected in monitoring wells screened in soil overlying low permeability clay layers that have perched water above the true water table of the sand-and-gravel aquifer. The other sites (Sites 3, 5, 6, 7, 32, 33, 1438, and 1439) have either known solvent and/or petroleum contamination in the vadose zone with underlying groundwater contamination. Rain water infiltration is the likely transfer mechanism for moving contaminants from vadose soil to groundwater in perched zones and the water table zone for the sand-and-gravel aquifer. The vadose zone typically ranges in thickness from approximately 80 to 120 feet across the industrial area of NAS Whiting Field that is identified as Site 40, so there is significant migration through the vadose zone prior to contaminants encountering the water table.

This section presents a brief overview of contaminant fate and transport pathways for the major chemical classes detected in groundwater at Site 40.

5.4.1 Volatile Organic Compounds

VOCs, including halogenated aliphatics and monocyclic aromatics, are typically considered to be fairly soluble with a low capacity for retention by soil organic carbon; therefore, these are the organic compounds most frequently detected in groundwater. These types of chemicals may migrate through the soil column after being released by a spill event or by subsurface waste burial as infiltrating precipitation solubilizes them. Some fraction of these chemicals is retained by the soil, but most will continue migrating downward to the water table. At that time, migration occurs primarily laterally with the hydraulic gradient. Again, some portion of the chemical may be retained by the saturated soil.

Petroleum-related constituents are found in soil at Sites 3, 4, 5, 6, 7, 32, 33, 2894, 1438, and 1439. TCE is present in groundwater underlying Sites 3 and 4 in the North Field and Sites 5, 6, and 7 in the South Field, but a specific “hot spot” source has not been found in the vadose zone at either area. At Sites 4 and 2894, free-phase petroleum product has been detected in soil overlying low permeability clay layers perched above the water table. The remaining sites (Sites 3, 4, 5, 6, 7, 32, 33, 2894, 1438, and 1439) have known contamination in the vadose zone with underlying groundwater contamination. Rain water infiltration is the likely transfer mechanism from vadose soil to groundwater.

Based on the results of the groundwater analyses, there is contamination by VOCs in groundwater samples from Sites 3, 4, 5, 6, 7, 32, 33, 2894, 1438, and 1439.

5.4.2 Inorganics

Inorganics are incorporated into the soil matrix due to natural geologic processes and remain bound to particulate matter such as clay or sand grains. As such, they migrate via bulk movement processes (erosion). There are some instances where these inorganics are found at high concentrations or in a form able to migrate in a solution or through precipitation. It is also possible that industrial activities could result in a discharge or release that saturate all available exchange sites in the soil and, hence, a metal may be mobilized because it could not be adsorbed or is released in preference to another more amenable inorganic species. Inorganics are also more mobile in groundwater at NAS Whiting Field due to the low pH found naturally occurring in regional groundwater. Finally, a metal solution may be utilized in some industrial applications. In these cases, it is possible for the inorganics solution to migrate vertically through the soil column and reach the groundwater. Inorganic solutions, however, have not been used at NAS Whiting Field.

5.5 FATE AND TRANSPORT SUMMARY

Based on the distribution of contaminants in Site 40 groundwater, overlying soils are considered the primary source for inorganics, VOCs, and CVOCs. The primary release mechanism for inorganics and VOCs is the direct contact of soil to groundwater. The primary release mechanism for CVOCs is contact with infiltrating precipitation and contaminated soil gas. The CSM is illustrated on Figure 1-4.

Tables 5-2 and 5-3 compare the frequency of detection (FOD) for analytes in groundwater in the NCA and SCA. Overall, FODs are approximately 50 percent for the NCA and 20 to 25 percent for VOCs in the SCA. Ethylbenzene was the most frequently detected organic (56 percent) of the VOCs in the NCA, while TCE was the most frequently detected (81 percent) of the CVOCs in the SCA.

The CVOCs (TCE and vinyl chloride), which were detected at concentrations exceeding USEPA MCLs and/or FDEP GCTLs, were present from the source areas to points at the distal end of the plume. The contaminant distribution in groundwater suggests a starting point or source area. The starting point is infiltrating groundwater moving through contaminated soil and migrating with contaminants to the water table creating an area of elevated concentrations beneath the suspect source area. As a result CVOC concentrations decrease along the length of the plume with subsequent migration away from the suspect source area.

Based on the concentrations and types of contaminants present in the groundwater at Site 40, several exposure pathways were defined. It should be noted that the migration of contaminants in the sand-and-gravel aquifer is likely governed by factors that control the movement of dissolved contaminants because the Site 40 groundwater data does not provide evidence of immiscible contaminants at concentrations exceeding water solubility levels. Free-phase petroleum product is only found on perched clay layers. Contaminants with higher molecular weight (such as SVOCs) adsorb strongly to soil and sediment and are highly insoluble and, as a result, are rather immobile and have not migrated into the groundwater at Site 40.

The detected VOCs (i.e., chlorinated aliphatics and monocyclic aromatics) tend to be mobile in environmental media as indicated by their presence in groundwater and their corresponding MI values. Their environmental mobility is a function of high water solubilities, high vapor pressures, low K_{ow} and K_{oc} values, and high MIs.

Inorganics can be found as solid complexes in soils at the site. Factors affecting the transport of inorganics in saturated soils are interactive and far more complex and numerous than those affecting the transport of organic contaminants. The most complicated pathway for inorganics contaminants is migration in subsurface soils and groundwater, where Eh and pH play critical roles. Soils at NAS Whiting Field are relatively neutral, so inorganics in the subsurface soil should be rather immobile.

The pH of groundwater at Site 40 is mildly acidic (ranging from 4.3 to 6.5), which tends to promote the dissolution of certain inorganics into the groundwater. Inorganic transport in groundwater is mainly a function of each analytes' solubility in solution under the chemical conditions of the soil-solution matrix. The inorganic must be dissolved (i.e., in solution) for leaching and transport by advection with the groundwater to occur. Generally, dynamic and reversible processes control solubility and transport of the dissolved ions. Such processes include precipitation/dissolution, adsorption/desorption, and ion exchange.

Inorganics could be sorbed onto colloidal materials, theoretically increasing their inherent mobility in saturated porous media. It is important to note, however, that colloids themselves are not mobile in most soil/water systems.

6.0 HUMAN HEALTH RISK ASSESSMENT

This section presents the Human Health Risk Assessment (HHRA) for Site 40, NAS Whiting Field. The objective of the HHRA is to determine whether detected concentrations of chemicals in groundwater within the study areas pose a substantial threat to potential human receptors under current and/or future land use. The potential risks to human receptors were estimated based on the assumption that no actions were taken to control human exposure to COPCs.

6.1 INTRODUCTION

A HHRA consists of five components: data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. Sections 6.2 through 6.6 contain detailed discussions of these five components.

Three major aspects of chemical contamination and environmental fate and transport must be considered in order to evaluate potential risks: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action; (2) potential exposure points must exist; and (3) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of these factors is absent for a site, the exposure route is regarded as incomplete, and no potential risks are considered to exist for human receptors.

It should be noted that aluminum, arsenic, iron, manganese, and vanadium are considered naturally occurring when slightly elevated concentrations are present in soil or groundwater. Unless these inorganics are detected at locations where facility operations may have caused an increase in the naturally elevated concentrations they have been removed from consideration as COPCs as described in section 4.8.1.

6.2 DATA EVALUATION

Data evaluation, the first component of a baseline HHRA, is a medium-specific task involving the compilation and evaluation of analytical data. The main objective of the data evaluation is to develop a medium-specific list of COPCs that will be used to quantitatively determine potential human health risks for site media.

The HHRA focuses only on the data collected from groundwater well samples at NAS Whiting Field during 2011. These data reflects the most recent conditions at the site. Groundwater data was separated into two exposure units to evaluate two groundwater contaminant plumes. The exposure units are identified as the NCA and SCA groundwater plumes in this report and the sampling locations for each plume are listed in Tables 1 and 2 of Appendix J.

Typically, screening by risk-based concentrations is used to focus the risk assessment on meaningful chemicals (i.e., the COPCs) and exposure routes.

The following sections define the screening criteria used to determine the COPCs for the two groundwater plumes at Site 40.

6.2.1 Derivation of Screening Criteria

Several types of screening levels were used to identify COPCs for Site 40. Screening concentrations based on USEPA Region Screening Levels (RSLs) (USEPA RSL Table, May, 2012) and FDEP GCTL (FDEP, 2005) was used to select COPCs. Adjusted risk-based USEPA RSL concentrations correspond to a hazard quotient (HQ) of 0.1 (for non-carcinogens) or an incremental lifetime cancer risk (ILCR) of 1 x 10^{-6} (for carcinogens). The published USEPA RSLs for non-carcinogens are based on a Hazardous Index (HI) of 1. These USEPA RSL values for non-carcinogens were multiplied by 0.1 to generate the adjusted USEPA RSL which then account for potential cumulative effects of several chemicals affecting the same target area or producing the same adverse non-carcinogenic health effect.

The FDEP GCTLs for groundwater (FDEP, 2005) were also used in the HHRA. GCTLs are identified as being based on the protection of human health or numerical standards based on health considerations, primary standards such as MCLs, organoleptic and aesthetic factors, and best available detection limits. Risk-based GCTLs based on the protection of human health were determined using a lifetime excess cancer risk of one in a million (1 x 10^{-6}) or using a HQ of 1. These risk-based GCTLs are usually adjusted to one-tenth of its value for the selection for COPCs in the HHRA. However, the GCTLs for chemicals detected at the site were not risk-based; therefore, the GCTLs were used at face value for COPC selection.

The USEPA RSLs and FDEP GCTLS used in the COPC selection for groundwater presented in Table 6-1.

6.2.2 COPCs Selected for HHRA

COPCs at Site 40 were selected for groundwater using the COPC screening levels described in Section 6.2.1. COPC selection tables are presented in Tables 6-2 and 6-3 for the NCA and SCA plumes respectively. Chemicals retained as COPCs for Site 40 are presented in Table 6-4.

A comparison of the maximum detected groundwater concentrations from the NCA plume to the screening levels based on the USEPA RSLs for tap water and FDEP GCTLs is presented in Table 6-2. The following six chemicals were detected in the NCA plume at maximum concentrations exceeding the direct contact COPC screening levels and were retained as COPCs for groundwater.

- Volatiles (benzene, cis-1,2-dichloroethene, ethylbenzene, toluene, total xylenes, and trichloroethene)

A comparison of the maximum detected groundwater concentrations from the SCA plume to the screening levels based on the USEPA RSLs for tap water and FDEP GCTLs is presented in Table 6-3. The following six chemicals were detected in the SCA plume at maximum concentrations exceeding the direct contact COPC screening levels and were retained as COPCs for groundwater.

- Volatiles (benzene, cis-1,2-dichloroethene, ethylbenzene, toluene, total xylenes, and trichloroethene)

6.3 EXPOSURE ASSESSMENT

This section presents the exposure assessment for Site 40. The methodology used to determine the exposure point concentrations (EPCs) (concentrations of COPCs to which a receptor is exposed) is also presented.

6.3.1.1 Potential Current and Future Receptors of Concern and Exposure Pathways

Receptors may come into contact with COPCs through direct contact with groundwater by ingestion and by using groundwater for domestic purposes (e.g., bathing, showering, and washing dishes). Current site users include adult trainees living on-site and adult base workers coming on-site. However, because future land use is unknown for purposes of completeness, the baseline risk assessment will consider receptor exposure under residential land use scenarios. Based on current and potential future land use, the following potential receptors may be exposed to contaminated environmental media within the study area:

- Adult Trainee – A plausible receptor under current and future land use. This includes adult military personnel living on-site. This receptor could be exposed to groundwater (tap water ingestion, dermal contact, and inhalation during showering).

- Adult Base Worker – A plausible receptor under current and future land use. This receptor could be exposed to groundwater (dermal contact).

- Residents – An unlikely receptor under future land use. Although this scenario is highly unlikely, a future residential scenario is typically evaluated in a risk assessment for decision-making purposes. For example, the need for deed restrictions at a site may be eliminated prior to site closure if minimal risks are estimated for residential receptors. It is assumed that a hypothetical resident may be exposed to and groundwater (tap water ingestion, dermal contact, and inhalation during showering).

Details regarding the assumed receptor characteristics (e.g., intake rate, frequency, duration of exposure) are defined in Section 6.3.4.

6.3.2 Central Tendency Exposure vs. Reasonable Maximum Exposure

Traditionally, exposures evaluated in the HHRA were based on the concept of a reasonable maximum exposure (RME) only, which is defined as "the maximum exposure that is reasonably expected to occur at a site" (USEPA, 1989). However, subsequent risk assessment guidance (USEPA, 1992b) indicates the need to address an average case or central tendency exposure (CTE).

To provide a full characterization of potential exposure, both scenarios were evaluated in the HHRA for Site. The available guidance (USEPA, 1993b) concerning the evaluation of CTE is limited and at times vague. Therefore, professional judgment was exercised in some cases to select one-half of the RME value for certain parameters such as exposure frequencies when defining CTE conditions for a particular receptor at a site.

6.3.3 Exposure Point Concentrations

The EPC, which is calculated for COPCs only, is an estimate of the chemical concentration within an exposure unit (EU) likely to be contacted over time by a receptor and is used to estimate exposure intakes. An exposure unit is defined as the area typically encountered/traversed by a receptor under a particular land use scenario. For example, a residential lot size of ¼ acre to 2 acres is often used for the evaluation of a hypothetical future resident. However, the size of an EU is typically based on the distribution of the chemical concentrations in a medium as well as on presumed receptor activity patterns. For groundwater the maximum concentration was used as the EPC

Table 6-5 summarizes the EPCs used in this HHRA. RAGS Part D Tables 3.1 RME and 3.2 RME for the EPCs are presented in Appendix J.

6.3.4 Chemical Intake Estimation

The methodologies and techniques used to estimate exposure intakes are presented in this section. Intakes for the identified potential receptor groups were calculated using current USEPA risk assessment guidance (USEPA, 1991Ae, 1997a, and 2004a) and presented in the risk assessment spreadsheets. All quantitative risk assessment results are presented in RAGS Part D format tables (Appendix J).

Noncarcinogenic hazards were assessed by estimating a total annual exposure, then converting the dose to an average daily intake. When compared to toxicity benchmarks, daily intake represents the rate of exposure and does not suggest incrementally increasing degrees of cumulative toxicity according to years of exposure duration. The intake incorporates terms describing the exposure time and/or frequency that represent the number of hours per day and the number of days per year that exposure occurs. The sum of exposures over one year was divided by 365 days of "averaging time" in order to convert the annual exposure to an average daily intake. Non-carcinogenic hazards for some exposure routes were generally greater for children than for adults because of differences in body weight and intake.

Carcinogenic risks, on the other hand, were estimated as an incremental lifetime risk and, therefore, incorporate terms to sum the exposures over an expected exposure duration (years of exposure), and then divide by the total days in a typical lifetime (70 years). The carcinogenic exposure model accounts for the probability of developing cancer increasing with every additional year of cumulative exposure.

The denominator of the intake equations for inhalation exposures was reported in units of hours, which differs from the units, expressed in days, that were applied to direct contact (ingestion and dermal) exposure equations. This is consistent with the approach specified in RAGS Part F inhalation guidance (USEPA, 2009).

RME input parameters and equations used to calculate daily intake of COPCs for all receptors, exposure media, and routes of exposure are shown in Appendix J in RAGS Part D Tables 4.1.RME through 4.7.RME. CTE parameters and equations are shown for receptors in Appendix J in RAGS Part D Tables 4.1.CTE through 4.7.CTE. The following pathway-specific assumptions and estimation methods for COPC exposures should be noted:

6.3.4.1 Dermal Contact with Groundwater

Direct physical contact with groundwater may result in the dermal absorption of chemicals. Residents and Adult trainees were assumed to be exposed to dermal contact with groundwater during daily showering. Adult base workers were assumed to have incidental dermal contact with exposed groundwater while drinking water. Exposures associated with the dermal route are estimated in the following manner (USEPA, 2004a):

$$\text{Intake}_{si} = \frac{(DA_{event})(EV)(EF)(ED)(SA)}{(BW)(AT)}$$

where:

Intake_{si} = amount of chemical "i" absorbed from skin contact with groundwater (mg/Kg/day)
SA = skin surface area available for contact (cm^2)
DA_{event} = absorbed dose per event (mg/cm^2-event)
EV = event frequency (events/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)

AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/year;
for carcinogens, AT = 70 years x 365 days/year

where:

C_{wi} = concentration of chemical "i" in groundwater (µg/L)
For Inorganics: DA_{event} = C x KP x ET
For organics: DA_{event} = C x KP x FA x 2 x (6 x Tau x ET / PI)^0.5 for organics where ET < T*, or
For organics: DA_{event} = C x KP x FA x [ET/(1+B) + Tau x (2+6B+6B^2)/(1+B)^2] organics, ET>T*
KP = chemical-specific permeability constant
FA = fraction absorbed (unitless)

The USEPA dermal guidance (2004a) identifies the values assumed for the chemical-specific constants KP, Tau, B, and B*. Most of the exposure assumptions used to estimate chemical intakes from dermal contact with groundwater were based on default assumptions described in standard USEPA guidance and are shown in Appendix J in RAGS Part D RME and CTE tables.

Chemical-specific permeability constants associated with modeling of dermal absorption are not shown on the exposure input tables. The dermal permeability constants were obtained from USEPA RAGS Part E, Dermal Exposure Guidance (2004a).

6.3.4.2 Ingestion of Groundwater

Ingestion of groundwater is applicable to tap water consumption by adult trainee and hypothetical future residents living on site. Exposures associated with ingestion were estimated in the following manner (USEPA, 1989):

$$\text{Intake}_{si} = \frac{(C_{wi})(IR)(EF)(ED)(CF)}{(BW)(AT)}$$

where:

Intake_{si} = intake of contaminant "i" from groundwater (mg/Kg/day)
C_{wi} = concentration of contaminant "i" in groundwater (µg/L)
IR = ingestion rate (L/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
CF = conversion factor (0.001 mg/µg)
BW = body weight (kg)
AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/year;
for carcinogens, AT = 70 years x 365 days/year

It was assumed adult residents and child residents would ingest 2L/day and 1L/day, respectively, (USEPA, 1991Ae) of tap water under the RME scenario and 1.4L/day and 0.74L/day of tap water, respectively, under the CTE scenario (USEPA, 1993a and 1997a). The same exposure frequencies and durations used in the estimation of dermal intakes were used to estimate exposure via incidental ingestion.

6.3.4.3 Inhalation of VOCs During Showering

Showering exposure was considered for the residential adult, residential child, and the adult trainee living on site. The Foster and Chrostowski showering model was applied to estimate time-varying air concentrations of volatile COPCs and inhaled dose during the time spent showering and while in the bathroom after showering. Showering model input assumptions were adopted from USEPA guidance (2004a) and as recommended by the developers of the model (Foster and Chrostowski, 1987). Henry's Law constants and other parameters used in this model were obtained from several sources, including USEPA (2002d) and Foster and Chrostowski (1987). Input parameters are shown in Appendix J in RAGS Part D RME and CTE tables. Exposures associated with inhalation while showering were estimated in the following manner (USEPA, 2009):

$$EC = \frac{(C_{air})(ET)(EF)(ED)}{AT}$$

where:

EC = exposure concentration (mg/m^3)
C_{air} = concentration of chemical in shower (mg/m^3) (from Foster & Chrostowski model)
ET = exposure time (hours/day)
EF = exposure frequency (days/yr)
ED = exposure duration (yr)
AT = averaging time (hours);
= ED x 365 days/yr x 24 hrs/day for non-carcinogens
= 70 yr x 365 days/yr x 24 hrs/day for carcinogens

6.3.4.4 Assessing Cancer Risks from Early Life Exposures

USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005b) recommends making adjustments to the toxicity of carcinogenic chemicals that act via the mutagenic mode of action when evaluating early-life exposures. The guidance recommends using age-dependent adjustment factors (ADAFs) combined with age-specific exposure estimates when assessing cancer risks. In the absence of chemical-specific data, the supplement guidance recommends the following default adjustments, which reflect the fact that cancer risks are generally higher from early-life exposures than from similar exposures later in life:

- For exposures before 2 years of age (i.e., spanning a 2-year interval from the first day of birth until a child's second birthday), a 10-fold adjustment.
- For exposures between 2 and 16 years of age (i.e., spanning a 14-year time interval from a child's second birthday until their sixteenth birthday), a three-fold adjustment.
- For exposures after turning 16 years of age, no adjustment.

The adjustments were applied using the same method as that used by USEPA in the development of RSLs. Children were evaluated as two age groups, ages 0 to 2 years and ages 2 to 6 years, and adults were evaluated as two age groups, ages 6 to 16, and ages greater than 16 years old. Using this approach, the intakes for child and adult recreational users and hypothetical residents were calculated as follows:

$$\text{Intake}_{\text{Child}} = \text{Intake}_{(\text{ages } 0-2 \text{ years})} \times 10 + \text{Intake}_{(\text{ages } 2-6 \text{ years})} \times 3$$
$$\text{Intake}_{\text{Adult}} = \text{Intake}_{(\text{ages } 6-16 \text{ years})} \times 3 + \text{Intake}_{(\text{ages} > 16 \text{ years})}$$

And the intakes for adolescent trespassers were calculated as follows:

$$\text{Intake}_{\text{Adolescent}} = \text{Intake}_{(\text{age } 6-16 \text{ years})} \times 3$$

The above approach was used only for those chemicals that are identified as mutagenic in the USEPA screening table (trichloroethene). Sample calculations showing how this approach was applied are included in Appendix J.

As referenced on USEPA’s IRIS toxicity website (USEPA, 2012), a special situation exists with the mutagenic substance trichloroethene. For TCE, the intake is calculated twice, with the first calculation involving the mutagenic component that includes the ADAF multipliers shown above, which is then multiplied by a mutagenic-specific slope factor to yield an estimate of TCE cancers associated with the kidney. Next, the non-mutagenic intake (no ADAFs involved) is calculated, which is then multiplied by a different, non-mutagenic TCE slope factor to yield an estimate of non-mutagenic types of TCE-induced cancers (liver and non-Hodgkin lymphoma). The total TCE cancer risk is then estimated by adding the nonmutagenic risk to the mutagenic component of cancer risk.

6.4 TOXICITY ASSESSMENT

The toxicity assessment identifies the potential health hazards associated with exposure to a COPC. Literature references establish that the selected COPCs have the potential to cause carcinogenic and/or non-carcinogenic health effects in humans. Dose-response relationships correlate the magnitude of the intake with the probability of toxic effects. Quantitative toxicity values determined during this component of the risk assessment are integrated with exposure assessment outputs to characterize the potential occurrence of adverse health effects for each receptor group.

USEPA guidance recommends the following primary literature sources for obtaining toxicity criteria (USEPA, 2003a):

- Tier 1 - Integrated Risk Information System (IRIS) (online).

- Tier 2 - USEPA Provisional Peer Reviewed Toxicity Values – The Office of Research and Development/National Center for Environmental Assessment (NCEA, 2002) Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by USEPA's Superfund program.
- Tier 3 - Other Toxicity Values – These sources include but are not limited to California Environmental Protection Agency (Cal EPA) toxicity values, the ATSDR Minimal Risk Levels (MRLs), and the Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b).

Oral RfDs and CSFs for the constituents identified as COPCs are presented in Tables 6-6 and 6-7.

6.4.1 Noncarcinogenic Toxicity

The reference dose (RfD) is the toxicity value used to evaluate noncarcinogenic health effects for ingestion and dermal exposures. The reference concentration (RfC) is used to evaluate noncarcinogenic health effects for inhalation exposures. The RfD and RfC estimate a daily exposure level for a human population that is unlikely to pose an appreciable risk during a portion or all of a human lifetime. Noncarcinogenic RfDs and RfCs are based on a review of animal and/or human toxicity data, including laboratory studies or epidemiological studies. RfDs may be based on a Benchmark Dose Lower-Confidence Limit, a No Observed Effects Level (NOAEL), a Lowest Observed Effects Level (LOAEL), or another suitable point of departure, with uncertainty/variability factors applied to reflect limitations of the data used. The RfD may be developed for various timeframe categories; for example, subchronic RfDs are specifically developed to be protective for a portion of a lifetime exposure to a compound (as a Superfund program guideline, short term). Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (as a Superfund program guideline, long term). The RfD is usually expressed as a dose (mg) per unit body weight (kg) per unit time (day).

Published RfDs and RfCs include uncertainty factors to account for specific areas of uncertainty in the available data. A factor of 10 is used to account for variations in the general population (to protect sensitive subpopulations), when test results from animals are extrapolated to humans (to account for interspecies variability), when a NOAEL derived from a subchronic study (instead of a chronic study) is used to develop the RfD, and when a LOAEL is used instead of a NOAEL. In addition, a modifying factor of up to 10 may be included based on any uncertainties in the database not already accounted for. The default value of the modifying factor is 1. In this manner, the RfD (as diminished by the uncertainty factor) is designed to maintain a margin of safety so that chronic human health effects are not underestimated. Thus, the average daily dose is compared to the RfD and a determination is made whether the goal of protection of a HI equal to 1 is exceeded.

Noncancer hazards are considered to be associated with particular target organs or critical effects, but are not additive across multiple chemicals except when the same target organ or critical effect is involved. Target organ data have been extracted from the toxicity sources listed in Section 6.4.

6.4.2 Carcinogenic Toxicity

Carcinogenic effects are quantified using the cancer slope factor (CSF) for ingestion and dermal exposures, and using inhalation unit risks (IUR) for inhalation exposure. CSFs and IURs are developed as a plausible upper-bound estimate of the probability of the development of cancer per unit intake of a chemical over a lifetime. CSFs are applicable for estimating the lifetime probability (assumed 70-year lifespan) of human receptors developing cancer as a result of exposure to known or potential carcinogens. CSFs generally represent an upper bound on the average risk in a population or the risk for a randomly selected individual, but not the risk for a highly susceptible individual or group (USEPA, 2005A). The slope factor is generally reported in units of 1/(mg/kg/day), and for most substances is derived through an assumed low-dosage linear relationship extrapolated from high to low dose responses, typically based on animal studies. The value used in reporting the slope factor is the upper 95 percent confidence limit.

6.4.3 Toxicity Criteria for Dermal Exposure

RfDs and CSFs in the scientific literature are typically expressed as “administered” (i.e., not absorbed) doses based on estimating toxicity via the oral route of exposure. Therefore, these values are considered inappropriate for estimating risks associated with dermal exposures. Oral dose response parameters based on administered doses must be adjusted to absorbed doses before they can be compared to estimated dermal exposure intakes.

When oral absorption is essentially complete (i.e., 100 percent), an absorbed dose is equivalent to the administered dose, and therefore no toxicity adjustment is necessary. Conversely, when the gastrointestinal (GI) absorption of a chemical is poor (e.g., 1 percent), the absorbed dose is smaller than the administered dose. In this case, the toxicity factors based on absorbed dose should be adjusted to account for the difference in the absorbed dose relative to the administered dose. USEPA (2004a) recommends a 50 percent absorption cut-off to reflect the intrinsic variability in analyzing absorption studies. Therefore, the adjustment from administered to absorbed dose was only performed when the chemical-specific GI absorption efficiency was less than 50 percent. The adjustment from administered to absorbed dose was made using chemical-specific GI absorption efficiencies published in numerous sources of guidance [e.g., USEPA 2004a (the primary reference), IRIS, ATSDR toxicological profiles, etc.], using the following equations:

$$RfD_{dermal} = (RfD_{oral}) \times (ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) / (ABS_{GI})$$

where: ABS_{GI} = absorption efficiency in the gastrointestinal tract

RfD_{dermal} = RfD for the dermal route of exposure

RfD_{oral} = RfD for the oral route of exposure
CSF_{dermal} = CSF for the dermal route of exposure
CSF_{oral} = CSF for the oral route of exposure

6.4.4 Inhalation Toxicity

The intake equations presented in RAGS, Part A (USEPA, 1989, Exhibit 6-16) are no longer recommended by EPA to be used when evaluating risk from the inhalation pathway. Instead, the revised equations from RAGS, Part F (USEPA, 2009) are recommended. The net impact of this change is to use IURs instead of inhalation slope factors for cancer risk, and RfCs instead of inhalation RfDs for noncancer hazards

6.4.5 Carcinogenic Weight of Evidence

A weight-of-evidence approach is used to classify the likelihood that a substance is a carcinogen. This qualitative information is important to consider when using CSFs to estimate potential risk. Each substance is assigned a weight-of-evidence for carcinogenicity. EPA has recently revised their weight-of-evidence classifications. The updated categories are listed as follows (USEPA, 2005A):

WEIGHT OF EVIDENCE CATEGORY	DEFINITION
Carcinogenic to Humans	There is strong evidence of human carcinogenicity
Likely to be Carcinogenic to Humans	The weight-of-evidence is adequate to demonstrate carcinogenic potential to humans, but does not reach the weight of evidence for the classification of "Carcinogenic to Humans"
Suggestive Evidence of Carcinogenic Potential	The weight of evidence is suggestive of carcinogenicity; a concern for potential carcinogenic effects in humans is raised, but the data are judged not sufficient for a stronger conclusion
Inadequate Information to Assess Carcinogenic Potential	Available data are judged inadequate for applying one of the other classifications
Not Likely to be Carcinogenic to Humans	The available data are considered robust enough for deciding that there is no basis for human health hazard

Weight-of-evidence classifications have not yet been updated for many substances. In these instances, it is appropriate to still list the old weight-of-evidence classifications (USEPA, 1986). The older weight-of-evidence categories were used in Appendix D.3 in RAGS D Tables 6.1 and 6.2, and are listed as follows:

- Group A - Human Carcinogen (Sufficient evidence from epidemiological studies to support a causal association between exposure and cancer).

- Group B1 - Probable Human Carcinogen (Limited evidence of carcinogenicity in humans from epidemiological studies; sufficient evidence in animals).

- Group B2 - Probable Human Carcinogen (Sufficient evidence of carcinogenicity in animals and no or inadequate evidence in humans).
- Group C - Possible Human Carcinogen (Limited evidence of carcinogenicity in animals).
- Group D - Not Classified (Inadequate evidence of carcinogenicity in animals).
- Group E - No Evidence of Carcinogenicity (No evidence of carcinogenicity in at least two adequate animal tests or in both epidemiological and animal studies).

6.4.6 Mutagenic Chemicals

USEPA's Guidelines for Carcinogen Risk Assessment (USEPA, 2005a) and Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005b) specify the use of ADAFs for carcinogens that act via a mutagenic mode of action. Trichloroethene is included in the group of chemicals that have been determined to act via the mutagenic mode of action. No chemical-specific ADAFs have been derived for these substances. Therefore, the guidance-recommended default values for ADAFs were applied as follows: 10 for ages 0 to 2, 3 for ages 2 to 16 and 1 (no adjustment) for ages 16 to 70. The ADAFs were used in evaluating exposures to trichloroethene for hypothetical residents using the approach presented in Section 6.3.4.4. No adjustments were necessary for adult workers or adult trainee.

6.5 RISK CHARACTERIZATION

This section provides a characterization of the potential human health risks associated with the potential exposures to contaminants at Site 40. The risk characterization quantitatively evaluates the potential for adverse health effects from exposure to COPC concentrations in environmental media by integrating information developed during the toxicity and exposure assessments.

6.5.1 Non-carcinogenic Hazards

Non-carcinogenic hazards are technically not risks since a probability of health effects is not developed for non-carcinogens. Non-carcinogenic hazards were assessed using the concept of HQs and HIs. The HQ for a COPC is defined for ingestion and dermal exposures as the ratio of the estimated intake (mg/kg/day) to the RfD, while for inhalation exposures, the HQ is the ratio of the exposure concentration (mg/m3) to the RfC, as follows:

HQ-oral/dermal = (Estimated Exposure Intake) / (RfD)
HQ-inhalation = (Estimated Exposure Concentration) / (RfC)

HIs are generated by summing individual HQs for COPCs. If the value of the total HI exceeds unity (1.0), the potential for noncarcinogenic health hazards associated with exposure to a particular chemical mixture cannot be ruled out (USEPA, 1986). In that case, a review of the target organ(s) affected by each chemical should be performed, which indicates the most sensitive toxic endpoints used to develop the associated RfDs for each substance. Target organ-specific HIs are evaluated for a receptor by summing the HQs for similar target organs. Since HIs for different organs are not truly additive, if each target organ-specific HI is less than 1, then adverse effects are not anticipated. The HI is not defined as a mathematical prediction of the severity of toxic effects; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects. Above an HI of 1, toxic effects would not necessarily occur but can no longer be ruled out. EPA's goal of protection for noncancer hazards is an HI less than or equal to 1 for a target organ.

6.5.2 Carcinogenic Risks

Incremental lifetime cancer risk (ILCR) estimates can be generated for each exposure pathway using the estimated intakes and published cancer toxicity factors. The ILCR for a COPC is defined for ingestion and dermal exposures and inhalation exposures as follows:

ILCR-oral/dermal = (Estimated Exposure Intake)(CSF)
ILCR-inhalation = (Estimated Exposure Concentration)(IUR)

The risk determined using these equations is defined as a unitless expression of an individual's increased likelihood of developing cancer over a lifetime as a result of a specific period and amount of exposure to carcinogenic chemicals. An ILCR of 1×10^{-6} indicates that the exposed receptor has a one in one million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of 1,000,000 persons. The calculated cancer risks should be recognized as upper-limit estimates.

6.5.3 Comparison of Cancer Risk Estimates and Non-cancer HIs to Reference Criteria

To interpret the estimates for cancer risks and non-cancer HIs to aid risk managers in determining the need for remediation at a site, quantitative risk estimates were compared to typical reference criteria. A COPC exhibiting an HQ above 1, or otherwise contributing to a non-cancer HI greater than 1 on the basis of a single target organ or effect indicates that there may be potential non-carcinogenic health risks associated with exposure. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) are regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1, but no adverse health effects are anticipated if the COPCs do not affect the same target organ or exhibit the same critical effect. However, remediation decisions are not made strictly based on HIs but are often further modified by other regulatory requirements such as chemical-specific clean-up goals.

USEPA has defined the range of 1×10^{-6} to 1×10^{-4} as the ILCR "target risk range" for most hazardous waste facilities addressed under CERCLA and RCRA. Individual or cumulative ILCRs greater than 1 x

10^{-4} will typically not be considered as protective of human health and ILCRs less than 1 x 10^{-6} will typically be regarded as protective. Risk management decisions are necessary when the ILCR is within the 1 x 10^{-6} to 1 x 10^{-4} cancer risk range.

6.5.4 Results of the Risk Characterization

This section contains a summary of the results of the risk characterization for Site 40. Quantitative risk estimates for potential human receptors are developed for chemicals detected in groundwater. Uncertainties associated with the risk estimates are discussed in Section 6.6. The methodology used to calculate the risks presented in this section is provided in Sections 6.3 and 6.4. Potential cancer risks and hazard indices were calculated for current/future exposures to adult trainee, adult base worker and hypothetical child and adult residents under the RME and CTE scenarios.

ILCRs and HIs are summarized for receptor exposures to groundwater use in Table 6-8 and Table 6-10 (RME risks for NCA plume and SCA plume respectively) and Table 6-9 and 6-11 (CTE risks for NCA plume and SCA plume respectively). A chemical-specific breakdown of receptor cancer risks and non-cancer hazards is presented in Appendix J in the form of RAGS D Table 7s and RAGS D Table 9s. In each RAGS D table where HQs were reported as N/A, the HQs were not calculable because no RfD has been established. Cancer risks that are reported as "N/A" generally indicate that the chemical is not carcinogenic or that an SF has not yet been developed. Sample calculations are presented in Appendix J.

6.5.4.1 NCA Plume

As shown in Table 6-8, the RME ILCRs for exposure to groundwater for the adult trainee (3 x 10^{-4}), adult base worker (9 x 10^{-4}), hypothetical child resident (2 x 10^{-3}), hypothetical adult resident (4 x 10^{-3}) and hypothetical lifelong resident (6 x 10^{-3}) were greater than the target acceptable risk range. For the adult trainee and adult base worker ethylbenzene and trichloroethene contributed ILCRs in the 1 x 10^{-5} to 1 x 10^{-4} risk range while benzene contributed ILCR greater than 1 x 10^{-4}. For the hypothetical child resident trichloroethene (mutagenic and nonmutagenic) contributed ILCR in the 1 x 10^{-5} to 1 x 10^{-4} range while benzene and ethylbenzene contributed ILCRs greater than 1 x 10^{-4}. For the hypothetical adult resident benzene, ethylbenzene, and trichloroethene nonmutagenic contributed ILCRs greater than 1 x 10^{-4} while trichloroethene mutagenic contributed ILCRs in the 1 x 10^{-5} to 1 x 10^{-4} range. For the hypothetical lifelong resident benzene, ethylbenzene, and trichloroethene (mutagenic and nonmutagenic) contributed ILCRs greater than 1 x 10^{-4}.

As shown in Table 6-8, the RME total HI exceeded 1 for an adult trainee (HI = 73), adult base worker (HI = 17), child resident (HI = 216), adult resident (HI = 108) exposed to COPCs via tap water use of groundwater. For the adult trainee benzene, cis-1,2-dichloroethene, ethylbenzene, toluene, total xylenes, and trichloroethene were the primary contributors to the non-cancer HIs. For the adult base worker benzene, cis-1,2-dichloroethene, ethylbenzene, toluene and trichloroethene were the primary contributors to the non-cancer HIs. For the hypothetical child resident benzene, cis-1,2-dichloroethene, ethylbenzene, toluene, total xylenes, and trichloroethene nonmutagenic were the primary contributors to the non-cancer HIs. For the hypothetical adult resident benzene, cis-1,2-dichloroethene,toluene, total xylenes, and trichloroethene nonmutagenic were the primary contributors to the non-cancer HIs.

The CTE ILCR for exposure to groundwater by an adult trainee was 8 x 10^{-5}, which is within the 1 x 10^{-6} to 1 x 10^{-4} target acceptable risk range (Table 6-9). The CTE ILCRs for exposure to groundwater by an adult base worker (4 x 10^{-4}), hypothetical child resident (3 x 10^{-4}), hypothetical adult resident (4 x 10^{-4}) and lifelong resident (7 x 10^{-4}) were greater than the 1x10^{-6} to 1 x 10^{-4} target acceptable risk range. Ethylbenzene and trichloroethene contributed ILCRs in the 1 x 10^{-5} to 1 x 10^{-4} risk range while benzene contributed ILCR greater than 1 x 10^{-4} for the adult base worker. For the hypothetical child resident benzene contributed ILCRs greater than 1 x 10^{-4}, ethylbenzene and trichloroethene mutagenic contributed ILCRs in the 1 x 10^{-5} to 1 x 10^{-4}, and trichloroethene nonmutagenic contributed ILCRs in the 1 x 10^{-6} to 1 x 10^{-5} risk range. For the hypothetical adult resident benzene contributed ILCRs greater than 1 x 10^{-4}, ethylbenzene and trichloroethene nonmutagenic contributed ILCRs in the 1 x 10^{-5} to 1 x 10^{-4}, and trichloroethene mutagenic contributed ILCRs in the 1 x 10^{-6} to 1 x 10^{-5} risk range. For the hypothetical lifelong resident benzene contributed ILCRs greater than 1 x 10^{-4}, ethylbenzene and trichloroethene nonmutagenic and mutagenic contributed ILCRs in the 1 x 10^{-5} to 1 x 10^{-4},

The CTE HI exceeded 1 for an adult trainee (HI = 57), adult base worker (HI = 7), hypothetical child resident (HI = 192), and hypothetical adult resident (HI = 39) exposed to COPCs via tap water use of groundwater (Table 6-9). Benzene, total xylenes, trichloroethene, cis-1,2-dichloroethene, ethylbenzene, and toluene were the primary contributors to the non-cancer HIs for the adult trainee. Benzene, trichloroethene, cis-1,2-dichloroethene, and toluene were the primary contributors to the non-cancer HIs for the adult base worker. Benzene, total xylenes, trichloroethene nonmutagenic, cis-1,2-dichloroethene, ethylbenzene, and were the primary contributors to the non-cancer HIs for the hypothetical child resident. Benzene, total xylenes, trichloroethene nonmutagenic, cis-1,2,-dichloroethene, ethylbenzene, and toluene were the primary contributors to the non-cancer HIs for the hypothetical adult resident.

6.5.4.2 SCA Plume

As shown in Table 6-10 the RME ILCRs for exposure to groundwater for the adult trainee was within the target acceptable risk range. The RME ILCRs for exposure to groundwater for the adult base worker (3 x 10^{-4}), hypothetical child resident (9 x 10^{-4}), hypothetical adult resident (2 x 10^{-3}), and lifelong resident (3 x 10^{-3}) were greater than the target acceptable risk range. For the adult base worker benzene contributed an ILCR greater than 1 x 10^{-4} while ethylbenzene and trichloroethene contributed an ILCR in the 1 x 10^{-5}

to 1 x 10^{-4} range. For the hypothetical child resident benzene, ethylbenzene, and trichloroethene mutagenic contributed ILCR greater than 1 x 10^{-4} while trichloroethene nonmutagenic contributed an ILCR in the 1 x 10^{-5} to 1 x 10^{-4} range. For the hypothetical adult resident benzene, ethylbenzene, and trichloroethene nonmutagenic contributed ILCR greater than 1 x 10^{-4} while trichloroethene mutagenic contributed an ILCR in the 1 x 10^{-5} to 1 x 10^{-4} range. For the hypothetical lifelong resident benzene, ethylbenzene, and trichloroethene mutagenic and nonmutagenic contributed ILCRa greater than 1 x 10^{-4}.

The RME total HI exceeded 1 for the adult trainee (HI = 19), adult base worker (HI = 4), hypothetical child resident (HI = 131), and hypothetical adult resident (HI = 68). For the adult trainee benzene, total xylenes, trichloroethene, cis-1,2-dichloroethene, ethylbenzene, and toluene were the primary contributors to the non-cancer HIs. For the adult worker benzene and trichloroethene were the primary contributors to the non-cancer HIs. For the hypothetical child resident benzene, total xylenes, trichloroethene nonmutagenic, cis-1,2-dichloroethene, ethylbenzene, and toluene were the primary contributors to the non-cancer HIs. For the hypothetical adult resident benzene, total xylenes, trichloroethene nonmutagenic, cis-1,2-dichloroethene, ethylbenzene, and toluene were the primary contributors to the non-caner HIs.

As shown in Table 6-11, the CTE ILCRs for exposure to groundwater for the adult trainee, adult base worker, and hypothetical child resident were within the target acceptable risk range. The CTE ILCRs for exposure to groundwater for the hypothetical adult resident (2 x 10^{-4}), and hypothetical lifelong resident (3 x 10^{-4}) were greater than the target acceptable risk range. For the hypothetical adult resident benzene, ethylbenzene, trichloroethene nonmutagnenic contributed ILCRS in the 1 x 10^{-5} to 1 x 10^{-4} risk range while trichloroethene mutagenic contributed an ILCR in the 1 x 10^{-6} to 1 x 10^{-5} risk range. For the hypothetical lifelong resident benzene, ethylbenzene, trichloroethene nonmutagenic and mutagenic contributed ILCRS in the 1 x 10^{-5} to 1 x 10^{-4} risk range.

The CTE total HI exceeded 1 for the adult trainee (HI = 7), adult base worker (HI = 2), hypothetical child resident (HI = 53), and hypothetical adult resident (HI = 23). For the adult trainee benzene, trichloroethene, cis-1,2-dichloroethene, ethylbenzene, and toluene were the primary risk contributors to the non-cancer HIs. For the adult base worker trichloroethene was the primary risk contributor to the non-cancer HI. For the hypothetical child and adult resident benzene, trichloroethene nonmutagenic, cis-1,2-dichloroethene, ethylbenzene, and toluene were the primary risk contributors to the non-cancer HI.

6.6 UNCERTAINTY ANALYSIS

There is uncertainty associated with all aspects of the baseline human health risk assessment. A summary of the uncertainties, including a discussion of how they may affect the final risk numbers, is provided in this section.

Uncertainty in the selection of COPCs is related to the current status of the predictive databases, the grouping of samples, the numbers, types, and distributions of samples, and the procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route or scenario, the assumptions made to determine exposure point concentrations, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose-response relationships and the weight-of-evidence used to determine the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the risk assessment process.

Whereas there are various sources of uncertainty, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose-response relationships. Throughout the entire risk assessment, assumptions are biased toward a margin of safety so that the final calculated risks are overestimated.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward over predicting both carcinogenic and noncarcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point of departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are less than an acceptable risk level (i.e., 1×10^{-6} to 1×10^{-4}), the interpretation of no significant risk is typically straightforward. However, when risks calculated using a high degree of uncertainty exceed an acceptable risk level (i.e., 1×10^{-4}); a conclusion can be difficult unless uncertainty is considered.

6.6.1 Uncertainty in Data Evaluation

The most significant issue related to uncertainty in the data evaluation are the usability of the existing database, the COPC screening levels used, and the absence of screening levels for a few chemicals detected in site media. A brief discussion of the uncertainty in the data evaluation is provided in the remainder of this section.

6.6.1.1 Usability of Existing Databases

All the data used in the HHRA were validated. A review of data quality is also provided in Section 5. The qualification of data during the formal data validation process is not expected to compromise the results of the baseline human health risk assessment. Analytical data qualified as estimated were utilized, even though the reported positive concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated data adds to the uncertainty associated with the risk assessment; however, the associated uncertainty is expected to be negligible compared to the other uncertainties inherent in the risk evaluation process (i.e., uncertainties with land uses, exposure scenarios, toxicological criteria, etc.). Because all data have been validated, the degree of uncertainty in the calculated risks associated with the analytical data is low.

6.6.1.2 COPC Screening Levels

The use of risk-based screening values based on conservative land-use scenarios (i.e., residential land use for ingestion of tap water for groundwater) corresponding to ILCRs of 10^{-6} and HIs of 0.1 ensured that all substances that contribute to significant risk from the site were evaluated. The elimination of chemicals present at concentrations that corresponded to ILCRs less than 10^{-6} and HIs less than 0.1 would not affect the final conclusion of the risk assessment because those chemicals were not expected to cause a potential health concern at the detected concentrations.

6.6.2 Uncertainty in the Exposure Assessment

6.6.2.1 Exposure Routes and Receptor Identification

The determination of various receptor groups and exposure routes of potential concern was based on current land use observed at the site and the anticipated future land use. Therefore, the uncertainty associated with the selection of exposure routes and potential receptors is minimal because they are considered to be well defined.

6.6.2.2 Exposure Parameters

Each exposure factor (for RME and CTE scenarios) selected for use in the risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological parameters and activity patterns from lifestyle profiles across the United States. The attributes studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, in most cases, the USEPA guidelines (1991e and 1993a) on the RME receptor were applied, which specify the use of the 95th percentile for many input parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Many of the exposure parameters were determined from statistical analyses on human population characteristics. Often, the database used to estimate an exposure parameter (e.g., body weight) is quite large. In such cases, the exposure parameter estimate should have low variability.

Many of the exposure parameters used to calculate exposures and risks in this report are selected from a distribution of possible values, including USEPA guidance (1991e and 1993a) and dermal guidance (USEPA, 1997c and 2004a). For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. This risk number is used in risk management decisions but does not indicate what a more average or typical exposure might be or what risk range might be expected for individuals in the exposed population.

To address these issues, USEPA (1992a) has suggested the use of the CTE receptor, whose intake variables are often set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Some of the parameters presented in this risk assessment were estimated using professional judgment, although USEPA does provide limited guidance for the CTE evaluation (1993a).

6.6.2.3 Modeling Contaminant Transport Pathways and Biological Uptake

Prediction of absorption rates, across the skin barrier, for lipophilic compounds is difficult due to, among other reasons, the possibility of a second absorption pathway that depends on the lipid content of the stratum corneum at the application site. Experimental determination of absorption rates indicates that interspecies differences are considerable, which, along with other variability's related to condition and age of skin, differences in lag time, and site of application effects, yields appreciable uncertainty in estimated dermal exposures by using published chemical-specific permeation functions. In addition, literature data indicate a variation by as much as a factor of 300 in chemical absorption rates for skin in different anatomical areas of the body. It should also be noted that children generally have greater absorption rates than adults and their activity patterns often result in greater soil-to-skin adherence factors.

Uncertainties exist in the exposure model for the inhalation of volatiles during showering such as chemical-specific rates of volatilization, droplet size, and droplet residence time in the shower. Most of the inputs into the models are considered conservative; therefore, the output may overestimate the exposure for this route.

6.6.3 Uncertainty in the Toxicological Evaluation

Uncertainty associated with the toxicity assessment is associated with hazard assessment and dose-response evaluations for the COPCs. The hazard assessment deals with characterizing the nature and strength of the evidence of causation or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination, using the USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the COC is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes the determination of a CSF for the carcinogenic assessment. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation.

Most toxicity experiments are performed with animals that are very similar in age and genotype, so intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity, including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a non-threshold assumption of carcinogenesis. Evidence suggests, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are noncarcinogenic. Therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

6.6.4 Uncertainty in the Risk Characterization

Uncertainty in risk characterization resulted from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing noncancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Even when compounds affect the same target organs, they may have different mechanisms of action or differ in their fate in the body, so additivity may not have been an appropriate assumption. However, the assumption of additivity was considered acceptable because in most cases it represented a conservative estimate of risk.

Risks to any individual may also have been overestimated by summing multiple assumed exposure pathway risks for any single receptor. Although every effort was made to develop reasonable scenarios, not all individual receptors may have been exposed via all pathways considered.

Also, the risk characterization did not consider antagonistic or synergistic effects. Little or no information was available to determine the potential for antagonism or synergism for the COPCs. Because chemical-specific interactions could not be predicted, the likelihood for risks to be over predicted or under predicted could not be defined, but the methodology used was based on current USEPA guidance.

6.7 HUMAN HEALTH SUMMARY AND CONCLUSIONS

This section summarizes the results of the baseline HHRA for Site 40 Base-Wide Groundwater which was performed to characterize the potential risks to likely human receptors under current and potential future land use. Potential receptors under current land use are adult trainee and adult base worker. Potential receptors under future land use are hypothetical child and adult residents. Although future land use is likely to be the same as current land use, the potential future receptors were evaluated in the baseline human health risk assessment, primarily for decision-making purposes.

The selected COPCs at Site 40 are presented in Table 6-4. The COPCs for both the NCA and SCA plumes for direct contact to groundwater:

- Benzene, cis-1,2-dichloroethene, ethylbenzene, toluene, total xylenes, and trichloroethene.

Quantitative estimates of noncarcinogenic hazards and carcinogenic risks (HIs and ILCRs, respectively) were developed for potential human receptors and are summarized in Tables 6-8 and 6-10 (RME risks for NCA and SCA plumes), 6-9 and 6-10 (CTE risks for NCA and SCA plumes).

6.7.1.1 NCA Plume

The RME ILCRs for exposure to groundwater for the adult trainee (3 x 10^{-4}), adult base worker (9 x 10^{-4}), hypothetical child resident (2 x 10^{-3}), adult resident (4 x 10^{-3}) and lifelong resident (6 x 10^{-3}) were greater than the target acceptable risk range. The RME total HI exceeded 1 for an adult trainee (HI = 73), adult base worker (HI = 17), child resident (HI = 216), adult resident (HI = 108) exposed to COPCs via tap water use of groundwater.

For The CTE ILCR for exposure to groundwater by an adult trainee (8 x 10^{-5}) was within the 1 x 10^{-6} to 1 x 10^{-4} target acceptable risk range. The CTE ILCRs for exposure to groundwater by an adult base worker (4 x 10^{-4}), hypothetical child resident (3 x 10^{-4}), hypothetical adult resident (4 x 10^{-4}) and lifelong resident (7 x 10^{-4}) were greater than the 1x10^{-6} to 1 x 10^{-4} target acceptable risk range. The CTE HI exceeded 1 for an adult trainee (HI of 57), adult base worker (HI = 7), hypothetical child resident (HI = 92), and hypothetical adult resident (HI = 39) exposed to COPCs via tap water use of groundwater.

6.7.1.2 SCA Plume

The RME ILCRs for exposure to groundwater for the adult trainee (was within the target acceptable risk range). The RME ILCRs for exposure to groundwater for the adult base worker (3 x 10^{-4}), hypothetical child resident (9 x 10^{-4}), hypothetical adult resident (2 x 10^{-3}), and lifelong resident (3 x 10^{-3}) were greater than the target acceptable risk range. The RME total HI exceeded 1 for the adult trainee (HI = 19), adult base worker (HI = 4), hypothetical child resident (HI = 131), and hypothetical adult resident (HI = 68).

The CTE ILCRs for exposure to groundwater for the adult trainee, adult bas worker, and hypothetical child resident were within the target acceptable risk range. The CTE ILCRs for exposure to groundwater for the hypothetical adult resident (2 x 10^{-4}), and hypothetical lifelong resident (3 x 10^{-4}) were greater than the target acceptable risk range. The CTE total HI exceeded 1 for the adult trainee (HI = 7), adult base worker (HI = 2), hypothetical child resident (HI = 53), and hypothetical adult resident (HI = 23).

7.0 ECOLOGICAL RISK ASSESSMENT

The goal of the ERA process in the Superfund Program is to provide the information necessary to assist risk managers at Superfund sites in making informed decisions regarding hazardous substances (USEPA, 1997d). With this in mind, the goal of this ERA is to determine whether groundwater contaminants emanating from Site 40 pose risks to ecological receptors and to provide information that will enable scientists and managers to conclude either that groundwater-related ecological risks at the site are negligible or that further information is necessary to evaluate potential ecological risks due to contaminated groundwater at Site 40.

Section 7.1 describes groundwater migration pathways at NAS Whiting Field. A summary of a previous ERA conducted at Site 39 (adjacent to Site 40) is included in Section 7.2. The Site 40 groundwater data are evaluated in Section 7.3.

7.1 EXPOSURE PATHWAYS

Most of the base facilities at NAS Whiting Field are located on a plateau that is approximately 195 feet above msl (see Figure 1-6). This plateau does not contain any water bodies within which groundwater discharges, and thus, ecological receptors on the plateau and most of its slopes within the Site 40 boundary are not exposed to groundwater contaminants. There is no exposure pathway to Site 40 groundwater for ecological receptors.

The vadose zone at NAS Whiting is typically greater than 90 feet thick and separates ecological receptors from groundwater with the exception of a narrow strip of land on the western side of NAS Whiting Field. The western portion of NAS Whiting Field slopes toward the valley where Clear Creek is found at an elevation of approximately 30 feet above msl. Clear Creek is located within the valley floodplain at the base of this slope. The NAS Whiting Field property boundary extends into and across the Clear Creek floodplain in an approximate 750 by 400 foot rectangular segment of Clear Creek where Site 39 is located (see Figure 1-2). The remainder of Clear Creek and its floodplain are beyond the base boundary. Groundwater flowing from beneath NAS Whiting Field discharges through the floodplain sediments to floodplain surface water and into Clear Creek. Within the limits of the Clear Creek floodplain there is no significant vadose zone acting as a barrier between ecological receptors and Site 40 Groundwater.

A recent USEPA publication entitled *Evaluating Ground-Water/Surface-Water Transition Zones in Ecological Risk Assessments* (2008) provides a thorough review of groundwater issues pertaining to ecological risk. Benthic and epibenthic communities (particularly invertebrate larvae, worms, bivalves, and fish) are typically major components of the groundwater-to-surface water transition zone ecosystem and many of these organisms spend part or all of their life cycle in contact with the sediments and groundwater that comprise this zone (2008).

Groundwater contaminants can potentially impact ecological receptors when surface water becomes contaminated by groundwater discharging into surface water. In addition, ecological receptors inhabiting sediment and/or pore water in the transition zone between groundwater and surface water can potentially be impacted by contaminated groundwater as it passes through the transition zone into overlying surface water (USEPA, 2008). Aquatic and benthic receptors are present in the streambed and floodplain of Clear Creek (Site 39) and may be exposed to Site 40 groundwater at seeps and springs.

7.2 CONSIDERATIONS OF SITE 39 REMEDIAL INVESTIGATION

A RI was recently conducted for NAS Whiting Field Site 39 as part of the Department of Defense IR Program (Tetra Tech, 2010b). Site 39 includes both Clear Creek and the Clear Creek floodplain (see Figure 1-2). Site 39 is approximately 750 feet in length and 300 to 400 feet wide. The study area for the Site 39 RI was larger than the dimensions of Site 39; the study area matched the width of the flood plain and encompassed a 9,000 foot segment of Clear Creek. A detailed description of Site 39 can be found in Section 7.1 of the Site 39 RI Report (Tetra Tech, 2010b). The ecological risk assessment for Site 39 evaluated sediment, surface water, and groundwater samples collected in Clear Creek and the floodplain. In accordance with USEPA guidance discussing groundwater issues pertaining to ecological risk (2008) groundwater data were compared to surface water benchmark values considered to be protective of aquatic and benthic organisms. The benchmark values were USEPA Region 4 chronic screening values for freshwater surface water (2001a) and FDEP Surface Water Quality Classifications for Class III Fresh Waters (Chapter 62-302.530, F.A.C.).

Tables 7-5 and 7-6 of the Site 39 RI (Tetra Tech, 2010b) summarize the screening of analytes detected in groundwater samples collected from the floodplain and creek bed, respectively, and are reproduced in Appendix K of this report. No groundwater analyte concentrations exceeded surface water benchmark values. Screening benchmark values were not available from USEPA Region 4 or FDEP for three VOCs (2-butanone, acetone, and vinyl chloride) detected in floodplain groundwater water and for one VOC (vinyl chloride) detected in creek bed groundwater. All groundwater concentrations of 2-butanone, acetone, and vinyl chloride, however, were less than alternate screening values of 14,000 µg/L for 2-butanone, 1,500 µg/L for acetone, and 930 µg/L for vinyl chloride (see Table 7-9 of Site 39 RI Report [Tetra Tech, 2010b]). Therefore, concentrations of all VOCs detected in groundwater were less than benchmark values or alternate toxicity values. Chemicals retained as ecological COPCs at the end of the ecological risk assessment for Site 39 consisted of 4,4’-DDE, total DDT, dieldrin, cadmium, copper, lead, and silver in floodplain sediment. No chemicals were retained as COPCs in floodplain surface water, creek surface water, or creek sediment at the end of the ecological risk assessment for Site 39 (Tetra Tech, 2010b).

7.3 EVALUATION OF SITE 40 GROUNDWATER

As discussed above, the ERA for Site 39 evaluated sediment, surface water, and groundwater samples collected in Clear Creek and the floodplain, and chemicals retained as ecological COPCs at the end of the ERA for Site 39 consisted of 4,4'-DDE, total DDT, dieldrin, cadmium, copper, lead, and silver in floodplain sediment. With this in mind, the pertinent question for the Site 40 groundwater investigation (as it relates to potential ecological risk) is, "Does groundwater from Site 40 contribute to concentrations of 4,4'-DDE, 4,4'-DDT, dieldrin, cadmium, copper, lead, and silver contamination in the floodplain of Clear Creek?" In other words, do chemicals other than the seven final COPCs pose minimal or negligible risk to ecological receptors in the creek and floodplain; therefore, the evaluation of Site 40 groundwater can be focused on the seven final COPCs identified at Site 39. Thus, the remainder of this section evaluates 4,4'-DDE, DDT, dieldrin, cadmium, copper, lead, and silver in Site 40 groundwater in order to determine the likelihood that Site 40 groundwater is the source of these chemicals in floodplain sediment associated with Clear Creek.

