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FINAL FEASIBILITY STUDY FOR OPERABLE UNIT 5 (OU 5) SITE 15 BLUE 10 ORDNANCE DISPOSAL AREA VOLUME 1 OF 3 TEXT NAS CECIL FIELD FL
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TETRA TECH NUS INC

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-94-D-0888

Feasibility Study Report for Operable Unit 5, Site 15 Blue 10 Ordnance Disposal Area

Volume I of III - Text

Naval Air Station Cecil Field
Jacksonville, Florida

Contract Task Order 0039

April 2007

NAVFAC
Naval Facilities Engineering Command
Southeast
2155 Eagle Drive
North Charleston, South Carolina 29406

TETRA TECH NUS, Inc.

FEASIBILITY STUDY REPORT
FOR
OPERABLE UNIT 5, SITE 15 – BLUE 10 ORDNANCE DISPOSAL AREA

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command
Southeast
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
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PREPARED UNDER THE SUPERVISION OF:

Mark P. Speranza

MARK SPERANZA, P.E.
TASK ORDER MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:

Debra M. Humbert

DEBRA M. HUMBERT
PROGRAM MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

This document, which describes the Feasibility Study Report for Operable Unit 5, Site 15, Naval Air Station Cecil Field, Jacksonville, Florida, was prepared under the direction of a Florida-registered professional engineer. The work and professional opinions rendered in this report were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice.

Mark P. Speranza

Mark Speranza, P.E.
Professional Engineer No. PE0050304

Date: 4/20/07

MARK P. SPERANZA
LICENSE
FLORIDA
PROFESSIONAL ENGINEER

Mark P. Speranza

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ACRONYMS

ABB-ES	ABB Environmental Services, Inc
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criterion
BAF	Bioaccumulation factor
BaPEq	Benzo(a)pyrene equivalent
BCT	BRAC Cleanup Team
BEHP	bis(2-Ethylhexyl) phthalate
bgs	Below ground surface
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BRAC	Base Realignment and Closure
BTEX	Benzene, toluene, ethylbenzene, and xylenes
^{o}C	Degrees Celsius
CAA	Clean Air Act
CAD	Cartridge activated devices
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CKD	Cement kiln dust
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chemical of concern
cm^2	Square centimeters
COE	United States Army Corps of Engineers
COPC	Chemical of potential concern
cPAH	Carcinogenic PAH
CSF	Cancer Slope Factor
CTO	Contract Task Order
CWA	Clean Water Act
DPT	Direct-push technology
ERA	Ecological risk assessment
°F	Degrees Fahrenheit
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FFA	Federal Facility Agreement
FGS	Florida Geologic Survey
FL-UCL	Florida UCL

FS	Feasibility Study
ft^2	Square feet
GAC	Granular activated carbon
GCTL	Groundwater cleanup target level
GRA	General Response Action
HI	Hazard index
HLA	Harding Lawson Associates
HMX	Cyclotetramethylenetetranitramine
HQ	Hazard quotient
IAS	Initial Assessment Study
IBDS	Inorganic Background Data Set
IR	Installation Restoration
kg	kilogram
LDR	Land Disposal Restriction
LUC	Land use control
m^3/day	Cubic meter per day
mg/day	Milligrams per day
mg/cm^2	Milligrams per centimeters squared
MCL	Maximum Contaminant Level
mg/kg	Milligrams per kilogram
µg/dL	Micrograms per deciliter
µg/kg	Micrograms per kilogram
mg/L	Milligrams per liter
µg/L	Micrograms per liter
NAAQS	National Ambient Air Quality Standard
NACIP	Navy Assessment and Control of Installation Pollutants
NAS	Naval Air Station
NAVFAC SE	Naval Facilities Engineering Command Southeast
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NFA	No further action
NGVD	National Geodetic Vertical Datum
NESHAP	National emission standards for hazardous air pollutant
NPDES	National pollution discharge elimination system
NPW	Net present worth
NSPS	New source performance standards
NTU	Nephelometric turbidity unit

O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbon
PEC	Probable effects concentration
PCDD	Polychlorinated dibenzo-p-dioxin
PCDF	Polychlorinated dibenzofuran
POTW	Publicly Owned Treatment Works
PPE	Personal protective equipment
PRE	Preliminary Risk Evaluation
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfD	Reference Dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act
SCTL	Soil Cleanup Target Level
SDWA	Safe Drinking Water Act
SMCL	Secondary MCL
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TBC	To Be Considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total dissolved solids
TEC	Threshold effects concentration
TEF	Toxicity equivalent factor
TNT	Trinitrotoluene
TOC	Total organic carbon
TRPH	Total recoverable petroleum hydrocarbons
TSDF	Treatment, storage, and disposal facility
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper confidence limit
USC	United States Code
USDA	U.S. Department of Agriculture

U.S. EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USN	United States Navy
UTS	Universal Treatment Standard
UXO	Unexploded ordnance
VOC	Volatile organic compound
yd^3	Cubic yard
YWWA	Yellow Water Weapons Area

EXECUTIVE SUMMARY

E.1 PURPOSE OF THE REPORT

The purpose of this Feasibility Study (FS) Report is to develop and evaluate options for the remediation of contaminated soil for Operable Unit (OU) 5, Site 15, Blue 10 Ordnance Disposal Area, at Naval Air Station (NAS) Cecil Field in Jacksonville, Florida. Investigation of groundwater at this site indicated that no further action (NFA) was required, and this conclusion is documented in the Technical Memorandum for No Further Groundwater Monitoring at Site 15 included in Appendix A.1 and in the addendum to this Technical Memorandum that specifically addresses arsenic contamination in groundwater and is included in Appendix A.2.

E.2 SITE DESCRIPTION AND HISTORY

Site 15, Blue 10 Ordnance Disposal Area, is located in the southwestern section of the Yellow Water Weapons Area (YWWA) of NAS Cecil Field. The site covers approximately 85 acres and is heavily forested and relatively flat. The ordnance burn chamber and static rocket firing pad located in the north central portion of the site are the only structures still existing at the site. The burn chamber is a rounded, steel, tank-like container approximately 10 feet in length and 4 feet in height. The static rocket firing pad is an L-shaped concrete structure approximately 10 feet long by 4 feet wide by 6 feet high. Several concrete building foundations, remnants of buildings that supported skeet range activities, are located in the area surrounding the burn chamber and firing pad. Five wetland areas designated as Wetlands A to F and covering a combined area of approximately 4.6 acres have been delineated and are discussed in the Wetlands Delineation Report provided in Appendix C.

From the early 1940s to the mid-1950s, Site 15 was used as a skeet range. Ordnance was disposed by incineration in the burn chamber and static firing on the firing pad from the mid-1960s through 1977. Overall, an estimated 350 tons of ordnance were disposed at the site. Several forest burning events have taken place in the area designated as “forest burn area” located in the southwestern portion of the site. The latest burning event in this area took place in the spring of 1999.

E.3 SUMMARY OF INVESTIGATION FINDINGS

Several environmental investigations were performed at Site 15 under the Navy’s Installation Restoration (IR) Program conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as administered by the Federal Facility Agreement (FFA) signed by the United States Environmental Protection Agency (U.S. EPA), Navy, and Florida Department of Environmental Protection (FDEP). Investigation at the began with an Initial Assessment Study (IAS) performed in 1985 and

included a Remedial Investigation (RI) conducted in 1994 and 1995 and complemented by 13 rounds of supplemental sampling performed from 1996 to 2005. These investigations showed that soil contains several chemicals of concern (COCs) at concentrations that could result in unacceptable human health risks under the currently planned recreational use of Site 15. A human health Preliminary Risk Evaluation (PRE) identified several polynuclear aromatic hydrocarbons (PAHs) collectively designated as benzo(a)pyrene equivalents (BaPEqs), two metals (arsenic and lead), and total recoverable petroleum hydrocarbons (TRPH), as chemicals of potential concern (COPCs). An ecological risk assessment (ERA) also identified PAHs, arsenic, and lead in soil as COPCs.

Investigations showed that groundwater beneath the site does not contain unacceptable concentrations of the chemicals detected in soil and associated with the past use of Site 15. Detailed information regarding the investigation of groundwater at Site 15 is presented in the Groundwater Technical Memorandum for No Further Action and Supplement to the Groundwater Technical Memorandum for No Further Action provided in Appendices A.1 and A.2, respectively.

E.4 REMEDIAL ACTION OBJECTIVES, PRELIMINARY REMEDIAL ACTION GOALS, AND VOLUMES OF CONTAMINATED SOIL

The Remedial Action Objectives (RAOs) identified for Site 15 soil are as follows:

- Prevent unacceptable human health risk associated with exposure to surface soil containing PAHs, arsenic, lead, and TRPH at concentrations greater than the established site-specific soil cleanup target levels (SCTLs).

- Reduce ecological risk associated with exposure to surface soil containing PAHs and lead at concentrations greater than the established site-specific ecological target levels.

The COCs and corresponding pickup values established to permit recreation use of the site are as follows:

COC	Maximum Concentration Detected	Recreational Use Cleanup Goal	Recreational Use Pickup Value(1)
BaPEqs	956,000 µg/kg	2,250 µg/kg	6,750 µg/kg(2)
Arsenic	451 mg/kg	36 mg/kg	108 mg/kg(2)
Lead	41,400 mg/kg	3,281 mg/kg (chronic)	6,500 mg/kg(3)
TRPH	2,380 mg/kg	8,900 mg/kg	340 mg/kg(4)

µg/kg: Micrograms per kilogram.
mg/kg: Milligrams per kilogram.

1. The “pickup value” is the COC concentration that, if soil with a greater concentration is removed or treated, the 95-percent upper confidence (UCL) (or average in the case of lead) of COC concentrations in remaining soil would be less than the cleanup goal.
2. Three times the site-specific recreational SCTL as per Chapter 62-780, Florida Administrative Code (F.A.C.) for acute toxicity.
3. Site-specific acute toxicity SCTL.
4. Chapter 62-777 leachability SCTL.

Based on the Site 15 soil database provided in Appendix E and on the findings of the Geostatistical Assessment Report provided in Appendix D (Newfields, 2004), it is estimated that a total volume of approximately 11,600 cubic yards (yd^3) of contaminated soil from 20 separate areas with a combined surface area of approximately 7.2 acres contain concentrations of COCs greater than the recreational site-specific SCTLs. These areas are as follows:

- PAH-contaminated soil with BaPEq concentrations greater than 6,750 µg/kg – nine areas totaling 235,900 square feet (ft^2), or 5.42 acres, from 0 to 1 foot below ground surface (bgs).

- Lead-contaminated soil with concentrations greater than 6,500 mg/kg – eight areas totaling 75,300 ft^2, or 1.73 acres, from 0 to 1 foot bgs.

- TRPH-contaminated soil with concentrations greater than 340 mg/kg – one 500 ft^2 area from 1 to 2 feet bgs. This area is located within one of the above-mentioned areas of PAH-contaminated soil.

- Arsenic-contaminated soil with concentrations greater than 36 mg/kg – Two areas totaling 1,600 ft^2, or 0.04 acre, from ground surface to the water table (assume to be 2 feet bgs). At the time of sample collection in these arsenic-contaminated areas, the water table was within 1 foot of the ground surface, limiting unsaturated soil sample collection to this depth. Because the water table has decreased, overexcavation to a depth of 2 feet bgs will be conducted.

Preliminary surface areas and volumes of soil that would need to be remediated to allow the potential future unrestricted use of Site 15 were also estimated. Based on a comparison of the Site 15 soil database to the site-specific SCTLs for a hypothetical future residential use scenario, it was estimated that a total volume of approximately 118,000 yd^3 of contaminated soil over a surface area of approximately 73 acres would need to be remediated, as follows:

- PAH-contaminated soil with BaPEq concentrations greater than 100 µg/kg: 1,772,803 ft^2, or 40.7 acres, from 0 to 1 foot bgs.

- Lead-contaminated soil with concentrations greater than 400 mg/kg – 632,460 ft^2, or 14.5 acres, from 0 to 1 foot bgs.

- PAH- and lead-contaminated soil with BaPEq concentrations greater than 100 µg/kg and lead concentrations greater than 400 mg/kg – 789,651 ft^2, or 18.1 acres, from 0 to 1 foot bgs.

- Arsenic-contaminated soil with concentrations greater than 2.1 mg/kg – included within the other areas from 0 to 2 foot bgs.

- TRPH-contaminated soil with concentrations greater than 340 mg/kg – included within the PAH-contaminated area noted above from a depth of 1 to 2 ft bgs.

The Geostatistical Assessment Report (Appendix D) stated that significant soil sampling was conducted at Site 15 and that the delineation of lead and BaPEqs was accurate and complete, and therefore confirmation sampling is not warranted. Additional discussions regarding this topic were held (BCT Meeting Minute No. 2208) and it was agreed by the Base Realignment and Closure (BRAC) Cleanup Team (BCT) (Decision No. 687) that the areas requiring remediation for BaPEqs only would not require confirmation sampling; however, the areas being remediated for lead would require limited confirmation sampling. Six areas have been identified as exceeding the lead pickup level for recreational use and therefore would require confirmation sampling. A confirmation sampling plan will be developed and implemented as part of the remedial design for Site 15.

E.5 SCREENING OF GENERAL RESPONSE ACTIONS, REMEDIATION TECHNOLOGIES, AND PROCESS OPTIONS

General Response Actions (GRAs) and the remediation technologies and process options associated with these GRAs were screened for effectiveness, implementability, and cost. Remediation technologies that were determined to be ineffective or too difficult to implement were eliminated from further consideration. The following GRAs, remediation technologies, and process options were retained to develop remedial alternatives for Site 15:

- No Action

- Limited Action: Land Use Controls (LUCs)

- Containment: Soil Cover

- Removal: Excavation

- Ex-Situ Treatment: On-Site Screening, Size Reduction, On-Site Soil Washing/Chemical Extraction, and Off-Site Chemical Fixation/Solidification

- Disposal: On-Site Beneficial Reuse, Off-Site Resource Conservation and Recovery Act (RCRA) Non-Hazardous (Subtitle D) Landfill, and Off-Site RCRA Hazardous (Subtitle C) Landfill

E.6 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The following remedial alternatives were developed for Site 15:

- **Alternative 1: No Action**. This alternative is required as a baseline for comparison to other alternatives.

- **Alternative 2: Soil Cover To Meet Recreational RAOs and LUCs**. This alternative would place a soil cover over the areas of Site 15 where concentrations of COCs in soil are greater than the recreational use pickup value. A total of 20 areas with an overall surface area of approximately 7.2 acres would be capped with a 2-foot-thick soil cover. Because the cover would need to be maintained to prevent exposure to the contaminated soil remaining on site, LUCs would have to be established through a LUC Remedial Design (RD) and enforced. These LUCs would include establishing an inspection and maintenance schedule for the cover and preventing, commercial/industrial, and high- and medium-intensity recreational uses.

- **Alternative 3A: Excavation To Meet Recreational RAOs, Off-Site Treatment and Disposal, and LUCs**. This alternative would remove soil from the areas of Site 15 where concentrations of COCs are greater than the recreational use pickup level. A total of approximately 11,600 yd^3 of contaminated soil would be excavated from the same 20 areas totaling approximately 7.2 acres that are considered for capping under Alternative 2. Most of the excavated soil (approximately 10,900 yd^3) would be disposed off site at a permitted RCRA non-hazardous (Subtitle D) treatment, storage, and disposal facility (TSDF) and the remainder (approximately 700 yd^3) would be disposed at an off-site permitted RCRA hazardous (Subtitle C) TSDF. The excavated areas would then be backfilled with 11,600 yd^3 of clean imported fill material, the site would be revegetated, and impacted wetlands would be restored. Because the soil remaining on site would continue to contain concentrations of COCs that would not be protective of hypothetical future high- and medium-intensity recreational, commercial/industrial, and residential human receptors, LUCs would have to be

established and enforced. These LUCs would prevent residential, commercial/industrial, and high- and medium-intensity recreational uses.

- **Alternative 3B: Excavation To Meet Recreational RAOs, On-Site Treatment and Reuse, and LUCs**. As with Alternative 3A, Alternative 3B would remove soil from the areas of Site 15 where concentrations of COCs are greater than the recreational use pickup level. A total of approximately 11,600 yd^3 of contaminated soil would be excavated from the same 20 areas totaling approximately 7.2 acres that would be excavated under Alternative 3A. The excavated soil would be screened on site, and approximately 600 yd^3 of oversized material would be landfilled at an off-site permitted RCRA Subtitle D facility. The screened soil would be treated on site by soil washing, and approximately 10,200 yd^3 of treated soil would be reused to backfill the excavated areas. The soil washing process would concentrate the COCs removed from the treated soil in a wet (65 percent moisture by weight) filter cake residue and approximately 2,600 yd^3 (or 3,500 tons) of this wet filter cake residue would be disposed at an off-site permitted RCRA Subtitle C TSDF. The backfilling of the excavated areas would be completed with 1,400 yd^3 of clean imported fill material, the site would be revegetated, and impacted wetlands would be restored. Alternative 3B would also incorporate the same LUCs as Alternative 3A to prevent unacceptable risks from exposure of hypothetical future high- and medium-intensity recreational, commercial/industrial, and residential human receptors to contaminated soil remaining on site. These LUCs would prevent residential, commercial/industrial, and high- and medium-intensity recreational uses.

- **Alternative 4A: Excavation To Allow Unrestricted Site Use and Off-Site Treatment and Disposal**. This alternative would remove contaminated soil to the extent necessary to allow unrestricted use of the site. This would essentially require excavation of all of the site surface soil because the areas identified as exceeding the site-specific residential SCTLs encompass the entire site. A total volume of approximately 118,000 yd^3 of contaminated soil would be excavated over an area of 73 acres. Approximately 108,000 yd^3 of the excavated soil would be disposed at an off-site permitted RCRA Subtitle D TSDF, and the remaining 10,000 yd^3 would be disposed at an off-site permitted RCRA Subtitle C TSDF. The excavated areas would then be backfilled with 118,000 yd^3 of clean imported fill material, the site would be revegetated, and impacted wetlands would be restored. Because the soil remaining on site would no longer contain concentrations of COCs that could be harmful to hypothetical future residential receptors, LUCs would not be required.

- **Alternative 4B: Excavation To Allow Unrestricted Site Use and On-Site Treatment and Reuse**. As with Alternative 4A, Alternative 4B would remove contaminated soil to the extent necessary to allow unrestricted use of the site, and approximately 118,000 yd^3 of contaminated soil would be excavated over an area of 73 acres. The excavated soil would be screened on site, and

approximately 6,000 yd^3 of oversized material would be landfilled at an off-site permitted RCRA Subtitle D facility. The screened soil would be treated on site by soil washing, and approximately 102,000 yd^3 of treated soil would be reused to backfill the excavated areas. Approximately 26,000 yd^3 (or 35,000 tons) of wet filter cake residue from the soil washing process would be disposed at an off-site permitted RCRA Subtitle C TSDF. The backfilling of the excavated areas would be completed with 14,000 yd^3 of clean imported fill material, the site would be revegetated, and impacted wetlands would be restored. As for Alternative 4A, no LUCs would be required.

E.7 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were analyzed in detail using seven of the nine criteria provided in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and CERCLA. These seven criteria are as follows:

- Overall Protection of Human Health and the Environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) and To-Be-Considered (TBC) guidance criteria
- Long-Term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

Two other criteria, State and Community Acceptance, were not evaluated in this report. They will be evaluated after regulatory and public comments are available.

E.8 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were compared to each other using the same criteria that were used for detailed analysis. The following is a summary of these comparisons:

- **Overall Protection of Human Health and Environment.** Alternative 1 would not be protective. Alternatives 2, 3A, 3B, 4A, and 4B would be protective. However, because of the dependence on LUCs to prevent residential, commercial/industrial, and high- and medium-intensity recreational uses in the future, Alternatives 2, 3A, and 3B would be ranked lower than Alternatives 4A and 4B. Alternatives 3A and 3B would be ranked higher than Alternative 2 because of the removal of contaminated soil in the former. Alternatives 3B and 4B would be ranked marginally higher than Alternatives 3A and 4A, respectively, because of their use of on-site treatment to remove COCs.

- **Compliance with ARARs and TBCs.** Alternative 1 would not comply with chemical- and location-specific ARARs. Action-specific ARARs do not apply to Alternative 1. Alternative 2 would not comply with chemical-specific ARARs but would comply with location- and action-specific ARARs. Alternatives 3A, 3B, 4A, and 4B would comply with the chemical-, location-, and action-specific ARARs.

- **Long-Term Effectiveness and Permanence.** Alternative 1 would not be effective in the long term and offers no permanent solution. Alternatives 2, 3A, 3B, 4A, and 4B offer varying degrees of long-term effectiveness and permanence.

  Alternatives 4A and 4B offer remedies that remove COCs from the site without the need for LUCs to prevent residential, commercial/industrial, and high- and medium-intensity recreational development. Alternatives 2, 3A, and 3B depend on LUCs and may be somewhat less effective in the long term. However, because of the removal of COCs from the site with either on-site or off-site treatment/disposal, Alternatives 3A and 3B are superior to Alternative 2, which depends on the maintenance of a soil cover for its effectiveness. Alternative 3B is marginally superior to Alternative 3A because the volume of contaminated material needing off-site treatment/disposal is smaller and therefore, the relative magnitude of future liability of the disposed material is less under Alternative 3B.

- **Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment.** Alternatives 1 and 2 do not employ any treatment. Alternatives that employ treatment to applicable material are ranked in the following order of decreasing volumes of soil treated: Alternative 4B (112,000 yd^3), Alternatives 3B (10,900 yd^3), Alternative 4A (10,000 yd^3), and Alternative 3A (700 yd^3). However, only Alternatives 3B and 4B would reduce the mass of COCs (and hence toxicity) at the site followed by irreversible treatment. Alternative 3B would treat 10,900 yd^3 of contaminated soil to reduce BaPEq concentrations by over 90 percent and would treat 700 yd^3 of high lead-content soil (included in the 10,900 yd^3) to attain the lead Universal Treatment Standard (UTS), resulting in approximately 2,600 yd^3 (or 3,500 tons) of highly contaminated filter cake treatment residue being removed from the site.

Alternative 4B would treat 112,000 yd^3 of contaminated soil to reduce BaPEq concentrations by over 99 percent and would treat 10,000 yd^3 of high lead-content soil (included in the 112,000 yd^3) to attain the lead UTS, resulting in approximately 26,000 yd^3 (or 35,000 tons) of highly contaminated filter cake treatment residue being removed from the site. Alternatives 3A and 4A would reduce the mobility of COCs by off-site treatment of a portion of the excavated soil. Alternative 4A would treat 10,000 yd^3 of lead-contaminated soil compared to 700 yd^3 for Alternative 3A to achieve mobility reduction.

- **Short-Term Effectiveness.** All of the alternatives would be effective in the short term in terms of short-term risks to workers, the community, and the environment, except Alternative 1 for which there are no relevant issues to address. However, a greater potential for release of contaminants exists under Alternatives 3B and 4B compared to the other alternatives. Alternative 2 employs the least volume of excavation and movement of contaminated soil and is likely to pose the least short-term risk. Alternative 3A is less likely to pose a short-term risk than Alternative 4A because of the lower volume of contaminated soil being excavated. Short-term risks for all alternatives, except Alternative 1, would be properly mitigated by application of engineering controls and adherence to appropriate health and safety procedures.

  The approximate timeframe for implementation and attainment of RAOs would be 1 year for Alternatives 2, 3A, and 3B, 2 years for Alternative 4A, and 3 years for Alternative 4B.

- **Implementability.** Alternative 1 is readily implementable because there is no action to implement. The other alternatives would be ranked in the following decreasing order of ease of implementability: Alternative 4A, Alternative 3A, Alternative 2, and Alternatives 3B and 4B. Alternative 4A is the easiest to implement because no on-site treatment or long-term maintenance would be required. Alternative 3A is expected to be somewhat more difficult to implement because of the need to conduct long-term site monitoring and to maintain LUCs. Alternative 2 would require maintenance of LUCs as well as maintenance of a cap. Alternatives 3B and 4B employ on-site treatment, which requires specialized engineering and trained technicians, and therefore they are likely to be more difficult to implement. Alternative 4B is more dependent on treatability studies and additional processing to meet more stringent on-site reuse than Alternative 3B.

- **Cost.** The capital and operation and maintenance (O&M) costs and net present worth (NPW) of the soil remedial alternatives were estimated to be as follows:

Alternative	Capital ($)	30-Year NPW of O&M ($)	30-Year NPW ($)
1	0	0	0
2	1,373,000	59,000	1,432,000
3A	1,882,000	35,000	1,917,000
3B	4,680,000	35,000	4,715,000
4A	15,804,000	0	15,804,000
4B	28,829,000	0	28,828,000

The above cost figures have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. A detailed breakdown of cost estimates is provided in Appendix G.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF REPORT

This Feasibility Study (FS) Report for Operable Unit (OU) 5, Site 15 at Naval Air Station (NAS) Cecil Field in Jacksonville, Florida, has been prepared by Tetra Tech NUS, Inc. (TtNUS) for Naval Facilities Engineering Command Southeast (NAVFAC SE) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0039. This report describes the formulation and evaluation of remedial action alternatives for soil at Site 15, the Blue 10 Ordnance Disposal Area.

This FS was conducted to establish Remedial Action Objectives (RAOs) and remedial pickup levels, to screen remedial technologies, and to assemble, evaluate, and compare remedial alternatives. The FS focuses on soil contamination at Site 15 identified during pre-Remedial Investigation (RI) sampling, the RI, and subsequent supplemental sampling.

1.2 SITE BACKGROUND

Figure 1-1 provides a site location map. Figure 1-2 is an aerial photograph that shows features in the vicinity of the site. Figure 1-3 provides the general arrangement of the site.

1.2.1 Site Description

Site 15 is located in the southwestern section of the Yellow Water Weapons Area (YWWA) portion of NAS Cecil Field (Figure 1-1). The area of investigation is approximately 85 acres with elevations ranging from approximately 72 to 79 feet above mean sea level [referenced to the National Geodetic Vertical Datum (NGVD)]. The site is heavily forested, primarily with slash pine and understory vegetation and includes a paved access road, oriented northwest to southeast (Figure 1-2). Several forest fires have occurred in the area designated as the "forest burn area" on Figure 1-3, which is located in the southwestern portion of the site.

The ordnance burn chamber and static rocket firing pad are the only structures currently at the site. The burn chamber is a rounded, steel, tank-like container approximately 10 feet in length and 4 feet in height. The chamber has a burn stack that rises approximately 3 feet above the body of the chamber. Access is gained to the chamber through a 2-foot by 2-foot hinged door. When full, the burn chamber can accommodate 1.5 cubic yards (yd^3) of material. The static rocket firing pad is an L-shaped concrete structure approximately 10 feet long by 4 feet wide by 6 feet high. Steel firing rods are seated in the

concrete at 45-degree angles. Several concrete building foundations, remnants of buildings that supported skeet range activities, are located in the area surrounding the burn chamber and firing pad.
An area of stressed vegetation, referred to as the forest burn area, is present in the southwestern portion of the site, approximately 900 feet southwest of the burn chamber and firing pad. Several slash pines are partially burned in this area. Controlled burns (burning of low-level vegetation in and around the trunks of slash pines) were commonly undertaken in this area to control understory growth in the planted pine forests. This is an area where elevated polynuclear aromatic hydrocarbon (PAH) concentrations were detected.

The primary drainage feature is a drainage ditch located south of the ordnance disposal area that drains the southern part of the site into a low-lying, swampy area and eventually into Yellow Water Creek. The northern part of the site drains overland into a swamp, which drains into Caldwell Branch (located approximately 1,000 feet west of the site) and eventually into Yellow Water Creek. Drainage features are not distinct in the central portion of the site. The majority of Site 15 remains dry throughout the year; however, the central area of the site may contain 2 to 4 inches of standing water during portions of the year. Site 15 was originally defined as an approximately 10-acre area around the burn chamber and firing pad. However, evaluation of surface soil screening data indicated PAH and lead contamination over a larger area, and the size of the site was increased to approximately 85 acres. The site boundaries were extending radially around the burn chamber and firing pad, to the south to include the forest burn area, and to the north and west to include the areas of the former trap and skeet ranges. The trap and skeet ranges were included because it was interpreted that lead shot from shooting activities was the main source of lead contamination. The forest burn area was included because combustion products of wood may produce organic residue similar to other organic burning reactions. This area is heavily planted with slash pines and typically supports a 4- to 6-inch cover of duff (pine straw and other forest detritus) over the land surface. The primary residuals produced from wood and forest floor duff and litter burning would be PAHs.

1.2.2 Site History

From the early 1940s to the mid-1950s, the site was used as a skeet range. The former skeet range was approximately 1,000 feet by 2,400 feet in size, with the long axis of the range parallel to and east of the access road to the burn chamber.

Ordnance was disposed at Site 15 from the mid-1960s through 1977, and disposal activities consisted of burning of ordnance materials in a large metal chamber and static firing of rockets (Envirodyne Engineers, 1985). The majority of ordnance disposed at the site was burned and included small arms munitions up to 20 millimeters in size, parachute and distress flares, Mark IV signal cartridges, rocket igniters, cartridge activated devices (CADs), and 2.75-inch and 5-inch rockets. Rocket propellant also

was reportedly placed on the ground and ignited in the area of the burn chamber. Rockets were disposed by static firing of both 2.75-inch and 5-inch rockets from a firing pad located south of the burn chamber. An estimated 2.5 tons of ordnance was disposed at the site each month; overall, an estimated 350 tons of ordnance were disposed during site operations.

Review of aerial photographs from 1952, prior to the initiation of ordnance disposal on Site 15, shows an active skeet range facility at the site. The area covered by the skeet range appears relatively large, approximately 50 acres in size, and is centered over the area in which the burn chamber and firing pad were constructed. Photographs taken in 1960 show the lineaments of the skeet range; however, the range did not appear to be active at that time. Photographs taken in 1980 no longer show any indication that a skeet range had once occupied the area. The site appears mostly forested in photographs taken in 1980, with a 3-acre open area immediately north of Site 15. No visual evidence of ordnance disposal was apparent at that time, which supports the historical documentation. Forest burning has continued in the southwestern corner of Site 15. The latest burning event took place in the spring of 1999.

1.2.3 Site Characteristics

The following sections discuss the site-specific physical characteristics of Site 15, including surface hydrology, soil characteristics, and groundwater.

1.2.3.1 Surface Hydrology

Drainage at Site 15 is limited because only two drainage pathways intersect the general area of the site. The primary pathway is a relatively short drainage ditch, 500 feet in length, that drains the south-central section of the site. It appears to be a natural drainage conduit that begins in a shallow depression 3 to 4 feet in depth and 10 to 12 feet in width. The shallow depression is located adjacent to and south of the paved road in the south-central portion of the site and drains into Yellow Water Creek. Flow through the drainage ditch is intermittent and the rate of flow depends on rainfall and could be fed by groundwater at certain times of the year. The second drainage pathway is a drainage ditch that flows past the northwestern perimeter of the site. This drainage ditch is relatively shallow, 8 to 10 inches in depth, and approximately 2 to 3 feet wide. Flow through the drainage ditch is also intermittent, and the rate of flow depends on rainfall. This drainage ditch drains southwest into Caldwell Branch and ultimately into Yellow Water Creek.

1.2.3.2 Soil

Three soil types cover Site 15 in nearly equal percentages, the Olustee Fine Sand, Leon Fine Sand, and Ridgeland Fine Sand. Each of the three soil types is described as a nearly level, poorly drained soil

found in broad flatwood areas. Natural vegetation associated with these soil types consists predominantly of oak, pine, and saw palmetto. Depth to groundwater ranges from less than 10 inches below ground surface (bgs) for 2 to 4 months of the year to 10 to 40 inches bgs during the remainder of the year. Permeability through the upper 6 inches of each soil type is moderate to rapid (USDA, 1978).

1.2.3.3 Groundwater

Three water-bearing systems are present beneath Site 15, including, in descending order, the surficial aquifer system, the intermediate aquifer and confining units, and the Floridan Aquifer system. Only the surficial aquifer was investigated at Site 15 because the other two aquifers, the intermediate and Floridan, are much deeper and overlaid by confining formations that shield them from typical environmental impacts.

The surficial aquifer at Site 15 is composed predominantly of sand from the ground surface to an approximate depth of 66 feet bgs. The water table is unconfined beneath the site and may range between 1 and 4 feet bgs during the year depending on rainfall events. The maximum total depth of monitoring wells installed in the surficial aquifer at Site 15 was approximately 14 feet bgs. Sand was reported from the ground surface to the total depth of each of the monitoring wells.

1.2.4 Site Investigations

Several environmental investigations were performed at Site 15 as part of the Navy's Installation Restoration (IR) Program conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as administered by the Federal Facility Agreement (FFA) signed by the United States Environmental Protection Agency (U.S. EPA), Navy, and Florida Department of Environmental Protection (FDEP). Extensive investigations of Site 15 were conducted beginning in 1985 and continuing through the preparation of this FS. During this period, 853 soil samples, 13 sediment samples, 7 surface water samples, 40 groundwater samples, and 15 ecological samples were collected and analyzed. Figure 1-5 shows all sample locations. Figure 1-6 shows the PAH sampling locations selected during the RI screening and confirmatory sampling of surface soil, subsurface soil, and sediment. Figure 1-7 shows the lead sampling locations selected during the RI screening and confirmatory sampling of surface soil, subsurface soil, and sediment. Figures 1-8 and 1-9 show the trinitrotoluene (TNT) and total recoverable petroleum hydrocarbon (TRPH) sampling locations selected during the RI screening of surface soils. Figures 1-10, 1-11, 1-12, and 1-13 show supplemental sample locations for PAH, lead, arsenic, and TRPH analyses, respectively, with respect to the historical sample locations for the same analyses during the RI. Figures 1-14 and 1-15 show isoconcentration contours for PAHs in terms of benzo(a)pyrene equivalents (BaPEqs) and lead based on all surface soil samples collected during screening,

confirmatory, and supplemental programs. Figure 1-16 shows monitoring well locations and groundwater sampling results for arsenic during the RI and subsequent sampling at Site 15.

The following provides a chronological list of the investigations conducted at Site 15:

- 1985 - An Initial Assessment Study (IAS) was prepared for NAS Cecil Field by Envirodyne Engineers under the Navy Assessment and Control of Installation Pollutants (NACIP) program, which was eventually replaced by the Navy's Installation Restoration (IR) Program. The IAS consisted of the following stages: (1) records search, (2) on-site survey, (3) confirmation study ranking, (4) site ranking, and (5) confirmation study recommendations.

- 1988 - A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was performed for NAS Cecil Field by Harding Lawson Associates (HLA) (1988a). The goals of the RFI were to verify the existence of suspected hazardous constituents at various waste disposal sites, to delineate the boundaries of potentially contaminated sites, to investigate the surficial aquifer and potable water supply wells, and to investigate selected surface areas for possible contamination. One surface soil sample was collected at Site 15 as part of the RFI. A geophysical survey was also conducted at the site.

- July 1993 - As part of the Basewide Ecological Assessment, one soil sample was collected at Site 15 (HLA, 1998b).

- August 1994 to April 1995 - As part of the OU 5 RI (ABB-ES, 1997) a field screening program consisting of an unexploded ordnance (UXO) survey, surface and subsurface soil screening, and installation of piezometers was completed. The UXO survey was completed at the site prior to the sampling activities. No UXO was found; however, several pieces of metal shell casings and similar items were located and removed. The soil screening program was designed to delineate the nature and extent of PAH, lead, TNT, and TRPH contamination in surface soil using on-site and off-site data analysis. Surface soil screening consisted of sample collection from 0 to 1 foot bgs at 100-foot grid spacing over an area approximately 2,000 feet by 3,000 feet, except in the area around the burn chamber and blast platform, where the grid spacing was increased to 25 feet over an area of 100 feet by 100 feet. Collection and analysis of samples for target screening parameters continued outward from the burn chamber and firing pad until a "no detection" result was obtained for that particular parameter, thus delineating the extent of contamination for that parameter. Analyses for other target parameters with detections continued outward. This screening technique resulted in varying combinations of analyses for samples collected from 409 locations. A total of 324 samples were collected for off-site lead analysis, 263 samples were collected for on-site PAH analysis, 146 samples

were collected for on-site TNT analysis, and 136 samples were collected for on-site TRPH analysis during the surface soil screening program. Subsurface soil screening consisted of the collection of 16 subsurface soil samples from four soil borings advanced in the area of the burn chamber and blast platform. Samples were collected at depths of 0 to 1 foot bgs, 1 to 3 feet bgs, 3 to 5 feet bgs, and 5 to 7 feet bgs at each of the four borings. Subsurface soil samples were analyzed off site for lead and on site for volatile organic compounds (VOCs), PAHs, and TRPH. Four temporary piezometers were installed to determine the direction of groundwater flow in the surficial aquifer. Evaluation of water level data collected on three separate occasions indicated that groundwater flow is to the southwest toward Yellow Water Creek. A groundwater screening program was not implemented at Site 15 because the chemicals of concern (COCs) were known to be relatively immobile when sorbed to site soil. However, eight monitoring wells, which would be used during the confirmatory sampling event, were installed at locations sealcted based on water level data.

- July and August 1995 - As part of the OU 5 RI, ABB-ES performed confirmatory sampling and analysis for surface and subsurface soil at Site 15 to refine the nature and extent of contamination in soil determined during the screening process. During this sampling round, 34 surface soil samples were collected at depths of 0 to 1 foot bgs and analyzed for Target Compound List (TCL) organics, Target Analyte List (TAL) inorganics, TRPH, and nitroaromatics. Six additional surface soil samples were analyzed for lead, four additional surface soil samples were analyzed for PAHs, and three additional surface soil samples were analyzed for nitroaromatics. Two of the surface soil samples were also analyzed for pH, moisture content, sieve and hydrometer size distribution, bulk density, and cation exchange capacity. Also during this sampling round, 12 subsurface soil samples were collected at depths of 1 to 3 feet (immediately above the water table) and were analyzed for TCL organics, TAL inorganics, TRPH, and nitroaromatics. In addition, four of these samples were analyzed for total organic carbon (TOC). One additional subsurface soil sample was analyzed for PAHs only, and one additional subsurface soil sample was analyzed for nitroaromatics only. Confirmatory groundwater samples collected from the eight Site 15 monitoring wells were analyzed for TCL organics, TAL inorganics, TRPH, and nitroaromatics. Selected groundwater samples were also submitted for TOC analysis, and slug tests on the monitoring wells were performed. A confirmatory surface water and sediment sampling program was completed to assess potential contaminant migration through groundwater-surface water interaction, surface runoff, and/or soil erosion, and to aid in assessment of potential human health and ecological risks. One surface water/sediment sample upgradient of the site and two downgradient surface water/sediment samples were collected and analyzed for TCL organics, TAL inorganics, TRPH, and nitroaromatics. Surface water samples were analyzed for cyanide, hexavalent chromium, sulfide, total dissolved solids (TDS), alkalinity, hardness, total phosphate, and Kjeldahl nitrogen. Field measurements of surface water pH,

temperature, turbidity, conductivity, and dissolved oxygen were recorded at each location at the time of sample collection.

- June 1996 - Soil toxicity testing to evaluate ecological risk was preformed. Six soil samples, including a reference sample, were collected for whole-soil toxicity testing. Two additional soil samples were also collected for definitive (dilution series) toxicity testing.

- February 1997 - To support the RI, 38 additional surface soil samples from 17 screening locations across the site were submitted for sieve and lead analysis. The objective of this additional sampling effort was to determine if it was feasible to separate lead shot and lead shot fragments from soil, if the remaining lead shot was responsible for high lead concentrations or if concentrations are due to lead leached into the soil, if lead concentrations were localized vertically at the ground surface, and if the soil would be considered under RCRA as characteristically hazardous if excavated. Four samples from the seven locations with the highest lead concentrations were collected at 3-inch intervals from the ground surface to a depth of 1 foot. Single samples were collected from 0 to 1 foot from the remaining 10 locations of lesser lead concentrations, although concentrations at these locations exceeded the United States Environmental Protection Agency (U.S. EPA) soil screening value (400 mg/kg). All samples were submitted for lead analysis and Toxicity Characteristic Leaching Procedure (TCLP) lead analysis. Sieve analyses were not performed.

- May 1997 - Another sampling event for surface and subsurface soils involved the collection of 14 surface soil samples analyzed for lead, nine surface soil samples analyzed for antimony and arsenic, and eight subsurface soil samples analyzed for PAHs. During this event, four sediment and surface water samples were also collected. Surface water samples were analyzed for lead; sediment samples were analyzed for lead, PAHs, and TRPH. These were the last data included in the OU 5 RI Report (ABB-ES, 1997).

- December 1997 - An additional sampling event was conducted that included the collection of nine soil samples from four locations. Seven of these samples were analyzed for antimony and arsenic, and the other two samples were analyzed for PAHs.

- April/June 1999 - A supplemental sampling event for surface soil and sediment was conducted in April and June 1999 to further determine the limits of lead and PAH contamination in surface soil to avoid having to extrapolate analytical data to verify delineation of these contaminants. This sampling event involved the collection of surface soil samples from 130 new locations. A total of 78 samples were collected for lead analysis, and 60 samples were collected for PAH analysis. Eight of the 130

surface soil locations were analyzed for PAHs and lead. During this sampling round, six sediment samples were also collected and analyzed for PAHs and lead.

- February 2000 - A supplemental sampling event to obtain data to develop site-specific leachability values for PAHs at Site 15 was conducted. Five surface soil samples were collected from 0 to 1 foot bgs for PAHs and Synthetic Precipitation Leaching Procedure (SPLP) analysis. The results of the soil SPLP analysis are presented in Appendix A.

- April 2000 - Groundwater samples were collected from the eight existing wells at the site and analyzed for PAHs, nitroaromatics, arsenic, antimony, and lead. Because of high turbidity, one of the wells was redeveloped and resampled for the inorganics. The results of the groundwater analyses are presented in Appendix A.

- June 2001 - A supplemental sampling event was conducted to support an ecological study. Soil samples were collected from locations with a range of previous lead detections for subsequent invertebrate sampling. Thirty-one surface soil samples were collected from the first 3 inches of mineral soil and the overlying duff (decaying organic matter) and analyzed for lead. Based on results of this sampling, 15 invertebrate samples were collected and analyzed for lead. This investigation was conducted to generate ecologically based remediation goals for PAHs and lead in surface soil at the site. The results of this sampling event are presented in the Development of Ecologically Based Remediation Goals for Lead and PAHs in Soil (TtNUS, 2001b) provided in Appendix B.

- May 2003 - A supplemental sampling event was conducted to delineate the vertical extent of PAH and lead contamination and to delineate the horizontal extent of arsenic contamination. Thirty-eight surface soil samples were collected, 17 samples from 0 to 1 foot bgs and 21 samples from 1 to 2 feet bgs.

- June to August 2003 - Another supplemental sampling event was conducted to delineate the vertical extent of TRPH and lead contamination and to delineate the horizontal extent of arsenic contamination in soil. Six soil samples were collected, three samples from 0 to 1 foot bgs, one sample from 1 to 2 feet bgs, and two samples from 2 to 3 feet bgs. This investigation also included the installation of six new monitoring wells and collection of groundwater samples from these new wells and one existing well. The new monitoring wells were installed at locations where soil contaminant concentrations exceeded Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs) for leachability based on groundwater criteria. The results of this investigation were used to eliminate groundwater as a medium of concern as identified in the Groundwater Technical Memorandum for No Further Action in Appendix A.1 and in the addendum to

this report entitled Supplement to Groundwater Technical Memorandum for No Further Action provided in Appendix A.2, which specifically addresses potential arsenic contamination identified in one well due to a change in the regulatory criteria subsequent to this sampling effort.

- October 2003 - A wetland delineation study was performed to identify areas meeting the U.S. EPA and United States Army Corps of Engineers (COE) definition of wetlands under Section 404 of the Clean Water Act [33 United States Code (USC) 1344]. The delineation also identified areas meeting the definition of wetlands used by the FDEP and St. Johns River Water Management District under Chapter 62-340, F.A.C. Six areas were identified within Site 15 as meeting the U.S. EPA and COE delineation criteria. These areas were designated as Wetlands A, B, C, D, E, and F. These six areas also meet the FDEP and St. Johns River Water Management District delineation criteria. All are non-tidal, freshwater wetlands. Wetlands A, B, C, D, and E was classified as "adjacent" wetlands subject to regulation under Section 404 of the Clean Water Act. Wetland F was classified as an "isolated" wetland not under Section 404 jurisdiction. The study showed that the three larger wetlands (A, C, and D) appear to be of natural origin, providing a good habitat for terrestrial wildlife and offering substantial aesthetic and scientific value as natural features. As such, it was recommended that efforts be made to minimize disturbance of these three wetlands during any remediation at Site 15 and that they be restored following such remediation. The study also showed that three smaller wetlands (B, E, and F) appear to be of man-made origin and are clearly of lower significance with respect to wetland values and functions. Although these smaller are still subject to federal and/or state regulation, extraordinary efforts to minimize their disturbance or to restore them were not recommended. The Wetland Delineation Report (TtNUS, 2003b) is provided as Appendix C.

- Late 2003 to early 2004 - A Geostatistical Assessment Report (Newfields, 2004) was prepared for soil data to develop more accurate estimates of the areas and volumes requiring remediation based on human health and ecological criteria. This report was used to identify and delineate the following areas:

  - Areas where concentrations of lead in soil are greater than the 6,500 mg/kg acute human health toxicity criterion.

  - Areas to be excavated so that the mean soil lead concentration of any 2-acre parcel is less than the 2,512 mg/kg mammalian ecological criterion.

  - Areas to be excavated so that the site-wide 95-percent upper confidence limit (UCL) of the mean concentration of BaPEqs in post-excavation soil is less than the 2,250 µg/kg human health toxicity criterion.

- Areas where concentrations of BaPEqs in soil are greater than 6,750 µg/kg, or three times the human health toxicity criterion.

Based on the above criteria, the geostatistical assessment determined that the areas to be excavated for lead totaled 1.84 acres and those to be excavated for BaPEqs totaled 5.33 acres, with no overlap. Assuming a 1-foot excavation depth, the total excavation volume was estimated as approximately 11,600 yd^3. The assessment also concluded that Site 15 has been thoroughly sampled for both lead and BaPEqs and that available data more than adequately characterized surficial soil at the site. Because of this and also because excavated soil would be replaced with clean fill, confirmation (post-excavation) sampling would not be warranted. A copy of the Geostatistical Assessment Report is provided as Appendix D.

- January 2005 - Supplemental sampling was performed. The first objective of this sampling was to investigate the potential for dioxins [polychlorinated dibenzo-p-dioxin (PCDD)/polychlolrinated dibenzofuran (PCDF)] to be present in soil immediately beyond the proposed excavation area around the burn chamber and static rocket stand. The second objective of this sampling was to investigate the potential for perchlorate to be present in groundwater of the same area. During this investigation, two surface soil samples were collected and analyzed for dioxin, and two groundwater samples were collected from existing monitoring wells CEF-015-02S and -11S and analyzed for perchlorate. Analytical results for these samples showed no exceedances.

- August 2006 - Wells CEF-015-01S and -05S were reinstalled (as CEF-015-01SR and CEF-015-05SR, respectively) and sampled to investigate exceedances of the RDX (CEF-015-01S only) and 4,4'-DDE FDEP Groundwater Cleanup Target Levels (GCTLs) detected in 1995 in these wells, which had since been abandoned (TtNUS, 2006b). RDX and 4,4'-DDE concentrations were less than analytical detection limits (0.07 µg/L for RDX, 0.02 µg/L for 4,4'-DDE) at both locations.

- November 2005 to February 2007. Three rounds of additional groundwater sampling were performed in the vicinity of well CEF-015-13S where a filtered arsenic concentration of 13.7 µg/L had been detected in July 2003. At that time, this concentration was less than the arsenic federal Maximum Contaminant Level (MCL) and FDEP GCTL, but these criteria were subsequently revised from 50 to 10 µg/L, prompting further investigation. In addition, the groundwater sample collected from well CEF-015-13S in 2003 was very turbid, with a reading of greater than 1,000 nephelometric turbidity units (NTUs), which cast doubt on the validity of the analytical results. In November 2005, well CEF-015-15S was installed and sampled at the location of well CEF-015-13S, which had been abandoned along with the other Site 15 wells. The unfiltered arsenic concentration measured in that sample was

16.5 µg/L, which was still greater than the revised MCL and GCTL, but groundwater turbidity was again very high, measuring approximately 500 NTUs immediately before collection of the filtered sample. Well CEF-015-15S was resampled on March 15, 2006, but sample turbidity was again greater than 1,000 NTUs, and the unfiltered arsenic concentration was 14.7 µg/L. In an effort to obtain a suitable sample, a new smaller (1-inch-diameter) (direct-push technology) DPT well identified as CEF-015-13S(R) was installed a few feet away from the location of CEF-015-15S and sampled on March 21, 2006. However, a clear sample still could not be obtained, and the unfiltered arsenic concentration was 22.4 µg/L. Finally, in February 2007, a new 2-inch well identified as CEF-015-16S was installed at the same location but with a larger diameter fine sand pack (30/45) and a smaller screen slot size (0.006-inch). After several days of purging, groundwater turbidity was reduced to approximately 110 NTUs, which is still greater than what standard procedures generally identify as appropriate (10 NTUs), but the sample was relatively clear compared to the samples previously submitted. The unfiltered arsenic concentration of this sample was less than the analytical detection limit of 2.8 µg/L.

As presented in the Supplement to Groundwater Technical Memorandum for No Further Action provided in Appendix A.2, the monitoring wells installed in the CEF-015-13S area were never able to be developed to provide a representative groundwater sample due to high turbidities, and these samples should not have been submitted for analysis with turbidities in the ranges identified. The NAS Cecil Field Base Realignment and Closure (BRAC) Cleanup Team (BCT) discussed conducting additional groundwater investigation using DPT at the site; however, based on the problems with the temporary wells installed using DPT in the CEF-015-13S area, the decision to install the permanent, 2-inch well identified as CEF-015-16S was made, which did produce a more representative groundwater sample with lower turbidity.

1.3 SUMMARY OF SITE INVESTIGATION RESULTS

The analytical results obtained during the investigation of Site 15 have been organized by medium and are provided in Appendix E. The following sections provide details regarding the investigation of these media.

1.3.1 Summary of 1988 RFI Results

The one surface soil sample collected at Site 15 during the base-wide RFI contained lead and 14 PAHs at concentrations greater than detection limits. The geophysical survey identified several anomalies located along the southwestern edge of the site. The RFI identified that additional investigation of Site 15 was warranted.

1.3.2 Summary of Field Investigations

Surface soil, subsurface soil, groundwater, surface water, and sediment were collected during the screening, confirmatory, and supplemental sampling programs. As part of the OU 5 RI, assessments of contaminant fate and transport, human health risks, and ecological risks were also performed.

1.4 NATURE AND EXTENT OF CONTAMINATION

Surface soil, subsurface soil, surface water, sediment, and groundwater results will be discussed in this section, with the focus on those contaminants that determine the extent of remediation.

1.4.1 Surface Soil

During the initial field screening program, conducted from April 1994 to April 1995, a total of 409 samples were collected and analyzed on site for PAHs (U.S. EPA Method 8310), TNT (U.S. EPA Draft Method 8515), TRPH (U.S. EPA Method 418.1), and off site at a fixed-base laboratory for lead (U.S. EPA Method 6010). Only data from the samples analyzed at the fixed-base laboratory are included in tables. All of the samples collected during the subsequent confirmatory and supplemental sampling programs were analyzed off site at a fixed-base laboratory.

During various sampling events at Site 15, a total of 783 surface soil samples were collected and analyzed for a variety of constituents. Tables 1-1 and 1-2 summarize the frequencies of detection, concentration ranges, and cleanup goals for organics and inorganics, respectively, in surface soil. Only constituents detected at least once in screening, confirmatory, or post-RI sampling of surface soil at Site 15 are presented in these tables. The cleanup goals presented are the most restrictive of the FDEP residential direct exposure or leachability to groundwater SCTLs. The NAS Cecil Field Inorganic Background Data Set (IBDS) concentrations are also shown in Table 1-2 for inorganics (HLA, 1998a).

During the field screening, confirmatory sampling, and supplemental sampling programs, lead was detected in 555 of 584 samples at concentrations ranging from 1.1 to 65,500 mg/kg. Maximum concentrations were detected downrange of the trap and skeet field and approximately 750 feet north of the ordnance disposal areas. Lead concentrations greater than the U.S. EPA recommended lead screening criterion and FDEP SCTL of 400 mg/kg were distributed over a wide area associated with the trap and skeet range.

During the field screening program, PAHs were detected in 171 of 263 samples at concentrations ranging from 0.2 to 13,000 mg/kg (expressed as total PAHs). These results indicated a widespread distribution of PAHs, with the greatest concentrations in samples collected in the burn chamber and blast platform area

and in the forest burn area. TNT was detected during the field screening program in 30 of 146 samples at concentrations ranging from 1.0 to 68 mg/kg. TNT was not detected during the confirmatory sampling program. The greatest concentrations of TNT were detected about 100 feet north of the burn chamber and blast platform areas. TRPH was detected in 26 of 136 field screening samples at concentrations ranging from 10 to 430 mg/kg. Maximum concentrations of TRPH were detected along the southwestern side of the former trap and skeet range.

The confirmatory and supplemental sampling programs verified that surface soil contamination at the site is generally continuous and widespread, covering an area of approximately 75 acres, with discrete areas of greater concentrations not always coincident for each of the contaminants.

During the field screening, confirmatory sampling, and supplemental sampling programs, the following organics were detected in surface soil samples from Site 15:

- VOCs – acetone and xylenes.
- Nitroaromatics – 3-nitrotoluene, 4-nitrotoluene, and cyclotetramethylenetetranitramine (HMX), and TNT.
- Pesticides – 4,4' DDE, 4,4'-DDT, dieldrin, Endosulfan II, endrin aldehyde, and methoxychlor.
- Semivolatile organic compounds (SVOCs) – 18 PAHs, three phthalates, carbazole, and dibenzofuran.
- TRPH.

Twenty-three inorganics were also detected in surface soil samples from Site 15.

Organic compounds detected at concentrations greater than SCTLs included the following:

- Benzo(a)pyrene equivalents (BaPEqs) – greater than the benzo(a)pyrene residential SCTL
- Fourteen PAHs – greater than leachability SCTLs
- Carbazole, dieldrin, 3-nitrotoluene, 4-nitrotoulene – greater than leachability SCTLs
- TRPH – greater than leachability SCTLs

Inorganics detected at concentrations greater than SCTLs and IBDS values include antimony, arsenic, and lead.

Soil samples collected in February 1997 were used to evaluate the leachability of lead and particulate distribution characteristics of lead contamination at the site. The results of this sampling effort indicated that most of the lead shot at the site had been oxidized and by that time was associated with medium- to fine-grained sand, with smaller amounts associated with silt and clay soil fractions. As a result, there

would be little benefit in sieving out the remaining lead shot from Site 15 soil. The data also showed that, although lead concentrations decreased with depth, decreases were not significant enough to warrant remediation to a depth of less than 1 foot. Finally, based on the results of lead TCLP data, soil samples containing lead concentrations greater than 700 mg/kg generally failed to meet the TCLP lead regulatory level of 5.0 milligrams per liter for classifying potential solid waste (excavated contaminated soil) as hazardous waste (ABB-ES, 1998). Prior to off-site disposal, the soil being excavated for lead contamination would be tested for leachability characteristics to determine proper classification. Of the 2,788 yd^3 of soil in the area delineated with lead concentrations exceeding 6,500 mg/kg, it is estimated that only approximately 25 percent or 700 yd^3 would fail TCLP testing after the material was consolidated. This assumption is based on the variability of the analytical results obtained and consolidation of material in stockpiles prior to disposal.

1.4.2 Subsurface Soil

During various investigations at Site 15, a total of 45 subsurface soil samples were collected and analyzed for a variety of constituents. Tables 1-3 and 1-4 summarize the frequencies of detection, concentration ranges, and cleanup goals (the most restrictive of the residential direct exposure and leachability to groundwater SCTLs) for organics and inorganics, respectively, detected at least once during screening, confirmatory, or supplemental sampling of subsurface soil at Site 15. IBDS concentrations are also shown in Table 1-4 for inorganics. Only results for samples analyzed at fixed-base laboratories are included in these tables.

Total PAHs were detected in 30 of 37 subsurface soil samples, with concentrations ranging from 1.5 to 366 mg/kg to a depth of 7 feet bgs. Generally, PAH concentrations decreased with depth. TRPH was detected in 11 of 17 subsurface samples collected, with concentrations ranging from 9.74 mg/kg to 103 mg/kg. Lead was detected in 17 of 19 samples to a depth of 7 feet bgs. Subsurface lead concentrations ranging from 1.1 to 223 mg/kg and were generally several orders of magnitude less than concentrations in corresponding surface soil samples.

Organics detected in subsurface soils at Site 15 included the following:

- VOCs – acetone and xylenes
- SVOCs – 16 PAHs, three phthalates, carbazole, and dibenzofuran
- TRPH

Thirteen inorganics were also detected in subsurface soil samples from Site 15.

Organic compounds detected in subsurface soil samples at concentrations greater than SCTLs included the following:

- BaPEqs – greater than the benzo(a)pyrene residential SCTL
- Six PAHs and carbazole – greater than leachability SCTLs

No inorganics were detected in subsurface soil samples at concentrations greater than SCTLs and IBDS values.

1.4.3 Groundwater

Table 1-5 summarizes the frequencies of detection, concentration ranges, FDEP GCTLs, U.S. EPA MCLs, and background screening concentrations for organic and inorganic analytes detected during groundwater sampling. Because bis-(2-ethylhexyl) phthalate (BEHP) is a common laboratory and field equipment contaminant, its detection at concentrations greater than the GCTL was determined not to be of concern. Aluminum was detected at concentrations greater than its GCTL but less than its IBDS value. Total arsenic concentrations in groundwater exceeded the FDEP GCTL, U.S. EPA MCL, and IBDS value. One exceedance of the 4,4'-DDE GCTL (0.26 µg/L at CEF-015-05S) and two exceedances of the RDX GCTL (0.451 µg/L at CEF-015-01S and 0.404 µg/L at CEF-015-05S) were also detected in 1995 but were not confirmed by the results of the resampling conducted in August 2006 in new wells installed at the same locations. Resampling results showed concentrations of 4,4'-DDE and RDX to be less than their respective analytical detection limits of 0.02 µg/L and 0.07 µg/L. One exceedance of the arsenic MCL and GCTL (13.7 µg/L at CEF-015-13S) was detected in July 2003 from a groundwater sample identified as having very high turbidity (greater than 1,000 NTUs). Although this exceedance was confirmed in November 2005 (16.5 µg/L at reinstalled CEF-015-13S) and in March 2006 (14.7 µg/L at reinstalled CEF-015-13S and 21.6 µg/L at new CEF-015-15S installed at same location), it was determined that the very high sample turbidities (up to 1,000 NTUs) observed in all of the collected samples were causing the elevated arsenic concentrations. All of the filtered samples had arsenic concentrations less than the FDEP GCTL and U.S. EPA MCL. Because of the high turbidities in the groundwater samples, the wells were not considered adequate to provide a representative sample from the aquifer. A third well, CEF-015-16S, was installed at the same location in February 2007. This monitoring well was a 2-inch well with a larger diameter and fine sand pack. Additionally, this well was purged for several days until the groundwater was relatively clear. The turbidity recorded prior to sample collection was reported as 110 NTUs. The unfiltered arsenic concentration detected in this last sample was less than the analytical detection limit of 2.8 µg/L, which is also less than the MCL and GCTL.

1.4.4 Sediment

Table 1-6 summarizes the frequencies of detection and the ranges of concentrations for analytes detected during confirmatory and supplemental sampling of Site 15 sediments. FDEP guidelines for the protection of freshwater sediment organisms are shown in Table 1-6. Because the ditches are typically dry and provide no permanent aquatic habitat, the table also includes FDEP SCTLs and IBDS concentrations. Sediment samples collected during the supplemental sampling program were collected in drainage ditches that are typically dry and contain water only intermittently after rain events (surface water samples could not be collected during the supplemental sampling program due to the lack of surface water in the ditches). One VOC, several SVOCs (including one phthalate, carbazole, and 16 PAHs), one nitroaromatic, four pesticides, TRPH, and eightl inorganics were detected in sediment samples collected from the two ditches at Site 15. Maximum concentrations of 11 PAHs exceeded their respective probable effects concentrations (PECs). Maximum concentrations of three pesticides (4,4'-DDD, 4,4'-DDE, and 4,4' DDT) were greater than their respective threshold effects concentrations (TECs) but less than their respective PECs. Concentrations of these pesticides detected in Site 15 ditches were comparable to those detected at other Cecil Field locations and therefore it is probable that they are the result of previous base-wide applications for pest control. Lead was the only inorganic analyte detected at concentrations exceeding its TEC, and lead concentrations in some samples also exceeded the PEC.

1.4.5 Surface Water

Table 1-6 summarizes the frequencies of detection, concentration ranges, and Florida Water Quality Criteria for organics and inorganics detected during confirmatory sampling of surface water at Site 15. IBDS concentrations are also shown in Table 1-5 for inorganics. No VOCs or pesticides were detected in the three surface water samples analyzed for these constituents. Four nitroaromatics (1,3,5-trinitrobenzene, 3-nitrotoluene, 4-nitrotoluene, and tetryl), TRPH, and 11 inorganics were detected in surface water samples at Site 15. Arsenic, which was present in all three samples in which it was analyzed, was detected at concentrations less than Florida surface water standards but greater than the IBDS value. Lead, which was present in all seven samples in which it was analyzed, and aluminum and iron, which were present in all three samples in which they were analyzed, were detected at concentrations less than the IBDS value but greater than Florida surface water standards. The concentration of copper (only one detected value) slightly exceeded the surface water standard. In general, the maximum concentrations of these metals occurred in the surface water sample collected approximately 1,700 feet south of the ordnance disposal area.

1.5 PRELIMINARY RISK EVALUATION

The objective of a human health risk assessment is to characterize the risks associated with potential exposures to site-related constituents. As part of this FS, a human health Preliminary Risk Evaluation (PRE) was conducted. The PRE is a screening-level evaluation of potential risks from site constituents to human receptors at the site. Although a site may have numerous hypothetical receptors, it is common to use the most sensitive receptor as a site-screening tool for risk calculations. For Site 15, the protection of a hypothetical future residential receptor formed the basis for selecting chemicals of potential concern (COPCs) and for determining if potential risks at the site are significant.

1.5.1 Selection of Chemicals of Potential Concern

In the first step of the PRE, COPCs were selected for each medium. COPCs are potentially site related and have maximum detected concentrations greater than the lesser of the medium-specific FDEP Cleanup Target Levels (FDEP, 2005). Metals are regarded as COPCs if their concentrations are greater than background screening concentrations (IBDS values) and the lesser of the medium-specific FDEP Cleanup Target Levels.

1.5.1.1 Surface Soil

To select COPCs in surface soil at Site 15, maximum detected concentrations of site constituents were compared to FDEP SCTLs for residential exposure and leachability (FDEP, 2005). For metals, the maximum concentrations were also compared to NAS Cecil Field IBDS values (HLA, 1998a). The data for surface soil are summarized in Tables 1-1 and 1-2. Table 1-8 includes the surface soil COPCs that were detected at concentrations greater than screening criteria.

No VOCs were detected In surface soil at Site 15 at concentrations greater than FDEP residential or leachability criteria. BaPEqs were identified as COPCs based on exceedances of the residential SCTL, and TRPH was identified as a COPC based on exceedances of leachability SCTLs. Antimony was identified as a COPC based on exceedances of residential and leachability SCTLs and its IBDS value. Arsenic and lead were identified as COPCs based on exceedances of residential SCTLs and IBDS values. Fourteen PAHs and carbazole were identified as COPCs in surface soil based on exceedances of leachability SCTLs (see Table 1-8).

The maximum detected concentrations of 3-nitrotoluene, 4-nitrotoluene, and dieldrin exceeded their leachability SCTLs, but these compounds were detected in less than 5 percent of the samples collected. Therefore, they are not considered COPCs based on their frequency of detection.

1.5.1.2 Subsurface Soil

To select COPCs in subsurface soil at Site 15, maximum detected concentrations of site constituents were compared to the same criteria as for surface soils, FDEP SCTLs for residential exposure and leachability and IBDS values for inorganics. The data for subsurface soil are summarized in Tables 1-3 and 1-4. Table 1-9 includes the COPCs detected at concentrations greater than screening criteria.

In subsurface soil at Site 15, only SVOCs were identified as COPCs. BaPEq concentrations exceeded the residential SCTL, and six PAHs and carbazole were identified as COPCs in subsurface soil based on exceedances of leachability SCTLs.

1.5.1.3 Groundwater

To select COPCs in groundwater at Site 15, maximum detected concentrations of site constituents were compared to FDEP GCTLs (FDEP, 2005), U.S. EPA MCLs (U.S. EPA, 2002), and NAS Cecil Field-specific IBDS values for inorganics (HLA, 1998a). The results of these comparisons are summarized in Table 1-5, which shows that none of the detected concentrations from samples identified as representative of the aquifer at Site 15 exceeded the screening criteria. Therefore, no groundwater COPCs were retained.

1.5.1.4 Sediment

To select COPCs in sediment at Site 15, maximum detected concentrations of site constituents were compared to FDEP SCTLs (FDEP, 2005) for residential exposure and to IBDS values for inorganics. The data for sediment are summarized in Table 1-6. Table 1-10 includes COPCs detected in sediment at concentrations greater than FDEP SCTLs.

In sediment at Site 15, BaPEq concentrations were greater than the residential SCTL, and the following were identified as COPCs based on exceedances of leachability SCTLs:

- 1-Methylnaphthalene
- Acenaphthene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoroanthene
- Dibenzo(a,h)anthracene
- 4-Nitrotoluene

Lead was also identified as a COPC based on exceedances of its residential SCTL and IBDS value.

1.5.1.5 Surface Water

To select COPCs in surface water at Site 15, maximum detected concentrations of site constituents were compared to FDEP freshwater surface water criteria (FDEP, 2005), and to IBDS values for inorganics. The data for surface water are summarized in Table 1-5. Table 1-11 includes COPCs detected at concentrations greater than their respective FDEP surface water criteria.

Lead was the only constituent identified as a COPC in surface water. Copper was detected at a concentration of 9 µg/L in one sample, which marginally exceeds the FDEP surface water criterion of 8.7 µg/L; therefore, it is not regarded as a COPC.

1.5.2 Risk Characterization

The risk characterization step of the PRE is conducted by generating a ratio between the exposure concentration and the appropriate screening value. For residential exposure, the exposure concentration is represented by the maximum detected concentration of the analyte. For industrial exposure, the exposure concentration is represented by the lesser of the 95-percent UCL of the mean or the maximum detected concentration (except for lead, see below). The maximum concentration is used for residential exposure because the exposure unit area for a residential site is typically expected to be less than 1 acre. Because industrial exposure may occur acress the entire site, the UCL of the mean is generally used to represent industrial exposure. If the UCL exceeded the maximum detected concentration of a constituent, the maximum detected concentration was used as the industrial exposure concentration. UCLs of the mean were calculated using the Florida UCL (FL-UCL) tool. The statistical output of FL-UCL is presented in Appendix D.

In assessing risk for residential exposure to lead, the maximum detected concentration was compared to the residential SCTL. In assessing risk for industrial exposure to lead, the average concentration was compared to the industrial SCTL. The average concentration for lead was used because this is the input value for U.S. EPA's Adult Lead Model (U.S. EPA, 1996).

For soil and sediment, residential and industrial SCTLs correspond to a carcinogenic risk of 1×10^{-6} and a hazard quotient (HQ) of 1.0 for carcinogens and non-carcinogens, respectively. Therefore, the ratio of the exposure concentration and the SCTL provides an indication of the total carcinogenic and non-carcinogenic risk associated with each constituent. For example, a ratio of 3 for a carcinogen indicates that the risk associated with that constituent is equivalent to 3×10^{-6}. This risk exceeds Florida's action level of 1×10^{-6} but is within the U.S. EPA target risk range of 1×10^{-4} to 1×10^{-6}. A ratio of 3 for a

noncarcinogen indicates that the HQ is greater than 1, and there is a potential for non-carcinogenic effects upon exposure to that concentration. Also, comparisons of metals concentrations to NAS Cecil Field IBDS values (HLA, 1988a) were used to identify whether the data were truly site related.

For soil, leachability SCTLs correspond to levels protective of groundwater. Comparison to these levels are only relevant if groundwater data indicate that the constituent is present in groundwater at the site. Leachability criteria are based on conservative assumptions regarding site conditions. Therefore, the absence of a constituent's detection in groundwater in conjunction with an exceedance of its leachability SCTL is sufficient evidence that site-specific conditions do not favor leaching.

Based on FDEP guidance (FDEP, 2005), concentrations of carcinogenic PAHs (cPAHs) were converted to BaPEq concentrations and compared to benzo(a)pyrene SCTLs for direct exposure (residential and industrial). Leachability SCTLs are available for individual cPAHs. If a specific cPAH was not detected in a sample, one-half of its detection limit was used in the calculation of BaPEqs. If no cPAHs were detected in a sample, one-half of the benzo(a)pyrene detection limit was used as the BaPEq concentration. Non-carcinogenic PAH results were compared to individual FDEP SCTLs for direct exposure and leachability to groundwater.

For surface soil, BaPEqs and arsenic were the carcinogens detected at maximum concentrations greater than residential SCTLs. Together, the potential carcinogenic risk estimated for the maximum detected concentrations of these constituents was 9.8×10^{-3} for potential future residents. This exceeds the FDEP's target risk and U.S. EPA target risk range. Using the UCL concentrations for these constituents, the potential carcinogenic risk for industrial exposure is 5.0×10^{-5} (Table 1-12). This exceeds FDEP's target risk but is within U.S. EPA's target risk range. For surface soil, TRPH and antimony were the non-carcinogens detected at maximum concentrations greater than residential SCTLs. Together, the HQ estimated for the maximum detected concentrations of these constituents is 91.4. This exceeds the FDEP and U.S. EPA target HQ of 1.0. Using the UCL concentrations for these constituents, the potential HQ for industrial exposure is 0.98 (Table 1-12), which is less than the target HQ. With regard to exposure to lead, the maximum lead concentration exceeded the residential SCTL, but the average concentration was less than the industrial SCTL.

For surface soil, acenaphthene, fluoranthene, naphthalene, phenanthrene, pyrene, 1-methylnaphthalene 2 methylnaphthalene, and TRPH concentrations exceeded leachability SCTLs. However, these constituents were not detected in groundwater at the site; therefore, they would not be expected to pose any adverse impact to human health.

For subsurface soil, BaPEqs was the carcinogen detected at maximum concentrations greater than its residential SCTL. The potential carcinogenic risk estimated for the maximum detected concentration of BaPEqs was 4.9 x 10^{-4} for potential future residents. This exceeds the target risk for FDEP and U.S. EPA. Using the UCL concentration of BaPEqs, the potential carcinogenic risk for industrial exposure is 7.4 x 10^{-6} (Table 1-13). This exceeds the target risk for FDEP but is within U.S. EPA's target risk range.

For groundwater, no chemicals were detected at concentrations greater than their MCL or GCTL. Therefore, no unacceptable human health risk is associated with groundwater.

For sediment, exposure is treated in a manner similar to soil because sediments at the site are typically dry. BaPEqs was the carcinogen detected at maximum concentrations greater than its residential SCTL in sediment. The potential carcinogenic risk estimated for the maximum detected concentration of BaPEqs was 3.1 x 10^{-4} for potential future residents. This exceeds FDEP's target risk and U.S. EPA's target risk range. Using the UCL concentrations for BaPEqs, the potential carcinogenic risk for industrial exposure was 4.4 x 10^{-5} (Table 1-14). This exceeds the target risk for FDEP but is within the target risk range for U.S. EPA. With regard to exposure to lead, the maximum lead concentration exceeded the residential SCTL, but the average concentration was less than the industrial SCTL.

In surface water, lead was detected at concentrations greater than its FDEP surface water cleanup target level. However, the presence of surface water at the site is intermittent, and surface water contamination would not be regarded as posing a significant risk to human health.

1.5.3 Summary of Ecological Risk Assessment

An ecological risk assessment (ERA) for Site 15 was conducted by ABB-ES as part of OU 5 RI and was based on data from surface soil, sediment, and surface water samples collected in 1995 and 1997 (ABB-ES, 1997). Chemical concentrations in each of these media were compared to ecological screening values. In addition, the ERA evaluated risks to upper-level receptors by estimating doses for representative wildlife receptors and comparing the doses to literature-derived toxicity reference values. The ERA also incorporated soil toxicity tests using laboratory-reared earthworms (*Eisenia foetida*) and lettuce seed (*Lactuca sativa*). The initial ERA represents Step 1 (Screening Level Problem Formulation and Ecological Effects Evaluation) and Step 2 (Screening Level Exposure Estimate and Risk Calculation) of U.S. EPA's eight-step process for designing and conducting ERAs. The ERA concluded that potential risks to ecological receptors existed at the site, due primarily to lead and PAHs in soil. The ERA also concluded that potential risks to some ecological receptors might exist due to aluminum, antimony, and arsenic in soil; lead, PAHs, DDT, and its breakdown products in sediment; and lead in surface water. Subsequent to the initial ERA, several additional sampling events were conducted to further characterize locations of elevated concentrations of lead and PAHs in soil at the site. The results of the additional

sampling were used to develop a draft Work Plan and Sampling and Analysis Plan, which were completed in March 2001. These plans represent Step 3 (Baseline Risk Assessment Problem Formulation) and Step 4 (Study Design and Data Quality Objective Process) of the eight-step process. Step 5 (Field Verification of Sampling Design) was conducted on May 3, 2001. The Work Plan and the Sampling and Analysis Plan were finalized on June 12, 2001 (TtNUS, 2001a). The field sampling component of Step 6 (Site Investigation and Data Analysis) was conducted from June 18 to 28, 2001. The development of remediation goals for the protection of ecological receptors is described in the document Ecologically Based Remediation Goals for Lead and PAHs in Soil, which is included in this report as Appendix B and represents the remainder of Step 6 (Data Analysis) and Step 7 (Risk Characterization). The methodologies through which the ecological cleanup goals were developed have been approved by representatives of the Navy, U.S. EPA Region 4, and FDEP. Subsections 1.5.3.1, 1.5.3.2, 1.5.3.3, and 1.5.3.4 below discuss ecological risk associated with Site 15 surface soil, groundwater, sediment, and surface water, respectively.

1.5.3.1 Surface Soil

There was a moderate correlation ($r^2 = 0.79$) between aluminum concentrations and earthworm growth in toxicity tests, suggesting that aluminum in surface soil might pose risks to soil invertebrates (ABB-ES, 1997). However, statistical analyses showed that aluminum concentrations in Site 15 samples were not significantly different than aluminum concentrations in background samples (ABB-ES, 1997). Aluminum concentrations at Site 15 (88 to 7,140 mg/kg, average of 1,190 mg/kg) exceeded the Cecil Field IBDS value (4,430 mg/kg) in only 2 of 35 samples. Furthermore, earthworm 30-day survival rates in toxicity tests were not correlated with aluminum concentrations, and lettuce seed germination tests showed no adverse impacts associated with aluminum. As indicated in the 1997 ERA, aluminum would not be expected to be related to past activities at the site. Aluminum does not significantly bioaccumulate or biomagnify, and food-chain modeling showed that aluminum concentrations at Site 15 do not pose potential risks to upper-level terrestrial or aquatic receptors. Overall, ecological risk posed by aluminum was concluded to be negligible.

Toxicity data for antimony are sparse, resulting in uncertainty regarding potential toxicity at Site 15. However, antimony does not significantly bioaccumulate or biomagnify, thus it would not pose potential risks to upper-level receptors. This conclusion was supported by food-chain modeling, which showed that antimony concentrations at Site 15 do not pose potential risk to upper-level terrestrial or aquatic receptors (ABB-ES, 1997). Lettuce seed germination tests conducted in support of the 1997 ERA showed poor germination in only one sample, and antimony concentrations were lower in this sample than in other samples for which no adverse effects were observed. Thus, the germination tests did not show phytotoxic effects from antimony. In summary, although potential risk to soil invertebrates from antimony was uncertain based on the 1997 earthworm toxicity tests, the germination tests did not show phytotoxic

effects from antimony. In addition, food-chain modeling showed that antimony did not pose potential risks to upper-level terrestrial or aquatic receptors. Overall risk posed by antimony appears to be negligible or minor at worst.

Arsenic was detected in 26 of 44 samples, and concentrations exceeded the U.S. EPA Region 4 ecological screening value (10 mg/kg based on plant toxicity) in 11 samples. However, lettuce seed germination tests showed poor germination in only one sample, and concentrations were lower in this sample than in other samples for which no adverse effects were observed (ABB-ES, 1997). Thus, the site-specific germination tests did not show phytotoxic effects from arsenic. Arsenic concentrations were not correlated with earthworm toxicity test results (ABB-ES, 1997). Nevertheless, arsenic can potentially be toxic to soil invertebrates at concentrations of 60 mg/kg or greater (Efroymson et al, 1997). Arsenic concentrations exceeded 60 mg/kg in two samples (451 and 96.5 mg/kg), thus arsenic could pose risk to soil invertebrates in the vicinity of these two samples (CF15SS015 and CF15SS055). Food-chain modeling indicated that arsenic might pose risk to small birds; however, associated HQs were relatively low. The maximum HQ was only 3.0 using a conservative area use factor of 100 percent (ABB-ES, 1997), which assumes that birds forage only in the vicinity of the maximum arsenic concentration. In summary, lettuce germination tests indicated negligible risk to plants. Potential risk to soil invertebrates and upper-level receptors such as birds exists only in the vicinity of two samples.

See Appendix B for an evaluation of ecological risks posed by lead and PAHs in surface soil.

1.5.3.2 Groundwater

Ecological risks associated with groundwater were not evaluated during the ERA. The pathways of groundwater exposure to ecological receptors are limited to the two ditches where sediment and surface water samples were collected. The two ditches are typically dry, except in the vicinity of the culvert under the access road into the site. The ditches provide no permanent habitat for aquatic communities.

1.5.3.3 Sediment

The 1997 ERA concluded that potential risks to some ecological receptors might exist due to lead, PAHs, DDT, and DDT breakdown products in sediment. The ditches from which sediment samples were collected include one in the northwestern portion of the site and one in the southern portion of the site. The northwestern ditch is typically dry, but the southern ditch often contains shallow standing water in the vicinity of the culvert under the access road into the site. The ditches provide no permanent habitat for aquatic communities, and the samples actually represent “damp soil” rather than sediment. Therefore, potential risk from lead and PAHs associated with the 13 sediment samples was evaluated as part of the assessment of soil data (see Appendix B).

Maximum concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT slightly exceeded their respective FDEP TECs for inland sediments but were less than their respective PECs. Food-chain modeling conducted during the 1997 ERA showed that these compounds did not pose potential risks to upper-level terrestrial or aquatic receptors. Concentrations of these pesticides detected in Site 15 ditches were comparable to those detected at other Cecil Field locations, and it is likely that they are the result of previous base-wide applications for pest control. Site-related risk from 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT appears to be negligible.

1.5.3.4 Surface Water

The 1997 ERA concluded that potential risks to some ecological receptors might exist due to lead in surface water. The surface water samples were collected from the same two ditches as the sediment samples. Lead concentrations in some surface water samples were elevated relative to ecological guidelines, but as mentioned above, the two ditches are typically dry except in the vicinity of the culvert under the access road into the site. The ditches provide no permanent habitat for aquatic communities. Lead-related risk has been investigated in other studies at NAS Cecil Field and appears to be negligible in water bodies into which these ditches drain. There are no other surface water bodies at Site 15.

1.5.3.5 Ecological Risk Conclusions

Based on the results of the ERA and subsequent associated evaluations, the NAS Cecil Field Base BCT (composed of representatives from the Navy, U.S. EPA Region 4, and FDEP) concluded that ecological COPCs at Site 15 were limited to lead, PAHs, and arsenic in surface soil.