Sites 15 and 16 lie slightly east of Clear Creek and Site 39 and are located between Site 39 and most of the facilities at NAS Whiting Field (see Figure 1-2). Therefore, the ecological evaluation of Site 40 groundwater was selectively limited to groundwater samples collected from groundwater monitoring wells located at Sites 15 and 16. Groundwater samples were collected at Sites 15 and 16 in 1993, 1996, 1997, 2000, and 2007.

Neither 4,4'-DDE nor dieldrin have been detected in any groundwater samples from Sites 15 and 16. 4,4'-DDT was detected in groundwater samples from one well set (WHF-16-MW-6S and WHF-16-MW-6D) in 1996 at concentrations of 0.15 J and 0.14 J µg/L, respectively, but has not been detected in any Site 15 or 16 groundwater samples in previous or subsequent sampling events.

Surface water ESVs used in the screening level ERA were determined by comparing USEPA Region 4 chronic screening values for freshwater surface water (2001c) to Florida Surface Water Quality Classifications for Class III Fresh Waters (Chapter 62-302.530, F.A.C.). For each analyte detected in surface water, the lower of the USEPA Region 4 value and the Florida Surface Water Quality Classifications was used as the ESV.

Freshwater surface water ESVs for some metals (including cadmium, copper, and lead) and are based on hardness. Surface water hardness was not measured in surface water samples collected for the Site 39

RI. Instead, hardness-dependent surface water ESVs were calculated for the Site 39 ERA using average calcium and magnesium concentrations in surface water. All calculated hardness values were less than 25 mg/L (Tetra Tech, 2010b). USEPA and FDEP guidance state that when calculating surface water ESVs for metals that are hardness-dependent, the hardness should be set at 25 mg/L if the actual hardness is less than 25 mg/L. Using a hardness value of 25 mg/L results in a cadmium ESV of 0.38 µg/L, a copper ESV of 3.62 µg/L, and a lead ESV of 0.54 µg/L. The ESV for silver (which is not hardness-dependent) is 0.012 µg/L.

Detected cadmium and silver concentrations in all groundwater samples collected from Sites 15 and 16 since 2007 (see Table 4-46) have been less than their respective surface water ESVs.

Detected copper concentrations in groundwater collected from Sites 15 and 16 since 2007 have exceeded the 3.62 µg/L ESV in nine samples, while detected lead concentrations in groundwater collected from Sites 15 and 16 since 2007 have exceeded the 0.54 µg/L ESV in five samples (see Table 4-46). All detected copper and lead concentrations, however, were from deep or intermediate wells (see Table 4-46) rather than shallow wells. Shallow groundwater might discharge into Clear Creek, but deeper groundwater would not be expected to discharge into the creek. Thus, the depth at which copper and lead concentrations are elevated suggests negligible potential risks to ecological receptors. Furthermore, detected copper and lead concentrations in samples collected from Sites 15 and 16 since 2007 have been within the range of background groundwater values (see Table 4-35) indicating that any potential risks from copper and lead are not related to Site 40 contamination.

In summary, there is no exposure pathway to Site 40 groundwater for ecological receptors. VOCs and SVOCs in groundwater pose negligible risks to ecological receptors in Clear Creek and its floodplain. The pesticides 4,4'-DDE and dieldrin have not been detected in any groundwater samples from Sites 15 and 16. The pesticide 4,4'-DDT was detected in one well set at Site 15 in 1993, but has not been detected in any groundwater sample thereafter. Cadmium and silver groundwater concentrations have been less than their respective surface water ESVs since 1997. Copper and lead have not been detected in shallow groundwater at Sites 15 and 16 since 1997, and concentrations in deeper groundwater are within background values. Although groundwater beneath NAS Whiting Field is contaminated by various chemicals, the only possible route of exposure for contact with ecological receptors is along Clear Creek and its floodplain. With the above factors in mind, no further evaluation of groundwater-related potential ecological risk is warranted for Site 40.

8.0 SUMMARY AND CONCLUSIONS

The preceding sections of this RI Report described the nature and extent of hazardous constituents in groundwater as well as the potential for contaminated soil to act as a source to groundwater. The risk to human health and the environment from exposure to the groundwater at Site 40 has also been examined. The facility was subdivided into the following three major geographic areas to make analysis and description of findings manageable:

1. The Northern Area (NA) includes Sites 1, 2, 17, 18, 38, The Former Gunnery Area and, The Skeet Range.

2. The North Central Area (NCA) includes Sites 3, 4 (former UST Site 1467), 32, 35, 36, 37, 41, and eight UST Sites 2832, 1438/1439, 2832, 2894, 2993, The Product Line Dispensing Facility, The Product Line Pump Station, and The Product Line Junction.

3. The South Central Area (SCA) includes Sites 5, 6, 7 (former UST Site 1466), 15, 16, 29, 30, and 33, 35, 36, and 37.

4. The Southern Area (SA) includes Sites 8, 9, 10, 11, 12, 13, 14, and 31A through 31F

Conclusions and recommendations are based on the information provided in this RI Report.

8.1 GENERAL INFORMATION FOR SITE 40

NAS Whiting Field was built in the 1940s and, with the development and operation of the facility, leaks and spills have occurred that have impacted soil and through infiltration subsequently groundwater. The distribution of contaminants in Site 40 groundwater reflects past impacts from various historical sources.

8.1.1 Site Sources of Contamination

Sources associated with NAS Whiting Field are the result of historical chemical and fuel storage, waste disposal, general maintenance and repair, and grounds keeping activities at the facility. Contaminants associated with these activities include waste solvents, paints, paint thinners, oils, hydraulic fluids, PCBs, pesticides, fuel sludge, and aviation fuels. These materials were deposited in landfills at several boundary road sites within the Southern and Northern Areas of the facility and are now detected in soils and groundwater in the form of SVOCs and VOCs as well as PCBs and pesticides. The NCA and SCA contain sources that contribute to groundwater contamination found at NAS Whiting Field. It should be noted that the contaminant stream contributed by NAS Whiting Field has likely diminished over time. Environmental laws and regulations enacted during the 1980s (and subsequently) reduced the amount of materials entering the landfills prior to landfill closures and, consequently, the amount of contaminants infiltrating to Site 40.

8.1.2 Contaminant Release Mechanisms

Waste materials were routinely disposed within designated landfills/waste piles such as Sites 1, 2, 9, 10, 11, 12, 12, 14, 15, 16, 17, and 18 and land disposal areas such as Sites 31A through 31E. These contaminants have been released to underlying soil and, then to, groundwater due to infiltration through soils. Additionally, there are several UST sites where fuels and solvents are or have been stored that have had pipeline leaks and spills due to accidents or equipment failures.

8.1.3 Transport/Migration Pathways

Contaminants found in surface and subsurface soil at sites located above Site 40 Base-Wide Groundwater have leached to the surficial water table. Contaminated groundwater below the sites flows from the facility in a southwesterly direction and eventually recharges Clear Creek and the Clear Creek floodplain.

8.2 GENERAL AND AREA-SPECIFIC CONCLUSIONS FOR SITE 40

The general conclusions of the remedial investigation are as follows:

- Volatile organics primarily TCE and BTEX are present in groundwater samples exceeding federal and state regulatory criteria are restricted to the NCA and SCA (see Table 4-37 and 4-45).

- Semivolatile organics and TPH detected in groundwater samples exceeding federal and state regulatory criteria are restricted primarily to the NCA (see Table 4-37 and 4-45).

- Pesticides detected in groundwater samples exceeding federal and state regulatory criteria are found only in the NCA (see Table 4-28).

- The groundwater flow direction of the NCA and SCA contaminant plumes is to the southwest.

- TCE and BTEX contamination extends from the SCA to Clear Creek.

- Groundwater in the region typically has low pH and facility groundwater reflects this tendency.

- Aluminum, iron, manganese, and vanadium are present in groundwater regionally in exceedance of federal and state regulatory criteria as well as in groundwater beneath NAS Whiting Field.

A HHRA and ERA was conducted based on the COPCs present in Site 40 groundwater samples. The following summarizes the results of the HHRA and ERA:

Human Health Risk Summary

In summary, there is a potential exposure pathway to Site 40 groundwater for both pilot trainees living on the facility and adult base workers. This potential pathway is present because Site 40 groundwater is pumped to the surface from public supply wells for consumption and general use by personnel at the facility. Groundwater is monitored quarterly prior to treatment for required pollutants. The analytical results are provided to FDEP for review. Treated (after GAC filtration) water is analyzed monthly and the results provided to FDEP.

Potential receptors under future land use are the hypothetical child and adult residents. Although future land use is likely to be the same as current land use, the potential future receptors were evaluated in the baseline human health risk assessment, primarily for decision making purposes.

The COPCs for both the NCA and SCA plumes for direct contact to groundwater are:

- Benzene, ethylbenzene, toluene, total xylenes, trichloroethene, and cis-1,2-dichloroethene.

An adult worker or hypothetical resident consuming untreated groundwater from the NCA or SCA plumes may be exposed to contaminants exceeding the USEPAs target acceptable risk range resulting in unacceptable carcinogenic risks. Carcinogenic risks for adult trainee’s exposure to groundwater from the SCA plumes are within the acceptable risk range established by USEPA.

The individual target organ HI for the adult trainee, adult base worker, and possible future residential receptors exceeded the USEPAs HI of 1 indicating that adverse non-carcinogenic affects are also anticipated from exposure to groundwater from the NCA and/or SCA plumes.

Ecological Risk Summary

The ERA determined no ecological risks were present from groundwater at Site 40 as there are no ecological receptors within its confines. There is, however, ecological risk at Site 39, Clear Creek, from groundwater upwelling in to Site 39 from Site 40. This is discussed in a separate RI report for Site 39 Clear Creek (Tetra Tech, 2010b).

8.3 CONCLUSIONS BY GEOGRAPHIC AREA

Table 8-1 correlates the detected surface and subsurface soil leachate concentrations that exceed federal and state criteria with corresponding site groundwater exceedances. It should be noted that recent sampling has been focused in the areas of the NCA and SCA plumes since 2007. As a result, the Northern and Southern Areas have not been sampled since approximately 2000. Also note, the indication that a site's soil was sampled to determine if soils were leaching does not mean that all soil samples from a site were tested for leaching.

8.3.1 Northern Area of Site 40

Results of SPLP leachate and groundwater samples associated with the Northern Area indicate there has been a possible release of aluminum and iron from subsurface soils at Sites 1 and 2 to groundwater resulting in an exceedance of GCTLs (see Table 8-1). At Site 38, two pesticides (total [alpha-, gamma-] chlordane and heptachlor epoxide), five inorganics (aluminum, arsenic, iron, manganese, and vanadium), were detected in soil SPLP leachate in exceedance of GCTLs at Site 38. Beta-BHC and heptachlor epoxide were also detected in groundwater samples at Site 38 in monitoring well WHF-38-MW-2S in exceedance of GCTLs. One pesticide (heptachlor epoxide) and four metals exceeded the GCTL in SPLP leachate samples as well as groundwater samples; therefore, soil contamination may be a source to groundwater at Site 38.

8.3.2 North Central Area of Site 40

Four organics (ethylbenzene, toluene, total xylenes, and naphthalene) and five inorganics (aluminum, iron, lead, manganese, and vanadium) were detected in SPLP leachate in exceedance of GCTLs primarily at Site 41. BTEX, TCE, cis-1,2-DCE, 1,1-DCA, BEHP, aluminum, arsenic iron, lead, manganese, mercury, and vanadium were found in exceedance of GCTLs within the mapped plume located in the NCA. Only ethylbenzene, toluene, total xylenes, aluminum, iron, and lead were found in both SPLP leachate and groundwater indicating a possible association between a soil contaminant source and GCTL exceedance in groundwater (see Table 8-1). The frequent occurrence of inorganics exceeding federal or state criteria reflects regional groundwater conditions not affected by operations at the facility or are likely a secondary response to the groundwater chemistry change caused by organic contamination.

8.3.3 South Central Area of Site 40

Eight organics (ethylbenzene, 2-methylnaphthalene, toluene, total xylenes, BEHP, naphthalene, dieldrin, and TPH) and six inorganic analytes (aluminum, iron, lead, manganese, mercury, and vanadium) were detected in soil SPLP leachate in exceedance of GCTLs. Benzene, cis-1,2-DCE, ethylbenzene, total xylenes, trans-1,2-DCE, TCE, vinyl chloride, aluminum, arsenic, iron, lead, manganese, and vanadium were found in exceedance of GCTLs within the mapped plume boundary located in the SCA. Only ethylbenzene, total xylenes, aluminum, iron, lead, manganese, and vanadium were found in both SPLP leachate and groundwater indicating an association between a soil contaminant source and GCTL exceedance in groundwater (see Table 8-1). The frequent occurrence of inorganics exceeding federal or state criteria reflects regional groundwater conditions not affected by operations at the facility or are likely a secondary response to the groundwater chemistry change caused by organic contamination.

8.3.4 Southern Area of Site 40

No organic compounds were found above regulatory limits in soil leachate in the Southern Area. Aluminum and mercury were detected in soil SPLP leachate in exceedance of GCTLs. Vinyl chloride, BEHP, aluminum, iron, and manganese were detected in exceedance of GCTLs in groundwater. Therefore, contaminated soil is a potential source to groundwater for aluminum. The other analytes detected in groundwater listed above may be leaching to groundwater, but the source was not detected (see Table 8-1).

8.3.5 Recommendation Summary

The HHRA and ERA state the exceedance of GCTLs in groundwater do not pose a threat to human health or the ecology under current exposure scenarios. This statement is based on a site model matching current conditions and assumes there is no route of exposure to groundwater. The HHRA and ERA do not account for changes in site conditions and use. Many sites within Site 40, however, have no detected analytes leaching to groundwater and no GCTL exceedances. Conversely, other sites have either one or a combination of the following conditions:

- Analytes above leachability standards in soil leaching to groundwater at concentrations exceeding GCTLs.

- Analytes above leachability standards in soil, but no corresponding analytes present in groundwater.

- No detected analytes leaching to groundwater but, with analytes exceeding GCTLs in groundwater.

Therefore, a focused FS for Site 40 is recommended based on the possibility of future exposure to contaminated groundwater.

REFERENCES

ABB-ES (ABB Environmental Services, Inc.), 1992a. Remedial Investigation and Feasibility Study Phase 1, NAS Whiting Field, Milton, Florida, Technical Memorandum No. 5 Groundwater Assessment, Final Report: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. October.

ABB-ES, 1992b. Phase I Technical Memorandum No. 2 Hydrogeologic Assessment, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. May.

ABB-ES, 1992c. Remedial Investigation and Feasibility Study, Technical Memorandum No. 3 Soils Assessment, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. May.

ABB-ES, 1992d. Site 3054 Contamination Assessment Report, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. September.

ABB-ES, 1992e. Remedial Investigation and Feasibility Study, Technical Memorandum No. 5 Groundwater Quality Assessment, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

ABB-ES, 1993a. Contamination Assessment Report Addendum for Site 3054 (IR Site 8), NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. November.

ABB-ES, 1993b. Soil Gas Survey Technical Report. NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. March.

ABB-ES, 1994a. Jurisdiction Assessment Report, Underground Storage Tank Program Sites 1466 and 1467, Installation Restoration Program Sites 4 and 7, NAS Whiting Field, Milton, Florida Final Report: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

ABB-ES, 1994b; In 1994, 20 shallow soil borings were drilled (1 to 8 feet bls, 3 to 4 feet bls, and 16 from 0.5 to 3 feet bls), and soil samples were collected by ABB-ES at the apron located east of Building 1454 as part of a contamination assessment of shallow soils for construction activities. Results of the investigation were presented in a letter report… Section 2.4.7, page 2-23

REFERENCES (Continued)

ABB-ES, 1994c. Remedial Investigation and Feasibility Study, Technical Memorandum No. 2, Geologic Assessment; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. November.

ABB-ES, 1995a. Remedial Investigation and Feasibility Study, Phase II-A, Technical Memorandum No. 2 (Final) Geologic Assessment; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. November.

ABB-ES, 1995b. Remedial Investigation and Feasibility Study, Phase II-A Technical Memorandum No. 4 Hydrogeologic Assessment; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. November.

ABB-ES, 1995c. Remedial Investigation and Feasibility Study, Phase II-A, Technical Memorandum No. 5, Groundwater Assessment; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. November.

ABB-ES, 1995d. Remedial Investigation and Feasibility Study, Phase II-A, Technical Memorandum No. 3 Soil Assessment; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. November.

ABB-ES, 1995e. Remedial Action Plan, Site 2894, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. October.

ABB-ES, 1996. Draft Remedial Investigation, Industrial Area Groundwater Investigation Interim Report, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. October.

ABB-ES, 1998a. Remedial Investigation and Feasibility Study General Information Report (GIR), NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. January.

ABB-ES, 1998b. Industrial Area Groundwater Investigation Interim report Addendum, NAS Whiting Field, Milton, Florida, Draft Report: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

REFERENCES (Continued)

ABB-ES, 1998c. Investigations at Site 35, 36, and 37 at NAS Whiting Field, Milton, Florida, Draft Report: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. January.

ABB-ES, 1998d. Site Assessment Report (SAR), Site 1438-1439, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. April.

ABB-ES, 1999. Remedial Investigation Report for Surface and Subsurface Soil Sites 3, 4, 6, 30, 32, and 33; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

Agency for Toxic Substances Disease Registry), 2002. Website. (http://www.atsdr.cdc.gov/mrls.html). July.

Bechtel (Bechtel Environmental, Inc.), 2000a. Interim Remedial Action/Completion Report for Sites 9, 10, 17, 18, and 31C, Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. February.

Bechtel, 2000b. Completion Report, Site 29, Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. March.

Boulton, N. S., 1955. "Unsteady Radial Flow to a Pumped Well Allowing for Delayed Yield from Storage. " International Association of Scientific Hydrology, Publication 37.

Bradley, P. M. and F. H. Chapelle, 1996. Anaerobic Mineralization of Vinyl Chloride in Fe (III)-Reducing Aquifer Sediments. Environmental Science Technologies 30(6) 2084-2086.

Bradley, P. M., and F. H. Chapelle, 1998, Microbial Mineralization of VC and DCE under different terminal electron accepting conditions. Anaerobe, 4 (2): 81 – 87.

Bradley, P. M., and F. H. Chapelle, 2000, Acetogenic microbial degradation of vinyl choride. Environmental Science and Technology, 34 (13): 2761-2763.

Bradley, P. M., and F. H. Chapelle, 2000a, Aerobic microbial mineralization of dichloroethene as sole carbon substate. Environmental Science and Technology, 34 (1): 221-223.

REFERENCES (Continued)

Bradley, P. M., 2003. History and Ecology of Chloroethene Biodegradation - A review. Bioremediation Journal 7 (2): 81-109.

Bradley, P. M. and F. H. Chapelle, 2011. Microbial Mineralization of Dichloroethene and Vinyl Chloride under Hypoxic Conditions. Ground Water Monitoring & Remediation, 31: no. doi: 10.1111/j.1745-6592.2011.01339.x.

Brown & Root (Brown & Root Environmental, Inc.), 1997. Remedial Investigation and Feasibility Study, Phase II-C Work Plan for Sites 3, 4, 30, 32, and 33, Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. August.

CH^{2}M HILL, 2002. Interim Removal Actions at Sites 6, 16 and 38, Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. December.

CH^{2}M HILL, 2012. Site Assessment Report, Site 4 – North AVGAS Tank Sludge Disposal Area, NAS Whiting Field, Milton, Florida. May.

Environmental Data Resources (EDR), 2011. Potable Water Well Survey, The EDR GeoCheck Report. August.

Envirodyne Engineers, Inc., 1985. Initial Assessment Study, NAS Whiting Field, Milton, Florida. Final Report. Prepared for Navy Energy and Environmental Support Activity, Port Hueneme, California.

FDEP, 1999. Chapters 62-777 and 785, Florida Administrative Code (F.A.C.), Contaminant Cleanup Target Levels Effective 8/5/99 - Groundwater and Surface Water Target Cleanup Levels.

FDEP, 2001. Letter from Mr. James Cason, FDEP, to Mr. James Holland, NAS Whiting Field. Analysis of Soil for Arsenic at Outlying Landing Fields. April.

FDEP, 2005. Technical Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C. February.

Ford, K. L. and P. Gurba, 1984. Health Risk Assessments for Contaminated Soils. In: Proceedings of the Fifth National Conference on Management of Uncontrolled Hazardous Waste Sites. Washington D.C.

REFERENCES (Continued)

Foster, S. A. and P.C. Chrostowski. 1987. Inhalation Exposures to Volatile Organic Contaminants in the Shower. Presented at the 80th Annual Meeting of the Air Pollution Control Association. New York, NY. June.

Geraghty & Miller, Inc., 1986. Verification Study Assessment of Potential Groundwater Pollution at NAS Whiting Field, Milton, Florida.

Hanstush, M. S., and C. E. Jacob, 1955. “Nonsteady Radial Flow in an Infinite Leaky Aquifer.” Transactions of the American Geophysics Union. 36 (No. 1): 95-100.

Harding ESE, 2000. Supplemental Assessment Results Letter Report for Underground Storage Tank (UST) Sites 1438 and 1439. April.

Hayes, L. R. and D. E. Barr, 1983. Hydrogeology of the sand-and-gravel aquifer, southern Okaloosa and Walton Counties, Florida. U.S.G.S. Water Resources Investigation Report no. 82-4110. 41p.

HLA (Harding Lawson Associates), 1998a. Remedial Investigation Report, Site 1, Northwest Disposal Area, Naval Air Station (NAS) Whiting Field, Milton, Florida: prepared for Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), North Charleston, South Carolina. June.

HLA, 1998b. Remedial Investigation Report, Site 2, Northwest Open Disposal Area, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. December.

HLA, 1999a. Record of Decision for Site 1, Northwest Disposal Area, Surface and Subsurface Soil, Naval Air Station Whiting Field, Milton, Florida. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. September.

HLA, 1999b. Record of Decision for Site 2, Northwest Open Disposal Area, Surface and Subsurface Soil, Naval Air Station Whiting Field, Milton, Florida. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. September.

HLA, 1999c. Remedial Investigation Report, Sites 17 and 18, Crash Crew Training Area, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. January.

REFERENCES (Continued)

HLA, 1999d. Draft Final Report on the Investigation at Sites 35, 36, and 37, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. February.

HLA, 1999e. Remedial Investigation Report, Site 15, Southwest Landfill; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. December.

HLA, 1999f. Remedial Investigation Report, Site 9, Waste Fuel Disposal Pit, and Site 10, Southeast Open Disposal Area, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. January.

HLA, 1999g. Remedial Investigation Report, Site 12, Tetraethyl Lead Disposal Area, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. August.

HLA, 1999h. Remedial Investigation Report for Surface and Subsurface Soil at Site 13, Sanitary Landfill; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. July.

HLA, 1999i. Remedial Investigation Report, Site 14, Short-term Sanitary Landfill; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. October.

HLA, 2000a. Remedial Investigation Report, Sites 17 and 18, Crash Crew Training Area, NAS Whiting Field, Milton, Florida; prepared for SOUTHNAVFACENCOM, North Charleston, South Carolina. March.

HLA, 2000b. Remedial Investigation Report, Site 16, Open Disposal and Burning Area; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. January.

HLA, 2000c. Industrial Area Groundwater Investigation Interim Report Addendum, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. February.

HLA, 2000d. Remedial Investigation Report, Site 11, Southeast Open Disposal Area, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. March.

HLA, 2001. Remedial Investigation Report, Site 31, Sludge Beds and Disposal Areas; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. April.

REFERENCES (Continued)

Jordan, E. C., 1990. Phase II Remedial Investigation Feasibility Study, Field Sampling and Analysis Plan. Naval Air Station Whiting Field Work Plan.

Laskowski, D. A., C. A. Goring, P. S. McCall, and R. L. Swann, 1983. Environmental Risk Analysis for Chemicals. Van Nostrand Reinhold Company, New York, NY.

Lyman et al., 1990. Equation 5-3, Handbook of Chemical Property Estimation Methods.

Marsh, O. T., 1966, Geology of Escambia and Santa Rosa Counties, Western Florida Panhandle: Florida Geologic Survey Bulletin No. 46, 140 p.

NCEA (National Center for Environmental Assessment), 2002. E-Mail from Technical Information Staff (regarding Kepone), Office of Research and Development (ORD). June.

NWFWMD, 2004. Availability of Groundwater from the Sand-and-Gravel Aquifer in Coastal Okaloosa County Florida, Water Resources Technical File Report 04-01. August.

Scott, T. M., 1992. A Geologic Overview of Florida: Florida Geologic Survey Open File Report No. 50.

Tetra Tech, 1998. Remedial Investigation Report Site 15; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. June.

Tetra Tech, 1999a. Remedial Investigation Report for Surface and Subsurface Soil, Sites 3, 4, 6, 30, 32, and 33; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. September.

Tetra Tech, 1999b. Remedial Investigation Report for Surface and Subsurface Soil, Site 12, Tetraethyl Lead Disposal Area; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. August.

Tetra Tech, 2000. Work Plan for Remedial Investigation and Feasibility Study for Sites 07, 29, 35, 38, 39, 40, and 1485C; NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. January.

REFERENCES (Continued)

Tetra Tech, 2001. Site Assessment Report and Addendum for Oil/Water Separator and Product Line Investigation, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. August.

Tetra Tech, 2002a. Remedial Action Plan for UST Site 1438 and 1439. NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

Tetra Tech, 2002b. Semiannual Sampling Event July 2002 System Observation Report for Site 2894, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. November.

Tetra Tech, 2002c. Record of Decision, Surface and Subsurface Soil at Site 31, Sludge Drying Beds and Disposal Areas, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2003. Site Assessment Report and Addendum for AV-GAS Pipe Line – Section E Investigation, NAS Whiting Field, Milton, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina. June.

Tetra Tech, 2004a, Record of Decision, Surface and Subsurface Soil at Site 3, Underground Waste Solvent Storage Area, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2004b, Record of Decision for Surface and Subsurface Soils at Site 32, North Field Maintenance Hangar, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2004c, Record of Decision, Surface and Subsurface Soil at Site 6, South Transformer Oil Disposal Area, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2004d, Record of Decision for Surface and Subsurface Soils at Site 33, Midfield Maintenance Hangar, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

REFERENCES (Continued)

Tetra Tech, 2004e, Record of Decision for Surface and Subsurface Soil at Site 30, South Field Maintenance Hangar, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2005a. Record of Decision, Surface and Subsurface Soil at Site 38, Building 2877, Former Golf Course Maintenance Building, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2005b. Remedial Investigation for Site 41, NAS Whiting Field, Milton, Florida: prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. July.

Tetra Tech, 2005c. Remedial Investigation for Sites 5, 7, 29, 35, and 38, NAS Whiting Field, Milton, Florida: prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. July.

Tetra Tech, 2005d. Record of Decision, Surface and Subsurface Soil at OU 5, Site 5A, Battery Acid Seepage Pit, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2005e. Record of Decision, Surface and Subsurface Soil at Site 29, Auto hobby Shop, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2005f. Record of Decision, Surface and Subsurface Soil at Site 9, Waste Fuel Disposal Pit, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2005g. Record of Decision, Surface and Subsurface Soil at Site 12, Tetraethyl Lead Disposal Area, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2006a. Record of Decision for Surface and Subsurface Soil at OU 16 - Site 17, Crash Crew Training Area A, Naval Air Station Whiting Field, Milton, Florida. September.

Tetra Tech, 2006b. Record of Decision for Surface and Subsurface Soil at OU 17 - Site 18, Crash Crew Training Area B, Naval Air Station Whiting Field, Milton, Florida. September.

REFERENCES (Continued)

Tetra Tech, 2006c. Record of Decision, Surface and Subsurface Soil at Site 35, Public Works Maintenance Facility, Naval Air Station Whiting Field, Milton, Florida. Prepared for NAVFAC EFD SOUTH, North Charleston, South Carolina. September.

Tetra Tech, 2006d. Record of Decision for Surface and Subsurface Soil at OU 14 - Site 15, Southwest Landfill, Naval Air Station Whiting Field, Milton, Florida. September.

Tetra Tech, 2006e. Record of Decision for Surface and Subsurface Soil at OU 12 - Site 13, Sanitary Landfill, Naval Air Station Whiting Field, Milton, Florida. September.

Tetra Tech, 2006f. Record of Decision for Surface and Subsurface Soil at OU 13 - Site 14, Short-Term Sanitary Landfill, Naval Air Station Whiting Field, Milton, Florida. September.

Tetra Tech, 2007a. Remedial Investigation Work Plan for Base-Wide Groundwater Assessment Activities at Site 40 and Well Abandonment.

Tetra Tech, 2007b. Record of Decision, Surface and Subsurface Soil at Site 10, Southeast Open Disposal Area A, Naval Air Station Whiting Field, Milton, Florida.

Tetra Tech, 2007c. Record of Decision, Surface and Subsurface Soil at Site 11, Southeast Open Disposal Area B, Naval Air Station Whiting Field, Milton, Florida.

Tetra Tech, 2008a. Work Plan for Base-Wide Groundwater Sampling, Membrane Interface Probe Investigation, and Monitoring Well Installation at Site 40. April.

Tetra Tech, 2008b. Record of Decision Amendment for OU 2 - Site 2, Northwest Open Disposal Area, Naval Air Station Whiting Field, Milton, Florida. September.

Tetra Tech, 2008c. RI for Site 41, Former Pesticide Storage Building 1485, Naval Air Station Whiting Field, Milton, Florida. March.

Tetra Tech, 2008d. Record of Decision, Surface and Subsurface Soil at OU 15 - Site 16, Open Disposal and Burning Area, Naval Air Station Whiting Field, Milton, Florida. September.

REFERENCES (Continued)

Tetra Tech, 2010a. Sampling and Analysis Plan, Remedial Investigation Addendum for Site 40, Base-Wide Groundwater Operable Unit 25.

Tetra Tech, 2010b. Remedial Investigation for Site 39, Clear Creek OU 24. Naval Air Station Whiting Field, Milton, Florida. October.

Tetra Tech, 2011, Record of Decision for Surface and Subsurface Soil at OU 27 - Site 41, Former Pesticide Storage Building 1485C, Naval Air Station Whiting Field, Milton, Florida. November.

USDA (United States department of Agriculture), 1980. Soil Conservation Service, Soil Survey of Santa Rosa County.

USEPA (United States Environmental Protection Agency), 1982. Aquatic Fate Process Data for Organic Priority Pollutants. December.

USEPA, 1986. Guidelines for the Health Risk Assessment of Chemical Mixtures. Federal Register, Vol. 51, No. 185, p. 34014 et seq. September 24.

USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response, Washington, D.C. December.

USEPA, 1991a. Standard Operating Procedures and Quality Assurance Manual, Environmental Compliance Branch, Region 4. February.

USEPA, 1991b. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors. Interim Final. Office of Emergency and Remedial Response. Washington, DC. OSWER 9285.6-03. March.

USEPA, 1992b. Guidance on Risk Characterization for Risk Managers and Risk Assessors. Memorandum from F. Henry Habicht on February 28, 1992. Office of the Administrator. Washington, DC.

REFERENCES (Continued)

USEPA, 1992b. Supplemental Guidance to Risk Assessment Guidance for Superfund: Calculating the Concentration Term. 9285.7-081. Office of Solid Waste and Emergency Response, Washington, D.C. May.

USEPA, 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C. May.

USEPA, 1993b. Superfund's Standard Default Exposure Factors for Central Tendency and Reasonable Maximum Exposure. Draft. May.

USEPA, 1994a. How To Evaluate Alternative Cleanup Technologies For Underground Storage Tank Sites: A Guide For Corrective Action Plan Reviewers (EPA 510-B-94-003; EPA 510-B-95-007; and EPA 510-R-04-002).

USEPA, July 1994b. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. Office of Solid Waste and Emergency Response, Washington, D.C. Directive 9355.4-12.

USEPA, 1997a. Environmental Research Brief. EPA/600/S-97/003. National Risk Management Reseach Laboratory, Ada, OK, August.

USEPA, 1997b. Exposure Factors Handbook. EPA/600/P-95/002Ba. National Center for Environmental Assessment, Washington, D.C. August.

USEPA, 1997c. Health Effects Assessment Summary Table (HEAST). July.

USEPA, 1997d. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Environmental Response Team. June.

USEPA, May 2000. Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment Bulletins. EPA Region 4, originally published November 1995, Website version last updated May 2000 (currently under revision).

USEAP, 2001 through 2007. USEPA Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), which was in effect until February 2007.

REFERENCES (Continued)

USEPA, 2002. USEPA Guidance via the Ecological Assessment Standard Operating Procedures and Quality Assurance Manual (EASOPQAM).

USEPA, 2003a. Integrated Risk Information System – On-Line Database. January.

USEPA, 2003b. Memorandum: Human Health Toxicity Values in Superfund Risk Assessments. OSWER Directive 9285.7-53, December 5. http://www.epa.gov/oswer/riskassessment/pdf/hhmemo.pdf

USEPA, 2004a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. USEPA/540/R/99/005, Office of Emergency and Remedial Response, Washington, D.C., July.

USEPA. 2004b. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. Revised. Office of Emergency and Remedial Response.

USEPA, 2005a. Guidelines for Carcinogen Risk Assessment. Risk Assessment Forum, Washington, D.C. USEPA/630/P-03/001F. March.

USEPA, 2005b. Supplemental guidance for assessing cancer susceptibility from early-life exposure to carcinogens. Risk Assessment Forum, Washington, DC. From website: http://www.USEPA.gov/ncea/raf. March.

USEPA, 2008. Evaluating Groundwater to Surface Water Transition Zones in Ecological Risk Assessments.

USEPA, 2009. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual. (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final. USEPA 540-R-070-002. Office of Emergency and Remedial Response. Washington, DC. January.

USEPA, 2011. Regional Screening Levels for Chemical Contaminants at Superfund Sites, prepared by Oak Ridge National Laboratory. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

USEPA, 2012, Regional Screening Levels for Chemical Contaminants at Superfund Sites, prepared by Oak Ridge National Laboratory, May. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

REFERENCES (Continued)

USGS (United States Geological Survey), 2005. Monitoring the Natural Attenuation of Petroleum in Ground Water at the Former Naval Complex, Operable Unit A, Adak Island, Alaska, May and June 2004. http://pubs.usgs.gov/sir/2005/5002/.

USGS, 2007, Dichloroethene and Vinyl Chloride Degradation Potential in Wetland Sediments at Twin Lakes and Pen Branch, Savannah River Laboratory, South Carolina

USGS, 2012, Ground Water Atlas of the United States, Alabama, Florida, Georgia, South Carolina HA 730-G http://pubs.usgs.gov/ha/ha730/ch_g/G-text3.html.

Wiedemeier, Todd H., John T. Wilson, Donald H. Kampbell, Ross N. Miller, and Jerry E. Hansen, 1995. Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater, U.S. Air Force Center for Environmental Excellence, San Antonio, TX.

Weidemeier, T. H. and F. H. Chapelle, 1998. Technical Guidelines for Evaluating Monitored Natural Attenuation of Petroleum Hydrocarbons and Chlorinated Solvents in Ground Water and Naval and Marine Corps Facilities, prepared for Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), North Charleston, South Carolina. September.

TABLES

SECTION 1 TABLE

TABLE 1-1
CHARACTERISTICS OF PUBLIC WATER SUPPLY WELLS
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD
MILTON, FL

Well Designation	Owner	Date Installed	Casing Diameter (inches)	Surface Elevation (ft mls)	Total Depth (ft msl)	Total Depth[1] (ft bsl)	Screened Interval (ft mls)	Top of Screend Interval[1] (ft bls)	Bottom of Screend Interval[1] (ft bls)	Gravel Pack Interval (ft mls)	Status
W-N1[2]	Navy	1943	NA	NA	NA	NA	NA	NA	NA	NA	1943 - Abandoned 1951[3]
W-N2	Navy	1951	16	168.1	(-256.4)	365	(-1.4)-(-31.4)	170	200.4	60-(-31)	1951 - Abandoned 1965[4]
W-N3	Navy	1975	NA	171.5	(-58.5)	222	36.5-(-23.5)	135	158.5	NA	1965 - Abandoned 1975[4]
W-N4	Navy	1975	16/12	180	(-38)	210	NA	NA	NA	NA	1975 to current - In use
W-W1[2]	Navy	1943	NA	NA	NA	NA	NA	NA	NA	NA	1943 - Abandoned 1951[3]
W-W2	Navy	1951	NA	197.6	(-157.4)	294	14.1-(-47.0)	183	230	NA	1951 - Abandoned 1965[4]
W-W3	Navy	1965	NA	180	(-35.0)	215	10.0-(-30.0)	170	200	80-(-30)	1975 to current - In use
W-S1[2]	Navy	1943	NA	NA	NA	NA	NA	NA	NA	NA	1943 - Abandoned 1951[3]
W-S2	Navy	1951	NA	181.5	(-159.5)	273	12.0-(-33.0)	169	202	17-(-33)	1951 to current - In use
P-3[5]	Point Baker Water System	1978	NA	200**	(-20)**	220	NA	NA	NA	NA	In use
P04[5]	Point Baker Water System	1983	NA	NA	NA	NA	NA	NA	NA	NA	In use
USGS	U.S. Geological Survey	1974	6	125	(-1165)	1290	Cased to (-860)	NA	NA	NA	Monitor Well

Source: Primarily the Hydrogeologic Assessment and Groundwater Monitoring Plan - Geraghty & Miller, Inc.

Notes: (1) modification based on data presented in the table (Modified by Tetra Tech)
(2) No available information on well location therefore not shown on Figure 1-2
(3) Abandonded likely for newer wells with increased capacity.
(4) Removed from service due to objectionable levels of iron.
(5) P-3 is located beyond facility boundary to the northeast. P04 is located to the west.

NA = = No Data Available

**Estimated

TABLE 1-2
SITE IDENTIFICATION, REGULATORY PROGRAM, MATERIAL RELEASED, AND STATUS
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD
MILTON FLORIDA

Site Number	OU	Site Name	Material Disposed of or Released	Regulatory Program	Status
1	01	Northwest Disposal Area	Refuse, waste paints, thinners, solvents, waste oils, and hydraulic fluids	CERCLA	Decision Made, LUCs, ROD 1999
2	02	Northwest Open Disposal Area	Construction/demolition debris, tires, furniture	CERCLA	Decision Made, NFA, 1999, ROD Amendment 2008
3	03	Underground Waste Solvent Storage Area	Waste solvents and paint stripping residue	CERCLA	Decision Made, NA, ROD 2004
4	04	North AVGAS Tank Sludge Disposal Area, UST Site 1467	Tank bottom sludge containing tetra ethyl lead and likely TCE	Florida UST	Under Investigation
5	05	Battery Acid Seepage Pit	Waste electrolyte solution containing heavy metals and waste battery acid	CERCLA	Site Closed, NA
5A	05	Battery Acid Seepage Pit	Pesticides, PCBs	CERCLA	Decision Made, NA, 2005
6	06	South Transformer Oil Disposal Area	PCB-contaminated dielectric fluid	CERCLA	Decision Made, NFA, ROD 2004
7	07	South AVGAS Tank Sludge Disposal Area, UST Site 1466	Tank bottom sludge containing tetra ethyl lead and likely TCE	Florida UST	Under investigation
8	NA	AVGAS Fuel Spill Area, UST Site 3054	AVGAS containing tetra ethyl lead	Florida UST	Site Closed, NA, 1996
9	08	Waste Fuel Disposal Area	Waste AVGAS containing tetra ethyl lead	CERCLA	Decision Made, NFA, ROD 2005
10	09	Southeast Open Disposal Area A	Construction/demolition debris, waste solvents, paints, oils, hydraulic fluid, PCBs, pesticides, and herbicides	CERCLA	Decision Made, LUCs, ROD 2007
11	10	Southeast Open Disposal Area B	Construction/demolition debris, waste solvents, paints, oils, hydraulic fluid, and PCBs	CERCLA	Decision Made, LUCs, ROD 2007
12	11	Tetra ethyl Lead Disposal Area	Tank bottom sludge and fuel filters contaminated with tetra ethyl lead	CERCLA	Decision Made, NA, ROD 2005
13	12	Sanitary Landfill	Refuse, waste solvents, paints, hydraulic fluid, and asbestos	CERCLA	Decision Made, LUCs, ROD 2006
14	13	Short-Term Sanitary Landfill	Refuse, waste solvents, oils, paint, and hydraulic fluids	CERCLA	Decision Made, NA, ROD 2006
15	14	Southwest Landfill	Refuse, waste paints, oils, solvents, thinners, asbestos, and hydraulic fluids	CERCLA	Decision Made, LUCs, ROD 2006
16	15	Open Disposal and Burning Area	Refuse, waste paints, oils, solvents, thinners, PCBs, and hydraulic fluids	CERCLA	Decision Made, LUCs, ROD 2008

TABLE 1-2
SITE IDENTIFICATION, REGULATORY PROGRAM, AND STATUS
SITE 40 REMEDIAL INVESTIGATION
NAVAL AIR STATION WHITING FIELD
MILTON FLORIDA
PAGE 2 OF 2

Site Number	OU	Site Name	Material Disposed of or Released	Regulatory Program	Status
17	16	Crash Crew Training Area A	JP-5 fuel	CERCLA	Decision Made, LUCs and ECs, ROD 2006
18	17	Crash Crew Training Area B	JP-5 fuel	CERCLA	Decision Made, LUCs and ECs, ROD 2006
29	26	Auto Hobby Shop	Auto repair, maintenance, and painting materials	CERCLA	Decision Made, NFA, ROD 2005
30	18	South Field Maintenance Hangar	Aircraft maintenance materials	CERCLA	Decision Made, LUCs and ECs, ROD 2004
31	19	Sludge Drying Beds and Disposal Areas	Wastewater treatment sludge	CERCLA	Site Closed, NFA, ROD 2002
32	20	North Field Maintenance Hangar	Aircraft maintenance materials	CERCLA	Decision Made, LUCs and ECs, ROD 2004
33	21	Midfield Maintenance Hangar	Aircraft maintenance materials	CERCLA	Decision Made, LUCs and ECs, ROD 2004
35	22	Public Works Maintenance Facility	Fuel, oil, and solvents	CERCLA	Decision Made, LUCs and ECs, ROD 2006
36	NA	Auto Repair Booth	Oil, grease, fuel, and solvents	CERCLA	Site Closed – NA
37	NA	Paint Spray Booth	Paint and solvents	CERCLA	Site Closed – NA
38	23	Former Golf Course Maintenance Building	Solvents, oil, pesticides, and metals	CERCLA	Decision Made, NFA, ROD 2005
39	24	Clear Creek Floodplain	Suspected solvents, oil, and fuel	CERCLA	Under Investigation
40	25	Basewide Groundwater	Solvents and fuel	CERCLA	Under Investigation
41	27	Former Pesticide Storage Building 1485C	cPAHs, pesticides	CERCLA	Decision made, soil excavation, ROD 2012
UXO 001	NA	Former Gunnery Area and Skeet Range	PAHs, lead	NAVY MMRP Program	Under Investigation
2894	NA	Site 2894, AVGAS E	AVGAS	Florida UST	Under Investigation
2832	NA	Site 2832,	AVGAS	Florida UST	Under Investigation
1438/39	NA	Site 1438 -1439	AVGAS	Florida UST	Under Investigation
OWS	NA	Oil/water Separator Site	Used Oil	Florida UST	Recommended NFA
PLF	NA	Product Line Dispensing Facility	Gasoline	Florida UST	Recommended NFA
PLP	NA	Product Line Pump Station	AVGAS	Florida UST	Recommended NFA
PLJ	NA	Product Line Junction	AVGAS	Florida UST	Additional Investigation Recommended

Notes:
Sites 19 through 28 are located at Outlying Field (OLF) Barin.
There is no Site 34.
AVGAS is a common aviation fuel.
OU = Operable Unit
cPAH = carcinogenic polynuclear aromatic hydrocarbon
UXO = Unexploded Ordnance
MMRP = Military Munitions Response Program
PLF = Product Line Dispensing Facility
PLP = Product Line Pump Station
PLJ = Product Line Junction
NA = Not applicable

SECTION 3 TABLES

TABLE 3-1
SITE-SPECIFIC SPLP SAMPLING SUMMARY
SITE 40 RI REPORT
NAS WHITING FIELD, MILTON, FLORIDA

Parameter	Sites Where SPLP Samples Were Collected
1-Methylnaphthalene	30, 32
1,1-DCA	32
1,1,1-TCA	32
cis-1,2-DCE	32
1,2-DCE (Total)	32
1,2,4-Trimethylbenzene	30, 32
1,3,5-Trimethylbenzene	30, 32
2-Methylnaphthalene	18, 30
2-Methylphenol	4
4-Methylphenol	4, 13, 15, 18
Benzene	4, 32, 35
Benzo(a)anthracene	30
Chloromethane	4, 32
Dieldrin	3, 5, 6, 10, 11, 33, 41
Ethylbenzene	4, 32, 33, 35
Isopropylbenzene	30, 32
Methylene Chloride	4, 16, 32
MTBE	35
n-Nitroso-di-n-propylamine	4
n-Nitroso-diphenylamine	30
Naphthalene	18, 30, 32
Phenol	13, 15, 18
PCE	32
Toluene	4, 32, 35
TCE	6, 30, 32
Xylenes (Total)	4, 14, 18, 30, 32, 33, 35
Aluminum	1, 2, 3, 4, 5, 6, 10, 11, 13, 14, 15, 16, 18, 30, 32, 33, 35, 1438, 41
Antimony	10, 16
Beryllium	10
Cadmium	14, 16
Chromium	3, 6, 30, 33
Chromium VI	10
Cobalt	3, 5, 10, 11, 13, 14, 15, 16, 18, 30, 32, 33, 35, 1438, 41
Copper	3, 4, 5, 6, 10, 11, 13, 14, 15, 16, 18, 30, 32, 33, 35, 1438, 41
Iron	1, 2, 3, 4, 5, 6, 10, 11, 13, 14, 15, 16, 30, 32, 33, 35, 1438, 41
Lead	1, 3, 4, 5, 6, 10, 11, 13, 14, 15, 16, 18, 30, 32, 33, 35, 1438, 41
Manganese	2, 3, 4, 5, 6, 10, 11, 13, 14, 15, 16, 18, 30, 32, 33, 35, 1438, 41
Mercury	13
Selenium	10
Zinc	5, 10, 41
TPH	7, 18, 29, 30, 32, 33, 35
PAHs (18 compounds)	35
TCL SVOCs	7, 29
TCL VOCs	7, 29
TAL Metals	7, 29

SECTION 4 TABLES

TABLE 4-1
GROUNDWATER BACKGROUND ANALYTICAL DETECTION SUMMARY
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD
MILTON, FLORIDA
Page 1 of 1

Sample Location			**WHF-BKG-MW-1S**	**WHF-BKG-MW-1S**	**WHF-BKG-MW-1S**	**WHF-BKG-MW-1I**	**WHF-BKG-MW-1D**	**WHF-BKG-MW-2S**	**WHF-BKG-MW-2S**	**WHF-BKG-MW-2I**	**WHF-BKG-MW-2D**
Sample No.			**WHFBKG1**	**BKG00101**	**BKG00101-DUP**	**BKG00102**	**BKG00103**	**WHFBKG2**	**BKG00201**	**BKG00202**	**BKG00203**
Collect Date			**10/11/1993**	**7/16/1996**	**7/16/1996**	**7/16/1996**	**7/16/1996**	**10/14/1993**	**7/17/1996**	**7/17/1996**	**7/30/1996**
	Groundwater Criteria[1]	**Primary[2]**									
Semivolatiles[3] (µg/L)											
BIS(2-ETHYLHEXYL)PHTHALATE	6	6	10 U	10 U	10 U	12 U	10 U	10 U	10 U	10 U	4 J
Pesticides/PCBS[4] (µg/L)											
BETA-BHC	0.02	NA	10 U	0.05 UJ	0.05 U	0.05 UJ	0.05 UJ	0.02 J	0.05 UJ	0.05 UJ	0.05 UJ
Metals[5] (µg/L)											
Aluminum	**200**	NA	**47100**	43.4 U	54.4 U	**420**	53.2 U	**27400**	202 U	48.8 U	**431**
Barium	2000	2000	94.2 J	15.6 J	15.6 J	23.5 J	31.3 J	60.4 J	139 J	8.9 J	12.5 J
Beryllium	4	4	2.5 J	0.30 U	0.30 U	0.30 U	0.40 J	2.1 J	0.53 J	0.30 U	0.30 U
Cadmium	5	5	3.2 U	1.2 U	1.2 U	2.2 J	1.2 U	3.2 U	1.2 U	1.2 U	1.2 U
Calcium	NA	NA	3440 J	536 J	558 J	2650 J	2170 J	2470 J	2840 J	721 J	2210 J
Chromium	100	100	148	2 U	2 U	4.7 J	2 U	110	2 U	2 U	3.8 J
Cobalt	140	NA	6.7 J	2.3 U	2.3 U	2.3 U	2.3 U	9.4 J	2.3 U	2.3 U	2.3 U
Copper	1000	1300	51.9	1.1 U	1.1 U	14.1 J	2.2 J	28.8	1.1 U	1.1 U	3.5 J
Iron	**300**	NA	**64,800**	54 U	57.9 U	**484**	157	**42200**	42.7 U	90.5 U	**972**
Lead	15	15	19.7	0.50 U	0.80 U	1.5 U	0.50 U	7.9	0.50 U	0.50 U	1.1 U
Magnesium	NA	NA	1070 J	499 J	521 J	667 J	1230 J	2520 J	3680 J	143 U	499 J
Manganese	**50**	NA	**141**	1.7 J	1.9 J	**57.2**	34.1	**65.4**	7.6 J	3.4 J	37.9
Nickel	100	NA	20 J	7.3 U	7.3 U	7.3 U	7.3 U	9 UJ	7.3 U	7.3 U	11.5 J
Potassium	NA	NA	1830 J	316 U	316 U	418 J	562 J	23100	594 J	1560 J	418 J
Selenium	50	50	2 U	0.67 J	0.60 U	0.60 U	0.60 U	2 J	0.60 U	0.60 U	0.60 UJ
Sodium	160000	NA	1240 J	1080 J	1080 J	2060 J	2720 J	5260	2400 J	2160 J	3700 J
Vanadium	**49**	NA	**227**	1.2 U	1.2 U	1.3 J	1.2 U	**176**	1.2 U	1.2 U	2.2 J
Zinc	5000	NA	148	2.4 U	1.1 U	268	25.1	40.8	2 U	2.4 U	7.7 J
Miscellaneous Parameters (µg/L)											
Cyanide	200	200	--	3.8 J	6.5 J	1.5 U	1.5 U	1.7 U	1.5 U	1.9 J	2.6 U
Hardness	NA	NA	--	10000 U	10000 U	10000 U	12000	--	10000 U	24000	10000 U
Nitrite/Nitrate	10000	10000	--	100 U	100 U	530	1930	--	150	4480	1180
Sulfate	NA	250000	--	200	210	140	190	--	170	100 U	250
Total Dissolved Solids	NA	500000	--	19000	10000 U	19000	19000	--	10000 U	38000	52000
Total Organic Carbon	NA	NA	--	1000 U	1000 U	1000 U	1000 U	--	8700	1000 U	1000 U

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] SW-846 8270C

[4] SW-846 8081A/8082

[5] SW-846 6010B

Notes:

Bold indicates the sample exceeds regulatory criteria, however the samples represent the background concentrations at the facility and are therefore not contaminants of concern
Bold indicates which regulatory criteria was exceeded
Sample number nomenclature ending with "DUP" indicates a duplicate sample.

CFR = Code of Federal Regulations
F.A.C. = Florida Administative Code
J = analyte concentration is an estimate
NA = Not applicable
PCBs = Polychlorinated
U = analyte was detected below laboratory method detection limit
µg/L = micrograms per liter
US = United States
USEPA = United States Environmental Protection Agency
-- = Not analyzed for

TABLE 4-2
WATER QUALITY AND NATURAL ATTENUATION PARAMETERS DETECTED IN NORTH AREA AND BACKGROUND GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Page 1 of 1

	Date	pH	Conductivity (uS/cm)	Temperature (ºC)	Turbidity NTU	DO-Horiba (mg/L)	DO-Colorimeter (mg/L)	Fe2+ (mg/L)	Alkalinity-phenolphthalein (mg/L)	Alkalinity-total (mg/L)	ORP (mV)	Cyanide (mg/L)
SDWS		**6.5-8.5**										
Monitoring Well												
WHF-BKG-MW-1S	10/15/1993	**4.86**	17	22.7	304							
WHF-BKG-MW-1I												
WHF-BKG-MW-1D												
WHF-BKG-MW-2S	10/14/1993	**5.78**	73	21.4	3,208							
WHF-BKG-MW-2I												
WHF-BKG-MW-2D												
WHF-01-MW-2S	8/20/2000	**4.21**	33	21.4	9	7.89	NM	NM	NM	NM	NM	NM
WHF-01-MW-3S	6/6/2000	**4.78**	26	20.6	8	7.00	NM	NM	NM	NM	NM	NM
WHF-01-MW-5S	6/3/2000	**4.62**	32	20.9	45	7.02	8.6	0.15	5	NM	286.1	0.005 UJ
WHF-02-MW-1S	6/7/2000	**4.39**	30	20.5	9	6.28	NM	NM	NM	NM	NM	NM
WHF-02-MW-4S	6/3/2000	**5.11**	26	21.2	18	6.99	7.1	ND	5	NM	-20.5	0.005 UJ
WHF-38-MW-1S	6/6/2000	**5.30**	71	21.4	17	6.93	7.20	0.00	10	NM	179.4	0.015
WHF-38-MW-2S	6/2/2000	**5.38**	105	23.3	15	12.35	9.10	0.52	10	NM	-11.8	0.006
WHF-38-MW-3S	6/2/2000	**5.43**	51	22.0	116	12.44	7.60	0.18	10	NM	-98.2	0.015
WHF-38-MW-4S	6/6/2000	**5.09**	38	21.8	31	6.28	7.70	0.04	0	5	193.1	0.005 U

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicated which regulatory limit was exceeded.

DO = Dissolved Oxygen
J = Estimated value
mg/L = milligrams per liter
mV = millivolts
NM = Not measured
NTU = Nephelometric Turbidity Unit
ORP = Oxygen Reduction Potential
pH = -log[H+]
SDWS = USEPA Secondary Drinking Water Standard
U = Compound not detected above instrument detection limit
uS/cm = microSiemen per centimeter
ºC = Degrees Celsius

TABLE 4-3
2011 WATER QUALITY AND NATURAL ATTENUATION PARAMETERS DETECTED IN GROUNDWATER IN THE NORTH CENTRAL AREA
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 1 OF 3

	FIELD							LABORATORY												
	pH	Conductivity (mS/cm)	Temperature (ºC)	Turbidity (NTU)	ORP (mV)	Hydrogen Sulfide (mg/L)	DO-CHEMets (mg/L)	DO (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	Carbon Dioxide (mg/L)	Chloride (mg/L)	DOC (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Total Kjeldahl Nitrogen (mg/L)	TOC (mg/L)	Total Phosphorus-P (mg/L)
SDWS	**6.5-8.5**																			
Monitoring Well																				
WHF-03-MW-1S	**6.39**	17.0	22.49	6.04	26.7	0.0	1.00	1.00	74.80	0.11 U	110.0	7.21	0.25 U	0.033 U	0.033 U	0.33 U	0.741 U	0.50 U	4.81	0.02 U
WHF-03-MW-1I	**6.49**	50.0	24.18	3.00	83.5	0.0	3.50	3.50	55.10	0.11 U	59.8	3.97	2.22	0.891	0.033 U	0.35 U	0.741 U	0.50 U	0.464 J	0.02 U
WHF-03-MW-1D	**5.18**	38.0	22.80	6.98	131.40	0.00	3.50	3.50	5.31	0.11 U	19.70	3.34	0.521 J	1.2	0.033 U	0.33 U	0.741 U	0.50 U	0.25 U	0.117
WHF-03-MW-2S	**5.95**	161.0	23.81	6.54	10.7	0.0	3.50	3.50	48.20	0.11 U	82.6	5.13	0.979 J	0.033 U	0.033 U	0.339 J	0.741 U	0.506 J	2.36	0.02 U
WHF-03-MW-2I	**5.46**	65.0	22.45	2.95	76.3	0.0	0.60	0.60	2.04	0.11 U	25.8	4.16	1.06	0.194 J	0.033 U	0.33 U	0.741 U	0.50 U	1.01	0.02 U
WHF-03-MW-3I	6.51	123.0	21.64	1.95	105.7	0.0	5.50	5.50	28.20	0.11 U	34.1	3.28	0.325 J	1.32 J	0.033 UJ	1.54 J	0.741 U	0.50 U	0.25 U	0.02 U
WHF-03-MW-4S	**6.02**	188.0	22.54	2.37	-42.0	0.0	0.00	0.10	62.90	0.11 U	97.0	3.8	3.73	0.033 U	0.033 U	0.33 U	0.678 U	0.50 U	3.52	0.02 U
WHF-03-MW-7S	**6.30**	234.0	22.14	1.95	-115.2	0.0	1.00	1.00	47.00	0.11 U	75.4	4.76	1.65	0.033 U	0.033 U	0.33 U	0.80 U	0.50 UJ	1.55	0.02 U
WHF-03-MW-7I	**5.33**	49.0	21.99	1.44	14.1	0.0	0.60	0.60	19.20	0.11 U	69.9	3.2	0.527 J	0.03 U	0.033 U	0.33 U	0.741 U	0.50 UJ	0.482 J	0.02 U
WHF-32-MW-1S	**6.19**	255.0	32.08	3.18	15.2	0.0	0.00	0.00	61.70	0.6	155.0	7.73	4.12	0.033 U	0.033 U	0.33 U	0.741 U	0.98 J	4.67	0.972
WHF-32-MW-2S	**5.52**	79.0	22.38	8.02	101.9	0.0	1.00	1.00	1 U	0.11 U	1 U	6.78	4.42	0.416 J	0.033 UJ	1.15 J	0.714 U	0.50 U	3.67	0.02 U
WHF-32-MW-3S	**5.23**	66.0	22.22	10.17	94.2	0.0	4.50	4.50	1.63	0.11 U	6.7	5.32	3.82	0.033 U	0.033 U	1.44 J	0.69 U	0.50 U	3.99	0.02 U
WHF-32-MW-3I	**4.53**	66.0	22.14	0.00	242.0	0.0	5.00	5.00	1 U	0.11 U	1 U	4.18	0.25 U	1.82 J	0.033 UJ	0.769 J	0.741 U	0.50 U	0.25 U	0.02 U
WHF-32-MW-5S	**11.29**	224.0	21.17	2.00	68.5	0.0	4.50	4.50	54.70	0.11 U	22.2	2.86	0.994 J	1.18 J	0.033 UJ	1.16 J	0.678 U	0.50 U	0.906 J	0.02 U
WHF-32-MW-8I	**4.39**	22.0	21.81	1.15	162.0	0.0	5.00	5.00	1.63	0.11 U	16.7	3.1	0.293 J	0.457 J	0.033 UJ	1.11 J	0.80 U	0.57 J	0.25 U	0.02 UJ

Notes: **Bold** indicates the parameter is outside the standard. **Bold** indicates which regulatory standard is outside the limits.

DO = Dissolved Oxygen
DOC = Dissolved Organic Carbon
J = Estimated value
mg/L = milligrams per liter
mS/cm = millisiemen per centimeter
mV = millivolts
ND = Not detected
NM = Not measured
NTU = Nephelometric Turbidity Unit
ORP = Oxygen Reduction Potential
pH = -log[H+]
SDWS = USEPA Secondary Drinking Water Standard
TOC = Total Organic Carbon
U = Compound not detected above instrument detection limit
USEPA = United States Environmental Protection Agency
ºC = Degrees Celsius

TABLE 4-3
2011 WATER QUALITY AND NATURAL ATTENUATION PARAMETERS DETECTED IN GROUNDWATER IN THE NORTH CENTRAL AREA
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 2 OF 3

	FIELD							LABORATORY												
	pH	Conductivity (mS/cm)	Temperature (ºC)	Turbidity (NTU)	ORP (mV)	Hydrogen Sulfide (mg/L)	DO-CHEMets (mg/L)	DO (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	Carbon Dioxide (mg/L)	Chloride (mg/L)	DOC (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Total Kjeldahl Nitrogen (mg/L)	TOC (mg/L)	Total Phosphorus-P (mg/L)
SDWS	**6.5-8.5**																			
Monitoring Well																				
WHF-32-MW-9I	**5.54**	57.0	21.92	0.10	88.5	0.0	4.00	4.00	14.70	0.11 U	19.2	3.41	0.474 J	1.11 J	0.033 UJ	0.927 J	0.741 U	0.558 J	0.421 J	0.02 UJ
WHF-32-MW-10I	**4.44**	25.0	21.85	1.44	196.6	0.0	5.00	5.00	1 U	0.11 U	1 U	2.92	0.25 U	0.787	0.033 U	0.835 J	0.741 U	0.50 U	0.25 U	0.02 U
WHF-1467-MW-14S	**4.50**	56.0	21.68	2.18	211.8	0.0	5.00	5.00	1.63	0.11 U	9.8	5.53	0.332 J	3.56	0.033 U	0.764 J	0.69 U	0.50 U	0.338 J	0.02 U
WHF-1467-MW-20S	**5.89**	195.0	20.07	4.45	0.3	0.0	0.00	0.00	58.00	0.142 J	123.0	4.4	5.65	0.033 UJ	0.033 UJ	0.33 U	0.69 U	0.864 J	6.9	0.071 J
WHF-1467-MW-21S	**4.70**	48.0	21.71	8.68	230.8	NM	NM	NM	1.63	0.11 U	27.8	3.23	0.366 J	2.77	0.033 U	2.23	0.741 U	0.50 U	0.321 J	0.052 J
WHF-1467-MW-27S	**5.63**	140.0	23.15	2.36	-67.0	1.5	0.00	0.00	69.80	0.163 J	111.0	3.14	6.45	0.033 UJ	0.033 UJ	0.33 U	0.741 U	0.50 U	6.73	0.02 U
WHF-1467-MW-2I	**6.15**	196.0	23.24	9.30	-63.0	0.0	0.00	0.00	55.20	0.11 U	86.8	3.3	2.35	0.033 U	0.033 U	0.383	0.741 U	0.50 U	2.22	0.218
WHF-1467-MW-31S	**4.62**	22.0	23.18	9.98	199.1	NM	NM	NM	1 U	0.11 U	1 U	2.46	0.355 J	0.356	0.033 U	1.36 J	0.741 U	0.50 U	0.25 U	0.028 J
WHF-1467-MW-31I	**4.61**	27.0	22.69	4.89	221.1	NM	NM	NM	1 U	0.11 U	1 U	2.74	0.26 J	1.06	0.033 U	0.592 J	0.741 U	0.50 U	0.25 U	0.02 U
WHF-1467-MW-34S	**4.37**	24.0	22.7	0.60	97.8	0.0	6.00	6.00	2.04	0.11 U	8.6	2.42	0.329 J	0.853 J	0.033 UJ	0.33 U	0.741 U	0.50 U	0.337 J	0.02 U
WHF-1467-MW-35I	**4.27**	46.0	22.41	2.20	247.0	0.1	5.00	5.00	1 U	0.11 U	1 U	2.47	0.25 U	0.955 J	0.033 UJ	0.781 J	0.69 U	0.50 U	0.25 U	0.02 U
WHF-1467-MW-36S	**6.03**	143.0	21.87	3.60	-36.5	0.0	0.05	0.05	38.80	0.11 U	61.7	2.33	2.31	0.033 UJ	0.033 UJ	0.33 U	0.741 U	0.50 U	2.14	0.02 U
WHF-1467-MW-37S	**5.54**	285.0	23.41	6.41	-34.0	NM	4.00	NM	58.00	0.11 U	92.2	4.76	2.65	0.033 U	0.033 U	0.33 U	0.727 U	0.50 U	2.43	0.02 U
WHF-1467-MW-39S	**4.81**	28.0	21.01	1.09	204.1	NM	3.00	NM	1 U	0.11 U	1 U	2.99	0.253 J	0.589	0.033 U	0.633	0.741 U	0.50 UJ	0.25	0.02 U
WHF-1467-MW-44S	**6.00**	209.0	22.62	1.15	-7.6	0.0	3.00	3.00	38.00	0.11 U	81.4	2.37	3.19	0.033 UJ	0.03 UJ	0.784 J	0.741 U	0.50 U	3.34	0.071 J
WHF-1467-MW-5D	**6.20**	86.0	21.82	4.52	103.8	0.0	6.00	6.00	24.50	0.110 U	23.7	2.79	0.314 J	0.771	0.033 U	0.330 U	0.741 U	0.500 U	0.255 J	0.020 U

Notes: **Bold** indicates the parameter is outside the standard. **Bold** indicates which regulatory standard is outside the limits.

CTL = Cleanup Target Levels
DO = Dissolved Oxygen
DOC = Dissolved Organic Carbon
J = Estimated value
mg/L = milligrams per liter
mS/cm = millisiemen per centimeter
mV = millivolts
ND = Not detected
NM = Not measured
NTU = Nephelometric Turbidity Unit
ORP = Oxygen Reduction Potential
pH = -log[H+]
SDWS = USEPA Secondary Drinking Water Standard
TOC = Total Organic Carbon
U = Compound not detected above instrument detection limit
ºC = Degrees Celsius

TABLE 4-3
2011 WATER QUALITY AND NATURAL ATTENUATION PARAMETERS DETECTED IN GROUNDWATER IN THE NORTH CENTRAL AREA
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 3 OF 3

	FIELD							LABORATORY													
	pH	Conductivity (mS/cm)	Temperature (ºC)	Turbidity (NTU)	ORP (mV)	Hydrogen Sulfide (mg/L)	DO-CHEMets (mg/L)	DO (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	Carbon Dioxide (mg/L)	Chloride (mg/L)	DOC (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Total Kjeldahl Nitrogen (mg/L)	TOC (mg/L)	Total Phosphorus-P (mg/L)
SDWS	**6.5-8.5**																			
Monitoring Well																				
WHF-2894-MW-3I	**5.61**	65.0	20.90	7.11	92.5	0.0	4.50	4.50	14.30	0.11 U	38.1	4.67	0.432 J	1.23	0.033 U	1.32 J	0.741 U	0.50 U	0.582 J	0.10 U
WHF-2894-MW-4I	**4.60**	27.0	20.64	2.90	210.1	0.0	4.00	4.00	4.90	0.11 U	15.8	3.14	0.274 J	0.382 J	0.033 UJ	1.65 J	0.741 U	0.50 U	0.25 U	0.02 U
WHF-PDF-1S	**6.35**	199.0	21.10	4.99	-38.5	0	0.02	0.02	16.30	0.253 J	20	5.77	1.35	0.033 UJ	0.033 UJ	0.33 U	0.80 U	0.639 J	1.26	0.02 U

Notes: **Bold** indicates the parameter is outside the standard. **Bold** indicates which regulatory standard is outside the limits.

CTL = Cleanup Target Levels
DO = Dissolved Oxygen
DOC = Dissolved Organic Carbon
J = Estimated value
mg/L = milligrams per liter
mS/cm = millisiemen per centimeter
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ND = Not detected
NM = Not measured
NTU = Nephelometric Turbidity Unit
ORP = Oxygen Reduction Potential
pH = -log[H+]
SDWS = USEPA Secondary Drinking Water Standard
TOC = Total Organic Carbon
U = Compound not detected above instrument detection limit
ºC = Degrees Celsius

TABLE 4-4
2011 WATER QUALITY AND NATURAL ATTENUATION PARAMETERS DETECTED IN GROUNDWATER IN THE SOUTH CENTRAL AREA
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 1 OF 3

	FIELD								LABORATORY													
	pH	Conductivity (mS/cm)	Temperature (ºC)	Turbidity NTU	DO-Horiba (mg/L)	ORP (mV)	Hydrogen Sulfide (mg/L)	DO-CHEMets (mg/L)	DO (mg/L)	Alkalinity (mg/L)	Ammonia-N (mg/L)	Carbon Dioxide (mg/L)	Chloride (mg/L)	DOC (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Orthophosphate	Sulfate (mg/L)	Sulfide (mg/L)	Total Kjeldahl Nitrogen (mg/L)	TOC (mg/L)	Total Phosphorus-P (mg/L)
SDWS	**6.5-8.5**																					
Monitoring Well																						
WHF-06-MW-1S	**6.01**	75.0	21.30	2.22	3.50	191.5	NM	NM	NM	12.3	0.11 U	35.6	4.45	0.306 J	0.249	0.033 U	0.02 U	2.92	0.741 U	0.50 U	0.25 U	NM
WHF-06-MW-3D	**4.97**	39.0	20.71	9.49	3.15	170.4	NM	NM	NM	4.08	0.11 U	12.9	3.34	0.334 J	0.365	0.033 U	0.02 U	5.74	0.741 U	0.50 U	0.25 U	NM
WHF-07-MW-1I	**6.10**	311.0	22.62	7.62	1.19	-46.0	0.05	NM	1.00	87.8	0.233	129	4.24	5.55	0.033 UJ	0.033 UJ	NM	0.33 U	0.69 U	0.50 U	5.47	0.02 U
WHF-1466-MW-1S	**4.13**	35.0	21.92	0.14	7.97	NM	0	4.00	4.00	2.45	0.11 U	17.3	4.27	0.762 J	0.781	0.033 U	NM	2.45 J	0.741 U	0.50 U	0.676 J	0.02 UJ
WHF-1466-MW-2I	**4.52**	34.0	21.13	4.46	3.62	254.7	0	3.50	3.50	2.86	0.11 U	35.4	5.16	1.41	1.34	0.33 U	NM	3.94 U	0.741 U	0.50 U	1.26	0.02 UJ
WHF-1466-MW-6I	**4.5**	53.0	21.93	NM	6.450	NM	0	3.0	3.0	2.04	0.11 U	27.6	7.36	0.487 J	1.88	0.033 U	NM	2.7 J	0.741 U	0.924 J	0.25 U	0.027 J
WHF-1466-MW-12S	**4.53**	40.0	21.49	9.01	3.06	272.7	0	NM	3.00	4.08	0.11 U	76.4	3.36	0.72 J	2.11 J	0.033 UJ	NM	0.911 J	0.69 U	0.50 U	0.663 J	0.027 J
WHF-1466-MW-13S	**4.43**	47.0	21.77	3.53	3.33	259.7	NM	NM	NM	1 U	0.11 U	1 U	4.36	0.515 J	1.8	0.033 U	NM	6.06 J	0.69 U	1.69	0.359 J	0.02 UJ
WHF-1466-MW-15S	**4.25**	45.0	23.01	2.28	8.20	120.4	0	5.00	5.00	1 U	0.11 U	1 U	3.35	0.322 J	2.58 J	0.033 UJ	NM	0.395 J	0.741 U	0.50 U	0.27 J	0.02 U
WHF-1466-MW-16S	**5.73**	57.0	22.20	3.67	2.80	154.0	0	4.00	4.00	26.6	0.11 U	25.6	2.07	0.377 J	1.78	0.033 U	NM	0.645 J	0.678 U	0.5 U	0.399 J	0.029 J
WHF-1466-MW-18S	**6.02**	282.0	19.38	3.15	5.76	-10.3	0	6.50	0.50	3.27	0.369	6.15	2.92	45.2	0.033 UJ	0.033 UJ	NM	0.33 U	0.69 U	0.846 J	42.1	0.067 J
WHF-1466-MW-19S	**4.82**	54.0	21.59	4.73	0.58	209.3	0	0.25	0.25	5.72	0.11 U	26.8	6.56	0.773 J	1.52	0.033 U	NM	3.18 J	0.714 U	0.50 U	0.837 J	0.027 J
WHF-1466-MW-20S	**5.46**	60.0	21.85	4.11	3.18	27.2	0	1.50	1.50	30.6	0.34	59.9	8.69	7.61	0.033 UJ	0.033 U	NM	1.21 J	0.69 U	0.50 U	7.27	0.02 UJ
WHF-1466-MW-23S	**4.52**	23.0	21.49	0.77	1.91	189.0	NM	NM	NM	1 U	0.11 U	1 U	2.89	0.25 U	0.456	0.033 U	NM	1.85 J	0.69 U	0.50 U	0.25 U	0.086
WHF-1466-MW-23I	**4.74**	31.0	19.94	0.58	3.17	203.0	NM	NM	NM	7.76	0.11 U	71.5	4.35	0.254 J	0.827 J	0.033 UJ	0.02 U	1.39 J	0.69 U	0.50 U	0.25 U	NM
WHF-1466-MW-23D	**4.70**	28.0	20.33	3.56	2.88	194.0	NM	NM	NM	2.45	0.11 U	29.7	3.3	0.25 U	0.314 J	0.033 UJ	0.02 U	0.912 J	0.741 U	0.50 U	0.25 U	NM
WHF-1466-MW-25S	**4.63**	46.0	21.45	2.96	4.16	248.1	0	3.50	3.50	1.63	0.11 U	9.46	4.69	0.489 J	2.06 J	0.033 UJ	NM	4.57	0.69 U	0.50 U	0.459 J	0.02 U
WHF-1466-MW-27S	**5.53**	64.0	22.24	9.90	2.81	32.5	0.3	3.50	3.50	22.9	0.11 U	39.2	3.9	3.02	1.31 J	0.033 UJ	NM	2.42	0.69 U	0.50 U	2.81	0.02 U

Notes: **Bold** indicates the parameter is outside standard limits. **Bold** indicated which regulatory standard was exceeded.

DO = Dissolved Oxygen
DOC = Dissolved Organic Carbon
J = Estimated value
mg/L = milligrams per liter
mS/cm = millisiemen per centimeter
mV = millivolts
NM = Not measured
NTU = Nephelometric Turbidity Unit
ORP = Oxygen Reduction Potential
pH = -log[H+]
SDWS = USEPA Secondary Drinking Water Standard
TOC = Total Organic Carbon
U = Compound not detected above instrument detection limit
USEPA = United States Environmental Protection Agency
ºC = Degrees Celsius

TABLE 4-4
2011 WATER QUALITY AND NATURAL ATTENUATION PARAMETERS DETECTED IN GROUNDWATER IN THE SOUTH CENTRAL AREA
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 2 OF 3

	FIELD								LABORATORY													
	pH	Conductivity (mS/cm)	Temperature (ºC)	Turbidity NTU	DO-Horiba (mg/L)	ORP (mV)	Hydrogen Sulfide (mg/L)	DO-CHEMets (mg/L)	DO (mg/L)	Alkalinity (mg/L)	Ammonia-N (mg/L)	Carbon Dioxide (mg/L)	Chloride (mg/L)	DOC (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Orthoph-osphate	Sulfate (mg/L)	Sulfide (mg/L)	Total Kjeldahl Nitrogen (mg/L)	TOC (mg/L)	Total Phosphorus-P (mg/L)
SDWS	**6.5-8.5**																					
Monitoring Well																						
WHF-15-MW-2I	**4.68**	45.0	21.20	9.90	4.620	72	0	3.5	3.5	1 U	0.11 U	1 U	6.23	0.25 U	2.04	0.033 U	NM	1.87 J	0.769 J	0.50 U	0.25 U	0.02 U
WHF-15-MW-3S	**4.13**	29.0	20.92	2.81	2.2	226	0	5	5	1 U	0.11 U	1 U	3.53	0.265 J	0.212	0.033 U	NM	8.38	0.741 U	0.5 U	0.25 U	0.02 U
WHF-15-MW-3I	**5.10**	29.0	23.35	2.74	1.13	58.7	NM	NM	NM	1 U	0.11 U	1 U	3.74	0.25 U	0.714 J	0.033 UJ	NM	1.31 J	0.727 U	0.50 U	0.25 U	0.02 U
WHF-15-MW-4S	**4.93**	30.0	20.68	3.18	3.1	200	0	6	6	4.9	0.11 U	9.58	3.52	0.25 U	0.388	0.033 U	NM	0.579 J	0.714 U	0.5 U	0.25 U	0.02 U
WHF-15-MW-5S	**4.15**	42.0	21.88	0.79	2.74	268	0	3	NM	2.04	0.11 U	27	3.8	0.295 J	1.13	0.033 U	NM	6.15 J	0.741 U	0.5 U	0.302 J	0.02 U
WHF-15-MW-5I	**4.58**	21.0	20.73	0.31	1.52	211.5	0	2	2	2.45	0.11 U	16.3	3.19	0.261 J	0.141 J	0.033 U	NM	0.791 J	0.69 U	0.50 U	0.25 U	0.12
WHF-15-MW-5D	**4.50**	29.0	21.28	0.06	2.11	205	0	1.5	1.5	1 U	0.11 U	1 U	3.66	0.27 J	0.83	0.033 U	NM	1.42 J	0.69 U	0.50 U	0.25 U	0.02 U
WHF-15-MW-6D	**4.46**	32.0	21.73	6.70	2.47	238	0	5	5	2.86	0.11 U	5.73	3.71	0.25 U	0.757	0.033 U	NM	1.91 J	0.769 U	0.5 U	0.25 U	0.02 U
WHF-15-MW-7I	**4.77**	25.0	20.40	0.73	1.38	222.9	0	0.6	0.6	2.04	0.11 U	21.8	3.28	0.251 J	0.289	0.033 U	NM	1.52 J	0.741 U	0.50 U	0.25 U	0.02 UJ
WHF-15-MW-7D	**4.66**	25.0	20.98	0.95	1.65	253.3	0	1.5	1.5	1 U	0.11 U	1 U	3.19	0.25 U	0.85	0.033 U	NM	0.844 J	0.741 U	0.50 U	0.25 U	0.02 U
WHF-15-MW-8I	**4.83**	45.0	20.68	8.68	4.12	121.1	0	3	3	14.3	0.11 U	26.3	6.7	0.316 J	2.08 J	0.033 UJ	NM	1.06 J	0.741 U	0.50 U	0.25 U	0.02 U
WHF-15-MW-8D	**4.73**	23.0	20.88	0.29	5.34	207.6	0	4.5	4.5	4.08	0.11 U	25.1	2.92	0.25 U	0.469 J	0.033 UJ	0.02 U	0.428 J	0.69 U	0.50 U	0.25 U	NM
WHF-16-MW-2I	**4.93**	29.0	21.31	1.51	0.91	47.8	0	0.2	0.2	4.49	0.11 U	28.1	2.79	0.25 U	0.034 J	0.033 UJ	NM	3.28	0.69 U	0.50 U	0.25 U	0.062 J
WHF-16-MW-2D	**4.54**	31.0	21.72	0.60	0.87	232	0	1	1	4.09	0.11 U	22.8	2.72	0.25 U	0.033 J	0.033 U	NM	3.81	0.678 U	0.5 U	0.25 U	0.02 U
WHF-16-MW-3I	**4.94**	47.0	20.71	2.15	3.73	178.2	0	3.5	3.5	2.45	0.11 U	5.63	6.57	0.25 U	0.586	0.033 U	NM	4.8	0.80 U	0.50 UJ	0.25 U	0.02 U
WHF-16-MW-4I	**4.91**	32.0	21.59	0.17	2.77	73.5	0	2	NM	4.49	0.11 U	16.4	5.03	0.25 U	0.491 J	0.033 UJ	NM	1.72	0.69 U	0.50 U	0.25 U	0.131
WHF-16-MW-4D	**4.77**	33.0	21.12	46.00	0.61	177	0	2	NM	4.9	0.11 U	31.9	2.8	0.25 U	0.033 U	0.033 U	NM	4.01	0.727 U	0.50 U	0.25 U	0.02 U
WHF-16-MW-7I	**5.83**	95.0	21.49	0.42	0.300	-10	0	0.3	NM	35.9	0.11 U	67.7	5.22	0.645 J	0.033 UJ	0.033 UJ	0.02 U	4	0.69 U	0.50 U	0.541 J	NM
WHF-16-MW-7D	**5.79**	77.0	21.46	0.58	0.41	48.8	NM	NM	NM	26.1	0.11 U	53.1	3.06	0.308 J	0.033 UJ	0.033 UJ	0.02 U	5.72	0.69 U	0.50 U	0.25 U	NM

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TOC = Total Organic Carbon
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TABLE 4-4
2011 WATER QUALITY AND NATURAL ATTENUATION PARAMETERS DETECTED IN GROUNDWATER IN THE SOUTH CENTRAL AREA
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 3 OF 3

	FIELD								LABORATORY													
	pH	Conductivity (mS/cm)	Temperature (ºC)	Turbidity NTU	DO-Horiba (mg/L)	ORP (mV)	Hydrogen Sulfide (mg/L)	DO-CHEMets (mg/L)	DO (mg/L)	Alkalinity (mg/L)	Ammonia-N (mg/L)	Carbon Dioxide (mg/L)	Chloride (mg/L)	DOC (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Orthoph-osphate	Sulfate (mg/L)	Sulfide (mg/L)	Total Kjeldahl Nitrogen (mg/L)	TOC (mg/L)	Total Phosphorus-P (mg/L)
SDWS	**6.5-8.5**																					
Monitoring Well																						
WHF-30-MW-3S	**4.68**	65.0	21.94	0.28	4.830	107	0	4.0	4.0	6.13	0.11 U	19.5	6.81	0.415 J	1.59 J	0.033 UJ	NM	4	0.69 U	0.50 U	0.356 J	0.02 U
WHF-30-MW-4S	**4.74**	54.0	21.77	4.54	2.27	86.2	0	0.02	0.05	16.3	0.11 U	22.2	4.71	5.08	0.486 J	0.033 UJ	NM	1.1 J	0.714 U	0.50 U	5.33	0.02 U
WHF-30-MW-5S	**5.10**	41.0	18.66	1.68	4.74	177.5	0	3.5	3.5	4.49	0.11 U	14.8	3.44	0.288 J	2.13 J	0.033 UJ	NM	3.44	0.69 U	0.50 U	0.272 J	0.02 U
WHF-33-MW-1S	**5.21**	74.0	20.48	1.25	4.69	263	0	4.5	4.5	2.45	0.11 U	13.6	4.87	0.56 J	2.42	0.033 U	NM	13.8	0.741 U	0.50 UJ	0.521 J	0.02 U
WHF-33-MW-3S	**5.19**	84.0	20.44	1.00	4.85	175.9	0	4.5	4.5	2.86	0.11 U	11	7.8	0.25 U	4.93	0.033 U	NM	7.55	0.741 U	0.50 UJ	0.25 U	0.04 U

Notes: **Bold** indicates the parameter is outside standard limits. **Bold** indicated which regulatory standard was exceeded.

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mV = millivolts
NM = Not measured
NTU = Nephelometric Turbidity Unit
ORP = Oxygen Reduction Potential
pH = -log[H+]
SDWS = USEPA Secondary Drinking Water Standard
TOC = Total Organic Carbon
U = Compound not detected above instrument detection limit
USEPA = United States Environmental Protection Agency
ºC = Degrees Celsius

TABLE 4-5
WATER QUALITY AND NATURAL ATTENUATION PARAMETERS DETECTED IN GROUNDWATER IN THE SOUTH AREA
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

	Date	pH	Conductivity (uS/cm)	Temperature (ºC)	Turbidity (NTU)	DO-Horiba (mg/L)	DO-Colorimeter (mg/L)	DO-CHEMets (mg/L)	Fe2+ (mg/L)	Alkalinity-phenol (mg/L)	Alkalinity-total (mg/L)	ORP (mV)	Chloride (mg/L)	Cyanide (mg/L)	DOC (mg/L)	Hydrogen Sulfide (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Nitrate/Nitrite (mg/L)	Sulfate (mg/L)
SDWS		**6.5-8.5**																		
Monitoring Well																				
WHF-09-MW-2S	9/2/2000	**11.02**	611	22.6	59	8.24	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-09-MW-3S	8/12/2000	8.22	63	21.0	84	7.42	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-11-MW-1S	8/12/2000	6.64	276	20.3	12	3.23	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-11-MW-2S	8/19/2000	**11.33**	1280	22.4	72	7.42	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-11-MW-3S	8/5/2000	**5.16**	15	21.5	10	6.39	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-11-MW-4D	8/10/2000	**5.56**	183	21.8	12	4.67	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-13-MW-1I	8/5/2000	**5.96**	290	21.4	2	2.56	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-13-MW-1D	8/6/2000	**5.11**	75	23.0	6	3.39	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-13-MW-2S	8/21/2000	**4.90**	29	20.9	93	5.61	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-13-MW-3S	8/21/2000	**4.16**	53	20.9	15	7.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-13-MW-3D	8/2/2000	**6.08**	81	20.7	52	2.63	NM	NM	NM	NM	NM	NM	NM	0.005 UJ	NM	NM	NM	NM	NM	NM
WHF-13-MW-4S	8/19/2000	**4.86**	35	20.8	66	8.98	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-13-MW-5S	2/20/2000	**5.12**	15	19.6	113	6.93	NM	NM	NM	NM	NM	NM	4.5	0.01U	8.199	2 U	0.33 J	NM	NM	21.1
WHF-14-MW-1I	8/22/2000	7.39	19	25.3	4	6.74	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-14-MW-3S	6/4/2000	**8.56**	139	21.9	-10	6.67	8.40	NM	0.03	4	NM	164.9	NM	0.005 UJ	NM	NM	NM	NM	NM	NM
WHF-15-MW-5D	3/1/2000	**4.86**	21	21.2	5	5.32	5.00	NM	ND	10	NM	136.7	3.5	NM	5.0U	2.0 U	4.5	0.010 U	NM	5.0 U
WHF-15-MW-8D	2/15/2000	**4.96**	15	21.1	8	6.96	7.30	NM	0.02	5	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-15-MW-8I	2/15/2000	**5.06**	27	21.0	8	3.20	2.50	NM	0.02	15	NM	NM	4.9	NM	5.0U	2.0 U	0.21	0.010 U	0.21	5.0 U
WHF-15-MW-8S	2/15/2000	**4.82**	21	20.6	288	4.85	4.70	NM	1.25	10	NM	NM	3.3	NM	5.0U	2.0 U	0.22	0.010 U	0.22	5.0 U
WHF-15-MW-8D3	12/5/2000	**5.46**	28	15.7	101	8.29	9.60	7.00	0.57	ND	80	-56.3	2.6	NM	5.0U	2.0 U	0.35	0.010 U	0.35	5.0 U
WHF-16-MW-7D	2/16/2000	**5.31**	42	21.4	4	1.86	1.10	NM	1.03	15	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-16-MW-7D3	12/6/2000	**8.66**	119	16.3	764	9.51	NM	3.00	ND	ND	NM	-66.0	4.5	0.010 U	4.5	2.0 U	NM	NM	0.010 U	100 U
WHF-16-MW-7D4	12/6/2000	8.23	187	18.3	9	8.13	NM	5.00	ND	ND	NM	-49.5	2.5	0.010 U	5.0U	2.0 U	NM	NM	0.010 U	10.7
WHF-16-MW-7S	2/16/2000	**8.95**	95	15.8	147	2.67	1.30	NM	1.34	60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-16-MW-7I	2/16/2000	**5.27**	43	20.9	0	2.40	0.40	NM	2.90	20	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
WHF-31-MW-5S	6/7/2000	**5.32**	15	21.6	111	6.92	8.80	NM	0.08	ND	10	NM	NM	0.01	NM	NM	NM	NM	NM	NM
WHF-31-MW-6S	6/5/2000	**5.66**	230	24.2	25	5.64	10.50	NM	0.17	ND	5	143.5	NM	0.019	NM	NM	NM	NM	NM	NM
WHF-31-MW-7S	6/7/2000	**5.49**	15	21.2	28	6.38	9.00	NM	0.03	ND	10	NM	NM	0.017	NM	NM	NM	NM	NM	NM
WHF-31-MW-8S	6/4/2000	**6.33**	16	23.3	0	2.08	7.00	NM	0.05	NM	10.00	161.80	NM	0.0050 U	NM	NM	NM	NM	NM	NM

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicated which regulatory limit was exceeded.

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mg/L = milligrams per liter
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ND=Not Detected
NM = Not measured
NTU = Nephelometric Turbidity Unit
ORP = Oxygen Reduction Potential
pH = -log[H+]
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U = Compound not detected above instrument detection limit

uS/cm=microSiemen per centimeter
USEPA = United States Environmental Protection Agency
ºC = Degrees Celsius

TABLE 4-6
SUMMARY OF ANALYTES DETECTED IN LEACHATE-SITE 1
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-01-SB-5	WHF-01-SB-5	WHF-01-SS-5
Sample No.		01D00510	01SB0510A	01SS0501
Collect Date		4/27/2000	8/14/2001	8/14/2001
Sample Depth (bls)		8-10'	8-10'	0-1'
	Groundwater Criteria [1]/Primary [2]/ Secondary [3]			
SPLP Volatiles [4] (µg/L)		ND	NM	NM
TCLP Semivolatiles [5] (µg/L)		ND	NM	NM
SPLP Total Petroleum Hydrocarbons [6] (µg/L)		ND	NM	NM
TCLP Metals [7] µg/L)		ND	NM	NM
SPLP Metals [8] (µg/L)				
Aluminum	**200**/NA/**50-200**	NM	ND	**10700**
Iron	**300**/NA/**300**	NM	58	**7900**
Lead	15/15/NA	NM	ND	11

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] FDEP FL-PRO, [7,8] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FL-PRO = Florida Petroleum Range Organics
NA = not applicable
ND = not detected
NM = not measured
SPLP = Synthetic Precipitation Leaching Procedure
TCLP = Toxicity Characteristic Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-7
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER-SITE 1
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-01-MW-2S	WHF-01-MW-3S	WHF-01-MW-5S
Sample No.		01GW00201	01G00301	01G00501
Collect Date		8/21/2000	6/6/2000	6/3/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]			
Volatiles [4] (µg/L)		NM	NM	ND
Semivolatiles [5] (µg/L)		NM	NM	ND
Pesticides/PCBs [6] (µg/L)		NM	NM	ND
Metals [7] (µg/L)				
Aluminum	**200**/NA/**50-200**	ND	91.4	**1450**
Barium	2000/2000/NA	NM	NM	41.4
Iron	**300**/NA/**300**	ND	119	**488**
Magnesium	NA/NA/NA	NM	NM	1260
Sodium	160000/NA/NA	NM	NM	2310
Cyanide [8] (µg/L)		NM	NM	ND

[1] Groundwater Clean-up Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February, 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081A/8082, [7] SW-846 6010B, [8] USEPA 335.2

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
NA = not applicable
ND = not detected
NM = not measured
PCBs = Polychlorinated Biphenyls
µg/L = micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-8
SUMMARY OF ANALYTES DETECTED IN LEACHATE-SITE 2
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-02-SB-4	WHF-02-SB-1	WHF-02-SB-4
Sample No.		02SLMW04S12	2SB0117	2SB0410
Collect Date		4/26/2000	6/30/2001	6/30/2001
Sample Depth (bls)		10-12'	15-17'	8-10'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]			
SPLP Volatiles [4] (μg/L)				
Chloroform	70/NA/NA	8.4	NM	NM
Methylene Chloride	**5**/NA/NA	**129**^{J}	NM	NM
TCLP Semivolatiles [5] (μg/L)		ND	NM	NM
TCLP Pesticides/PCBs [6] (μg/L)		ND	NM	NM
SPLP Total Petroleum Hydrocarbons [7] (μg/L)		ND	NM	NM
TCLP Metals[8] (μg/L)		ND	NM	NM
SPLP Metals[8] (μg/L)				
Aluminum	**200**/NA/**50-200**	NM	**320**	**640**
Iron	**300**/NA/**300**	NM	280	**450**

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 and/or Chapter 62-777, F.A.C. Table 1, Feb. 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081A/8082, [7] FDEP FL-PRO, [8] SW-846 6010B

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicatble
ND = not detected
NM = not measured
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
TCLP = Toxicity Characteristic Leaching Procedure
USEPA = United States Environmental Protection Agency
μg/L =micrograms per liter

TABLE 4-9
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER-SITE 2
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-02-MW-1S	WHF-02-MW-4S
Sample No.		02G00101	02G00401
Collect Date		6/7/2000	6/3/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
Volatiles [4] (µg/L)		NM	ND
Semivolatiles [5] (µg/L)		NM	ND
Pesticides/PCBs [6] (µg/L)		NM	ND
Metals [7] (µg/L)			
Aluminum	**200**/NA/**50-200**	**640**	**265**
Barium	2000/2000/NA	NM	18.8
Calcium	NA/NA/NA	NM	2110
Iron	**300**/NA/**300**	NM	**542**
Magnesium	NA/NA/NA	NM	588
Sodium	160000/NA/NA	NM	1840
Cyanide [8] (µg/L)		NM	ND

[1] Groundwater Clean-up Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081A/8082, [7] SW-846 6010B, [8] USEPA 335.2

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
NA = not applicable
ND = not detected
NM = not measured
PCBs = Polychlorinated Biphenyls
ug/L = micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-10
SUMMARY OF ANALYTES DETECTED IN LEACHATE-SITE 18
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-18-SB-6	WHF-18-SB-8
Sample No.		18SB0609	18SB0809
Collect Date		5/17/2001	5/17/2001
Sample Depth (bls)		7-9'	7-9'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
SPLP Volatiles[4] (μg/L)		ND	ND
SPLP Semivolatiles[5] (μg/L)		ND	ND
SPLP Total Petroleum Hydrocarbons[6] (μg/L)		ND	ND
SPLP Metals [7] (μg/L)			
Aluminum	**200**/NA/**50-200**	**1100**	ND
Iron	**300**/NA/**300**	**570**	35
Manganese	50/NA/50	9.1	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 and/or Chapter 62-777, F.A.C. Table 1, Feb. 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 82606B, [5] SW-846 8270C, [6] FDEP FL-PRO, [7] SW-846 6010B

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
NA = not applicable
ND = not detected
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
μg/L = micrograms per liter

TABLE 4-11
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL LEACHATE-SITE 38
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 1 OF 3

Sample Location		WHF-38-SS-1	WHF-38-SS-2	WHF-38-SS-3	WHF-38-SS-3	WHF-38-SS-4
Sample No.		38D00101	38D00201	38D00301	38D00301D	38D00401
Collect Date		5/31/2000	5/31/2000	5/31/2000	5/31/2000	5/31/2000
Sample Depth (bls)		0-1'	0-1'	0-1'	0-1'	0-1'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]					
SPLP Semivolatiles[4] (µg/L)		NM	NM	NM	NM	NM
SPLP Total Petroleum Hydrocarbons [5] (µg/L)		ND	ND	ND	ND	ND
SPLP Pesticides/PCBs [6] (µg/L)						
Total (alpha-, gamma-) Chlordane	2/2/NA	NM	NM	NM	NM	ND
Heptachlor Epoxide	0.2/0.2/NA	NM	NM	NM	NM	ND
SPLP Metals [7] (µg/L)						
Aluminum	**200**/NA/**50-200**	**15800**^{J}	ND	**3600**^{J}	**13800**^{J}	**24000**^{J}
Arsenic	10/10/NA	ND	ND	ND	ND	6.1
Barium	2000/2000/NA	19^{J}	ND	ND	ND	22^{J}
Calcium	NA/NA/NA	ND	ND	ND	ND	ND
Chromium	100/100/NA	14	ND	ND	9.3	17
Copper	1000/NA/1000	ND	ND	ND	ND	ND
Iron	**300**/NA/**300**	**8400**^{J}	ND	**1900**^{J}	**7900**^{J}	**12600**^{J}
Lead	15/15/NA	ND	ND	ND	ND	12
Magnesium	NA/NA/NA	630	ND	520	670	530
Manganese	**50**/NA/**50**	**220**^{J}	ND	**57**^{J}	**120**^{J}	**130**^{J}
Mercury	2/2/NA	ND	ND	ND	ND	ND
Nickel	100/NA/NA	ND	ND	ND	ND	ND
Vanadium	49/NA/NA	23	ND	5.3	21	35
Zinc	5000/NA/5000	ND	ND	ND	ND	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8270C, [5] FDEP FL-PRO, [6] SW-846 8081A/8082, [7] SW-846 6010B

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below surface level
CFR = Code of Federal Regulations
D = A "D" at the end of sample number nomenclature indicates a duplicate
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected above regulatory criteria
NM = not measured
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-11
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL LEACHATE-SITE 38
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 2 OF 3

Sample Location		WHF-38-SS-5	WHF-38-SS-6	WHF-38-SS-7	WHF-38-SS-8	WHF-38-SS-9
Sample No.		38D00501	38D00601	38D00701	38D00801	38D00901
Collect Date		5/31/2000	5/31/2000	5/31/2000	5/31/2000	5/31/2000
Sample Depth (bls)		0-1'	0-1'	0-1'	0-1'	0-1'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]					
SPLP Semivolatiles[4] (µg/L)		NM	NM	NM	NM	NM
SPLP Total Petroleum Hydrocarbons [5] (µg/L)		ND	ND	ND	ND	ND
SPLP Pesticides/PCBs [6] (µg/L)						
Total (alpha-, gamma-) Chlordane	2/2/NA	NM	NM	NM	ND	ND
Heptachlor Epoxide	0.2/0.2/NA	NM	NM	NM	ND	ND
SPLP Metals [7] (µg/L)						
Aluminum	**200**/NA/**50-200**	**3800**^{J}	**12300**^{J}	**13500**^{J}	**46000**^{J}	**17200**^{J}
Arsenic	10/10/NA	ND	ND	ND	10	4.9
Barium	2000/2000/NA	ND	12^J	18^J	42^J	17^J
Calcium	NA/NA/NA	1700	ND	ND	2000	ND
Chromium	100/100/NA	ND	9.8	12	31	13
Copper	1000/NA/1000	ND	ND	ND	12	ND
Iron	**300**/NA/**300**	**2200**^{J}	**7100**^{J}	**7700**^{J}	**22500**^{J}	**10300**^{J}
Lead	**15**/**15**/NA	ND	ND	ND	**18**	ND
Magnesium	NA/NA/NA	600	510	550	1100	670
Manganese	**50**/NA/**50**	**180**^{J}	**170**^{J}	**270**^{J}	**400**^{J}	**180**^{J}
Mercury	2/2/NA	ND	ND	ND	ND	ND
Nickel	100/NA/NA	ND	ND	ND	ND	ND
Vanadium	**49**/NA/NA	6.2	19	21	**64**	27
Zinc	5000/NA/5000	ND	ND	ND	ND	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8270C, [5] FDEP FL-PRO, [6] SW-846 8081A/8082, [7] SW-846 6010B

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below surface level
CFR = Code of Federal Regulations
D = A "D" at the end of sample number nomenclature indicates a duplicate
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected above regulatory criteria
NM = not measured
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-11
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL LEACHATE-SITE 38
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location		WHF-38-SS-10	WHF-38-SS-11	WHF-38-SS-11	WHF-38-SS-12
Sample No.		38D01001	38D01101	38D01101D	38D01201
Collect Date		5/31/2000	5/31/2000	5/31/2000	5/31/2000
Sample Depth (bls)		0-1'	0-1'	0-1'	0-1'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]				
SPLP Semivolatiles[4] (µg/L)		NM	NM	NM	NM
SPLP Total Petroleum Hydrocarbons [5] (µg/L)		ND	ND	ND	ND
SPLP Pesticides/PCBs [6] (µg/L)					
Total (alpha-, gamma-) Chlordane	**2**/**2**/NA	ND	**2.24**	**4.2**	1.61
Heptachlor Epoxide	**0.2**/**0.2**/NA	ND	0.19^J	**0.28**^{J}	**0.42**^{J}
SPLP Metals [7] (µg/L)					
Aluminum	**200**/NA/**50-200**	**41500**^{J}	**37000**^{J}	**24000**^{J}	**50500**^{J}
Arsenic	**10**/**10**/NA	**24**	**68**	**50**	**55**
Barium	2000/2000/NA	39^J	27^J	24^J	39^J
Calcium	NA/NA/NA	ND	ND	ND	ND
Chromium	100/100/NA	30	26	18	37
Copper	1000/NA/1000	12	11	ND	13
Iron	**300**/NA/**300**	**21200**^{J}	**19800**^{J}	**12100**^{J}	**28600**^{J}
Lead	**15**/**15**/NA	12	**20**	15	**23**
Magnesium	NA/NA/NA	1200	830	750	1200
Manganese	**50**/NA/**50**	**490**^{J}	**650**^{J}	**450**^{J}	**770**^{J}
Mercury	**2**/**2**/NA	ND	**12**^{J}	**7.9**^{J}	**7.9**^{J}
Nickel	100/NA/NA	ND	39	ND	ND
Vanadium	**49**/NA/NA	**62**	**53**	35	**76**
Zinc	5000/NA/5000	ND	100	83	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8270C, [5] FDEP FL-PRO, [6] SW-846 8081A/8082, [7] SW-846 6010B

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below surface level
CFR = Code of Federal Regulations
D = A "D" at the end of sample number nomenclature indicates a duplicate
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected above regulatory criteria
NM = not measured
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-12
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER-SITE 38
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON FLORIDA
Page 1 of 1

Sample Location		WHF-38-MW-1S	WHF-38-MW-2S	WHF-38-MW-3S	WHF-38-MW-4S
Sample No.		38G00101	38G00201	38G00301	38G00401
Collect Date		6/6/2000	6/2/2000	6/2/2000	6/6/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]				
Volatiles [4] (μg/L)		ND	ND	ND	ND
Semivolatiles [5] (μg/L)					
DEHP	**6**/**6**/NA	ND	ND	**13.1**	ND
Pesticides/PCBs [6] (μg/L)					
Beta-BHC	**0.02**/NA/NA	ND	**0.049**^{J}	ND	ND
Gamma-BHC	**0.2**/**0.2**/NA	ND	**0.029**^{J}	ND	ND
Heptachlor Epoxide	**0.2**/**0.2**/NA	ND	**0.29**	ND	ND
Total Petroleum Hydrocarbons [7] (μg/L)	5000/NA/NA	ND	ND	ND	ND
Metals [8] (μg/L)					
Aluminum	**200**/NA/**50-200**	**821**	**4610**	**11800**	ND
Arsenic	**10**/**10**/NA	ND	4.1	**13.2**	ND
Barium	2000/2000/NA	32.2^{J}	61.1	67.8	40.2^{J}
Calcium	NA/NA/NA	1110^{J}	1330	3680	720^{J}
Chromium	100/100/NA	ND	17.7	64.1	ND
Copper	1000/NA/1000	ND	8.6	29	ND
Iron	**300**/NA/**300**	**631**	**15400**	**32400**	**607**
Magnesium	NA/NA/NA	1010	941	1260	1030
Manganese	**50**/NA/**50**	23	**51.1**	**60.2**	6.2
Potassium	NA/NA/NA	1220	ND	1560	ND
Sodium	160000/NA/NA	9810	7080	14500	4050
Vanadium	**49**/NA/NA	2.4	32.7	**77.2**	ND
Zinc	5000/NA/5000	ND	11.9	13.4	3.3
Cyanide [9] (μg/L)	200/200/NA	15	6.0	15	ND

[1] Groundwater Clean-up Criteria from Chapter 62-550, F.A.C., and/ or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081A/8082, [7] FDEP FL-PRO, [8] SW-846 6010B, [9] USEPA 335.2

Notes: **Bold** indicates an exceedance of regulatroy limits. **Bold** indicates which regulatory limit was exceeded.

BHC = Benzenehexachloride
CFR = Code of Federal Regulations
DEHP = Bis(2-ethylhexyl)phthalate
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicatble
ND = not detected
PCBs = Polychlorinated Biphenyls
μg/L =micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-13
SUMMARY OF ANALYTES DETECTED IN SURFACE AND SUBSURFACE SOIL LEACHATE-SITE 3
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-03-SB-1	WHF-03-SS-3	WHF-03-SB-12
Sample No.		3SB0107	3SS0302	3SB1218
Collect Date		6/28/2001	6/30/2001	6/29/2001
Sample Depth (bls)		5-7'	0-2'	16-18'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]			
SPLP Pesticides/ PCBs [4] (µg/L)				
Dieldrin	*0.0020* /NA/NA	*0.5 U*	*0.5 U*	*0.5 U*
SPLP Metals [5] (µg/L)				
Aluminum	200/NA/**50-200**	**190**	NM	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, Feb. 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8081A, [5] SW-846 6010B

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.
Italic indicates a MDL greater than regulatory criteria for the undetected analyte (reported with a 'U').

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
MDL = method detection limit
NA = not applicatble
ND = not detected above regulatory criteria
NM = not measured
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
U = Analyte was below method detection limit.
USEPA = United States Environmental Protection Agency
µg/L =micrograms per liter

Table 4-14
SUMMARY OF VOLATILE ANALYTES DETECTED IN NORTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-03-MW-1S**			**WHF-03-MW-1I**			**WHF-03-MW-1D**		
Sample No.			03G0101	03G0101	WHF03G0101	03G0102	03G0102	WHF03G0102	03G0103	03G0103	WHF03G0103
Collect Date			20070815	20080514	20110223	20070815	20080514	20110223	20070815	20080514	20110223
	Groundwater Criteria[1]	Primary[2]									
Volatile Organics[3] (µg/L)											
1,2-Dibromoethane	0.02	0.05	0.3 U	7 U	NS	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	**2300**	**2600**	**3580**	**47**	**21**	0.25 U	0.4 U	**3**	0.25 U
BTEX Total	N/A	N/A	14000	26600	41380	370	229	0	1.6	30	0
CIS-1,2-Dichloroethene	**70**	**70**	**390**	**460**	**636**	6	4	0.25 U	0.3 U	0.3 U	0.25 U
Ethylbenzene	**30**	**700**	**1100**	**1300**	**2020**	**43**	24	0.25 U	0.4 U	2	0.25 U
Tetrachloroethene	3	5	0.5 U	9 U	25 U	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	**8800**	**20000**	**31500 J**	**170**	**100**	0.25 U	1	21	0.25 U
Total Xylenes	**20**	10000	**1800**	**2700**	**4280**	**110**	**84**	0.75 U	0.4 U	4	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	10 U	25 U	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**72**	**66**	**64.4 J**	**38**	**27**	**5.44**	0.5 U	0.5 U	0.25 U
Vinyl Chloride	1	2	0.4 U	9 U	25 U	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases (µg/L)											
Ethane	NA	NA	NS	NS	22.4 J	NS	NS	1 UJ	NS	NS	1 UJ
Ethene	NA	NA	NS	NS	4.66	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	293 J	NS	NS	1 U	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-770 F.A.C., Table 1, February 2005

[2] USEPA Primary Drinking Water Standard

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 2 of 12

Sample Location			**WHF-03-MW-2S**			**WHF-03-MW-2I**			**WHF-03-MW-3I**			**WHF-03-MW-4S**	
Sample No.			03G0201	03G0201	WHF03G0201	03G0202	03G0202	WHF03G0202	03G0302	03G0302	WHF03G0302	03G0401	WHF-03G0401
Collect Date			20070808	20080513	20110223	20070815	20080513	20110223	20070815	20080513	20110223	20070817	20110318
	Groundwater Criteria[1]	Primary[2]											
Volatile Organics[3] (µg/L)													
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 UJ	3 U	NS	0.3 U	0.3 U	NS	0.3 UJ	NS
Benzene	**1**	**5**	**8**	**16**	**22.1**	**2400**	**890**	**181**	0.4 U	0.4 U	0.25 U	**2200**	**2440**
BTEX Total	N/A	N/A	10.55	78	30.501	19510	8610	3838	0.75	2.6	0	38700	46360
CIS-1,2-Dichloroethene	**70**	**70**	0.6 J	0.6 J	0.612 J	**82 J**	35	22 J	0.3 U	0.3 U	0.25 U	**230**	**329**
Ethylbenzene	**30**	**700**	0.4 J	2	0.551 J	**810**	**320**	**244**	0.4 U	0.4 U	0.25 U	**1600**	**2520**
Tetrachloroethene	3	5	0.5 U	0.5 U	0.766 J	0.5 UJ	5 U	6.25 U	0.5 U	0.5 U	0.25 U	0.5 UJ	25 U
Toluene	**40**	**1000**	0.3 U	**52**	4.78	**14000**	**6400**	**2740**	0.3 U	2	0.25 U	**31000**	**35000 J**
Total Xylenes	**20**	10000	2 J	8	3.07	**2300**	**1000**	**673**	0.4 U	0.4 U	0.75 U	**3900**	**6400**
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 UJ	5 U	6.25 U	0.5 U	0.5 U	0.25 U	0.5 UJ	25 U
Trichloroethene	**3**	**5**	**60**	**56**	**75.1**	**20 J**	5 U	**29.3**	0.5 U	3	0.364 J	**140 J**	**51.2 J**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 UJ	4 U	6.25 U	0.4 U	0.4 U	0.25 U	0.4 UJ	25 U
Volatile Gases (µg/L)													
Ethane	NA	NA	NS	NS	1 UJ	NS	NS	1 UJ	NS	NS	1 UJ	NS	11.2
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U	NS	NS	2.28 J	NS	2.39 J
Methane	NA	NA	NS	NS	3.91 J	NS	NS	9.12	NS	NS	1 U	NS	1300

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 3 of 12

Sample Location			WHF-03-MW-7S			WHF-03-MW-7I					
Sample No.			03G0701	03G0701	WHF03G0701	03G0702	03G0702-DUP	03G0702	03G0702	WHF03G0702	WHF03G0702-DUP
Collect Date			20070814	20080514	20110308	20070815	20070815	20080514	20080514	20110308	20110308
	Groundwater Criteria[1]	Primary[2]									
Volatile Organics[3] (µg/L)											
1,2-Dibromoethane	0.02	0.05	0.3 U	1 U	NS	0.3 U	0.3 U	0.7 U	0.7 U	NS	NS
Benzene	**1**	**5**	**630**	**1500**	**1660**	**220**	**220**	**100**	**100**	**21.2**	**21.5**
BTEX Total	N/A	N/A	4090	8800	6090	962	992	2050	2060	561.2	555.5
CIS-1,2-Dichloroethene	**70**	**70**	**170**	**300**	**300**	9	10	6	6	5.01	4.6
Ethylbenzene	**30**	**700**	**560**	**1100**	**1380**	**270**	**290**	**270**	**280**	**168**	**166**
Tetrachloroethene	3	5	0.5 U	2 U	5 U	0.5 U	0.5 U	0.9 U	0.9 U	0.50 U	0.50 U
Toluene	**40**	**1000**	**1700**	**4300**	**1310**	**42**	**42**	**1000**	**1100**	**143**	**142**
Total Xylenes	**20**	10000	**1200**	**1900**	**1740**	**430**	**440**	**680**	**580**	**229**	**226**
Trans-1,2-Dichloroethene	100	100	0.5 U	2 U	5 U	0.5 U	0.5 U	1 U	1 U	0.50 U	0.50 U
Trichloroethene	**3**	**5**	**7**	**11**	**13.5 J**	**45**	**51**	**52**	**48**	**52.6**	**50.3**
Vinyl Chloride	1	2	0.4 U	2 U	5 U	0.4 U	0.4 U	0.9 U	0.9 U	0.50 U	0.50 U
Volatile Gases (µg/L)											
Ethane	NA	NA	NS	NS	6.54	NS	NS	NS	NS	1 U	NS
Ethene	NA	NA	NS	NS	1 U	NS	NS	NS	NS	1 U	NS
Methane	NA	NA	NS	NS	2450	NS	NS	NS	NS	8.63	NS

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 4 of 12

Sample Location			**WHF-1467-MW-2I**				**WHF-1467-MW-5D**			
Sample No.			1467G0202	1467G0202	WHF-1467G0202	WHF-1467G0202-DUP	1467G0503	1467G0503-DUP	1467G0503	1467G0503
Collect Date			20070805	20080514	20110318	20110318	20070817	20070817	20080515	20110317
	Groundwater Criteria[1]	Primary[2]								
Volatile Organics[3] (µg/L)										
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	NS	0.3 U	0.3 U	0.3 U	NS
Benzene	**1**	**5**	**980**	**640**	**1260**	**1280**	0.4 U	0.4 U	0.4 U	0.25 U
BTEX Total	N/A	N/A	5530	858	13910	14340	1.55	0.75U	5.1	0
CIS-1,2-Dichloroethene	**70**	**70**	**190**	**170**	**297**	**308**	0.3 U	0.3 U	0.3 U	0.25 U
Ethylbenzene	**30**	**700**	**720**	**190**	**1900**	**2020**	0.4 U	0.4 U	0.9 J	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	12.5 U	12.5 U	0.5 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	**3200**	16	**8810**	**9000**	0.3 U	0.3 U	2	0.25 U
Total Xylenes	**20**	10000	**630**	12	**1940**	**2040**	1 J	0.4 U	2 J	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	12.5 U	12.5 U	0.5 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**34**	0.5 U	12.5 U	12.5 U	0.5 U	0.5 U	0.5 U	0.25 U
Vinyl Chloride	1	2	0.4 U	0.4 U	12.5 U	12.5 U	0.4 U	0.4 U	0.4 U	0.25 U
Volatile Gases (µg/L)										
Ethane	NA	NA	NS	NS	13.9	NS	NS	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	NS	NS	1 U
Methane	NA	NA	NS	NS	8960	NS	NS	NS	NS	1 U

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 5 of 12

Sample Location			**WHF-1467-MW-14S**		**WHF-1467-MW-20S**			**WHF-1467-MW-21S**			
Sample No.			1467G1401	1467G1401	1467G2001	1467G2001	WHF1467G2001	1467G2101	1467G2101	WHF-1467G2101	WHF-1467G2101-DUP
Collect Date			20101212	20110301	20071218	20080514	20110302	20070805	20080514	20110225	20110225
	Groundwater Criteria[1]	Primary[2]									
Volatile Organics[3] (µg/L)											
1,2-Dibromoethane	0.02	0.05	0.25 U	NS	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS	NS
Benzene	**1**	**5**	0.25 U	0.25 U	**900**	**1700**	**361**	0.4 U	0.4 U	0.25 U	0.25 U
BTEX Total	N/A	N/A	0	0	2870	4000	1084.7	0.75 U	3	0.33	0
CIS-1,2-Dichloroethene	**70**	**70**	0.25 U	0.25 U	**120**	**76**	**278**	0.3 U	0.3 U	0.25 U	0.25 U
Ethylbenzene	**30**	**700**	0.25 U	0.25 U	**750**	**1100**	**519**	0.4 U	0.8 J	0.33 J	0.25 U
Tetrachloroethene	3	5	0.25 U	0.25 U	1	0.7 J	1.25 U	0.5 U	0.5 U	0.25 U	0.25 U
Toluene	**40**	**1000**	0.25 U	0.25 U	**120**	**660**	14.7	0.3 U	1	0.25 U	0.25 U
Total Xylenes	**20**	10000	0.75 U	0.75 U	**1100**	**540**	**190**	0.4 U	1 J	0.75 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.25 U	0.25 U	0.5 U	0.5 U	1.25 U	0.5 U	0.5 U	0.25 U	0.25 U
Trichloroethene	**3**	**5**	0.25 U	0.25 U	**200**	**150**	**3.26 J**	3	3	**3.67 J**	2.4 J
Vinyl Chloride	1	2	0.25 U	0.25 U	0.4 U	0.4 U	1.25 U	0.4 U	0.4 U	0.25 U	0.25 U
Volatile Gases (µg/L)											
Ethane	NA	NA	NS	1 U	NS	NS	1 U	NS	NS	1 U	NS
Ethene	NA	NA	NS	1 U	NS	NS	1 U	NS	NS	1 U	NS
Methane	NA	NA	NS	1 U	NS	NS	1590 J	NS	NS	1 U	NS

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-1467-MW-27S**			**WHF-1467-MW-31S**				
Sample No.			1467G2701	1467G2701	WHF-1467G2701	1467G3101	1467G3101	1467G3101	WHF-1467G3101	WHF-1467G3101-DUP
Collect Date			20070805	20080607	20110318	20070805	20071218	20080608	20110225	20110225
	Groundwater Criteria[1]	Primary[2]								
Volatile Organics[3] (µg/L)										
1,2-Dibromoethane	0.02	0.05	0.3 UJ	28 U	NS	**2**	**3 J**	0.3 U	NS	NS
Benzene	**1**	**5**	**700**	**650**	**513**	**2000**	**3800**	**310**	**6.22**	**6**
BTEX Total	N/A	N/A	13200	12850	10333	10760	25700	658	7.609	7.352
CIS-1,2-Dichloroethene	**70**	**70**	60 J	**73 J**	**79.3 J**	0.6 J	1 J	0.2 U	0.25 U	0.25 U
Ethylbenzene	**30**	**700**	**1300**	**1400**	**1590**	**1000**	**2400**	**66**	0.339 J	0.322 J
Tetrachloroethene	3	5	0.5 UJ	40 U	25 U	0.5 U	0.5 UJ	0.4 U	0.25 U	0.25 U
Toluene	**40**	**1000**	**9700**	**8900 J**	**5860**	**6800**	**17000**	**220**	1.05	1.03
Total Xylenes	**20**	10000	**1500**	**1900**	**2370**	**960**	**2500**	**62**	0.75 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 UJ	35 U	25 U	0.5 U	0.5 UJ	0.4 U	0.25 U	0.25 U
Trichloroethene	**3**	**5**	**140 J**	**110**	**43 J**	**20**	**25 J**	**8**	0.897 J	0.612 J
Vinyl Chloride	1	2	0.4 UJ	26 U	25 U	0.4 U	0.4 UJ	0.3 U	0.25 U	0.25 U
Volatile Gases (µg/L)										
Ethane	NA	NA	NS	NS	1 U	NS	NS	NS	1 U	NS
Ethene	NA	NA	NS	NS	1 U	NS	NS	NS	1 U	NS
Methane	NA	NA	NS	NS	554	NS	NS	NS	4.21	NS

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Sample Location			**WHF-1467-MW-31I**		**WHF-1467-MW-34S**		**WHF-1467-MW-35S**	**WHF-1467-MW-35I**		
Sample No.			1467G3102	WHF-1467G3102	1467G3401	WHF1467G3401	1467G3501	1467G3502	1467G3502	WHF-1467G3502
Collect Date			20080619	20110225	20080619	20110303	20080618	20080618	20080618	20110317
	Groundwater Criteria[1]	Primary[2]								
Volatile Organics[3] (µg/L)										
1,2-Dibromoethane	0.02	0.05	0.3 U	NS	0.3 U	NS	0.3 U	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.3 J	0.25 U	**180**	**4.42**	0.3 U	**2**	**2**	0.25 U
BTEX Total	N/A	N/A	20.3	0	332	23.73	0.65 U	3.3	4.3	0
CIS-1,2-Dichloroethene	**70**	**70**	0.2 U	0.25 U	0.2 U	0.25 U	0.2 U	0.2 U	0.2 U	0.25 U
Ethylbenzene	**30**	**700**	1	0.25 U	**86**	6.81	0.3 U	0.3 U	0.3 U	0.25 U
Tetrachloroethene	3	5	0.4 UJ	0.25 U	0.4 UJ	0.25 U	0.4 UJ	0.4 UJ	0.4 UJ	0.25 U
Toluene	**40**	**1000**	14	0.25 U	30	2.93	0.4 U	1	2	0.25 U
Total Xylenes	**20**	10000	5	0.75 U	**36**	9.57	0.3 U	0.3 U	0.3 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.4 U	0.25 U	0.4 U	0.25 U	0.4 U	0.4 U	0.4 U	0.25 U
Trichloroethene	**3**	**5**	0.4 U	0.25 U	**9**	0.714 J	0.4 U	0.6 J	0.6 J	0.25 U
Vinyl Chloride	1	2	0.3 U	0.25 U	0.3 U	0.25 U	0.3 U	0.3 U	0.3 U	0.25 U
Volatile Gases (µg/L)										
Ethane	NA	NA	NS	1 U	NS	1 U	NS	NS	NS	1 U
Ethene	NA	NA	NS	1 U	NS	1 U	NS	NS	NS	1 U
Methane	NA	NA	NS	1 U	NS	1 U	NS	NS	NS	1 U

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NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 8 of 12

Sample Location			**WHF-1467-MW-36S**				**WHF-1467-MW-37S**		**WHF-1467-MW-39S**
Sample No.			1467G3601	1467G3601	WHF1467G3601	WHF1467G3601-D	1467G3701	WHF-1467G3701	WHF1467G3901
Collect Date			20080618	20101213	20110303	20110303	20080619	20110301	20110308
	Groundwater Criteria[1]	Primary[2]							
Volatile Organics[3] (µg/L)									
1,2-Dibromoethane	0.02	0.05	0.3 U	12.5 U	NS	NS	0.3 U	NS	NS
Benzene	**1**	**5**	**790**	**241**	**248**	**232**	**1200**	**2270**	0.25 U
BTEX Total	N/A	N/A	24890	0	16208	17222	5610	8884	0.33
CIS-1,2-Dichloroethene	**70**	**70**	0.8 J	12.5 U	12.5 U	12.5 U	0.3 J	6.25 U	0.25 U
Ethylbenzene	**30**	**700**	**1400**	**958**	**1630**	**1630**	**1400**	**2070**	0.25 U
Tetrachloroethene	3	5	0.4 U	12.5 U	12.5 U	12.5 U	0.4 UJ	6.25 U	0.25 U
Toluene	**40**	**1000**	**20000**	**6390**	**10300**	**11300**	10	14 J	0.33 J
Total Xylenes	**20**	10000	**2700**	**2360**	**4030**	**4060**	**3000**	**4510**	0.75 U
Trans-1,2-Dichloroethene	100	100	0.4 U	12.5 U	12.5 U	12.5 U	0.4 U	6.25 U	0.25 U
Trichloroethene	**3**	**5**	**190**	**80.7**	**105**	**94.2**	0.4 U	6.25 U	0.25 U
Vinyl Chloride	1	2	0.3 U	12.5 U	12.5 U	12.5 U	0.3 U	6.25 U	0.25 U
Volatile Gases (µg/L)									
Ethane	NA	NA	NS	NS	4.5	NS	NS	4.34	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U	1 U
Methane	NA	NA	NS	NS	80.7	NS	NS	2410	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-770 F.A.C., Table 1, February 2005

[2] USEPA Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1

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Bold indicates which regulatory limit was exceeded.