TABLE 1-1

SUMMARY OF ORGANICS DETECTED IN SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection	Range of Detections	FDEP Soil Cleanup Target Levels [1]	
			Residential	Leachability
Volatile Organic Compounds, mg/kg				
Acetone	1/36	0.006	11,000	25
Xylenes, total	1/44	0.002	130	0.2
Semivolatile Organic Compounds, mg/kg				
1-Methylnaphthalene	15/78	0.057 - 168	200	3.1
2-Methylnaphthalene	29/128	0.022 - 204	210	8.5
Acenaphthene	67/400	0.031 - 410	2,400	2.1
Acenaphthylene	24/400	0.0423 - 17	1,800	27
Anthracene	88/400	0.0068 - 110	21,000	2,500
Benzo(a)anthracene	177/400	0.0058 - 1,300	#	0.8
Benzo(a)pyrene	171/400	0.0066 - 1,100	0.1	8
Benzo(b)fluoranthene	179/400	0.0079 - 1,300	#	2.4
Benzo(g,h,i)perylene	122/400	0.0074 - 820	2,500	32,000
Benzo(k)fluoranthene	150/400	0.0069 - 1,500	#	24
bis(2-Ethylhexyl) phthalate	12/44	0.021 - 0.52	72	3,600
Butylbenzylphthalate	10/44	0.082 - 0.44	17,000	310
Carbazole	15/44	0.021 - 43	49	0.2
Chrysene	195/400	0.0138 - 1,700	#	77
Dibenzo(a,h)anthracene	60/400	0.0216 - 140	#	0.7
Dibenzofuran	8/44	0.035 - 8	320	15
Di-n-butylphthalate	33/44	0.061 - 6.7	7,300	47
Fluoranthene	205/400	0.008 - 2,000	3,200	1,200
Fluorene	40/400	0.043 - 58	2,600	160
Indeno(1,2,3-cd)pyrene	113/400	0.0054 - 560	#	6.6
Naphthalene	44/400	0.024 - 17	55	1.2
Phenanthrene	154/400	0.0056 - 600	2,200	250
Pyrene	198/400	0.0085 - 1,800	2,400	880
BaPEqs	400/400	0.0026 - 956	0.1	NC
Pesticides/Herbicides, mg/kg				
4,4'-DDE	3/41	0.00016 - 0.0013	2.9	18
4,4'-DDT	3/41	0.00069 - 0.021	2.9	11
Dieldrin	1/41	0.00037 - 0.024	0.06	0.002
Endosulfan II	3/41	0.00014 - 0.0019	450	3.8
Endrin aldehyde	1/41	0.0027	NC	NC
Methoxychlor	1/41	0.049	420	160
Nitroaromatic Compounds, mg/kg				
HMX[2]	1/38	3.001	NC	NC
3-Nitrotoluene	1/38	5.08	400	0.9
4-Nitrotoluene	2/38	1.17 - 4.34	640	1.4
Miscellaneous Parameters, mg/kg				
TRPH	33/40	9.74 - 450	460	340

1 - Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs), Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
2 - Cyclotetramethylenetetranitramine.
NC - No criterion.
TRPH - Total recoverable petroleum hydrocarbons.
BaPEqs - Benzo(a)pyrene equivalents.
= Based on Chapter 62-777, F.A.C., site concentrations of carginogenic polynuclear aromatic hydrocarbons (PAHs) are converted to BaPEqs before comparison to benzo(a)pyrene (BaP) SCTLs.
** = One-half of the BaP detection limit was used as the BaPEq concentration if no carcinogenic PAHs were detected in a sample.

TABLE 1-2

SUMMARY OF INORGANICS DETECTED IN SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection	Range of Detections	FDEP Soil Cleanup Target Levels (1)		Background Screening Concentration (2)
			Residential	Leachability	
Inorganic Analytes, mg/kg					
Aluminum	39/40	29.4 - 7,140	80,000	***	4,430
Antimony	30/56	0.46 - 2,440	27	0.03	9.44
Arsenic	41/69	0.91 - 451	2.1	***	2.04
Barium	38/40	0.88 - 107	120**	1,600	14.4
Cadmium	7/40	0.3 - 2.4	82	7.5	1.72
Calcium	31/40	38.3 - 102,000	NC	NC	9.44
Chromium	10/40	0.45 - 26.9	210	38	7.75
Cobalt	7/40	0.22 - 1.8	1,700	***	3.11
Copper	14/40	0.835 - 21.2	150**	***	5.97
Iron	38/40	57.5 - 1,340	53,000	***	1,490
Lead	555/584	1.1 - 65,500	400	***	197
Magnesium	15/40	51.5 - 631	NC	NC	329
Manganese	28/40	0.45 - 32.2	3,500	***	22.0
Mercury	4/39	0.09 - 0.8	3.0	2.1	0.16
Nickel	11/40	0.69 - 2.2	340**	130	3.89
Potassium	18/40	21.7 - 2,130	NC	NC	102
Selenium	6/40	0.88 - 1.7	440	5.2	1.68
Silver	4/40	0.61 - 5.3	410	17	2.13
Sodium	18/40	118 - 1,370	NC	NC	343
Thallium	1/40	0.45	NC	NC	2.84
Vanadium	32/40	0.28 - 5.2	67	980	6.3
Zinc	7/40	20.3 - 57.5	26,000	***	37.0
Cyanide	3/34	0.2 - 0.27	34**	0.8	1.19

1 - Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs), Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
2 - NAS Cecil Field Inorganic Background Data Set (HLA, 1998a).
NC - No criterion.
** - Direct exposure value based on acute toxicity considerations. The criterion is applicable in scenarios where children must be exposed to soils (e.g., residences, schools, playgrounds).
*** - Leachability values may be derived using SPLP Test to calculate site-specific SCTLs or may be determined using TCLP in the event oily wastes are present.

TABLE 1-3

SUMMARY OF ORGANICS DETECTED IN SUBSURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection	Range of Detections	FDEP Soil Cleanup Target Levels (1)	
			Residential	Leachability
Volatile Organic Compounds, mg/kg				
Acetone	2/12	0.009 - 0.013	11,000	25
Xylenes, total	3/23	0.003 - 0.004	130	0.2
Semivolatile Organic Compounds, mg/kg				
2-Methylnaphthalene	2/37	0.051 - 0.11	210	8.5
Acenaphthene	12/49	0.35 - 22	2,400	2.1
Anthracene	13/49	0.032 - 8.2	21,000	2,500
Benzo(a)anthracene	21/49	0.03 - 34	#	0.8
Benzo(a)pyrene	32/49	0.035 - 33	0.1	8
Benzo(b)fluoranthene	33/49	0.042 - 47	#	2.4
Benzo(g,h,i)perylene	21/49	0.034 - 14	2,500	32,000
Benzo(k)fluoranthene	26/49	0.03 - 21	#	24
bis(2-Ethylhexyl) phthalate	2/16	0.052 - 0.053	72	3,600
Butylbenzylphthalate	1/16	0.056	17,000	310
Carbazole	6/16	0.027 - 4.3	49	0.2
Chrysene	20/49	0.04 - 38	#	77
Dibenzo(a,h)anthracene	12/49	0.022 - 5.2	#	0.7
Dibenzofuran	2/16	0.085 - 0.46	320	15
Di-n-butylphthalate	11/16	0.099 - 5.6	7,300	47
Fluoranthene	32/49	0.039 - 61	3,200	1,200
Fluorene	3/49	0.11 - 1.1	2,600	160
Indeno(1,2,3-cd)pyrene	22/49	0.024 - 13	#	6.6
Naphthalene	6/49	0.064 - 1.1	55	1.2
Phenanthrene	26/49	0.033 - 27	2,200	250
Pyrene	31/49	0.041 - 51	2,400	880
BaPEqs	49/49	0.009 - 46	0.1	NC
Miscellaneous Parameters, mg/kg				
TRPH	11/17	9.74 - 103	460	340

1 - Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs), Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
NC - No criterion.
TRPH - Total recoverable petroleum hydrocarbons.
BaPEqs - Benzo(a)pyrene equivalents.
= Based on Chapter 62-777, F.A.C., site concentrations of carginogenic polynuclear aromatic hydrocarbons (PAHs) are converted to BaPEqs before comparison to benzo(a)pyrene (BaP) SCTLs.
** = One-half of the BaP detection limit was used as the BaPEq concentration if no carcinogenic PAHs were detected in a sample.

TABLE 1-4

SUMMARY OF INORGANICS DETECTED IN SUBSURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection	Range of Detections	FDEP Soil Cleanup Target Levels (1)		Background Screening Concentration (3)
			Residential	Leachability	
Inorganic Analytes, mg/kg					
Aluminum	12/12	224 - 2,360	80,000	***	4,430
Antimony	4/12	0.93 - 4.2	27	0	9.44
Barium	11/12	0.75 - 17.4	120**	1,600	14.4
Calcium	9/12	62.7 - 2,510	NC	NC	9.44
Chromium	3/12	1.9 - 2.7	210.0	38	7.75
Cobalt	1/12	0.35	1,700	***	3.11
Iron	12/12	66.6 - 298	53,000	***	1,490
Lead	17/19	1.1 - 223	400	***	197
Manganese	8/12	0.82 - 3	3,500	***	22.0
Nickel	8/12	0.73 - 1.4	340**	130	3.89
Potassium	2/12	22.7 - 27.6	NC	NC	102
Sodium	3/12	156 - 251	NC	NC	343
Vanadium	12/12	0.49 - 2.2	67	980	6.30

1 - Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs), Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
2 - NAS Cecil Field Inorganic Background Data Set (HLA, 1998).
NC - No criterion.
** - Direct exposure value based on acute toxicity considerations. The criterion is applicable in scenarios where children must be exposed to soils (e.g., residences, schools, playgrounds).
*** - Leachability values may be derived using SPLP to calculate site-specific SCTLs or may be determined using TCLP in the event oily wastes are present.

TABLE 1-5

SUMMARY OF ORGANIC AND INORGANIC ANALYTES DETECTED IN GROUNDWATER
SITE 15
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection	Range of Detections	FDEP GCTL[1]	U.S. EPA MCL[2]	Background Screening Concentration[3]
Semivolatile Organic Compounds, µg/L					
bis(2-Ethylhexyl) phthalate	4/8	1.0 - 240	6.0	NC	NA
Pesticides, µg/L					
4,4'-DDD	1/8	0.065	0.1	NC	NA
4,4'-DDE	0/8	[4]	0.1	NC	NA
4,4'-DDT	1/8	0.067	0.1	NC	NA
Nitroaromatic Compounds, µg/L					
3-Nitrotoluene	8/10	1.87 - 3.39	70	NC	NA
RDX	0/10	[4]	0.3	NC	NA
Nitrobenzene	1/11	0.228	3.5	NC	NA
Inorganic Analytes (Total), µg/L					
Aluminum	8/8	205 - 635	200	50 to 200[5]	13,100
Antimony	1/8	42.9	6.0	6.0	44.5
Arsenic	0/9	[6]	10.0	10.0	7.1
Barium	8/8	14.3 - 28.7	2,000	2,000	88.2
Beryllium	1/8	1.0	4.0	4.0	3.5
Calcium	2/8	5,620 - 6,380	NC	NC	81,100
Cobalt	3/8	1.4 - 1.9	140	NC	12.8
Copper	6/8	4.7 - 8.7	1,000	1,300	12.5
Iron	8/8	633 - 3,140	300	300[5]	7,760
Lead	0/9	ND	15	15	5.35
Magnesium	8/8	598 - 1,500	NC	NC	10,000
Manganese	8/8	8.3 - 49.6	50.0	50[5]	150
Nickel	1/8	17.5	100	NC	24.5
Potassium	1/8	2,010	NC	NC	4,330
Sodium	5/8	5,510 - 10,800	160,000	NC	16,500
Thallium	2/8	5.0 - 6.1	2.0	2.0	13.3
Vanadium	1/8	1.8	49	NC	20.2
Zinc	3/8	92 - 246	5,000	5,000[5]	76.8
Cyanide	3/8	3.1 - 3.8	200	200	22.0

1 - Florida Department of Environmental Protection (FDEP Groundwater Cleanup Target Levels (GCTLs), Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
2 - United States Environmental Protection Agency (U.S. EPA) Maximum Contaminant Levels (MCLs) (U.S. EPA, 2002)
3 - NAS Cecil Field Inorganic Background Data Set values (HLA, 1998).
4 - Wells with detected concentrations of 4,4'-DDE and RDX were resampled in August 2006, and previous detections were not verified and thus not included in table (see Section 1.4.3).
5 - U.S. EPA Secondary MCLs (U.S. EPA, 2002)
6 - Representative sample from location with previous arsenic detections was non-detect (see Section 1.4.3).
NA - Not applicable.
NC - No criterion.
ND - Not detected.
RDX - Hexahydro-1,3,5-trinitro-1,3,5-triazine.
Only most recent results were included for wells that were sampled more than once.

TABLE 1-6

SUMMARY OF ORGANICS AND INORGANICS DETECTED IN SEDIMENT
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection	Range of Detections	FDEP Soil Cleanup Target Levels[1]		Background Screening Concentration[2]	FDEP Guidelines for Protection of Sediment-Dwelling Organisms[3]	
			Residential	Leachability		TEC	PEC
Volatile Organic Compounds, mg/kg							
2-Butanone	2/3	0.009 - 0.018	16,000	17	NA	NC	NC
Semivolatile Organic Compounds, mg/kg							
2-Methylnaphthalene	3/13	0.189 - 31.7	210	6.1	NA	NC	NC
Acenaphthene	4/13	0.0692 - 46.9	2,400	2.1	NA	0.0067	0.089
Acenaphthylene	2/13	0.0996 - 0.319	1,800	27	NA	0.0059	0.13
Anthracene	4/13	0.043 - 3.48	21,000	2,500	NA	0.057	0.85
Benzo(a)anthracene	12/13	0.0126 - 6.1	#	0.8	NA	0.11	1.1
Benzo(a)pyrene	13/13	0.0231 - 48.2	0.1	8	NA	0.15	1.5
Benzo(b)fluoranthene	12/13	0.0201 - 38	#	2.4	NA	NC	NC
Benzo(g,h,i)perylene	10/13	0.1 - 3.5	2,500	32,000	NA	NC	NC
Benzo(k)fluoranthene	11/13	0.0585 - 10.8	#	24	NA	NC	NC
Carbazole	1/3	0.058	49	0.2	NA	NC	NC
Chrysene	13/13	0.0557 - 7.3	#	77	NA	0.17	1.3
Dibenzo(a,h)anthracene	4/13	0.034 - 1.1	#	0.7	NA	0.033	0.14
Di-n-butylphthalate	3/3	0.38 - 3.5	7,300	47	NA	NC	0.043
Fluoranthene	12/13	0.079 - 73.4	3,200	1,200	NA	0.42	2.2
Fluorene	4/13	0.0303 - 21.9	2,600	160	NA	0.077	0.54
Indeno(1,2,3-cd)pyrene	8/13	0.094 - 4.3	#	6.6	NA	NC	NC
Phenanthrene	9/13	0.073 - 23.3	2,200	250	NA	0.2	1.2
Pyrene	12/13	0.0263 - 65.2	2,400	880	NA	0.2	1.5
BaPEqs	13/13	0.030 - 31	0.1	NC	NA	NC	NC
Nitroaromatic Compounds, mg/kg							
4-Nitrotoluene	1/3	37.5	640	1.4	NA	NC	NC
Pesticides, mg/kg							
Dieldrin	1/3	0.00046	0.06	0.002	NA	0.0019	0.062
4,4'-DDD	2/3	0.0026 - 0.011	4.2	5.8	NA	0.0049	0.028
4,4'-DDE	2/3	0.0032 - 0.0083	2.9	18	NA	0.0032	0.031
4,4'-DDT	2/3	0.004 - 0.0081	2.9	11	NA	0.0042	0.063

TABLE 1-6

SUMMARY OF ORGANICS AND INORGANICS DETECTED IN SEDIMENT
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection	Range of Detections	FDEP Soil Cleanup Target Levels[1]		Background Screening Concentration[2]	FDEP Guidelines for Protection of Sediment-Dwelling Organisms[3]	
			Residential	Leachability		TEC	PEC
Miscellaneous Parameters, mg/kg							
TRPH	4/7	15 - 160	460	340	NA	NC	NC
TOC	3/3	5,600 - 14,000	NC	NC	NA	NC	NC
Inorganic Analytes, mg/kg							
Aluminum	3/3	543 - 2,850	80,000	*	10,200	NC	NC
Barium	3/3	2.3 - 4.1	120	1,600	36.1	20	60
Calcium	3/3	62.8 - 91.4	NC	NC	5,920	NC	NC
Chromium	1/3	3.1	210	38	16.0	43	110
Iron	3/3	87.8 - 207	53,000	*	3,330	NC	NC
Lead	13/13	29 - 840	400	*	44.6	36	130
Magnesium	2/3	29.5 - 58.8	NC	NC	379	NC	NC
Sodium	3/3	145 - 221	NC	NC	388	NC	NC
Vanadium	3/3	0.72 - 2.7	67	980	15.0	NC	NC

1 - Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs), Chpater 62-777, Florida Adminstrative Code (F.A.C.) (FDEP, 2005).
2 - NAS Cecil Field Inorganic Background Data Set values (HLA, 1998a).
3 - MacDonald, et al., 2003.
NA - Not applicable.
NC - No criterion.
TEC - Threshold effects concentration.
PEC - Probable effects concentration.
= Based on Chapter 62-777, F.A.C., site concentrations of carginogenic polynuclear aromatic hydrocarbons (PAHs) are converted to benzo(a)pyrene equivalents (BaPEqs) before comparison to benzo(a)pyrene (BaP) SCTLs.
* = Leachability values may be derived using the Synthetic Precipitation Leaching Procedure (SPLP) test to calculate site-specific SCTLs or may be determined using the Toxicity Characteristic Leaching Procedure (TCLP) in the event that oily wastes are present.

TABLE 1-7

SUMMARY OF ORGANICS AND INORGANICS DETECTED IN SURFACE WATER
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection	Range of Detections	FDEP Surface Water Criterion (Freshwater)(1)	Background Screening Concentration(2)
Nitroaromatic Compounds, µg/L				
1,3,5-Trinitrobenzene	1/3	6.73	19	NA
3-Nitrotoluene	1/3	4.95	380	NA
4-Nitrotoluene	3/3	1.11 - 46.1	550.0	NA
Tetryl	2/3	18.1 - 18.7	NC	NA
Miscellaneous Parameters, mg/L				
TRPH	1/3	0.6	5000 (3)	NA
Inorganic Analytes, µg/L				
Aluminum, Total	3/3	441 - 649	13	1,040
Aluminum, Dissolved	3/3	403 - 585	13	1,040
Arsenic, Total	3/3	4 - 12	50(3)	5.45
Arsenic, Dissolved	2/3	5.6 - 12.2	50(3)	5.45
Barium, Total	3/3	9.3 - 17.1	NC	43.7
Barium, Dissolved	3/3	8.3 - 14.9	NC	43.7
Calcium, Total	3/3	620 - 4,940	NC	43,000
Calcium, Dissolved	3/3	538 - 3,960	NC	43,000
Copper, Total	1/3	9	8.7	7.35
Iron, Total	3/3	605 - 1,980	1000(3)	3,030
Iron, Dissolved	3/3	468 - 1,650	1000(3)	3,030
Lead, Total	7/7	91 - 398	1.30	5.35
Lead, Dissolved	3/3	79.5 - 225	2.0(4)	5.35
Magnesium, Total	3/3	429 - 557	NC	5,580
Magnesium, Dissolved	3/3	396 - 493	NC	5,580
Potassium	1/3	362	NC	2,060
Potassium, Dissolved	1/3	528	NC	2,060
Sodium, Total	3/3	3,650 - 5,220	NA	12,200
Sodium, Dissolved	3/3	3,400 - 4,070	NA	12,200
Vanadium, Total	1/3	3.3	NC	4.5

1 - Florida Department of Environmental Protection (FDEP) surface water criteria based on freshwater classification, Chapter 62-777, Florida adminstrative Code (F.A.C.) (FDEP, 2005).
2 - NAS Cecil Field Inorganic Background Data Set values (HLA, 1998a).
3 - Surface water criteria based on Class III freshwater (Chapter 62-302.530, F.A.C.).
4 - Hardness dependent.
TRPH - Total recoverable petroleum hydrocarbons.
NC - No xriterion.
NA - Not applicable.

TABLE 1-8

SURFACE SOIL ANALYTES DETECTED AT CONCENTRATIONS GREATER THAN SCREENING CRITERIA
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Analyte	Frequency of Detection(1)	Screening Concentration(2)	IBDS Value(3)	FDEP SCTL(4)		
				Residential	Industrial	Leachability
Semivolatile Organic Compounds (mg/kg)						
1-Methylnaphthalene	15/78	168	NA	200	1,800	**3.1**
2-Methylnaphthalene	29/128	204	NA	210	2,100	**8.5**
Acenaphthene	67/400	410	NA	2,400	20,000	**2.1**
Benzo(a)anthracene	177/400	1,300	NA	#	#	**0.8**
Benzo(a)pyrene	171/400	1,100	NA	**0.1**	**0.7**	**8**
Benzo(b)fluoranthene	179/400	1,300	NA	#	#	**2.4**
Benzo(k)fluoranthene	150/400	1,500	NA	#	#	**24**
Carbazole	15/44	43	NA	49	240	**0.2**
Chrysene	195/400	1,700	NA	#	#	**77**
Dibenzo(a,h)anthracene	60/400	140	NA	#	#	**0.7**
Fluoranthene	205/400	2,000	NA	3,200	59,000	**1,200**
Indeno(1,2,3-cd)pyrene	113/400	560	NA	#	#	**6.6**
Naphthalene	44/400	17	NA	55	300	**1.2**
Phenanthrene	154/400	600	NA	2,200	36,000	**250**
Pyrene	198/400	1,800	NA	2,400	45,000	**880**
BaPEqs	400/400	965	NA	**0.1**	**0.7**	NC
Pesticides/Herbicides (mg/kg)						
Dieldrin	1/41	0.024	NA	0.06	0.3	**0.002**
Nitroaromatic Compounds (mg/kg)						
3-Nitrotoluene	1/38	5.08	NA	400	3,300	**0.9**
4-Nitrotoluene	2/38	4.34	NA	640	12,000	**1.4**
Metals (mg/kg)						
Antimony	30/56	2,440	**9.44**	**27**	**370**	**0.03**
Arsenic	41/69	451	**2.04**	**2.1**	**12**	*
Lead	555/584	65,500	**197**	**400**	**1,400**	*
Miscellaneous Parameters (mg/kg)						
TRPH	33/40	450	NA	460	2,700	460

1 Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed.
2 Maximum detected concentration.
3 NAS Cecil Field Inorganic Background Data Set values (HLA, 1998a).
4 Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs), Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
Bold indicates exceedance of SCTL.
NA Not applicable.
NC No criterion.
TRPH - Total recoveralbe petroleum hydrocarbons.
BaPEqs - Benzo(a)pyrene equivalents.
= Based on Chapter 62-777, F.A.C., site concentrations of carginogenic polynuclear aromatic hydrocarbons (PAHs) are converted to BaPEqs before comparison to benzo(a)pyrene (BaP) SCTLs.
* = Leachability values may be derived using the Synthetic Precipitation Leaching Procedure (SPLP) test to calculate site-specific SCTLs or may be determined using the Toxicity Characteristic Leaching Procedure (TCLP) in the event that oily wastes are present.

TABLE 1-9

SUBSURFACE SOIL ANALYTES DETECTED AT CONCENTRATIONS GREATER THAN SCREENING CRITERIA
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Analyte	Frequency of Detection[1]	Screening Concentration[2]	FDEP SCTL[3]		
			Residential	Industrial	Leachability
Semivolatile Organic Compounds (mg/kg)					
Acenaphthene	13/49	22	2,400	20,000	**2.1**
Benzo(a)anthracene	21/49	36	#	#	**0.8**
Benzo(a)pyrene	32/49	35	**0.1**	**0.7**	**8**
Benzo(b)fluoranthene	33/49	53	#	#	**2.4**
Carbazole	6/16	4.6	49	240	**0.2**
Dibenzo(a,h)anthracene	12/49	5.2	#	#	**0.7**
Indeno(1,2,3-cd)pyrene	22/49	14	#	#	**6.6**
BaPEqs	49/49	49	**0.1**	**0.7**	NC

1 Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed.
2 Maximum detected concentration.
3 Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs), Chapter 62-7 Florida Administrative Code (F.A.C.) (FDEP, 2005).
Bold indicates exceedance of SCTL.
NA Not applicable.
NC No criterion.
BaPEqs - Benzo(a)pyrene equivalents.
= Based on Chapter 62-777, F.A.C., site concentrations of carginogenic polynuclear aromatic hydrocarbons (are converted to BaPEqs before comparison to benzo(a)pyrene (BaP) SCTLs.
* = Leachability values may be derived using the Synthetic Precipitation Leaching Procedure (SPLP) test to calculate site-specific SCTLs or may be determined using the Toxicity Characteristic Leaching Procedure (TCLP) in the event that oily wastes are present.

TABLE 1-10

SEDIMENT ANALYTES DETECTED AT CONCENTRATIONS GREATER THAN SCREENING CRITERIA
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Analyte	Frequency of Detection[1]	Screening Concentration[2]	NAS Cecil Field IBDS	FDEP SCTL[4]		
				Residential	Industrial	Leachability
Semivolatile Organic Compounds (mg/kg)						
1-Methylnaphthalene	3/13	31.7	NC	210	2,100	**8.5**
Acenaphthene	4/13	46.9	NC	2,400	20,000	**2.1**
Benzo(a)anthracene	12/13	6.1	NC	#	#	**0.8**
Benzo(a)pyrene	13/13	48.2	NC	**0.1**	**0.7**	**8**
Benzo(b)fluoranthene	12/13	38	NC	#	#	**2.4**
Dibenzo(a,h)anthracene	4/13	1.1	NC	#	#	**0.7**
Indeno(1,2,3-cd)pyrene	8/13	4.3	NC	#	#	6.6
BaPEqs	13/13	52	NC	**0.1**	**0.7**	NC
Nitroaromatic Compounds (mg/kg)						
4-Nitrotoluene	1/3	37.5	NC	640	12,000	**1.4**
Metals (mg/kg)						
Lead	13/13	840	**197**	**400**	**1,400**	*

1 Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed.
2 Maximum detected concentration.
3 NAS Cecil Field Inorganic Background Data Set values (HLA, 1998a).
4 Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs), Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
Bold indicates exceedance of SCTL.
NA Not applicable.
NC No criterion.
= Based on F.A.C. 62-777, site concentrations of carginogenic polynuclear aromatic hydrocarbons (PAHs) are converted to benzo(a)pyrene equivalents (BaPEq) before comparison to benzo(a)pyrene (BaP) SCTLs.
* = Leachability values may be derived using the Synthetic Precipitation Leaching Procedure (SPLP) test to calculate site-specific SCTLs or may be determined using the Toxicity Characteristic Leaching Procedure (TCLP) in the event that oily wastes are present.

TABLE 1-11

SURFACE WATER ANALYTES DETECTED AT CONCENTRATIONS GREATER THAN SCREENING CRITERIA
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Analyte	Frequency of Detection(1)	Screening Concentration(2)	NAS Cecil Field IBDS Value(3)	FDEP Surface Water Criterion (Freshwater)(4)
Metals (µg/L)				
Copper	1/3	9	**7.35**	**8.7**
Lead	7/7	398	**5.35**	**1.3**

1 Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed.
2 Maximum detected concentration.
3 NAS Cecil Field Inorganic Background Data Set values (HLA, 1998a).
4 - Florida Department of Environmental Protection surface water criteria based on freshwater classification, Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
Bold indicates exceedance of SCTL.

TABLE 1-12

PRE RISKS FOR EXPOSURE TO SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Analyte	C or N	Maximum Detected Concentration	FDEP Residential SCTL	Residential Risk Ratio(1)	UCL	FDEP Industrial SCTL	Industrial Risk Ratio(2)
BaPEqs	C	956	0.1	9,560	32	0.7	46
Antimony	N	2,440	27	90.4	334	370	0.94
Arsenic	C	451	2.1	215	44	12	3.7
TRPH	N	450	460	0.98	111	2,700	0.04
Lead	N	65,500	400	NA	990	1,400	NA

Carcinogen (C) or noncarcinogen (N).
Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs) for residential and industrial direct contact exposure, Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
1 Ratio of maximum detected concentration to residential SCTL.
2 Ratio of UCL to indusrial SCTL.
95% Upper confidence limit (UCL) of the mean as calculated by FL-UCL software.
NA = Not applicable. SCTLs are levels that result in a protective blood-lead concentration.
All concentrations in mg/kg.

TABLE 1-13

PRE RISKS FOR EXPOSURE TO SUBSURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Analyte	C or N	Maximum Detected Concentration	FDEP Residential SCTL	Residential Risk Ratio(1)	UCL	FDEP Industrial SCTL	Industrial Risk Ratio(2)
BaPEqs	C	46	0.1	460	5.2	0.7	7.4

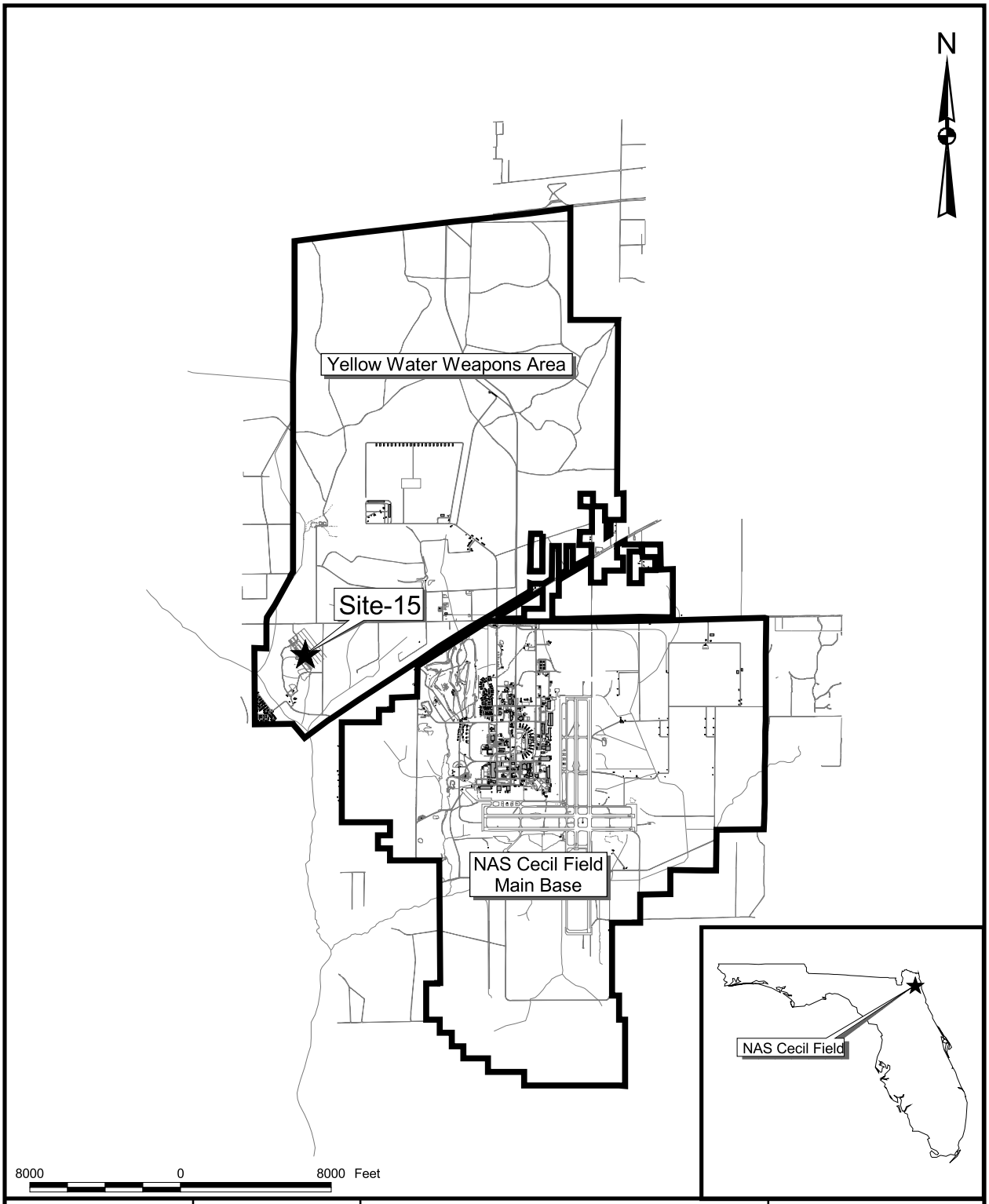
BaPEqs - Benzo(a)pyrene equivalents.
Carcinogen (C) or noncarcinogen (N).
Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs) for residential and industrial direct contact exposure, Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
1 Ratio of maximum detected concentration to residential SCTL.
2 Ratio of UCL to indusrial SCTL.
95% Upper confidence limit (UCL) of the mean as calculated by FL-UCL software.
All concentrations in mg/kg.

TABLE 1-14

PRE RISKS FOR EXPOSURE TO SEDIMENT
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

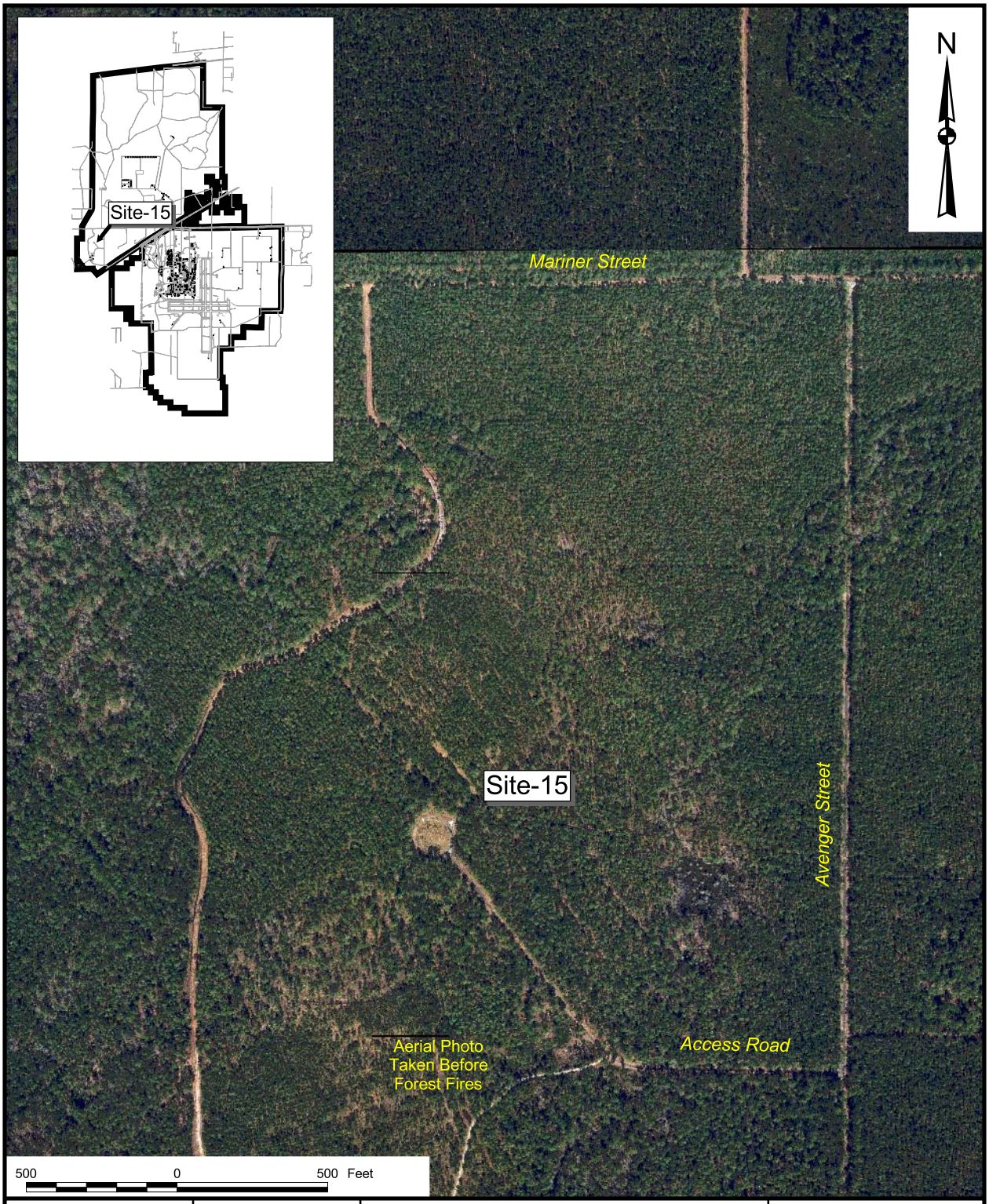
Analyte	C or N	Maximum Detected Concentration	FDEP Residential SCTL	Residential Risk Ratio(1)	UCL	FDEP Industrial SCTL	Industrial Risk Ratio(2)
BaPEqs	C	31	0.1	310	31	0.7	44
Lead	N	840	400	NA	249	920	NA

BaPEqs - Benzo(a)pyrene equivalents.
Carcinogen (C) or noncarcinogen (N).
Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs) for residential and industrial direct contact exposure, Chapter 62-777, Florida Administrative Code (F.A.C.) (FDEP, 2005).
1 Ratio of maximum detected concentration to residential SCTL.
2 Ratio of UCL to indusrial SCTL.
95% Upper confidence limit (UCL) of the mean as calculated by FL-UCL software.
NA = Not applicable. SCTLs are levels that result in a protective blood-lead concentration.
All concentrations in mg/kg.



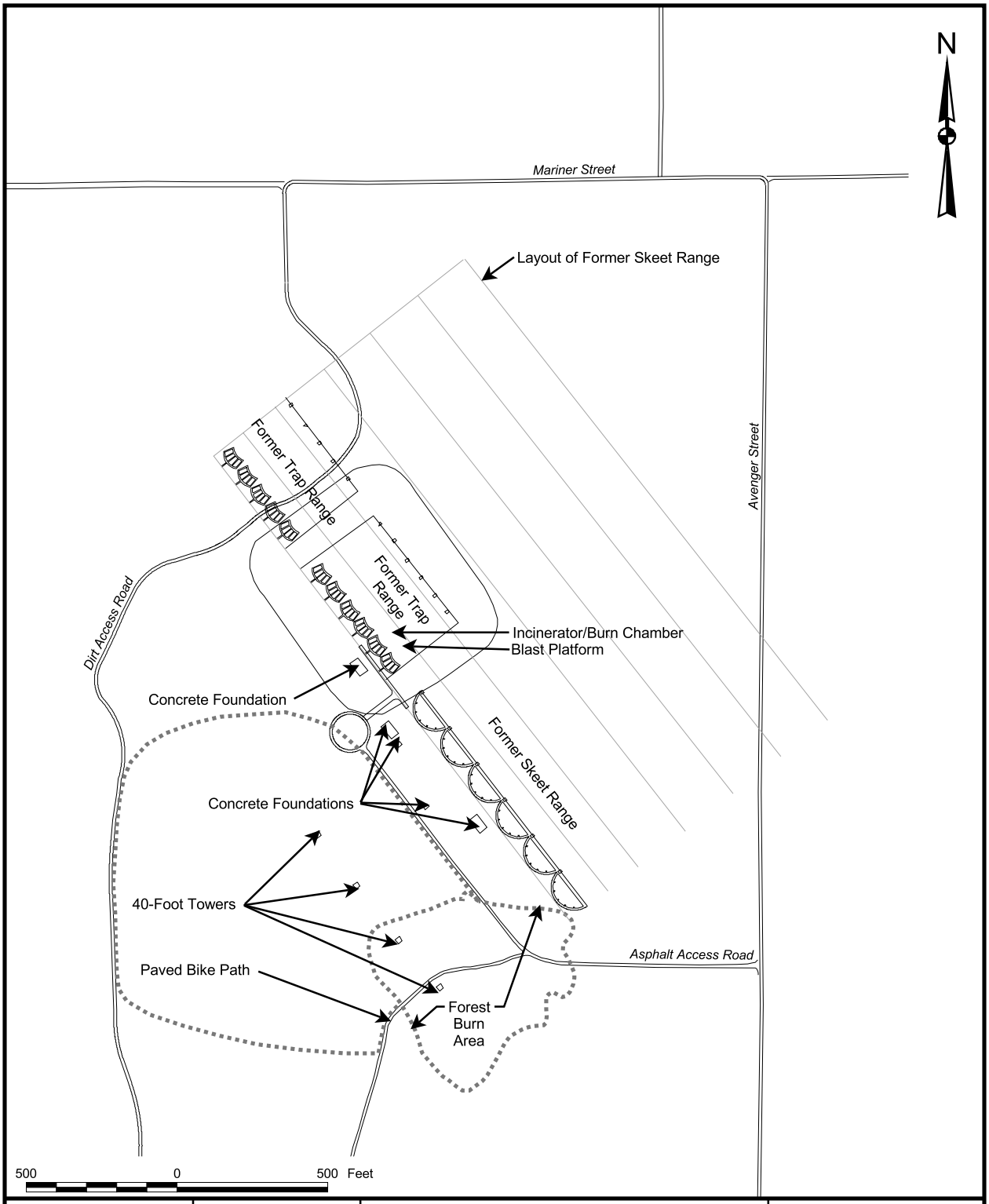
DRAWN BY MJJ	DATE 14Jan00	GENERAL LOCATION MAP OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-1 / REV 0

P:\GIS\Cecil\Site-15_FS.apr 17Apr05 MJJ 00-Layout-SiteLocationMap



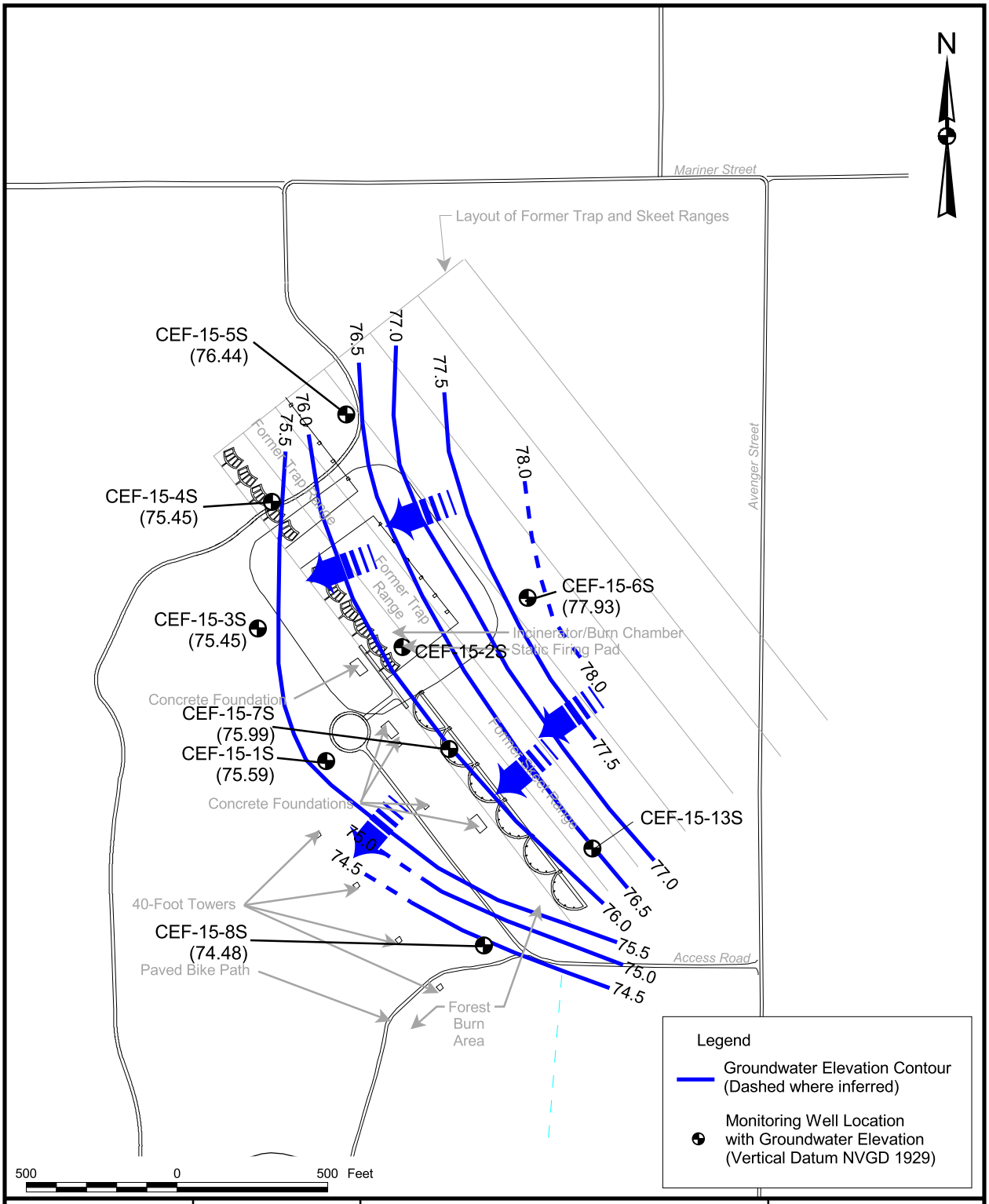
DRAWN BY MJJ	DATE 14Jan00	SITE VICINTY MAP OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-2 / REV 0

P:\GIS\Cecil\Site-15_FS.apr 17Apr05 MJJ 01-Layout-SiteVicinityMap



DRAWN BY MJJ	DATE 14Jan00	GENERAL ARRANGEMENT OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-3 / REV 0

P:\GIS\Cecil\Site-15_FS.apr 17Apr05 MJJ 02-Layout-SiteArrangement



DRAWN BY MJJ	DATE 05Jun06	POTENTIOMETRIC MAP SEPTEMBER 1995 OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-4 / REV 0

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Legend
- Monitoring Well
- Surface Soil Sample Location
- Subsurface Soil Sample Location
- Surface Water / Sediment Sample Location
- Confirmation Soil Sample Location
- Post RI Surface Soil Sample Location
- Post RI Surface Water / Sediment Sample Location

N

Inset 2

50 0 50 100 Feet

SEE INSET 1

SEE INSET 2

Inset 1

50 0 50 100 Feet

100 0 100 200 Feet

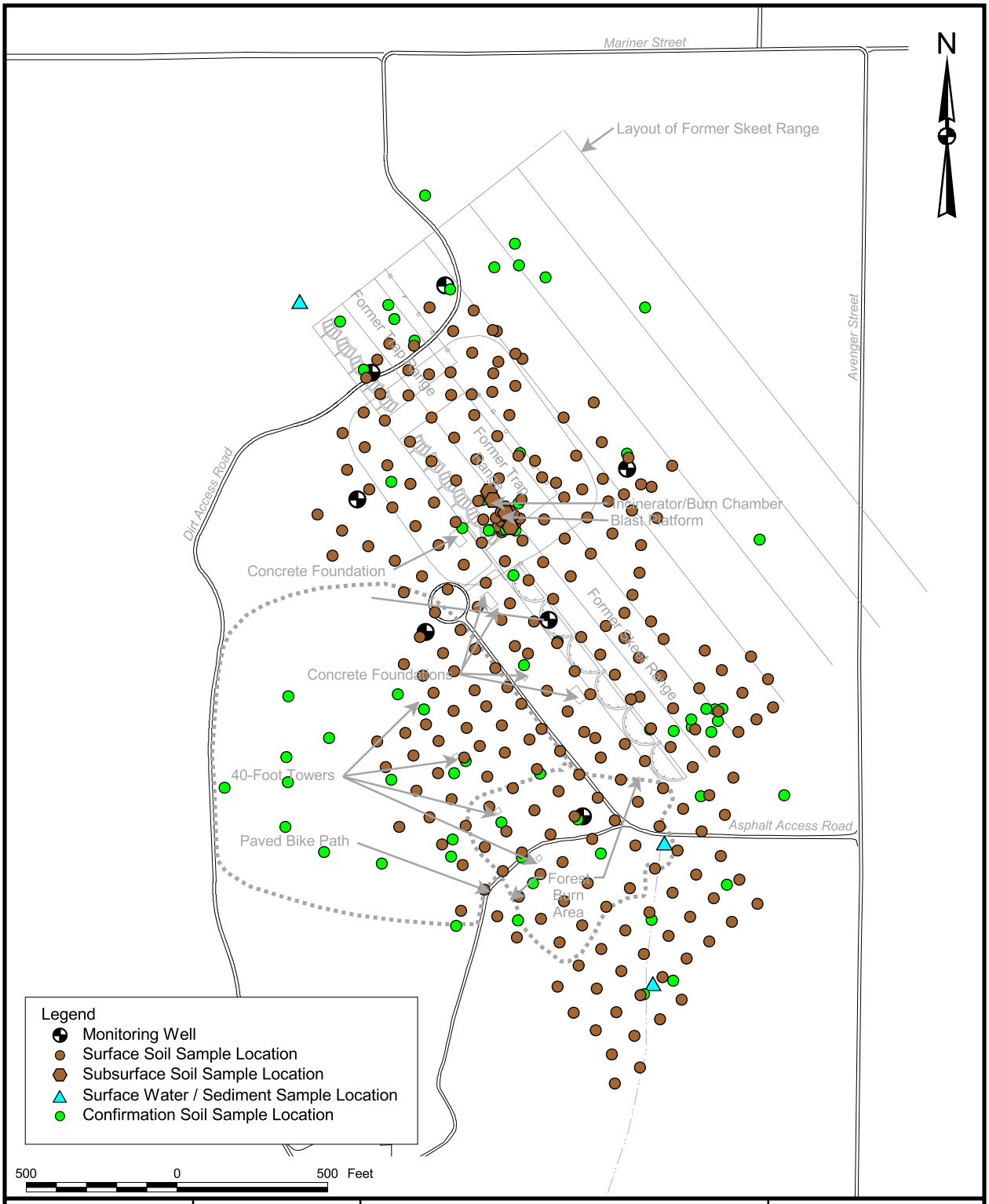
P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 03-Layout-SampleLocations

DRAWN BY	DATE
MJJ	23Oct03
CHECKED BY	DATE
	DATE
SCALE	
AS NOTED	

NAVFAC

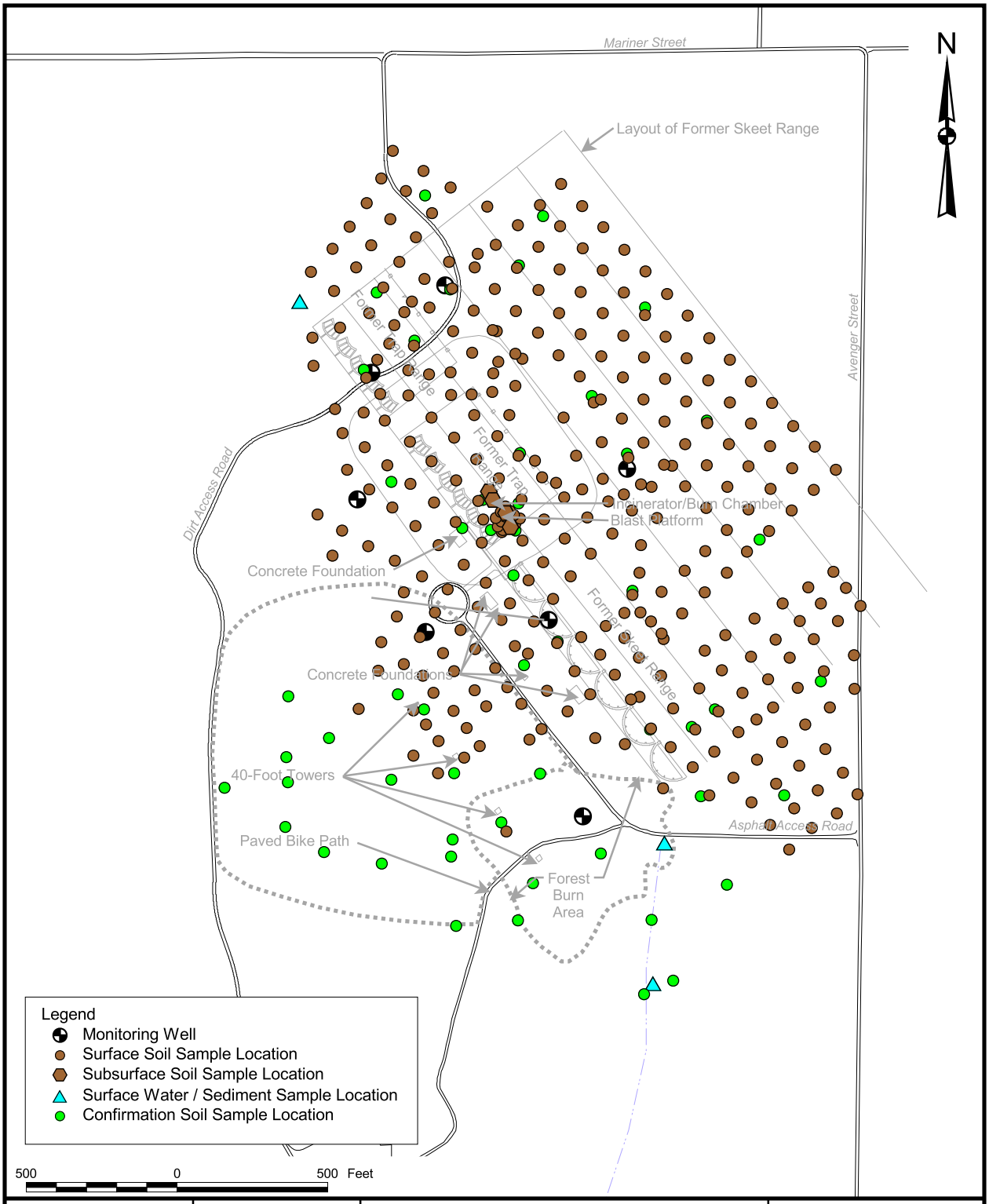
SAMPLE LOCATION MAP
OU 5, SITE 15
FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

CONTRACT NO.	
7653	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 1-5	0



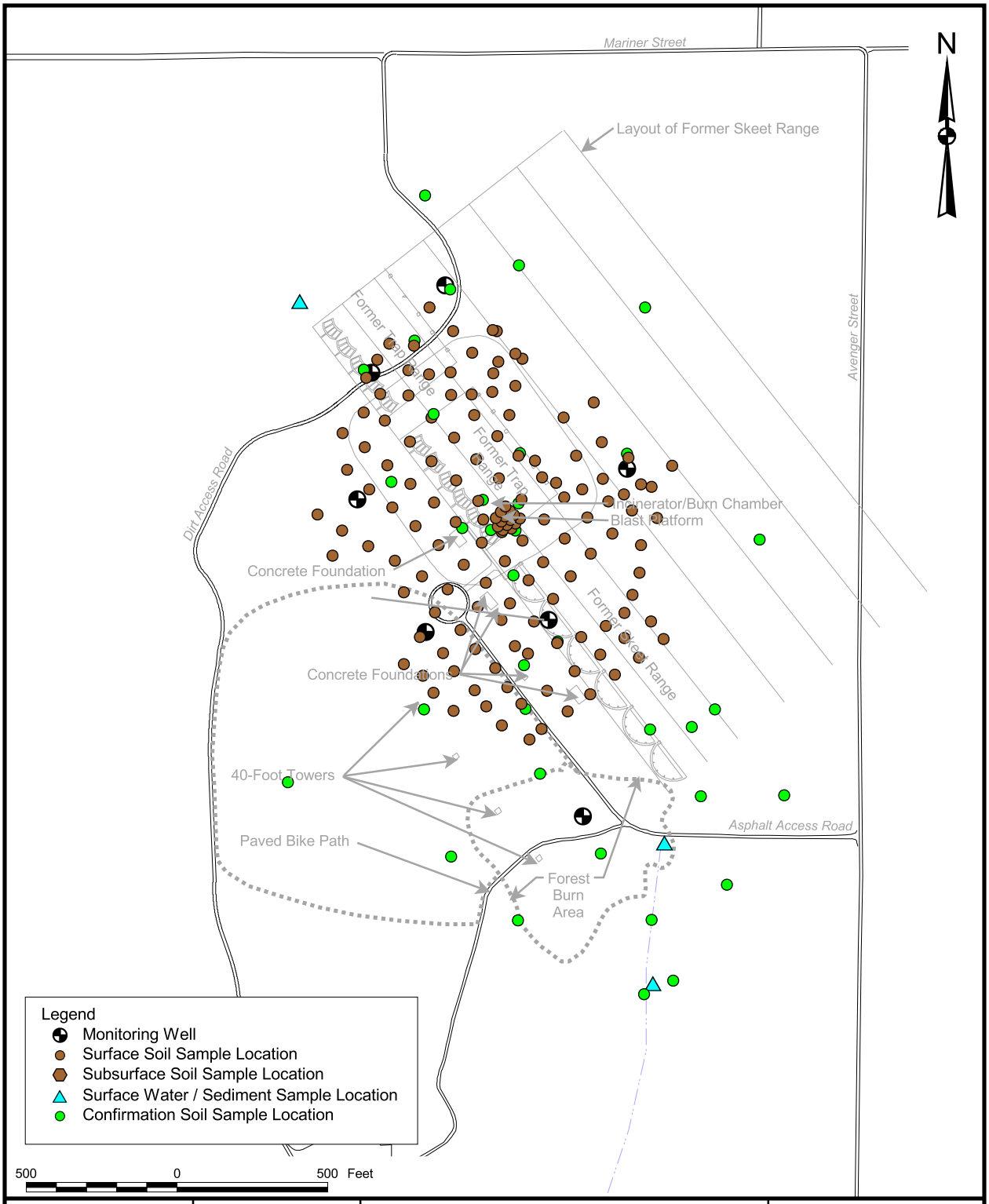
DRAWN BY	DATE			CONTRACT NUMBER
MJJ	21Jan00		RI SAMPLING LOCATIONS SELECTED FOR	7653
CHECKED BY	DATE		PAH SCREENING & CONFIRMATORY SAMPLING	APPROVED BY / DATE
COST/SCHEDULE-AREA			OU 5, SITE 15	APPROVED BY / DATE
SCALE			FEASIBILITY STUDY REPORT	DRAWING NO. FIGURE 1-6
AS NOTED			NAS CECIL FIELD	REV 0
			JACKSONVILLE, FLORIDA	

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 04-Layout-PAH_Samples



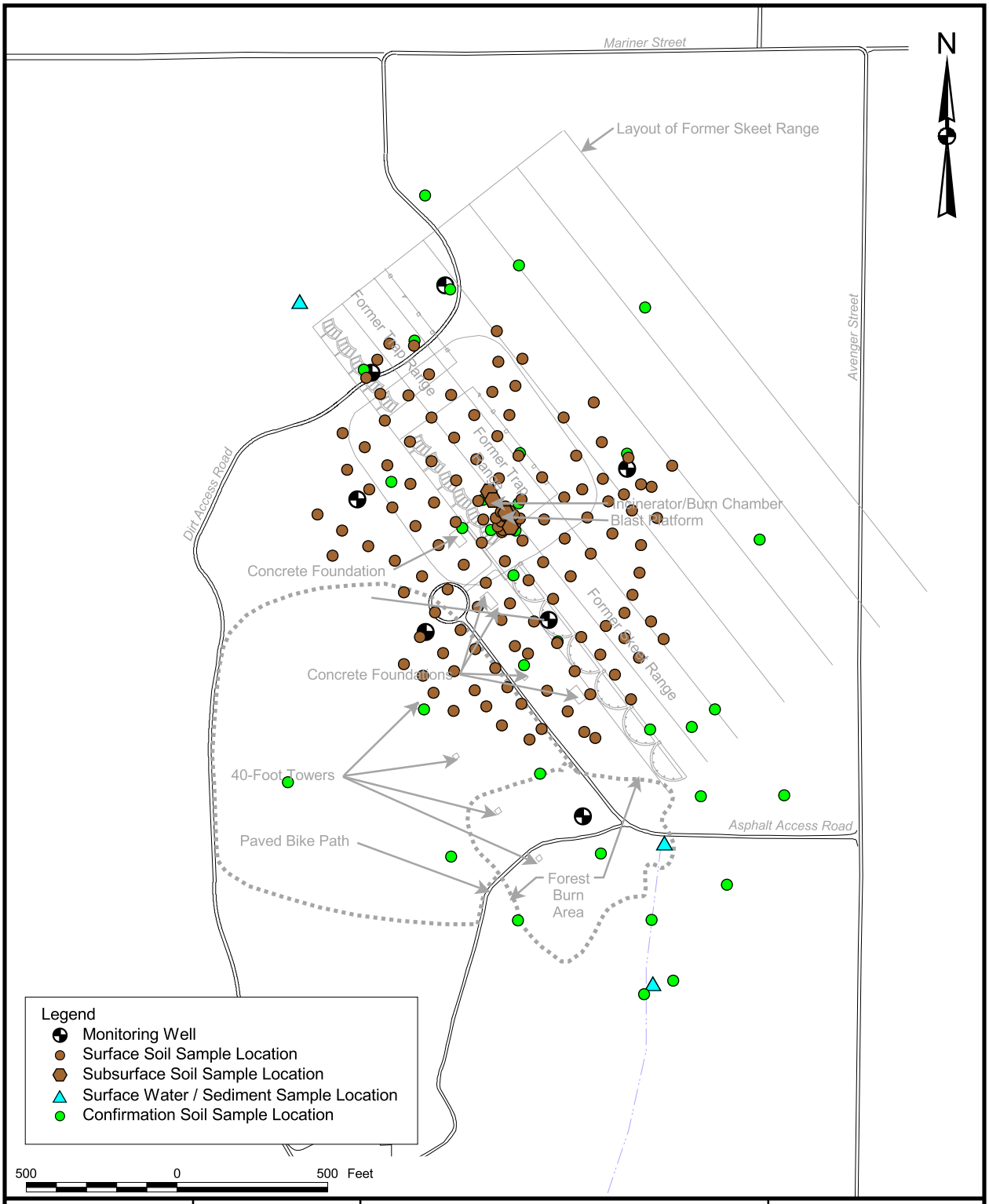
DRAWN BY	DATE			CONTRACT NUMBER
MJJ	21Jan00		RI SAMPLING LOCATIONS SELECTED FOR	7653
CHECKED BY	DATE		LEAD SCREENING & CONFIRMATORY SAMPLING	APPROVED BY DATE
COST/SCHEDULE-AREA			OU 5, SITE 15	APPROVED BY DATE
			FEASIBILITY STUDY REPORT	
SCALE		NAVFAC	NAS CECIL FIELD	DRAWING NO. FIGURE 1-7 / REV 0
AS NOTED			JACKSONVILLE, FLORIDA	

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 05-Layout-Lead_Samples



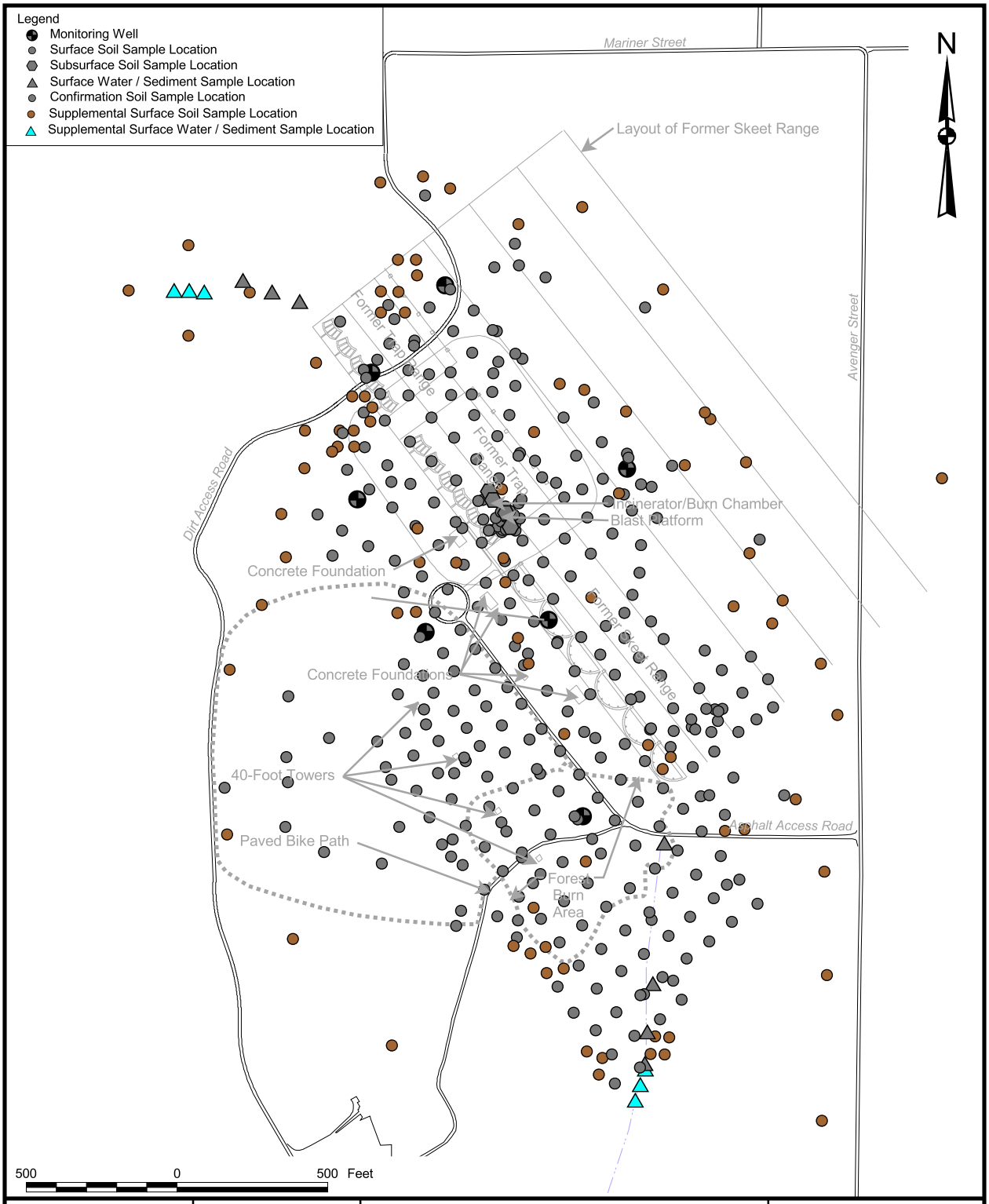
DRAWN BY MJJ DATE 21Jan00			CONTRACT NUMBER 7653
CHECKED BY DATE			APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED	NAVFAC	RI SAMPLING LOCATIONS SELECTED FOR TNT SCREENING & CONFIRMATORY SAMPLING OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	DRAWING NO. FIGURE 1-8 REV 0

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 06-Layout-TNT_Samples



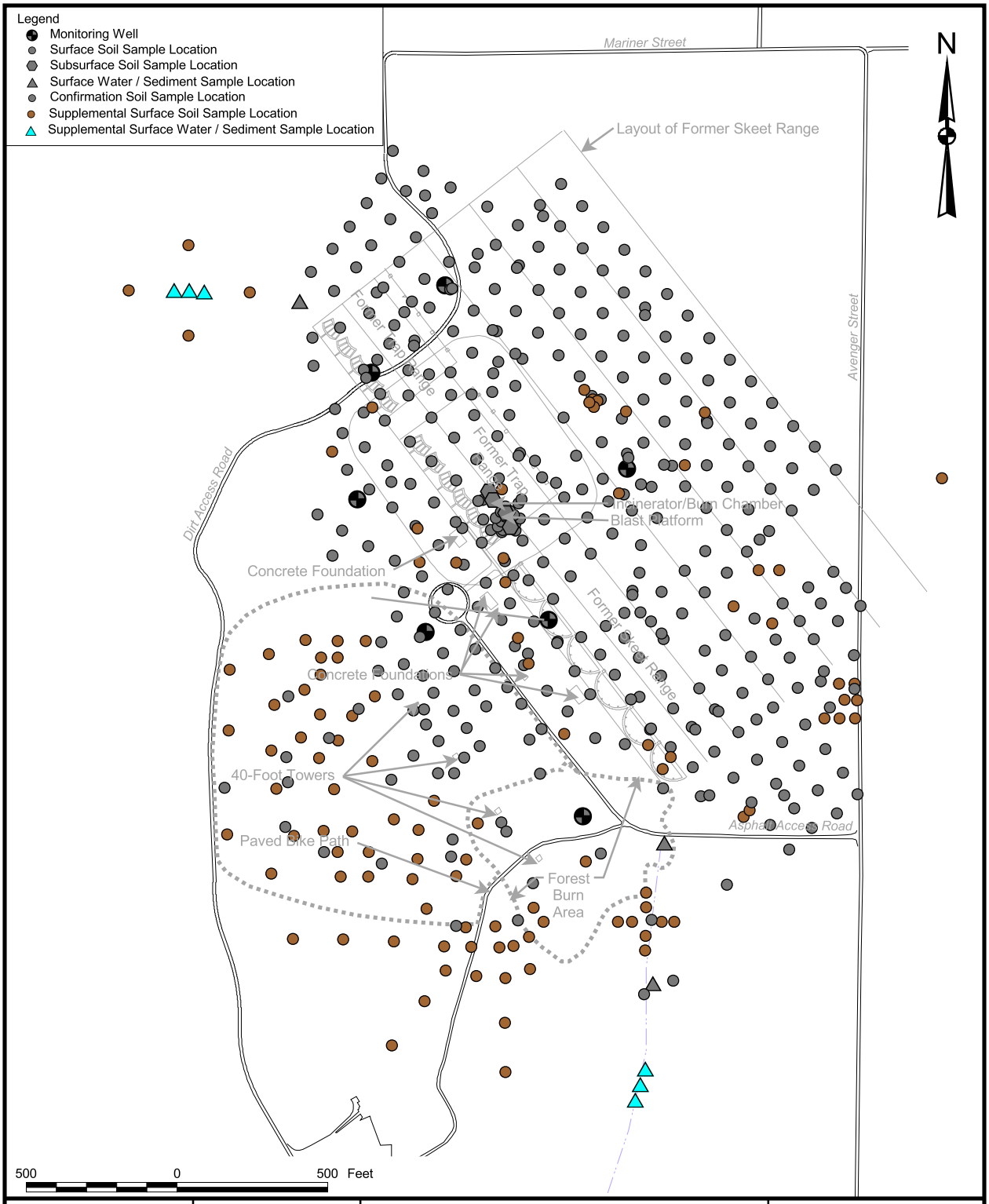
DRAWN BY MJJ DATE 21Jan00	NAVFAC	RI SAMPLING LOCATIONS SELECTED FOR TRPH SCREENING & CONFIRMATORY SAMPLING OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY DATE			APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-9 REV 0

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 07-Layout-TRPH_Samples



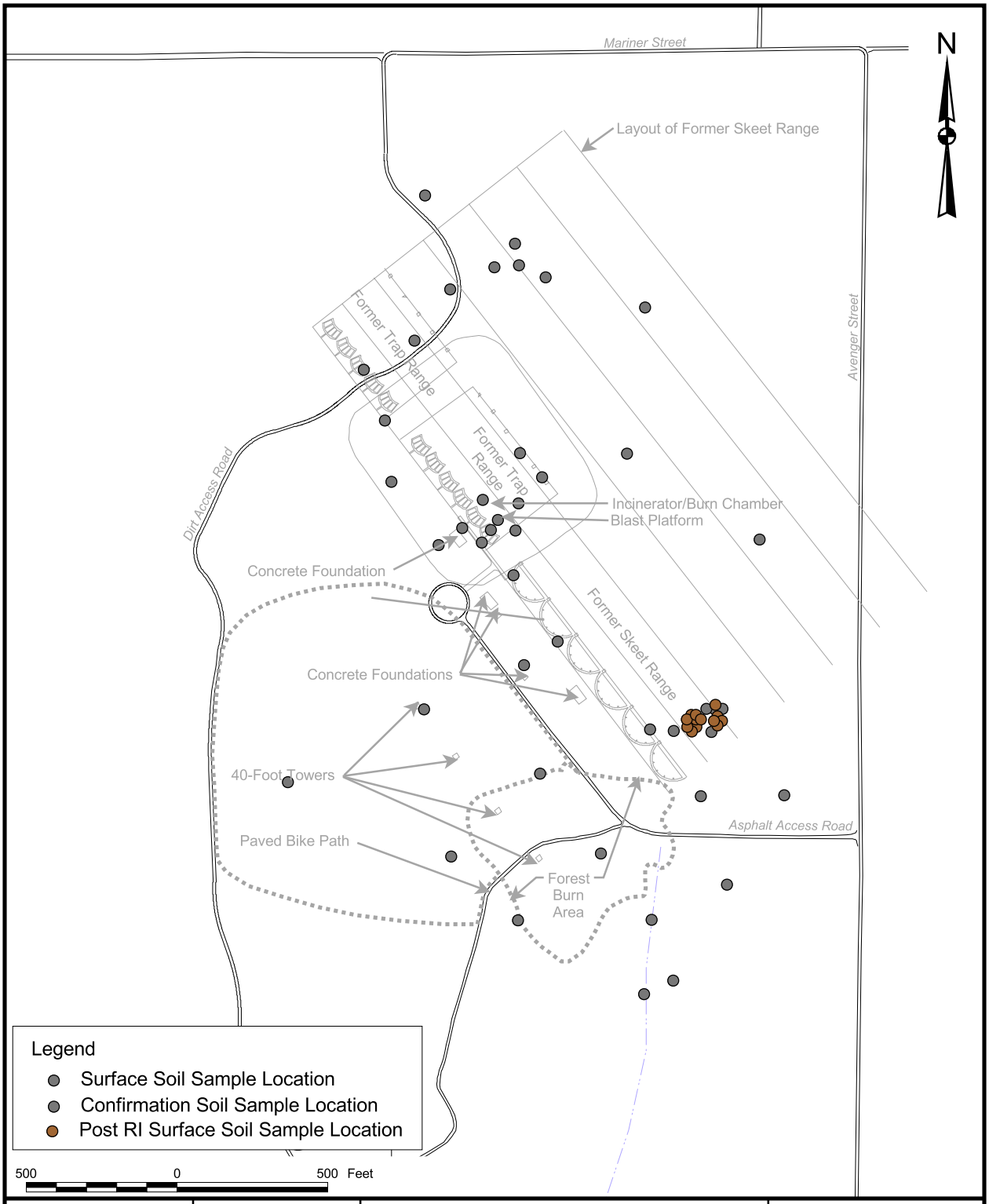
DRAWN BY MJJ	DATE 21Jan00	SUPPLEMENTAL SURFACE SOIL/SEDIMENT SAMPLING LOCATIONS SELECTED FOR PAH ANALYSIS OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-10 / REV 0

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 09-Layout-PostPAH_Samples



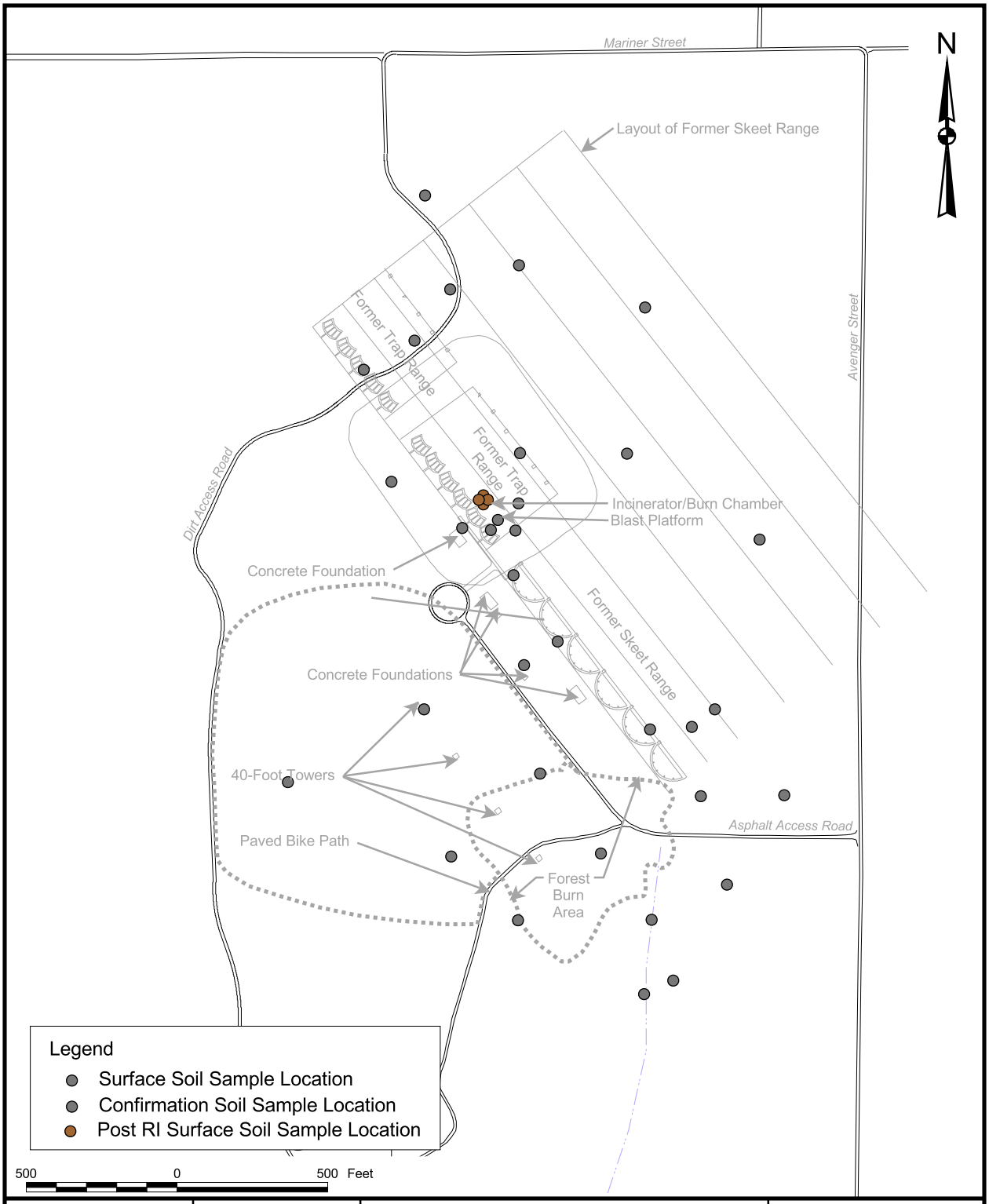
DRAWN BY MJJ	DATE 21Jan00	SUPPLEMENTAL SURFACE SOIL/SEDIMENT SAMPLING LOCATIONS SELECTED FOR LEAD ANALYSIS OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-11 / REV 0