BTEX = Benzene, ethylbenzene, toluene, and total xylenes
DUP = Duplicate Sample
F.A.C. = Florida Administrative Code
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Table 4-14
SUMMARY OF VOLATILE ANALYTES DETECTED IN NORTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-1467-MW-44S**	**WHF-2894-MW-3I**	**WHF-2894-MW-4I**	**WHF-32-MW-1S**		
Sample No.			WHF-1467G4401	WHF2894G0302	2894G0402	32G0101	32G0101	WHF32G0101
Collect Date			20110317	20110228	20110301	20070816	20080513	20110301
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (µg/L)								
1,2-Dibromoethane	0.02	0.05	NS	NS	NS	0.3 UJ	7 U	NS
Benzene	**1**	**5**	**21.2**	0.25 U	0.25 U	**890**	**1000**	**776**
BTEX Total	N/A	N/A	21.454	0.261	0	33490	48600	17756
CIS-1,2-Dichloroethene	**70**	**70**	0.25 U	0.25 U	0.25 U	49 J	44	31.8 J
Ethylbenzene	**30**	**700**	0.254 J	0.25 U	0.25 U	**2300**	**2200**	**2690**
Tetrachloroethene	3	5	0.25 U	0.25 U	0.25 U	0.5 UJ	9 U	12.5 U
Toluene	**40**	**1000**	0.25 U	0.261 J	0.25 U	**23000**	**38000**	**6230 J**
Total Xylenes	**20**	10000	0.75 U	0.75 U	0.75 U	**7260**	**7470**	**8060**
Trans-1,2-Dichloroethene	100	100	0.25 U	0.25 U	0.25 U	0.5 UJ	10 U	12.5 U
Trichloroethene	**3**	**5**	**4.77**	0.25 U	0.25 U	**38 J**	**32**	**45.4 J**
Vinyl Chloride	1	2	0.25 U	0.25 U	0.25 U	0.4 UJ	9 U	12.5 U
Volatile Gases (µg/L)								
Ethane	NA	NA	4.58	2.7 J	1 U	NS	NS	8.89
Ethene	NA	NA	1 U	1 U	1 U	NS	NS	2.49 J
Methane	NA	NA	144	11.6	1 U	NS	NS	396

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-770 F.A.C., Table 1, February 2005

[2] USEPA Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1

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Table 4-14
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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 10 of 12

Sample Location			**WHF-32-MW-2S**			**WHF-32-MW-3S**			
Sample No.			32G0201	32G0201	WHF32G0201	32G0301	32G0301	WHF32G0301	WHF32G0301-DUP
Collect Date			20070817	20080514	20110301	20070818	20080514	20110301	20110301
	Groundwater Criteria[1]	Primary[2]							
Volatile Organics[3] (µg/L)									
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS	NS
Benzene	**1**	**5**	**220**	**130**	**60.8**	**380**	**290**	**92.3**	**89.3**
BTEX Total	N/A	N/A	268.15	169	70.39	729	408	176.5	172.2
CIS-1,2-Dichloroethene	**70**	**70**	41	**72**	**176**	**350**	**250**	64.6	62
Ethylbenzene	**30**	**700**	**44**	26	9.59	**270**	**98**	**55.7**	**56**
Tetrachloroethene	3	5	0.5 U	0.6 J	1.98 J	0.5 U	2	0.559 J	0.577 J
Toluene	**40**	**1000**	0.3 U	2	1.25 U	12	6	12.9	11.9
Total Xylenes	**20**	10000	4.4	11.4	3.75 U	**66.8**	14	15.6	15
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	1.25 U	2	0.6 J	0.50 U	0.50 U
Trichloroethene	**3**	**5**	**93**	**150**	**376**	**400**	**270**	**68.5**	**65.2**
Vinyl Chloride	1	2	0.4 U	0.4 U	1.25 U	0.4 U	0.4 U	0.50 U	0.50 U
Volatile Gases (µg/L)									
Ethane	NA	NA	NS	NS	1 U	NS	NS	1 U	NS
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U	NS
Methane	NA	NA	NS	NS	94	NS	NS	1 U	NS

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-770 F.A.C., Table 1, February 2005

[2] USEPA Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 11 of 12

Sample Location			**WHF-32-MW-3I**			**WHF-32-MW-5S**			**WHF-32-MW-8I**			
Sample No.			32G0302	32G0302	32G0302_201103	32G0501	32G0501	WHF32G0501	32G0802	32G0802	32G0802	WHF32G0802
Collect Date			20070816	20080514	20110317	20070816	20080515	20110301	20070804	20080608	20080608	20110302
	Groundwater Criteria[1]	Primary[2]										
Volatile Organics[3] (µg/L)												
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS	0.3 U	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	**230**	**170**	0.25 U	0.4 U	0.3 U	0.3 U	0.25 U
BTEX Total	N/A	N/A	0.75 U	14.2	0	317	203.9	0	0.75 U	101.15	73.15	0
CIS-1,2-Dichloroethene	**70**	**70**	0.3 U	0.3 U	0.25 U	3 J	10	0.25 U	0.3 U	0.2 U	0.2 U	0.25 U
Ethylbenzene	**30**	**700**	0.4 U	2	0.25 U	**59 J**	30	0.25 U	0.4 U	**35**	26	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U	0.5 U	0.4 U	0.4 U	0.25 U
Toluene	**40**	**1000**	0.3 U	6	0.25 U	13 J	0.9 J	0.25 U	0.3 U	5	4	0.25 U
Total Xylenes	**20**	10000	0.4 U	6	0.75 U	15 J	3	0.75 U	1 U	**61**	**43**	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U	0.5 U	0.4 U	0.4 U	0.25 U
Trichloroethene	**3**	**5**	0.5 U	0.5 U	0.25 U	**9 J**	**16**	0.25 U	0.5 U	0.4 U	0.4 U	0.25 U
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U	0.4 U	0.3 U	0.3 U	0.25 U
Volatile Gases (µg/L)												
Ethane	NA	NA	NS	NS	1 U	NS	NS	1 U	NS	NS	1 U	NS
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U	NS	NS	1 U	NS
Methane	NA	NA	NS	NS	1 U	NS	NS	1 U	NS	NS	1 U	NS

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-770 F.A.C., Table 1, February 2005

[2] USEPA Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1

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SUMMARY OF VOLATILE ANALYTES DETECTED IN NORTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 12 of 12

Sample Location			**WHF-32-MW-9I**			**WHF-32-MW-10I**	**WHF-PDF-MW-1S**	
Sample No.			32G0902	32G0902	WHF32G0902	32G1002	WHFPDF0101	WHFPDF0101-DUP
Collect Date			20070817	20080514	20110302	20110301	20110223	20110223
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (µg/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	NS	NS	NS
Benzene	**1**	**5**	1	**8**	**46.4**	0.25 U	0.25 U	0.25 U
BTEX Total	N/A	N/A	1.55	18	10194.4	0	0	0
CIS-1,2-Dichloroethene	**70**	**70**	0.3 U	0.3 U	1.25 U	0.25 U	0.25 U	0.25 U
Ethylbenzene	**30**	**700**	0.4 U	1	**141**	0.25 U	0.25 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	1.25 U	0.25 U	0.25 U	0.25 U
Toluene	**40**	**1000**	0.3 U	7	**463**	0.25 U	0.25 U	0.25 U
Total Xylenes	**20**	10000	1 U	2 J	**369**	0.75 U	0.75 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	1.25 U	0.25 U	0.25 U	0.25 U
Trichloroethene	**3**	**5**	3	**6**	**16.7**	0.25 U	0.25 U	0.25 U
Vinyl Chloride	1	2	0.4 U	0.4 U	1.25 U	0.25 U	0.25 U	0.25 U
Volatile Gases (µg/L)								
Ethane	NA	NA	NS	NS	1 U	1 U	1 UJ	1 UJ
Ethene	NA	NA	NS	NS	1 U	1 U	1 UJ	1 U
Methane	NA	NA	NS	NS	46.1	1 U	3.33 J	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-770 F.A.C., Table 1, February 2005

[2] USEPA Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1

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Table 4-15
SUMMARY OF INORGANIC ANALYTES DETECTED IN NORTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 5

Sample Location		**WHF-03-MW-1S**		**WHF-03-MW-1I**	**WHF-03-MW-1D**	**WHF-03-MW-2S**		**WHF-03-MW-2I**		**WHF-03-MW-3I**		
Sample No.		03G0101	03G0101	03G0102	03G0103	03G0201	03G0201	03G0202	03G0202	03G0302	03G0302	03G0302-DUP
Collect Date		20070815	20080514	20070815	20070815	20070808	20080513	20070815	20080513	20070815	20080513	20080513
	Groundwater Criteria[1/] Primary[2/] Secondary[3]											
Metals[4] (µg/L)												
Aluminum	**200/** NA/ **50-200**	27.0 J	14.6 U	44.9 J	19.0 UJ	**157**	153 U	43.7	15 U	**741**	**172**	168 U
Antimony	6/ 6/ NA	5.2 U	4.4	2.5 U	1.1 U	0.87 U	0.78 U	2.3 U	0.94 U	1.1 U	0.78 U	0.78 U
Arsenic	**10/** **10/** NA	**28.2**	**34.7**	0.83 U	1.1 U	1.4 U	4.5 U	3.7	4.6 U	0.92	3.5 U	3.5 U
Barium	2000/ 2000/ NA	83.2	88	60.4	9.9	10.5	7.8	45.4	39.8	34.1	30.2	30.3
Beryllium	4/ 4/ NA	0.12 U	0.13 U	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.13 U	0.12 U	0.13 U	0.13 U
Cadmium	5/ 5/ NA	0.1 U	0.46 U	0.25 U	0.1 U	0.1 U	0.08 U	0.1 U	0.04 U	0.1 U	0.04 U	0.04 U
Calcium	NA/ NA/ NA	8440	9310	9260	914	1320	1320	2160	1780	1060	811	821
Chromium	100/ 100/ NA	0.28 U	0.41 U	1.1 U	0.28 U	0.47 U	0.41 U	0.28 U	0.41 U	0.92	0.41 U	0.41 U
Cobalt	140/ NA/ NA	0.26 U	0.47	18.9	0.26 U	0.26 U	0.24 U	0.26 U	0.24 U	0.56	0.29 U	0.33 U
Copper	1000/ 1300/ 1000	0.22 U	0.75 U	1.6 U	2.1 U	1.6 U	1 U	0.22 U	0.75 U	2.8	1.3 U	1.2 U
Iron	**300/** NA/ NA	**44900 J**	**48300**	**313 J**	6.7 U	**2040**	**1250**	**14500 J**	**8220**	155 J	88.5	68.2 U
Lead	**15/** **15/** NA	**65.1**	**145**	9.5	0.91 U	0.91 U	0.97 U	**128**	**43.8**	1	0.97 U	0.97 U
Magnesium	NA/ NA/ NA	8160	9050	866	635	580	552	1550	1350	883	1010	1020
Manganese	**50/** NA/ **50**	**97**	**101**	**226**	2.5	5.4	3.7	**51.2**	47.4	5	2.7	2.6
Mercury	**2/** **2/** NA	0.02 U	0.030 U	0.42	0.02 U	**4.9**	**4.8**	0.02	0.03 U	**2.4**	0.27	0.33
Nickel	100/ NA/ NA	0.41 U	0.42 U	2.7 U	0.41 U	0.41 U	0.42 U	0.41 U	0.42 U	0.41 U	0.42 U	0.42 U
Potassium	NA/ NA/ NA	398 U	412 U	866	733	86 U	416 U	2880	1750	14800	1020	1040
Selenium	50/ 50/ NA	1.5 U	0.96 U	1.5 U	1.5 U	1.5 U	1.3	1.6 U	0.96 U	2 U	0.96 U	0.96 U
Silver	100/ NA/ 100	0.46 U	0.29 U	0.46 U	0.51 U	0.55	0.29 U	0.46 U	0.29 U	0.53	0.29 U	0.29 U
Sodium	160000/ NA/ NA	5150	5700	2820	2460	2560 J	2760	5820	4890	3750	2090	2090
Thallium	**2/** **2/** NA	0.71 U	1.64 U	0.78 U	0.71 U	0.71 U	3.2 U	1.2 U	1.64 U	1.7 U	1.8 U	1.64 U
Vanadium	**49/** NA/ NA	3.7	0.70 U	0.36	0.48	0.29 U	1.1 U	0.29 U	0.5 U	0.29 U	0.79 U	0.56 U
Zinc	5000/ NA/ 5000	13.6 J	5.6	6.7 U	3.7 U	9.8	5.2	4.6 U	5.1	6.1 U	4	4.7

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] USEPA CFR Secondary Drinking Water Standard

[4] SW-846 6010B

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Page 2 of 5

Sample Location		**WHF-03-MW-4S**	**WHF-03-MW-7S**		**WHF-03-MW-7I**		**WHF-1467-MW-2I**		**WHF-1467-MW-5D**		**WHF-1467-MW-21S**
Sample No.		03G0401	03G0701	03G0701	03G0702	03G0702-DUP	1467G0202	1467G0202	1467G0503	1467G0503-DUP	1467G2101
Collect Date		20070817	20070814	20080514	20080514	20080514	20070805	20080514	20070817	20070817	20070805
	Groundwater Criteria[1/] Primary[2/] Secondary[3]										
Metals[4] (µg/L)											
Aluminum	**200/** NA/ **50-200**	**456**	**6110 J**	14.6 U	28.9	14.6 U	**897**	**95**	**204 J**	158 J	**1680**
Antimony	6/ 6/ NA	2.9 U	3.6 U	2.4	0.78 U	0.78 U	1.7	3	0.87 U	0.87 U	0.87 U
Arsenic	**10/** **10/** NA	**18.6**	**112**	17.5 U	3.9 U	4.9 U	**21.8**	**26.9**	0.83 U	0.83 U	0.86 U
Barium	2000/ 2000/ NA	57.9	258	88.5	50	50.4	45.4	42.6	85.7	82.9	43.7
Beryllium	4/ 4/ NA	0.12 U	0.6 U	0.13 U	0.13 U	0.13 U	0.12 U	0.13 U	0.12 U	0.12 U	0.12 U
Cadmium	5/ 5/ NA	0.13 U	0.7 U	0.56 U	0.07 U	0.08 U	0.36	0.52 U	0.1 U	0.1 U	0.1 U
Calcium	NA/ NA/ NA	5620	14900	8900	1830	1750	10900	11700	7820	7870	2830
Chromium	100/ 100/ NA	4.6	90.5	0.41 U	0.41 U	0.41 U	2.8	0.41 U	0.6 U	0.58 U	2.5
Cobalt	140/ NA/ NA	0.39	6.3 J	0.24 U	0.24 U	0.24 U	0.26 U	0.24 U	0.32	0.34	0.53 U
Copper	1000/ 1300/ 1000	4.8	32.2 J	0.75 U	0.75 U	0.75 U	11.8	0.75 U	1.5 U	2.3 U	26.7
Iron	**300/** NA/ NA	**34700**	**227000 J**	**54300**	**9380**	**9310**	**36100**	**41600**	172 J	169 J	**1540**
Lead	**15/** **15/** NA	**240**	**148**	**38.8**	13.6	14.4	**192**	**179**	0.91 U	0.91 U	1.7
Magnesium	NA/ NA/ NA	4480	7760	9470	2160	2150	4820	5660	880	893	1690
Manganese	**50/** NA/ **50**	**51.5**	**254**	**95.6**	20.9	21.2	**58.6**	**59.4**	43.6	42.7	19.5
Mercury	**2/** **2/** NA	0.02 U	0.13	0.03 U	0.03 U	0.03 U	0.02 U	0.03 U	0.02 U	0.02 U	0.03
Nickel	100/ NA/ NA	1.5	28.9 J	0.42 U	0.42 U	0.42 U	1.8	0.42 U	3.3	3.1	1.5
Potassium	NA/ NA/ NA	429	18100	2000	360 U	376 U	1540	1030	1030	1000	1470
Selenium	50/ 50/ NA	3.7 U	1.5 UJ	0.96 U	1.6	0.96 U	1.5 U	0.96 U	1.5 U	1.5 U	1.5 U
Silver	100/ NA/ 100	0.46 U	0.46 U	0.29 U	0.29 U	0.29 U	0.46 U	0.29 U	0.46 U	0.46 U	0.64
Sodium	160000/ NA/ NA	3620	7260	5270	2230	2220	3410	3720	1620	1630	2760
Thallium	**2/** **2/** NA	0.71 U	0.71 U	1.64 U	2.1 U	1.64 U	0.71 U	1.64 U	1.1 U	0.71 U	0.71 U
Vanadium	**49/** NA/ NA	2.6 U	48.1	0.38 U	0.38 U	0.38 U	2.2	0.65 U	0.74	0.5	3.8
Zinc	5000/ NA/ 5000	8	127 J	4.6	3.6	3.1	20	6.8	17.2 J	17.4 J	23.9

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] USEPA CFR Secondary Drinking Water Standard

[4] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits.
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DUP = Duplicate
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NA = Not applicable
µg/L = micrograms per liter
U = The analyte was not detected above method detection limits
USEPA = United States Environmental Protection Agency

Table 4-15
SUMMARY OF INORGANIC ANALYTES DETECTED IN NORTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 3 of 5

Sample Location		**WHF-1467-MW-27S**		**WHF-1467-MW-31S**		**WHF-1467-MW-31I**	**WHF-1467-MW-34S**	**WHF-1467-MW-35S**	**WHF-1467-MW-35I**	
Sample No.		1467G2701	1467G2701	1467G3101	1467G3101	1467G3102	1467G3401	1467G3501	1467G3502	1467G3502-DUP
Collect Date		20070805	20080607	20070805	20080608	20080619	20080619	20080618	20080618	20080618
	Groundwater Criteria[1/] Primary[2/] Secondary[3]									
Metals[4] (µg/L)										
Aluminum	**200/** NA/ **50-200**	37.1 U	25.5 U	**3040**	**1050**	103 U	46.8 U	**907 J**	88 U	78.6 U
Antimony	6/ 6/ NA	0.87 U	0.78 U	0.87 U	2	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U
Arsenic	**10/** **10/** NA	4.5 U	7.6	3.7 U	1.69 U	1.69 U	1.69 U	1.69 U	1.69 U	1.69 U
Barium	2000/ 2000/ NA	147	97.2	23.2	22.8	9	38.4	15.3	24.4	23.4
Beryllium	4/ 4/ NA	0.12 U	0.13 U	0.12 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
Cadmium	5/ 5/ NA	0.1 U	0.1 U	0.1 U	0.06 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Calcium	NA/ NA/ NA	4020	4380	2550	2320	2200	2820	2140	654	586
Chromium	100/ 100/ NA	0.64	0.6 U	3.5	5.4 U	1.7	1.3	5.5	0.94	1
Cobalt	140/ NA/ NA	0.26 U	0.24 U	0.37 U	0.24 U	0.24 U	0.6	1	0.24 U	0.24 U
Copper	1000/ 1300/ 1000	1.3 U	0.75 U	14.6	9.2	0.75 U	0.75 U	9.9	2.2	2.1
Iron	**300/** NA/ NA	**23500**	**27600**	**13100**	**2850**	**367**	**19200**	**4230**	**315**	286
Lead	**15/** **15/** NA	**31.6**	**63.7**	**438**	**30.8**	0.97 U	6	1.4	2	1.4
Magnesium	NA/ NA/ NA	4660	3490	2480	714	738	1740	740	745	715
Manganese	**50/** NA/ **50**	39.8	34.6	40.1	16.7	30.5	**229**	**130**	6.6	5.5
Mercury	**2/** **2/** NA	0.02 U	0.03 U	0.02	0.03	0.03 U	0.03 U	0.03 U	0.08	0.08
Nickel	100/ NA/ NA	0.41 U	0.42 U	0.41 U	1.2	1	2.8	2.4	0.54	0.47
Potassium	NA/ NA/ NA	343	275	316	248	583	347	1140	205 U	184 U
Selenium	50/ 50/ NA	1.5 U	0.96 U	1.5 U	2.5	0.96 U	0.96 U	0.96 U	0.96 U	1.6
Silver	100/ NA/ 100	0.46 U	0.29 U	0.46 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U
Sodium	160000/ NA/ NA	5730	4000 J	2000	3110 J	4510	3730	9950	1810	1710
Thallium	**2/** **2/** NA	0.71 U	1.64 U	0.71 U	**2.6**	1.64 U	1.64 U	1.64 U	1.64 U	1.64 U
Vanadium	**49/** NA/ NA	0.84 U	0.73 U	5	5.9 U	0.85 U	0.38 U	1.5 U	0.53 U	0.38 U
Zinc	5000/ NA/ 5000	2.3 U	14	9	8.1	3.9	5.4	5.9	6.1	4.4

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] USEPA CFR Secondary Drinking Water Standard

[4] SW-846 6010B

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Table 4-15
SUMMARY OF INORGANIC ANALYTES DETECTED IN NORTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Page 4 of 5

Sample Location		**WHF-1467-MW-36S**	**WHF-1467-MW-37S**	**WHF-32-MW-1S**		**WHF-32-MW-2S**	**WHF-32-MW-3S**	**WHF-32-MW-3I**
Sample No.		1467G3601	1467G3701	32G0101	32G0101	32G0201	32G0301	32G0302
Collect Date		20080618	20080619	20070816	20080513	20070817	20070818	20070816
	Groundwater Criteria[1/] Primary[2/] Secondary[3]							
Metals[4] (µg/L)								
Aluminum	**200/** NA/ **50-200**	104 U	**897 J**	**1920 J**	17.6 U	82.9 U	**891**	**989 J**
Antimony	6/ 6/ NA	0.89	0.8	2.3 U	2 U	0.87 U	0.87 U	1.3 U
Arsenic	**10/** **10/** NA	1.69 U	**24.6**	**17.7**	**18.8**	3.9	5.8	1.8 U
Barium	2000/ 2000/ NA	84	75.5	119	134	55.4	44.1	35.5
Beryllium	4/ 4/ NA	0.13 U	0.13 U	0.12 U	0.13 U	0.12 U	0.12 U	0.12 U
Cadmium	5/ 5/ NA	0.04 U	0.04 U	0.1 U	0.52 U	0.12 U	0.27 U	0.1 U
Calcium	NA/ NA/ NA	9150	8290	1160	979	563	1020	1240
Chromium	100/ 100/ NA	1.1	12.6	0.94 U	0.6 U	0.28 U	2.5	1.8 U
Cobalt	140/ NA/ NA	1.3	0.24 U	0.26 U	0.8 U	0.26 U	1	0.26 U
Copper	1000/ 1300/ 1000	0.75 U	14.5	0.44 U	0.75 U	0.32 U	8.2	9.3
Iron	**300/** NA/ NA	**27400**	**63700**	**93800 J**	**87300**	**14800**	**10700**	**2900 J**
Lead	**15/** **15/** NA	**25.8**	**50.8**	**110**	**142**	0.91 U	7	3
Magnesium	NA/ NA/ NA	5450	2680	1260	1440	1370	914	1060
Manganese	**50/** NA/ **50**	**300**	**112**	**9880**	**7000**	43	**468**	11.9
Mercury	**2/** **2/** NA	0.03 U	0.03 U	0.02 U	0.03 U	0.02 U	0.02 U	0.02 U
Nickel	100/ NA/ NA	0.69	12.2	0.41 U	0.42 U	0.41 U	0.63	0.86 U
Potassium	NA/ NA/ NA	570	1240	639 U	425 U	99.1	86 U	467 U
Selenium	50/ 50/ NA	0.96 U	0.96 U	1.5 U	0.96 U	1.5 U	4 U	1.5 U
Silver	100/ NA/ 100	0.29 U	0.29 U	0.55 U	0.29 U	0.46 U	0.46 U	0.46 U
Sodium	160000/ NA/ NA	12200	8600	7600	6670	2950	6710	2900
Thallium	**2/** **2/** NA	1.64 U	1.64 U	2.0 U	1.64 U	0.71 U	0.71 U	0.71 U
Vanadium	**49/** NA/ NA	0.9 U	4.8	2.7	0.38 U	1.1 U	2.6 U	10.4
Zinc	5000/ NA/ 5000	6.4	12	21.3 J	5.5	7.8	17.2	8.9 J

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] USEPA CFR Secondary Drinking Water Standard

[4] SW-846 6010B

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Table 4-15
SUMMARY OF INORGANIC ANALYTES DETECTED IN NORTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 5 of 5

Sample Location		**WHF-32-MW-5S**	**WHF-32-MW-8I**			**WHF-32-MW-9I**
Sample No.		32G0501	32G0802	32G0802	32G0802-DUP	32G0902
Collect Date		20070816	20070804	20080608	20080608	20070817
	Groundwater Criteria[1/] Primary[2/] Secondary[3]					
Metals[4] (µg/L)						
Aluminum	**200/** NA/ **50-200**	**122 J**	**22800**	55 U	24.2 U	**542**
Antimony	6/ 6/ NA	1.0 U	0.87 U	0.78 U	0.78 U	0.87 U
Arsenic	**10/** **10/** NA	1.7 U	**26.3**	1.69 U	1.69 U	1.2
Barium	2000/ 2000/ NA	58.7	306	19.5	20	37.9
Beryllium	4/ 4/ NA	0.12 U	0.51 U	0.13 U	0.13 U	0.12 U
Cadmium	5/ 5/ NA	0.1 U	0.1 U	0.04 U	0.04 U	0.1 U
Calcium	NA/ NA/ NA	792	1750	464	475	1110
Chromium	100/ 100/ NA	0.28 U	86.8	0.68 U	0.52 U	1.6 U
Cobalt	140/ NA/ NA	4.2	0.57 U	0.24 U	0.27	0.4
Copper	1000/ 1300/ 1000	1.3 U	31.4	0.75 U	0.75 U	6.8
Iron	**300/** NA/ NA	**8030 J**	**41400**	12.3	14.5	**431**
Lead	**15/** **15/** NA	0.91 U	**30.5**	0.97 U	1.2	1.9
Magnesium	NA/ NA/ NA	1280	2070	533	546	1260
Manganese	**50/** NA/ **50**	**651**	**117**	1.09 U	1.2	4.3
Mercury	**2/** **2/** NA	0.02 U	0.34	0.03 U	0.03 U	0.09
Nickel	100/ NA/ NA	0.47 U	5.3	0.42 U	0.79 U	0.63
Potassium	NA/ NA/ NA	273 U	1430	40.8 U	40.8 U	195
Selenium	50/ 50/ NA	1.5 U	1.5 U	1.2 U	0.96 U	1.7 U
Silver	100/ NA/ 100	0.46 U	0.46 U	0.29 U	0.29 U	0.46 U
Sodium	160000/ NA/ NA	3010	1500	1440 J	1460 J	1800
Thallium	**2/** **2/** NA	0.71 U	0.71 U	1.64 U	1.64 U	0.71 U
Vanadium	**49/** NA/ NA	0.8	**230**	0.38 U	0.38 U	1.2 U
Zinc	5000/ NA/ 5000	5.9 U	20.2	3.4	3.7	10.1

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005
[2] USEPA CFR Primary Drinking Water Standard
[3] USEPA CFR Secondary Drinking Water Standard
[4] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits.
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TABLE 4-16
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE-SITE 4
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample No.		4SB0322	4SB0620
Sample Location		WHF-04-SB-3	WHF-04-SB-6
Collect Date		6/28/2001	6/28/2001
Sample Depth (bls)		20-22'	18-20'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
SPLP Volatiles [4] (μg/L)			
Ethylbenzene	**30**/700/NA	ND	**170**
Toluene	**40**/1000/NA	ND	**267**
Xylenes	**20**/10000/NA	ND	**553**
SPLP Semivolatiles [5] (μg/L)			
SPLP Metals [6] (μg/L)			
Lead	15/15/NA	ND	7.2

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C., Table 1, February 2005.

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 6010B

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
NA = not applicable
ND = not detected above regulatory criteria
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
μg/L = micrograms per liter

TABLE 4-17
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE-SITE 32
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-32-SB-1	WHF-32-SB-B2	WHF-32-SB-E4	WHF-32-SB-N1	WHF-32-SB-S3
Sample No.		32SB0107	32SBB0212	32SBE0410	32SBN0110	32SBS0310
Collect Date		6/28/2001	6/28/2001	6/28/2001	6/28/2001	6/28/2001
Sample Depth (bls)		5-7'	10-12'	8-10'	8-10'	8-10'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]					
SPLP Volatiles [4] (µg/L)						
Ethylbenzene	**30**/700/NA	ND	**54.4**	ND	ND	NM
Xylenes	**20**/10000/NA	ND	**591**	2.6^{J}	NM	ND
SPLP Petroleum Hydrocarbons [5] (µg/L)						
Naphthalene	**14**/NA/NA	ND	**77**	ND	ND	NM
Total Petroleum Hydrocarbons[6]	5000/NA/NA	ND	2690	ND	ND	ND
SPLP Metals [7] (µg/L)						
Copper	1000/NA/1000	11	NM	NM	NM	NM
Lead	**15**/**15**/NA	**97**	ND	ND	ND	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8310, [6] FDEP FL-PRO, [7] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected
NM = not measured
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L =micrograms per liter

TABLE 4-18
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE - SITE 35
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 3

Sample Location		WHF-35-SB-11	WHF-35-SB-12	WHF-35-SB-13
Sample No.		35SB01115	35SB01220	35SB01315
Collect Date		5/14/2001	5/14/2001	5/14/2001
Sample Depth (bls)		13-15'	18-20'	13-15'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]			
SPLP Volatiles [4] (μg/L)				
Acetone	6300/NA/NA	ND	100	NM
TCLP Metals [5] (μg/L)		NM	NM	NM

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 6010B

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ND = not detected
NM = not measured
SPLP = Synthetic Precipitation Leaching Procedure
TCLP = Toxicity Characteristic Leaching Procedure
USEPA = United States Environmental Protection Agency
μg/L =micrograms per liter

TABLE 4-18
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE - SITE 35
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location		WHF-35-SB-10	WHF-35-SB-11	WHF-35-SB-11	WHF-35-SB-12	WHF-35-SB-12
Sample No.		35D01020	35D01115	35D01132	35D01230	35D01215
Collect Date		6/6/2000	6/6/2000	6/6/2000	6/6/2000	6/6/2000
Sample Depth (bls)		18-20'	13-15'	30-32'	28-30'	13-15'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]					
SPLP Volatiles [4] (µg/L)		NM	NM	NM	NM	NM
TCLP Metals [5] (µg/L)		ND	ND	ND	ND	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 6010B

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ND = not detected
NM = not measured
SPLP = Synthetic Precipitation Leaching Procedure
TCLP = Toxicity Characteristic Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L =micrograms per liter

TABLE 4-18
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE - SITE 35
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 3 of 3

Sample Location		WHF-35-SB-13	WHF-35-SB-13
Sample No.		35D01325	35D01320
Collect Date		6/6/2000	6/6/2000
Sample Depth (bls)		23-25'	28-20'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
SPLP Volatiles [4] (μg/L)		NM	NM
TCLP Metals [5] (μg/L)		ND	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 6010B

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ND = not detected
NM = not measured
SPLP = Synthetic Precipitation Leaching Procedure
TCLP = Toxicity Characteristic Leaching Procedure
USEPA = United States Environmental Protection Agency
μg/L =micrograms per liter

Table 4-19
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER SAMPLES FOR SITES 35, 36, AND 37
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 2

Sample Location			**WHF-35-1S**		**WHF-35-1I**	**WHF-35-1D**	**WHF-35-2S**	**WHF-35-2I**	
Sample No.			35G00101	35G00101D	35G00102	35G00103	35G00201	35G00202	35G00202D
Collect Date			19970611	19970611	19970612	19970611	19970615	19970615	19970615
	Groundwater Criteria [1]	Primary [2]							
Volatile Organics^{3} (µg/L)									
1,1-Dichloroethene	7	7	6 J	7J	NS	NS	NS	NS	NS
Chloroform	6	100/80	NS	NS	NS	NS	3 J	3 J	3 J
1,1,1-Trichloroethane	200	200	2 J	2J	NS	NS	NS	NS	NS
Carbon tetrachloride	3	5	NS	NS	NS	NS	NS	NS	NS
Trichloroethene	**3**	**5**	NS	NS	NS	NS	NS	NS	NS
Benzene	**1**	5	NS	NS	NS	NS	NS	NS	NS
Semivolatile Organic Compounds^{4} (µg/L)									
Pyrene	210	NA	NS	NS	NS	NS	1 J	NS	NS
bis(2-Ethylhexyl) phthalate	**6**	NA	NS	NS	NS	NS	**9 J**	NS	5 J
Metals^{5} and Cyanide^{6} (µg/L)									
Aluminum	**200**	NA	47.8 J	45.2 J	68.9 J	**245 J**	**3,380 J**	65 J	50.7 J
Barium	2,000	2000	78.8	79	21 J	23.5 J	32	24.8 J	25.3
Calcium	NA	NA	3,150	3,240	1,230	1,150	1,320	973	1,030
Chromium	100	100	NS	NS	NS	NS	7.6 J	NS	NS
Cobalt	NA	NA	NS	NS	NS	NS	NS	NS	NS
Iron	**300**	NA	NS	NS	NS	**407 J**	**6,050 J**	180 J	196 J
Magnesium	NA	NA	2,340	2,370	849	590	594	813	819
Maganese	**50**	NA	28.7 J	28.9 J	22.1 J	34.4 J	44.5 J	9.5 J	9.3 J
Nickel	100	100	NS	NS	NS	NS	14.1 J	NS	NS
Potassium	NA	NA	NS	NS	NS	NS	NS	NS	NS
Selenium	50	50	NS	NS	NS	NS	NS	NS	2.6 J
Sodium	160,000	NA	4,330 J	4,430 J	3,700 J	3,970 J	19,900 J	20,900 J	21,700 J
Vanadium	49	NA	NS	NS	NS	NS	10.9	NS	NS
Zinc	5000	NA	NS	130	NS	NS	NS	NS	NS
Cyanide	200	200	NS	NS	NS	NS	NS	NS	NS

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-770 F.A.C., Table 1, February 2005

[2] USEPA Primary Drinking Water Standard

[3] SW-846 8260B, [4] SW-846 8270C, [5] SW-846 6010B, [6] USEPA 335.2

Notes: **Bold** indicates an exceedance of regulatory limits.
Bold indicates which regulatory limit has been exceeded.

D = A "D" at the end of a sample number nomenclature indicates a duplicate
F.A.C. = Florida Administrative Code
J = The detection is estimated
NA = Not applicable
NS = Analyte not sampled for
µg/L = micrograms per liter
U = The analyte was not detected above method detection limits

Table 4-19
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER SAMPLES FOR SITES 35, 36, AND 37
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 2 of 2

Sample Location			**WHF-35-2D**	**WHF-36-1S**	**WHF36-1I**	**WHF-36-1D**	**WHF-37-1S**	**WHF-37-1I**
Sample No.			35G00203	36G00101	36G00102	36G00103	37G00101	37G00102
Collect Date			19970615	19970612	19970613	19970613	19970612	19970612
	Groundwater Criteria [1]	Primary [2]						
Volatile Organics[3] (µg/L)								
1,1-Dichloroethene	7	7	1 J	2 J	2 J	NS	4 J	7 J
Chloroform	6	100/80	NS	NS	NS	NS	NS	NS
1,1,1-Trichloroethane	200	200	NS	NS	2 J	NS	3 J	6 J
Carbon tetrachloride	3	5	NS	1 J	NS	NS	NS	NS
Trichloroethene	**3**	**5**	NS	**16**	**17**	NS	5 J	3 J
Benzene	**1**	5	NS	NS	NS	NS	NS	**3 J**
Semivolatile Organic Compounds[4] (µg/L)								
Pyrene	210	NA	NS	NS	NS	NS	NS	NS
bis(2-Ethylhexyl) phthalate	**6**	NA	NS	NS	NS	NS	NS	NS
Metals[5] and Cyanide[6] (µg/L)								
Aluminum	**200**	NA	38.2 J	151 J	108 J	30.7 J	50.4 J	24.7 J
Barium	2,000	2000	77.3	14.5 J	13.8 J	5.6 J	43.6	32.5
Calcium	NA	NA	4,570	1,410	992	NS	5,120	869
Chromium	100	100	NS	NS	NS	NS	NS	NS
Cobalt	NA	NA	3.4 J	NS	NS	NS	NS	NS
Iron	**300**	NA	NS	NS	NS	253 J	**530 J**	NS
Magnesium	NA	NA	3,200	731	396 J	142 J	1,150	1,150
Maganese	**50**	NA	**109 J**	44 J	28.9 J	28.8 J	**178 J**	**83.5 J**
Nickel	100	100	22.8	NS	NS	NS	12.1 J	NS
Potassium	NA	NA	1,080 J	NS	NS	NS	NS	NS
Selenium	50	50	NS	NS	NS	NS	NS	NS
Sodium	160,000	NA	7,730 J	5,330 J	6,720 J	3,190 J	8,410 J	4,390 J
Vanadium	49	NA	NS	NS	NS	NS	NS	NS
Zinc	5000	NA	NS	NS	NS	NS	NS	NS
Cyanide	200	200	NS	NS	1.8 J	NS	2.2 J	NS

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-770 F.A.C., Table 1, February 2005

[2] USEPA Primary Drinking Water Standard

[3] SW-846 8260B, [4] SW-846 8270C, [5] SW-846 6010B, [6] USEPA

Notes: **Bold** indicates an exceedance of regulatory limits.
Bold indicates which regulatory limit has been exceeded.

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NA = Not applicable
NS = Analyte not sampled for
µg/L = micrograms per liter
U = The analyte was not detected above method detection limits

TABLE 4-20
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL LEACHATE-SITE 41
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-1485C-SS-1	WHF-1485C-SS-2	WHF-1485C-SS-3	WHF-1485C-SS-4	WHF-1485C-SS-5	WHF-1485C-SS-6
Sample No.		1485CD00101	1485CD00201	1485CD00301	1485CD00401	1485CD00501	1485CD00601
Collect Date		5/24/2000	5/24/2000	5/24/2000	5/24/2000	5/24/2000	5/24/2000
Sample Depth (bls)		0-1'	0-1'	0-1'	0-1'	0-1'	0-1'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]						
SPLP Semivolatiles [4] (µg/L)		NM	ND	ND	NM	NM	ND
SPLP Pesticides/PCBs [5] (µg/L)		ND	ND	ND	ND	ND	ND
SPLP Total Petroleum Hydrocarbons [6] (µg/L)		ND	NM	NM	ND	ND	ND
SPLP Metals [7] (µg/L)							
Aluminum	**200**/NA/**50-200**	**72800**	**53800**	**13000**	**23800**	**54600**	**64500**
Barium	2000/2000/NA	53	33	14	31	38	78
Calcium	NA/NA/NA	5200	7500	2400	9000	6200	8100
Chromium	100/100/NA	46	37	ND	20	37	42
Copper	1000/NA/1000	17	13	ND	16	28	18
Iron	**300**/NA/**300**	**34800**	**31400**	**6600**	**11100**	**28900**	**26400**
Lead	**15**/**15**/NA	**23**	ND	ND	**190**	**31**	**37**
Magnesium	NA/NA/NA	1800	1200	810	1300	1600	2000
Manganese	**50**/NA/**50**	**220**	**210**	**110**	**130**	**250**	**550**
Nickel	100/NA/NA	ND	ND	ND	ND	ND	21
Potassium	NA/NA/NA	2900^{J}	3300^{J}	ND	ND	2300^{J}	4100^{J}
Sodium	160000/NA/NA	5700	5100	8400	9800	11300	8000
Vanadium	**49**/NA/NA	**94**	**80**	19	40	**76**	**84**
Zinc	5000/NA/5000	53^{J}	47^{J}	ND	120^{J}	64^{J}	66^{J}

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standards

[3] USEPA 40 CFR Secondary Drinking Water Standards

[4] SW-846 8270C, [5] SW-846 8081A/8082, [6] FDEP FL-PRO, [7] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
NM = not measured
ND = not detected
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-21
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE-SITE 41
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-1485C-SB-5	WHF-1485C-SB-6	WHF-1485C-SB-7	WHF-1485C-SB-8
Sample No.		1485CD00510	1485CD00605	1485CD00705	1485CD00810
Collect Date		6/5/2000	6/5/2000	6/5/2000	6/5/2000
Sample Depth (bls)		8-10'	3-5'	3-5'	8-10'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]				
SPLP Pesticides/PCBs [4] (µg/L)		ND	ND	ND	ND
SPLP Metals [5] (µg/L)					
Mercury	2/2/NA	1.3	ND	0.72	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standards

[3] USEPA 40 CFR Secondary Drinking Water Standards

[4] SW-846 8081A/8082, [5] SW-846 6010B/7470

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

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F.A.C. = Florida Administrative Code
ND = not detected
NA = not applicable
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-22
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITE 41
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-1485C-MW-1S	WHF-1485C-MW-1S
Sample No.		1485CG00101	1485CG00101D
Collect Date		6/1/2000	6/1/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
Volatiles [4] (µg/L)		ND	ND
Semivolatiles [5] (µg/L)			
DEHP	**6**/**6**/NA	**25.9**	**64.4**
Pesticides/PCBs [6] (µg/L)		ND	ND
Total Petroleum Hydrocarbons [7] (µg/L)		ND	ND
Metals [8] (µg/L)			
Aluminum	**200**/NA/**50-200**	**4940**^{J}	**3340**^{J}
Barium	2000/2000/NA	21.2	17.4
Calcium	NA/NA/NA	7000	5750
Chromium	100/100/NA	13.4	8.9
Iron	**300**/NA/**300**	**7080**^{J}	**4660**^{J}
Magnesium	NA/NA/NA	699	618
Manganese	50/NA/50	11.1	8.3
Sodium	160000/NA/NA	4490	4760
Vanadium	49/NA/NA	46.1	30.3
Zinc	5000/NA/5000	9.9	8.6
Cyanide [9] (µg/L)	200/200/NA	6.0	9.0

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081A/8082, [7] FDEP FL-PRO, [8] SW-846 6010B, [9] USEPA 335.2

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations

D = A "D" at the end of sample number nomenclature indicates a duplicate

DEHP = Bis(2-ethylhexyl)phthalate

F.A.C. = Florida Administrative Code

FDEP = Florida Department of Environmental Protection

FL-PRO = Florida Petroleum Range Organics

^{J} Indicates the presence of a chemical at an estimated concentration.

ND = not detected

NA = not applicable

PCBs = Polychlorinated Biphenyls

µg/L = micrograms per liter

USEPA = United States Environmental Protection Agency

TABLE 4-23
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE-SITE 1438/1439
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-1438-SS-7	WHF-1438-SB-7
Sample No.		1438D00717	1438SB0721
Collect Date		5/3/2000	6/30/2001
Sample Depth (bls)		17-19'	19-21'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
SPLP Volatiles [4] (μg/L)		ND	NM
SPLP Semivolatile [5] (μg/L)		ND	NM
TCLP Pesticides/PCBs [6] (μg/L)		ND	NM
SPLP Total Petroleum Hydrocarbons [7] (μg/L)		ND	NM
SPLP Metals [8] (μg/L)			
Aluminum	**200**/NA/**50-200**	NM	**240**

[1] Groundwater Clean-up Criteria as provided in Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standards

[3] USEPA 40 CFR Secondary Drinking Water Standards

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081A/8082, [7] FDEP FL-PRO, [8] SW-846 6010B

Notes: **Bold** indicates an exceedance of limits. **Bold** indicates which regulatory limit was exceeded.

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CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
NA = not applicable
ND = not detected
NM = not measured
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
TCLP = Toxicity Characteristic Leaching Procedure
USEPA = Unites States Environmental Protection Agency
μg/L = micrograms per liter

TABLE 4-24
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITE 1438/1439
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-1438-MW-2S	WHF-1438-MW-2D	WHF-1438-MW-3S	WHF-1438-MW-5S	WHF-1438-MW-6S	WHF-1438-MW-7S	WHF-1438-MW-7S
Sample No.		1438G0201	1438G0203	1438G0301	1438G0501	1438G0601	1438G0701	1438G0701
Collect Date		12/11/2010	12/11/2010	12/10/2010	12/10/2010	12/10/2010	2/20/2001	12/11/2010
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]							
Volatiles [4] (µg/L)								
1,2-Dibromoethane	**0.02**/0.05/NA	NM	NM	NM	NM	NM	**0.023**	NM
Acetone	700/NA/NA	NM	NM	NM	NM	NM	18.3	NM
Benzene	**1**/**5**/NA	**12.9**	ND	ND	ND	ND	**63.6**	0.363^{J}
Ethylbenzene	30/700/NA	1.16 ^{J}	ND	ND	ND	ND	0.90^{J}	ND
Xylenes, total	20/10000/NA	3.3	ND	ND	ND	ND	7.2	ND
Total Petroleum Hydrocarbons [5] (µg/L)	5000/NA/NA	NM	NM	NM	NM	NM	1640	NM
Metals [6] (µg/L)		NM	NM	NM	NM	NM	ND	NM

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-843 8260B, [5] FDEP FL-PRO, [6] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

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FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration.
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NM = not measured
µg/L = micrograms per Liter
USEPA = United States Environmental Protection Agency

TABLE 4-25
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER-SITE 2832
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-2832-MW-1S	WHF-2832-MW-2S	WHF-2832-MW-3S	WHF-2832-MW-4S
Sample No.		WHF-2832-MW-1S	WHF-2832-MW-2S	AVGEGL3S01	AVGEGL4S01
Collect Date		5/22/2002	5/22/2002	10/1/2002	10/17/2002
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]				
Volatiles [4] (µg/L)					
Trichloroethene	3/5/NA	ND	0.76^J	ND	ND
Semivolatiles [5] (µg/L)					
DEHP	**6**/**6**/NA	**8.4^J**	ND	NM	NM
Polycyclic Aromatic Hydrocarbons [6] (µg/L)					
Benzo(b)Fluoranthene	0.20/NA/NA	ND	ND	0.10^J	ND
Pesticides/PCBs [7] (µg/L)		ND	ND	NM	NM
Total Petroleum Hydrocarbons [8] (µg/L)		ND	ND	ND	ND
Metals [9] (µg/L)					
Aluminum	**200**/NA/**50-200**	**1300**	**495**	NM	NM
Barium	2000/2000/NA	35.2	8.6	NM	NM
Calcium	NA/NA/NA	1440^J	1090^J	NM	NM
Chromium	100/100/NA	0.87	ND	NM	NM
Cobalt	420/NA/NA	1.4	ND	NM	NM
Copper	1000/1000/NA	17.7	0.5	NM	NM
Iron	**300**/NA/**300**	**880**	271	NM	NM
Lead	15/15/NA	ND	ND	10.3	ND
Magnesium	NA/NA/NA	606^J	328^J	NM	NM
Manganese	**50**/NA/**50**	**51.1**	23.7	NM	NM
Nickel	100/NA/NA	3.1	ND	NM	NM
Sodium	160000/NA/NA	14800	6210	NM	NM
Vanadium	49/NA/NA	1.5	ND	NM	NM
Zinc	5000/NA/5000	51.5	5.2	NM	NM
Cyanide [10] (µg/L)		ND	ND	NM	NM

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8310, [7] SW-846 8081/8082, [8] FDEP FL-PRO, [9] SW-846 6010B, [10] SW-846 9010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

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DEHP = Bis(2-ethylhexyl)phthalate
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NM = not measured
PCBs = Polychlorinated Biphenyls
USEPA = United States Environmental Protection Agency
µg/L = micrograms per Liter

TABLE 4-26
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER-SITE 2894
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 1 OF 4

Sample Location		WHF-2894-MW-1S	WHF-2894-MW-2S				WHF-2894-MW-3S		
Sample No.		2894G0102	W94MW0020101	2894GL0201	2894GL0202	2894G0202	W94MW0030101	2894GL0301	2894G0302
Collect Date		12/11/2010	4/20/1998	12/21/2001	7/24/2002	12/11/2010	4/27/1998	12/21/2001	7/24/2002
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]								
Volatiles [4] (µg/L)									
1,2-Dibromoethane		NM	NM	ND	ND	NM	ND	ND	NM
Chloromethane	2.7/NA/NA	NM	ND	ND	ND	NM	1.2	ND	NM
Toluene	40/1,000/NA	NM	ND	ND	ND	NM	ND	ND	NM
Semivolatiles [5] (µg/L)									
1-Methylnaphthalene	28/NA/NA	NM	ND	NM	ND	NM	ND	NM	NM
2-Methylnaphthalene	28/NA/NA	NM	ND	NM	ND	NM	ND	NM	NM
Dibenzo(a,h)anthracene	**0.2**/NA/NA	NM	ND	NM	ND	NM	**1.0**^{J}	NM	NM
Di-n-butyl phthalate	700/NA/NA	NM	ND	NM	NM	NM	18^{J}	NM	NM
Indeno(1,2,3-c,d)pyrene	**0.2**/NA/NA	NM	ND	NM	ND	NM	**1.0**^{J}	NM	NM
Naphthalene	14/NA/NA	NM	ND	NM	ND	NM	ND	NM	NM
Polycyclic Aromatic Hydrocarbons[6] (µg/L)		NM	NM	ND	NM	NM	NM	ND	NM
Total Petroleum Hydrocarbons[7] (µg/L)		NM	ND	NM	NM	NM	ND	NM	NM
Dissolved Gases [8] (µg/L)									
Ethane	NA/NA/NA	NM	ND	NM	NM	NM	ND	NM	NM
Methane	NA/NA/NA	NM	ND	NM	NM	NM	ND	NM	NM

[1] Groundwater criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B or USEPA 601/602/504, [5] SW-846 8270C, [6] USEPA 610, [7] FDEP FL-PRO, [8] SM 3810

Notes: **Bold** indicates an exceedance of limits. **Bold** indicates which regulatory limit was exceeded.

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ND = not detected
NM = not measured
µg/L =micrograms per liter
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TABLE 4-26
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER-SITE 2894
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location		WHF-2894-3I		WHF-2894-MW-4I	WHF-2894-MW-5S		WHF-2894-MW-7S		
Sample No.		2894G0302	WHF2894G0302	2894G0402	2894GL0501	2894GL0502	2894GL0701	2894GL0702	2894G0701
Collect Date		7/24/2002	2/28/2011	3/1/2011	12/21/2001	7/23/2002	12/20/2001	7/24/2002	12/12/2010
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]								
Volatiles [4] (μg/L)									
1,2-Dibromoethane		0.015 J	NM	NM	ND	ND	ND	ND	NM
Chloromethane	2.7/NA/NA	ND	NM	NM	ND	ND	ND	ND	NM
Toluene	40/1000/NA	ND	0.261 J	ND	ND	0.51 J	ND	ND	ND
Semivolatiles [5] (μg/L)									
1-Methylnaphthalene	28/NA/NA	ND	NM	NM	NM	7.9	NM	1.8	NM
2-Methylnaphthalene	28/NA/NA	ND	NM	NM	NM	5.9	NM	1.9	NM
Dibenzo(a,h)anthracene	0.2/NA/NA	ND	NM	NM	NM	ND	NM	ND	NM
Di-n-butyl phthalate	700/NA/NA	NM	NM	NM	NM	NM	NM	NM	NM
Indeno(1,2,3-c,d)pyrene	0.2/NA/NA	ND	NM	NM	NM	ND	NM	ND	NM
Naphthalene	14/NA/NA	ND	NM	NM	NM	0.59 J	NM	0.65 J	NM
Polycyclic Aromatic Hydrocarbons[6] (μg/L)		NM	NM	NM	ND	NM	ND	NM	NM
Total Petroleum Hydrocarbons[7] (μg/L)		NM	NM	NM	NM	NM	NM	NM	NM
Dissolved Gases [8] (μg/L)									
Ethane	NA/NA/NA	NM	2.7 J	ND	NM	NM	NM	NM	NM
Methane	NA/NA/NA	NM	11.6	ND	NM	NM	NM	NM	NM

[1] Groundwater criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B or USEPA 601/602/504, [5] SW-846 8270C, [6] USEPA 610, [7] FDEP FL-PRO, [8] SM 3810

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[J] Indicates the presence of a chemical at an estimated concentration.
NA = not applicatble
ND = not detected
NM = not measured
μg/L =micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-26
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER-SITE 2894
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 3 OF 4

Sample Location		WHF-2894-MW-2S				WHF-2894-MW-3S		
Sample No.		W94MW0020101	2894GL0201	2894GL0202	2894G0202	W94MW0030101	2894GL0301	2894G0302
Collect Date		4/20/1998	12/21/2001	7/24/2002	12/11/2010	4/27/1998	12/21/2001	7/24/2002
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]							
Metals [4] (µg/L)								
Aluminum	**200**/NA/**50-200**	ND	NM	NM	NM	**1640^J**	NM	NM
Barium	2000/2000/NA	31.6	NM	NM	NM	21	NM	NM
Calcium	NA/NA/NA	ND	NM	NM	NM	4030	NM	NM
Chromium	100/100/NA	ND	NM	NM	NM	63.1	NM	NM
Copper	1000/NA/1000	ND	NM	NM	NM	5.2	NM	NM
Iron	**300**/NA/**300**	ND	NM	NM	NM	**2020^J**	NM	NM
Magnesium	NA/NA/NA	878	NM	NM	NM	871	NM	NM
Manganese	50/NA/50	11.5	NM	NM	NM	13.4	NM	NM
Nickel	100/NA/NA	ND	NM	NM	NM	42.7	NM	NM
Potassium	NA/NA/NA	ND	NM	NM	NM	7490	NM	NM
Sodium	160000/NA/NA	2590	NM	NM	NM	4270	NM	NM
Vanadium	49/NA/NA	ND	NM	NM	NM	5.9	NM	NM
Zinc	5000/NA/5000	23.6	NM	NM	NM	ND	NM	NM
Dissolved Metals (ug/L)		NM	NM	NM	NM	NM	NM	NM
Inorganic Parameters [5] (µg/L)								
Chloride	250000/NA/250000	4560	NM	NM	NM	4610	NM	NM
Nitrate	10000/NA/10000	1390	NM	NM	NM	1340^J	NM	NM
Reactive Sulfide	NA/NA/NA	3000	NM	NM	NM	ND	NM	NM
Sulfate	250000/NA/250000	331	NM	NM	NM	1510	NM	NM

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 6010B, [5] USEPA 300/376.1/415.1

Notes: **Bold** indicates an exceedance of regulatory limits.**Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicatble
ND = not detected
NM = not measured
µg/L =micrograms per Liter
USEPA = United States Environmental Protection Agency

TABLE 4-26
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER-SITE 2894
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 4 OF 4

Sample Location		WHF-2894-MW-3I	WHF-2894-MW-4I	WHF-2894-MW-5S		WHF-2894-MW-7S		
Sample No.		WHF2894G0302	2894G0402	2894GL0501	2894GL0502	2894GL0701	2894GL0702	2894G0701
Collect Date		2/28/2011	3/1/2011	12/21/2001	7/23/2002	12/20/2001	7/24/2002	12/12/2010
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]							
Metals [4] (µg/L)		NM	NM	NM	NM	NM	NM	NM
Dissolved Metals (ug/L)								
Iron	**300**/NA/**300**	**2950**	**327**	NM	NM	NM	NM	NM
Manganese	**50**/NA/**50**	**161**	39.9	NM	NM	NM	NM	NM
Inorganic Parameters [5] (µg/L)								
Alkalinity	NA/NA/NA	14300	4900	NM	NM	NM	NM	NM
Carbon Dioxide	NA/NA/NA	38100	15800	NM	NM	NM	NM	NM
Chloride	250000/NA/250000	4670	3140	NM	NM	NM	NM	NM
Dissolved Organic Carbon	NA/NA/NA	432 J	274 J	NM	NM	NM	NM	NM
Nitrate	10000/NA/10000	1230	382 J	NM	NM	NM	NM	NM
Reactive Sulfide	NA/NA/NA	NM	NM	NM	NM	NM	NM	NM
Sulfate	250000/NA/250000	1320 J	1650 J	NM	NM	NM	NM	NM
Total Organic Carbon	NA/NA/NA	582 J	ND	NM	NM	NM	NM	NM

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005
[2] USEPA 40 CFR Primary Drinking Water Standard
[3] USEPA 40 CFR Secondary Drinking Water Standard
[4] SW-846 6010B, [5] USEPA 300/376.1/415.1

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[J] Indicates the presence of a chemical at an estimated concentration.
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ND = not detected
NM = not measured
µg/L =micrograms per Liter
USEPA = United States Environmental Protection Agency

TABLE 4-27
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL LEACHATE - SITE 5
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD
Page 1 of 1

Sample Location		WHF-05A-SS-2	WHF-05A-SS-4
Sample No.		05SS0202	05SS0402
Collect Date		8/14/2001	8/14/2001
Sample Depth (bls)		0-2'	0-2'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
SPLP Pesticides/PCBs [4] (μg/L)			
Dieldrin	**0.002**/NA/NA	ND	**0.80**
SPLP Metals[5] (μg/L)			
Aluminum	**200**/NA/**50-200**	**1400**	**1600**
Iron	**300**/NA/**300**	**950**	**980**
Lead	**15**/**15**/NA	ND	**16**
Manganese	50/NA/50	9.8^{J}	39^{J}

[1] Groundwater criteria from Chapter 62-550 F.A.C. and/or 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8081A, [5] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
μg/L = micrograms per liter

TABLE 4-28
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE - SITE 6
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-06-SB-1	WHF-06-SB-2
Sample No.		6SB0107	6SB0217
Collect Date		6/28/2001	6/28/2001
Sample Depth (bls)		5-7'	15-17'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
SPLP Volatiles [4] (μg/L)		ND	ND
SPLP Pesticides/PCBs [5] (μg/L)		ND	ND
SPLP Metals [6] (μg/L)		ND	ND

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 F.A.C., Chapter 62-777 F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8081A, [6] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
ND = not detected
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
μg/L = micrograms per liter

TABLE 4-29
SUMMARY OF ANALYTES DETECTED IN LEACHATE-SITE 33
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-33-SB-2	WHF-33-SB-5
Sample No.		33SB0207	33SB0510
Collect Date		6/29/2001	6/29/2001
Sample Depth (bls)		5-7'	8-10'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
SPLP Volatiles [4] (μg/L)		ND	ND
SPLP Pesticides/PCBs [5] (μg/L)		ND	ND
SPLP Total Petroleum Hydrocarbons [6] (μg/L)		ND	ND
SPLP Metals [7] (μg/L)			
Aluminum	**200**/NA/**50-200**	**5900**	ND
Iron	**300**/NA/**300**	**3200**	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005.