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 10-Layout-PostLead_Samples



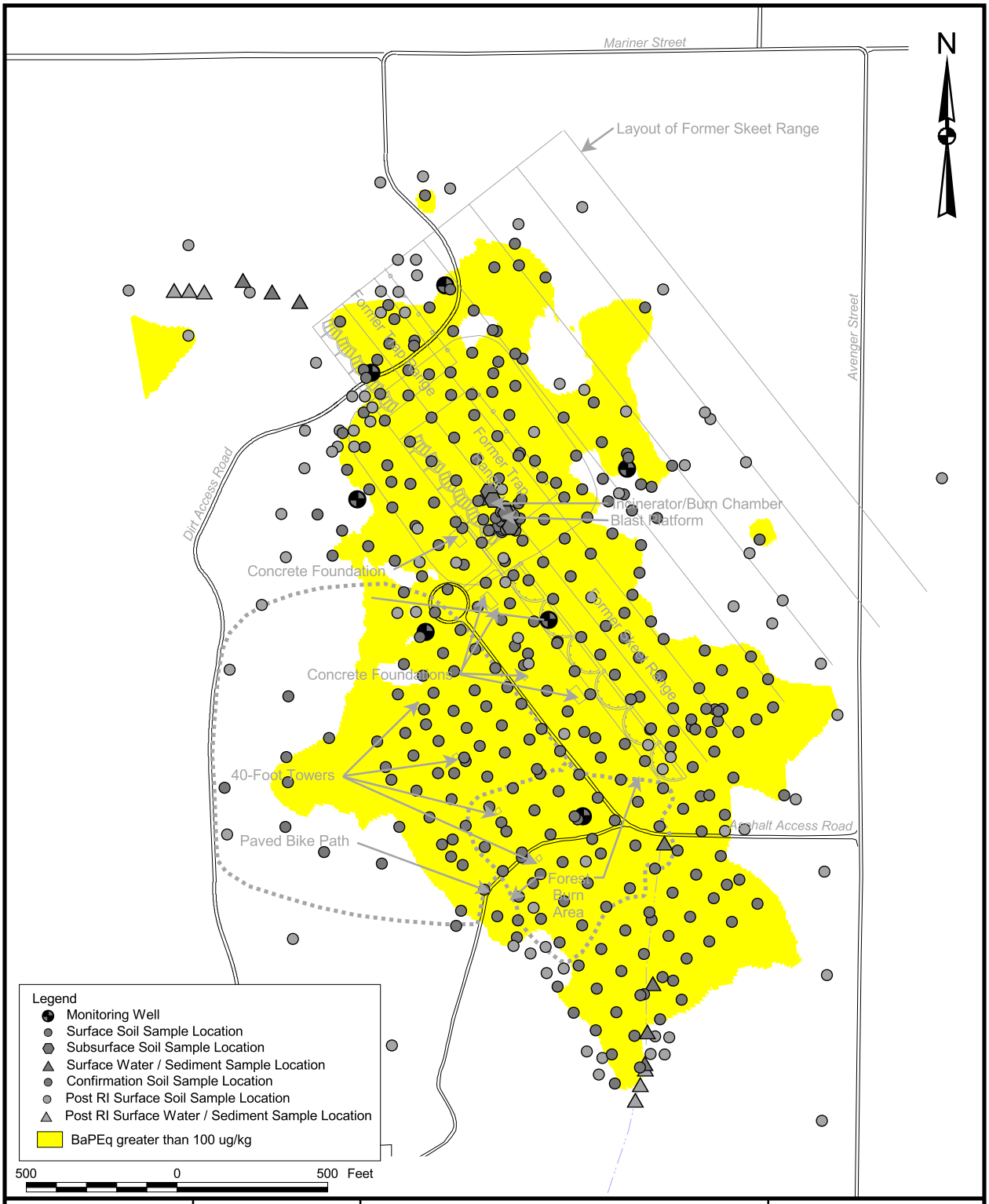
DRAWN BY MJJ	DATE 21Jan00	SUPPLEMENTAL SURFACE SOIL/SEDIMENT SAMPLING LOCATIONS SELECTED FOR ARSENIC ANALYSIS OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-12 REV 0

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 16-Layout-PostArsenic_Samples



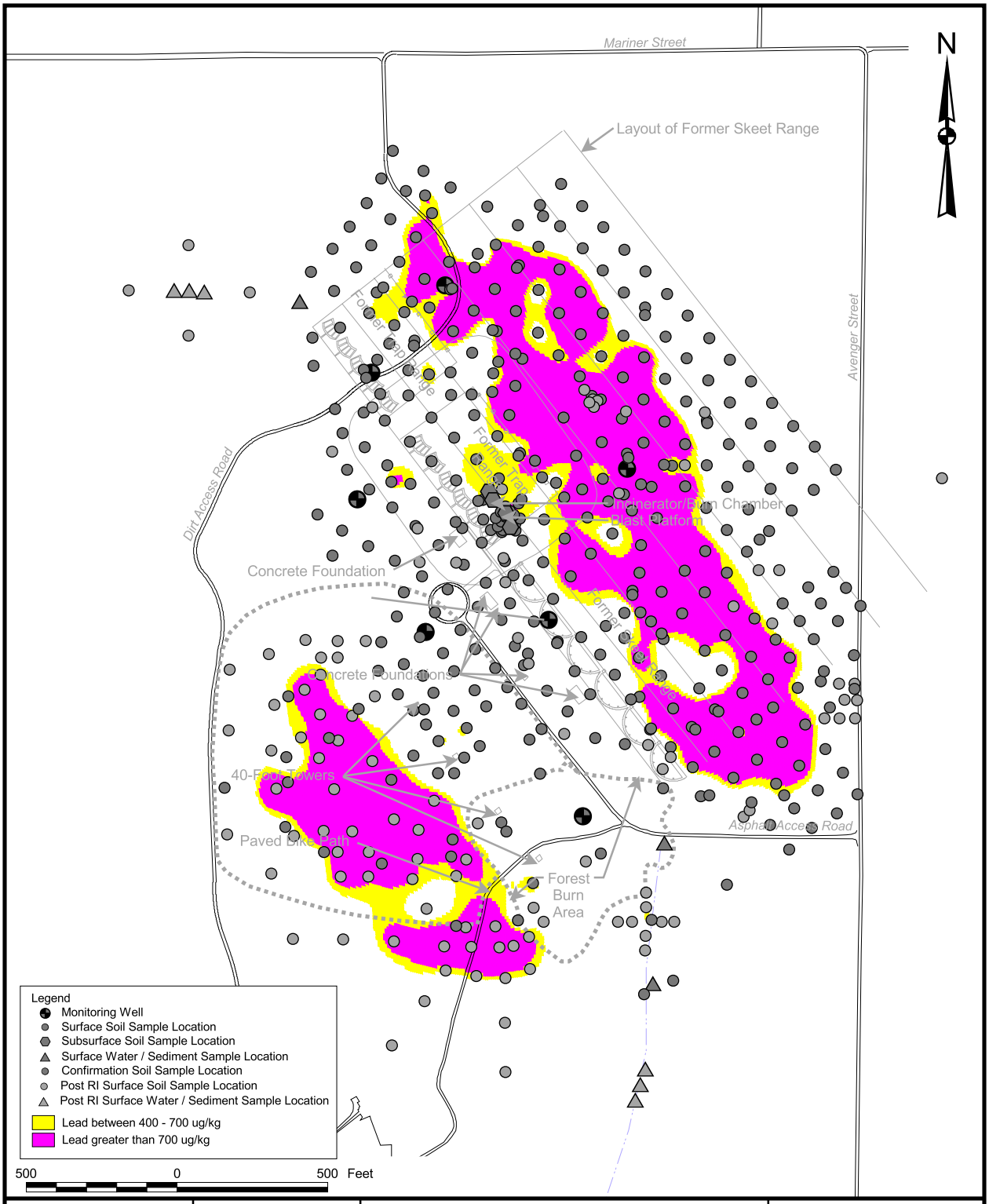
DRAWN BY MJJ DATE 21Jan00		SUPPLEMENTAL SURFACE SOIL/SEDIMENT SAMPLING LOCATIONS SELECTED FOR TRPH ANALYSIS OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY DATE			APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED	NAVFAC		DRAWING NO. FIGURE 1-13 REV 0

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 17-Layout-PostTRPH_Samples



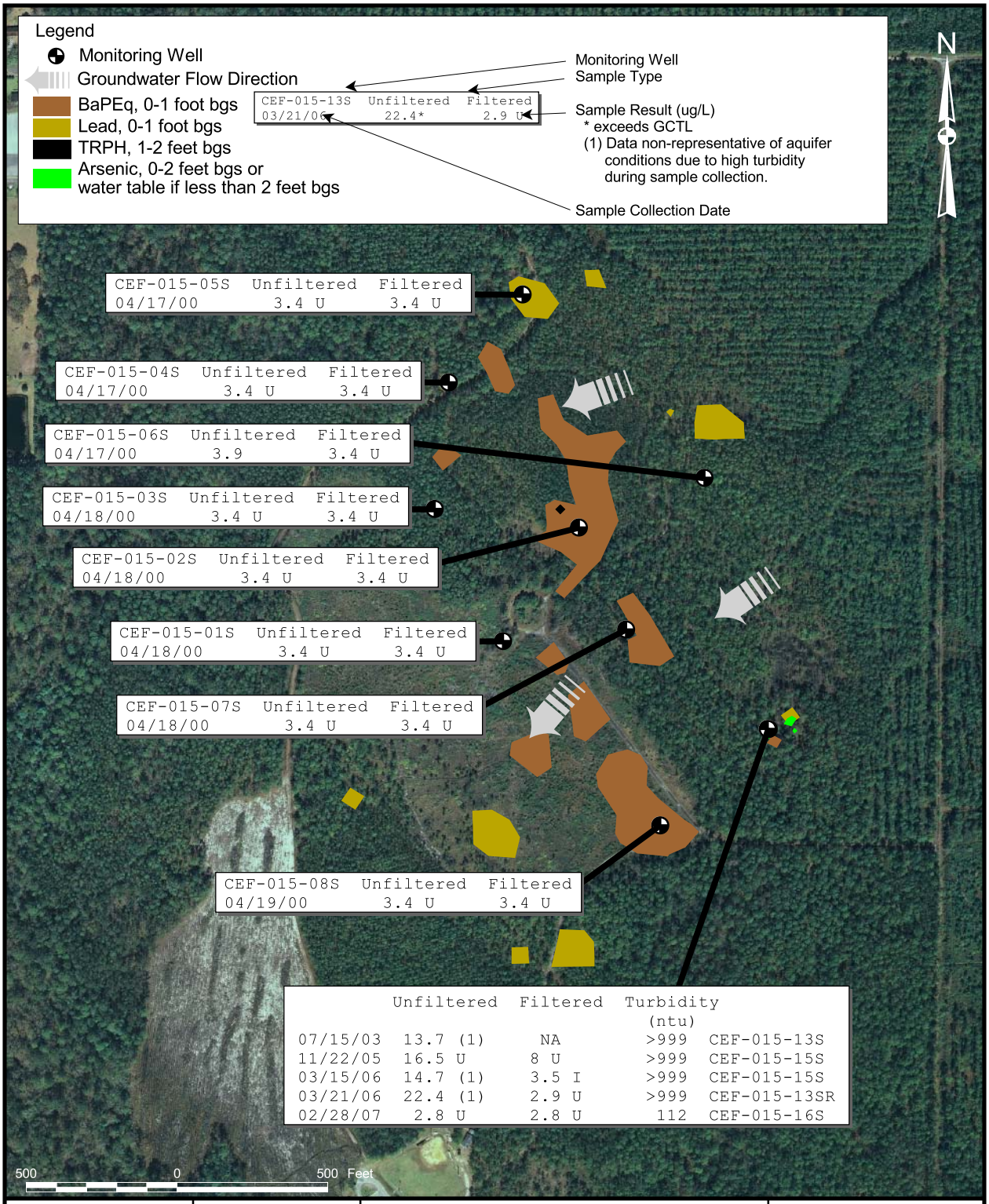
DRAWN BY MJJ	DATE 21Jan00	PAH CONCENTRATIONS IN SURFACE SOIL SAMPLES EXCEEDING FDEP SCTLs OU 5, SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 7653
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-14 REV 0

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 12-Layout-PAH Exceeding FDEP



DRAWN BY MJJ	DATE 21Jan00	LEAD CONCENTRATIONS IN SURFACE SOIL SAMPLES EXCEEDING FDEP SCTLs	CONTRACT NUMBER 7653
CHECKED BY	DATE	OU 5, SITE 15	APPROVED BY / DATE
COST/SCHEDULE-AREA		FEASIBILITY STUDY REPORT	APPROVED BY / DATE
SCALE AS NOTED	NAVFAC	NAS CECIL FIELD JACKSONVILLE, FLORIDA	DRAWING NO. FIGURE 1-15 / REV 0

P:\GIS\Cecil\Site-15_FS.apr 11Aug06 MJJ 13-Layout-Lead Exceeding FDEP



DRAWN BY	DATE			CONTRACT NUMBER
MJJ	05Jun06			7653
CHECKED BY	DATE			APPROVED BY DATE
COST/SCHEDULE-AREA				APPROVED BY DATE
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 1-16 / 0

GROUNDWATER IMPACTED AREA
OU 5, SITE 15
FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

P:\GIS\Cecil\Site-15_FS.apr 23Mar07 MJJ 21-Layout-ArsenicMap

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section develops RAOs for soil and describes the derivation of site-wide cleanup goals and remedial pickup levels for contaminated soil at OU 5, Site 15 based on the site conditions presented in Section 1.0. The RAOs provide the basis for selecting appropriate remedial alternatives. General Response Actions (GRAs) that may be suitable to achieve the site-wide cleanup goals for soil are also presented in this section.

The regulatory requirements [chemical-, location-, and action-specific Applicable or Relevant and Appropriate Requirements (ARARs)] and TBC criteria that may potentially govern remedial activities at the site are also presented in this section. In addition, this section presents the COCs and the conceptual pathways through which these chemicals may affect human health, and thus derives the environmental media of concern. Finally, this section presents an estimate of the volume of contaminated soil.

2.1 REMEDIAL ACTION OBJECTIVES

The purpose of this section is to develop RAOs for Site 15 at NAS Cecil Field, Jacksonville, Florida. Development of RAOs is an important step in the FS process. RAOs are medium-specific goals that define the objective of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and acceptable contaminant levels for the site. Section 2.1.1 presents the RAOs developed for Site 15.

The development of RAOs takes into consideration ARARs and TBC criteria. Section 2.1.2 identifies the ARARs and TBC criteria, Section 2.1.3 identifies the medium of concern, and Section 2.1.4 identifies the COCs for remediation.

2.1.1 Statement of Remedial Action Objectives

Site-specific RAOs specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. This FS addresses soil contamination at Site 15. The RAOs were developed to permit consideration of a range of treatment and containment alternatives based on the future use of the site for low-intensity recreation activities (see Section 2.2.1), a green corridor connecting two state forests, and open space. To protect the public from potential current and future health risks, and to protect the environment, the following RAOs were developed for OU 5, Site 15:

- Prevent unacceptable human health risk associated with exposure to surface soil containing PAHs, arsenic, and lead at concentrations greater than the established site-specific SCTLs.

- Reduce ecological risk associated with exposure to surface soil containing PAHs and lead at concentrations greater than site-specific ecological target levels.

2.1.2 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria

ARARs consist of the following:

- Any standard, requirement, criterion, or limitation under federal environmental law.
- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-siting law that is more stringent than the associated federal standard, requirement, criterion, or limitation.

TBC criteria are non-promulgated guidelines or criteria that may be useful for developing a remedial action or are necessary for determining what is protective to human health and/or the environment. Examples of TBC criteria include U.S. EPA's Drinking Water Health Advisories, Reference Doses (RfDs), and Cancer Slope Factors (CSFs).

CERCLA Section 121(d) specifies in part that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or a waiver must be obtained [see also 40 Code of Federal Regulations (CFR) 300.430(f)(1)(ii)(B)]. ARARs include only federal and state environmental or facility siting laws/regulations and do not include occupational safety or worker protection requirements. In addition, per 40 CFR 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (TBC guidance category).

According to 40 CFR 300.430(f)(1)(i)(A), overall protection of human health and the environment and compliance with ARARs are threshold requirements that each alternative must meet to be eligible for selection.

2.1.2.1 Definitions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 CFR Part 300.5 provides the following definitions for ARARs:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law

that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law. While these relevant and appropriate requirements are not "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, location, or other circumstance at a CERCLA site, they address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Per 40 CFR 300.430(g)(3), other advisories, criteria, or guidance are to be considered for a particular release. The TBC category consists of advisories, criteria, or guidance that were developed by U.S. EPA, other federal agencies, or states that may be useful in developing CERCLA remedies.

The U.S. EPA in various guidance documents and the NCP has divided ARARs into three categories to facilitate identification. Chemical-specific and location-specific ARARs are identified early in the process, generally during the RI, and action-specific ARARs are normally identified during the FS in the detailed analysis of alternatives. The three ARAR categories are defined as follows:

- Chemical-Specific: Health- or risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples include MCLs and Clean Water Act (CWA) Ambient Water Quality Criteria (AWQCs).

- Location-Specific: Restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of these areas regulated under various federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present.

- Action-Specific: Technology- or activity-based requirements, limitations on actions, or conditions involving special substances. Examples of action-specific ARARs include RCRA regulations for generation, characterization, and management of hazardous wastes and CWA effluent limitations and pre-treatment standards for wastewater discharges.

This section discusses chemical- and location-specific ARARs and TBC criteria. Action-specific ARARs and TBC criteria are presented in Section 2.3 along with the discussion of GRAs.

2.1.2.2 Chemical-Specific ARARs and TBC Criteria

Tables 2-1 and 2-2 present lists of federal and State of Florida chemical-specific ARARs and TBC criteria for this FS. These ARARs and TBC criteria provide some medium-specific guidance on "acceptable" or "permissible" concentrations of contaminants.

2.1.2.3 Location-Specific ARARs and TBC Criteria

Tables 2-3 and 2-4 present lists of federal and State of Florida location-specific ARARs and TBC criteria for this FS. These ARARs and TBC criteria place restrictions on concentrations of contaminants or the conduct of activities solely based on the site's particular characteristics or location.

2.1.3 Medium of Concern

Based on the discussion in Section 1.0 involving toxicity and risk assessment for both human and ecological receptors, the medium of concern at Site 15 was determined to be surface soil, less than 2 feet in depth and mostly contained to the first foot of soil.

As documented in the Technical Memorandum for No Further Groundwater Monitoring provided in Appendix A.1 and in the addendum to this Technical Memorandum that is included in Appendix A.2, groundwater was eliminated as a medium of concern at Site 15 (TtNUS, 2006a).

2.1.4 Chemicals of Concern for Remediation

COCs for Site 15 were established based on an initial screening of maximum concentrations compared to FDEP SCTLs (FDEP, 2005) as published in Chapter 62-777, Florida Administrative Code (F.A.C.) (soil leachability criteria or residential direct exposure, whichever was more restrictive), and the NAS Cecil Field site-specific IBDS values (HLA, 1998a) as outlined in Section 1.4.1 of this FS. Site-specific SCTLs were developed for the COCs to be protective of human health and ecological receptors as presented in Section 2.2. The COCs are BaPEqs, arsenic, lead, antimony, and TRPH.

2.2 CLEANUP GOALS

Cleanup goals are concentrations of COCs in environmental media that, when attained, should achieve RAOs. According to the NCP, cleanup goals are based on readily available information such as chemical-specific ARARs. Pickup levels are developed to ensure that exposure concentrations left on site are protective of human receptors (based on future recreational land use) and ecological receptors. In general, cleanup goals are established with consideration to the following:

- Protecting human receptors from adverse health effects
- Protecting the environment from detrimental impacts from site-related contamination
- Compliance with federal and state ARARs

Surface soil cleanup goals were determined for the COCs identified in Section 1.5. The cleanup goals were based on the following criteria:

- Protection of human health from direct exposure to contaminants in surface soil at levels exceeding the site-specific SCTLs.

- Protection of potential ecological receptors from direct exposure to contaminants in surface soil and sediment at levels exceeding the site-specific ecological target levels.

2.2.1 Development of Site-Specific SCTLs for Human Health

The reuse plan for NAS Cecil Field stipulates that Site 15 will be maintained as a green space with no planned development for the site. Therefore, it was agreed by the BCT that future human receptors for the site would be limited to low-intensity recreational receptors with infrequent exposure, such as hikers, bikers, horseback riders, birders, and hunters. Based on the results of previous investigations and the PRE, the main COCs are BaPEqs and lead. Additional COCs include antimony, arsenic, and TRPH. Therefore, site-specific SCTLs for these COCs that would be protective of the hypothetical recreational receptor were developed.

Based on the known future use of the site, U.S. EPA, FDEP, and the Navy agreed that the human health SCTLs should be protective of the recreational user. The exposure assumptions for the Site 15 recreational user are presented below.

Site 15 Exposure Assumptions for the Adult Recreational User	
Exposure Frequency (EF)	50 days/year
Exposure Duration (ED)	20 years
Fraction from Source (FC)	1
Soil Ingestion Rate (IR)	50 mg/day
Surface Area (SA)	3,000 cm^2
Soil Adherence Factor (AF)	0.07 mg/cm^2
Inhalation Rate (IRi)	15 m^3/day
Body Weight (BW)	35 kg

In developing site-specific SCTLs protective of the recreational user, the BCT agreed that the receptor is exposed through incidental ingestion, dermal contact, and inhalation of fugitive dust. It was assumed that the receptor is present on site 1 day per week, 50 weeks per year (50 days per year) for 20 years. The exposure frequency and exposure duration were initially based on revised assumptions included in FDEP's exposure assumptions for recreational exposure at former cattle-dip sites (prepared by Woodward-Clyde for FDEP). Specifically, these assumptions for exposure frequency and exposure duration correspond to a "Restricted II" site, which is a site that involves infrequent site contact. The document identifies a hiking trail to be a "Restricted II" site. It was also assumed that soil ingestion for this receptor is 50 mg per day. This ingestion rate corresponds to U.S. EPA's and FDEP's default value for an adult worker. The nature of the site and the nature of the assumed activities do not constitute a need to assume a higher ingestion rate. Dermal exposure was also considered in the development of the SCTL. It was agreed that the surface area potentially exposed to soil would be 3,000 square centimeters (cm^2), which is between the FDEP adult worker surface area (2,000 cm^2) and the adult residential surface area (3,674 cm^2). It was also agreed that the soil adherence factor would be 0.07 mg per cm^2, a value referenced in U.S. EPA's Exposure Factors Handbook (U.S. EPA, 1997a) for the adult resident. The inhalation rate corresponds to the FDEP and U.S. EPA default value for the worker.

Using these assumptions in conjunction with FDEP's equation for calculating an SCTL, the Site 15 recreational SCTL for cPAHs in terms of BaPEqs is 2,250 µg/kg. Details regarding the development of this SCTL are presented in Appendix F.

The same exposure assumptions used to derive the site-specific BaPEq SCTL were used to derive the site-specific SCTL for lead. The primary difference was that the U.S. EPA's Adult Lead Model was used (1996). This model can be used to determine the soil lead concentration that would result in a fetal blood lead level of 10 milligram per deciliter (µg/dL). Based on the same exposure assumptions outlined above, the adult recreational SCTL for lead at Site 15 is 3,281 mg/kg. Details regarding the development of this site-specific SCTL are presented in Appendix F.

In the context of assessing potential risks to human health from exposure to lead in soils at Site 15, the question arose as to what constitutes an acceptable soil lead concentration limit based on acute contact by a small child. This question was considered important because it would define an effective not-to-exceed value for lead in areas where small children could ingest large quantities of soil. It is unlikely that a child would be left unattended to ingest quantities of soil greater than the intake used to assess chronic exposures. Nonetheless, an analysis was conducted to determine a not-to-exceed lead concentration in soil such that acute exposure, in the form of a soil pica episode (single dose), would not result in a blood lead concentration associated with acute lead toxicity in children. This analysis was conducted by Drs. Stephen Roberts and Bernard Gadagbui of the University of Florida, Dr. Joel Pounds of Battelle

Northwest Laboratories, and Dr. Ted Simon of U.S. EPA Region 4. The analysis resulted in a not-to-exceed lead concentration of 6,500 mg/kg. The value is based on a child of 2 years, the approximate age when a soil pica event while at play is most likely, ingesting 10 grams of soil in an episode. The basis for this determination is presented in more detail in Appendix F.

Site-specific SCTLs were developed for the other COCs (antimony, arsenic, and lead) using the same exposure assumptions in conjunction with the toxicity factors and chemical properties used in developing FDEP SCTLs. Details regarding development of these SCTLs are presented in Appendix F.

Although the reuse plan for Site 15 stipulates that the site will be maintained as a green space with no development, determining the requirements for unrestricted use of the site (e.g., residential use) was evaluated to provide a basis of comparison. To achieve unrestricted use, the entire site must be remediated such that COC concentrations within 0.25-acre exposure units are less than the Chapter 62-777, F.A.C. residential SCTLs.

The following table summarizes the site-specific recreational SCTLs developed based on protection of human health and the Chapter 62-777 FDEP residential SCTLs for the Site 15 COCs.

SCTLs for Site 15 COCs		
COC	**Site-Specific Recreational SCTL**	**FDEP Residential SCTL**
BaPEqs	2,250 µg/kg	0.1 µg/kg
Lead (Acute)	6,500 mg/kg	NA
Lead (Chronic)	3,281 mg/kg	400 mg/kg
Antimony	1,440 mg/kg	27 mg/kg
Arsenic	36 mg/kg	2.1 mg/kg
TRPH	8,900 mg/kg	460 mg/kg

2.2.2 Development of Site-Specific Ecological Target Levels

The detailed development of target levels also identified as remediation goals for protection of ecological receptors is described in Appendix B. The methodologies through which the ecological target levels were developed have been approved by representatives of the Navy, U.S. EPA Region 4, and FDEP.

As discussed in Appendix B, the toxicity of PAHs to upper-level receptors such as birds and mammals via the terrestrial food web is negligible at the concentrations present at Site 15. The concentration of total PAHs (the sum of individual detected PAHs) believed to be potentially toxic to soil invertebrates at Site 15 is greater than 1,121,520 µg/kg, based on a site-specific toxicity test. This was the maximum total PAH concentration tested in the study.

Risk to invertebrates from lead in soil was evident at the highest concentration tested (5,470 mg/kg). There was no indication of lead-related impacts at concentrations less than 1,120 mg/kg. There is uncertainty regarding lead toxicity to invertebrates at soil concentrations between these two values. The soil target level for lead to be protective of insectivorous birds is 1,127 mg/kg (site-wide average lead concentration). The characterization of lead-related risk to insectivorous mammals is complicated by uncertainty regarding the most appropriate soil-to-invertebrate bioaccumulation factor (BAF). Based on the regression-derived BAF from 12 invertebrate and corresponding soil samples, the soil ecological target level for lead that is protective of insectivorous mammals is 2,512 mg/kg. Based on the median BAF, the soil ecological target level for lead that is protective of insectivorous mammals is 4,716 mg/kg. Both of the insectivorous mammal screening values apply to 2-acre average lead concentrations.

2.2.3 Determining the Extent of Remediation Required to Achieve Cleanup Goals

A statistically based approach was used to determine the concentrations above which soil must be removed to achieve UCLs or average concentrations less than or equal to site-specific SCTLs for a defined exposure unit, the area to which a receptor is assumed to be exposed. For human and avian receptors, the entire site is defined as the exposure unit. For mammalian receptors, the exposure unit is a 2-acre unit, which represents the home range of the shrew.

For Site 15, there is a need to achieve exposure concentrations less than site-specific SCTLs concurrently for BaPEqs and lead. The cleanup goals for all receptors are summarized below.

Summary of Cleanup Goals			
COC	**Receptor**	**Recreational and Ecological**	**Residential and Ecological(1)**
Lead	Human (Site-wide)	3,281 mg/kg	400 mg/kg
	Acute Toxicity Human (Site-wide)	6,500 mg/kg	6,500 mg/kg
	Avian (Site-wide)	1,127 mg/kg(2)	1,149 mg/kg
	Mammalian (2-Acre)	2,512 mg/kg(2)	2,512 mg/kg
BaPEqs	Human (Site-wide)	2,250 µg/kg	100 µg/kg
Arsenic	Human (Site-wide)	36 mg/kg	2.1 mg/kg
Antimony	Human (Site-wide)	1,440 mg/kg	27 mg/kg
TRPH	Human (Site-wide)	8,900 mg/kg	400 mg/kg

1 These values apply to 0.25-acre exposure units.
2 The minimum remedial goal for these receptors based on the uncertainty of the variables.

The pre-remediation conditions identifying maximum concentrations, UCLs, and average concentrations for the identified COCs are summarized below.

Pre-Remediation Conditions			
COC	**Maximum Concentration**	**UCL**	**Average Concentration**
Lead	41,400 mg/kg	Not applicable	990 mg/kg
BaPEqs	1,573,000 µg/kg	13,000 µg/kg	9,400 µg/kg
Arsenic	451 mg/kg	29 mg/kg	17 mg/kg
Antimony	2,440 mg/kg	164 mg/kg	78 mg/kg
TRPH	2,380 mg/kg	273 mg/kg	96 mg/kg

The site-wide average lead concentration of 990 mg/kg is already less than its minimum site-wide goal of 1,127 mg/kg, the concentration protective of the avian receptor. Therefore, site-wide remediation for lead would not be required to be protective of avian receptors. However, to address acute toxicity to children, it was agreed that soil with lead concentrations greater than 6,500 mg/kg would be removed. Removal of soil with lead concentrations greater than 6,500 mg/kg results in a site-wide post-remedial concentration of 577 mg/kg, which is protective of human receptors under a low-intensity recreational reuse scenario and site-wide ecological receptors.

To address the mammalian ecological receptors represented by the least shrew, which has an average home range of 2 acres, Site 15 was divided into a grid of 2-acre exposure units. A statistical analysis was performed for each 2-acre exposure unit assuming removal of all soil with lead concentrations greater than 6,500 mg/kg. The average lead concentration in two 2-acre exposure units exceeded the remedial goal (2,512 mg/kg) for the least shrew. Therefore, additional removal of soil in these two 2-acre units with lead concentrations greater than 4,000 mg/kg would be required to achieve the mammalian ecological remedial goal.

In accordance with Chapter 62-780, F.A.C., soil with concentrations greater than three times the site-specific SCTLs would be removed based on acute toxicity. Based on the existing conditions and site-specific SCTLs, remediation or treatment would not be needed to address antimony contamination. Removal of soil with BaPEq and arsenic concentrations greater than three times their site-specific SCTLs is more than sufficient to result in site-wide UCLs less than site-specific SCTLs. To be protective of human and ecological receptors, the existing on-site TRPH concentrations indicate that remediation or treatment would not be needed. However, there are locations where TRPH concentrations exceed the leachability criterion of 340 mg/kg, the most restrictive FDEP SCTL for TRPH. Because the volume of soil associated with the exceedances of the leachability criterion was relatively insignificant, it was agreed that the pickup value for TRPH would be based on the leachability criterion.

The corresponding pickup values that comply with regulatory requirements and would obtain site-wide cleanup goals that allow for recreational use of the site are presented below.

Recreational Pickup Values			
COC	**Maximum Detected Concentration**	**Recreational Use Cleanup Goal**	**Recreation Use Pickup Value**
BaPEqs	956,000 µg/kg	2,250 µg/kg	6,750 µg/kg(1)
Arsenic	451 mg/kg	36 mg/kg	108 mg/kg(1)
Lead	41,400 mg/kg	3,281 mg/kg (chronic)	6,500 mg/kg(2)
TRPH	2,380 mg/kg	8,900 mg/kg	340 mg/kg(3)

1 Three times the site-specific recreational SCTL as per Chapter 62-780, F.A.C. for acute toxicity.
2 Site-specific acute toxicity SCTL.
3 Chapter 62-777, F.A.C. leachability SCTL.

The post-remedial conditions that exist after applying the recreational pickup values are presented below.

Post-Remediation Conditions		
COC	**Maximum Concentration**	**Site-Wide Concentration(1)**
Lead (site wide)	6,500 mg/kg	577(2) mg/kg
BaPEqs	6,750 µg/kg	695 µg/kg
Arsenic	34.5 mg/kg	7.3 mg/kg
Antimony	221 mg/kg	30.8 mg/kg
TRPH	114 mg/kg	39.4 mg/kg

1 Represented by the 95-percent UCL, except as noted.
2 Average concentration.

For lead, it is necessary to achieve a site-wide concentration of 1,127 mg/kg to protect the most sensitive receptor, the mockingbird, and to achieve 2-acre concentrations less than 2,512 mg/kg to protect the shrew. To be protective of an acute lead exposure, it was agreed that the maximum lead concentration remaining on site would be 6,500 mg/kg. Removal of soil with lead concentrations greater than 6,500 mg/kg results in attainment of the site-wide SCTL. Additional removal of soil with lead concentrations greater than 4,000 mg/kg was required in two 2-acre units to attain the mammalian ecological SCTL.

For cPAHs, it is necessary to achieve a site-wide BaPEq concentration of 2,250 µg/kg to protect the low-intensity recreational receptor. For arsenic, it is necessary to achieve a site-wide concentration of 36 mg/kg. Removal or treatment of soils with concentrations greater than three times their site-specific SCTLs results in post-remediation site-wide UCL concentrations less than these site-wide SCTLs.

2.3 GENERAL RESPONSE ACTIONS AND ACTION-SPECIFIC ARARs

GRAs are broadly defined remedial approaches that may be used (by themselves or in combination with one or more of the others) to attain RAOs. Action-specific ARARs and TBC criteria are those regulations, criteria, and guidances that must be complied with or taken into consideration during remedial activities on site.

2.3.1 General Response Actions

GRAs describe categories of actions that could be implemented to satisfy or address a component of an RAO for the site. Remedial action alternatives are then composed using GRAs individually or in combination to meet the RAOs. The remedial action alternatives, composed of GRAs, will be capable of achieving the RAOs for contaminated soil at Site 15.

The following GRAs were considered for surface soil:

- No Action
- Limited Action: Land Use Controls (LUCs)
- Containment
- Removal
- In-Situ Treatment
- Ex-Situ Treatment
- Disposal

2.3.2 Action-Specific ARARs

Action-specific ARARs and TBC criteria are technology- or activity-based regulatory requirements or guidance that would control or restrict remedial action. Tables 2-5 and 2-6 present a list of federal and State of Florida action-specific ARARs and TBCs for this FS.

2.4 ESTIMATED VOLUMES OF CONTAMINATED SOIL

Preliminary surface areas and volumes of soil that would need to be remediated to allow for the planned future low-intensity recreational use of Site 15 were estimated. Based on the Site 15 soil database provided in Appendix E and on the findings of the Geostatistical Assessment Report provided in Appendix D (Newfields, 2004), it is estimated that a total volume of approximately 11,600 yd^3 of contaminated soil from 20 separate areas with a combined surface of approximately 7.2 acres contains concentrations of

COCs greater than recreational pickup values. These areas are illustrated on Figure 2-1 and summarized as follows:

- PAH-contaminated soil with BaPEq concentrations greater than 6,750 µg/kg – Nine areas totaling 235,900 square feet (ft^2), or 5.42 acres, from 0 to 1 foot bgs.

- Lead-contaminated soil with concentrations greater than 6,500 mg/kg – Eight areas totaling 75,300 ft^2, or 1.73 acres, from 0 to1 foot bgs.

- TRPH-contaminated soil with concentrations greater than 340 mg/kg – One 500 ft^2 area (0.01 acre) from a depth of 1 to 2 feet bgs. This area is located within one of the above-mentioned areas of PAH-contaminated soil.

- Arsenic-contaminated soil with concentrations greater than 36 mg/kg – Two areas totaling 1,600 ft^2, or 0.04 acre, from ground surface to the water table (assume to be 2 feet bgs). At the time of sample collection in these arsenic-contaminated areas, the water table was within 1 foot of the ground surface, limiting unsaturated soil sample collection to this depth. Because the water table has decreased, overexcavation to a depth of 2 feet bgs will be conducted in these areas.

Preliminary surface areas and volumes of soil that would need to be remediated to allow for potential future unrestricted use of Site 15 were also estimated. Based on a comparison of the Site 15 soil database to the pickup values for hypothetical future residential use, it was estimated that a total volume of approximately 118,000 yd^3 of contaminated soil over a surface area of approximately 73 acres of would need to be remediated, as illustrated on Figure 2-2 and summarized as follows:

- PAH-contaminated soil with BaPEq concentrations greater than 100 µg/kg – 1,772,800 ft^2, or 40.7 acres, from 0 to 1 foot bgs.

- Lead-contaminated soil with concentrations greater than 400 mg/kg – 632,460 ft^2, or 14.5 acres, from 0 to 1 foot bgs.

- PAH- and lead-contaminated soil with BaPEq concentrations greater than 100 µg/kg and lead concentrations greater than 400 mg/kg – 789,650 ft^2, or 18.1 acres, from 0 to 1 foot bgs.

- Arsenic-contaminated soil with concentrations greater than 2.04 mg/kg – Included within the other areas from 0 to 2 feet bgs.

- TRPH-contaminated soil with concentrations greater than 340 mg/kg – Included within the PAH-contaminated area noted above from a depth of 1 to 2 feet bgs.

The Geostatistical Assessment Report (Appendix D) stated that significant soil sampling was conducted at Site 15 and that the delineation of lead and BaPEqs was accurate and complete, and therefore confirmation sampling is not warranted. Additional discussions regarding this topic were held (as identified in BCT Meeting Minute No. 2208), and it was agreed by the BCT (Decision No. 687) that the areas requiring remediation for BaPEqs only would not require confirmation sampling; however, the areas being remediated for lead would require limited confirmation sampling. Six areas have been identified as exceeding the lead pickup level for recreational use and therefore would require confirmation sampling. A confirmation sampling plan will be developed as part of the remedial design. The confirmation sampling will be conducted prior to the implementation of the remedial action.

TABLE 2-1

FEDERAL CHEMICAL-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Cancer Slope Factors (CSFs)	NA	To Be Considered	CSFs are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	CSFs would be considered for development of human health protection PRGs for soil at this site.
Reference Doses (RFDs)	NA	To Be Considered	RFDs are guidance values used to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	RFDs would be considered for development of human health protection PRGs for soil at this site.

NA – Not applicable.

TABLE 2-2

STATE CHEMICAL-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Contaminant Cleanup Target Levels Rule	Chapter 62-777, Florida Administrative Code (F.A.C.)	Relevant and Appropriate	This document provides guidance for soil, groundwater, and surface water cleanup levels that can be developed on a site-by-site basis.	These guidelines would be used in determining cleanup goals.
Approach to the Assessment of Sediment Quality in Florida Coastal Waters, 1995		To Be Considered	This document recommends effects-based sediment quality assessments such as identifying nonpoint source management, designing wetlands restoration projects, and monitoring trends in environmental contamination.	These guidelines would be used when evaluating the potential biological harm posed by contaminated sediments in Florida coastal waters.

TABLE 2-3

FEDERAL LOCATION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Endangered Species Act Regulations	50 Code of Federal Regulations(CFR) Parts 81, 225, 402	Potentially Applicable	This act requires federal agencies to take action to avoid jeopardizing the continued existence of federally listed endangered or threatened species.	If a site investigation or remediation could potentially affect an endangered species or their habitat, these regulations would apply.
Historic Sites Act Regulations	36 CFR Part 62	Potentially Applicable	Requires federal agencies to consider to existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	The existence of Natural Landmarks would be identified prior to remedial activities on site including remedial investigations
Clean Water Act (CWA) Regulations, Guidelines for Specification of Disposal Sites for Dredged or Filled Materials	40 CFR Part 230	Potentially Applicable	These regulations apply to all existing, proposed, or potential disposal sites for discharges of dredged or fill material into U.S. waters, including wetlands.	If a remediation involves the discharge of dredged or fill material into a wetland, it must be demonstrated that such a discharge will not have an unacceptable effect on the wetland.
Fish and Wildlife Coordination Act Regulations	33 CFR Subsection 320.3	Potentially Applicable	Requires that the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and related state agencies be consulted prior to structural modification of any body of water, including wetlands. If modifications must be conducted, the regulation requires that adequate protection be provided for fish and wildlife resources.	If a remedial alternative involves the alteration of a stream or wetland, these agencies would be consulted.

TABLE 2-3

FEDERAL LOCATION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
National Environmental Policy Act (NEPA) Regulations, Wetlands, Floodplains, etc.	40 CFR Subsection 6.302 [a]	Potentially Applicable	These regulations contain the procedures for complying with Executive Order 11990 on wetlands protection. Appendix A states that no remedial alternative adversely affect a wetland if another practicable alternative is available. If no alternative is available, impacts from implementing the chosen alternative must be mitigated.	If remedial action affects a wetland, these regulations would apply. Approximately 7,000 square feet of wetlands would be affected under the recreational scenario, and all the wetland identified would be affected under the unrestricted reuse scenario.
National Environmental Policy Act (NEPA) Regulations, Floodplain Management, Executive Order 11988	40 CFR Part 6, Appendix A	Potentially Applicable	Appendix A describes the policy for carrying out the Executive Order regarding floodplains. If no practicable alternative exists to performing cleanup in a floodplain, potential harm must be mitigated and actions taken to preserve the beneficial value of the floodplain.	If removal actions take place in a floodplain, alternatives would be considered that would reduce the risk of flood loss and restore and preserve the floodplain.
Fish and Wildlife Conservation Act	40 CFR Section 6.302	Potentially Applicable	Requires action to be taken to protect fish and wildlife from projects affecting streams or rivers.	United States Fish and Wildlife Service (USFWS) officials would be consulted on how to minimize impacts of any remedial activities on any wildlife. The presence of gopher tortoises will be taken into account for possible relocation if remedial activities may adversely impact their habitat.