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8081, [6] FDEP FL-PRO, [7] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
NA = not applicable
ND = not detected
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitate Leachate Procedure
USEPA = United States Environmental Protection Agency
μg/L =micrograms per liter

TABLE 4-30
SUMMARY OF VOLATILE ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 26

Sample Location			**WHF-06-MW-1S**			**WHF-06-MW-3D**		
Sample No.			06G0101	06G0101	WHF06G0101	06G0303	06G0303	WHF06G0303
Collect Date			20070807	20080509	20110225	20070807	20080509	20110225
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	1.6	0.75 U	0.678	1.7	0.75 U	10
CIS-1,2-Dichloroethene	**70**	**70**	11	10	13.7	4	3	6.39
Ethylbenzene	**30**	**700**	0.5 J	0.4 U	0.25 U	0.6 J	0.4 U	1.43
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.7 J	0.3 U	0.678 J	0.7 J	0.3 U	5.23
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.4 U	0.4 U	3.34
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**270**	**230**	**208**	**160**	**95**	**142**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 U	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	1 U	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or
62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1, [4] SM 3810

Notes: **Bold** indicates an exceedance of regulatory limits.
Bold indicates which regulatory limit was exceeded.
Sample number nomenclature that have a "D" at the end
represent duplicate samples

BTEX = Benzene, Tolulene, Ethylbenzene, Xylene
CFR = Code of Federal Regulations
D = A 'D' at the end of sample number nomenclature indicates a duplicate
F.A.C. = Florida Administrative Code
J = The detection is estimated
NA = Not applicable
NS = Analyte not sampled for
ug/L = micrograms per liter
U = The analyte was not detected above method
detection limits
USEPA = United States Environmental Protection Agency

TABLE 4-30
SUMMARY OF VOLATILE ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 2 of 26

Sample Location			**WHF-07-MW-1I**			**WHF-1466-MW-1S**		
Sample No.			07G0102	07G0102	WHF07G0102	1466G0101	1466G0101	WHF1466G0101
Collect Date			20070806	20080512	20110303	20070804	20080607	20110302
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	2 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	**1800**	**2900**	**1010**	**4**	**4**	0.382 J
BTEX Total	NA	NA	10800	10900	5384.8	4.55	4.5	0.382
CIS-1,2-Dichloroethene	**70**	**70**	12	11	5.52 J	5	2	0.26 J
Ethylbenzene	**30**	**700**	**2300**	**2200**	**1840**	0.4 U	0.3 U	0.25 U
Tetrachloroethene	3	5	0.5 U	2 U	5 U	0.5 U	0.4 U	0.25 U
Toluene	**40**	**1000**	**3000**	**2800**	14.8 J	0.3 U	0.4 U	0.25 U
Total Xylenes	**20**	10000	**3700**	**3080**	**2520**	0.4 U	0.3 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	2 U	5 U	0.5 U	0.4 U	0.25 U
Trichloroethene	**3**	**5**	1	3 J	5 U	**50**	**31**	**24.8**
Vinyl Chloride	1	2	0.4 U	2 U	5 U	0.4 U	0.3 U	0.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	15.3	NS	NS	1 U
Ethene	NA	NA	NS	NS	2.4 J	NS	NS	1 U
Methane	NA	NA	NS	NS	2660 J	NS	NS	11.1

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1, [4] SM 3810

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TABLE 4-30
SUMMARY OF VOLATILE ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-1466-MW-2I**				**WHF-1466-MW-6I**		
Sample No.			1466G0202	1466G0202	WHF1466G0202	WHF1466G0202-D	1466G0602	1466G0602	WHF1466G0602
Collect Date			20070806	20080508	20110302	20110302	20070804	20080607	20110302
	Groundwater Criteria[1]	Primary[2]							
Volatile Organics[3] (ug/L)									
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	0.25 U	0.4 U	0.3 U	0.25 U
BTEX Total	NA	NA	1.5	0.75 U	0.99	0.908	0.75 U	0.65 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	0.6 J	0.3 U	0.338 J	0.409 J	0.3 U	0.2 U	0.25 U
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.473 J	0.476 J	0.4 U	0.3 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.408 J	0.468 J	0.5 U	0.4 U	0.25 U
Toluene	**40**	**1000**	0.9 J	0.3 U	0.517 J	0.432 J	0.3 U	0.4 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.75 U	0.4 U	0.3 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.25 U	0.5 U	0.4 U	0.25 U
Trichloroethene	**3**	**5**	**25**	**11**	**21.5**	**18.9**	**5**	**6**	1.48
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.25 U	0.4 U	0.3 U	0.25 U
Volatile Gases[4] (ug/L)									
Ethane	NA	NA	NS	NS	1 U	NS	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	NS	1 U
Methane	NA	NA	NS	NS	5.15	NS	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1, [4] SM 3810

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TABLE 4-30
SUMMARY OF VOLATILE ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 4 of 26

Sample Location			**WHF-1466-MW-12S**			**WHF-1466-MW-13S**		
Sample No.			1466G1201	1466G1201	WHF1466G1201	1466G1301	1466G1301	WHF1466G1301
Collect Date			20070806	20080508	20110302	20070808	20080508	20110302
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.258 J	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	1.5	0.75 U	2.403	0.75 U	0.75 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	4	0.8 J	1.91	68	**72**	24.7
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.848 J	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.26 J	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.9 J	0.3 U	0.54 J	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.757 J	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.6 J	1	0.25 U
Trichloroethene	**3**	**5**	**120**	**28**	**37.4**	**160**	**180**	**99.9**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 U	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	10.1	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1, [4] SM 3810

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TABLE 4-30
SUMMARY OF VOLATILE ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-1466-MW-15S**			**WHF-1466-MW-16S**
Sample No.			1466G1501	1466G1501	WHF1466G1501	1466G1601
Collect Date			20070804	20080607	20110303	20110316
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	NS
Benzene	**1**	**5**	0.4 U	0.3 U	0.25 U	0.25 U
BTEX Total	NA	NA	0.75 U	0.65 U	3.554	0.0
CIS-1,2-Dichloroethene	**70**	**70**	20	1	28.2	0.53 J
Ethylbenzene	**30**	**700**	0.4 U	0.3 U	0.394 J	0.25 U
Tetrachloroethene	3	5	0.5 U	0.4 U	0.25 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.4 U	2.03	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.3 U	1.13 J	0.75 U
Trans-1,2-Dichloroethene	100	100	0.6 J	0.4 U	0.25 U	0.25 U
Trichloroethene	**3**	**5**	**76**	**25**	**114**	**15.5**
Vinyl Chloride	1	2	0.4 U	0.3 U	0.25 U	0.25 U
Volatile Gases[4] (ug/L)						
Ethane	NA	NA	NS	NS	1 U	1 U
Ethene	NA	NA	NS	NS	1 U	1 UJ
Methane	NA	NA	NS	NS	2.7 J	4.26

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005
[2] USEPA CFR Primary Drinking Water Standard
[3] SW-846 8260B/EPA 504.1, [4] SM 3810

Notes: **Bold** indicates an exceedance of regulatory limits.
Bold indicates which regulatory limit was exceeded.
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CFR = Code of Federal Regulations
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NS = Analyte not sampled for
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TABLE 4-30
SUMMARY OF VOLATILE ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 6 of 26

Sample Location			**WHF-1466-MW-18S**		
Sample No.			1466G1801	1466G1801	WHF1466G1801
Collect Date			20070807	20080512	20110303
	Groundwater Criteria[1]	Primary[2]			
Volatile Organics[3] (ug/L)					
1,2-Dibromoethane	0.02	0.05	0.3 U	0.7 U	NS
Benzene	**1**	**5**	**1200**	**1400**	**531**
BTEX Total	NA	NA	5700	7350	5739.1
CIS-1,2-Dichloroethene	**70**	**70**	29	30	13.9 J
Ethylbenzene	**30**	**700**	**1700**	**2200**	**1710**
Tetrachloroethene	3	5	0.5 U	0.9 U	5 U
Toluene	**40**	**1000**	**700**	**150**	28.1
Total Xylenes	**20**	10000	**2058**	**3665**	**3470**
Trans-1,2-Dichloroethene	100	100	0.5 U	1 U	5 U
Trichloroethene	**3**	**5**	**4**	2	5 U
Vinyl Chloride	1	2	0.4 U	0.9 U	5 U
Volatile Gases[4] (ug/L)					
Ethane	NA	NA	NS	NS	11.4
Ethene	NA	NA	NS	NS	1 U
Methane	NA	NA	NS	NS	324 J

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1, [4] SM 3810

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TABLE 4-30
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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 7 of 26

Sample Location			**WHF-1466-MW-19S**			
Sample No.			1466G1901	1466G1901-D	1466G1901	WHF1466G1901
Collect Date			20070807	20070807	20080508	20110302
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.4 U	0.5 J
BTEX Total	NA	NA	2.3	1.4	0.75 U	0.769
CIS-1,2-Dichloroethene	**70**	**70**	0.3 U	0.3 U	0.3 U	0.25 U
Ethylbenzene	**30**	**700**	0.6 J	0.5 J	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.5 J	0.5 J	0.3 U	0.269 J
Total Xylenes	**20**	10000	1 J	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	0.5 U	0.5 U	**7**	0.274 J
Vinyl Chloride	1	2	0.4 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)						
Ethane	NA	NA	NS	NS	NS	1 U
Ethene	NA	NA	NS	NS	NS	1 U
Methane	NA	NA	NS	NS	NS	13.4

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-1466-MW-20S**			
Sample No.			1466G2001	1466G2001	1466G2001-D	WHF1466G2001
Collect Date			20070818	20080508	20080508	20110302
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	0.3 U	NS
Benzene	**1**	**5**	**6**	**8**	**8**	**3.19**
BTEX Total	NA	NA	10.35	21.15	20.15	17.13
CIS-1,2-Dichloroethene	**70**	**70**	0.3 U	0.3 U	0.3 U	0.25 U
Ethylbenzene	**30**	**700**	4	10	9	5.01
Tetrachloroethene	3	5	0.5 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.3 U	1.43
Total Xylenes	**20**	10000	0.4 U	3 J	3 J	7.5
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	0.5 U	1	1	0.664 J
Vinyl Chloride	1	2	0.4 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)						
Ethane	NA	NA	NS	NS	NS	1 U
Ethene	NA	NA	NS	NS	NS	1 U
Methane	NA	NA	NS	NS	NS	26.9

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-1466-MW-23S**			**WHF-1466-MW-23I**		
Sample No.			1466G2301	1466G2301	WHF-1466G2301	1466G2302	1466G2302	WHF-1466G2302
Collect Date			20070818	20080506	20110223	20070724	20080506	20110223
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	0.75 U	0.75 U	0.0	0.75 U	0.75 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	0.8 J	0.3 U	0.637 J	1	0.6 J	0.479 J
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**11**	3	2.96	**19**	3	**5.77**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 UJ	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	8.54	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or
62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-1466-MW-23D**			**WHF-1466-MW-25S**		
Sample No.			1466G2303	1466G2303	WHF-1466G2303	1466G2501	1466G2501	WHF1466G2501
Collect Date			20070724	20080506	20110223	20070803	20080508	20110303
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	**2**	0.4 U	1.25 U
BTEX Total	NA	NA	0.75 U	0.75 U	NS	2.95	0.75 U	5.67
CIS-1,2-Dichloroethene	**70**	**70**	0.5 J	0.3 U	1.13	21	13	13.7
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U	0.6 J	0.4 U	1.72 J
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	1.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U	0.3 U	0.3 U	1.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.4 U	0.4 U	3.95 J
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	1.25 U
Trichloroethene	**3**	**5**	**16**	**12**	**10.7**	**550**	**430**	**522**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	1.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 U	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	1 U	NS	NS	15.8

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 11 of 26

Sample Location			**WHF-1466-MW-27S**		
Sample No.			1466G2701	1466G2701	WHF1466G2701
Collect Date			20070806	20080509	20110303
	Groundwater Criteria[1]	Primary[2]			
Volatile Organics[3] (ug/L)					
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS
Benzene	**1**	**5**	**260**	**97**	**130**
BTEX Total	NA	NA	4560	2047	10340
CIS-1,2-Dichloroethene	**70**	**70**	9	9	12.5 U
Ethylbenzene	**30**	**700**	**430**	**240**	**850**
Tetrachloroethene	3	5	0.5 U	0.5 U	12.5 U
Toluene	**40**	**1000**	**2900**	**1200**	**7510**
Total Xylenes	**20**	10000	**970**	**531**	**1850**
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	12.5 U
Trichloroethene	**3**	**5**	**420**	**500**	**134**
Vinyl Chloride	1	2	0.4 U	0.4 U	12.5 U
Volatile Gases[4] (ug/L)					
Ethane	NA	NA	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U
Methane	NA	NA	NS	NS	412 J

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 12 of 26

Sample Location			**WHF-15-MW-2I**			**WHF-15-MW-3S**
Sample No.			15G0202_	15G0202	WHF15G0202	15G0301
Collect Date			20070719	20080506	20110222	20110315
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	0.25 U
BTEX Total	NA	NA	0.75 U	0.75 U	0.0	0.0
CIS-1,2-Dichloroethene	**70**	**70**	0.3 U	0.3 U	0.25 U	0.25 U
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.25 U
Trichloroethene	**3**	**5**	1	0.5 J	0.353 J	0.25 U
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.25 U
Volatile Gases[4] (ug/L)						
Ethane	NA	NA	NS	NS	1 UJ	1 U
Ethene	NA	NA	NS	NS	1 UJ	1 UJ
Methane	NA	NA	NS	NS	1 UJ	1 U

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NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 13 of 26

Sample Location			**WHF-15-MW-3I**			**WHF-15-MW-4S**	**WHF-15-MW-5S**
Sample No.			15G0302	15G0302	WHF15G0302	15G0401	15G0501
Collect Date			20070719	20080507	20110222	20110315	20110315
	Groundwater Criteria[1]	Primary[2]					
Volatile Organics[3] (ug/L)							
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	NS	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	0.25 U	0.25 U
BTEX Total	NA	NA	0.75 U	0.75 U	0.0	0.0	0.0
CIS-1,2-Dichloroethene	**70**	**70**	0.3 U	0.3 U	0.25 U	0.25 U	0.25 U
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U	0.25 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.25 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U	0.25 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.75 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.25 U	0.25 U
Trichloroethene	**3**	**5**	2	1 J	0.25 U	0.25 U	0.25 U
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.25 U	0.25 U
Volatile Gases[4] (ug/L)							
Ethane	NA	NA	NS	NS	1.91 J	1 U	1 U
Ethene	NA	NA	NS	NS	1 UJ	1 UJ	1 UJ
Methane	NA	NA	NS	NS	1 UJ	2.72 J	1 U

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 14 of 26

Sample Location			**WHF-15-MW-5I**			
Sample No.			15G0502	15G0502-D	15G0502	WHF-15G0502
Collect Date			20070717	20070717	20080506	20110223
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	0.75 U	0.75 U	0.75 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	12	12	9	6.59
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**5**	**5**	**6**	**4.15**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)						
Ethane	NA	NA	NS	NS	NS	1 U
Ethene	NA	NA	NS	NS	NS	1 U
Methane	NA	NA	NS	NS	NS	1 U

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 15 of 26

Sample Location			**WHF-15-MW-5D**			
Sample No.			15G0503	15G0503	WHF-15G0503	WHF15G0503
Collect Date			20070717	20080506	20110223	20110315
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	NS
BTEX Total	NA	NA	0.75 U	0.75 U	0.0	NS
CIS-1,2-Dichloroethene	**70**	**70**	21	11	13	NS
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U	NS
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	NS
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U	NS
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	NS
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	NS
Trichloroethene	**3**	**5**	**130**	**110**	**103**	NS
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	NS
Volatile Gases[4] (ug/L)						NS
Ethane	NA	NA	NS	NS	1 UJ	NS
Ethene	NA	NA	NS	NS	1 U	NS
Methane	NA	NA	NS	NS	1 U	NS

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005
[2] USEPA CFR Primary Drinking Water Standard
[3] SW-846 8260B/EPA 504.1, [4] SM 3810

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TABLE 4-30
SUMMARY OF VOLATILE ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-15-MW-6D**	**WHF-15-MW-7I**		
Sample No.			15G0603	15G0702	15G0702	WHF15G0702
Collect Date			20110315	20070718	20080507	20110307
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.25 U	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	0.0	0.75 U	0.75 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	0.25 U	0.3 U	0.3 U	0.25 U
Ethylbenzene	**30**	**700**	0.25 U	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.25 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.25 U	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.75 U	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.25 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	0.302 J	**4**	2	1.89
Vinyl Chloride	1	2	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)						
Ethane	NA	NA	1 U	NS	NS	1 U
Ethene	NA	NA	1 UJ	NS	NS	1 UJ
Methane	NA	NA	1 U	NS	NS	1 UJ

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-15-MW-7D**			
Sample No.			15G0703	15G0703	15G0703-D	WHF15G0703
Collect Date			20070718	20080507	20080507	20110307
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	0.75 U	0.75 U	0.75 U	NS
CIS-1,2-Dichloroethene	**70**	**70**	1 J	0.3 U	0.3 U	0.469 J
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**20**	0.6 J	0.5 U	**10.7**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)						
Ethane	NA	NA	NS	NS	NS	1 U
Ethene	NA	NA	NS	NS	NS	1 UJ
Methane	NA	NA	NS	NS	NS	1 UJ

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-15-MW-8I**			**WHF-15-MW-8D**		
Sample No.			15G0802	15G0802	WHF15G0802	15G0803	15G0803	WHF-15G0803
Collect Date			20070724	20080507	20110223	20070725	20080507	20110223
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	0.75 U	0.75 U	0.0	0.75 U	0.75 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	0.3 U	0.3 U	0.25 U	0.3 U	0.3 U	0.25 U
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**7**	**6**	**7.48**	**4**	3	1.71
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 UJ	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	1 U	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-16-MW-2I**			**WHF-16-MW-2D**		
Sample No.			16G0202	16G0202	WHF16G0202	16G0203	16G0203	16G0203
Collect Date			20070718	20080506	20110222	20070718	20080506	20110315
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	**170**	**140**	0.25 U	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	171.65	141.6	0.0	0.75 U	0.75 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	35	42	0.25 U	0.3 U	0.3 U	0.25 U
Ethylbenzene	**30**	**700**	0.5 J	1 J	0.25 U	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.4 J	0.25 U	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	1 J	0.4 U	0.75 U	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**5**	**4**	0.342 J	0.5 U	0.5 U	0.33 J
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 UJ	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 UJ	NS	NS	1 UJ
Methane	NA	NA	NS	NS	2.94 J	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 20 of 26

Sample Location			**WHF-16-MW-3I**		
Sample No.			16G0302	16G0302	WHF16G0302
Collect Date			20070725	20080507	20110308
	Groundwater Criteria[1]	Primary[2]			
Volatile Organics[3] (ug/L)					
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS
Benzene	**1**	**5**	**2**	**2**	0.25 U
BTEX Total	NA	NA	2.55	2.55	0.0
CIS-1,2-Dichloroethene	**70**	**70**	16	16	0.506 J
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	1 J	2	0.25 U
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)					
Ethane	NA	NA	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U
Methane	NA	NA	NS	NS	1 U

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 21 of 26

Sample Location			WHF-16-MW-4II				
Sample No.			16G0402	16G0402-D	16G0402	16G0402-D	WHF16G0402
Collect Date			20070723	20070723	20080507	20080507	20110222
	Groundwater Criteria[1]	Primary[2]					
Volatile Organics[3] (ug/L)							
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	**3**	**3**	0.25 U
BTEX Total	NA	NA	0.75 U	0.75 U	3.55	3.55	0.0
CIS-1,2-Dichloroethene	**70**	**70**	0.9 J	0.9 J	4	4	1.84 J
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**6**	**6**	**6**	**6**	**3.19 J**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)							
Ethane	NA	NA	NS	NS	NS	NS	1 UJ
Ethene	NA	NA	NS	NS	NS	NS	1 UJ
Methane	NA	NA	NS	NS	NS	NS	2.47 J

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 22 of 26

Sample Location			**WHF-16-MW-4D**		
Sample No.			16G0403	16G0403	WHF16G0403
Collect Date			20070723	20080507	20110222
	Groundwater Criteria[1]	Primary[2]			
Volatile Organics[3] (ug/L)					
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS
Benzene	**1**	**5**	1	0.4 U	0.25 U
BTEX Total	NA	NA	1.55	0.75 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	3	0.3 U	0.25 U
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	0.5 U	0.5 U	0.25 U
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)					
Ethane	NA	NA	NS	NS	1 UJ
Ethene	NA	NA	NS	NS	4.32 J
Methane	NA	NA	NS	NS	1.75 J

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-16-MW-7I**			
Sample No.			16G0702	16G0702	WHF-16G0702	WHF-16G0702-D
Collect Date			20070725	20080507	20110223	20110223
	Groundwater Criteria[1]	Primary[2]				
Volatile Organics[3] (ug/L)						
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	NS
Benzene	**1**	**5**	**2**	**2**	**4.21**	**4**
BTEX Total	NA	NA	2.55	3.15	5.666	5.425
CIS-1,2-Dichloroethene	**70**	**70**	26	25	37.2	36.2
Ethylbenzene	**30**	**700**	0.4 U	0.8 J	1.13	1.1
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.326 J	0.325 J
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.25 U
Trichloroethene	**3**	**5**	2	3	2.36	2.39
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.25 U
Volatile Gases[4] (ug/L)						
Ethane	NA	NA	NS	NS	2.92 J	NS
Ethene	NA	NA	NS	NS	1 U	NS
Methane	NA	NA	NS	NS	397 J	NS

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 24 of 26

Sample Location			**WHF-16-MW-7D**			**WHF-30-MW-3S**		
Sample No.			16G0703	16G0703	WHF-16G0703	30G0301	30G0301	WHF30G0301
Collect Date			20070725	20080507	20110223	20070807	20080508	20110303
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.9 J	1	0.939 J	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	1.45	1.55	0.939	1.4	0.75 U	0.251
CIS-1,2-Dichloroethene	**70**	**70**	4	4	7.27	18	17	25.3
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U	0.4 J	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.25 U	0.6 J	0.3 U	0.251 J
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	0.5 U	0.5 U	0.299 J	**100**	**96**	**97.2**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 U	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	1 U	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or
62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

[3] SW-846 8260B/EPA 504.1, [4] SM 3810

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TABLE 4-30
SUMMARY OF VOLATILE ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Sample Location			**WHF-30-MW-4S**			**WHF-30-MW-5S**		
Sample No.			30G0401	30G0401	WHF30G0401	30G0501	30G0501	WHF30G0501
Collect Date			20070807	20080508	20110303	20070731	20080508	20110303
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	**2**	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
BTEX Total	NA	NA	45	36.35	2.493	0.75 U	0.75 U	0.0
CIS-1,2-Dichloroethene	**70**	**70**	0.3 U	0.3 U	0.25 U	0.3 U	0.6 J	0.25 U
Ethylbenzene	**30**	**700**	19	28	0.779 J	0.4 U	0.4 U	0.25 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Toluene	**40**	**1000**	8	0.3 U	0.564 J	0.3 U	0.3 U	0.25 U
Total Xylenes	**20**	10000	16	8	1.15 J	0.4 U	0.4 U	0.75 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.25 U
Trichloroethene	**3**	**5**	**10**	3	**13.9**	**31**	**62**	**33.9**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.25 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 U	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	1 U	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 26 of 26

Sample Location			**WHF-33-MW-1S**			**WHF-33-MW-3S**		
Sample No.			33G0101	33G0101	WHF33G0101	33G0301	33G0301	WHF33G0301
Collect Date			20070818	20080512	20110308	20070807	20080507	20110308
	Groundwater Criteria[1]	Primary[2]						
Volatile Organics[3] (ug/L)								
1,2-Dibromoethane	0.02	0.05	0.3 U	0.3 U	NS	0.3 U	0.3 U	NS
Benzene	**1**	**5**	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.50 U
BTEX Total	NA	NA	0.75 U	0.75 U	0.837	4.1	0.75 U	2.73
CIS-1,2-Dichloroethene	**70**	**70**	4	4	2.57	6	1	9.26
Ethylbenzene	**30**	**700**	0.4 U	0.4 U	0.25 U	0.9 J	0.4 U	0.50 U
Tetrachloroethene	3	5	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.50 U
Toluene	**40**	**1000**	0.3 U	0.3 U	0.837 J	1	0.3 U	2.73
Total Xylenes	**20**	10000	0.4 U	0.4 U	0.75 U	2 J	0.4 U	1.5 U
Trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.25 U	0.5 U	0.5 U	0.50 U
Trichloroethene	**3**	**5**	**180**	**180**	**45.3**	**280**	**50**	**311**
Vinyl Chloride	1	2	0.4 U	0.4 U	0.25 U	0.4 U	0.4 U	0.50 U
Volatile Gases[4] (ug/L)								
Ethane	NA	NA	NS	NS	1 U	NS	NS	1 U
Ethene	NA	NA	NS	NS	1 U	NS	NS	1 U
Methane	NA	NA	NS	NS	1 U	NS	NS	1 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

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TABLE 4-31
SUMMARY OF INORGANIC ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION, WHITING FIELD, MILTON, FLORIDA

Sample Location		**WHF-05-MW-3I**	**WHF-05-MW-10I**	**WHF-06-MW-1S**	**WHF-06-MW-3D**	**WHF-07-MW-1I**	
Sample No.		05G0302	05G1002	06G0101	06G0303	07G0102	07G0102
Sample Date		8/7/2007	7/19/2007	20070807	20070807	20070806	20080512
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]						
Metals[4] (ug/L)							
Aluminum	**200/** NA/ **50-200**	**368**	**4000**	**3310**	**6260**	19 U	15.4 U
Antimony	6/ 6/ NA	0.87 U	1.2	0.87 U	0.87 U	3	2.3 U
Arsenic	**10/** **10/** NA	0.83 U	1.9 U	2.4 U	1.6 U	**37.6**	27 U
Barium	200/0 2000/ NA	91.9	35.7	49	62.7	87.2	85.1
Beryllium	4/ 4/ NA	0.12 U	0.12 U	0.12 U	0.14	0.12 U	0.13 U
Cadmium	5/ 5/ NA	0.12 U	0.1 U	0.11 U	0.18 U	2.6	0.04 U
Calcium	NA/ NA/ NA	6490	1000	1510	2770	18100	18400
Chromium	100/ 100/ NA	0.28 U	6.1	9.6	15.3	0.28 U	0.41 U
Cobalt	140/ NA/ NA	0.52	0.31	2.1	0.68	0.26 U	0.24 U
Copper	1000/ 1300/ 1000	2 U	15.6	10.9	9.8	0.22 U	0.75 U
Iron	**300/** NA/ **300**	52.7	**2370 J**	**2940**	**5950**	**62200**	**52000**
Lead	**15/** **15/** NA	1.2	3.8 U	4.3	5.4	**489**	**151**
Magnesium	NA/ NA/ NA	2320	1080	1400	1740	4930	6450
Manganese	**50/** NA/ **50**	23.3	4.5	46.5	15.3	**823**	**675**
Mercury	2/ 2/ NA	0.02 U	0.21 U	0.02 U	0.02 U	0.02 U	0.06 U
Nickel	100/ NA/ NA	0.76	1.7 U	8.7	6.8	0.41 U	0.42 U
Potassium	NA/ NA/ NA	151	825	7300	1340	1590	2260
Selenium	50/ 50/ NA	1.5 U	2.6 U	2.5 U	1.7 U	1.5 U	1.5
Silver	100/ NA/ 100	0.46 U	0.46 U	0.46 U	0.46 U	1.2	0.29 U
Sodium	160000/ NA/ NA	2920 J	15200	3450 J	1650 J	3640 J	5320
Thallium	2/ 2/ NA	NS	NS	0.71 U	0.71 U	0.71 U	1.64 U
Vanadium	**49/** NA/ NA	0.29 U	8.4	8.4	16.5	0.29 U	0.38 U
Zinc	5000/ NA/ 5000	7.6	8.3 U	7.7	25.1	12.4	4.5

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

3 USEPA CFR Secondary Drinking Water Standards

[4] SW-846 6010B

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION, WHITING FIELD, MILTON, FLORIDA
Page 2 of 7

Sample Location		**WHF-15-MW-2I**	**WHF-15-MW-3I**	**WHF-15-MW-5I**		**WHF-15-MW-5D**	**WHF-15-MW-7I**	**WHF-15-MW-7D**
Sample No.		15G0202	15G0302	15G0502	15G0502	15G0503	15G0702	15G0703
Sample Date		20070719	20070719	20070717	20070717	20070717	20070718	20070718
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]							
Metals[4] (ug/L)								
Aluminum	**200/** NA/ **50-200**	**893**	**209**	35	35	**892**	**2160**	**140**
Antimony	6/ 6/ NA	0.87 U	1.5	1.2	1.2	0.87 U	0.87 U	1.3
Arsenic	**10/** **10/** NA	0.97 U	0.83 U	1.1 U	1.5 U	0.83 U	1.2 U	1.8 U
Barium	200/0 2000/ NA	26.2	21	14.8	14.8	18.3	21.6	11.4
Beryllium	4/ 4/ NA	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.14 U	0.12 U
Cadmium	5/ 5/ NA	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Calcium	NA/ NA/ NA	816	759	450	468	669	1590	606
Chromium	100/ 100/ NA	1.8	0.28 U	0.29	0.46	1.2	2	0.41
Cobalt	140/ NA/ NA	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	1.5	0.26 U
Copper	1000/ 1300/ 1000	16	3.1 U	3.3 U	3.4 U	14.9	16.1	2.4 U
Iron	**300/** NA/ **300**	**1180 J**	221 J	**1000 J**	**1580 J**	**514 J**	**1140 J**	83.2 U
Lead	**15/** **15/** NA	2.7 U	1 U	2 U	2.5 U	3.5 U	5.8 U	1.8 U
Magnesium	NA/ NA/ NA	876	796	535	540	596	794	522
Manganese	**50/** NA/ **50**	6.9	5.3	22.2	23.1	11.8	**132**	2.1
Mercury	2/ 2/ NA	0.1 U	0.02 U	0.03 U	0.04 U	0.1 U	0.02 U	0.02 U
Nickel	100/ NA/ NA	0.63 U	0.6 U	0.41 U	0.79 U	0.94 U	16.2	0.41 U
Potassium	NA/ NA/ NA	230	172	167	164	224	431	148
Selenium	50/ 50/ NA	1.5 U	1.5 U	1.5 U	2.9 U	1.5 U	1.5 U	1.5 U
Silver	100/ NA/ 100	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U
Sodium	160000/ NA/ NA	4540	4230	2080	2070	3210	2360	2580
Thallium	2/ 2/ NA	0.71 U	0.71 U	1.6 U	0.82 U	0.71 U	0.71 U	0.71 U
Vanadium	**49/** NA/ NA	2.2	0.29 U	0.29 U	0.39	0.98	3.4	0.29 U
Zinc	5000/ NA/ 5000	10.9 U	4.5 U	17.4	16.2	14	14.5	7.9 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

3 USEPA CFR Secondary Drinking Water Standards

[4] SW-846 6010B

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION, WHITING FIELD, MILTON, FLORIDA

Sample Location		**WHF-15-MW-8I**	**WHF-15-MW-8D**	**WHF-16-MW-2I**	**WHF-16-MW-2D**	**WHF-16-MW-3I**	**WHF-16-MW-4II**	**WHF-16-MW-4D**
Sample No.		15G0802	15G0803	16G0202	16G0203	16G0302	16G0402	16G0403
Sample Date		20070724	20070725	20070718	20070718	20070725	20070723	20070723
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]							
Metals[4] (ug/L)								
Aluminum	**200/** NA/ **50-200**	**481**	**508**	**118**	**236**	**1000**	**1270**	**10600**
Antimony	6/ 6/ NA	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U
Arsenic	**10/** **10/** NA	0.83 U	0.83 U	5.7 U	0.83 U	0.83 U	1.2 U	2.2 U
Barium	200/0 2000/ NA	18.4	14.1	54.8	19.4	31.6	45.9	34.6
Beryllium	4/ 4/ NA	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.29 U
Cadmium	5/ 5/ NA	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Calcium	NA/ NA/ NA	1040	1270	5770	1010	1110	3730	1930
Chromium	100/ 100/ NA	0.98	0.66	0.28 U	0.31	3.7	2.3	19.1
Cobalt	140/ NA/ NA	0.26 U	1.4 U	0.26 U	0.26 U	0.26 U	0.95	4.8
Copper	1000/ 1300/ 1000	2 U	4.6	0.91 U	3.7 U	16	13.6	20.2
Iron	**300/** NA/ **300**	294 J	235	**25700 J**	157 U	**1450**	**901 J**	**2790 J**
Lead	**15/** **15/** NA	1.2 U	3.2	3.4 U	1.1 U	2.5	2.4 U	8.4
Magnesium	NA/ NA/ NA	753	531	4920	810	1230	889	1270
Manganese	**50/** NA/ **50**	21.8	27.2	**59.5**	36.4	27.3	26.1	40.4
Mercury	2/ 2/ NA	0.02 U	0.02 U	0.02 U	0.04 U	1.6	0.04 U	0.17 U
Nickel	100/ NA/ NA	1 U	0.45	0.41 U	0.41 U	0.74	0.86 U	3.5
Potassium	NA/ NA/ NA	214	171	144	324	491	264	1160
Selenium	50/ 50/ NA	1.5 U	1.5 U	1.7 U	1.5 U	1.5 U	1.5 U	2.2 U
Silver	100/ NA/ 100	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U
Sodium	160000/ NA/ NA	4750	2320	5780	2170	3970	2940	3690
Thallium	2/ 2/ NA	0.71 U	0.71 U	0.71 U	0.78 U	0.71 U	0.71 U	0.71 U
Vanadium	**49/** NA/ NA	0.37	0.56 U	0.36	0.29 U	2.5	2.3	10.7
Zinc	5000/ NA/ 5000	7.6 U	6.3 U	4.1 U	5.3 U	6.7 U	17.6	12.2 U

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

3 USEPA CFR Secondary Drinking Water Standards

[4] SW-846 6010B

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RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION, WHITING FIELD, MILTON, FLORIDA

Sample Location		**WHF-16-MW-7D**	**WHF-16-MW-7I**	**WHF-30-MW-3S**	**WHF-30-MW-4S**	**WHF-30-MW-5S**	**WHF-33-MW-1S**	
Sample No.		16G0703	16G0702	30G0301	30G0401	30G0501	33G0101	33G0101
Sample Date		20070725	20070725	20070807	20070807	20070731	20070818	20080512
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]							
Metals[4] (ug/L)								
Aluminum	**200/** NA/ **50-200**	**595**	**395**	**360**	**891**	**1210**	**17800**	31.5 U
Antimony	6/ 6/ NA	0.87 U	1.2	0.87 U	0.87 U	0.87 U	2.2 U	0.78 U
Arsenic	**10/** **10/** NA	2.3 U	0.86 U	1.2 U	6.4	0.83 U	**10.5**	3 U
Barium	200/0 2000/ NA	48.1	56.6	52	15.3	50.9	150	122
Beryllium	4/ 4/ NA	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.31 U	0.13 U
Cadmium	5/ 5/ NA	0.1 U	0.1 U	0.1 U	0.12 U	0.1 U	0.13 U	0.08 U
Calcium	NA/ NA/ NA	3200	4740	1200	1070	2030	8130	3700
Chromium	100/ 100/ NA	1.9	0.28 U	0.93 U	6.1	2.2	29.1	0.72 U
Cobalt	140/ NA/ NA	1.4 U	0.75 U	1.2	0.26 U	0.68 U	3.3	1.1 U
Copper	1000/ 1300/ 1000	13.6	5.2	1.3 U	8.9	18.5	34.5	0.75 U
Iron	**300/** NA/ **300**	**5890**	**3750**	183	**26400**	**689**	**17000**	16.5 U
Lead	**15/** **15/** NA	4.3	2	0.91 U	2.6	1.9	**18.7**	0.97 U
Magnesium	NA/ NA/ NA	2640	4820	1470	1360	1460	3620	3950
Manganese	**50/** NA/ **50**	**161**	**99.8**	**99**	**244**	3.1	20	4
Mercury	2/ 2/ NA	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.11	0.06 U
Nickel	100/ NA/ NA	1.3	0.7	0.63	7.1	1.1	7.5	0.64
Potassium	NA/ NA/ NA	430	258	1290	592	477	2170	1840
Selenium	50/ 50/ NA	1.5 U	1.5 U	1.5 U	3.6 U	1.5 U	4.7 U	2.2
Silver	100/ NA/ 100	0.46 U	0.46 U	0.52	0.46 U	0.46 U	0.46 U	0.29 U
Sodium	160000/ NA/ NA	2330	3070	5780 J	2500 J	2060	4350	3920
Thallium	2/ 2/ NA	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	1.64 U
Vanadium	**49/** NA/ NA	2.3	0.3 U	0.38	4.5	2.5	**60.9**	0.38 U
Zinc	5000/ NA/ 5000	13	3.8 U	13.5	20.8	34.4	57.7	3.5

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3 USEPA CFR Secondary Drinking Water Standards

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NAVAL AIR STATION, WHITING FIELD, MILTON, FLORIDA

Sample Location		**WHF-33-MW-3S**	**WHF-1466-MW-1S**	**WHF-1466-MW-2I**	**WHF-1466-MW-6I**	**WHF-1466-MW-12S**	**WHF-1466-MW-13S**
Sample No.		33G0301	1466G0101	1466G0202	1466G0602	1466G1201	1466G1301
Sample Date		20070807	20070804	20070806	20070804	20070806	20070808
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]						
Metals[4] (ug/L)							
Aluminum	**200/** NA/ **50-200**	**7060**	68.6 U	**2010**	**132**	**16800**	**334**
Antimony	6/ 6/ NA	0.87 U	0.87 U	0.87 U	0.87 U	1	0.87 U
Arsenic	**10/** **10/** NA	2.5 U	4.2 U	0.94 U	0.83 U	8.4	0.83 U
Barium	200/0 2000/ NA	70.2	17.6	17.1	33.7	48.2	55.2
Beryllium	4/ 4/ NA	0.12 U	0.12 U	0.12 U	0.12 U	0.35	0.12 U
Cadmium	5/ 5/ NA	0.22 U	0.1 U	0.1 U	0.1 U	0.1 U	0.15 U
Calcium	NA/ NA/ NA	3250	370	792	1040	1040	1080
Chromium	100/ 100/ NA	16.6	0.28 U	2.6 U	0.42	34.1	0.42 U
Cobalt	140/ NA/ NA	0.82	2.7	0.3	0.37 U	0.78	0.72
Copper	1000/ 1300/ 1000	11.7	0.82 U	2.6 U	0.81 U	24.1	1.1 U
Iron	**300/** NA/ **300**	**4060**	**5580**	**629**	107	**15200**	108
Lead	**15/** **15/** NA	5.3	0.91 U	0.91 U	0.91 U	10	0.91 U
Magnesium	NA/ NA/ NA	2240	470	824	1280	1080	1500
Manganese	**50/** NA/ **50**	27.4	**234**	4.6	9.5	25.9	4
Mercury	2/ 2/ NA	0.11	0.02 U	0.02 U	0.13	0.04	0.05
Nickel	100/ NA/ NA	8.6	0.75	0.8	0.58	11.5	0.67
Potassium	NA/ NA/ NA	867	249	272	337	1020	202
Selenium	50/ 50/ NA	2.1 U	1.5 U	1.5 U	1.5 U	2.2 U	2.8 U
Silver	100/ NA/ 100	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.54
Sodium	160000/ NA/ NA	5930 J	4080	3930 J	6450	3600 J	3690 J
Thallium	2/ 2/ NA	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U
Vanadium	**49/** NA/ NA	18.8	0.46 U	4	0.54 U	**56.8**	1
Zinc	5000/ NA/ 5000	10.2	4.8 U	15.5	2.6 U	15.3	16.1

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

3 USEPA CFR Secondary Drinking Water Standards

[4] SW-846 6010B

Notes:

Sample numbers that have a "D" at the end of the nomenclature represent duplicate samples

Bold indicates an exceedance of regulatory limits.

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NA = Not applicable

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ug/L = micrograms per liter

U = The analyte was not detected above method detection limits

USEPA = United States Environmental Protection Agency

TABLE 4-31
SUMMARY OF INORGANIC ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION, WHITING FIELD, MILTON, FLORIDA
Page 6 of 7

Sample Location		**WHF-1466-MW-15S**		**WHF-1466-MW-18S**		**WHF-1466-MW-19S**		**WHF-1466-MW-20S**	**WHF-1466-MW-23S**
Sample No.		1466G1501	1466G1501	1466G1801	1466G1801	1466G1901	1466G1901-D	1466G2001	1466G2301
Sample Date		20070804	20080607	20070807	20080512	20070807	20070807	20070818	20070818
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]								
Metals[4] (ug/L)									
Aluminum	**200/** NA/ **50-200**	**33400**	**237**	**5360**	**329**	**83.4**	**68.9**	24.9 U	**3150**
Antimony	6/ 6/ NA	0.87 U	0.93	0.87 U	1.5 U	1.2	0.87 U	0.87 U	0.87 U
Arsenic	**10/** **10/** NA	**11.4**	1.69 U	**16.6**	**17.4**	0.83 U	0.83 U	2.8	0.83 U
Barium	200/0 2000/ NA	179	59.9	68.4	59	84.2	83	34.3	32.5
Beryllium	4/ 4/ NA	1	0.13 U	0.12 U	0.13 U	0.12 U	0.12 U	0.12 U	0.12 U
Cadmium	5/ 5/ NA	0.17	0.04 U	0.62 U	0.04 U	0.17 U	0.1 U	0.1 U	0.1 U
Calcium	NA/ NA/ NA	22500	4780	8370	7670	1960	1950	1760	604
Chromium	100/ 100/ NA	63.8	0.84 U	17.2	2 U	0.28 U	0.43 U	0.71 U	5.5
Cobalt	140/ NA/ NA	8	0.46	0.26 U	0.24 U	1.3	1.2	0.26 U	0.72
Copper	1000/ 1300/ 1000	49.8	0.75 U	12	7.9	1.4 U	1.2 U	1 U	3.6
Iron	**300/** NA/ **300**	**36600**	178	**33600**	**35700**	18.7 U	13.6 U	**10700**	**2310**
Lead	**15/** **15/** NA	**40.5**	0.97 U	8.4	0.98	0.91 U	0.91 U	0.91 U	2.1
Magnesium	NA/ NA/ NA	2510	1240	4920	5550	2840	2770	865	935
Manganese	**50/** NA/ **50**	**110**	4.5	**99.2**	**93.3**	**104**	**101**	18.6	8.6
Mercury	2/ 2/ NA	0.86	0.03 U	0.02 U	0.07 U	0.02 U	0.02 U	0.02 U	0.14
Nickel	100/ NA/ NA	27.5	1 U	12.9	1.1	1.1	0.77	0.41 U	1.4
Potassium	NA/ NA/ NA	1380	294	26900	31600	982	916	115	249
Selenium	50/ 50/ NA	1.5 U	0.96 U	1.6 U	2.2	1.5 U	1.5 U	1.5 U	2.3 U
Silver	100/ NA/ 100	0.46 U	0.33	0.52	0.29 U	0.65	0.46 U	0.46 U	0.46 U
Sodium	160000/ NA/ NA	3470	2800 J	11600 J	12800	5180 J	5030 J	4760	1890
Thallium	2/ 2/ NA	0.71 U	1.8 U	0.71 U	1.64 U	0.71 U	0.71 U	0.71 U	0.71 U
Vanadium	**49/** NA/ NA	**129**	0.85 U	22.1	2.3 U	0.33	0.29 U	0.57 U	7.2
Zinc	5000/ NA/ 5000	31.9	3.5	46.2	12.2	2.6 U	2.9 U	5.4 U	15.5

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

3 USEPA CFR Secondary Drinking Water Standards

[4] SW-846 6010B

Notes:

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TABLE 4-31
SUMMARY OF INORGANIC ANALYTES DETECTED IN THE SOUTH CENTRAL AREA GROUNDWATER SAMPLES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION, WHITING FIELD, MILTON, FLORIDA

Sample Location		**WHF-1466-MW-23I**	**WHF-1466-MW-23D**	**WHF-1466-MW-25S**	**WHF-1466-MW-27S**	
Sample No.		1466G2302	1466G2303	1466G2501	1466G2701	1466G2701
Sample Date		20070724	20070724	20070803	20070806	20080509
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]					
Metals[4] (ug/L)						
Aluminum	**200/** NA/ **50-200**	**275**	**342**	**118**	**689**	14.6 U
Antimony	6/ 6/ NA	1	1.2	0.87 U	1.2	0.78 U
Arsenic	**10/** **10/** NA	0.84 U	0.83 U	0.83 U	**10.8**	5.9 U
Barium	200/0 2000/ NA	25.3	10.7	47.4	52.4	35.1
Beryllium	4/ 4/ NA	0.12 U	0.12 U	0.12 U	0.12 U	0.13 U
Cadmium	5/ 5/ NA	0.1 U	0.1 U	0.1 U	0.2 U	0.04 U
Calcium	NA/ NA/ NA	1800	1060	1490	3910	1240
Chromium	100/ 100/ NA	0.98	0.28 U	0.28	4.1	0.41 U
Cobalt	140/ NA/ NA	0.29	0.26 U	0.54 U	0.75	0.29
Copper	1000/ 1300/ 1000	3.6 U	3 U	2.6 U	3.6 U	0.75 U
Iron	**300/** NA/ **300**	**469 J**	200 J	**335**	**14600**	**6910**
Lead	**15/** **15/** NA	1.9 U	1.2 U	0.91 U	**87.2**	**60**
Magnesium	NA/ NA/ NA	858	593	1650	2340	1440
Manganese	**50/** NA/ **50**	15.8	5.7	17.2	**193**	**116**
Mercury	2/ 2/ NA	0.2 U	0.04 U	0.02 U	0.02 U	0.03 U
Nickel	100/ NA/ NA	0.94 U	0.69 U	1.7	4.6	0.42 U
Potassium	NA/ NA/ NA	246	212	318	336	234
Selenium	50/ 50/ NA	2.5 U	1.5 U	1.5 U	1.5 U	0.96 U
Silver	100/ NA/ 100	0.46 U	0.46 U	0.46 U	0.49	0.29 U
Sodium	160000/ NA/ NA	3130	2710	5100	3950 J	4340
Thallium	2/ 2/ NA	0.71 U	0.71 U	0.71 U	0.84 U	1.64 U
Vanadium	**49/** NA/ NA	1.8	0.41	0.29 U	3.5	0.38 U
Zinc	5000/ NA/ 5000	10.5 U	9.9 U	6.4 U	6.2	3.5

[1] Groundwater Cleanup Criteria as provided in Chapter 62-550 and/or 62-777 F.A.C., Table 1, February 2005

[2] USEPA CFR Primary Drinking Water Standard

3 USEPA CFR Secondary Drinking Water Standards

[4] SW-846 6010B

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J = The detection is estimated

NA = Not applicable

NS = Analyte not sampled for

ug/L = micrograms per liter

U = The analyte was not detected above method detection limits

USEPA = United States Environmental Protection Agency

TABLE 4-32
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL LEACHATE - SITE 7
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-07-SS-2	WHF-07-SS-3	WHF-07-SS-8	WHF-07-SS-8	WHF-07-SS-10
Sample No.		07D00201	07D00301D	07D00801	07D00801D	07D01001
Collect Date		5/24/2000	5/24/2000	5/24/2000	5/24/2000	5/24/2000
Sample Depth (bls)		0-1'	0-1'	0-1'	0-1'	0-1'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]					
SPLP Semivolatiles [4] (µg/L)		NM	ND	NM	NM	NM
SPLP Total Petroleum Hydrocarbons [5] (µg/L)		ND	ND	ND	ND	ND
SPLP Metals [6] (µg/L)						
Aluminum	**200**/NA/**50-200**	**2900**	**45200**	ND	ND	ND
Barium	2000/2000/NA	ND	20	ND	ND	ND
Chromium	100/100/NA	ND	28	ND	ND	ND
Copper	1000/NA/1000	ND	9.6	ND	ND	ND
Iron	**300**/NA/**300**	**1400**	**23600**	ND	ND	ND
Lead	**15**/**15**/NA	ND	**20**	ND	ND	ND
Manganese	**50**/NA/**50**	**57**	**83**	**53**	**62**	22
Mercury	2/2/NA	ND	ND	ND	0.72	ND
Sodium	160000/NA/NA	420	5500	150	450	440
Vanadium	**49**/NA/NA	ND	**62**	ND	ND	ND
Zinc	5000/NA/5000	ND	23[J]	ND	ND	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standards

[3] USEPA 40 CFR Secondary Drinking Water Standards

[4] SW-846 8270C, [5] FDEP FL-PRO, [6] SW-846 6010B/7471

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
D = A "D" at the end of sample number nomenclature indicates a duplicate
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
[J] Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
NM = not measured
ND = not detected
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-33
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE - SITE 7
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 1 OF 2

Sample Location		WHF-07-SB-23	WHF-07-SB-23	WHF-07-SB-24
Sample No.		07D02308	07D02320	07D02460
Collect Date		6/1/2000	6/1/2000	6/2/2000
Sample Depth (bls)		6-8'	18-20'	58-60'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]			
SPLP Volatiles [4] (µg/L)				
Methyl isobutyl ketone	560/NA/NA	NM	ND	10.3
Ethylbenzene	**30**/700/NA	NM	**109**	ND
Toluene	40/1000/NA	NM	12.7^{J}	ND
Xylenes	**20**/10000/NA	NM	**781**	1.5^{J}
SPLP Semivolatiles [5] (µg/L)				
2-Methylnaphthalene	**28**/NA/NA	ND	**87.1**	ND
Fluoranthene	280/NA/NA	ND	30.9^{J}	ND
Naphthalene	**14****/NA/NA	ND	**93.7**	ND
Phenanthrene	210/NA/NA	ND	93	ND
Pyrene	210/NA/NA	ND	23.2^{J}	ND
SPLP Total Petroleum Hydrocarbons [6] (µg/L)	**5000**/NA/NA	ND	**5510**	ND
SPLP Metals [7] (µg/L)				
Mercury	2/2/NA	ND	1.3	ND
Sodium	160000/NA/NA	690	240	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777,F.A.C. Table 1, February 2005
[2] USEPA 40 CFR Primary Drinking Water Standards
[3] USEPA 40 CFR Secondary Drinking Water Standards
[4] SW-846 8260B, [5] SW-846 8270C, [6] FDEP FL-PRO, [7] SW-846 6010B/7471

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^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected
NM = not measured
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter
** = Groundwater cleanup target levels for Class C carcinogens with no cancer slope factor were developed using the reference dose divided by a factor of 10, as described in the February 2005 'Final Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C.

TABLE 4-33
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE - SITE 7
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 2 OF 2

Sample Location		WHF-07-SB-35	WHF-07-SB-35	WHF-07-SB-36
Sample No.		07SB03520	07SB03540	07SB03680
Collect Date		6/15/2001	6/15/2001	6/15/2001
Sample Depth (bls)		18-20'	38-40'	78-80'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]			
SPLP Volatiles [4] (µg/L)				
Acetone	6300/NA/NA	23.1[J]	5.2[J]	ND
SPLP Semivolatiles [5] (µg/L)				
DEHP	**6**/**6**/NA	**126**	**60.1**	**68.2**
Di-n-octylphthalate	140/NA/NA	52.3	ND	ND
SPLP Total Petroleum Hydrocarbons [6] (µg/L)		ND	ND	ND
SPLP Metals [7] (µg/L)				
Barium	2000/2000/NA	ND	1.5	ND
Cobalt	420/NA/NA	ND	3.8	ND
Mercury	**2**/**2**/NA	0.78	**2.6**	1.0

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777,F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standards

[3] USEPA 40 CFR Secondary Drinking Water Standards

[4] SW-846 8260B, [5] SW-846 8270C, [6] FDEP FL-PRO, [7] SW-846 6010B/7471

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CFR = Code of Federal Regulations
DEHP = Bis(2-ethylhexyl)phthalate
F.A.C. = Florida Administrative Code
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FL-PRO = Florida Petroleum Range Organics
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ND = not detected
NM = not measured
SPLP = Synthetic Precipitation Leaching Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-34
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE - SITE 15
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-15-SB-2	WHF-15-SB-6
Sample No.		15SB0212	15SB0612
Collect Date		5/17/2001	5/17/2001
Sample Depth (bls)		10-12'	10-12'
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]		
SPLP Semivolatiles [4] (μg/L)		ND	ND
SPLP Metals [5] (μg/L)			
Aluminum	**200**/NA/**50-200**	**250**	**600**
Iron	300/NA/300	150	190
Manganese	50/NA/50	33	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, Feb. 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8270C, [5] SW-846 6010B

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F.A.C. = Florida Administrative Code
NA = Not Applicable
ND = not detected
SPLP = Synthetic Precipitate Leachate Proceedure
USEPA = United States Environmental Protection Agency
μg/L = micrograms per liter

TABLE 4-35
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL LEACHATE- SITE 16
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-16-SS-10
Sample No.		16SS1002
Collect Date		8/14/2001
Sample Depth (bls)		0-2'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]	
SPLP Metals [4] (μg/L)		
Aluminum	**200**/NA/**50-200**	**13800**
Iron	**300**/NA/**300**	**9900**
Lead	15/15/NA	10
Manganese	50/NA/50	27[J]

[1] Groundwater cleanup criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 6010B

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μg/L =micrograms per liter

TABLE 4-36
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL LEACHATE - SITE 29
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-29-SS-1	WHF-29-SS-2	WHF-29-SS-3	WHF-29-SS-4	WHF-29-SS-5	WHF-29-SS-6
Sample No.		29D00101	29D00201	29D00301	29D00401	29D00501	29D00601
Collect Date		5/26/2000	5/26/2000	5/26/2000	5/26/2000	5/26/2000	5/26/2000
Sample Depth (bls)		0-1'	0-1'	0-1'	0-1'	0-1'	0-1'
	Groundwater Criteria^1/Primary^2/ Secondary^3						
SPLP Volatiles ^{4} (μg/L)							
Acetone	6300/NA/NA	14.2^J	102^J	39.3^J	ND	53.1	393^J
SPLP Semivolatiles ^{5} (μg/L)		NM	NM	ND	ND	ND	ND
SPLP Total Petroleum Hydrocarbons ^{6} (μg/L)		ND	ND	ND	ND	ND	ND
SPLP Metals ^{7} (μg/L)							
Aluminum	**200**/NA/**50-200**	ND	**13900**	**29700**	**24700**	**13700**	**28700**
Arsenic	10/10/NA	ND	ND	6.6	10	ND	ND
Barium	2000/2000/NA	ND	6.7	14	10	10	13
Chromium	100/100/NA	ND	ND	29	20	ND	24
Copper	1000/NA/1000	ND	ND	12	8.3	ND	ND
Iron	**300**/NA/**300**	ND	**6900**	**12600**	**13000**	**7600**	**12300**
Lead	**15**/**15**/NA	ND	ND	**68**	**24**	**28**	**19**
Manganese	50/NA/50	ND	24	14	22	21	17
Nickel	100/NA/NA	ND	ND	5.6	3.5	2.7	3.7
Sodium	160000/NA/NA	9200^J	18800^J	21500^J	20700^J	18400^J	22400^J
Vanadium	**49**/NA/NA	ND	20	36	36	20	**53**
Zinc	5000/NA/5000	ND	9.5	140	31	66	43

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] FDEP FL-PRO, [7] SW-846 6010B

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TABLE 4-37
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL LEACHATE - SITE 30
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-30-SB-1	WHF-30-SB-2	WHF-30-SB-B1	WHF-30-SB-E2	WHF-30-SB-N3
Sample No.		30SB0107	30SB0202	30SBB0119	30SBE0207	30SBN0309
Collect Date		6/29/2001	6/29/2001	6/29/2001	6/29/2001	6/29/2001
Sample Depth (bls)		5-7'	0-2'	17-19'	5-7'	7-9'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]					
SPLP Volatiles [4] (μg/L)		ND	NM	ND	ND	NM
SPLP Semivolatiles [5] (μg/L)		ND	NM	NM	ND	NM
SPLP Polycyclic Aromatic Hydrocarbons [6] (μg/L)		ND	NM	ND	ND	NM
SPLP Total Petroleum Hydrocarbons [7] (μg/L)		ND	ND	ND	ND	NM
SPLP Metals [8] (μg/L)						
Aluminum	200/NA/50-200	ND	NM	NM	NM	NM
Chromium	100/100/NA	NM	NM	NM	NM	ND
Cobalt	140/NA/NA	ND	NM	NM	NM	NM
Copper	1000/NA/1000	ND	NM	NM	NM	NM
Iron	300/NA/300	ND	NM	NM	NM	NM
Lead	15/15/NA	ND	NM	ND	NM	ND
Manganese	50/NA/50	ND	NM	NM	NM	NM

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8310, [7] FDEP FL-PRO, [8] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
NA = not applicable
ND = not detected
NM = not measured
SPLP = Synthetic Precipitate Leachate Procedure
USEPA = United States Environmental Protection Agency
μg/L =micrograms per liter

TABLE 4-38
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITE 9
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD
Page 1 of 1

Sample Location		WHF-09-MW-3S	WHF-09-MW-2S
Sample No.		09G00301	09GW00201
Collect Date		8/12/2000	8/19/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
Metals [4] (µg/L)			
Aluminum	**200**/NA/**50-200**	**2860**	**4180**

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and or Chapter 62-777, F.A.C., Table 1 February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 6010B

Notes: **Bold** indcates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
NA = not applicable
µg/L = micrograms per Liter
USEPA = United States Environmental Protection Agency

TABLE 4-39
SUMMARY OF ANALYTES DETECTED IN LEACHATE - SITE 10
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-10-SB-2
Sample No.		10SB0209
Collect Date		5/17/2001
Sample Depth (bls)		7-9'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]	
SPLP Pesticides [4] (μg/L)		ND
SPLP Metals [5] (μg/L)		
Aluminum	200/NA/**50-200**	**110**
Iron	300/NA/300	84
Manganese	50/NA/50	16

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8081A, [5] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulator limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
NA = not applicable
ND = not detected
SPLP = Synthetic Precipitate Leachate Procedure
USEPA = United States Environmental Protection Agency
μg/L = micrograms per liter

TABLE 4-40
SUMMARY OF ANALYTES DETECTED IN LEACHATE - SITE 11
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-11-SB-3
Sample No.		11SB0310
Collect Date		5/17/2001
Sample Depth (bls)		8-10'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]	
SPLP Pesticides [4] (µg/L)		ND
SPLP Metals [5] (µg/L)		
Iron	300/NA/300	160

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8081A, [5] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
NA = not applicable
ND = not detected
SPLP = Synthetic Precipitate Leachate Procedure
USEPA = United States Environmental Protection Agency
µg/L = micrograms per liter

TABLE 4-41
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITE 11
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-11-MW-1S	WHF-11-MW-3S	WHF-11-MW-4S	WHF-11-MW-2I
Sample No.		11G00101	11G00301	11G00403	11GW00201
Collect Date		8/12/2000	8/5/2000	8/10/2000	8/19/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]				
Volatiles [4] (μg/L)					
1,2-Dichloroethene (total)	63/70/NA	9.4	NM	NM	NM
Acetone	700/NA/NA	19.4^{J}	NM	NM	NM
Trichloroethene	3/5/NA	0.97^{J}	NM	NM	NM
Vinyl Chloride	**1**/2/NA	**1.1**	NM	NM	NM
Semivolatiles [5] (μg/L)					
DEHP	**6**/**6**/NA	NM	ND	NM	**12**
Metals [6] (μg/L)					
Aluminum	**200**/NA/**50-200**	NM	**1370**	ND	**2190**
Iron	**300**/NA/**300**	**1330**	**2880**	NM	ND
Manganese	50/NA/50	NM	NM	15.8	NM

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
DEHP = Bis(2-ethylhexyl)phthalate
F.A.C. = Florida Administrative Code
^{J} Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected
NM = not measured
μg/L = micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-42
SUMMARY OF ANALYTES DETECTED IN LEACHATE-SITE 13
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample No.		13SB0509
Sample Location		WHF-13-SB-5
Collect Date		5/17/2001
Sample Depth (bls)		7-9'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]	
SPLP Semivolatiles [4] (µg/L)		ND
SPLP Metals [5] (µg/L)		
Aluminum	200/NA/**50-200**	**180**
Iron	300/NA/300	170
Manganese	50/NA/50	1.1
Mercury	**2**/**2**/NA	**6.0**

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550 F.A.C. and/or Chapter 62-777, F.A.C. Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8270C, [5] SW-846 6010B and 7470A/7471A

Notes: **Bold** indicates the exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
NA = not applicable
ND = not detected
SPLP = Synthetic Precipitate Leachate Procedure
USEPA = United States Environmental Protection Agency
µg/l = micrograms per liter

TABLE 4-43
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITE 13
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 3

Sample Location		WHF-13-MW-3D	WHF-13-MW-5S
Sample No.		13G00303	13G00501
Collect Date		8/3/2000	2/20/2001
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
Volatiles [4] (μg/L)		ND	ND
Semivolatiles [5] (μg/L)			
DEHP	6/6/NA	ND	3.0^J
Polycyclic Aromatic Hydrocarbons[6] (μg/L)		ND	ND
Pesticides/PCBs[7] (μg/L)		ND	ND
Total Petroleum Hydrocarbons [8] (μg/L)	5000/NA/NA	NM	610

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8310/8270, [7] SW-846 80801A/8082, [8] FDEP FL-PRO

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
FDEP = Florida Department of Environmental Protection
FL-PRO = Florida Petroleum Range Organics
^{J} Indicates the presence of a chemical at an estimated concentration
ND = not detected
NA = not applicable
NM = not measured
PCBs = Polychlorinated Biphenyls
μg/L = micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-43
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITE 13
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 2 OF 3

Sample Location		WHF-13-MW-1I	WHF-13-MW-1D	WHF-13-MW-2S	WHF-13-MW-2S	WHF-13-MW-3S
Sample No.		13G00102	13G00103	13GW00201	13GW00201D	13GW00301
Collect Date		8/5/2000	8/6/2000	8/21/2000	8/21/2000	8/21/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]					
Metals [4] (µg/L)						
Aluminum	**200**/NA/**50-200**	ND	NM	NM	NM	**241**
Iron	**300**/NA/**300**	NM	**929**	NM	NM	ND
Manganese	**50**/NA/**50**	**179**	6.9	ND	ND	ND
Cyanide [5] (µg/L)		NM	NM	NM	NM	NM

[1] Groundwater criteria from Chapter 62-550, F.A.C., Chapter 62-777, F.A.C., Table 1 Groundwater Cleanup Target Level, Feb. 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 6010B, [5] USEPA 335.2

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
ND = not detected
NM = not measured
µg/L = micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-43
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITE 13
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
PAGE 3 OF 3

Sample Location		WHF-13-MW-3D	WHF-13-MW-4S	WHF-13-MW-5S
Sample No.		13G00303	13GW00401	13G00501
Collect Date		8/3/2000	8/19/2000	2/20/2001
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]			
Metals [4] (μg/L)				
Aluminum	**200**/NA/**50-200**	**559**	NM	**217**
Barium	2000/2000/NA	9.1	NM	9.3
Calcium	NA/NA/NA	1510^J	NM	1160^J
Cobalt	420/NA/NA	ND	NM	0.56
Copper	1000/NA/1000	2.4	NM	1.5
Iron	**300**/NA/**300**	**820**	NM	**421**
Magnesium	NA/NA/NA	598	NM	371
Manganese	50/NA/50	**75.2^J**	ND	6.3
Nickel	100/NA/NA	ND	NM	0.81
Sodium	160000/NA/NA	11900^J	NM	1820
Vanadium	49/NA/NA	ND	NM	0.65
Zinc	5000/NA/5000	22.4	NM	10
Cyanide [5] (μg/L)		ND	NM	ND

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, Feb. 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 6010B, [5] USEPA 335.2

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
^{J} Indicates the presence of a chemical at an estimated concentration
NA = not applicable
ND = not detected
NM = not measured
μg/L = micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-44
SUMMARY OF ANALYTES DETECTED IN LEACHATE - SITE 14
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-14-SB-3	WHF-14-SB-2	WHF-14-SB-2
Sample No.		14D00320	14SB0212	14SB0212D
Collect Date		5/10/2000	5/17/2001	5/17/2001
Sample Depth (bls)		18-20'	10-12'	10-12'
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]			
SPLP Volatiles [4] (μg/L)				
Acetone	6300/NA/NA	2310[J]	NM	NM
Methylene Chloride	**5**/**5**/NA	**104[J]**	NM	NM
SPLP Pesticides/PCBs [5] (μg/L)		ND	NM	NM
SPLP Metals [6] (μg/L)				
Iron	300/NA/300	NM	30	38
Manganese	50/NA/50	NM	23	ND

[1] Groundwater Clean-up Criteria as provided in Chapter 62-550, F.A.C and/or Chapter 62-777, F.A.C., Table I, Februaury 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8082, [6] SW-846 6010B

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

bls = below land surface
CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
[J] Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected
NM = not measured
PCBs = Polychlorinated Biphenyls
SPLP = Synthetic Precipitate Leachability Procedure
USEPA = United States Environmental Protection Agency
μg/L = micrograms per liter

TABLE 4-45
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITE 14
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample Location		WHF-14-MW-3S
Sample No.		14G00301
Collect Date		6/4/2000
	Groundwater Criteria[1]/ Primary[2]/ Secondary[3]	
Volatiles [4] (μg/L)		ND
Semivolatiles [5] (μg/L)		ND
Pesticides/PCBs [6] (μg/L)		ND
Metals [7] (μg/L)		
Aluminum	**200**/NA/**50-200**	**1210**
Barium	2000/2000/NA	76.7
Calcium	NA/NA/NA	16600
Iron	**300**/NA/**300**	**312**
Magnesium	NA/NA/NA	600
Potassium	NA/NA/NA	5500
Sodium	160000/NA/NA	5550
Cyanide [8] (μg/L)		ND

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081A/8082, [7] SW-846 6010B, [8] EPA 335.2

Notes: **Bold** indcates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
NA = not applicable
ND = not detected
PCBs = Polychlorinated Biphenyls
μg/L = micrograms per Liter
USEPA = United States Environmental Protection Agency

TABLE 4-46
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITES 31B and 31D
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA
Page 1 of 1

Sample No.		31G00601	31G00801
Sample Location		WHF-31-MW-6S	WHF-31-MW-8S
Collect Date		6/5/2000	6/4/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
Volatiles [4] (μg/L)		ND	ND
Semivolatiles [5] (μg/L)			
DEHP	**6**/**6**/NA	**22.9**	ND
Diethyl phthalate	5600/NA/NA	3.7[J]	ND
Pesticides/PCBs [6] (μg/L)		ND	ND
Metals [7] (μg/L)			
Aluminum	**200**/NA/**50-200**	**843**	**759**
Barium	2000/2000/NA	29	14.7
Chromium	100/100/NA	14.6	22.8
Iron	**300**/NA/**300**	248	**1180**
Magnesium	NA/NA/NA	878	499
Manganese	50/NA/50	11.2	7.1
Sodium	160000/NA/NA	2430	1370
Cyanide [8] (μg/L)		ND	ND

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081/8082, [7] SW-846 6010B , [8] USEPA 335.2

Notes: **Bold** indicates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
DEHP = Bis(2-ethylhexyl)phthalate
F.A.C. = Florida Administrative Code
[J] Indicates the presence of a chemical at an estimated concentration.
NA = not applicable
ND = not detected
PCBs = Polychlorinated Biphenyls
μg/L =micrograms per liter
USEPA = United States Environmental Protection Agency

TABLE 4-47

SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - SITES 31E and 31F
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Page 1 of 1

Sample Location		WHF-31-MW-5S	WHF-31-MW-7S
Sample No.		31G00501	31G00701
Collect Date		6/7/2000	6/7/2000
	Groundwater Criteria[1]/Primary[2]/ Secondary[3]		
Volatiles [4] (µg/L)		ND	ND
Semivolatiles [5] (µg/L)		ND	ND
Pesticides/PCBs [6] (µg/L)		ND	ND
Metals [7] (µg/L)			
Aluminum	**200**/NA/**50-200**	**4130**^{J}	**936**^{J}
Barium	2000/2000/NA	26.3^{J}	16.7^{J}
Calcium	NA/NA/NA	516	535
Copper	1000/NA/1000	5.0	ND
Iron	**300**/NA/**300**	**1420**	**498**
Magnesium	NA/NA/NA	546	441
Sodium	160000/NA/NA	1520	1720
Zinc	5000/NA/5000	11.2	ND
Cyanide [8] (µg/L)	200/200/NA	10	17

[1] Groundwater Cleanup Criteria from Chapter 62-550, F.A.C., and/or Chapter 62-777, F.A.C., Table 1, February 2005

[2] USEPA 40 CFR Primary Drinking Water Standard

[3] USEPA 40 CFR Secondary Drinking Water Standard

[4] SW-846 8260B, [5] SW-846 8270C, [6] SW-846 8081/8082, [7] SW-846 6010B , [8] USEPA 335.2

Notes: **Bold** indcates an exceedance of regulatory limits. **Bold** indicates which regulatory limit was exceeded.

CFR = Code of Federal Regulations
F.A.C. = Florida Administrative Code
^{J} Indicates the presence of a chemical at an estimated concentration
NA = not applicatble
ND = not detected
PCBs = Polychlorinated Biphenyls
µg/L =micrograms per liter
USEPA = United States Environmental Protection Agency

SECTION 5 TABLES

TABLE 5-1

ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC AND INORGANIC CHEMICALS
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

PAGE 1 OF 1

Chemical	**Specific Gravity (@ 20/4°C)(2)**	**Vapor Pressure (mm Hg @ 20°C)(2)**	**Solubility (mg/L @ 20°C)(2)**	**Octanol/Water Partition Coefficient(2)**	**Organic Carbon Partition Coefficient(4)**	**Henry's Law Constant (atm-m3/mole)(2)**	**Bioconcentration Factor (mg/L/mg/kg)(4)**	**Mobility Index log((solubility*VP)/K_{oc})**
DISSOLVED METALS								
Aluminum	2.64							
Iron	0.7899	2.66E+2 (25°C)	Miscible	5.75E-01	7.08E+03 (10)	4.276E-5 (25°C)	3.81E-1(6)	NA
Manganese	0.8054	1.0E+2 (25°C)	2.75E+05	1.82E+00	4.44E+0(9)	4.66E-5 (25°C)	9.3E-1(6)	6.79E+00
Vanadium	5.5							
VOLATILES								
Benzene	0.8765	95	1750	1.35E+02	6.50E+01	5.55E-03	3.70E+01	3.41E+00
cis-1,2-Dichloroethene	1.2837	2.02E+2 (25°C)	800	1.58E+02	3.55E+01 (10)	4.08E-3 (24.8°C)	1.4E+1(3)	3.66E+00
Ethyl benzene	0.867	10	169	3.15	204	0.0084	1.9	8.28E+00
Tetrachloroethene	1.46	18.47	200	3.4	665	0.00184	49	5.55E+00
Toluene	0.865	22	515	2.73	259	0.00664	20	4.37E+01
Total Xylenes	0.86	10	175	3.12	240	0.007	3.12	7.29E+00
Trichloroethene	0.8765	95	1750	1.35E+02	9.43E+01	5.55E-03	3.70E+01	1.76E+03

1 NA - Not Available
2 USEPA, September 1992, Handbook of RCRA Groundwater Monitoring Constituents: Chemical and Physical Properties.
3 Lyman et al., 1990; Equation 5-3, Handbook of Chemical Property Estimation Methods.
4 USEPA, December 1982, Aquatic Fate Process Data for Organic Priority Pollutants.

TABLE 5-2

GROUNDWATER COMPARISION AT NCA - SITE 40

RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Chemical	Frequency of Detection	Mininum Concentration[(1)]	Maximum Concentration[(1)]	Sample of Maximum Concentration
VOLATILES (UG/L)				
BENZENE	18/34	4.42	3580	WHF03G0101
TOLUENE	18/34	0.261 J	35000 J	WHF-03G0401
ETHYLBENZENE	19/34	0.254 J	2690	WHF32G0101
TOTAL XYLENES	15/34	3.07	8060	WHF32G0101
VOLATILES (CVOCs) (UG/L)				
TETRACHLOROETHENE	3/34	0.559 J	1.98 J	WHF32G0201
TRICHLOROETHENE	19/34	0.364 J	376	WHF32G0201
CIS-1,2-DICHLOROETHENE	12/34	0.612 J	636	WHF03G0101
DISSOLVED INORGANICS (UG/L)				
IRON	19/34	289 J	34200	WHF32G0101
MANGANESE	26/34	3.66 J	2940	WHF32G0101

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.

Definitions:
J = Estimated value

TABLE 5-3

GROUNDWATER COMPARISION AT SCA - SITE 40

RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Chemical	Frequency of Detection	Mininum Concentration(1)	Maximum Concentration(1)	Sample of Maximum Concentration
VOLATILES (UG/L)				
BENZENE	9/42	0.258 J	1010	WHF07G0102
ETHYLBENZENE	11/42	0.394 J	1840	WHF07G0102
TOLUENE	15/42	0.251 J	7510	WHF1466G2701
TOTAL XYLENES	9/42	0.757 J	3470	WHF1466G1801
VOLATILES (CVOCs) (UG/L)				
TETRACHLOROETHENE	2/42	0.26 J	0.468 J	WHF1466G0202-D
TRICHLOROETHENE	34/42	0.274 J	522	WHF1466G2501
CIS-1, 2-DICHLOROETHENE	24/42	0.26 J	37.2	WHF-16G0702
DISSOLVED INORGANICS (UG/L)				
IRON	10/42	31.3 J	17600	WHF1466G1801
MANGANESE	33/42	3.27 J	598	WHF07G0102

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.

Definitions:
J = Estimated value

SECTION 6 TABLES

TABLE 6-1
SCREENING CRITERIA
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

Chemical	Adjusted USEPA RSL - Tapwater(1)	Florida CTL - Groundwater(2)
VOLATILES (UG/L)		
BENZENE	0.39 C	1
CIS-1,2-DICHLOROETHENE	2.8 N	70
ETHYLBENZENE	1.3 C	30
TETRACHLOROETHENE	3.5 N(3)	3
TOLUENE	86 N	40
TOTAL XYLENES	19 N	20
TRICHLOROETHENE	0.26 N(3)	3

Footnotes:

1 - USEPA RSLs for Chemicals at Superfund Sites, May 2012. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).

2 - Florida Department of Environmental Protection CTLs, February 2005.

3 - One-tenth the non-carcinogenic screening level is less than the carcinogenic screening level; therefore, the non-carcinogenic screenig level is presented.

TABLE 6-2
CHEMICALS OF POTENTIAL CONCERN NORTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

Chemical	Mininum Concentration(1)	Maximum Concentration(1)	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	Adjusted USEPA RSL - Tapwater(5)	USEPA COPC Flag	Florida CTL - Groundwater(6)	Florida COPC Flag	Rationale for Contaminant Deletion or Selection(7)
VOLATILES (UG/L)												
BENZENE	4.42	3580	WHF03G0101	18/34	0.25	3580	NA	**0.39 C**	YES	**1**	YES	ASL
CIS-1,2-DICHLOROETHENE	0.612 J	636	WHF03G0101	12/34	0.25-12.5	636	NA	**2.8 N**	YES	**70**	YES	ASL
ETHYLBENZENE	0.254 J	2690	WHF32G0101	19/34	0.25	2690	NA	**1.3 C**	YES	**30**	YES	ASL
TETRACHLOROETHENE	0.559 J	1.98 J	WHF32G0201	3/34	0.25-25	1.98	NA	3.5 N(8)	NO	3	NO	BSL
TOLUENE	0.261 J	35000 J	WHF-03G0401	18/34	0.25-1.25	35000	NA	**86 N**	YES	**40**	YES	ASL
TOTAL XYLENES	3.07	8060	WHF32G0101	15/34	0.75-3.75	8060	NA	**19 N**	YES	**20**	YES	ASL
TRICHLOROETHENE	0.364 J	376	WHF32G0201	19/34	0.25-12.5	376	NA	**0.26 N(8)**	YES	**3**	YES	ASL

Footnotes:

1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data are available for groundwater.
5 - USEPA RSLs for Chemicals at Superfund Sites, May 2012. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
6 - Florida Department of Environmental Protection CTLs, February 2005.
7- The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - One-tenth the non-carcinogenic screening level is less than the carcinogenic screening level; therefore, the non-carcinogenic screenig level is presented.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:

C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not available
RSL = Regional Screening Level
USEPA = United States Environmental Protection Agency
ug/L = micrograms per liter

Rationale Codes:

For selection as a COPC:
ASL = Above screening level
For elimination as a COPC:
BSL = Below screening level

TABLE 6-3

CHEMICALS OF POTENTIAL CONCERN SOUTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

Chemical	Mininum Concentration(1)	Maximum Concentration(1)	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	Adjusted USEPA RSL - Tapwater(5)	USEPA COPC Flag	Florida CTL - Groundwater(6)	Florida COPC Flag	Rationale for Contaminant Deletion or Selection(7)
VOLATILES (UG/L)												
BENZENE	0.258 J	1010	WHF07G0102	9/42	0.25-1.25	1010	NA	**0.39 C**	YES	**1**	YES	ASL
CIS-1,2-DICHLOROETHENE	0.26 J	37.2	WHF-16G0702	24/42	0.25-12.5	37.2	NA	**2.8 N**	YES	**70**	YES	ASL
ETHYLBENZENE	0.394 J	1840	WHF07G0102	11/42	0.25-0.5	1840	NA	**1.3 C**	YES	**30**	YES	ASL
TETRACHLOROETHENE	**0.26 J**	**0.468 J**	WHF1466G0202-D	2/42	0.25-12.5	0.468	NA	3.5 N(8)	NO	3	NO	BSL
TOLUENE	0.251 J	7510	WHF1466G2701	15/42	0.25-1.25	7510	NA	**86 N**	YES	**40**	YES	ASL
TOTAL XYLENES	0.757 J	3470	WHF1466G1801	9/42	0.75-1.5	3470	NA	**19 N**	YES	**20**	YES	ASL
TRICHLOROETHENE	0.274 J	522	WHF1466G2501	34/42	0.25-5	522	NA	**0.26 N(8)**	YES	**3**	YES	ASL

Footnotes:

1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data are available for groundwater.
5 - USEPA RSLs for Chemicals at Superfund Sites, May 2012. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
6 - Florida Department of Environmental Protection CTLs, February 2005.
7- The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - One-tenth the non-carcinogenic screening level is less than the carcinogenic screening level; therefore, the non-carcinogenic screenig level is presented.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:

C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not available
RSL = Regional Screening Level
USEPA = United States Environmental Protection Agency

Rationale Codes:

For selection as a COPC:
ASL = Above screening level
For elimination as a COPC:
BSL = Below screenig level

TABLE 6-4

CHEMICALS RETAINED AS COPCs
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

COPCs	**North Plume**	**South Plume**
Volatile Organics		
BENZENE	X	X
CIS-1,2-DICHLOROETHENE	X	X
ETHYLBENZENE	X	X
TOLUENE	X	X
TOTAL XYLENES	X	X
TRICHLOROETHENE	X	X

X - Indicates chemical was retained as a COPC.

TABLE 6-5

EXPOSURE POINT CONCENTRTATIONS
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

COPCs	North Plume (µg/L)	South Plume (µg/L)
Volatile Organics		
BENZENE	3580	1010
CIS-1,2-DICHLOROETHENE	636	37.2
ETHYLBENZENE	2690	1840
TOLUENE	35000	7510
TOTAL XYLENES	8060	3470
TRICHLOROETHENE	376	522

TABLE 6-6
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organics										
BENZENE	Chronic	4.0E-03	mg/kg/day	1	4.00E-03	mg/kg/day	Blood	NA	IRIS	1/19/2000
CIS-1,2-DICHLOROETHENE	Chronic	2.00E-03	mg/kg/day	1	2.00E-03	mg/kg/day	Kidney	NA	IRIS	9/30/2010
ETHYLBENZENE	Chronic	0.1	mg/kg/day	1	1.00E-01	mg/kg/day	Liver, Kidney	NA	IRIS	6/1/1991
TOLUENE	Chronic	0.08	mg/kg/day	1	8.00E-02	mg/kg/day	Kidney	NA	IRIS	9/23/2005
TOTAL XYLENES	Chronic	2.0E-01	mg/kg/day	1	2.00E-01	mg/kg/day	Body Weight	NA	IRIS	2/21/2003
TRICHLOROETHENE	Chronic	0.0005	mg/kg/day	1	5.00E-04	mg/kg/day	Immune System, Developmental	NA	IRIS	9/28/2011

1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

TABLE 6-7
CANCER TOXICITY DATA -- ORAL/DERMAL
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal(1)	Absorbed Cancer Slope Factor for Dermal(2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Inorganics								
Volatile Organics								
BENZENE	5.5E-02	mg/kg/day	1	5.5E-02	mg/kg/day	A	IRIS	1/19/2000
CIS-1,2-DICHLOROETHENE	NA	NA	1	NA	NA	NA	NA	NA
ETHYLBENZENE	1.1E-02	mg/kg/day	1	1.1E-02	mg/kg/day	D	IRIS	3/1/1991
TOLUENE	NA	NA	1	NA	NA	NA	NA	NA
TOTAL XYLENES	NA	NA	1	NA	NA	NA	NA	NA
TRICHLOROETHENE	0.0093	mg/kg/day	1	9.3E-03	mg/kg/day	A	IRIS	9/28/2011

Notes:

1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.

EPA Group:

A - Human carcinogen.
B1 - Probable human carcinogen - indicates that limited human data are available.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .
C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
E - Evidence of noncarcinogenicity.
NA - Not Applicable/not available

E = U.S. EPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July 1993, EPA/600/R-93/089.

TABLE 6-8

SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES - NORTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Adult Trainee	Groundwater	Ingestion	2E-04	Benzene	Ethylbenzene	Trichloroethene	47	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	4E-05	--	Benzene	Ethylbenzene, Trichloroethene	10	Benzene,Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Inhalation	8E-05	--	Benzene	Ethylbenzene, Trichloroethene	15	Benzene, Toluene, Total Xylenes, Trichloroethene
		Total	3E-04	Benzene	Ethylbenzene, Trichloroethene	--	73	Benzene, Total Xylenes, Toluene, Ethylbenzene, Trichloroethene, Cis-1,2-Dichloroethene
Adult Base Worker	Groundwater	Ingestion	8E-04	Benzene	Ethylbenzene, Trichloroethene	--	17	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Total	9E-04	Benzene	Ethylbenzene, Trichloroethene	--	17	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
Child Residents	Groundwater	Ingestion	1E-03	Benzene, Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	158	Benzene, Total Xylenes, Trichloroethene (Nonmutagenic), Iron, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	3E-04	Benzene	Ethylbenzene, Trichloroethene (Mutagenic)	Trichloroethene (Nonmutagenic)	31	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Inhalation	2E-04	Benzene	Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	27	Benzene, Toluene, Total Xylenes, Trichloroethene (Nonmutagenic)
		Total	2E-03	Benzene, Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	216	Benzene, Total Xylenes, Toluene, Ethylbenzene, Trichloroethene (Nonmutagenic), Iron, Cis-1,2-Dichloroethene

TABLE 6-8

SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES - NORTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA
PAGE 2 OF 2

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Adult Residents	Groundwater	Ingestion	2E-03	Benzene, Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	68	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	5E-04	Benzene, Ethylbenzene	Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	14	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Inhalation	9E-04	Benzene, Ethylbenzene	Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	27	Benzene, Toluene, Total Xylenes, Trichloroethene (Nonmutagenic)
		Total	4E-03	Benzene, Ethylbenzene, Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	--	108	Benzene, Total Xylenes, Toluene, Ethylbenzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene
Lifelong (Child and Adult)	Groundwater	Ingestion	4E-03	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	--	NA	--
		Dermal Contact	8E-04	Benzene, Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	NA	--
		Inhalation	1E-03	Benzene, Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	NA	--
		Total	6E-03	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	--	NA	--

TABLE 6-9

SUMMARY OF CANCER RISKS AND HAZARD INDICES
CENTRAL TENDENCY EXPOSURES - NORTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Adult Trainee	Groundwater	Ingestion	6E-05	--	Benzene	Ethylbenzene, Trichloroethene	48	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	1E-05	--	--	Benzene, Ethylbenzene	7	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Inhalation	4E-06	--	--	Benzene	2	Target Organs HI < 1
		Total	8E-05	--	Benzene	Ethylbenzene, Trichloroethene	57	Benzene, Total Xylenes, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
Adult Base Worker	Groundwater	Ingestion	4E-04	Benzene	Ethylbenzene, Trichloroethene	--	7	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Toluene
		Total	4E-04	Benzene	Ethylbenzene, Trichloroethene	--	7	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Toluene
Child Residents	Groundwater	Ingestion	2E-04	Benzene	Ethylbenzene, Trichloroethene (Mutagenic)	Trichloroethene (Nonmutagenic)	78	Benzene, Trichloroethene (Nonmutagenic), Iron, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	4E-05	--	Benzene	Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	12	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Inhalation	5E-06	--	--	Benzene	2	Target Organs HI < 1
		Total	3E-04	Benzene	Ethylbenzene, Trichloroethene (Mutagenic)	Trichloroethene (Nonmutagenic)	92	Benzene, Total Xylenes, Trichloroethene (Nonmutagenic), Iron, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene

TABLE 6-9

SUMMARY OF CANCER RISKS AND HAZARD INDICES
CENTRAL TENDENCY EXPOSURES - NORTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA
PAGE 2 OF 2

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Adult Residents	Groundwater	Ingestion	3E-04	Benzene	Ethylbenzene, Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	32	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	6E-05	--	Benzene, Ethylbenzene	Trichloroethene (Nonmutagenic)	6	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Inhalation	2E-05	--	--	Benzene, Ethylbenzene	2	Target Organs HI < 1
		Total	4E-04	Benzene	Ethylbenzene, Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	39	Benzene, Total Xylenes, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
Lifelong (Child and Adult)	Groundwater	Ingestion	6E-04	Benzene	Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	NA	--
		Dermal Contact	1E-04	--	Benzene, Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	NA	--
		Inhalation	2E-05	--	Benzene	Ethylbenzene	NA	--
		Total	7E-04	Benzene	Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	NA	--

TABLE 6-10
SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES - SOUTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

PAGE 1 OF 2

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Adult Trainee	Groundwater	Ingestion	6E-05	--	Benzene, Ethylbenzene, Trichloroethene	--	11	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	2E-05	--	--	Benzene, Ethylbenzene, Trichloroethene	3	Trichloroethene
		Inhalation	3E-05	--	Benzene	Ethylbenzene, Trichloroethene	5	Benzene, Total Xylenes, Trichloroethene
		Total	1E-04	--	Benzene, Ethylbenzene, Trichloroethene	--	19	Benzene, Total Xylenes, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
Adult Base Worker	Groundwater	Ingestion	3E-04	Benzene	Ethylbenzene, Trichloroethene	--	4	Benzene, Trichloroethene
		Total	3E-04	Benzene	Ethylbenzene, Trichloroethene	--	4	Benzene, Trichloroethene
Child Residents	Groundwater	Ingestion	7E-04	Benzene	Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	92	Benzene, Trichloroethene (Nonmutagenic), Iron, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	2E-04	--	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	17	Benzene, Trichloroethene (Nonmutagenic), Ethylbenzene, Toluene
		Inhalation	1E-04	--	Benzene, Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	21	Benzene, Total Xylenes, Trichloroethene (Nonmutagenic)
		Total	9E-04	Benzene, Ethylbenzene, Trichloroethene (Mutagenic)	Trichloroethene (Nonmutagenic)	--	131	Benzene, Total Xylenes, Trichloroethene (Nonmutagenic), Iron, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
Adult Residents	Groundwater	Ingestion	1E-03	Benzene, Ethylbenzene, Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	--	40	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	2E-04	--	Benzene, Ethylbenzene, Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	7	Trichloroethene (Nonmutagenic)
		Inhalation	4E-04	Benzene	Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	21	Benzene, Total Xylenes, Trichloroethene (Nonmutagenic)
		Total	2E-03	Benzene, Ethylbenzene, Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	--	68	Benzene, Total Xylenes, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene

TABLE 6-10
SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES - SOUTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA
PAGE 2 OF 2

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Lifelong (Child and Adult)	Groundwater	Ingestion	2E-03	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	--	NA	--
		Dermal Contact	2E-03	Ethylbenzene	Benzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	NA	--
		Inhalation	2E-03	Benzene	Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	NA	--
		Total	3E-03	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	--	NA	--

NOTES:

TABLE 6-11
SUMMARY OF CANCER RISKS AND HAZARD INDICES
CENTRAL TENDENCY EXPOSURES - SOUTH CENTRAL AREA PLUME
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD, MILTON, FLORIDA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Adult Trainee	Groundwater	Ingestion	2E-05	--	Benzene	Ethylbenzene, Trichloroethene	5	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	6E-06	--	--	Benzene, Ethylbenzene	1	Trichloroethene
		Inhalation	1E-06	--	--	--	0	--
		Total	3E-05	--	Benzene	Ethylbenzene, Trichloroethene	7	Benzene, Trichloroethene, Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
Adult Base Worker	Groundwater	Ingestion	1E-04	--	Benzene, Ethylbenzene, Trichloroethene	--	2	Trichloroethene
		Total	1E-04	--	Benzene, Ethylbenzene, Trichloroethene	--	2	Trichloroethene
Child Residents	Groundwater	Ingestion	1E-04	--	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	46	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	2E-05	--	--	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	6	Trichloroethene (Nonmutagenic)
		Inhalation	2E-06	--	--	--	1	--
		Total	1E-04	--	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	53	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
Adult Residents	Groundwater	Ingestion	1E-04	--	Benzene, Ethylbenzene, Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	19	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
		Dermal Contact	3E-05	--	--	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	3	Trichloroethene (Nonmutagenic)
		Inhalation	7E-06	--	--	Benzene, Ethylbenzene	1	--
		Total	2E-04	--	Benzene, Ethylbenzene, Trichloroethene (Nonmutagenic)	Trichloroethene (Mutagenic)	23	Benzene, Trichloroethene (Nonmutagenic), Cis-1,2-Dichloroethene, Ethylbenzene, Toluene
Lifelong (Child and Adult)	Groundwater	Ingestion	2E-04	--	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	NA	--
		Dermal Contact	5E-05	--	Benzene, Ethylbenzene	Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	NA	--
		Inhalation	9E-06	--	--	Benzene, Ethylbenzene	NA	--
		Total	3E-04	--	Benzene, Ethylbenzene, Trichloroethene (Mutagenic), Trichloroethene (Nonmutagenic)	--	NA	--

SECTION 8 TABLES

TABLE 8-1
ANALYTES DETECTED IN SURFACE AND SUBSURFACE SOIL LEACHATE AND GROUNDWATER BY AREA AND SITE
SITE 40, BASE-WIDE GROUNDWATER
NAVAL AIR STATION WHITING FIELD, MILTON, FLORIDA

Analytes Detected	Northern Area					North Central Area								South Central Area								Southern Area							
	Site 1	Site 2	Site 17#	Site 18	Site 38	Site 3	Site 4 (1467)	Site 32	Site 35	Site 36#	Site 37#	Site 41	Site 1438/1439	Site 5	Site 6	Site 7 (1466)	Site 15	Site 16	Site 29	Site 30	Site 33	Site 8#	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 31
Volatiles																													
1,2-Dibromoethane	* ■	* ■		*	■	* ■	* ■	* ■	*			■	* G		*	*			*	*	*				■		■	* ■	■
Benzene	* ■	* ■		*	■	* G	* G	* G	*			■	* G		*	* G		G	*	* G	*				■		■	* ■	■
Bromomethane	* ■	* ■			■	■	■	■	*			■	*		*	*			*	*	*				■		■	* ■	■
Cis-1,2-Dichloroethene	* ■	* ■		*	■	* G	* G	*	*			■	*		*	* G			*	*	*				■		■	* ■	■
1,2-DCE	* ■	* ■			■	■	■	■	*			■	*		*	*			*	*	*				■		■	* ■	■
Chloromethane,	* ■	* ■			■	■	■	■	*			■	*		*	*			*	*	*				■		■	* ■	■
Ethylbenzene	* ■	* ■		*	■	G	L G	L G	*			■	*		*	L G			*	*	*				■		■	* ■	■
Methylene chloride	* ■	L		*	■	* ■	* ■	*	*			■	*		*	*			*	*	*				■		■	* ■	■
2-Methylnaphthalene	* ■	* ■		*	■	*	*	*	*			* ■	*		*	L			*	*	*				■	*	■	* ■	■
Toluene	* ■	* ■		*	■	G	L G	* G	*			■	*		*	L			*	*	*				■		■	* ■	■
Total Xylenes	* ■	* ■		*	■	G	L G	L G	*			■	*		*	L G			*	*	*				■		■	* ■	■
Trans-1,2-Dichloroethene	* ■	* ■		*	■	* ■	* ■	* ■	*			■	*		*	* G			*	*	*				■		■	* ■	■
Trichloroethene	* ■	* ■		*	■	* G	* G	* G	*			■	*		* G	* G			*	*	*				■		■	* ■	■
Vinyl Chloride	* ■	* ■		*	■	* ■	* ■	* ■	*			■	*		*	* G	G	G	*	* G	* G				G		■	* ■	■
Semivolatiles																													
Bis (2-ethyhexyl) thphalate	■	■			* G	■	■	*	G			* G	*			L	*		*	*					G		* ■	* ■	G
Benzo(a)pyrene	■	■			■		*	*				* ■	*			*	*		*	*					■		* ■	■	■
Carbazole	■	■			■		*	*				* ■	*			*	*		*	*					■		* ■	■	■
Dibenzo(a,h)anthracene	■	■			■		*	*				* ■	*			*	*		*	*					■		* ■	■	■
Indeno(1,2,3-cd)pyrene,	■	■			■		*	*				* ■	*			*	*		*	*					■		* ■	■	■
2,6-dinitrotoluene	■	■			■		*	*				* ■	*			*	*		*	*					■		* ■	■	■
2-Methylphenol,	■	■			■		*	*				* ■	*			*	*		*	*					■		* ■	■	■
4-Methylphenol	■	■			■		*	*				* ■	*			*	*		*	*					■		* ■	■	■
Naphthalene	* ■	* ■		*	* ■	*	*	L				* ■	*			L	*		*	*	*				■	*	* ■	■	■
Phenol,	■	■			■		*	*				* ■	*			*	*		*	*					■		* ■	■	■
Pesticides																													
Total (alpha-, gama-) Chlordane	■	■			*	*						* ■	*	*	*						*			*	*		■	* ■	■
Dieldrin	■	* ■			L	*						* ■	*	L ■	*				*		*			*	*		■	* ■	■
Beta-BHC	■	■			G	*						* ■	*	*	*						*			*	*		■	* ■	■
Gamma-BHC	■	■			G	*						* ■	*	*	*						*			*	*		■	* ■	■
Heptachlor Epoxide	■	■			L G	*						* ■	*	*	*						*			*	*		■	* ■	■
Total Petroleum Hydrocarbons	* ■	* ■		*	* ■	*	*	*	*			* ■	*			L			*	*	*						■	■	■
Metals																													
Aluminum	L G	L G		L	L G	L G	* G	* G	* G			L G	L	L G	* G	L G	L G	L G	* ■	* G	L G		G	L	G	*	L G	G	G
Arsenic	* ■	* ■		*	L G	* G	* G	* G	*			* ■		* ■	* ■	G	* ■	* ■	* ■	* ■	G			*	* ■		* ■	* ■	■
Iron	L G	L G		L	L G	* G	* G	* G	* G		G	L G		L G	* G	L G	G	L G	L	* ■	L G			*	* G	*	* G	G	G
Lead	* ■	* ■		*	* ■	* G	* G	L G	*			L ■		* ■	* ■	L G	* ■	■	L	* ■	G			*	* ■		* ■	* ■	■
Manganese	* ■	* ■		*	L G	* G	* G	* G	* G		G	L ■		* ■	* ■	L G	G	G	* ■	* G	* ■			*	G	*	* G	■	■
Mercury	* ■	* ■		*	* ■	* G	*	*	*			* ■		* ■	* ■	L ■	* ■	* ■	* ■	■	* ■			*	* ■	*	L	* ■	■
Vanadium	* ■	* ■		*	L G	*	*	* G	*			L ■		* ■	* ■	L G	* ■	* ■	L	G	G			*	* ■		* ■	* ■	■

Notes:

North and South Areas were last sampled in approximately 2000. North and South Central Areas soil was last sampled in 2000, groundwater in 2011.

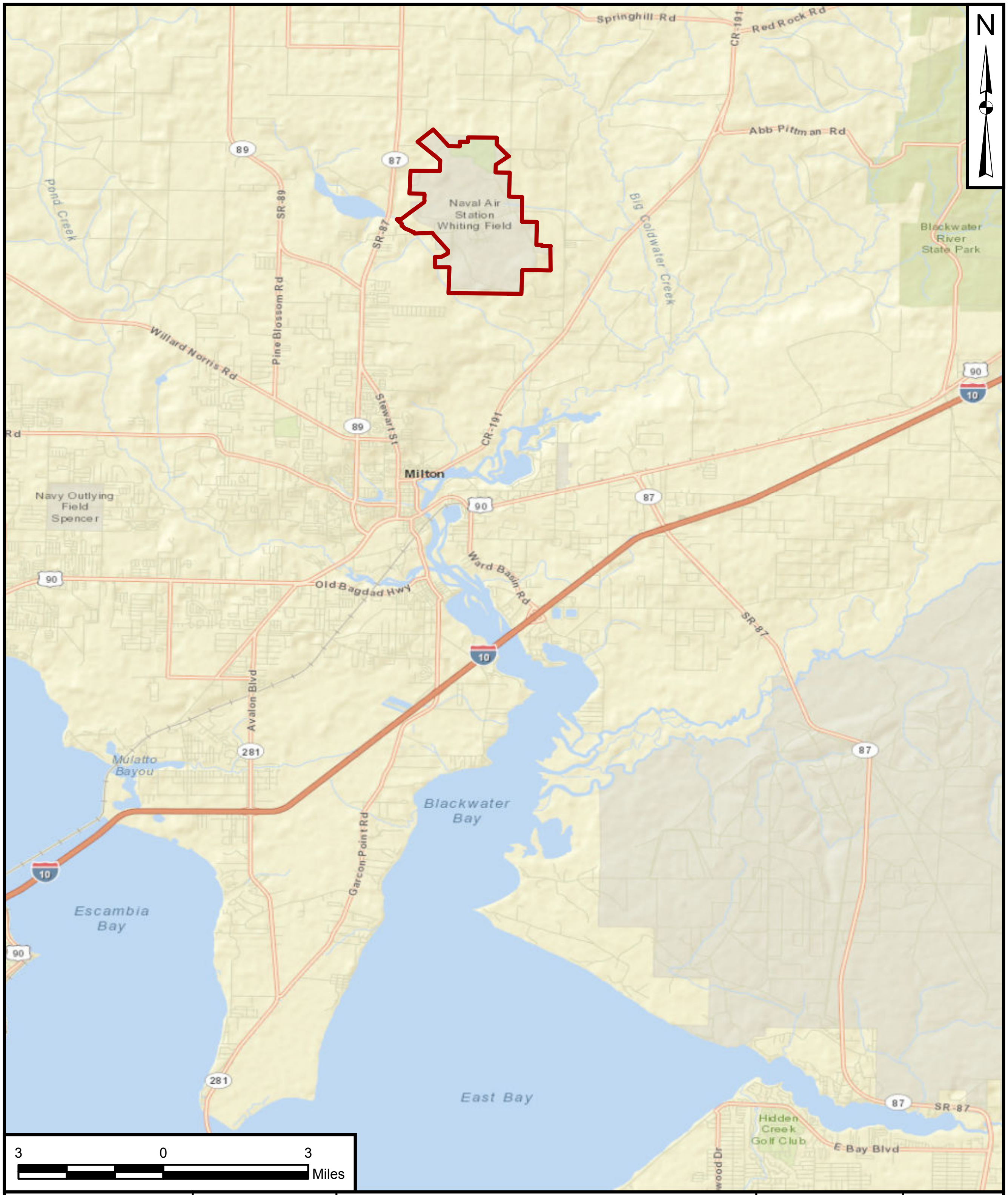
No samples were collected from the sites after 1998
Blank space = no analysis performed
* = Analysis performed to detect analyte in leachate, analyte not detected exceeding Federal or Florida criteria
L = Analyte detected in leachate at concentrations exceeding Federal or Florida criteria
■ = Analysis performed to detect analyte in groundwater, analyte not detected exceeding Federal or Florida criteria
G= Analyte detected in groundwater at concentrations exceeding Federal or Florida criteria

*	Not detected in leachate exceeding critria
■	Not detected in groundwater exceeding criteria
* ■	Not detected in leachate or groundwater exceeding criteria
L	Detected in leachate exceeding criteria groundwater not analyzed
L ■	Analyte detected in leachate exceeding criteria, analyte not detected exceeding criteria
L G	Detected in leachate and groundwater exceeding criteria
G	Leachate not analyzed, detected in groundwater exceeding criteria
* G	Not detected in leachate, detected in groundwater exceeding criteria

FIGURES

SECTION 1 FIGURES

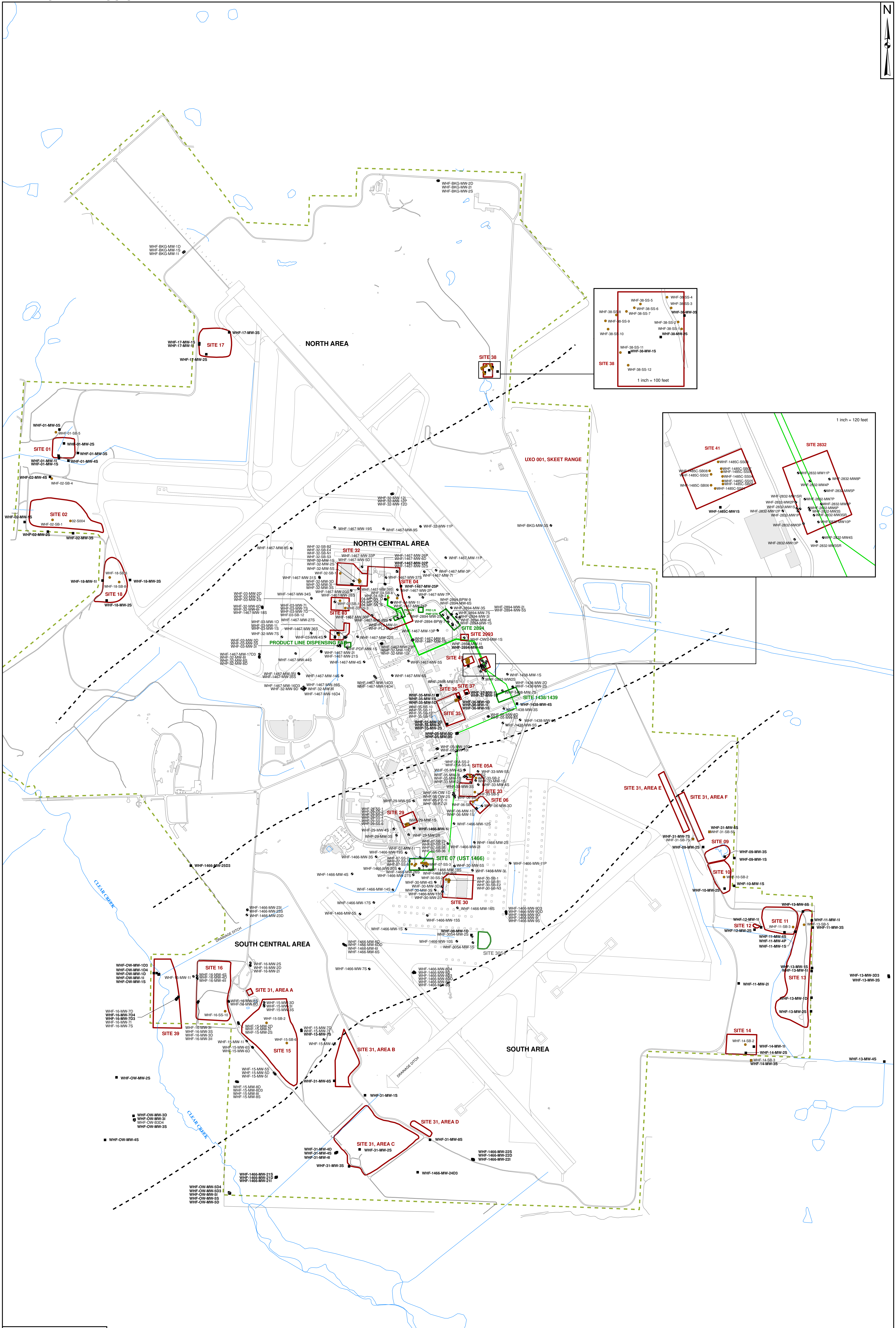
PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\FACILITY_LOCATION.MXD 10/9/2012 KM



DRAWN BY K. MOORE	DATE 10/9/12	FACILITY LOCATION REMEDIAL INVESTIGATION REPORT FOR SITE 40, BASE-WIDE GROUNDWATER NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NUMBER 0069	CTO NUMBER ___
CHECKED BY L. SMITH	DATE 10/9/12		APPROVED BY ___	DATE ___
REVISED BY	DATE		APPROVED BY ___	DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 1-1	REV 0

NAVFAC

PGH P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\BASEWIDE_MW_LOCS_D.MXD 11\28\11 SP



Legend

- Monitoring Well Location
- Monitoring Well Location (Abandoned/Destroyed)
- Leachate Sample Location
- base_divisions
- Facility and Site 40 Boundary
- 🟥 IR Site Boundary
- 🟩 UST Site Boundary

720 0 720 Feet

DRAWN BY S. PAXTON	DATE 11/28/11	
CHECKED BY L. SMITH	DATE 11/28/11	
REVISED BY ____	DATE ____	
SCALE AS NOTED		

NAVFAC

MAP OF SITE 40 WITH ACTIVE MONITORING WELLS,
ABANDONED WELLS, AND
LEACHATE SAMPLE LOCATIONS
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER ____	CTO NUMBER ____
APPROVED BY ____	DATE ____
APPROVED BY ____	DATE ____
FIGURE NO. FIGURE 1-2	REV 0

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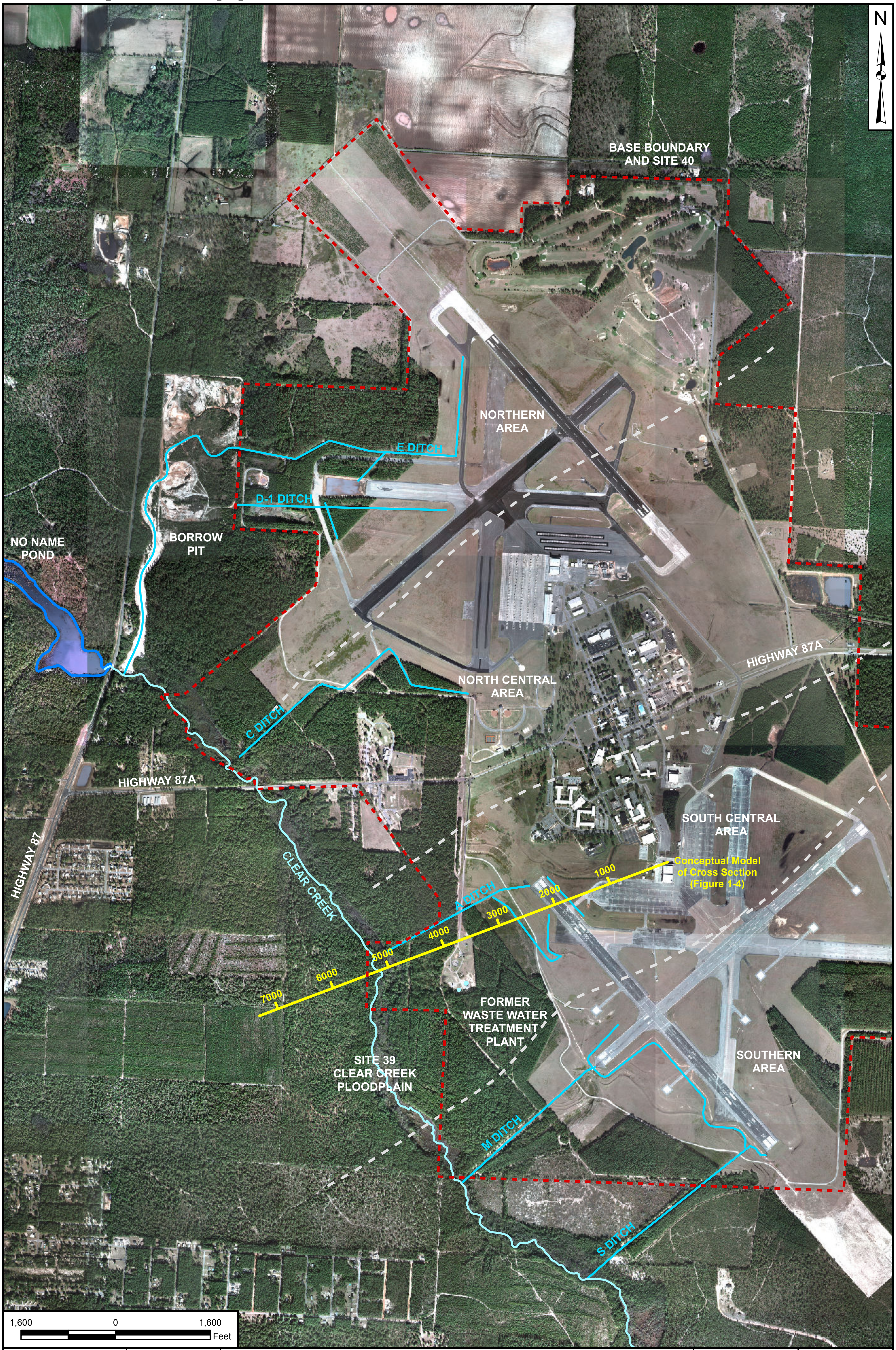

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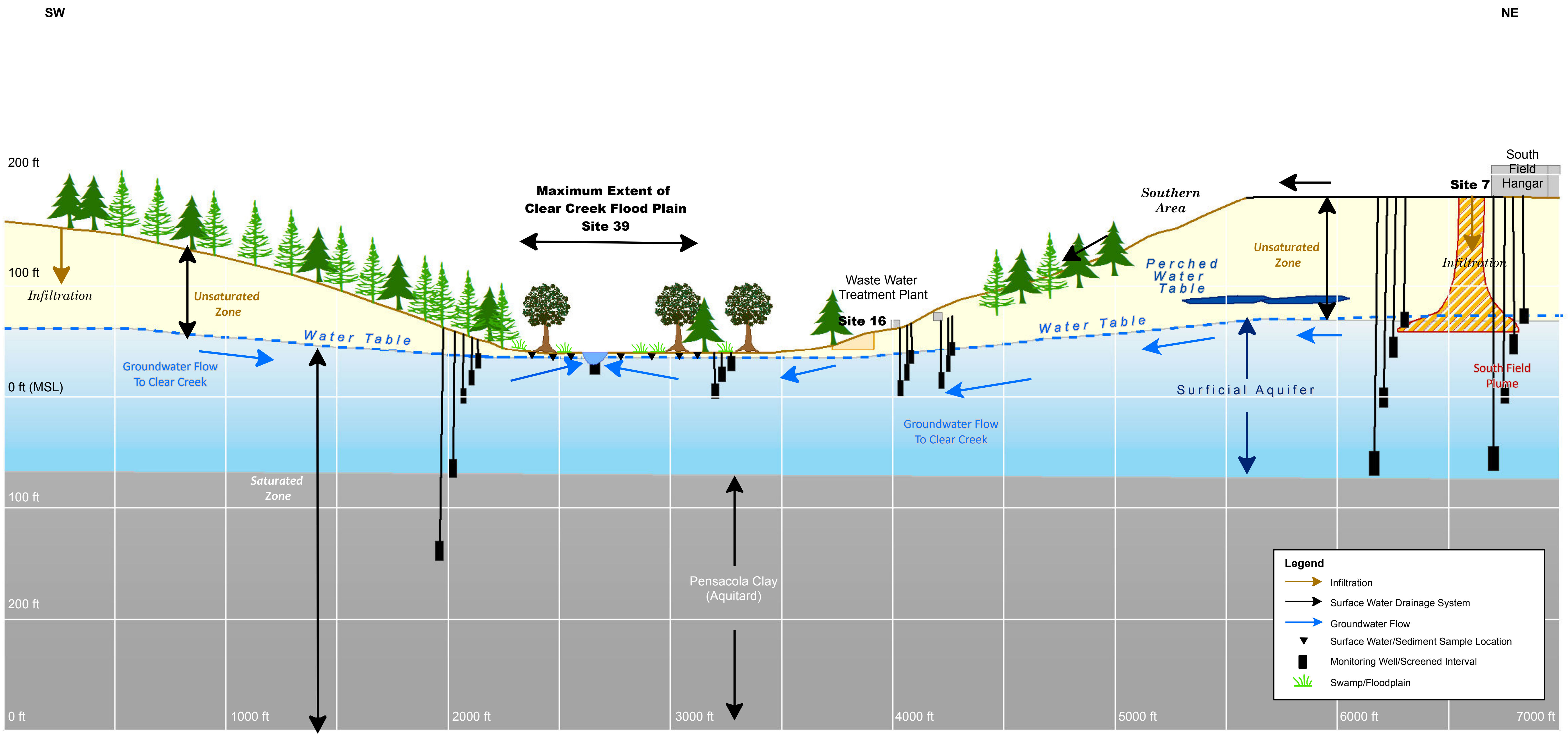
L. SMITH	10/9/12
REVISED BY	DATE
K. MOORE	10/9/12
SCALE	
AS NOTED	

NAVFAC

FACILITY SURFACE FEATURES
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
___	___
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
FIGURE NO.	REV
1-3	0

P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\SITE39_CONCEPTUAL_SITE_MODEL_REV.MXD 10/9/12 KM



DRAWN BY K. MOORE DATE 1/13/12
CHECKED BY L. SMITH DATE 10/9/12
REVISED BY K. MOORE DATE 10/9/12
SCALE AS NOTED

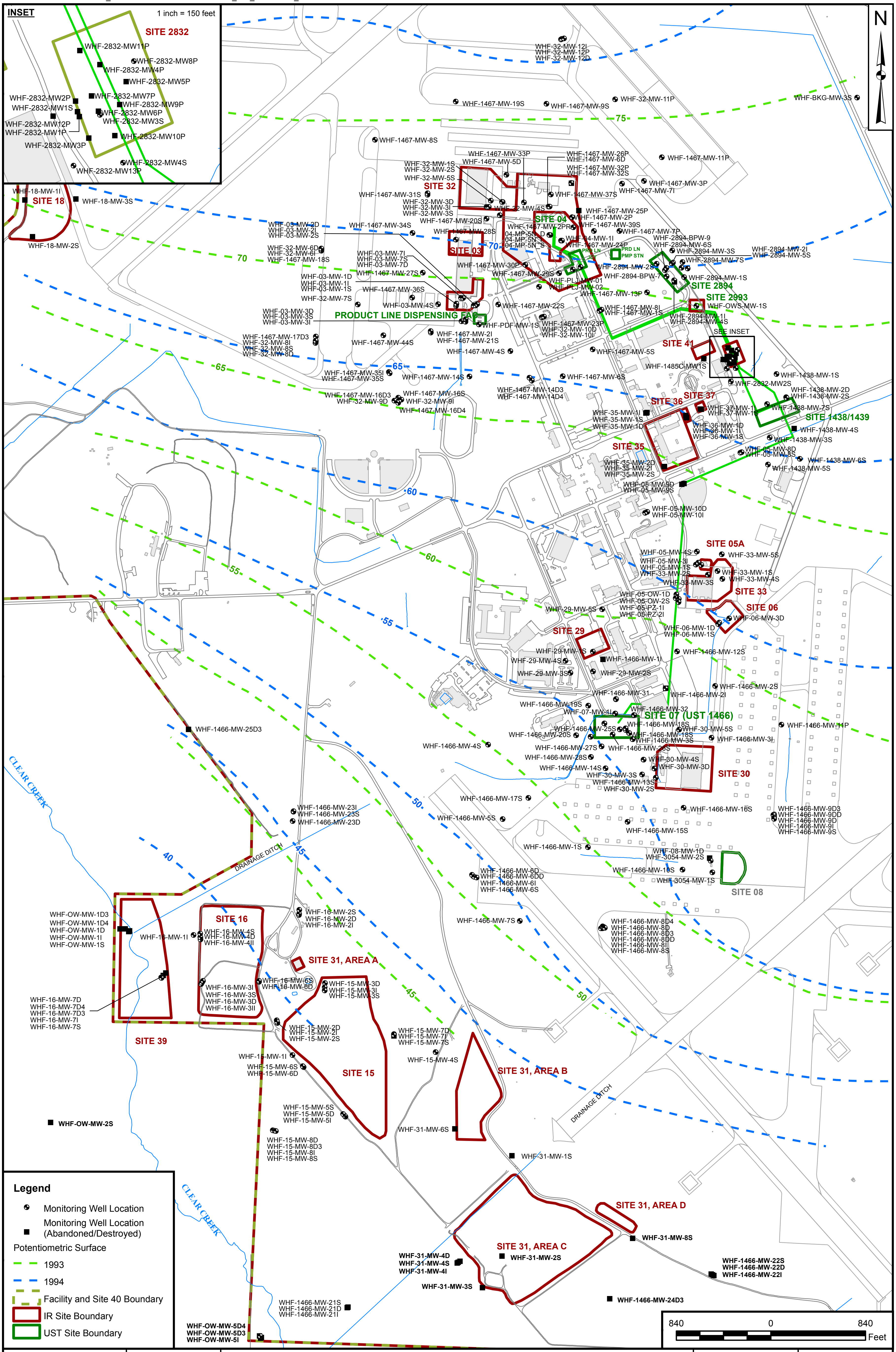
NAVFAC

CONCEPTUAL SITE MODEL
OF SOUTHERN AREA HYDROGEOLOGY
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER
APPROVED BY ___ DATE ___
APPROVED BY ___ DATE ___
FIGURE NO. 1-4
REV 0

SECTION 2 FIGURES

PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\BASEWIDE_GW_CONTOUR_MAP.MXD 11/27/2012 KM



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CHECKED BY	DATE
L. SMITH	10/9/12
REVISED BY	DATE
K. MOORE	10/9/12
SCALE	
AS NOTED	

NAVFAC

GROUNDWATER CONTOUR MAP OF THE WATER TABLE
IN THE SAND-AND-GRAVEL AQUIFER,
INSTALLATION WIDE, OCTOBER 1993 AND FEBRUARY 1994
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
—	—
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO. 2-1	REV 0

PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\SITE40_STRATIGRAPHIC_COLUMN.MXD 10/8/2012 KM

Series	Stratigraphic and Hydrologic Units			Lithology
Holocene and Pleistocene	Alluvium and terrace deposits		Sand-and-Gravel Aquifer	Undifferentiated silt, sand, and gravel, with some clay. Surficial zone of aquifer.
Pliocene	Citronelle Formation			Sand, very fine to very coase and poorly sorted. Hardpan layers in upper part.
Miocene	Unnamed coarse clastics	Choctawhatchee Formation		Sand, shell, and marl
		Alum Bluff Group Shoal River Formation Chipola Formation		Sand with lenses of silt, clay, and gravel (includes unnamed coarse clastics and Alum Bluff Group). Main producing zone of aquifer.
	Pensacola Clay		Confining unit	Dark to light gray sandy clay. Is basal confining unit in southern one-half of area
	St. Marks Formation		Floridan aquifer system	Limestone and dolomite-top of the Floridan aquifer system.