TABLE 2-4

STATE LOCATION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Delineation of the Landward Extent of Wetlands and Surface Waters	Chapter 62-340, Florida Administrative Code (F.A.C.)	Potentially Applicable	This rule's intent is to provide a unified statewide methodology for the delineation of the extent of wetlands and surface waters	To be used to determine the extent of wetlands.
Environmental Resource Permit Procedures	Chapter 62-343, F.A.C.	Potentially Applicable	This rule provides the procedural requirements for processing environmental resource permits and for obtaining formal determinations of the landward extent of wetlands and surface waters.	This rule will be followed if any discharge to surface is required.

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Resource Conservation and Recovery Act (RCRA) Regulations, Identification and Listing of Hazardous Wastes	40 Code of Federal Regulations (CFR) Part 261	Potentially Applicable	Defines the listed and characteristic hazardous wastes subject to RCRA. Appendix II contains the Toxicity Characteristic Leaching Procedure.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations.
Clean Air Act (CAA) Regulations, National Ambient Air Quality Standards (NAAQSs)	40 CFR Part 50	Potentially Applicable	Establishes primary (health-based) and secondary (welfare-based) air quality standards for carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur oxides emitted from a major source of air emissions. The NAAQS form the basis for all regulations promulgated under the CAA. However, the NAAQS themselves are non-enforceable and are not ARARs themselves.	Site remediation activities must comply with NAAQSs. The principal application of these standards is during remedial activities resulting in exposures through dust and vapors. In general, emissions from CERCLA activities are not expected to qualify as a major source, and are therefore, not expected to be applicable requirements. However, the requirements may be determined to be relevant and appropriate for non-major sources with significantly similar emissions.
RCRA Regulations, Land Disposal Restrictions (LDRs)	40 CFR Part 268	Potentially Applicable	This regulation prohibits the land disposal of untreated hazardous wastes and provides criteria for the treatment of hazardous waste prior to land disposal.	Remedial actions that involve excavating, treating, and redepositing hazardous soil would comply with LDRs. However, consolidation of contaminated soil within Site 15 for the purposes of reducing the size of the contaminated area would not constitute land disposal, per Area of Contamination policy letter (U.S. EPA, March 1996).

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Clean Water Act, National Pollution Discharge Elimination System (NPDES)	40 CFR Parts 122 through 125, and 131	Potentially Relevant and Appropriate	NPDES permits are required for any discharges to navigable waters. If remedial activities include such a discharge, the NPDES standards would be ARARs.	Any alternative which would discharge into any navigable water would require compliance with these regulations including treatment, if necessary.
Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Potentially Applicable	NESHAPs are a set of emissions standards for specific chemicals from specific production activities.	Emissions of hazardous air pollutants would be minimized by fugitive dust control and off gas treatment from a thermal desorption facility remedy.
Air/Superfund National Technical Guidance	U.S. EPA Guidance: EPA/450/1-89/001-EPA/450/1-89/004	To Be Considered	This guidance describes methodologies for predicting risks due to air release at a Superfund site.	These guidance documents would be considered when risks due to air releases from fugitive dust and thermal desorption are being evaluated.
CAA Regulations, New Source Performance Standards (NSPSs)	40 CFR Part 60	Potentially Relevant and Appropriate	This rule establishes NSPSs for specified sources that are similar to a source that has established NSPSs (such as air stripping technologies). The NSPSs limit the emissions of a number of different pollutants, including the six criteria pollutants list (for which NAAQSs are established) as well fluorides, sulfuric acid mist, and total reduced sulfur including hydrogen sulfide (H_2S).	This rule may be a relevant and appropriate requirement for a new source that is similar to a source that has established NSPSs (such as thermal desorption). If it is determined that the remedy would create potential air impacts, the response action or the equipment for the response action may qualify as a new source; therefore, these requirements would be met.

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
CWA Regulations, National Pretreatment Standards	40 CFR Part 403	Potentially Relevant and Appropriate	Sets pretreatment standards through the National Categorical Standards of the General Pretreatment Regulations for the introduction of pollutants from non-domestic sources into Publicly Owned Treatment Works (POTWs) in order to control pollutants that pass through, cause interference, or are otherwise incompatible with treatment processes at a POTW.	If wastewater from an alternative is discharged to a POTW or the FOTW, the discharge must meet local limits imposed by the POTW. A discharge from a CERCLA site must meet the POTW's pretreatment standards in the effluent of the POTW. Discharge to a POTW is considered an off-site activity and is, therefore subject to both the substantive requirements of this rule.
RCRA Regulations, General Facility Standards	40 CFR Subpart B, 264.10-264.18	Potentially Relevant and Appropriate	Sets the general facility requirements including general waste analysis, security measures, inspections, and training requirements. Section 264.18 establishes that a facility located in a 100-year floodplain must be designed, constructed, and maintained to prevent washout of any hazardous wastes by a 100-year flood.	If the remedial action involves construction of an on-site treatment facility, the substantive requirements of this rule would be applicable requirements. A permitted treatment facility must be selected for off-site treatment.
RCRA Regulations, Miscellaneous Units	40 CFR Part 264, Subpart X	Potentially Relevant and Appropriate	These standards are applicable to miscellaneous units not previously defined under existing RCRA regulations. Subpart X outlines performance requirements that miscellaneous units be designed, constructed, operated, and maintained to prevent releases to the subsurface, groundwater, and wetland that may have adverse effects on human health and the environment.	The design of proposed treatment alternatives, not specifically regulated under other subparts of RCRA, must prevent the release of hazardous constituents and future impacts on the environment. This subpart would apply to on-site construction of any treatment facility that is not previously defined under the RCRA regulation.

TABLE 2-5

FEDERAL ACTION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
RCRA Regulations, Standards for Owners and Operators of Hazardous Waste TSDFs.	40 CFR Part 264	Potentially Relevant and Appropriate	Establishes minimum national standards defining the acceptable management of hazardous wastes for owners and operators of facilities that treat, store, or dispose of hazardous wastes.	If remedial actions involving management of RCRA wastes at an off-site TSDF or if RCRA wastes are managed on-site, the requirements of this rule would be followed.
RCRA Regulations, Use and Management of Containers	40 CFR Part 264, Subpart I	Potentially Relevant and Appropriate	Sets standards for the storage of containers of hazardous waste.	This requirement would apply if a remedial alternative involves the storage of a hazardous waste (i.e. contaminated soil) in containers, prior to treatment or disposal.
Migratory Bird Treaty Act	16 USC 703-711	Potentially Applicable	Protects migratory birds and their nests.	Proposed action shall not kill migratory birds or destroy their nests and eggs.

References:
U.S. EPA, March 1996. Policy letter "Area of Contamination" from Michael Shapiro, Director, Office of Solid Waste, EPA Washing ton, D.C., to Norman H. Nosenchuck, Director of Division of Solid & Hazardous Materials, New York State Department of Environmental Conservation.

TABLE 2-6

STATE ACTION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Hazardous Waste Rules – October 1993	FAC Chapter 62-730	Potentially Applicable	Adopts by reference sections of the federal hazardous waste regulations and establishes minor additions to these regulations concerning the generation, storage, treatment, transportation and disposal of hazardous wastes.	These regulations would apply if waste onsite was deemed hazardous and needed to be stored, transported, or disposed of properly.
Florida Wetland Application Regulations – November 1989	FAC Chapter 62-611	Potentially Applicable	Sets requirements for discharge of domestic wastewater to wetland. This rule mainly addresses the discharge of domestic wastewater to wetlands. Discharge limits are established for Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), nitrogen, and phosphorus.	This rule would be considered for remedial alternatives that would result in discharges to wetlands where these limits may be approached.
Florida Dredge and Fill Activities	FAC Chapter 62-312	Potentially Applicable	This rule establishes requirements for dredging, filling, excavating, or placing material in or over the waters of the state, including wetlands.	The requirements of these rules would be considered when developing and implementing remedial activities that involve waters of the state.
Florida Solid Waste Management Facilities	FAC Chapter 62-701	Potentially Applicable	Sets the facility standards for construction, operation, and closure of SWMUs.	These requirements would apply if on-site waste was deemed a nonhazardous solid waste and needed to be stored, transported, or disposed of properly.

TABLE 2-6

STATE ACTION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Air Pollution Rules – October 1992	Chapter 62-2, Florida Administrative Code (F.A.C.)	Potentially Relevant and Appropriate	Establishes permitting requirements for owners or operators of any source that emits any air pollutant. This rule also establishes ambient air quality standards for sulfur dioxide, carbon monoxide, lead, and ozone.	Although this rule is directly applicable to industrial polluters, these requirements are relevant and appropriate for a remedial action that could result in release of regulated contaminants to the atmosphere, such as may occur during excavation.
Florida Regulation of Stormwater Discharge – May 1993	Chapter 62-25, F.A.C.	Potentially Relevant and Appropriate	Establishes requirements for discharges of untreated stormwater to ensure protection of the surface water of the state.	Remedial actions would consider the impact of the discharge of untreated stormwater from the site.
Florida Ambient Air Quality Standards – December 1994	Chapter 62-272, F.A.C.	Potentially Applicable	Establishes ambient air quality standards necessary to protect human health and public welfare. It also establishes maximum allowable increases in ambient concentrations for subject pollutants to prevent significant deterioration of air quality in areas where ambient air quality standards are being met. Approved air quality monitoring methods are also specified.	These ambient air quality standards would be met for remedial actions involving the possible release exposure of contaminants to the atmosphere.

TABLE 2-6

STATE ACTION-SPECIFIC ARARs
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Air Pollution Episodes – September 1994	Chapter 62-273, F.A.C.	Potentially Relevant and Appropriate	This rule classifies an air episode as an air alert, warning or emergency and establishes criteria for determining the level of the air episode. It also establishes response requirements for each level.	These regulations would be adhered to if remedial actions involve air emissions.
Florida Rules on Hazardous Waste Warning Signs – July 1991	Chapter 62-736, F.A.C.	Applicable	Requires warning signs at NPL and FDEP identified hazardous waste sites to inform the public of the presence of potentially harmful conditions.	This requirement will be met.

Legend
- Monitoring Well
- Surface Soil Sample Location
- Subsurface Soil Sample Location
- Surface Water / Sediment Sample Location
- Confirmation Soil Sample Location
- Post RI Surface Soil Sample Location
- Post RI Surface Water / Sediment Sample Location
- BaPEq, 0-1 foot bgs
- Lead, 0-1 foot bgs
- TRPH, 1-2 feet bgs
- Arsenic, 0-2 feet bgs or water table if less than 2 feet bgs
- Wetlands

Wetland A

Wetland B

Survey Limits

Wetland D

Wetland E

Wetland F

Wetland C

SEE INSET 1

SEE INSET 2

Inset 2

Inset 1

N

100 0 100 200 Feet

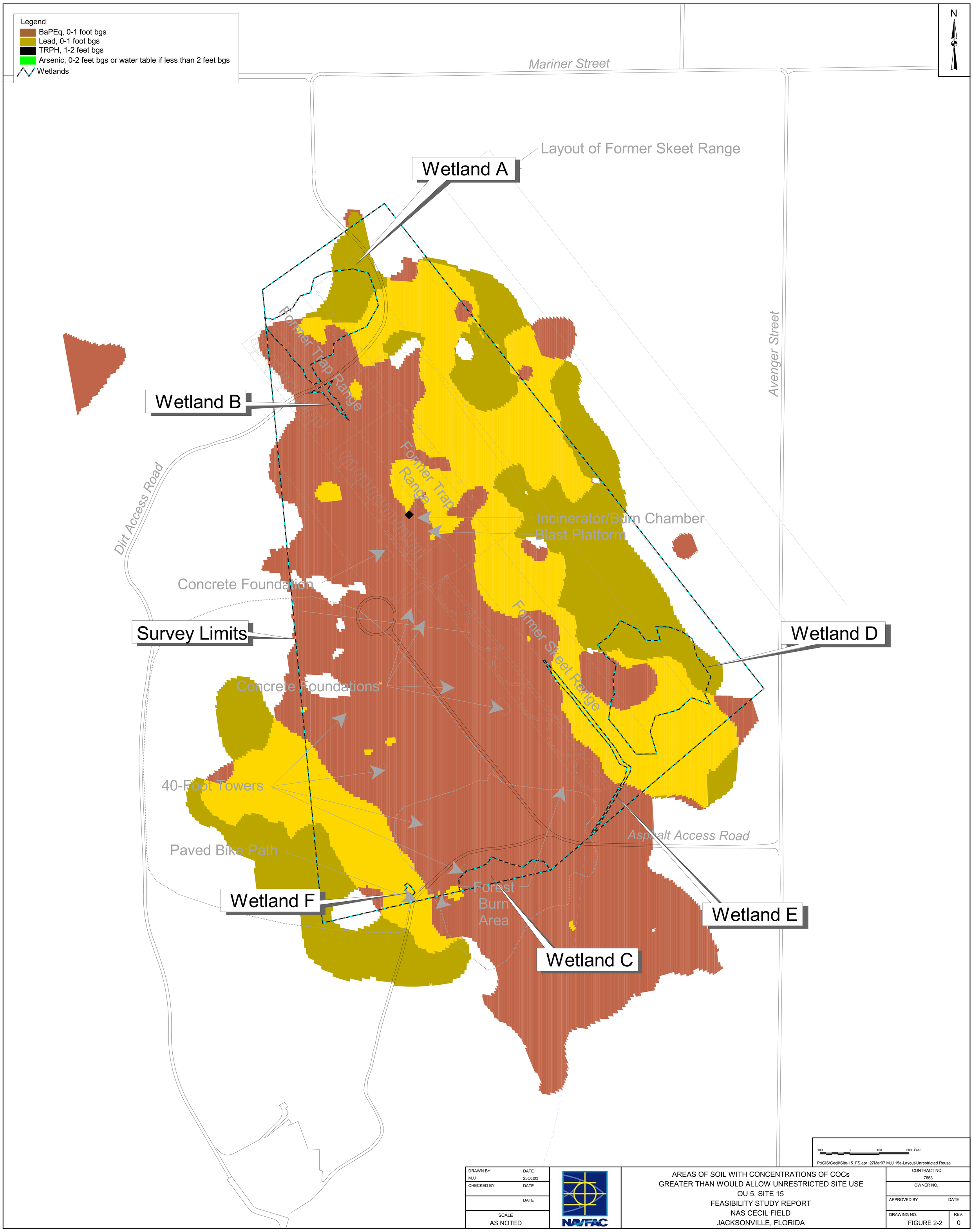
P:\GIS\Cecil\Site-15_FS.apr 27Mar07 MJJ 14a-Layout-Recreational Reuse

DRAWN BY	DATE
MJJ	23Oct03
CHECKED BY	DATE
	DATE
SCALE	
AS NOTED	

NAVFAC

AREAS OF SOIL WITH CONCENTRATIONS OF COCs
GREATER THAN RECREATIONAL PRGs
OU 5, SITE 15
FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

CONTRACT NO.	
7653	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 2-1	0


Legend
BaPEq, 0-1 foot bgs
Lead, 0-1 foot bgs
TRPH, 1-2 feet bgs
Arsenic, 0-2 feet bgs or water table if less than 2 feet bgs
Wetlands
N
Mariner Street
Layout of Former Skeet Range
Wetland A
Avenger Street
Former Trap Range
Wetland B
Former Trap Range
Dirt Access Road
Incinerator/Burn Chamber
Blast Platform
Concrete Foundation
Survey Limits
Former Skeet Range
Wetland D
Concrete Foundations
40-Foot Towers
Asphalt Access Road
Paved Bike Path
Forest Burn Area
Wetland F
Wetland E
Wetland C
100 0 100 200 Feet
P:\GIS\Cecil\Site-15_FS.apr 27Mar07 MJJ 15a-Layout-Unrestricted Reuse
DRAWN BY MJJ
DATE 23Oct03
CHECKED BY
DATE
DATE
SCALE AS NOTED
NAVFAC
AREAS OF SOIL WITH CONCENTRATIONS OF COCs
GREATER THAN WOULD ALLOW UNRESTRICTED SITE USE
OU 5, SITE 15
FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA
CONTRACT NO. 7653
OWNER NO.
APPROVED BY
DATE
DRAWING NO. FIGURE 2-2
REV. 0

3.0 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential technologies and process options that may be applicable to develop the remedial alternatives for OU 5, Site 15 at NAS Cecil Field. The primary objective of this phase of the FS is to develop an appropriate range of remedial technologies and process options that will be used for developing the remedial alternatives.

The basis for technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Development of RAOs
- Identification of ARARs
- Identification of COCs
- Development of cleanup goals
- Identification of GRAs
- Identification of volumes and areas of medium of concern

Technology screening evaluation is performed in this section with the completion of the following analytical steps:

- Identification and preliminary screening of remedial technologies and process options.
- Detailed screening of remedial technologies and process options that pass the preliminary screening step.
- Evaluation and selection of representative process options.

In this section, a variety of technologies and process options are identified under each GRA (discussed in Section 2.3.1) and screened. The selection of technologies and process options for initial screening is based on the Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA (U.S. EPA, 1988). The screening is first conducted at a preliminary level to focus on relevant technologies and process options, then the screening is conducted at a more detailed level based on certain evaluation criteria. Finally, process options are selected to represent the technologies that have passed the detailed evaluation and screening.

The evaluation criteria for detailed screening of technologies and process options that have been retained after the preliminary screening are effectiveness, implementability, and cost. The following are descriptions of these evaluation criteria:

- Effectiveness
  - Protection of human health and environment; reduction in toxicity, mobility, or volume; and permanence of the solution.
  - Ability of the technology to address the estimated areas or volumes of contaminated medium.
  - Ability of the technology to meet the cleanup goals identified in the RAOs.
  - Technical reliability (innovative versus proven) with respect to contaminants and site conditions.

- Implementability
  - Overall technical feasibility at the site.
  - Availability of vendors, mobile units, storage and disposal services, etc.
  - Administrative feasibility.
  - Special long-term operation and maintenance (O&M) requirements.

- Cost (Qualitative)
  - Capital cost.
  - O&M costs.

Technologies and process options identified for the remediation of soil at Site 15 are discussed in the following sections.

3.1 PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and screens technologies and process options for soil at a preliminary stage based on implementation with respect to site conditions and COPCs. Table 3-1 summarizes the preliminary screening of technologies and process options applicable to soil. This table presents the GRAs, identifies the technologies and process options, and provides a brief description of each process option followed by screening comments. The technologies and process options that passed the initial screening step were retained for detailed screening in Section 3.2 and are summarized in Table 3-2.

3.2 DETAILED SCREENING OF TREATMENT TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and develops the representative process options, through a detailed screening procedure, that will be used in the formulation of remedial alternatives to accomplish the RAOs and meet the cleanup goals identified in Section 2.

3.2.1 No Action

No Action consists of maintaining status quo at the site. As required under CERCLA regulations, the No Action alternative is carried through the FS to provide a baseline for comparison of alternatives and their effectiveness in mitigating risks posed by site contaminants.

Effectiveness

No action would not be effective in meeting the soil RAOs. No action would not actively reduce the toxicity, mobility, or volume of contaminants in the soil. There would be no reduction in risk through exposure control or treatment. Lead contamination would remain and, although the PAH contamination may degrade through natural processes over time, this would not be verified.

Implementability

There would be no implementability concerns because no action would be implemented.

Cost

There would be no costs associated with the No Action alternative.

Conclusion

No action is retained because of NCP requirements, although it would not be effective.

3.2.2 Limited Action

This GRA consists of LUCs to limit or restrict site use.

3.2.2.1 Institutional Controls

LUCs would be developed to prevent the site from being used in the future for any purposes other than as a low-intensity recreational area. Physical restrictions to the site may include signage, fencing, physical barriers, and site security.

LUC performance objectives and restrictions for Site 15 would be as follows:

- Prohibit residential, industrial, commercial, agricultural (specifically growing crops for human consumption), and medium- and high-intensity recreational reuse of the site unless prior written

approval is obtained from the Navy, U.S. EPA, and FDEP. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities. Prohibited high-intensity recreational activities include, but are not limited to, playgrounds, athletic fields, etc. Prohibited medium-intensity recreational activities include, but are not limited to, picnic grounds, camping, etc. Allowable low-intensity recreational activities include hiking, biking, horseback riding, hunting, etc.

- Prohibit the excavation of soils from the site unless prior written approval is obtained from the Navy, U.S. EPA, and FDEP.

- Maintain the integrity of any existing or future monitoring or remediation system(s) unless prior written approval is obtained from the Navy, U.S EPA, and FDEP.

Annual inspections of the site would be conducted to confirm compliance with LUC objectives, and an annual compliance certificate would be prepared and provided to U.S. EPA and FDEP. Prior to any property conveyance, U.S. EPA and FDEP would be notified.

The LUCs would be implemented through a LUC Remedial Design (RD) that would be prepared as a component of the overall RD. In addition to the U.S. EPA and FDEP, copies of the LUC RD would be sent to the City of Jacksonville Parks and Recreation Department, City of Jacksonville Environmental Resource Management Department, City of Jacksonville Planning and Development Department, City of Jacksonville Development Management Group, Jacksonville Electric Authority, and St. Johns River Water Management District. The LUCs would be maintained for as long as they are required to prevent unacceptable exposure to contaminated soil and/or to preserve the integrity of the selected remedy.

Effectiveness

LUCs would not reduce the toxicity, mobility, or volume of COCs in soil. Lead contamination would remain and PAH contamination may degrade through natural processes over time. Prohibiting future residential development of the site would effectively prevent the occurrence of unacceptable risks to human receptors from direct exposure to contaminated soil. However, LUCs would not protect ecological receptors.

Implementability

LUCs would be readily implementable. The implementability of these controls would be more of a concern if the site is transferred to private owners. Provisions would be incorporated in property transfer

documents to insure the continued implementation of institutional controls. Resources are readily available for the preparation of a LUC RD.

Cost

Costs of LUCs would be low.

Conclusion

LUCs are retained in combination with other process options for the development of remedial alternatives.

3.2.3 Containment

The technology considered under this GRA is soil cover.

3.2.3.1 Soil Cover

A soil cover would prevent human receptor contact with Site 15 surface soil and minimize migration and transport of COCs due to erosion. The soil cover would also prevent exposure of ecological receptors to COCs in surface soil. Due to the dense tree and plant growth at Site 15, clearing and grubbing of the area would be required to establish an appropriate cover.

Effectiveness

A soil cover would be effective in preventing potential receptors from direct contact with the contaminated soil. A soil cover would not reduce the toxicity or volume of contaminants in the soil. Lead contamination would remain and PAH contamination may degrade through natural processes over time. Long-term maintenance and monitoring would ensure that the cover remains effective in minimizing the exposure of receptors to COCs. Any exposure to on-site workers during cover installation or monitoring could be easily controlled by complying with the site-specific health and safety plan.

Implementability

Installation of a soil cover at Site 15 would be implementable. Materials and services required to implement this technology are readily available. Clearing of the area to remove trees and vegetation would be required to construct a cover. Removal of the pine needle layer (i.e., duff) would not be required for construction of the soil cover.

This technology is well proven and established in the construction/remediation industry. During installation of the cover, site-specific health and safety procedures and OSHA regulations would have to be complied with to ensure that the exposure of the workers to COCs is minimized. Following installation of the cover, impacted wetlands would have to be restored.

Cost

Capital costs for a soil cover would be low. O&M costs would also be low.

Conclusion

A soil cover is retained to be used in combination with other process options for the development of soil remedial alternatives.

3.2.4 Removal

The technology considered under this GRA is excavation.

3.2.4.1 Excavation

A variety of equipment such as front-end loaders, backhoes, and grade-alls could be used to perform the excavation. The type of equipment selected must take into consideration several factors such as the type of material to be removed, the load-bearing capacity of the ground surrounding the removal area, the depth and areal extent of removal, the required rate of removal, and the elevation of the groundwater table. Excavation is the technology of choice for the removal of well-consolidated material such as soil from well-defined areas of ground with significant load-bearing capacity (i.e., greater than 1,500 pounds per ft^2).

The logistics of excavation must take into account the available space for operating the equipment, loading and unloading of the excavated material, location of the site, etc. After excavation is completed, the location would be filled and graded with clean fill material or treated soils.

Effectiveness

Excavation is a well-proven and effective method of removing contaminated material from a site. Properly designed excavation would remove soil with concentrations of COCs greater than the pickup values, and the remaining soil would not pose an unacceptable risk to human health or the environment.

Implementability

Excavation of contaminated soil at Site 15 would be implementable. Excavation equipment is readily available from multiple vendors. This technology is well proven and established in the construction/remediation industry. During excavation, site-specific health and safety procedures and OSHA regulations would have to be complied with to ensure that the exposure of workers to COCs is minimized.

Because the excavation depth at this site would be limited to a depth of 1 to 2 feet bgs, no shoring would be necessary. Existing structures, tanks, concrete pads, etc. located at the site would have to be removed prior to excavation. Because they are no longer in use, there would be no need to replace them at the completion of the excavation. Following excavation, impacted wetlands would have to be restored.

Cost

Cost of excavation at OU 5, Site 15 on a unit volume basis would be low because of the shallow depth and presence of sandy soils.

Conclusion

Excavation is retained in combination with other process options for the development of remedial alternatives.

3.2.5 Ex-Situ Treatment

The technologies considered under this GRA include soil washing/chemical extraction, chemical fixation/solidification, size reduction, screening, and on-site thermal desorption.

3.2.5.1 Physical/Chemical

3.2.5.1.1 Soil Washing-Chemical Extraction

Soil washing uses physical processes such as high-pressure water, screening, attrition scrubbing, froth flotation, electromagnetic separation, mechanical separation, hydrogravimetric separation (including hydrocyclones, mineral jigs, and spiral classifiers), and multigravity separation. Such physical separation processes achieve waste minimization through a volume reduction process by separating out a size fraction of the soil containing little or no contamination (such as coarse-grained soils and large-sized material) from the more highly contaminated, finer-grained material such as clays and silts.

Chemical extraction uses water or other solvents to extract or desorb COCs from the soil and dissolve them into the liquid phase. Chemical extraction often requires preliminary treatment using physical separation to reduce the volume of material to be treated.

Effectiveness

The effectiveness of soil washing is highly waste specific and is typically well suited for the removal of SVOCs/PAHs and metals such as lead. A thorough physical and chemical characterization of the waste and treatability testing are essential to determine the most suitable and efficient means of separating the COCs from clean soil. When different classes of contaminants are present, such as metals and PAHs, a series of extraction operations using different solvents, pH adjustment. etc., may be required.

A combination of physical separation and various chemical extraction techniques might be used to remove the COCs from Site 15 soil. Nontoxic organic solvents may be used for the removal of PAHs, and acids may be used to remove arsenic and lead. The extraction process would yield clean soil that would require water rinsing to remove the residual extractant. By-products from the process would consist of spent solvent streams containing the wastes requiring further treatment/disposal and recovery/recycle of the extractants.

Implementability

Soil washing/chemical extraction could be implemented at Site 15. However, a full-scale soil washing/chemical extraction system would be very complex, consisting of physical separation operations and chemical extraction processes. Physical separation would consist of several operations depending on the type of debris, sizes, densities of materials, etc. A sieve analysis of the soil would be required for the design of the treatment system. Chemical extraction would require treatability studies to determine the specific type and composition of solvent to be used. Typically, waste streams produced from chemical extraction are more contaminated and greater in volume than waste streams from other processes. To treat the extracted liquid, an extensive wastewater treatment facility would be required to separate the reagents from the treated soils and then to treat the residuals. The wastewater facility would be required to have organic treatment and neutralization processes in addition to dewatering processes. Unless efficient recovery/recycling of the extractant is achievable, there would be significant implementability concerns for further treatment/disposal of the waste streams. Due to potentially high concentrations of lead, the substantive requirements of a RCRA hazardous waste (Subtitle C) treatment, storage, and disposal facility (TSDF) would have to be met by an on-site soil washing/chemical extraction system.

Cost

Capital and O&M costs for soil washing/chemical extraction would be moderate to high. Additional costs for disposal of residues could also be moderate to high.

Conclusion

Soil washing/chemical extraction is retained in combination with other process options for the development of soil remedial alternatives.

3.2.5.1.2 Chemical Fixation/Solidification

Chemical fixation/solidification mixes chemical agents with contaminated soil to immobilize organic and inorganic contaminants. Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (chemical fixation). Binding and hardening material ties up the free water in the soil matrix. Potential chemical agents include Portland cement, cement kiln dust (CKD) lime, thermoplastic binders (i.e., asphalt), sorbents such as granular activated carbon (GAC), clays, zeolites, and anhydrous sodium silicate, or Maectite® reagents. The top 1 to 2 feet of contaminated soil would be excavated and mixed then treated on site to render the soil non-hazardous prior to disposal. In the case of asphalt emulsion-based encapsulation (Encapco Technologies, LLC), the treated soil is typically used as structural fill or road base material. The Encapco technology uses proprietary emulsions of asphalt or tall oil pitch that encapsulate soil particles and form an integral, stable product that is chemically and physically bonded. Upon curing, the product retains its adhesive, durability, and water-resistant properties and can be compacted to form structurally stable road base, or can be used as fill material, erosion control layer, etc. The chemical composition of the asphalt-based emulsion is very similar to the asphalt used for paving roads or parking lots and therefore the technology, although innovative, is gaining acceptance.

Effectiveness

Chemical fixation/solidification is typically quite effective for the immobilization of inorganic chemicals. Therefore, it would be effective for immobilizing the lead in Site 15 contaminated soil. However, traditional chemical fixation/stabilization processes have only limited effectiveness for the immobilization of SVOCs in contaminated soil. The major advantage to this process is that excavated soil at Site 15, which would typically be classified as hazardous as a result of TCLP lead concentrations, would be rendered non-hazardous because the chemical fixation/solidification process would prevent lead from leaching from the solidified soil matrix. Therefore, disposal at a hazardous (RCRA Subtitle C) TSDF would not be necessary. Although most traditional chemical fixation/solidification processes result in a

significant increase in volume, more innovative processes such as the Maectite® chemical fixation process could reduce the total volume of soil through the formation of tight geochemically stable synthetic mineral crystals that form within the waste matrix. which also offers the added advantage of being able to immobilize organic contaminants in addition to inorganics (especially lead), as demonstrated by various TCLP test results.

Implementability

Chemical fixation/solidification is implementable. This technology is well demonstrated, can be applied to the most common site and waste types, requires conventional materials handling equipment, and is available competitively from a number of vendors. Most reagents and additives are also widely available and relatively inexpensive industrial commodities. The Encapco technology is an innovative technology based on a patent. The emulsion is prepared by a proprietary process at a sole-source facility. Although reuse of the treated Encapco product on site would be incompatible with revegetation, its use as an off-site road base material may be suitable, especially if the untreated soil was originally non-hazardous. However, the reuse of the treated Encapco product (even if the soil was originally non-hazardous) would require the identification of a suitable off-site user with adequate need for a large volume of road base, and negotiation of Best Management Practices (BMPs) for the use of the material according to Industrial Byproducts requirements of the FDEP (Personal Communication, Jim Levine, LFR Levine Fricke). If the soil was originally hazardous based on exceeding TCLP standards for lead, an additional requirement would be for the treated product to meet the lead Universal Treatment Standard (UTS) of 0.75 mg/L so that it could be used off site as a recycled product.

Treatability studies would be required to determine or verify such design parameters as pretreatment needs, volume of stabilized soil generated, types and amounts of stabilizing agents, water-to-stabilizer mixing ratios, mixing times, treatment processes involved, and anticipated effectiveness for COC stabilization in the soil matrix. Chemical fixation/solidification has been used at many sites including Superfund sites. The Encapco technology is relatively new to the remediation industry. It is claimed that the treatability studies can be easily performed by following mixing/curing instructions with a free sample of Encapco supplied emulsion (Personal Communication with Bill Jones, Encapco Technologies, LLC, October 10, 2003). Field-scale implementation does not require any specialized equipment that are atypical of the paving industry, i.e., excavator, vibrating screen, pug mill, etc. The emulsion is supplied in a tanker with a metering pump that will directly feed the emulsion into the pug mill.

Cost

Costs for chemical fixation/solidification processes vary widely according to materials or reagents used, their availability, project size, and chemical nature of contaminants.

Conclusion

Chemical fixation/stabilization at an off-site RCRA Subtitle C TSDF is retained for consideration for the treatment of lead-contaminated soil. Ex-situ treatment using the Encapco technology is eliminated because there are currently no end users identified. Also, on-site reuse of the treated product would be incompatible with revegetation of the site.

3.2.5.1.3 Size Reduction

Size reduction would consist of grinding or shredding contaminated debris such as tree stumps so that they would meet the particle size requirements for disposal or subsequent treatment processes. This size reduction would be accomplished by processing the oversized contaminated debris in specialized mechanical equipment such as grinders and shredders.

Effectiveness

Size reduction would not of itself be effective for contaminant removal. However, it would be effective for reducing particle size, which is often required as a pre-treatment to optimize the effectiveness of other treatment processes such as thermal desorption, chemical fixation/stabilization, or soil washing. This could be performed on site following excavation or at an off-site facility.

During operation, risk to site workers operating the size-reduction equipment could be adequately minimized through the use of dust suppression controls, wearing of appropriate personal protective equipment (PPE), and compliance with OSHA regulations and site-specific health and safety procedures.

Implementability

Size reduction would be readily implementable as a pretreatment step. The equipment and labor to operate this equipment would be readily available.

Cost

Capital and O&M costs for size reduction would be low.

Conclusion

Size reduction is retained in combination with other process options for the development of soil remedial alternatives.

3.2.5.1.4 Screening

Screening would consist of separating the excavated material based on particle size. This technology is typically used as a pre-treatment step. Rotary screens (trammels), tumbler screens, vibrating bar screens (grizzlies), etc are some of the configurations and types of mechanical devices available for dry screening applications.

Effectiveness

Screening would be effective for the separation of oversized material that is typically either much less contaminated or non-contaminated. Screening would also be effective and is often required as a pre-treatment to optimize the effectiveness of other treatment processes such as thermal desorption or soil washing. This would reduce the volume of material to be processed through the downstream treatment technology. Screening would best be performed on site, immediately following excavation.

During operation, risk to site workers operating the screening equipment could be adequately minimized through the use of dust suppression controls, wearing of appropriate PPE, and compliance with OSHA regulations and site-specific health and safety procedures.

Implementability

On-site screening would be readily implementable. The equipment and labor to operate this equipment would be readily available.

Cost

Capital and O&M costs for screening would be low.

Conclusion

On-site screening is retained in combination with other process options for the development of soil remedial alternatives.

3.2.5.2 Thermal Treatment

3.2.5.2.1 On-Site Thermal Desorption

Thermal desorption technology uses direct or indirect heating to thermally desorb or volatilize organic contaminants. The temperatures used are contaminant and matrix specific, with a range of approximately 200 to 1,200 degrees Fahrenheit (°F) [95 to 650 degrees Celsius (°C)]. Typically, wastes are processed through an externally fired pug mill or rotary drum system equipped with heat-transfer surfaces that are heated by circulating hot oil. An induced airflow conveys the desorbed organic chemicals through a secondary treatment system such as a baghouse/scrubber for particulates removal and a vapor-phase GAC adsorption unit, a catalytic oxidation unit, or an afterburner. It should be noted, however, that use of an afterburner for secondary treatment has typically resulted in the thermal desorption unit being considered as an incinerator by regulatory agencies. The off-gas is then discharged through a stack.

Effectiveness

The effectiveness of thermal desorption is highly contaminant and matrix specific. Therefore a full characterization of the waste to be treated would be required, and treatability testing would have to be performed to verify the level of effectiveness and to determine the optimum operating temperature and detention time. Thermal desorption effectiveness is very sensitive to particle size; therefore, pre-treatment with size separation and crushing/grinding/shredding would likely be required.

Thermal desorption would likely be very effective for the removal of PAHs from contaminated soil at Site 15, although operating temperatures may be close to the higher end of the typical range. Thermal desorption would require additional treatment of the volatilized contaminants that would be accomplished through treatment of off-gases by such processes as condensation, vapor-phase GAC adsorption, or catalytic oxidation. However, this technology would not be very effective for the removal of lead contamination, although some degree of lead sublimation might be achieved.

Implementability

On-site treatment of contaminated Site 15 soil with thermal desorption would be implementable. Qualified contractors are readily available to provide the necessary services. Pre-treatment of the excavated material for size separation and/or reduction would most likely be required and could be accomplished on site. Exhaust gas from the thermal desorption unit would have to be treated to remove the volatilized PAHs and fine, particulate dust, thereby generating potentially hazardous waste for off-site

treatment/disposal. Treated soil would need to be amended prior to reuse at Site 15 so that revegetation could occur.

Cost

Costs of on-site thermal desorption at Site 15 would be high. The high water content of site soil would make the cost of thermal desorption even higher.

Conclusion

On-site thermal desorption is eliminated because its effectiveness would essentially be limited to the removal of PAHs, and the volumes of soil that also need treatment for lead are significant. Therefore, other technologies would be needed for treatment of soil contaminated with lead, thereby adding additional expense to the cost of thermal desorption, which is expected to be high.

3.2.6 Disposal

The technology considered under this GRA is off-site landfilling.

3.2.6.1 Off-Site Landfilling

Off-site landfilling would consist of transporting excavated soil for burial at an off-site TSDF. Excavated soil characterized as RCRA non-hazardous waste could be disposed in a RCRA Subtitle D solid waste landfill. Excavated soil characterized as RCRA hazardous waste would have to be disposed in a RCRA Subtitle C hazardous waste landfill.

Effectiveness

Off-site landfilling does not permanently or irreversibly reduce contaminant concentrations. However, although the CERCLA preference for treatment relegates landfilling to a less preferable option, this technology can be an effective disposal option for contaminated soil. Off-site landfills are only permitted to operate if they meet certain requirements of design and operation governing foundation, liner, leak detection, leachate collection and treatment, daily cover, post-closure inspections and monitoring, etc., which ensure the effectiveness of these facilities. The requirements of a RCRA hazardous (Subtitle C) landfill are typically more stringent than those of a RCRA non-hazardous (Subtitle D) solid waste landfill.

Implementability

Off-site landfilling would be easily implementable. Facilities and services are available. Disposal at a RCRA Subtitle D landfill may require certain pre-treatment, mainly the removal of free liquids but, because soil would only be excavated to a depth of 1 to 2 feet, no associated water should be present and this requirement should be easy to meet. In addition, a waste profile would have to be prepared indicating contaminant concentrations and their leachability. Disposal of any soil containing lead with TCLP levels exceeding hazardous criteria would require pre-treatment to meet land disposal restrictions prior to landfilling. If treatment achieves UTS levels, disposal of the treated soil in a RCRA Subtitle D landfill (i.e., non-hazardous) would be permissible. If not, the treated soil would need to disposed in a RCRA Subtitle C (i.e., hazardous) landfill.

Cost

Cost of off-site landfilling would be low to moderate depending on volume.

Conclusion

Off-site landfilling is retained in combination with other process options for the development of remedial alternatives.

3.3 SELECTION OF REPRESENTATIVE PROCESS OPTIONS

The following GRAs, technologies, and process options, under the GRAs as noted, were retained for the development of soil remedial alternatives:

- No Action.
- Limited Action: LUCs.
- Containment: Soil Cover.
- Removal: Excavation.
- Ex-Situ Treatment: On-Site Screening, Size Reduction, On-Site Soil Washing/Chemical Extraction, and Off-Site Chemical Fixation/Solidification.

- Disposal: On-Site Beneficial Reuse, Off-Site RCRA Non- Hazardous (Subtitle D) Landfill, and Off-Site RCRA Hazardous (Subtitle C) Landfill.