Several geologic units of Miocene age and younger comprise the sand and gravel aquifer in the westernmost part of panhandle Florida. The aquifer extends to the land surface thoughout its are of occurrence.

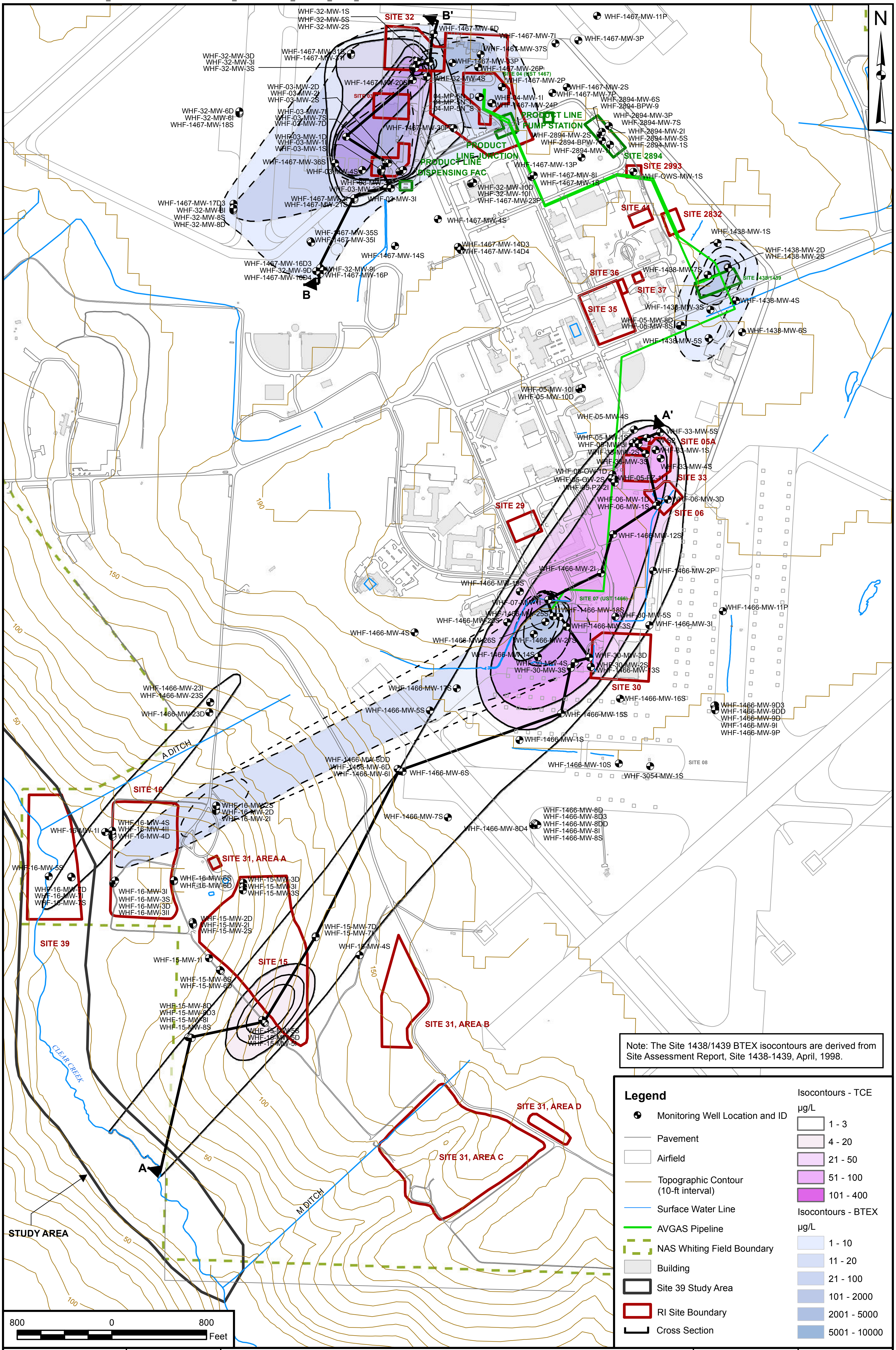
Modified from Cush-Roisin and Franks, 1982

DRAWN BY K. MOORE	DATE 01/12/12	CONTRACT NUMBER	CTO NUMBER JM40
CHECKED BY L. SMITH	DATE 10/8/12	APPROVED BY	DATE
REVISED BY	DATE	APPROVED BY	DATE
SCALE AS NOTED		FIGURE NO. 2-2	REV 0

NAVFAC

STRATIGRAPHIC COLUMN OF THE
SAND-AND-GRAVEL AQUIFER
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\BASEWIDE_COMMINGLED_PLUMES_TOPO_B.MXD 12/5/2012 KM



Note: The Site 1438/1439 BTEX isocontours are derived from Site Assessment Report, Site 1438-1439, April, 1998.

DRAWN BY S. PAXTON	DATE 11/23/11
CHECKED BY L. SMITH	DATE 12/5/12
REVISED BY __	DATE __
SCALE AS NOTED	

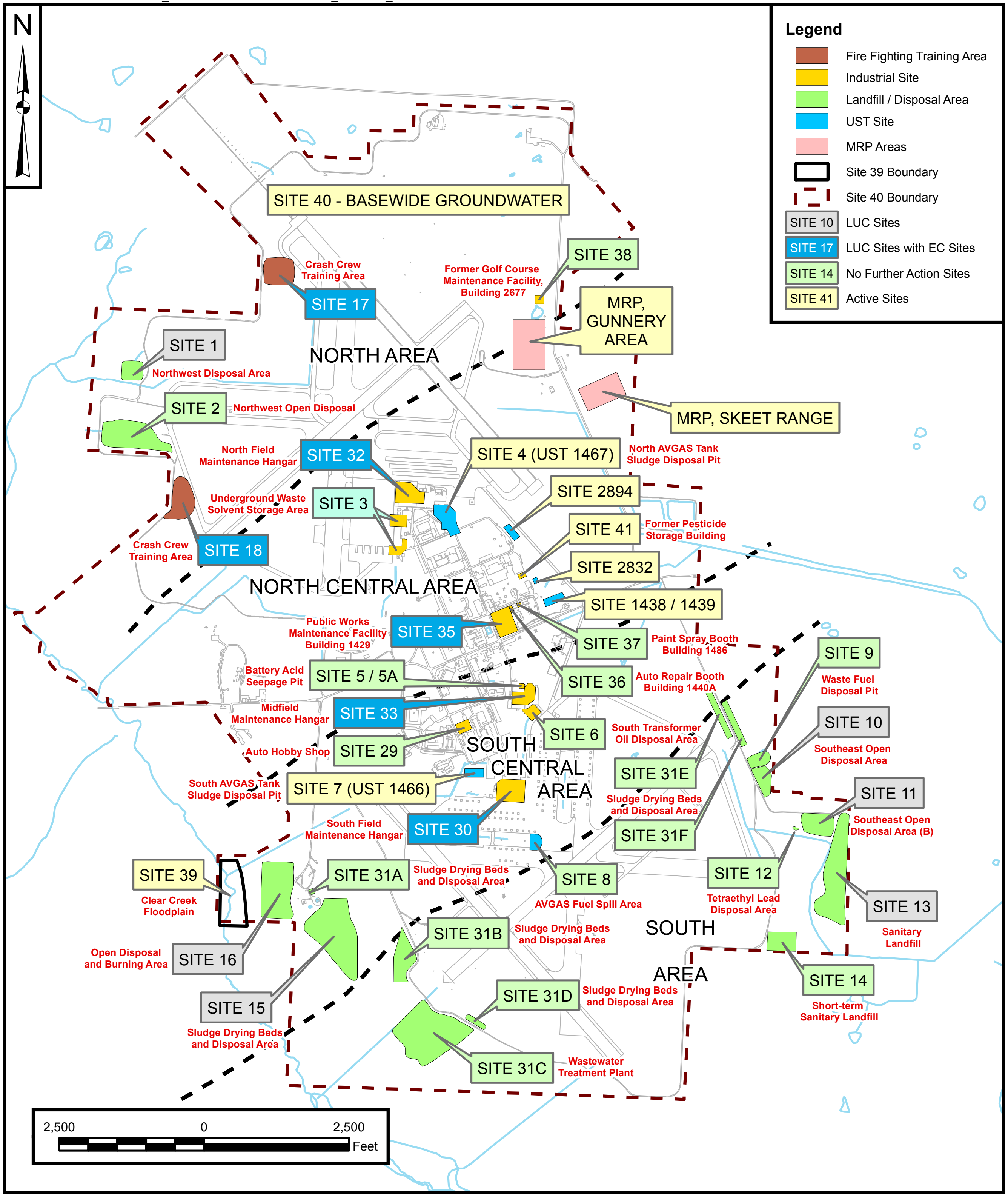
NAVFAC

NORTHERN AND SOUTHERN COMMINGLED PLUMES
AND THE BTEX PLUMES AT SITE 1438/1439
WITH TOPOGRAPHIC ISOCONTOURS
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER __	CTO NUMBER __
APPROVED BY __	DATE __
APPROVED BY __	DATE __
FIGURE NO. 2-3	REV 0

SECTION 4 FIGURES

PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\SITE40_STATUS_MAP.MXD 10/8/2012 KM



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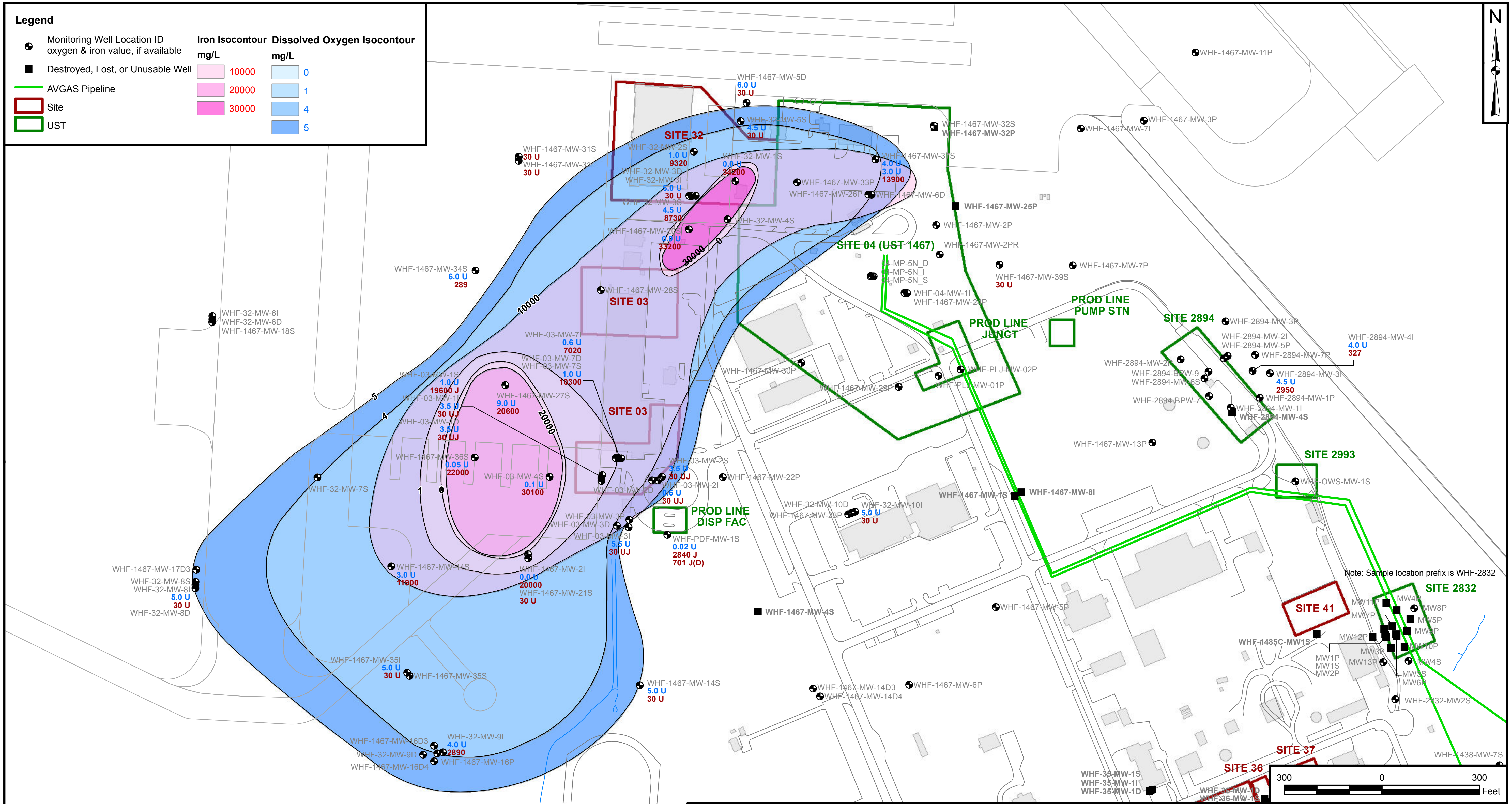
K. MOORE	01/12/12
CHECKED BY	DATE
L. SMITH	10/8/12
REVISED BY	DATE
K. MOORE	10/8/12
SCALE AS NOTED	

SITE STATUS MAP WITH AREA DIVISIONS
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
___	JM40
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
FIGURE NO.	REV
4-1	0

PGH P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\NORTH_FIELD_DO_FE_2011.MXD 10/11/12 KM



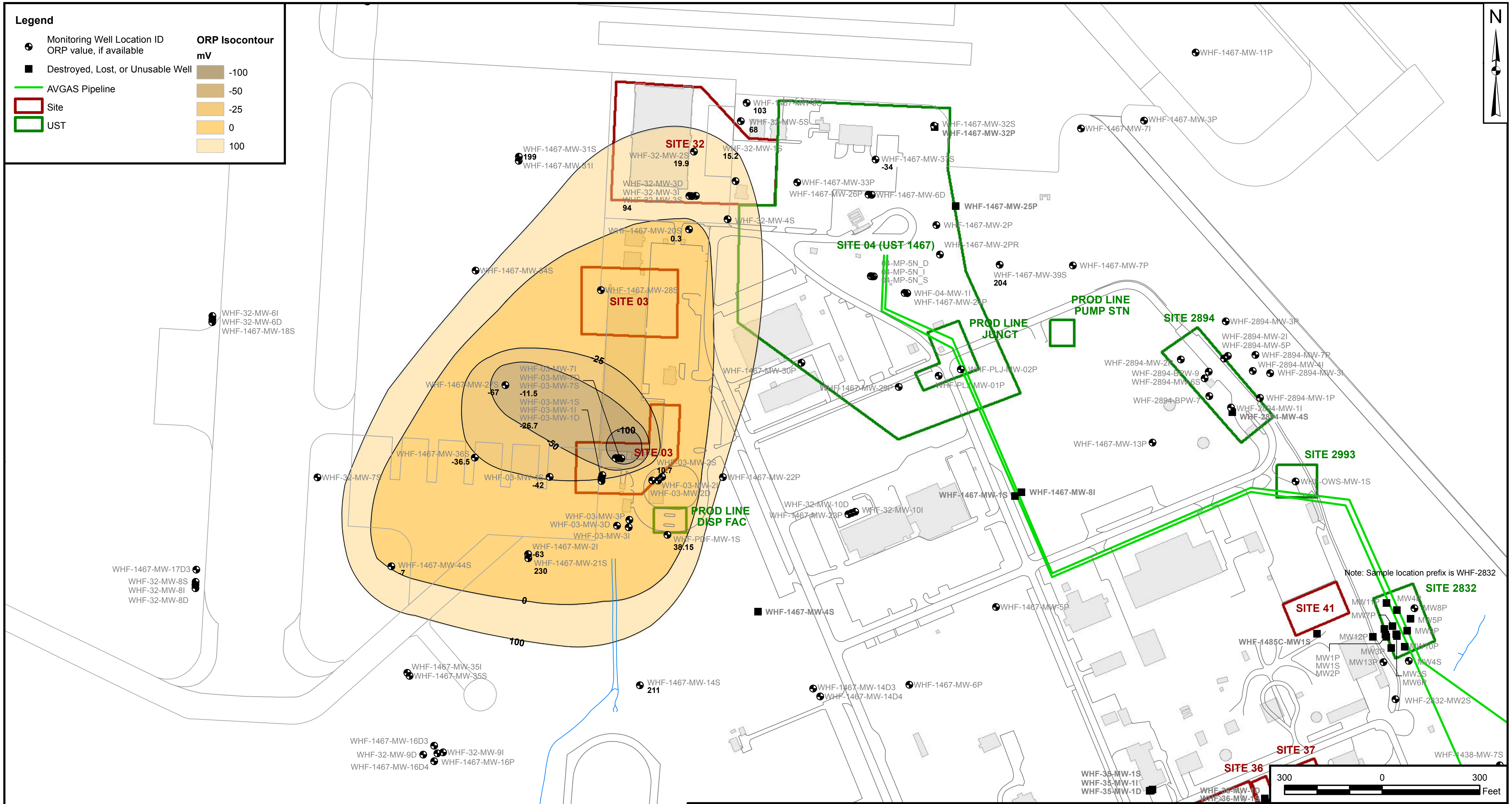
DRAWN BY S. PAXTON DATE 01/08/12
CHECKED BY L. SMITH DATE 10/11/12
REVISED BY K. MOORE DATE 10/11/12
SCALE AS NOTED

NAVFAC

NCA DISSOLVED OXYGEN AND IRON
IN SHALLOW GROUNDWATER
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER
CTO NUMBER
APPROVED BY DATE
APPROVED BY DATE
FIGURE NO. 4-2
REV 0

PGH P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\NORTH_FIELD_ORP_2011.MXD 10/11/12 KM



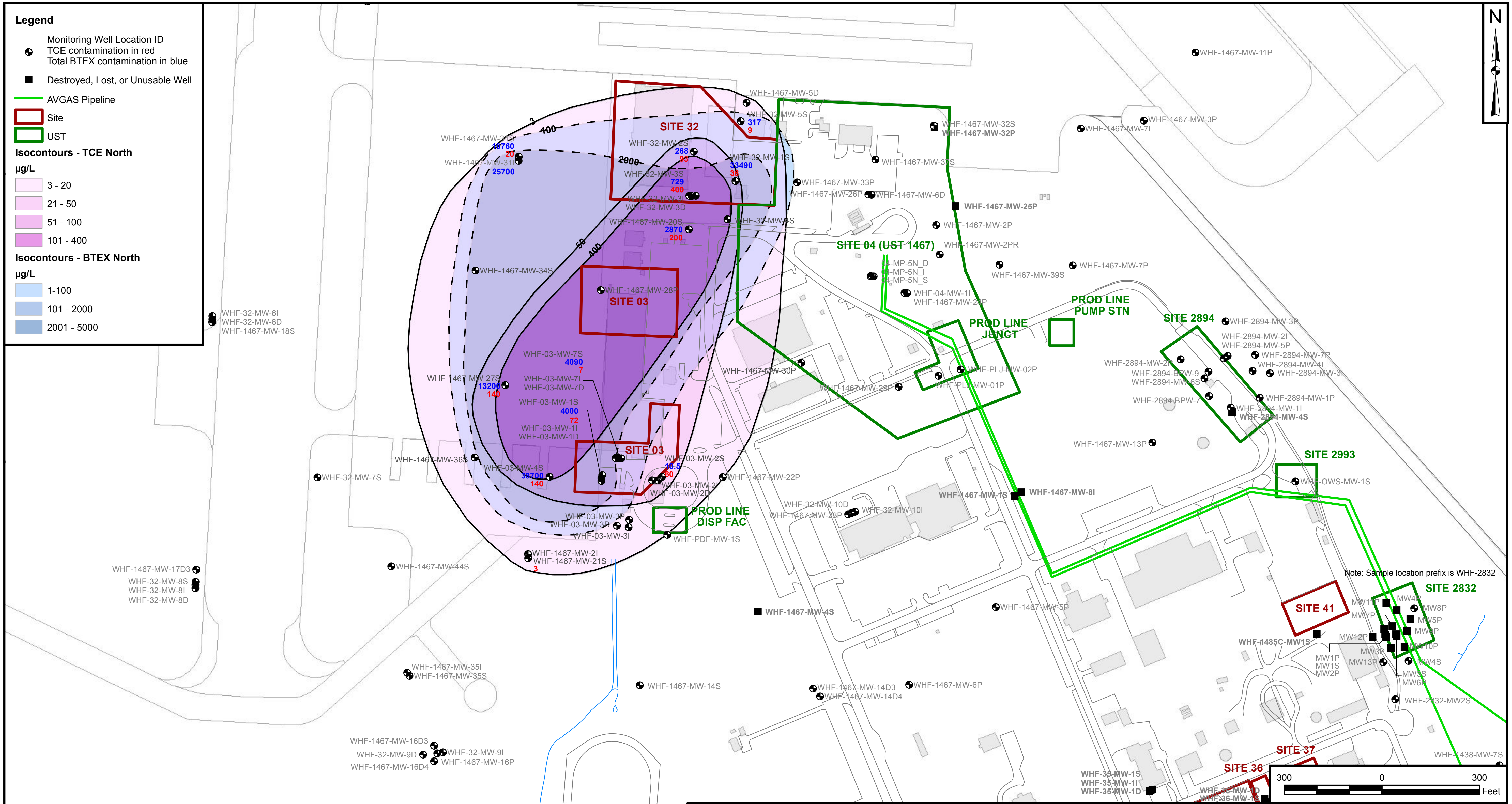
DRAWN BY	DATE
S. PAXTON	01/08/12
CHECKED BY	DATE
L. SMITH	10/11/12
REVISED BY	DATE
K. MOORE	10/11/12
SCALE	
AS NOTED	

NAVFAC

NCA OXIDATION-REDUCTION POTENTIAL
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 4-3	REV 0

PGH P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\NORTH_FIELD_BTEX_TCE_2007.MXD 10/11/12 KM



Legend

● Monitoring Well Location ID
TCE contamination in red
Total BTEX contamination in blue

■ Destroyed, Lost, or Unusable Well

AVGAS Pipeline

🟥 Site

🟩 UST

Isocontours - TCE North

µg/L

- 3 - 20
- 21 - 50
- 51 - 100
- 101 - 400

Isocontours - BTEX North

µg/L

- 1-100
- 101 - 2000
- 2001 - 5000

Note: Sample location prefix is WHF-2832

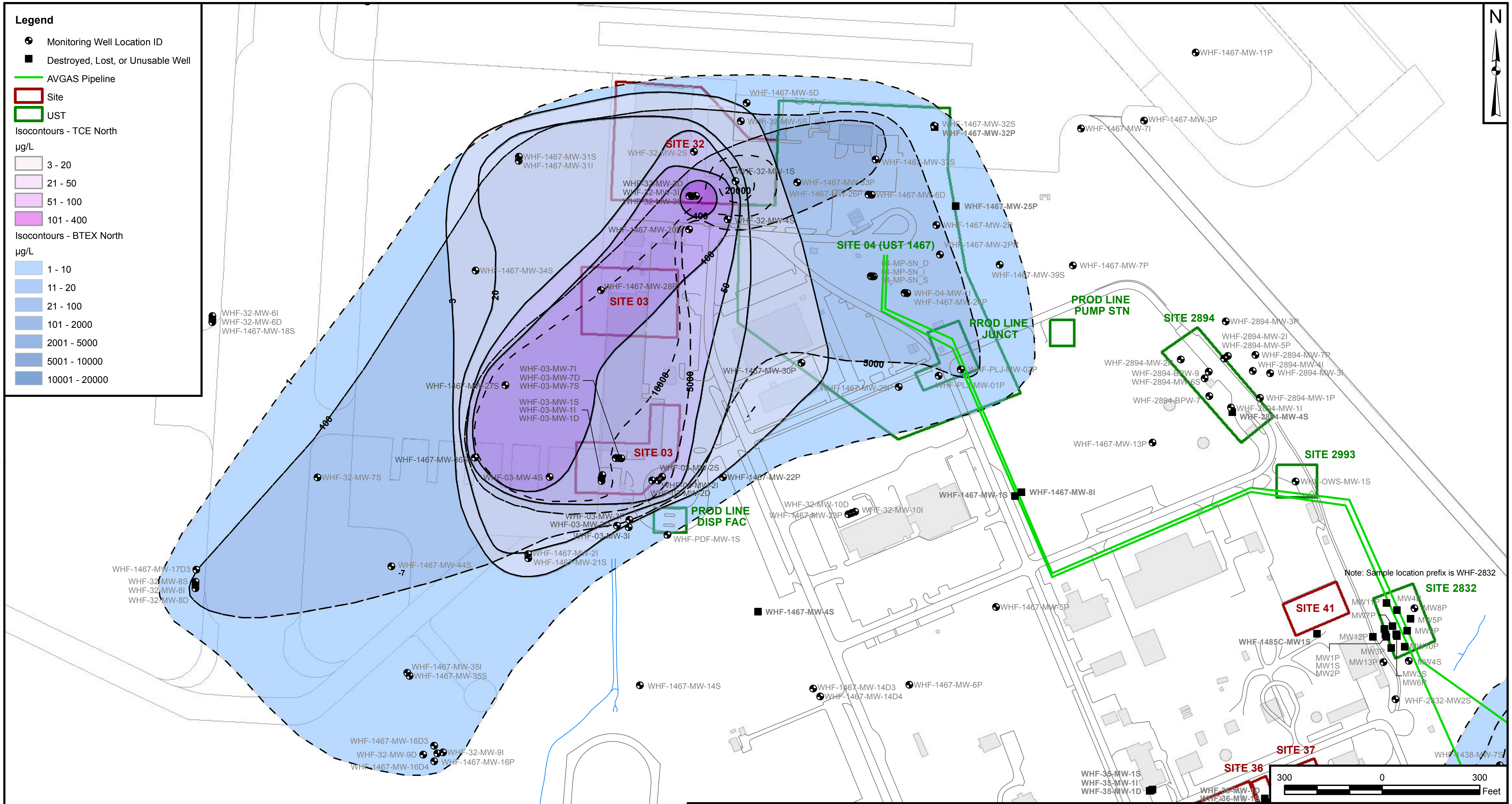
DRAWN BY	DATE
K. MOORE	01/09/12
CHECKED BY	DATE
L. SMITH	10/11/12
REVISED BY	DATE
K. MOORE	10/11/12
SCALE AS NOTED	

NAVFAC

NCA TCE AND TOTAL BTEX IN SHALLOW GROUNDWATER,
2007 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 4-4	REV 0

PGH P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\NORTH_FIELD_BTEX_TCE_2008.MXD 10/11/12 KM



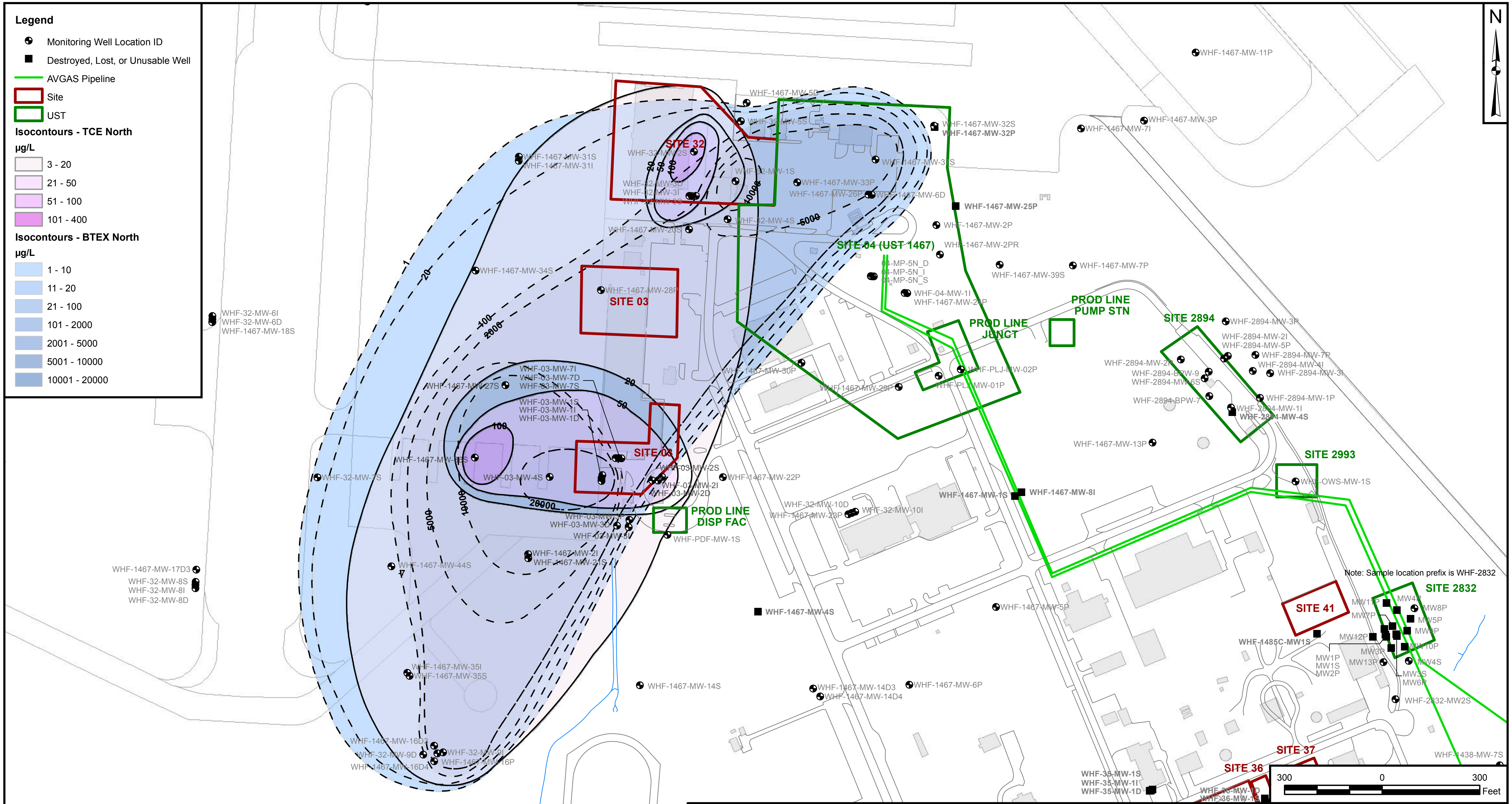
DRAWN BY	DATE
S. PAXTON	01/08/12
CHECKED BY	DATE
L. SMITH	10/11/12
REVISED BY	DATE
K. MOORE	10/11/12
SCALE AS NOTED	

NAVFAC

NCA TCE AND TOTAL BTEX IN SHALLOW GROUNDWATER,
2008 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 4-5	REV 0

PGH P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\NORTH_FIELD_BTEX_TCE_2011.MXD 10/11/12 KM



Legend

- ● Monitoring Well Location ID
- ■ Destroyed, Lost, or Unusable Well
- — AVGAS Pipeline
- 🟥 Site
- 🟩 UST

Isocontours - TCE North

µg/L

- ▨ 3 - 20
- ▨ 21 - 50
- ▨ 51 - 100
- ▨ 101 - 400

Isocontours - BTEX North

µg/L

- ▨ 1 - 10
- ▨ 11 - 20
- ▨ 21 - 100
- ▨ 101 - 2000
- ▨ 2001 - 5000
- ▨ 5001 - 10000
- ▨ 10001 - 20000

Note: Sample location prefix is WHF-2832

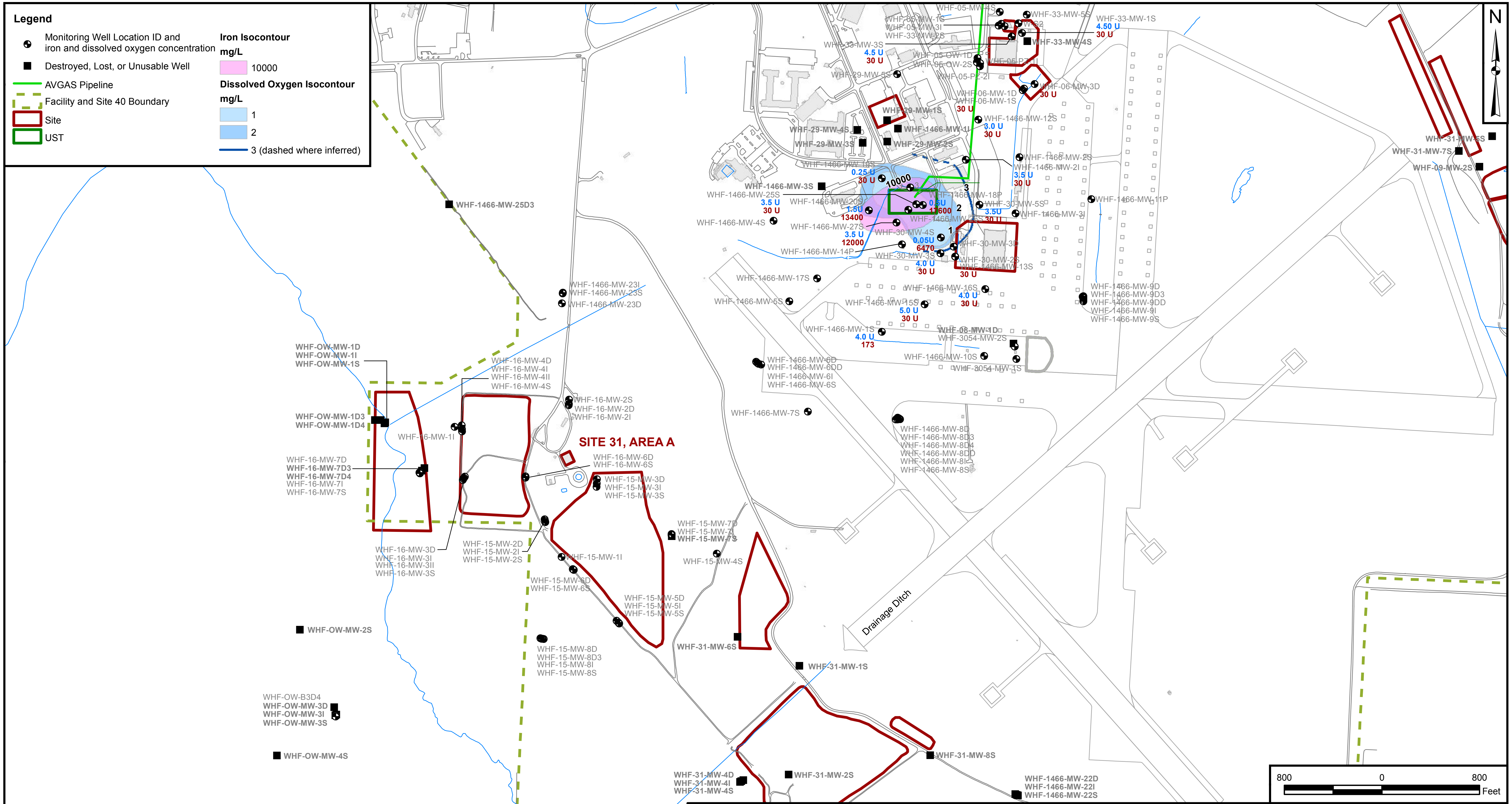
DRAWN BY S. PAXTON	DATE 01/08/12
CHECKED BY L. SMITH	DATE 10/11/12
REVISED BY K. MOORE	DATE 10/11/12
SCALE AS NOTED	

NAVFAC

NCA TCE AND TOTAL BTEX IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER ___	CTO NUMBER ____
APPROVED BY __	DATE __
APPROVED BY __	DATE __
FIGURE NO. 4-6	REV 0

PGH P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\SOUTH_FIELD_DO_FE_2011.MXD 10/11/12 KM



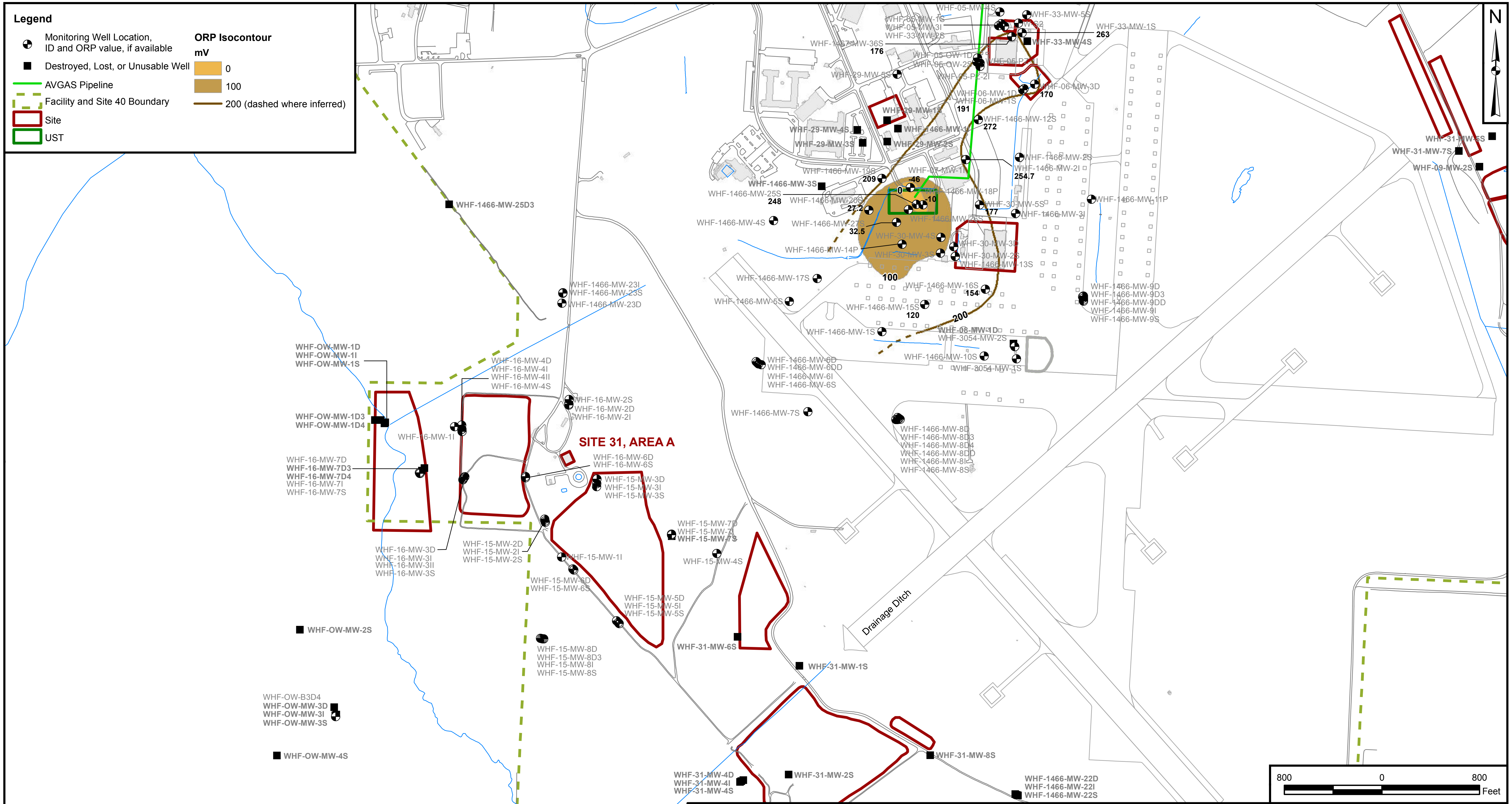
DRAWN BY	DATE
S. PAXTON	01/08/12
CHECKED BY	DATE
L. SMITH	10/11/12
REVISED BY	DATE
K. MOORE	10/11/12
SCALE	
AS NOTED	

NAVFAC

SCA DISSOLVED OXYGEN AND IRON
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
___	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
FIGURE NO. 4-7	REV 0

PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\SOUTH_FIELD_ORP_2011.MXD 10/15/2012 KM



Legend

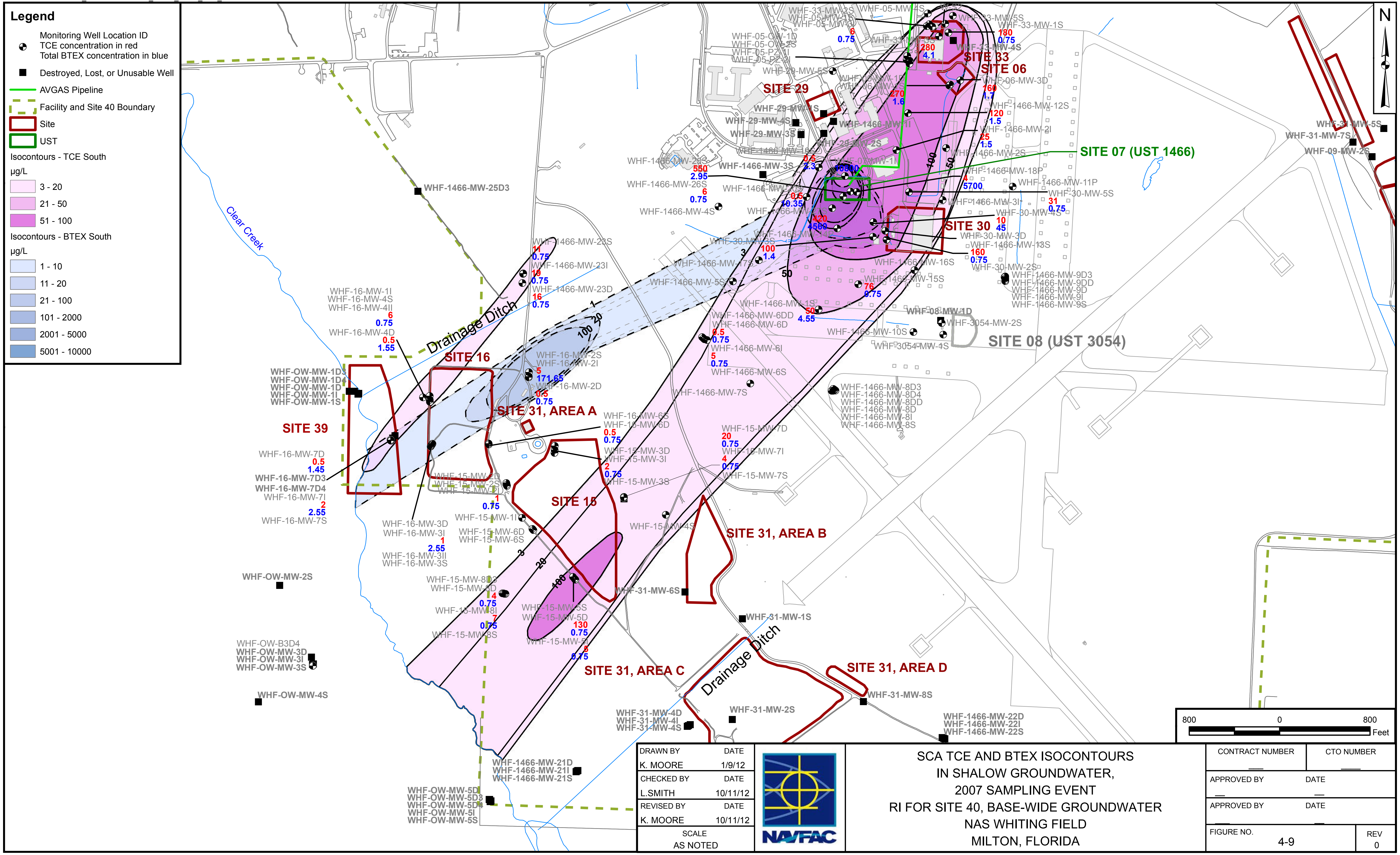
◐	Monitoring Well Location, ID and ORP value, if available	**ORP Isocontour**	
		mV	
■	Destroyed, Lost, or Unusable Well	🟧	0
—	AVGAS Pipeline	🟫	100
▭	Facility and Site 40 Boundary	—	200 (dashed where inferred)
🟥	Site		
🟩	UST		

DRAWN BY K. MOORE	DATE 01/09/12
CHECKED BY L. SMITH	DATE 10/8/12
REVISED BY K. MOORE	DATE 10/8/12
SCALE AS NOTED	

NAVFAC

SCA OXIDATION-REDUCTION POTENTIAL ISOCONTOURS
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER __	CTO NUMBER __
APPROVED BY __	DATE __
APPROVED BY __	DATE __
FIGURE NO. 4-8	REV 0



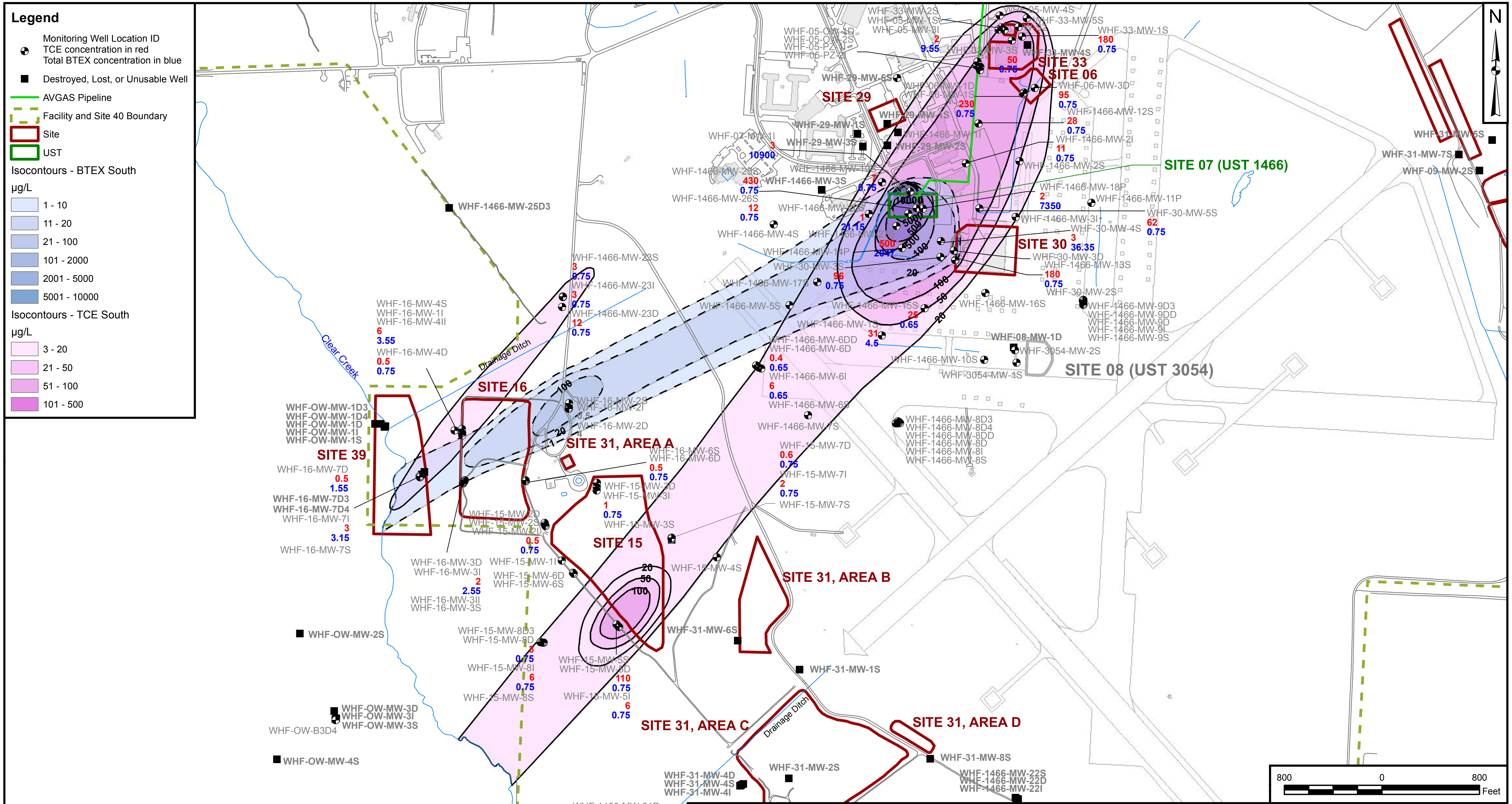
DRAWN BY	DATE
K. MOORE	1/9/12
CHECKED BY	DATE
L.SMITH	10/11/12
REVISED BY	DATE
K. MOORE	10/11/12
SCALE AS NOTED	

NAVFAC

SCA TCE AND BTEX ISOCONTOURS
IN SHALOW GROUNDWATER,
2007 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
—	—
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO. 4-9	REV 0

PGH P:\GIS\WHITINGFIELD_NAS\MXD\SOUTH_FIELD_BTEX_TCE_2008.MXD 10/11/12 KM



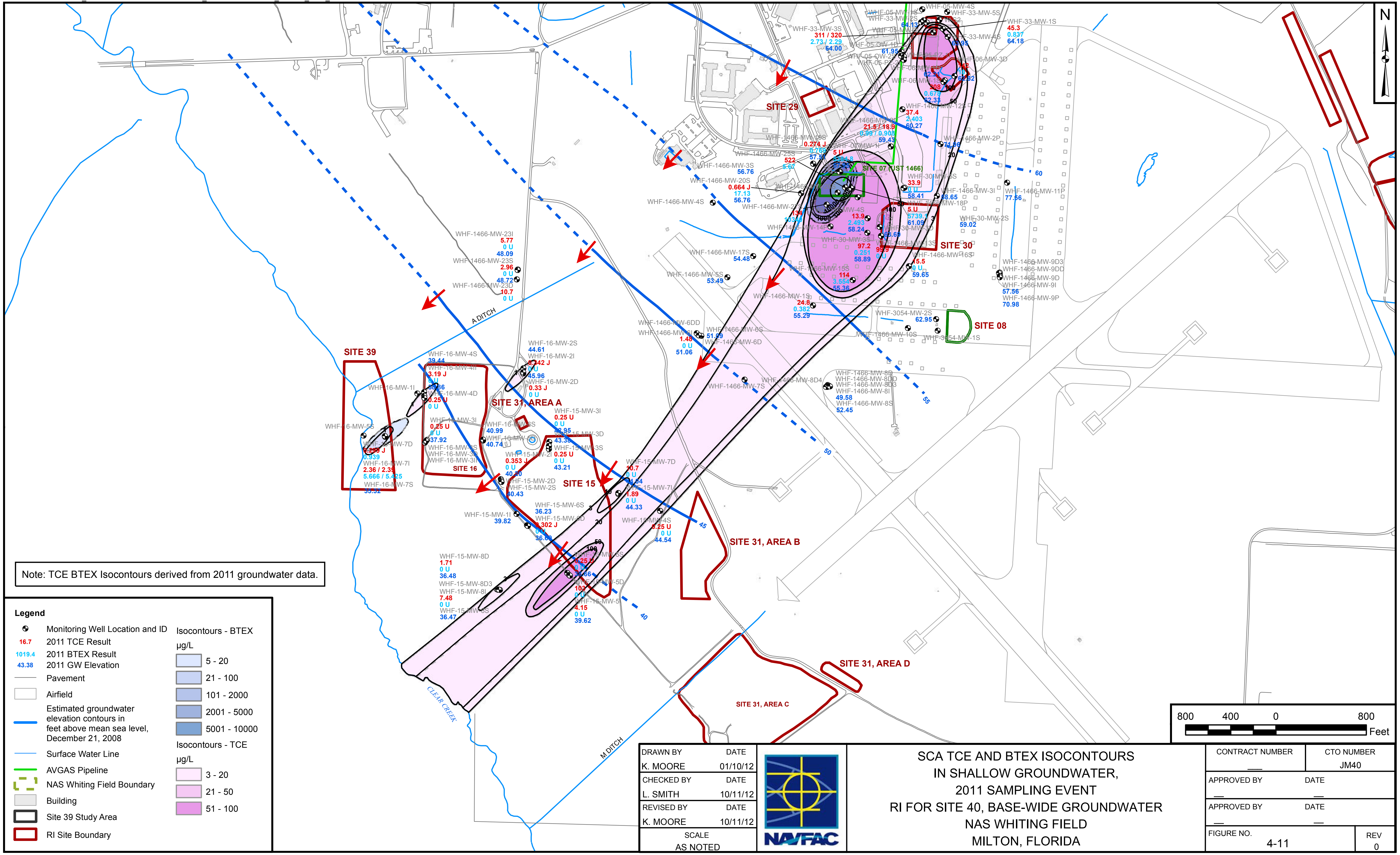
DRAWN BY	DATE
K. MOORE	1/9/12
CHECKED BY	DATE
L. SMITH	10/11/12
REVISED BY	DATE
K. MOORE	10/11/12
SCALE	
AS NOTED	

NAVFAC

SCA TCE AND BTEX ISOCONTOURS
IN SHALLOW GROUNDWATER,
2008 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 4-10	REV 0

P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\BASEWIDE_CONTAMINATIONS_PLUME_2011_B-SIZE.MXD 10/11/12 KM



Note: TCE BTEX Isocontours derived from 2011 groundwater data.

Legend

●	Monitoring Well Location and ID
16.7	2011 TCE Result
1019.4	2011 BTEX Result
43.38	2011 GW Elevation
—	Pavement
☐	Airfield
—	Estimated groundwater elevation contours in feet above mean sea level, December 21, 2008
—	Surface Water Line
—	AVGAS Pipeline
⬚	NAS Whiting Field Boundary
▭	Building
▭	Site 39 Study Area
▭	RI Site Boundary

Isocontours - BTEX

µg/L

▭	5 - 20
▭	21 - 100
▭	101 - 2000
▭	2001 - 5000
▭	5001 - 10000

Isocontours - TCE

µg/L

▭	3 - 20
▭	21 - 50
▭	51 - 100

DRAWN BY	DATE
K. MOORE	01/10/12
CHECKED BY	DATE
L. SMITH	10/11/12
REVISED BY	DATE
K. MOORE	10/11/12
SCALE	
AS NOTED	

NAVFAC

SCA TCE AND BTEX ISOCONTOURS
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
—	JM40
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
4-11	0

WHF-1467-MW-21S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	3	0.33	▶
BENZENE	ND	ND	ND	---
TOLUENE	ND	1	ND	---
ETHYLBENZENE	ND	0.8J	0.33J	▶
XYLENE	ND	1J	ND	---

WHF-1467-MW-2I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	5530	858	13910	▶
BENZENE	**980**	**640**	**1260**	▶
TOLUENE	**3200**	16	**8810**	▶
ETHYLBENZENE	**720**	**190**	**1900**	▶
XYLENE	**630**	12	**1940**	---

WHF-03-MW-3D	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-03-MW-1S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	14000	26600	41380	▶
BENZENE	**2300**	**2600**	**3580**	▶
TOLUENE	**8800**	**20000**	**31500**	▶
ETHYLBENZENE	**1100**	**1300**	**2020**	▲
XYLENE	**1800**	**2700**	**4280**	▲

WHF-03-MW-7S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	4090	8800	6090	▶
BENZENE	**630**	**1500**	**1660**	▲
TOLUENE	**1700**	**4300**	**1310**	▶
ETHYLBENZENE	**560**	**1100**	**1380**	▲
XYLENE	**1200**	**1900**	**1740**	▶

WHF-1467-MW-20S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	2870	4000	1084.7	---
BENZENE	**900**	**1700**	**361**	---
TOLUENE	**120**	**660**	**14.7**	---
ETHYLBENZENE	**750**	**1100**	**519**	---
XYLENE	**1100**	**540**	**190**	---

WHF-32-MW-1S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	33490	48600	17756	---
BENZENE	**890**	**1000**	**776**	---
TOLUENE	**23000**	**38000**	**62305**	---
ETHYLBENZENE	**2300**	**2200**	**2690**	---
XYLENE	**7300**	**7400**	**8060**	---

WHF-32-MW-9I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	1.55	18	1019.4	---
BENZENE	1	**8**	**46.4**	---
TOLUENE	ND	7	**463**	---
ETHYLBENZENE	ND	1	**141**	---
XYLENE	ND	2J	**369**	---

WHF-03-MW-3I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	2.6	ND	---
BENZENE	ND	ND	ND	---
TOLUENE	ND	2	ND	---
ETHYLBENZENE	ND	ND	ND	---
XYLENE	ND	ND	ND	---

WHF-03-MW-1I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	370	229	ND	---
BENZENE	**47**	**21**	ND	---
TOLUENE	**170**	**100**	ND	---
ETHYLBENZENE	**43**	24	ND	---
XYLENE	**110**	**84**	ND	---

WHF-03-MW-7I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	962	2050	561.2	---
BENZENE	**220**	**100**	**21.2**	---
TOLUENE	**42**	**1000**	**142**	---
ETHYLBENZENE	**270**	**270**	**168**	---
XYLENE	**430**	**680**	**229**	---

WHF-1467-MW-27S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	13200	12850	10333	▶
BENZENE	**700**	**650**	**513**	▶
TOLUENE	**9700**	**8900J**	**5860**	▶
ETHYLBENZENE	**1300**	**1400**	**1590**	▲
XYLENE	**1500**	**1900**	**2370**	▲

WHF-32-MW-3S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	729	408	176.5	▶
BENZENE	**380**	**290**	**92.3**	▶
TOLUENE	12	6	12.9	▶
ETHYLBENZENE	**270**	**98**	55.7	---
XYLENE	**67**	14	15.6	▶

WHF-32-MW-5S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	230	170	ND	---
BENZENE	**13J**	0.93	ND	---
TOLUENE	**59J**	30	ND	---
ETHYLBENZENE	15J	3	ND	---
XYLENE	**317**	**203.9**	ND	---

WHF-32-MW-9D	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-1467-MW-16D3	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-1467-MW-16D4	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-03-MW-3S	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-03-MW-1D				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	1.6	30	ND	---
BENZENE	ND	**3**	ND	---
TOLUENE	1	21	ND	---
ETHYLBENZENE	ND	2	ND	---
XYLENE	ND	4	ND	---

WHF-03-MW-7D	
ANALYTE	TRENDS
BENZENE	▶
TOLUENE	▶
ETHYLBENZENE	▶
XYLENE	▶

WHF-32-MW-3I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	14.2	ND	---
BENZENE	ND	ND	ND	---
TOLUENE	ND	6	ND	---
ETHYLBENZENE	ND	2	ND	---
XYLENE	ND	6	ND	---

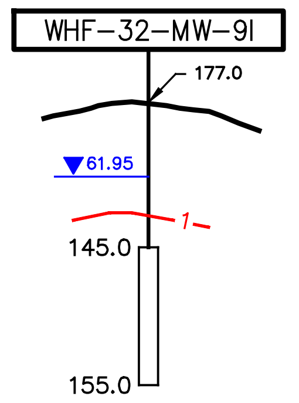
WHF-1467-MW-5D				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	1.55	5.1	ND	---
BENZENE	ND	ND	ND	---
TOLUENE	ND	2	ND	---
ETHYLBENZENE	ND	0.9J	ND	---
XYLENE	1J	2J	ND	---

WHF-32-MW-3D	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

NOTE

DATA FROM 2007, 2008, AND 2011

MONITORING WELL LEGEND



TREND LEGEND

▶	STABLE
▲	SIGNIFICANT UPWARD TREND
---	NO SUFFICIENT DATA

LEGEND

BGS	BELOW GROUND SURFACE
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
FT	FEET
GCTL	GROUNDWATER CLEANUP TARGET LEVEL
MCL	MAXIMUM CONCENTRATION LEVEL
MSL	MEAN SEA LEVEL
NCA	NORTH CENTRAL AREA
ND	NON DETECT
ug/L	MICROGRAMS PER LITER
USEPA	UNITED STATES ENVIRONMENTAL PROTECTION ACENCY
BOLD	ANALYTE CONCENTRATION EXCEEDS FLORIDA GCTL
BOLD	ANALYTE CONCENTRATION EXCEEDS USEPA MCL
*	GEOCHEMISTRY DATA COLLECTED

ANALYTE (ug/L)	FLORIDA GCTL	USEPA MCL
BENZENE	1	5
TOLUENE	40	1000
ETHYLBENZENE	30	700
XYLENE	20	10000

0 100 200
HORIZONTAL SCALE: 1" = 100'

0 50 100
VERTICAL SCALE: 1" = 50'

DRAWN BY CK	DATE 1/20/11
CHECKED BY LWS	DATE 1/10/12
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

NCA BTEX CONTAMINANT TRENDS SECTION B TO B'
SITE 40 REMEDIAL INVESTIGATION
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NO.
3064

OWNER NO.

APPROVED BY DATE

DRAWING NO.
FIGURE 4-12

REV.
0

R:\3064\Figures\3064FG006.dwg PIT CARLY.KRAMER 1/11/2012 3:25:13 PM

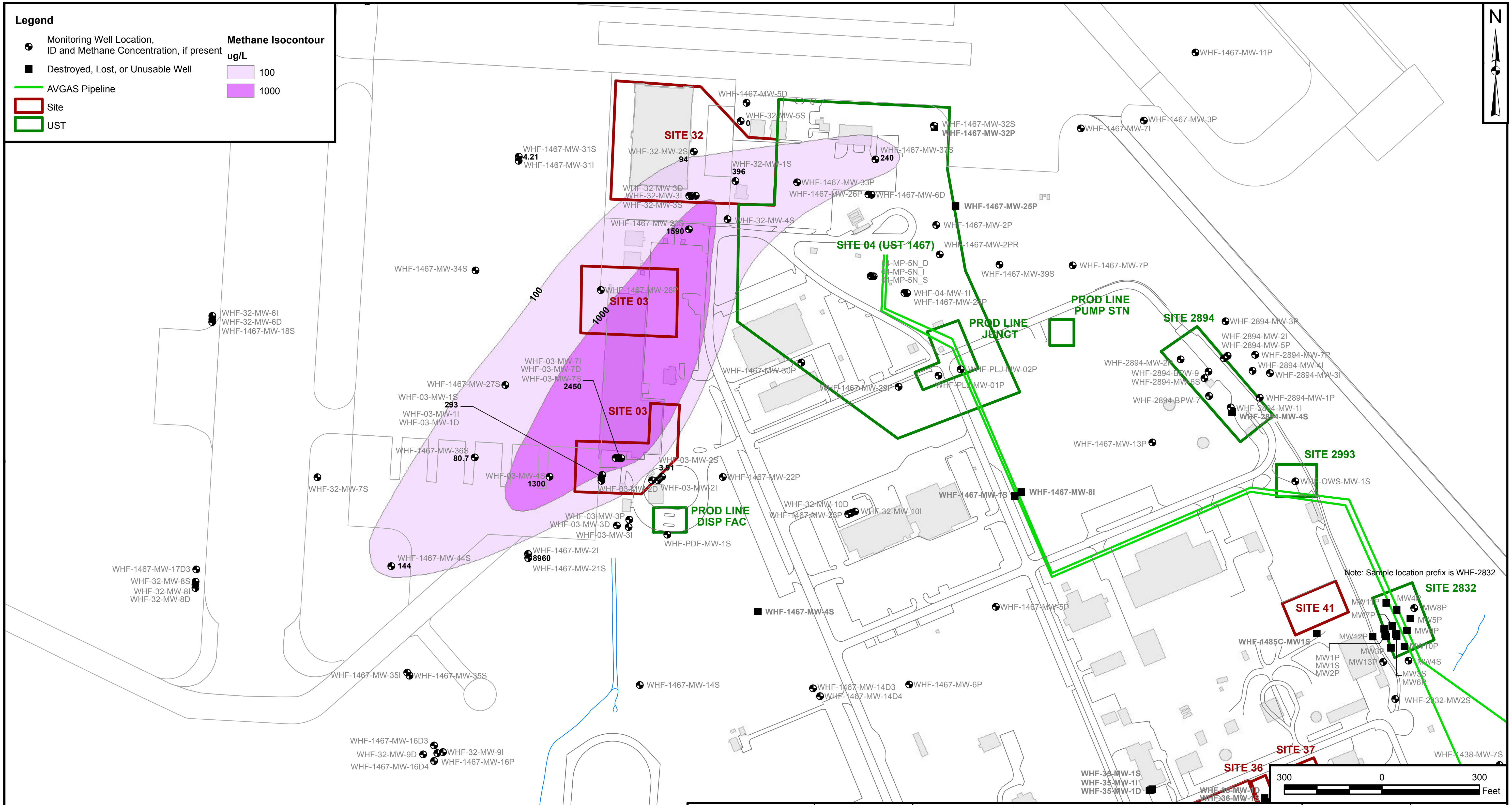
PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\NORTH_FIELD_METHANE_2011.MXD 10/15/2012 KM

Legend

- ⊕ Monitoring Well Location, ID and Methane Concentration, if present
- ■ Destroyed, Lost, or Unusable Well
- — AVGAS Pipeline
- ▭ Site
- ▭ UST

Methane Isocontour
ug/L

- ▨ 100
- ▨ 1000



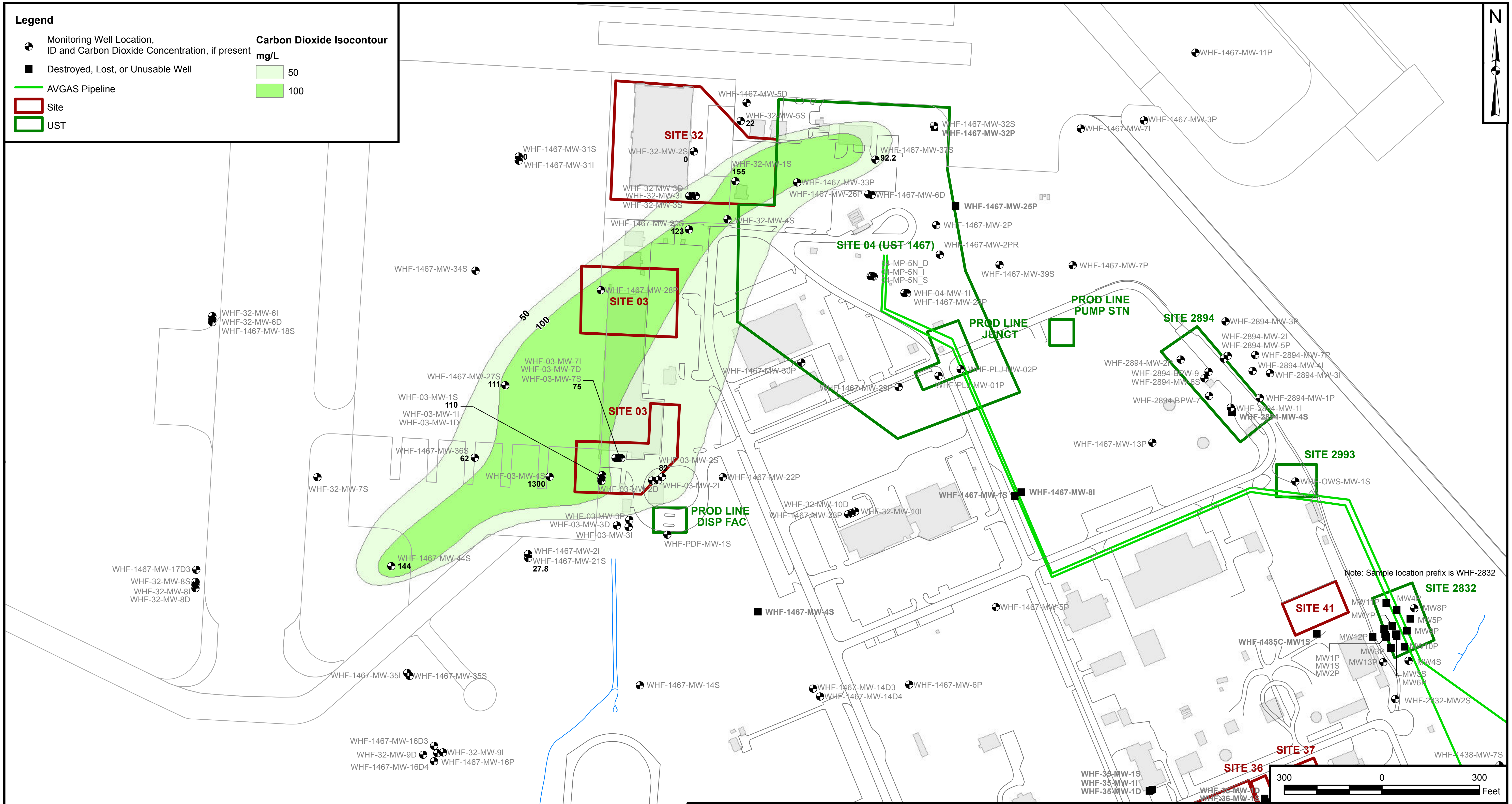
DRAWN BY	DATE
K. MOORE	1/10/12
CHECKED BY	DATE
L. SMITH	10/8/12
REVISED BY	DATE
K. MOORE	10/8/12
SCALE AS NOTED	

NAVFAC

NCA METHANE ISOCONTOURS
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 4-13	REV 0

PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\NORTH_FIELD_CO2_2011.MXD 10/15/2012 KM



Legend

●	Monitoring Well Location, ID and Carbon Dioxide Concentration, if present
■	Destroyed, Lost, or Unusable Well
—	AVGAS Pipeline
🟥	Site
🟩	UST

Carbon Dioxide Isocontour
mg/L

🟩	50
🟩	100

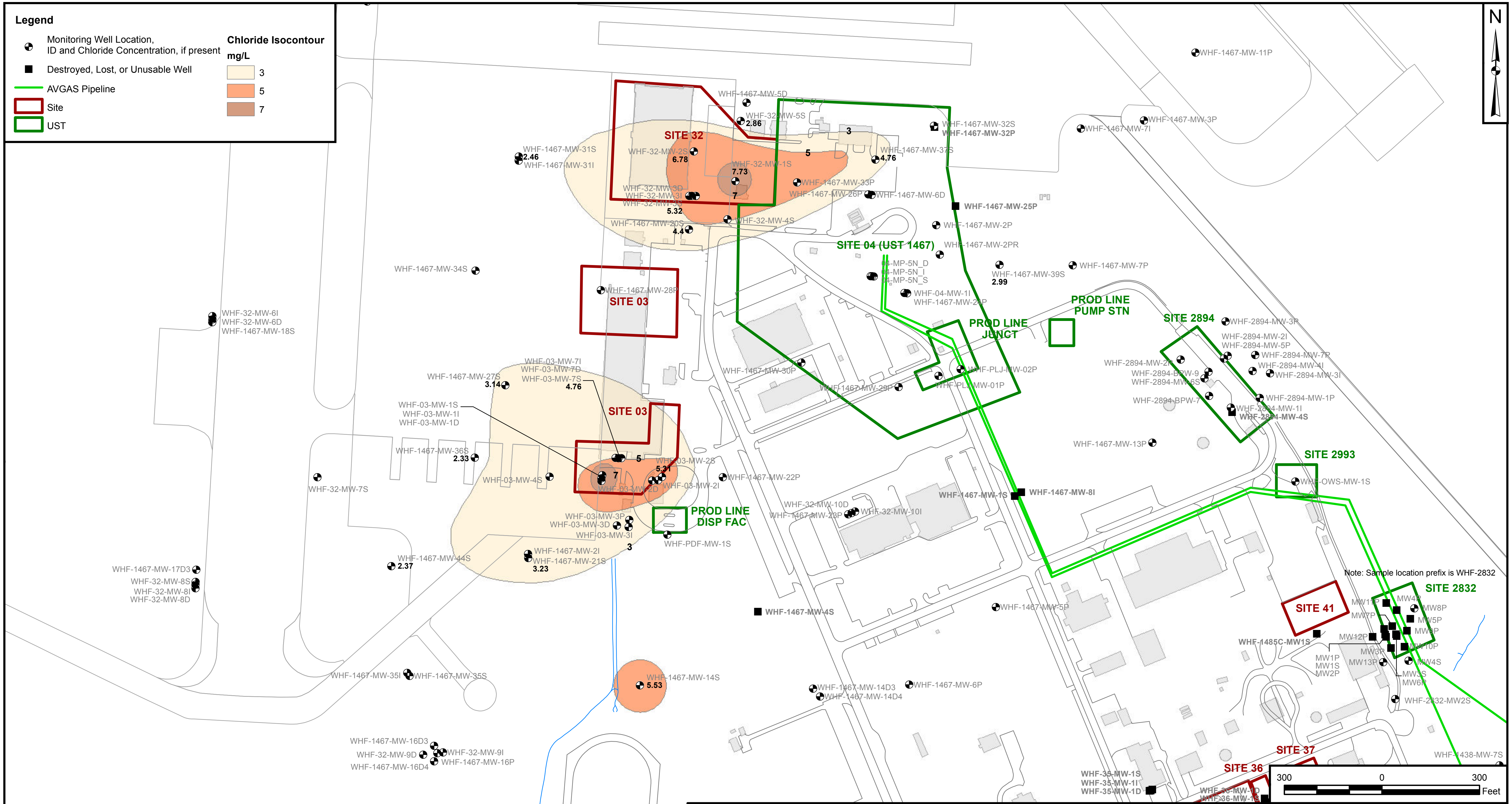
DRAWN BY	DATE
K. MOORE	1/10/12
CHECKED BY	DATE
L. SMITH	10/8/12
REVISED BY	DATE
K. MOORE	10/8/12
SCALE	
AS NOTED	

NAVFAC

NCA CARBON DIOXIDE ISOCONTOURS
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO.	REV
4-14	0

PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\NORTH_FIELD_CHLORIDE_2011.MXD 10/15/2012 KM



DRAWN BY K. MOORE	DATE 1/10/12
CHECKED BY L. SMITH	DATE 10/8/12
REVISED BY K. MOORE	DATE 10/8/12
SCALE AS NOTED	

NAVFAC

NCA CHLORIDE ISOCONTOURS
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 4-15	REV 0

WHF–1467–MW–21S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	3	3	**3.67J**	▶

WHF–03–MW–3D

ANALYTE	TRENDS
TCE	---

WHF–1467–MW–20S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**200**	**150**	**3.56J**	---

WHF–32–MW–1S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**38J**	**32**	**45.4J**	---

WHF–1467–MW–2I

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**34**	ND	ND	---

WHF–03–MW–3I

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	ND	ND	ND	▶

WHF–03–MW–1S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**72**	**66**	**64.4**	▶

WHF–03–MW–7S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**7**	**11**	**13.5J**	---

WHF–1467–MW–27S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**140J**	**110**	**43J**	▶

WHF–32–MW–1S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**9J**	**16**	ND	---

WHF–03–MW–3S

ANALYTE	TRENDS
TCE	---

WHF–03–MW–1I

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**38**	**27**	**5.44**	---

WHF–03–MW–7I

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**45**	**52**	**52.6**	---

WHF–32–MW–1S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	ND	ND	ND	---

WHF–32–MW–9I

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	3	**6**	**16.7**	---

WHF–32–MW–3S

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	**400**	**270**	**68.5**	▶

WHF–03–MW–1D

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	ND	ND	ND	---

WHF–03–MW–7D

ANALYTE	TRENDS
TCE	---

WHF–32–MW–9D

ANALYTE	TRENDS
TCE	---

WHF–1467–MW–16D3

ANALYTE	TRENDS
TCE	---

WHF–1467–MW–16D4

ANALYTE	TRENDS
TCE	---

WHF–32–MW–3I

ANALYTE	YEAR 07	YEAR 08	YEAR 11	TRENDS
TCE	ND	ND	ND	---

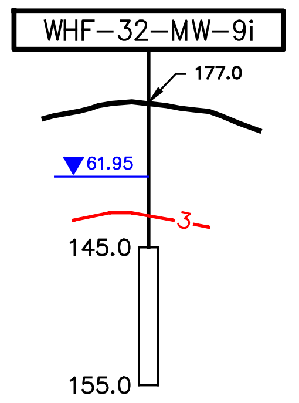
WHF–32–MW–3D

ANALYTE	TRENDS
TCE	---

NOTE

DATA FROM 2007, 2008, AND 2011

MONITORING WELL LEGEND



MONITORING WELL NUMBER
GROUND SURFACE ELEVATION
GROUND SURFACE
GROUNDWATER ELEVATION (FEET MSL)
TOTAL TCE CONTOUR (ug/L)
TOP OF MONITORED INTERVAL (FT BGS)
BOTTOM OF MONITORED INTERVAL (FT BGS)

TREND LEGEND

▶	STABLE
---	NO SUFFICIENT DATA

LEGEND

BGS	BELOW GROUND SURFACE
FT	FEET
GCTL	GROUNDWATER CLEANUP TARGET LEVEL
MCL	MAXIMUM CONCENTRATION LEVEL
MSL	MEAN SEA LEVEL
NCA	NORTH CENTRAL AREA
ND	NON DETECT
TCE	TRICHLOROETHENE
ug/L	MICROGRAMS PER LITER
USEPA	UNITED STATES ENVIRONMENTAL PROTECTION ACENCY
BOLD	ANALYTE CONCENTRATION EXCEEDS FLORIDA GCTL
BOLD	ANALYTE CONCENTRATION EXCEEDS USEPA MCL
*	GEOCHEMISTRY DATA COLLECTED

ANALYTE (ug/L)	FLORIDA GCTL	USEPA MCL
TCE	3	5

0 100 200
HORIZONTAL SCALE: 1" = 100'

0 50 100
VERTICAL SCALE: 1" = 50'

DRAWN BY CK	DATE 1/20/11		CONTRACT NO. 3064
CHECKED BY LWS	DATE 1/10/12		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4–16 / REV. 0

NAVFAC

NCA TCE CONTAMINANT TRENDS SECTION B–B'
SITE 40 REMEDIAL INVESTIGATION
NAS WHITING FIELD
MILTON, FLORIDA

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WHF-15-MW-8S	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-15-MW-8I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	ND	ND	▶
BENZENE	ND	ND	ND	✕
TOLUENE	ND	ND	ND	▶
ETHYLBENZENE	ND	ND	ND	▶
XYLENE	ND	ND	ND	▶

WHF-15-MW-8D				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	ND	ND	▶
BENZENE	ND	ND	ND	▶
TOLUENE	ND	ND	ND	▶
ETHYLBENZENE	ND	ND	ND	▶
XYLENE	ND	ND	ND	▶

WHF-15-MW-8D3	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-15-MW-5S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	NS	NS	ND	---
BENZENE	NS	NS	ND	---
TOLUENE	NS	NS	ND	---
ETHYLBENZENE	NS	NS	ND	---
XYLENE	NS	NS	ND	---

WHF-15-MW-5I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	ND	ND	---
BENZENE	ND	ND	ND	---
TOLUENE	ND	ND	ND	---
ETHYLBENZENE	ND	ND	ND	---
XYLENE	ND	ND	ND	---

WHF-15-MW-5D				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	ND	ND	▼
BENZENE	ND	ND	ND	▶
TOLUENE	ND	ND	ND	▶
ETHYLBENZENE	ND	ND	ND	▶
XYLENE	ND	ND	ND	▶

WHF-15-MW-7I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	ND	ND	---
BENZENE	ND	ND	ND	---
TOLUENE	ND	ND	ND	---
ETHYLBENZENE	ND	ND	ND	---
XYLENE	ND	ND	ND	---

WHF-15-MW-7D				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	ND	ND	---
BENZENE	ND	ND	ND	---
TOLUENE	ND	ND	ND	---
ETHYLBENZENE	ND	ND	ND	---
XYLENE	ND	ND	ND	---

WHF-1466-MW-7S	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-1466-MW-6S	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-1466-MW-6I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	ND	ND	---
BENZENE	ND	ND	ND	---
TOLUENE	ND	ND	ND	---
ETHYLBENZENE	ND	ND	ND	---
XYLENE	ND	ND	ND	---

WHF-1466-MW-6D	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

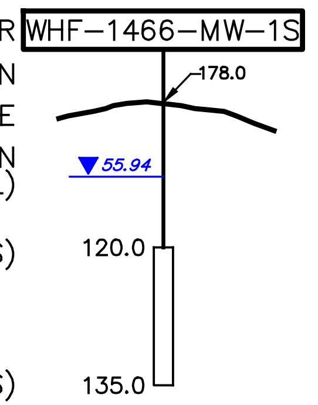
WHF-1466-MW-6DD	
ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF-1466-MW-1S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	4.55	4.5	0.382	▶
BENZENE	**4**	**4**	0.382J	✕
TOLUENE	ND	ND	ND	✕
ETHYLBENZENE	ND	ND	ND	✕
XYLENE	ND	ND	ND	▶

NOTE

DATA FROM 2007, 2008, AND 2011

MONITORING WELL LEGEND



TREND LEGEND

▶	STABLE
▼	SIGNIFICANT DOWNWARD TREND
✕	NO TREND
---	NO SUFFICIENT DATA

LEGEND

BGS	BELOW GROUND SURFACE
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
FT	FEET
GCTL	GROUNDWATER CLEANUP TARGET LEVEL
MCL	MAXIMUM CONCENTRATION LEVEL
MSL	MEAN SEA LEVEL
ND	NON DETECT
SCA	SOUTH CENTRAL AREA
ug/L	MICROGRAMS PER LITER
USEPA	UNITED STATES ENVIRONMENTAL PROTECTION ACENCY
BOLD	INDICATES ANALYTE CONCENTRATION EXCEEDS FLORIDA GCTL
*	GEOCHEMISTRY DATA COLLECTED

ANALYTE (ug/L)	FLORIDA GCTL	USEPA MCL
BENZENE	1	5
TOLUENE	40	1000
ETHYLBENZENE	30	700
XYLENE	20	10000

0 150 300
HORIZONTAL SCALE: 1" = 150'

0 50 100
VERTICAL SCALE: 1" = 50'

DRAWN BY CK	DATE 1/18/11
CHECKED BY LWS	DATE 1/10/12
REVISED BY	DATE
SCALE AS NOTED	

SCA BTEX CONTAMINANT TRENDS SECTION A TO A'
DOWNGRADIENT AREA OF BTEX PLUME
SITE 40 REMEDIAL INVESTIGATION
MILTON, FLORIDA
NAS WHITING FIELD

CONTRACT NO. 3064	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 4-17	REV. 0

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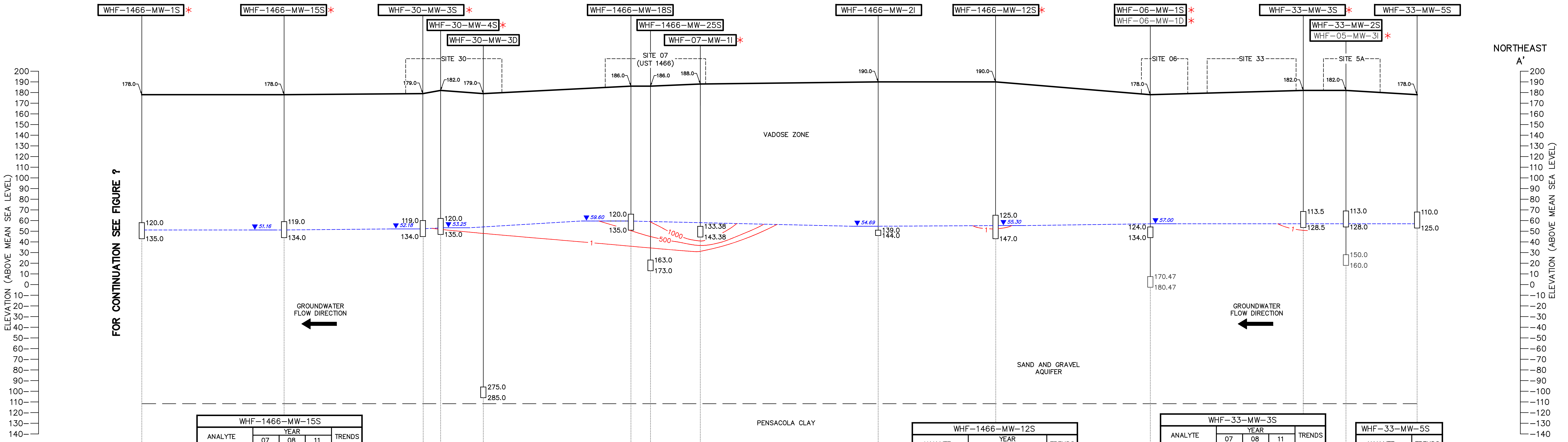


WHF–1466–MW–1S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	4.55	4.5	0.382	▶
BENZENE	**4**	**4**	0.382J	✕
TOLUENE	ND	ND	ND	✕
ETHYLBENZENE	ND	ND	ND	✕
XYLENE	ND	ND	ND	▶

WHF–1466–MW–15S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	ND	ND	ND	✕
BENZENE	ND	ND	ND	▶
TOLUENE	ND	ND	ND	✕
ETHYLBENZENE	ND	ND	ND	▶
XYLENE	ND	ND	ND	✕

WHF–30–MW–3S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	1.4	ND	0.251	▼
BENZENE	ND	ND	ND	▶
TOLUENE	0.6	ND	0.251J	▶
ETHYLBENZENE	ND	ND	ND	▶
XYLENE	ND	ND	ND	▶

WHF–30–MW–4S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	45	36.35	2.493	▼
BENZENE	**2**	ND	ND	✕
TOLUENE	8	ND	0.564J	✕
ETHYLBENZENE	19	28	0.779J	✕
XYLENE	16	8	1.15J	▼

WHF–30–MW–3D

ANALYTE	TRENDS
TCE	---
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF–1466–MW–18S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	1200	36.35	2.493	---
BENZENE	**700**	**150**	ND	---
TOLUENE	**1700**	**2200**	**1710**	---
ETHYLBENZENE	**2100**	**3200**	**3470**	---
XYLENE	**5700**	**7350**	**3739.1**	---

WHF–1466–MW–25S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	2.95	ND	ND	---
BENZENE	**2**	ND	ND	---
TOLUENE	ND	ND	ND	---
ETHYLBENZENE	0.6J	ND	ND	---
XYLENE	ND	ND	ND	---

WHF–07–MW–1I

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	10800	10900	5384.8	▶
BENZENE	**1800**	**2900**	**1010**	▶
TOLUENE	**3000**	**2800**	14.8J	▼
ETHYLBENZENE	**2300**	**2200**	**1840**	▼
XYLENE	**3700**	**3000**	**2300**	▼

WHF–1466–MW–2I

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	1.5	ND	0.99	---
BENZENE	ND	ND	ND	---
TOLUENE	0.93	ND	0.517J	---
ETHYLBENZENE	ND	ND	0.473	---
XYLENE	ND	ND	ND	---

WHF–1466–MW–12S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	1.5	ND	2.403	▶
BENZENE	ND	ND	0.258J	▶
TOLUENE	0.9J	ND	0.54J	▶
ETHYLBENZENE	ND	ND	0.848J	✕
XYLENE	ND	ND	0.757J	▶

WHF–06–MW–1S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	1.6	ND	0.678	▶
BENZENE	ND	ND	ND	▶
TOLUENE	0.7J	ND	0.676J	▶
ETHYLBENZENE	0.5J	ND	ND	▶
XYLENE	ND	ND	ND	▶

WHF–06–MW–1D

ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF–33–MW–3S

ANALYTE	YEAR			TRENDS
	07	08	11	
TOTAL BTEX	4.1	ND	2.73	▶
BENZENE	ND	ND	ND	▶
TOLUENE	1	ND	2.73	✕
ETHYLBENZENE	0.9J	ND	ND	✕
XYLENE	2J	ND	ND	✕

WHF–33–MW–5S

ANALYTE	TRENDS
TCE	---
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

WHF–33–MW–2S

ANALYTE	TRENDS
BENZENE	---
TOLUENE	---
ETHYLBENZENE	---
XYLENE	---

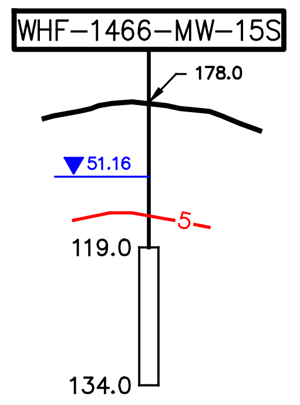
WHF–05–MW–3I

ANALYTE	TRENDS
BENZENE	✕
TOLUENE	▶
ETHYLBENZENE	▶
XYLENE	▶

NOTE

DATA FROM 2007, 2008, AND 2011

MONITORING WELL LEGEND



MONITORING WELL NUMBER
GROUND SURFACE ELEVATION
GROUND SURFACE
GROUNDWATER ELEVATION (FEET MSL)
TOTAL BTEX CONTOUR (ug/L)
TOP OF MONITORED INTERVAL (FT BGS)
BOTTOM OF MONITORED INTERVAL (FT BGS)

TREND LEGEND

▶	STABLE
▼	SIGNIFICANT DOWNWARD TREND
✕	NO TREND
---	NO SUFFICIENT DATA

LEGEND

BGS	BELOW GROUND SURFACE
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
FT	FEET
GCTL	GROUNDWATER CLEANUP TARGET LEVEL
MCL	MAXIMUM CONCENTRATION LEVEL
MSL	MEAN SEA LEVEL
ND	NON DETECT
SCA	SOUTH CENTRAL AREA
ug/L	MICROGRAMS PER LITER
USEPA	UNITED STATES ENVIRONMENTAL PROTECTION ACENCY
BOLD	ANALYTE CONCENTRATION EXCEEDS FLORIDA GCTL
BOLD	ANALYTE CONCENTRATION EXCEEDS USEPA MCL
*	GEOCHEMISTRY DATA COLLECTED

ANALYTE (ug/L)	FLORIDA GCTL	USEPA MCL
BENZENE	1	5
TOLUENE	40	1000
ETHYLBENZENE	30	700
XYLENE	20	10000

0 150 300
HORIZONTAL SCALE: 1" = 150'

0 50 100
VERTICAL SCALE: 1" = 50'

DRAWN BY CK	DATE 1/18/11
CHECKED BY LWS	DATE 1/10/12
REVISED BY	DATE
SCALE AS NOTED	

SCA BTEX CONTAMINANT TRENDS SECTION A TO A'
UPGRADIENT AREA OF BTEX PLUME
SITE 40 REMEDIAL INVESTIGATION
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NO.
3064
OWNER NO.
APPROVED BY DATE
DRAWING NO.
FIGURE 4–17A
REV.
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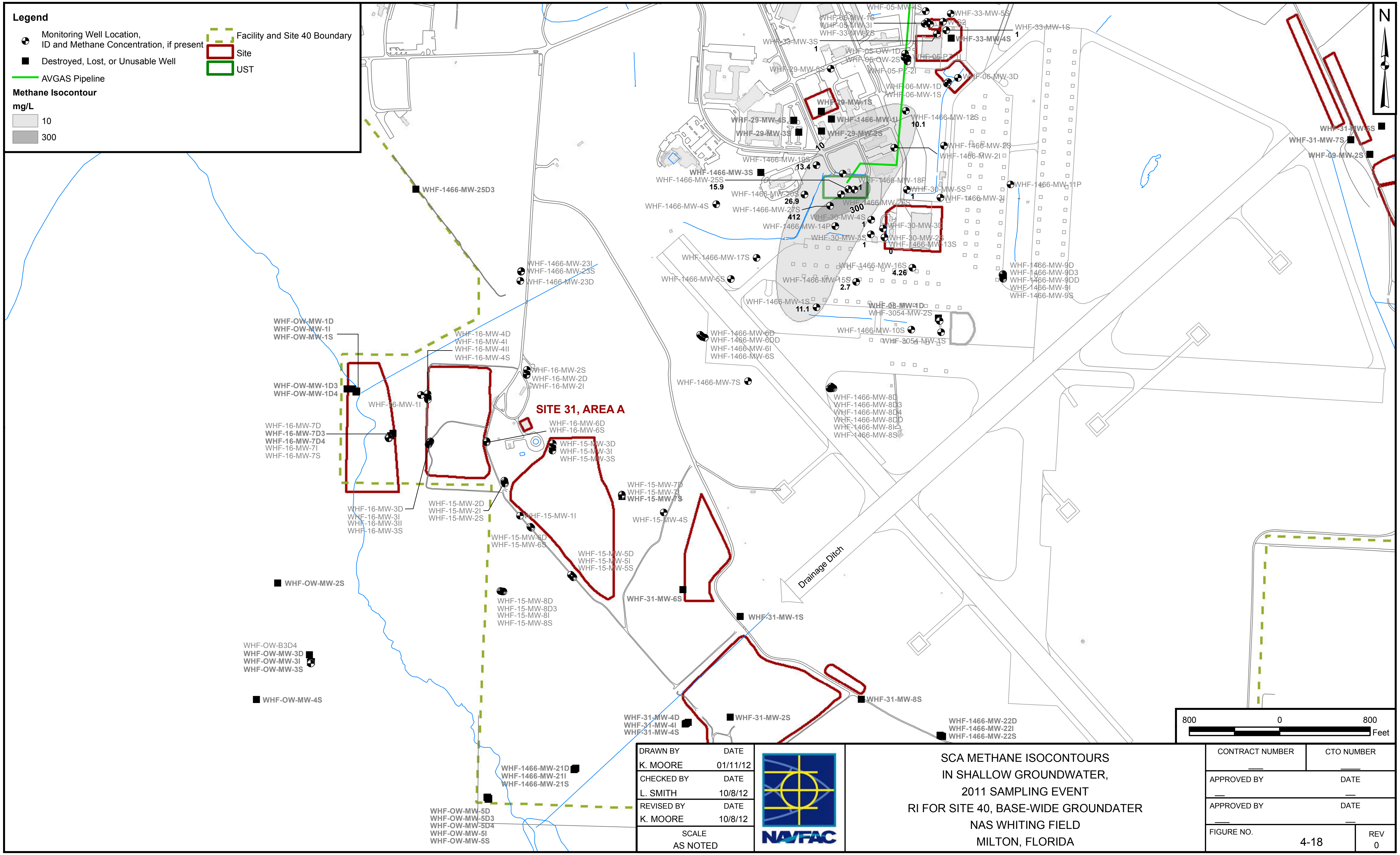
PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\SOUTH_FIELD_METHANE_2011.MXD 10/15/2012 KM



Legend

- ◐ Monitoring Well Location, ID and Methane Concentration, if present
- ■ Destroyed, Lost, or Unusable Well
- — AVGAS Pipeline
- ▭ Facility and Site 40 Boundary
- 🟥 Site
- 🟩 UST

Methane Isocontour

mg/L

- ░ 10
- ▒ 300

DRAWN BY K. MOORE	DATE 01/11/12
CHECKED BY L. SMITH	DATE 10/8/12
REVISED BY K. MOORE	DATE 10/8/12
SCALE AS NOTED	

NAVFAC

SCA METHANE ISOCONTOURS
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER ____	CTO NUMBER ____
APPROVED BY ____	DATE ____
APPROVED BY ____	DATE ____
FIGURE NO. 4-18	REV 0

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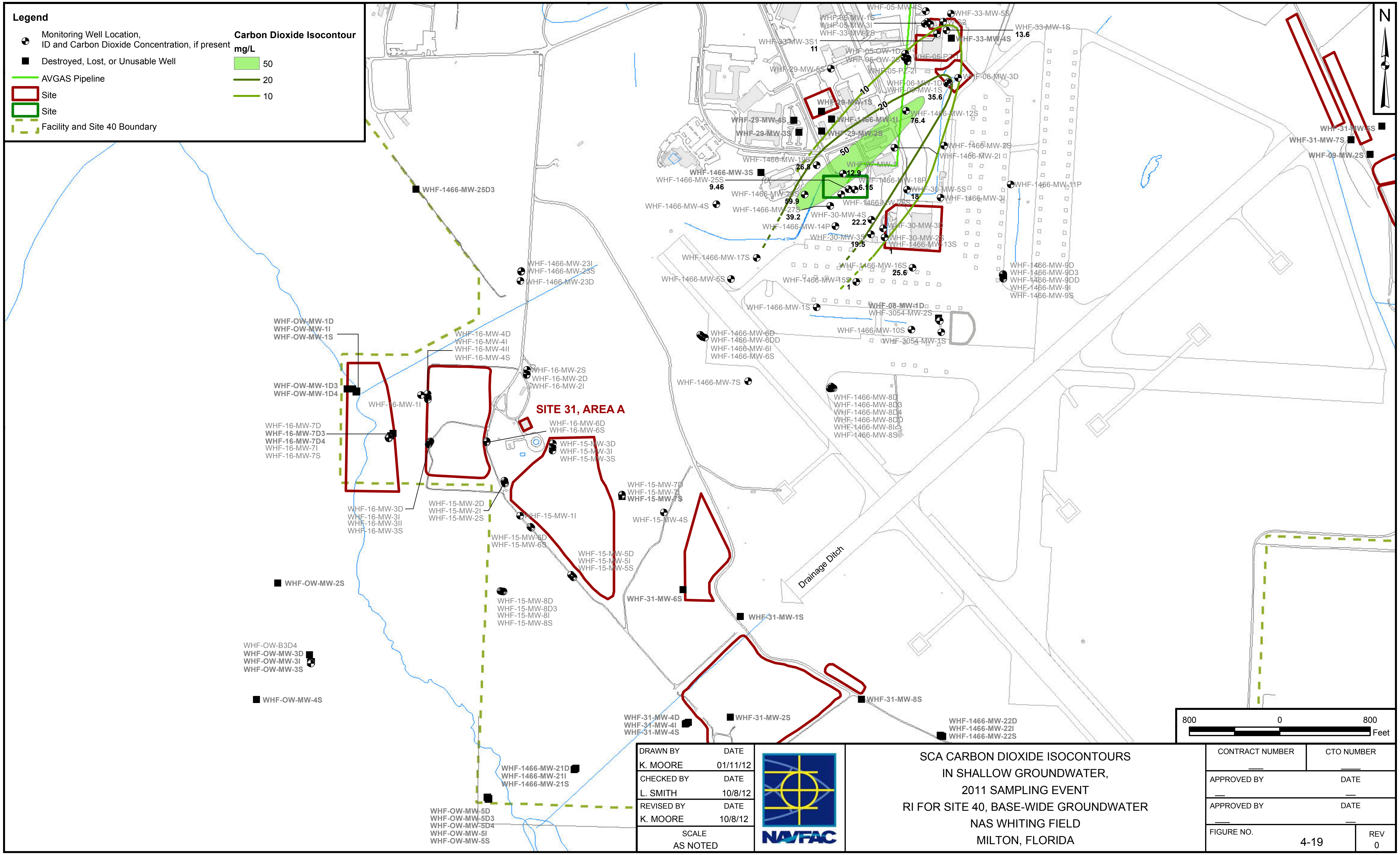
Legend

●	Monitoring Well Location, ID and Carbon Dioxide Concentration, if present
■	Destroyed, Lost, or Unusable Well
—	AVGAS Pipeline
🟥	Site
🟩	Site
▨	Facility and Site 40 Boundary

Carbon Dioxide Isocontour mg/L

🟩	50
—	20
—	10



DRAWN BY K. MOORE	DATE 01/11/12
CHECKED BY L. SMITH	DATE 10/8/12
REVISED BY K. MOORE	DATE 10/8/12
SCALE AS NOTED	

NAVFAC

SCA CARBON DIOXIDE ISOCONTOURS
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDWATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER —	CTO NUMBER —
APPROVED BY —	DATE —
APPROVED BY —	DATE —
FIGURE NO. 4-19	REV 0

WHF−15−MW−8S

ANALYTE	TRENDS
TCE	−−−

WHF−15−MW−8I

ANALYTE	YEAR 07	08	11	TRENDS
TCE	**7**	**6**	**7.48**	▶

WHF−15−MW−8D

ANALYTE	YEAR 07	08	11	TRENDS
TCE	**4**	3	1.71	▼

WHF−15−MW−8D3

ANALYTE	TRENDS
TCE	−−−

WHF−15−MW−5S

ANALYTE	YEAR 07	08	11	TRENDS
TCE	NS	NS	0.25	−−−

WHF−15−MW−5I

ANALYTE	YEAR 07	08	11	TRENDS
TCE	**5**	**6**	**4.15**	−−−

WHF−15−MW−5D

ANALYTE	YEAR 07	08	11	TRENDS
TCE	**130**	**110**	**103**	▼

WHF−15−MW−7I

ANALYTE	YEAR 07	08	11	TRENDS
TCE	**4**	2	1.89	−−−

WHF−15−MW−7D

ANALYTE	YEAR 07	08	11	TRENDS
TCE	**20**	0.44	**10.7**	−−−

WHF−1466−MW−7S

ANALYTE	TRENDS
TCE	−−−

WHF−1466−MW−6S

ANALYTE	TRENDS
TCE	−−−

WHF−1466−MW−6I

ANALYTE	YEAR 07	08	11	TRENDS
TCE	**5**	**6**	1.48	−−−

WHF−1466−MW−6D

ANALYTE	TRENDS
TCE	▶

WHF−1466−MW−6DD

ANALYTE	TRENDS
TCE	−−−

WHF−1466−MW−1S

ANALYTE	YEAR 07	08	11	TRENDS
TCE	**50**	**31**	**24.8**	▼

NOTE

DATA FROM 2007, 2008, AND 2011

MONITORING WELL LEGEND

MONITORING WELL NUMBER WHF−15−MW−8S
GROUND SURFACE ELEVATION 80.0
GROUND SURFACE
GROUNDWATER ELEVATION (FEET MSL) 35.15
TOTAL TCE CONTOUR (ug/L) 3
TOP OF MONITORED INTERVAL (FT BGS) 40.0
BOTTOM OF MONITORED INTERVAL (FT BGS) 55.0

TREND LEGEND

▶	STABLE
▼	SIGNIFICANT DOWNWARD TREND
−−−	NO SUFFICIENT DATA

LEGEND

BGS	BELOW GROUND SURFACE
FT	FEET
GCTL	GROUNDWATER CLEANUP TARGET LEVEL
MCL	MAXIMUM CONCENTRATION LEVEL
MSL	MEAN SEA LEVEL
SCA	SOUTH CENTRAL AREA
TCE	TRICHLOROETHENE
ug/L	MICROGRAMS PER LITER
USEPA	UNITED STATES ENVIRONMENTAL PROTECTION ACENCY
BOLD	ANALYTE CONCENTRATION EXCEEDS FLORIDA GCTL
BOLD	ANALYTE CONCENTRATION EXCEEDS USEPA MCL
*	GEOCHEMISTRY DATA COLLECTED

ANALYTE (ug/L)	FLORIDA GCTL	USEPA MCL
TCE	3	5

0 150 300
HORIZONTAL SCALE: 1" = 150'

0 50 100
VERTICAL SCALE: 1" = 50'

DRAWN BY CK	DATE 1/18/11
CHECKED BY LWS	DATE 1/10/12
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

SCA TCE CONTAMINANT TRENDS SECTION A TO A'
DOWNGRADIENT AREA OF TCE PLUME
SITE 40 REMEDIAL INVESTIGATION
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NO. 3064	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 4−20	REV. 0

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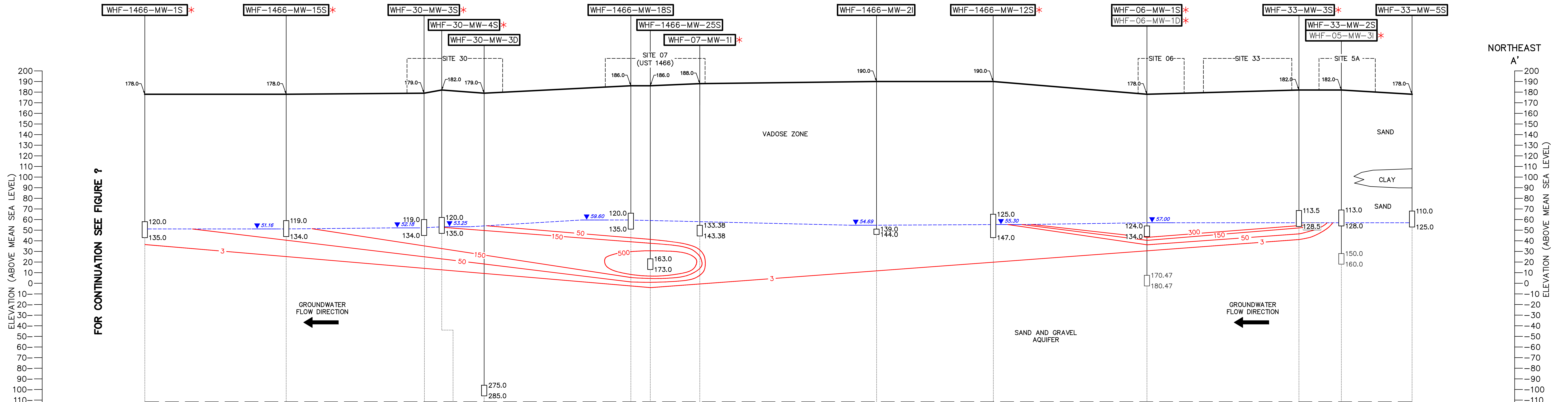


WHF–1466–MW–1S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**50**	**31**	**24.8**	🟩▼

WHF–30–MW–3S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**100**	**96**	**97.2**	▶

WHF–1466–MW–18S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**4**	2	5u/ND	–––

WHF–07–MW–1I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	1	3J	5u/ND	✕

WHF–1466–MW–12S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**120**	**28**	**37.4**	▶

WHF–06–MW–1S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**270**	**230**	**208**	▶

WHF–33–MW–5S	
ANALYTE	TRENDS
TCE	–––

WHF–1466–MW–15S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**76**	**25**	**114**	▶

WHF–30–MW–3D	
ANALYTE	TRENDS
TCE	–––

WHF–1466–MW–25S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**550**	**430**	**522**	–––

WHF–1466–MW–2I				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**25**	**11**	**21.5**	–––

PENSACOLA CLAY

WHF–06–MW–1D	
ANALYTE	TRENDS
TCE	–––

WHF–33–MW–3S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**280**	**50**	**311**	▶

WHF–30–MW–4S				
ANALYTE	YEAR			TRENDS
	07	08	11	
TCE	**10**	3	**13.9**	–––

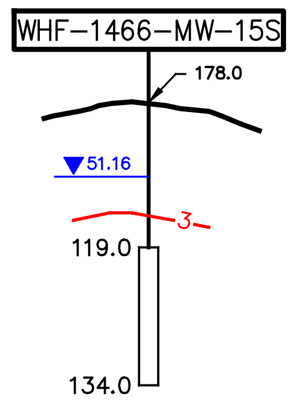
WHF–33–MW–2S	
ANALYTE	TRENDS
TCE	–––

WHF–05–MW–3I	
ANALYTE	TRENDS
TCE	✕

NOTE

DATA FROM 2007, 2008, AND 2011

MONITORING WELL LEGEND



MONITORING WELL NUMBER
GROUND SURFACE ELEVATION
GROUND SURFACE
GROUNDWATER ELEVATION (FEET MSL)
TOTAL TCE CONTOUR (ug/L)
TOP OF MONITORED INTERVAL (FT BGS)
BOTTOM OF MONITORED INTERVAL (FT BGS)

TREND LEGEND

▶	STABLE
🟩▼	SIGNIFICANT DOWNWARD TREND
✕	NO TREND
–––	NO SUFFICIENT DATA

LEGEND

BGS	BELOW GROUND SURFACE
FT	FEET
GCTL	GROUNDWATER CLEANUP TARGET LEVEL
MCL	MAXIMUM CONCENTRATION LEVEL
MSL	MEAN SEA LEVEL
ND	NON DETECT
SCA	SOUTH CENTRAL AREA
TCE	TRICHLOROETHENE
ug/L	MICROGRAMS PER LITER
USEPA	UNITED STATES ENVIRONMENTAL PROTECTION ACENCY
BOLD	ANALYTE CONCENTRATION EXCEEDS FLORIDA GCTL
BOLD	ANALYTE CONCENTRATION EXCEEDS USEPA MCL
*	GEOCHEMISTRY DATA COLLECTED

ANALYTE (ug/L)	FLORIDA GCTL	USEPA MCL
TCE	3	5

0 150 300
HORIZONTAL SCALE: 1" = 150'

0 50 100
VERTICAL SCALE: 1" = 50'

DRAWN BY CK	DATE 1/18/11	SCA TCE CONTAMINANT TRENDS SECTION A TO A' UPGRADIENT AREA OF TCE PLUME SITE 40 REMEDIAL INVESTIGATION NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 3064
CHECKED BY LWS	DATE 1/10/12		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4–20A / REV. 0

NAVFAC

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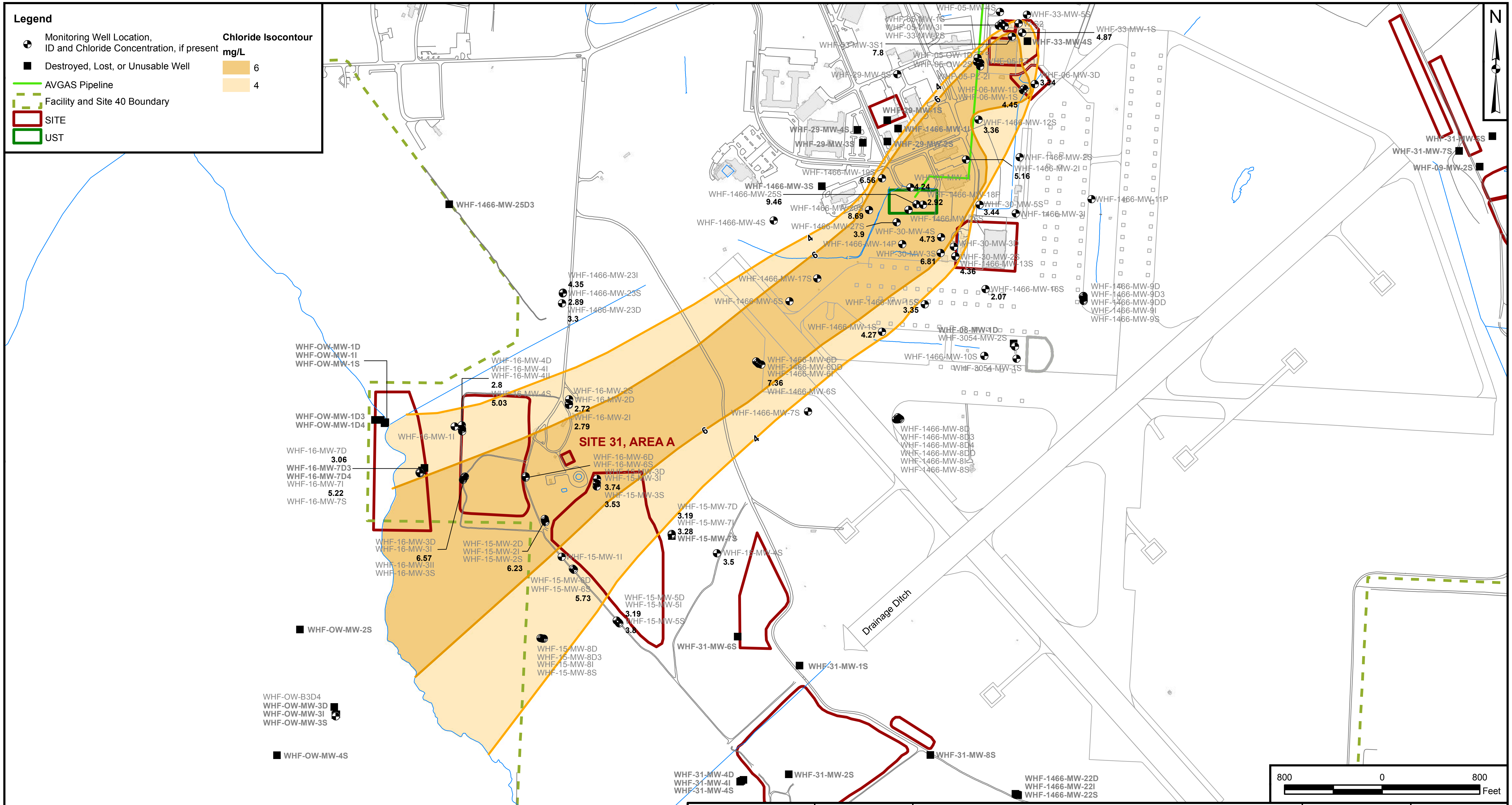
PGH:P:\GIS\WHITINGFIELD_NAS\MAPDOCS\MXD\SOUTH_FIELD_CHLORIDE_2011.MXD 10/15/2012 KM



DRAWN BY K. MOORE DATE 01/11/12
CHECKED BY L. SMITH DATE 10/8/12
REVISED BY K. MOORE DATE 10/8/12
SCALE AS NOTED

NAVFAC

SCA CHLORIDE ISOCONTOURS
IN SHALLOW GROUNDWATER,
2011 SAMPLING EVENT
RI FOR SITE 40, BASE-WIDE GROUNDATER
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NUMBER ___
CTO NUMBER ___
APPROVED BY ___ DATE ___
APPROVED BY ___ DATE ___
FIGURE NO. 4-21
REV 0