The next step is to select representative process options from each technology to assemble an adequate variety of alternatives and evaluate the alternatives in sufficient detail to aid in the final selection process. All process options listed in Table 3-2 were retained for the formulation of alternatives because the processes are sufficiently varied in their functions.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
No Action	None	Not Applicable	No activities conducted at the site to address contamination. Biodegradation of PAHs may occur through natural attenuation processes, which will not be verified.	Required by law. Retain for baseline comparison to other technologies.
Limited Action	Land Use Controls (LUCs)	Engineered Controls: Physical Barriers/ Security Guards	Fencing, markers, warning signs, and monitoring to restrict site access.	Eliminate. Prevents human exposure to contaminants, but does not reduce exposure to ecological receptors.
		Administrative Controls: Deed or Site Use Restrictions	Administrative action using property deeds or other land use prohibitions to restrict future site activities. Five-year reviews would be conducted to evaluate if additional remedial actions would be required.	Retain. May be used in conjunction with certain remedial alternatives to control future development and/or to maintain design integrity of containment systems.
	Monitoring	Sampling and Analysis	Sampling and analysis of groundwater, to evaluate if additional remedial actions would be warranted.	Addressed in Table 3-2.
Containment	Cover/Barrier	Soil Cover/Multi-Media Cap	Use of semipermeable or impermeable barriers to minimize direct exposure to contaminants and potential migration to groundwater.	Retain soil cover to reduce exposure by human and animal receptors to site contaminants. A multi-media cap is not required because potential migration of soil COCs to groundwater is not a concern at Site 15.
	Erosion control	Rip-Rap Cover/Vegetation	Use of gravel/cobbles or dense plant growth to minimize migration of wastes/contaminated soils.	Eliminate. Site 15 is relatively flat and erosion is not a concern. However, revegetation is retained to allow future site use as a green space.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
Removal	Excavation	Mechanical	Means for removal of contaminated soils by backhoe, bulldozer, loader, etc.	Retain for removal of contaminated soil and dry sediments.
In-Situ Treatment	Thermal	Vitrification	Use of high-temperature melting to fuse inorganic contaminants into a glass matrix within vadose zone or the use of moderate temperature heating to volatilize contaminants and remove them from the vadose zone.	Eliminate because of implementability concerns associated with the shallow groundwater table and high moisture content of the soil. Typically used for highly contaminated or radioactive materials.
		Radiofrequency Heating	Use of radio-frequency energy to heat soil and cause volatilization of contaminants	Eliminate. Limited thickness and shallow depth of contaminated soil renders this technology difficult to implement with limited, commercially available equipment(1). Not applicable for treatment of arsenic and lead.
		Electrical Heating	Use of an electrical blanket or electrical heating elements within slotted pipes to volatilize contaminants	Eliminate. The shallow depth to groundwater renders this technology difficult to implement.(2) Not applicable for treatment of arsenic and lead.
	Physical/ Chemical	Soil Flushing/ Chemical Extraction	Use of water/solvents to remove contaminants from the vadose zone by flushing and collecting the contaminated wastewater in the saturated zone followed by above ground pump and treat.	Eliminate. The result of this technology would be the migration of COCs from the soil to the groundwater. Therefore, the implementation of this technology could contaminate “clean” groundwater.
		Dynamic Underground Stripping	Steam injection at the periphery of the contaminated area resulting in the vaporization of volatile compounds bound to soil and the movement of contaminants to a centrally located extraction well.	Eliminate. Difficult to implement due to the shallow groundwater table. No applicable for treatment of arsenic and lead.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
In-Situ Treatment (Continued)	Physical/ Chemical (Continued)	Soil Vapor Extraction	Use of vacuum and possibly air sparging to volatilize contaminants.	Eliminate. This technology is better suited to volatile organic contaminants than the polynuclear aromatic hydrocarbons (PAHs) at Site 15. In addition, it is not applicable to arsenic and lead.
		Chemical Fixation/ Solidification	Mixing of chemical agents in the vadose zone to chemically bind, solidify, and reduce contaminant mobility.	Eliminate. Mobility of soil COCs is not a concern at this site. Moreover the treated material would not be suitable for revegetation.
		Electrokinetic Separation	Use of electrodes with the application of direct current-based electrical fields that can induce the migration of metallic contaminants from soil towards electrodes or to induce electrochemical reactions to destroy selected organic contaminants.	Eliminate. Shallow depth to groundwater would minimize the available resistivity required for application of this technology. [(3)]
	Biological	Biodegradation	Nutrients and amendments are added to surface soil to promote biodegradation of PAHs.	Eliminate. Would be difficult to achieve cleanup levels for PAHs. Not effective for lead contamination.
		Phytoremediation	Use of selected plants cultivated in contaminated soil to lead to uptake of metallic contaminants or enhancement of biodegradation of organic contaminants by indigenous microorganisms in the rootzone.	Eliminate. This innovative technology has limited demonstrated effectiveness for areas with high levels of organic contaminants[(4)]. Has potential in reducing lower level organic contamination left in place, however not applicable to achieve identified cleanup goals.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
Ex-Situ Treatment	Physical/ Chemical	Soil Washing/ Chemical Extraction	Use of solubilization and chemical (oxidation/reduction/neutralization) processes to remove contaminants from the solid phase and convert them into more concentrated forms or less toxic forms in liquid phase.	Retain. May be used in conjunction with other remedial technologies to treat both PAHs and lead. Predominantly fine-medium grained sand particles with lenses of silt and clay make this technology potentially effective.
		Chemical Fixation/ Solidification	Mixing of chemical agents to bind, solidify, and reduce contaminant mobility.	Retain. May be used in conjunction with other remedial technologies to render excavated lead contaminated soil to a non-hazardous classification for off-site disposal. However, not suitable for use on site to return treated soil to the excavated area because the treated matrix would be unsuitable for revegetation.
	Biological	On-Site Landfarming	Tilling of contaminated soils and wastes in layers of surface soil within a treatment bed to aerate and biodegrade organic contaminants.	Eliminate. Limited effectiveness for PAH contamination and not effective for arsenic and lead.
	Thermal	Off-Site Incineration	Use of high temperatures to pyrolize or oxidize organic contaminants into less toxic gases.	Eliminate. Although effective for destruction of PAHs, it would be ineffective for lead and arsenic contamination.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
Ex-Situ Treatment (continued)	Thermal (continued)	Off-Site Thermal Desorption	Use moderate temperatures to volatilize contaminants and remove them from the solid phase into the gaseous phase.	Retain. May be used to treat PAH contamination. Off-gas treatment may be required to treat soils where metals are also present. This technology is more cost effective than incineration for removal of organic contaminants and should be evaluated further.
	Solids Processing	Size Reduction	Crushing/grinding/shredding of wastes as a preliminary process to aid in downstream treatment.	Eliminate crushing because it would apply to rock that would typically not be further treated. Retain grinding and shredding as pretreatment step for vegetative material (tree stumps) prior to other processes.
		Screening	Removal/segregation of material based on size as a preliminary process to aid in downstream treatment.	Retain to remove oversized material that is typically not contaminated and as a pretreatment step for other processes.
Disposal	Off-Site	Hazardous/ Non-Hazardous Waste Landfilling	Disposal of excavated wastes and treatment residuals in a permitted RCRA "C" or RCRA "D" facility.	Retain landfilling to be used in conjunction with other remedial technologies.
	On-Site	Consolidation	Excavation and relocation of contaminated soil to minimize space and closure requirements.	Eliminate. Would trigger on-site issues that are unacceptable to regulatory agencies.
		Beneficial Reuse	Reuse of treated soil as fill material.	Retain as a possible process option to be used in conjunction with other technologies.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SURFACE SOIL
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Sources:

1. Personal communication between J.P. Kumar, TtNUS, and XDD, Inc., Stratham, NH, (Bruce Cliff, Co-owner, 603-788-1888) October 14, 2003.
2. Personal communication between J.P. Kumar, TtNUS, and Terra Therm, Inc., Fitchburg, MA, (Hiroshi Fujita, Project Coordinator, 978-343-0300), October 13, 2003.
3. Personal communication between J.P. Kumar, TtNUS, and Onion Equipment Company, Naples, Florida, (Barry Zvibleman, developer of Electro Klean ™ technology, 239-566-7007), October 10, 2003.
4. Personal communication between J.P. Kumar, TtNUS, and EPA, Cincinnati, OH, (Steve Rock, Research Scientist, 513-569-7149), October, 15, 2003.

TABLE 3-2

TECHNOLOGIES AND PROCESS OPTIONS RETAINED FOR DETAILED SCREENING
SITE 15 FEASIBILITY STUDY REPORT
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

General Response Action	Remedial Technology	Process Option
No Action	None	Not Applicable
Limited Action	Land Use Controls (LUCs)	Administrative Controls: Deeds and Site Use Restrictions
Containment	Cover/Barrier	Soil/Multi-Media Cap
Removal	Excavation	Mechanical
Ex-Situ Treatment	Physical/Chemical	Soil Washing/Chemical Extraction
		Chemical Fixation/Solidification
	Thermal	Off-Site Thermal Desorption
	Solids Processing	Screening
Disposal	Off-Site	Hazardous/Non-Hazardous Waste Landfill
	On-Site	Beneficial Reuse
	Monitoring	Sampling and Analysis

4.0 DEVELOPMENT AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section discusses the development of the remedial alternatives developed from the process options retained in Section 3.0 and provides a description of the conceptual design for each alternative. This section also presents an evaluation of each remedial alternative with respect to the criteria of the NCP of 40 CFR Part 300, as revised in 1990. The criteria, and the relative importance of these criteria, are also discussed in this section.

4.1 DEVELOPMENT OF ALTERNATIVES

The technologies and process options retained after detailed screening in Section 3.0 were assembled into alternatives. The GRAs, remedial technologies, and process options retained are as follows:

- No Action.
- Limited Action: LUCs.
- Containment: Soil Cover.
- Removal: Excavation.
- Ex-Situ Treatment: On-Site Screening, Grinding/Shredding, On-Site Soil Washing/Chemical Extraction, and Off-Site Chemical Fixation/Solidification.
- Disposal: On-Site Beneficial Reuse, Off-Site RCRA Non- Hazardous (Subtitle D) Landfill, and Off-Site RCRA Hazardous (Subtitle C) Landfill.

The following remedial alternatives have been assembled and developed based on the rationale discussed below:

1. No Action:

   This alternative is required by the guidance document as a baseline for comparison to other alternatives.

2. Soil Cover to Meet Recreational RAOs and LUCs:

This alternative would place a soil cover over the areas of Site 15 where concentrations of COCs in soil are greater than the recreational use pickup values defined in Section 2.0. A total of 20 areas with an overall surface of approximately 7.2 acres would be capped with a 2-foot-thick soil cover. Because the cover would need to be maintained to prevent exposure to contaminated soil remaining on site, LUCs would have to be established and enforced. These LUCs would include establishing an inspection and maintenance schedule for the cover and preventing residential, commercial/industrial, and medium- and high-intensity recreational land use.

Providing a cover over areas of soil with concentrations of COCs greater than residential criteria would essentially require capping of the entire 73-acre site. Such an alternative was not developed and evaluated because, compared to the partial capping presented under Alternative 2, it would not improve site usability and would substantially adversely impact site wetlands. LUCs would still be required to protect the soil cover from future development, and site use would therefore remain restricted.

3A. Excavation to Meet Recreational RAOs, Off-Site Treatment and Disposal, and LUCs:

This alternative would remove soil from areas of Site 15 where concentrations of COCs are greater than the recreational use pickup values. A total of approximately 11,600 yd^3 of contaminated soil would be excavated from 20 areas totaling approximately 7.2 acres that are considered for capping under Alternative 2. Most of the excavated soil (approximately 10,900 yd^3) would be disposed off site at a permitted RCRA non-hazardous (Subtitle D) TSDF, and the remainder (soil excavated from lead-contaminated areas that failed TCLP analysis, approximately 700 yd^3) would be disposed at an off-site permitted RCRA hazardous (Subtitle C) TSDF. The excavated areas would then be backfilled with 11,600 yd^3 of clean imported fill material, the site would be revegetated, and impacted wetlands would be restored. Because the soil remaining on site would continue to contain concentrations of COCs that would not be protective of hypothetical future high- and medium-intensity recreational, commercial/industrial, and residential human receptors, the same type of LUCs would have to be established and enforced as in Alternative 2. These LUCs would prevent land use other than low-intensity recreational activities.

3B. Excavation to Meet Recreational RAOs, On-Site Treatment and Reuse, and LUCs:

As with Alternative 3A, Alternative 3B would remove soil from areas of Site 15 where concentrations of COCs are greater than the recreational use pickup values. A total of approximately 11,600 yd^3 of contaminated soil would be excavated from 20 areas totaling approximately 7.2 acres that would be excavated under Alternative 3A. The excavated soil would be screened on site, and approximately 600 yd^3 of oversized material would be landfilled at an off-site permitted RCRA Subtitle D facility. The screened soil would be treated on site by soil washing, and approximately 10,200 yd^3 of treated soil would be reused to backfill the excavated areas. The soil washing process would concentrate the COCs removed from the treated soil in a wet (65 percent moisture by weight) filter cake residue, and approximately 2,600 yd^3 (or 3,500 tons) of this wet filter cake residue would be disposed at an off-site permitted RCRA Subtitle C TSDF. The backfilling of the excavated areas would be completed with 1,400 yd^3 of clean imported fill material, the site would be revegetated, and impacted wetlands would be restored. Alternative 3B would incorporate the same LUCs as Alternative 3A to prevent unacceptable risks from exposure of hypothetical future high- and medium-intensity recreational, commercial/industrial, and residential human receptors to contaminated soil remaining on site. These LUCs would prevent land use other than low-intensity recreational activities.

4A. Excavation to Allow Unrestricted Site Use and Off-Site Treatment and Disposal:

This alternative would remove contaminated soil to the extent necessary to allow for unrestricted use of the site. This would essentially require excavation of all of the site surface soil because the area identified as exceeding the residential SCTLs encompasses the entire site. A total volume of approximately 118,000 yd^3 of contaminated soil would be excavated over an area of 73 acres. Approximately 108,000 yd^3 of the excavated soil would be disposed at an off-site permitted RCRA Subtitle D TSDF, and the remaining 10,000 $yd^{3,}$ which is assumed would fail TCLP testing, would be disposed at an off-site permitted RCRA Subtitle C TSDF. The excavated areas would then be backfilled with 118,000 yd^3 of clean imported fill material, the site would be revegetated, and impacted wetlands would be restored. Because the soil remaining on site would no longer contain concentrations of COCs that could be harmful to hypothetical future residential receptors, LUCs would not be required.

4B. Excavation to Allow Unrestricted Site Use and On-Site Treatment and Reuse:

As with Alternative 4A, Alternative 4B would remove contaminated soil to the extent necessary to allow unrestricted use of the site; approximately 118,000 yd^3 of contaminated soil would be excavated over an area of 73 acres. The excavated soil would be screened on site, and approximately 6,000 yd^3 of oversized material would be landfilled at an off-site permitted RCRA

Subtitle D facility. The screened soil would be treated on site by soil washing, and approximately 102,000 yd^3 of treated soil would be reused to backfill the excavated areas. Approximately 26,000 yd^3 (or 35,000 tons) of wet filter cake residue from the soil washing process would be disposed at an off-site permitted RCRA Subtitle C TSDF. The backfilling of the excavated areas would be completed with 14,000 yd^3 of clean imported fill material, the site would be revegetated, and impacted wetlands would be restored. As for Alternative S-4A, no LUCs would be required.

4.2 DESCRIPTION AND DETAILED ANALYSIS OF ALTERNATIVES

This section presents a description of the conceptual design of each alternative, followed by the detailed analysis using the nine criteria of the NCP under 40 CFR Part 300. The evaluation criteria are discussed below.

4.2.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

Overall Protection of Human Health and the Environment

Alternatives must be assessed for adequate protection of human health and environment, in the short and the long term, from unacceptable risks posed by hazardous substances or contaminants present at the site by eliminating, reducing, or controlling exposure to levels exceeding remediation goals. Overall protection draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs

Alternatives must be assessed to determine whether they attain ARARs under federal environmental laws and state environmental or facility siting laws. CERCLA Section 121(d) specifies in part that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or a waiver must be obtained [see also 40 CFR 300.430(f)(1)(ii)(B)]. ARARs include only federal and state environmental or facility siting laws/regulations and do not include occupational safety or worker protection requirements. In addition, per 40 CFR 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (TBC guidance category).

Long-Term Effectiveness and Permanence

Alternatives must be assessed for the long-term effectiveness and permanence they offer, along with a degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following:

Magnitude of Residual Risk

This refers to risk posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

Adequacy and Reliability of Controls

Controls such as containment systems and LUCs that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. These include the uncertainties associated with land disposal for providing long-term protection from residuals, the assessment for the potential need to replace technical components of the alternative such as a cap, a slurry wall, or a treatment system, and the potential exposure pathways and risks posed should the remedial action need replacement.

Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the alternative employs recycling or treatment that reduces the toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:

- The treatment or recycling processes the alternative employs and the materials that they will treat.

- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.

- The degree of expected reduction in toxicity, mobility, or volume of waste due to treatment or recycling and the specification of which reduction(s) is occurring.

- The degree to which the treatment is irreversible.

- The type and quantity of residuals that will remain following treatment considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents.

- The degree to which treatment reduces the inherent hazards posed by principal threats at the site.

Short-Term Effectiveness

The short-term impacts of the alternative shall be assessed considering the following:

- Short-term risks that might be posed to the community during implementation.

- Potential impacts to workers during remedial action and the effectiveness and reliability of protective measures.

- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigation measures during implementation.

- Time until protection is achieved.

Implementability

The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors, as appropriate:

- Technical feasibility including technical difficulties and unknowns associated with the construction and operation of a technology, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy.

- Administrative feasibility including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).

- Availability of services and materials including the availability of adequate off-site treatment capacity, storage capacity, and disposal capacity and services, the availability of necessary equipment and specialists, and provisions to ensure necessary additional resources, the availability of services and materials, and availability of prospective technologies.

Cost

Capital costs shall include both direct and indirect costs. Annual O&M costs shall be provided. A net present worth (NPW) value of the capital and O&M costs shall also be provided. Typically, the cost estimate accuracy range is plus 50 percent to minus 30 percent.

State Acceptance

The State's concerns must be assessed to include the following:

- The State's position and key concerns related to the preferred alternative and other alternatives.
- State comments on ARARs or the proposed use of waivers.

These concerns cannot be evaluated at this time in the FS because the State has not reviewed and commented on the FS. These concerns will be discussed, to the extent possible, in the Proposed Plan to be issued for public comment.

Community Acceptance

This assessment consists of responses of the community to the Proposed Plan. This assessment includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. This assessment can only be done after comments on the Proposed Plan are received from the public.

4.2.1.1 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be the following:

- Overall Protection of Human Health and the Environment

- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume
- Short-Term Effectiveness
- Implementability
- Cost

The balancing criteria are used to weigh the relative merits of alternatives.

The remaining two of the nine criteria, State Acceptance and Community Acceptance, are considered to be modifying criteria that must be considered during remedy selection. These last two criteria can be evaluated after the State of Florida has reviewed this FS and after the Proposed Plan has been discussed in a public meeting, if requested, and opened to public comment. Therefore, this document addresses only seven of the nine criteria.

4.2.2 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative and presentation of the alternative in a Proposed Plan submitted to the community for review and comment. The preferred alternative must meet the following criteria:

- Protection of human health and the environment.
- Compliance with ARARs unless a waiver is justified.
- Cost effectiveness in protecting human health and environment and in complying with ARARs.
- Utilization of permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

The second step consists of the review of comments received for the Proposed Plan and consultation with the State of Florida to determine whether or not the preferred alternative continues to be the most appropriate remedial action for the site.

4.2.3 Alternative 1: No Action

4.2.3.1 Description of Alternative 1

This alternative is a "walk-away" alternative that is required under CERCLA to establish a basis for comparison with other alternatives. Under this alternative, the property would be released for unrestricted use.

4.2.3.2 Detailed Analysis of Alternative 1

Overall Protection of Human Health and Environment

Alternative 1 would not be protective of human health and the environment. Concentrations of PAHs, arsenic, and lead would remain in surface soil at levels that exceed the established site-specific SCTLs for human health. Concentrations of PAHs and lead would remain in surface soil at levels that exceed the site-specific ecological target levels for ecological receptors. Therefore, two of the three RAOs for Site 15 would not be achieved.

Compliance with ARARs

There are no applicable ARARs; however, Alternative 1 would not achieve human health site-specific SCTLs derived using the guidance provided in Chapter 62-777, F.A.C.

Long-Term Effectiveness and Permanence

Alternative 1 would not be effective in the long term because soil COCs would remain on site and pose potential human health and ecological hazards. Although concentrations of soil COCs might gradually decrease to acceptable levels over a long period of time as a result of natural processes, this would not be monitored to verify its occurrence.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 does not employ any treatment. There would most likely be some reduction in toxicity (i.e., concentrations) of COCs over time due to natural attenuation, but this process would not be monitored.

Short-Term Effectiveness

There are no relevant issues under Alternative 1 because no action would occur.

Implementability

There are no implementability concerns for Alternative 1 because no action would be implemented.

Cost

There are no costs associated with Alternative 1.

4.2.4 Alternative 2: Soil Cover to Meet Recreational RAOs and LUCs

4.2.4.1 Description of Alternative 2

Alternative 2 is illustrated on Figure 4-1 and would consist of two major components: (1) soil cover to meet recreational RAOs and (2) LUCs.

Component 1: Soil Cover to Meet Recreational RAOs

Figure 4-2 shows the areas of the site that would be capped with a soil cover to meet the recreational RAOs. A total of 20 areas of contaminated soil with a combined surface of approximately 7.2 acres would be capped with a 2-foot-thick cover. The following are the areas of contamination that would be addressed:

- PAH-contaminated soil with BaPEq concentrations greater than 6,750 µg/kg – nine areas totaling 235,900 ft^2 from 0 to 1 foot bgs.

- Lead-contaminated soil with concentrations greater than 6,500 mg/kg – eight areas totaling 75,300 ft^2 from 0 to 1 foot bgs.

- TRPH-contaminated soil with concentrations greater than 340 mg/kg – one 500 ft^2 area from of 1 to 2 feet bgs. This area is located within one of the above-mentioned areas of PAH-contaminated soil.

- Arsenic-contaminated soil with concentrations greater than 36 mg/kg – Two areas totaling 1,600 ft^2, or 0.04 acre, from ground surface to the water table (assume to be 2 feet bgs). At the time of sample collection in these arsenic-contaminated areas, the water table was within 1 foot of the ground surface, limiting unsaturated soil sample collection to this depth. Because the water table has decreased, overexcavation to a depth of 2 feet bgs will be conducted.

Prior to any construction activities, a survey would be performed to identify the presence of active gopher tortoise habitats in the areas to be remediated. If such habitats are identified, they would be relocated prior to disruption of the area.

As part of site preparation, temporary haul routes would be constructed to allow equipment to access the areas to be capped, and these areas would be cleared. Larger trees would be harvested and their stumps cut flush or ground flush with the existing grade. Small trees and underbrush would be cleared using a bulldozer or similar equipment and mulched. For the purpose of this FS, it was estimated that approximately 880 larger trees covering an total area of 4.3 acres would have to be removed and that a total area of 2.8 acres of small trees and underbrush would have to be cleared.

The soil cover would consist of 30 inches of select fill material to permit settling of the material while maintaining a 2-foot protective barrier to the impacted soils. Approximately 29,000 yd^3 of clean soil would be imported from a suitable borrow location outside of NAS Cecil Field to construct the soil cover. As part of soil cover construction, a detection netting or fabric would be placed on the surfaces to be covered to provide a reference point to monitor cover thickness. During construction activities, erosion control procedures such as hay bales, silt fences, or sediment traps would be implemented.

It is anticipated that a total of approximately 0.18 acre of the wetland areas identified in the Site 15 Wetland Delineation Report (TtNUS, 2003b), including approximately 0.14 acre in Wetland A and 0.03 acre in Wetland D, would need to be restored. Following cover construction, the capped areas would be re-vegetated as appropriate and the impacted wetland areas would be restored.

Component 2: LUCs

LUCs would be developed to prevent the site from being used in the future for any purposes other than as a low-intensity recreational area. Physical restrictions to the site may include signage, fencing, physical barriers, and site security. LUC performance objectives and restrictions for Site 15 would be as follows:

- Prohibit residential, industrial, commercial, agricultural (specifically growing crops for human consumption), and medium- and high-intensity recreational reuse of the site unless prior written approval is obtained from the Navy, U.S. EPA, and FDEP. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities. Prohibited high-intensity recreational activities include, but are not limited to, playgrounds, athletic fields, etc. Prohibited medium-intensity recreational activities include, but are not limited to, picnic grounds, camping, etc. Allowable low-intensity recreational activities include hiking, biking, horseback riding, hunting, etc.

- Prohibit the excavation of soils from the site unless prior written approval is obtained from the Navy, U.S. EPA, and FDEP.

- Maintain the integrity of any existing or future monitoring or remediation system(s) unless prior written approval is obtained from the Navy, U.S EPA, and FDEP.

Annual inspections of the site would be conducted to confirm compliance with LUC objectives, and an annual compliance certificate would be prepared and provided to U.S. EPA and FDEP. Prior to any property conveyance, U.S. EPA and FDEP would be notified.

The LUCs would be implemented through a LUC RD that would be prepared as a component of the overall RD. In addition to the U.S. EPA and FDEP, copies of the LUC RD would be sent to the City of Jacksonville Parks and Recreation Department, City of Jacksonville Environmental Resource Management Department, City of Jacksonville Planning and Development Department, City of Jacksonville Development Management Group, Jacksonville Electric Authority, and St. Johns River Water Management District. The LUCs would be maintained for as long as they are required to prevent unacceptable exposure to contaminated soil and/or to preserve the integrity of the selected remedy.

The LUC RD would also include procedures for regular inspections of the soil cover and maintenance and repair of the cover as required. LUCs would be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions, per letter dated October 2, 2003 from Raymond F. DuBois, Deputy Under Secretary of Defense (Installations and Environment), to Hon. Marianne Lamont Horinko, Acting Administrator, U.S. EPA. Implementation of this alternative would therefore require a survey of the site, annual visual inspections, and five-year review report preparation.

4.2.4.2 Detailed Analysis of Alternative 2

Overall Protection of Human Health and Environment

Alternative 2 would be protective of human health and the environment. A soil cover barrier over the area of contamination exceeding pickup values for a recreational receptor would ensure that the most likely future potential site users would be protected from exposure to unacceptable levels of PAHs, TRPH, arsenic, and lead. The use of LUCs would prevent potential residential, commercial/industrial, and high- and medium-intensity recreational receptors from being exposed to unacceptable levels of residual PAHs, TRPH, arsenic, and lead that would remain under the covered areas and other areas outside the cover. The site would be suitable for revegetation and future use as a natural and recreational corridor with low-intensity recreational activities. All of the RAOs for Site 15 would be met.

Compliance with ARARs

Alternative 2 would not comply with chemical-specific ARARs, but exposure to soil with contaminant concentrations greater than chemical-specific ARARs would be prevented by the soil cover and LUCs. The following location-specific and action-specific ARARs would be complied with in substance:

- RCRA regulations detailing Identification and Listing of Hazardous Wastes and Land Disposal Restrictions.
- National Environmental Policy Act (NEPA) regulations on wetlands, floodplains, etc.
- Fish and Wildlife Coordination Act regulations.
- Endangered Species Act regulations.
- Florida Air Pollution Rules.
- Florida Regulation of Stormwater Discharge.
- Florida Rules on Hazardous Waste Warning Signs.

Long-Term Effectiveness and Permanence

Alternative 2 would be effective in the long term because the soil cover would provide a barrier that would prevent recreational and ecological receptors from unacceptable exposure to COCs in soil. The detection grid installed to identify the separation between native soil and cap material would deter burrowing animals such as the gopher tortoise from burrowing into capped areas.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 2 would not reduce the toxicity, mobility or volume through treatment. However, the soil COCs present at the site are not currently migrating to groundwater and are not expected to do so in the future because of their relative low mobility.

Short-Term Effectiveness

Alternative 2 would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during on-site remedial activities. Erosion control measures would minimize the potential migration of COCs into nearby streams. Workers on site would be adequately protected if suitable health and safety procedures are followed. Relocation of gopher tortoise habitats would reduce adverse impacts to the site ecological system during excavation. The time frame for implementation of this alternative is estimated to be approximately 1 year, after which it would be protective assuming LUCs have been implemented.

Implementability

Alternative 2 is implementable. Excavation equipment considered under this alternative is typical in the construction industry and readily available from several local sources. Off-site borrow locations for clean soil can be identified. Establishment of LUCs would require negotiation and agreement on the specifics of the procedures between the Navy, U.S. EPA, FDEP, and potential future site owners who might be affected by deed restrictions.

Cost

Estimated costs for Alternative 2 are as follows:

- Capital: $1,373,000
- 30-Year NPW of O&M: $59,000
- 30-Year NPW: $1,432,000

The above figures have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. A more detailed breakdown of these cost estimates is provided in Appendix G.

4.2.5 Alternative 3A: Excavation to Meet Recreational RAOs, Off-Site Treatment and Disposal, and LUCs

4.2.5.1 Description of Alternative 3A

Alternative 3A is illustrated on Figure 4-3 and would consist of three major components: (1) excavation to meet recreational RAOs, (2) off-site treatment and disposal, and (3) LUCs.

Component 1: Excavation to Meet Recreational RAOs

The same 20 areas of contaminated soil with a combined surface of approximately 7.2 acres that were designated for capping under Alternative 2 (as illustrated on Figure 4-2) would be excavated under Alternative 3A as described below:

- PAH-contaminated soil with BaPEq concentrations greater than 6,750 µg/kg – nine areas totaling 235,900 ft^2 from 0 to 1 foot bgs.

- Lead-contaminated soil with concentrations greater than 6,500 mg/kg – eight areas totaling 75,300 ft^2 from 0 to 1 foot bgs.

- TRPH-contaminated soil with concentrations greater than 340 mg/kg – one 500 ft^2 area from of 1 to 2 feet bgs. This area is located within one of the above-mentioned areas of PAH-contaminated soil.

- Arsenic-contaminated soil with concentrations greater than 36 mg/kg – Two areas totaling 1,600 ft^2, or 0.04 acre, from ground surface to the water table (assume to be 2 feet bgs). At the time of sample collection in these arsenic-contaminated areas, the water table was within 1 foot of the ground surface, limiting unsaturated soil sample collection to this depth. Because the water table has decreased, overexcavation to a depth of 2 feet bgs will be conducted.

Prior to any construction activities, a survey would be performed to identify the presence of active gopher tortoise habitats in the areas to be remediated. If such habitats are identified, they would be relocated prior to disruption of the area.

As part of site preparation, temporary haul routes would be constructed to allow equipment to access the areas to be excavated, and these areas would be cleared. Larger trees would be harvested and their stumps either cut or ground flush with the existing grade. Small trees and underbrush would be cleared using a bulldozer or similar equipment and mulched. For the purpose of this FS, it was estimated that approximately 880 larger trees covering an total area of 4.3 acres would have to be removed and that a total area of 2.8 acres of small trees and underbrush would have to be cleared.

Excavation of the duff overlying the surface of the soil and excavation of soil to a depth of up to 2 feet bgs would be conducted using a bulldozer, front-end loader, or similar equipment. A total volume of approximately 11,600 yd^3 of contaminated soil would be excavated.

The Geostatistical Assessment Report (Appendix D) stated that significant soil sampling was conducted at Site 15 and that the delineation of lead and BaPEqs was accurate and complete, and therefore confirmation sampling is not warranted. Additional discussions regarding this topic were held (as identified in BCT Meeting Minute No. 2208), and it was agreed by the BCT (Decision No. 687) that the areas requiring remediation for BaPEqs only would not require confirmation sampling; however, the areas being remediated for lead would require limited confirmation sampling. Six areas have been identified as exceeding the lead pickup level for recreational use and therefore would require confirmation sampling. A confirmation sampling plan will be developed as part of the remedial design, and confirmation sampling will be conducted prior to the implementation of the remedial action.

Following excavation, the excavated areas would be backfilled with clean material, graded to original contours and revegetated.

It is also anticipated that a total of approximately 0.17 acre of the wetland areas identified in the Site 15 Wetland Delineation Report (TtNUS, 2003b), including approximately 0.14 acre in Wetland A and 0.03 acre in Wetland D, would need to be restored.

Component 2: Off-Site Treatment and Disposal

The following are the assumed dispositions of the excavated soil:

- Approximately 10,900 yd^3 would be identified as RCRA non-hazardous and would be transported to the RCRA Subtitle D facility located near Folkston, Georgia, 35 miles northeast of Jacksonville, for direct landfilling.

- Approximately 700 yd^3 that failed TCLP testing would be identified as RCRA hazardous and would be transported to the RCRA Subtitle C TSDF located In Emelle, Alabama for treatment to meet TCLP limits followed by landfilling.

The volumes estimated for disposal at the various facilities would need to be verified based on sampling and analysis of stockpiled soil, followed by profiling as necessary for each facility.

Component 3: LUCs

The LUC RD prepared and implemented as part of this component would be very similar to that prepared and implemented as part of Component 2 of Alternative 2. The only significant difference is that there would be no need for inspection, maintenance, and repair of a soil cover system.

4.2.5.2 Detailed Analysis of Alternative 3A

Overall Protection of Human Health and Environment

Alternative 3A would be protective of human health and the environment. The removal of contamination exceeding the established pickup values for a recreational receptor would ensure that future potential users of the site would be protected from exposure to unacceptable levels of PAHs, arsenic, and lead. The use of LUCs would prevent potential residential, commercial/industrial, and high- and medium-intensity recreational receptors from being exposed to unacceptable levels of residual PAHs, arsenic, and lead that would remain in the unexcavated areas. The site would be suitable for revegetation and future use as a natural and recreational corridor with low-intensity recreational activities. All of the RAOs for Site 15 would be met.

Compliance with ARARs

Alternative 3A would comply with chemical-specific ARARs. The following location-specific and action-specific ARARs would be complied with in substance:

- RCRA regulations detailing Identification and Listing of Hazardous Wastes and Land Disposal Restrictions.
- NEPA regulations on wetlands, floodplains, etc.
- Fish and Wildlife Coordination Act regulations.
- Endangered Species Act regulations.
- Florida Air Pollution Rules.
- Florida Regulation of Stormwater Discharge.
- Florida Rules on Hazardous Waste Warning Signs.

Long-Term Effectiveness and Permanence

Alternative 3A would be effective in the long term because the COCs would be removed from the site and disposed in a suitable landfill outside the facility, resulting in residual levels that would not longer pose an unacceptable risk to recreational and ecological receptors.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 3A would permanently and irreversibly reduce the mobility of the most contaminated portion of the soil containing lead exhibiting leachability at levels exceeding TCLP criteria. Approximately 700 yd^3 of soil (to be verified at the time of remedial design) would be treated by chemical fixation and solidification at an off-site RCRA Subtitle C TSDF such that leachable lead levels would no longer exceed TCLP criteria. The treated soil would be deposited in a secure landfill, thereby rendering it unlikely to be exposed to reversible chemical reactions. In that regard, the overall remedy would employ irreversible components. The remaining excavated soil would be deposited in a non-hazardous waste landfill where its exposure to the environment would be adequately controlled.

Short-Term Effectiveness

Alternative 3A would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during on-site remedial activities. Erosion control measures would minimize the migration of COCs into nearby streams. Transportation of contaminated soil to an off-site TSDF would be conducted in suitable containers and by reputable transporters. In the unlikely event of a traffic accident releasing contaminated soil to the environment,

transported soil would not pose an immediately hazard to the community because of the non-volatile nature and relatively low solubility of the COCs present in the soil. However, should such an event occur, measures to prevent washing away of the soil by storm events would be warranted. Workers on site would be adequately protected if suitable health and safety procedures are followed. Relocation of gopher tortoise habitats would reduce adverse impacts to the site ecological system during excavation. The time frame for implementation of this alternative is estimated to be approximately 1 year, after which it would be protective assuming LUCs have been implemented.

Implementability

Alternative 3A is implementable. Excavation equipment considered under this alternative is typical in the construction industry and readily available from several local sources. Suitable TSDFs are available for treatment and/or direct disposal of the excavated soil and have been identified at nearby locations. Establishment of LUCs would require negotiation and agreement on the specifics of the procedures between the Navy, U.S. EPA, FDEP, and potential future site owners who might be affected by deed restrictions.

Cost

Estimated costs for Alternative 3A are as follows:

- Capital: $1,882,000
- 30-Year NPW of O&M: $35,000
- 30-Year NPW: $1,917,000

A more detailed breakdown of these cost estimates is provided in Appendix G.

4.2.6 Alternative 3B: Excavation to Meet Recreational RAOs, On-Site Treatment and Reuse, and LUCs

4.2.6.1 Description of Alternative 3B

Alternative 3B is illustrated on Figure 4-4 and would consist of three major components: (1) excavation to meet recreational RAOs, (2) on-site treatment and reuse, and (3) LUCs.

Component 1: Excavation to Meet Recreational RAOs

This component would be identical to Component 1 of Alternative 3A.

Component 2: On-Site Treatment and Reuse

The excavated material would be treated on site with soil washing to meet the recreational pickup values. Soil washing would use a combination of physical separation and solvent extraction processes to remove COCs from the larger-sized particles and concentrate them in a relatively small volume of treatment residue made of the smallest-sized particles. This treatment residue most often takes the form of a moist cake generated by the filtration process used to recover and recycle the majority of the extracting solvent. The treated soil would be suitable for on-site reuse to backfill the majority of the excavated areas, and the filter cake treatment residue would require off-site disposal at a RCRA Subtitle C TSDF. The treated soil would be evaluated for pH and nutrient content to assure suitability for reuse and adjusted as needed as part of this process prior to use as backfill.

Typically, soil washing operations concentrate the removed contaminants within 5 to 10 percent of the original volume of processed soil. Subject to confirmation by a treatability study and for the purpose of this FS, it was assumed that on-site washing of contaminated Site 15 soil would concentrate the removed COCs within 7 percent of the original volume of soil treated.

Approximately 11,600 yd^3 of excavated contaminated soil would be screened on site, and an estimated 600 yd^3, or approximately 5 percent, of oversized material would be separated and landfilled at the RCRA Subtitle D facility located near Folkston, Georgia. The oversized material would also be ground and/or shredded either on site or off site as required prior to landfilling. The screened soil would be treated on site, yielding or approximately 10,200 yd^3 of clean treated soil. Assuming that the soil being processed has a dry basis density of 1.5 tons per yd^3 and that the moist filter cake residue has a typical solids content of 35 percent by weight, it is estimated that approximately 2,600 yd^3 (or 3,500 tons) of this filter cake would have to be transported to the RCRA Subtitle C TSDF located in Emelle, Alabama for further treatment followed by landfilling. The quantity of filter cake residue to be disposed would have to be more precisely estimated through a treatability study and would need to be verified based on sampling and analysis of the filter cake, followed by profiling.

Following on-site reuse of the treated soil, approximately 1,400 yd^3 of additional clean fill material would be imported to complete the backfilling of the excavated areas. The site would then be graded to original contours and revegetated. It is also anticipated that a total of approximately 0.17 acre of the wetland areas identified in the Site 15 Wetland Delineation Report (TtNUS, 2003b), including approximately 0.14 acre in Wetland A and 0.03 acre in Wetland D, would need to be restored.

Component 3: LUCs

This component would be identical to Component 3 of Alternative 3A.

4.2.6.2 Detailed Analysis of Alternative 3B

Overall Protection of Human Health and Environment

Alternative 3B would be protective of human health and the environment. The treatment of contamination exceeding the pickup values for a recreational receptor would ensure that future potential site users would be protected from exposure to unacceptable levels of PAHs, arsenic, and lead. The use of LUCs would prevent potential residential, commercial/industrial, and high- and medium-intensity recreational receptors from being exposed to unacceptable levels of residual PAHs, arsenic, and lead that would remain in the untreated areas. The site would be suitable for revegetation and future use as a natural and recreational corridor with low-intensity recreational activities. All of the RAOs for Site 15 would be met.

Compliance with ARARs

Alternative 3B would comply wiith applicable chemical-specific ARARs. The following location-specific and action-specific ARARs would be complied with in substance:

- RCRA regulations detailing Identification and Listing of Hazardous Wastes, Land Disposal Restrictions, and Standards for Owners and Operators of Hazardous Waste TSDFs.
- NEPA regulations on wetlands, floodplains, etc.
- Fish and Wildlife Coordination Act regulations.
- Endangered Species Act regulations.
- Florida Air Pollution Rules.
- Florida Regulation of Stormwater Discharge.
- Florida Rules on Hazardous Waste Warning Signs.

Long-Term Effectiveness and Permanence

Alternative 3B would be effective in the long term because the COCs to would be treated and treatment residues would be removed from the site and deposited in a suitable landfill outside the facility, resulting in residual levels that would not longer pose an unacceptable risk to recreational and ecological receptors.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 3B would permanently remove from the site the COCs contained in approximately 11,600 yd^3 of contaminated soil. PAH concentrations would be reduced from an average BaPEq concentration of approximately 91,000 µg/kg by a minimum of 93 percent to meet the recreational pickup value of

6,750 µg/kg. Average concentrations of lead already meet the acute lead level of 6,500 mg/kg, and on-site treatment would further reduce these concentrations so that the 700 yd^3 of highly contaminated soil that currently exhibits leachability levels exceeding TCLP criteria would meet 0.75 mg/L lead UTS for on-site reuse. The reduction in lead concentration that would be required to meet the UTS would be estimated as part of treatability studies during which TCLP concentrations of lead in the more highly contaminated soil would be determined. Lead removed from the highly contaminated soil would be included within the filter cake residue from the soil washing process and treated by chemical fixation and solidification at an off-site RCRA Subtitle C TSDF such that leachable lead levels would no longer exceed TCLP criteria. This filter cake residue (2,600 yd^3 or 3,500 tons, to be verified by treatability studies) would then be deposited in a secure landfill, thereby rendering it unlikely to be exposed to reversible chemical reactions. In that regard, this alternative is nearly 100 percent irreversible.

Short-Term Effectiveness

Alternative 3B would be effective in the short term. Dust suppression control measures would be implemented to minimize the emission of contaminated soil particulates during on-site remedial activities. Erosion control measures would minimize the migration of COCs into nearby streams. Transportation of the screening and soil washing residues to an off-site TSDF would be conducted in suitable containers and by reputable transporters. In the unlikely event of a traffic accident releasing contaminated material to the environment, transported soil would not pose an immediately hazard to the community because of the non-volatile nature and relatively low solubility of the COCs present at the site. However, should such an event occur, measures to prevent washing away of the material by storm events would be warranted. Workers on site would be adequately protected if suitable health and safety procedures are followed. Relocation of gopher tortoise habitats would reduce adverse impacts to the site ecological system during excavation. The time frame for implementation of this alternative is estimated to be approximately 1 year, after which it would be protective assuming LUCs have been implemented.

Implementability

Alternative 3B is implementable. Excavation equipment considered under this alternative is typical in the construction industry and readily available from several local sources. Soil washing is offered by relatively few vendors; however, at least two have been identified with an established track record in treating contaminated media containing similar constituents and with the ability to easily achieve the removal efficiencies expected in this alternative. However, treatability studies are recommended to allow better estimates of the efficiency and cost. Suitable TSDFs are available for the ultimate disposal of on-site screening and treatment residues and have been identified at nearby locations. Establishment of LUCs would require negotiation and agreement on the specifics of the procedures between the Navy, U.S. EPA, FDEP, and potential future site owners who might be affected by deed restrictions.

Cost

Estimated costs for Alternative 3B are as follows:

- Capital: $4,680,000
- 30-Year NPW of O&M: $35,000
- 30-Year NPW: $4,715,000

A more detailed breakdown of these cost estimates is provided in Appendix G.

4.2.7 Alternative 4A: Excavation to Allow Unrestricted Site Use and Off-Site Treatment and Disposal

4.2.7.1 Description of Alternative 4A

Alternative 4A is illustrated on Figure 4-5 and would consist of two major components: (1) excavation to allow unrestricted site use and (2) off-site treatment and disposal.

Component 1: Excavation to Allow Unrestricted Site Use

This component would be similar to Component 1 of Alternatives 3A and 3B, except that it would involve excavation of a much larger area, essentially encompassing the entire site. A total of approximately 118,000 yd^3 of contaminated soil over a surface area of approximately 73 acres of would be excavated, as illustrated on Figure 4-6 and summarized as follows:

- PAH-contaminated soil with BaPEq concentrations greater than 100 µg/kg – 1,772,803 ft^2 or 40.7 acres from 0 to 1 foot bgs.

- Lead-contaminated soil with concentrations greater than 400 mg/kg – 632,460 ft^2 or 14.5 acres from 0 to 1 foot bgs.

- PAH- and lead-contaminated soil with BaPEq concentrations greater than 100 µg/kg and lead concentrations greater than 400 mg/kg – 789,651 ft^2 or 18.1 acres from 0 to 1 foot bgs.

- TRPH-contaminated soil with concentrations greater than 340 mg/kg – included within the PAH-contaminated area noted above from a depth of 1 to 2 ft bgs.

- Arsenic-contaminated soil with concentrations greater than 36 mg/kg – Two areas totaling 1,600 ft^2, or 0.04 acre, from ground surface to the water table (assume to be 2 feet bgs). At the time of sample collection in these arsenic-contaminated areas, the water table was within 1 foot of the ground surface, limiting unsaturated soil sample collection to this depth. Because the water table has decreased, overexcavation to a depth of 2 feet bgs will be conducted.

Prior to any construction activities, a survey would be performed to identify the presence of active gopher tortoise habitats in the areas to be remediated. If such habitats are identified, they would be relocated prior to disruption of the area.

As part of site preparation, temporary haul routes would be constructed to allow equipment to access the areas to be excavated, and these areas would be cleared. Larger trees would be harvested and their stumps either cut or ground flush with the existing grade. Small trees and underbrush would be cleared using a bulldozer or similar equipment and mulched. For the purpose of this FS, it was estimated that approximately 10,500 larger trees covering an total area of 52.4 acres would have to be removed and that a total area of approximately 73 acres of small trees and underbrush would have to be cleared.

Excavation of the duff overlying the surface of the soil and excavation of soil to a depth of up to 2 feet bgs would be conducted using a bulldozer, front-end loader, or similar equipment. A total volume of approximately 118,000 yd^3 of contaminated soil would be excavated.

The Geostatistical Assessment Report (Appendix D) stated that significant soil sampling was conducted at Site 15 and that the delineation of lead and BaPEqs was accurate and complete, and therefore confirmation sampling is not warranted. Additional discussions regarding this topic were held (as identified in BCT Meeting Minute No. 2208), and it was agreed by the BCT (Decision No. 687) that the areas requiring remediation for BaPEqs only would not require confirmation sampling; however, the areas being remediated for lead would require limited confirmation sampling. Six areas have been identified as exceeding the lead pickup level for recreational use and therefore would require confirmation sampling. A confirmation sampling plan will be developed as part of the remedial design, and confirmation sampling will be conducted prior to the implementation of the remedial action.

Following excavation, the excavated areas would be backfilled with clean material, graded to original contours, and revegetated. It is also anticipated that all six of the wetlands identified at Site 15 (Wetlands A to F) during the Wetlands Delineation Study (TtNUS, 2003b) and totaling a surface area of approximately 4.3 acres would need to be restored.

Component 2: Off-Site Treatment and Disposal

The following are the assumed dispositions for the excavated soil:

- Approximately 108,000 yd^3 would be identified as RCRA non-hazardous and would be transported to the RCRA Subtitle D facility located near Folkston, Georgia for direct landfilling.

- Approximately 10,000 yd^3 that failed TCLP testing would be identified as RCRA hazardous and would be transported to the RCRA Subtitle C TSDF located In Emelle, Alabama for treatment to meet TCLP limits followed by landfilling.

The volumes estimated for disposal at the various facilities would need to be verified based on sampling and analysis of stockpiled soil, followed by profiling as necessary for each facility.

4.2.7.2 Detailed Analysis of Alternative 4A

Overall Protection of Human Health and Environment

Alternative 4A would be protective of human health and the environment. The removal of contamination exceeding the pickup value for a hypothetical future residential receptor would ensure that unrestricted use of the site would be protective. Protection of ecological receptors would also be achieved. The site would be suitable for revegetation and future unrestricted use. All of the RAOs for Site 15 would be met.

Compliance with ARARs

Alternative 4A would comply with chemical-specific ARARs. The following location-specific and action-specific ARARs would be complied with in substance:

- RCRA regulations detailing Identification and Listing of Hazardous Wastes and Land Disposal Restrictions.
- NEPA regulations on wetlands, floodplains, etc.
- Fish and Wildlife Coordination Act regulations.
- Endangered Species Act regulations.
- Florida Air Pollution Rules.
- Florida Regulation of Stormwater Discharge.
- Florida Rules on Hazardous Waste Warning Signs

Long-Term Effectiveness and Permanence

Alternative 4A would be effective in the long term because the COCs would be removed from the site and deposited in a suitable landfill outside the facility, resulting in residual levels that would not longer pose an unacceptable risk to residential and ecological receptors.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 4A would permanently and irreversibly reduce the mobility of the most contaminated portion of the soil containing lead exhibiting leachability at levels exceeding TCLP criteria. Approximately 10,000 yd^3 or soil (to be verified at the time of remedial design) would be treated by chemical fixation and solidification at an off-site RCRA Subtitle C TSDF such that leachable lead levels would no longer exceed TCLP criteria. The treated soil would be deposited in a secure landfill, thereby rendering it unlikely to be exposed to reversible chemical reactions. In that regard, this alternative employs irreversible components. The remaining excavated soil would be deposited in a non-hazardous waste landfill where its exposure to the environment would be adequately controlled.

Short-Term Effectiveness

Alternative 4A would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during onsite remedial activities. Erosion control measures would minimize the migration of COCs into nearby streams. Transportation of contaminated soil to an off-site TSDF would be conducted in suitable containers and by reputable transporters. In the unlikely event of a traffic accident releasing contaminated soil to the environment, transported soil would not pose an immediately hazard to the community because of the non-volatile nature and relatively low solubility of the COCs present in the soil. However, should such an event occur, measures to prevent washing away of the soil by storm events would be warranted. Workers on site would be adequately protected if suitable health and safety procedures are followed. Relocation of gopher tortoise habitats would reduce adverse impacts to the site ecological system during excavation. The time frame for implementation of this alternative is estimated to be approximately 2 years.

Implementability

Alternative 4A is implementable. Excavation equipment considered under this alternative is typical in the construction industry and readily available from several local sources. Suitable TSDFs are available for treatment and/or direct disposal of the excavated soil and have been identified at nearby locations.

Cost

Estimated costs for Alternative 4A are as follows:

- Capital: $15,804,000
- O&M: $0
- NPW: $15,804,000

A more detailed breakdown of these cost estimates is provided in Appendix G.

4.2.8 Alternative 4B: Excavation to Allow Unrestricted Site Use and On-Site Treatment and Reuse

4.2.8.1 Description of Alternative 4B

Remedial Alternative 4B is illustrated on Figure 4-7 and would consist of two major components: (1) excavation to allow unrestricted site use and (2) on-site treatment and reuse.

Component 1: Excavation to Allow Unrestricted Site Use

This component would be identical to Component 1 of Alternative 4A.

Component 2: On-Site Treatment and Reuse

This component would be similar to Component 2 of Alternative 3B, except for the significantly larger volume of contaminated soil involved and for the fact that the on-site soil washing system would have to produce a treated soil that meets residential rather than recreational cleanup goals.

Approximately 118,000 yd^3 of excavated contaminated soil would be screened on site, and approximately 6,000 yd^3 of oversized material would be separated and landfilled at the RCRA Subtitle D facility located near Folkston, Georgia. The oversized material would also be ground and/or shredded either on site or off-site as required prior to landfilling. The screened soil would be treated on site, yielding approximately 102,000 yd^3 of clean treated soil. Assuming that the soil being processed has a dry basis density of 1.5 tons per yd^3 and that the moist filter cake residue has a typical solids content of 35 percent by weight, it is estimated that approximately 26,000 yd^3 (or 35,000 tons) of this filter cake would have to be transported to the RCRA Subtitle C TSDF located in Emelle, Alabama for further treatment followed by landfilling. The quantity of filter cake residue to be disposed would have to be more precisely estimated through a treatability study and would need to be verified based on sampling and analysis of the filter cake, followed by profiling.

Following on-site reuse of the treated soil, approximately 14,000 yd^3 of additional clean fill material would be imported to complete the backfilling of the excavated areas. The site would then be graded to original contours and revegetated. As for Alternative 4A, it is also anticipated that all six of the wetlands identified at Site 15 (Wetlands A to F) during the Wetlands Delineation Study (TtNUS, 2003b), totaling a surface area of approximately 4.5 acres, would need to be restored.

4.2.8.2 Detailed Analysis of Alternative 4B

Overall Protection of Human Health and Environment

Alternative 4B would be protective of human health and the environment. The treatment of contamination exceeding the pickup values for a residential receptor would ensure that unrestricted site use would be protective. The site would be suitable for revegetation and future unrestricted use. All of the RAOs for Site 15 would be met.

Compliance with ARARs

Alternative 4B would comply with applicable chemical-specific ARARs. The following location-specific and action specific ARARs would be complied with in substance:

- RCRA regulations describing Identification and Listing of Hazardous Wastes, Land Disposal Restrictions, and Standards for Owners and Operators of Hazardous Waste TSDFs.
- NEPA regulations on wetlands, floodplains, etc.
- Fish and Wildlife Coordination Act regulations.
- Endangered Species Act regulations.
- Florida Air Pollution Rules.
- Florida Regulation of Stormwater Discharge.
- Florida Rules on Hazardous Waste Warning Signs.

Long-Term Effectiveness and Permanence

Alternative 4B would be effective in the long term because the COCs would be treated and treatment residues would be removed from the site and deposited in a suitable landfill outside the facility, resulting in residual levels that would not longer pose an unacceptable risk to residential or ecological receptors.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 4B would permanently remove from the site the COCs contained in approximately 118,000 yd^3 of contaminated soil. Concentrations of BaPEqs would be reduced from an average of approximately 15,000 µg/kg by over 99 percent to meet the residential cleanup goal of 100 µg/kg. Average concentrations of lead would be reduced from an average of 1,300 mg/kg to 400 mg/kg. Minor quantities of arsenic and antimony would also be treated in the process. On-site treatment would reduce lead concentrations so that the 10,000 yd^3 of highly contaminated soil that currently exhibits leachability levels exceeding the TCLP criteria would meet 0.75 mg/L lead UTS for on-site reuse. The reduction in lead concentration that would be required to meet the UTS would be estimated as part of treatability studies during which TCLP concentrations of lead in the more highly contaminated soil would be determined. Lead removed from the highly contaminated soil would be included within the filter cake residue from the soil washing process and treated by chemical fixation and solidification at an off-site RCRA Subtitle C TSDF such that leachable lead levels would no longer exceed TCLP criteria. This filter cake residue (26,000 yd^3 or 35,000 tons, to be verified by treatability studies) would then be deposited in a secure landfill, thereby rendering it unlikely to be exposed to reversible chemical reactions. In that regard, this alternative is nearly 100 percent irreversible.

Short-Term Effectiveness

Alternative 4B would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during on-site remedial activities. Erosion control measures would minimize the migration of COCs into nearby streams. Transportation of screening and soil washing residues to an off-site TSDF would be conducted in suitable containers and by reputable transporters. In the unlikely event of a traffic accident releasing contaminated material to the environment, transported soil would not pose an immediately hazard to the community because of the non-volatile nature and relatively low solubility of the COCs present at the site. However, should such an event occur, measures to prevent washing away of the material by storm events would be warranted. Workers on site would be adequately protected if suitable health and safety procedures are followed. Relocation of gopher tortoise habitats would reduce adverse impacts to the site ecological system during excavation. The time frame for implementation of this alternative is estimated to be approximately 3 years.

Implementability

Alternative 4B is implementable. Excavation equipment considered under this alternative is typical in the construction industry and readily available from several local sources. Soil washing is offered by relatively few vendors; however, at least two have been identified with an established track record in

treating contaminated media containing similar constituents and with the ability to achieve the removal efficiencies expected in this alternative. However, treatability studies are strongly recommended to allow better estimates of the efficiency and cost associated with the need for multiple passes to meet the high treatment efficiency. Suitable TSDFs are available for the disposal of the screening and soil washing residues and have been identified at nearby locations.

Cost

Estimated costs for Alternative 4B are as follows:

- Capital: $28,828,000
- O&M: $0
- NPW: $28,828,000

A more detailed breakdown of these cost estimates is provided in Appendix G.

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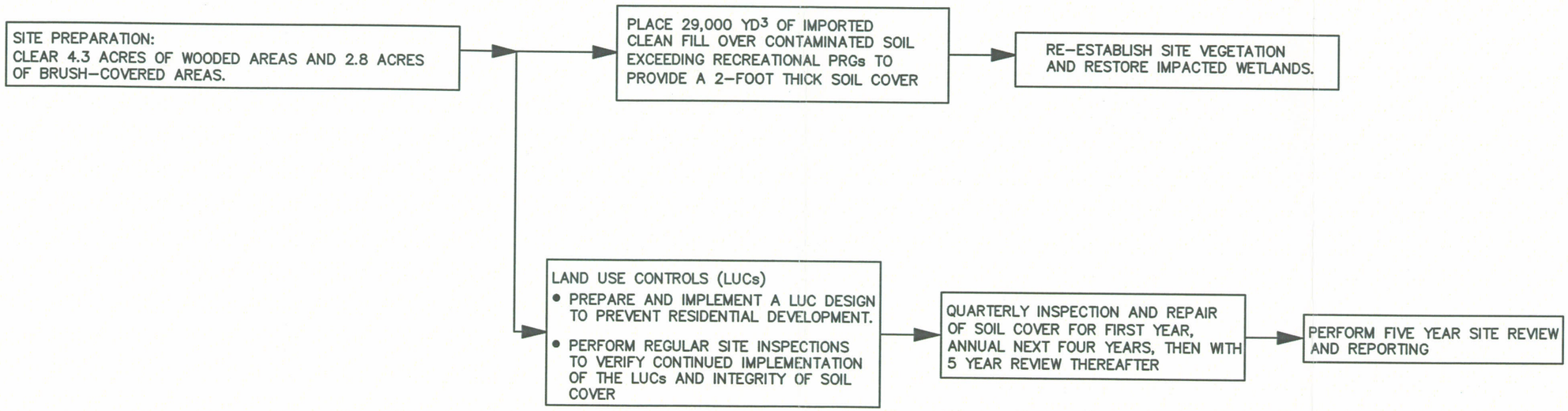
ALTERNATIVE 2
SOIL COVER TO MEET RECREATIONAL RAOs AND LUCs



KEY:

LUCs	LAND USE CONTROLS
PRG	PRELIMINARY REMEDIATION GOAL
RAOs	REMEDIAL ACTION OBJECTIVES
YD^3	CUBIC YARDS

DRAWN BY HJB	DATE 4/14/05	
CHECKED BY	DATE	
REVISED BY	DATE	
SCALE AS NOTED		

NAVFAC

BLOCK FLOW DIAGRAM
SOIL ALTERNATIVE 2
SITE 15 FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

CONTRACT NO. 7653	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 4-1	REV. 0

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

Legend
- Monitoring Well
- Surface Soil Sample Location
- Subsurface Soil Sample Location
- Surface Water / Sediment Sample Location
- Confirmation Soil Sample Location
- Post RI Surface Soil Sample Location
- Post RI Surface Water / Sediment Sample Location
- BaPEq, 0-1 foot bgs
- Lead, 0-1 foot bgs
- TRPH, 1-2 feet bgs
- Arsenic, 0-2 feet bgs or water table if less than 2 feet bgs
- Wetlands

Wetland A

Wetland B

Survey Limits

Wetland D

Wetland E

Wetland F

Wetland C

SEE INSET 1

SEE INSET 2

Inset 1

Inset 2

N

100 0 100 200 Feet

P:\GIS\Cecil\Site-15_FS.apr 27Mar07 MJJ 14b-Layout-Recreational Reuse

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MJJ	23Oct03
CHECKED BY	DATE
	DATE
SCALE	
AS NOTED	

NAVFAC

AREAS OF SOIL TO BE REMEDIATED TO ALLOW RECREATIONAL SITE USE
OU 5, SITE 15
FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

CONTRACT NO. 7653

OWNER NO.

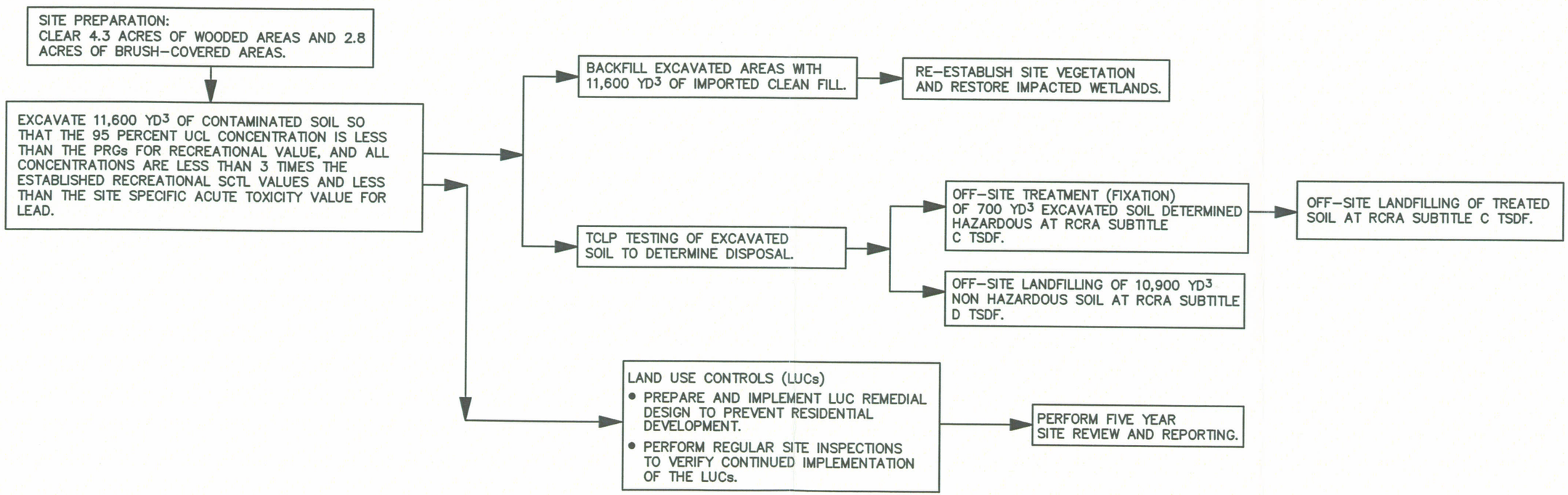
APPROVED BY DATE

DRAWING NO. FIGURE 4-2

REV. 0

ACAD: 7653KF11.dwg 05/18/05 HJB PIT

ALTERNATIVE 3A
EXCAVATION TO MEET RECREATIONAL RAOs, OFF-SITE TREATMENT & DISPOSAL, AND LUCs



KEY:

LUCs	LAND USE CONTROLS
PRGs	PRELIMINARY REMEDIATION GOALS
RAOs	REMEDIAL ACTION OBJECTIVES
RCRA	RESOURCE CONSERVATION AND RECOVERY ACT
TCLP	TOXICITY CHARACTERISTICS LEACHING PROCEDURE
SCTL	SOIL CLEANUP TARGET LEVEL
TSDF	TREATMENT STORAGE AND DISPOSAL FACILITY
UCL	UPPER CONFIDENCE LIMIT
YD3	CUBIC YARDS

DRAWN BY HJB	DATE 4/14/05	BLOCK FLOW DIAGRAM SOIL ALTERNATIVE 3A SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA
CHECKED BY	DATE	
REVISED BY	DATE	
SCALE AS NOTED		

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CONTRACT NO. 7653	
OWNER NO. 0000	
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DRAWING NO. FIGURE 4-3	REV. 0

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

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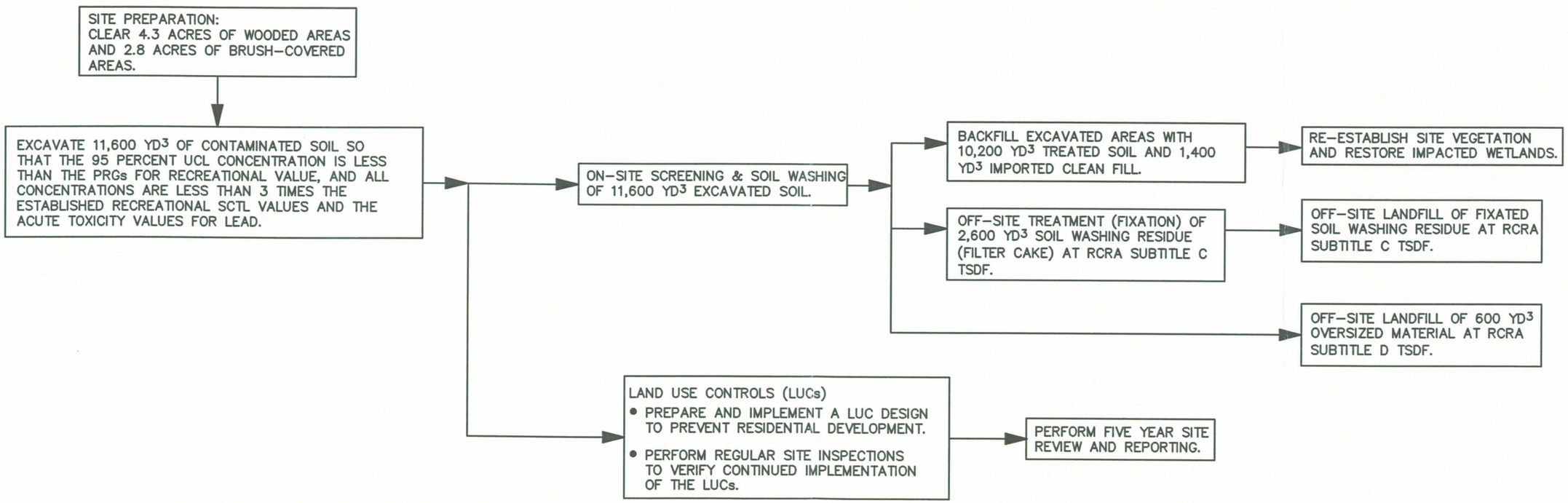
ALTERNATIVE 3B
EXCAVATION TO MEET RECREATIONAL RAOs, ON-SITE TREATMENT, AND REUSE AND LUCs



KEY:

LUCs	LAND USE CONTROLS
PRGs	PRELIMINARY REMEDIATION GOALS
RAOs	REMEDIAL ACTION OBJECTIVES
RCRA	RESOURCE CONSERVATION AND RECOVERY ACT
TSDF	TREATMENT STORAGE AND DISPOSAL FACILITY
UCL	UPPER CONFIDENCE LIMIT
YD3	CUBIC YARDS

DRAWN BY HJB	DATE 4/14/05	BLOCK FLOW DIAGRAM SOIL ALTERNATIVE 3B SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACSONVILLE, FLORIDA
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REVISED BY	DATE	
SCALE AS NOTED		

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CONTRACT NO. 7653	
OWNER NO. 0000	
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DRAWING NO. FIGURE 4-4	REV. 0

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

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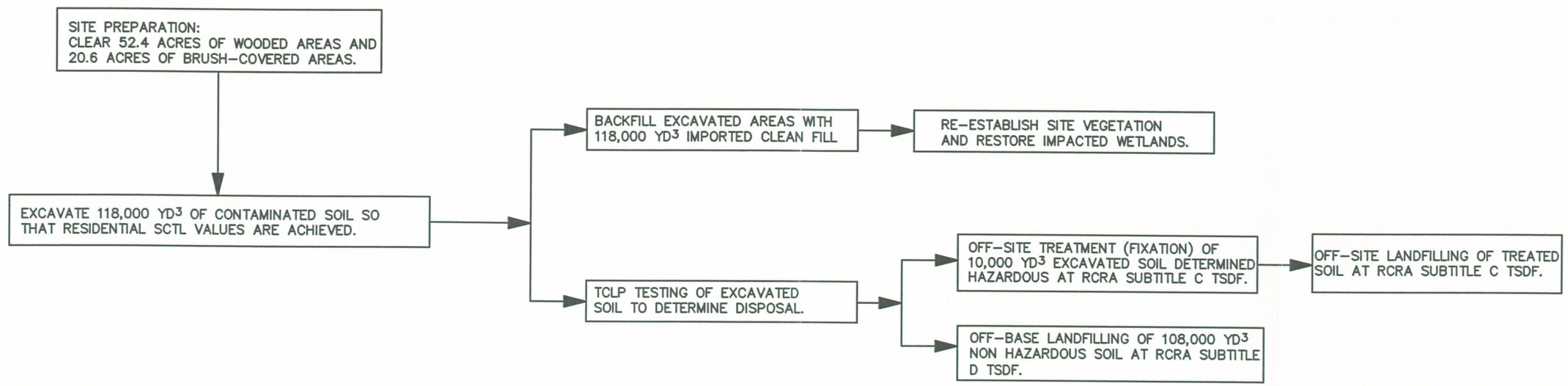
ALTERNATIVE 4A
EXCAVATION TO ALLOW UNRESTRICTED SITE USE AND OFF-SITE TREATMENT & DISPOSAL



KEY:

LUCs	LAND USE CONTROLS
RCRA	RESOURCE CONSERVATION AND RECOVERY ACT
SCTL	SOIL CLEANUP TARGET LEVEL
TSDF	TREATMENT STORAGE AND DISPOSAL FACILITY
TCLP	TOXICITY CHARACTERISTICS LEACHING PROCEDURE
UCL	UPPER CONFIDENCE LIMIT
YD^3	CUBIC YARDS

DRAWN BY HJB	DATE 4/14/05	BLOCK FLOW DIAGRAM SOIL ALTERNATIVE 4A SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA
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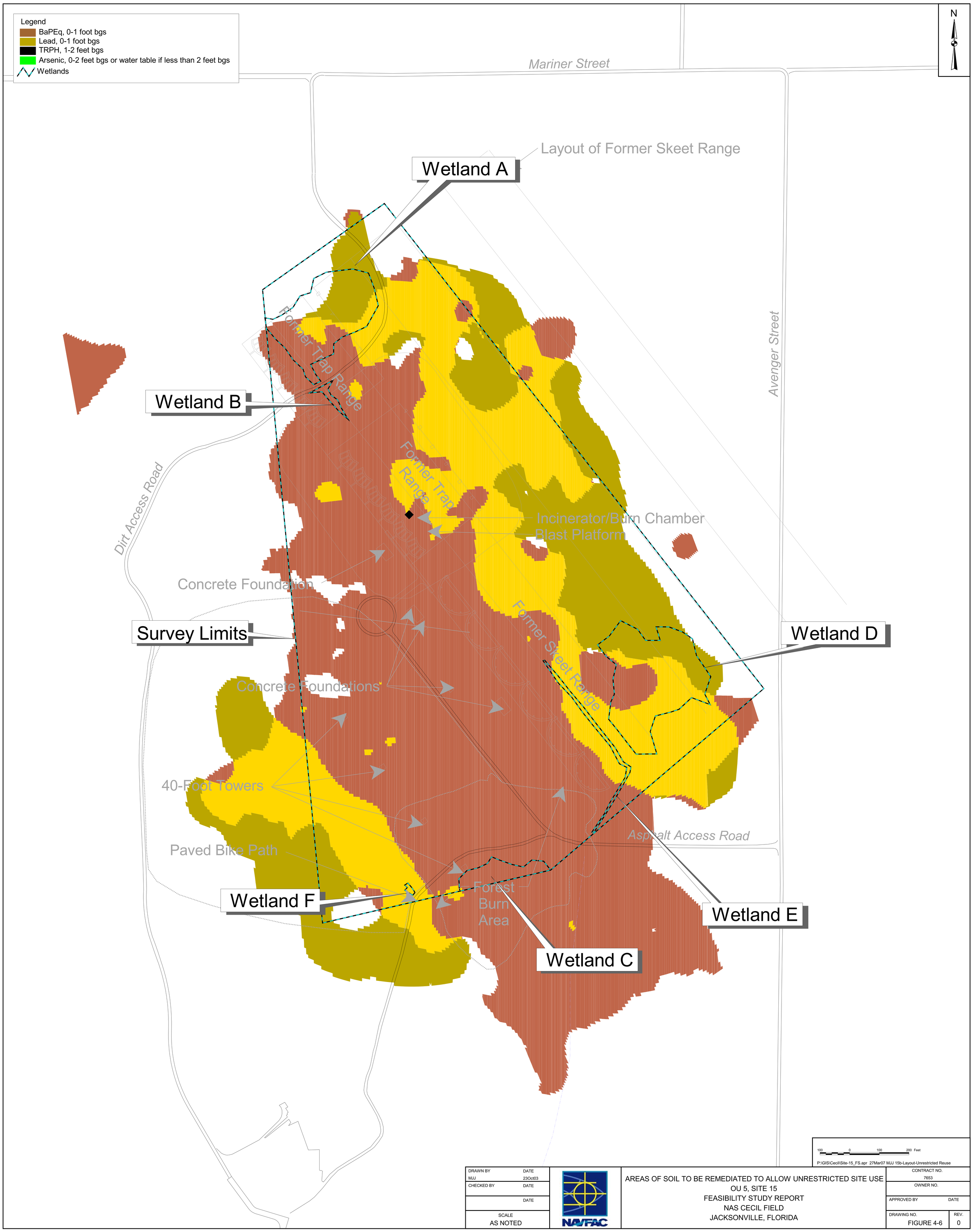
FORM CADD NO. SDIV-BH.DWG - REV 1 - 9/10/98


Legend
BaPEq, 0-1 foot bgs
Lead, 0-1 foot bgs
TRPH, 1-2 feet bgs
Arsenic, 0-2 feet bgs or water table if less than 2 feet bgs
Wetlands
N
Mariner Street
Layout of Former Skeet Range
Wetland A
Avenger Street
Former Trap Range
Wetland B
Dirt Access Road
Former Trap Range
Incinerator/Burn Chamber
Blast Platform
Concrete Foundation
Survey Limits
Former Skeet Range
Wetland D
Concrete Foundations
40-Foot Towers
Asphalt Access Road
Paved Bike Path
Forest Burn Area
Wetland F
Wetland E
Wetland C
100 0 100 200 Feet
P:\GIS\Cecil\Site-15_FS.apr 27Mar07 MJJ 15b-Layout-Unrestricted Reuse
DRAWN BY MJJ
DATE 23Oct03
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DATE
DATE
SCALE AS NOTED
NAVFAC
AREAS OF SOIL TO BE REMEDIATED TO ALLOW UNRESTRICTED SITE USE
OU 5, SITE 15
FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA
CONTRACT NO. 7653
OWNER NO.
APPROVED BY
DATE
DRAWING NO. FIGURE 4-6
REV. 0

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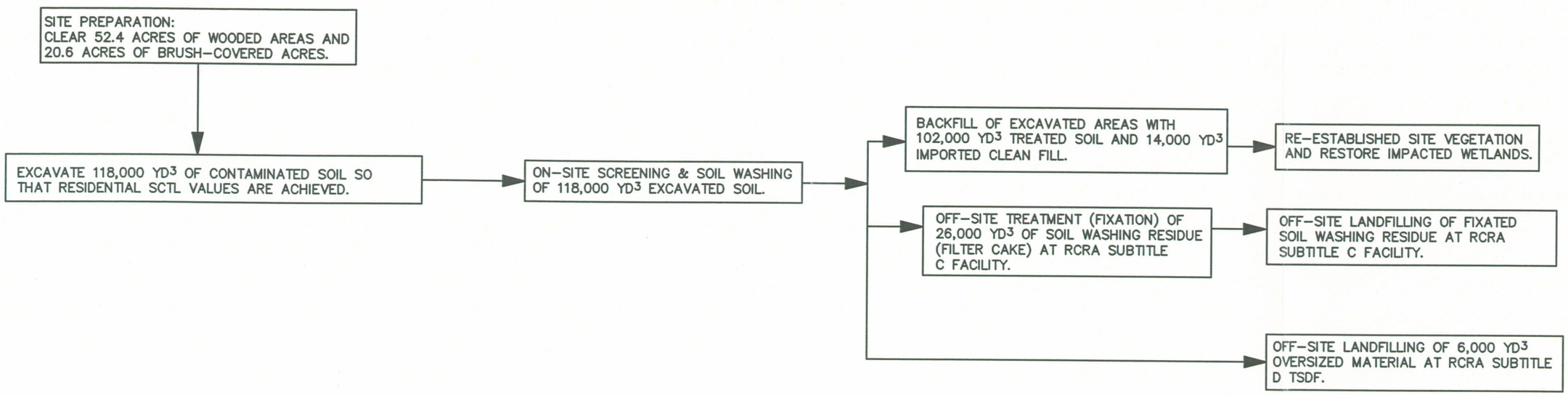
ALTERNATIVE 4B
EXCAVATION TO ALLOW UNRESTRICTED SITE USE AND ON-SITE TREATMENT AND REUSE



KEY:

PRG	PRELIMINARY REMEDIATION GOAL
RCRA	RESOURCE CONSERVATION AND RECOVERY ACT
SCTL	SOIL CLEANUP TARGET LEVEL
TSDF	TREATMENT STORAGE AND DISPOSAL FACILITY
UCL	UPPER CONFIDENCE LIMIT
YD^3	CUBIC YARDS

DRAWN BY HJB	DATE 4/14/05	BLOCK FLOW DIAGRAM SOIL ALTERNATIVE 4B SITE 15 FEASIBILITY STUDY REPORT NAS CECIL FIELD JACKSONVILLE, FLORIDA
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SCALE AS NOTED		

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CONTRACT NO. 7653	
OWNER NO. 0000	
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FORM CADD NO. SDIV-BH.DWG - REV 1 - 9/10/98

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares the analyses presented for each of the remedial alternatives in Section 4.0 of this FS. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

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

- Alternative 1: No Action
- Alternative 2: Soil Cover to Meet Recreational RAOs and LUCs
- Alternative 3A: Excavation to Meet Recreational RAOs, Off-Site Treatment and Disposal, and LUCs
- Alternative 3B: Excavation to Meet Recreational RAOs, On-Site Treatment and Reuse, and LUCs
- Alternative 4A: Excavation to Allow Unrestricted Site Use and Off-Site Treatment and Disposal
- Alternative 4B: Excavation to Allow Unrestricted Site Use and On-Site Treatment and Reuse

5.1 OVERALL PROTECTION OF HEALTH AND THE ENVIRONMENT

Alternative 1 would not be protective. Alternatives 2, 3A, 3B, 4A, and 4B would be protective; however, because of the dependence on LUCs to prevent residential, commercial/industrial, and high and medium-intensity recreational uses in the future, Alternatives 2, 3A and 3B would be ranked lower than Alternatives 4A and 4B. Alternatives 3A and 3B would be ranked higher than Alternative 2 because of the removal of contaminated soil in the former. Alternatives 3B and 4B would be ranked marginally higher than Alternatives 3A and 4A, respectively, because of their use of on-site treatment to remove COCs.

5.2 COMPLIANCE WITH ARARS AND TBCS

Alternative 1 would not comply with chemical-specific or location-specific ARARs. Action-specific ARARs do not apply to Alternative 1. Alternative 2 would not comply with chemical-specific ARARs, but exposure to soil with contaminant concentrations greater than these ARARs would be prevented by the soil cover and LUCs. Alternatives 3A, 3B, 4A, and 4B would comply with chemical-, location-, and action-specific ARARs.

5.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 would not be effective in the long term and offers no permanent solution. Alternatives 2, 3A, 3B, 4A and 4B offer varying degrees of long-term effectiveness and permanence.

Alternatives 4A and 4B offer remedies that remove COCs from the site without the need for LUCs to prevent residential and commercial/industrial development and medium- and high-intensity recreational use. Alternatives 2, 3A, and 3B depend on LUCs and may be somewhat less effective in the long term. Because of the removal of COCs from the site with either on-site or off-site treatment/disposal, Alternatives 3A and 3B are superior to Alternative 2, which depends on the maintenance of a soil cover for its effectiveness. Alternative 3B would be marginally superior to Alternative 3A because the volume of contaminated material needing off-site treatment/disposal is smaller, and therefore the relative magnitude future liability associated with the disposed material is less under Alternative 3B.

5.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternatives 1 and 2 do not employ any treatment. Alternatives that employ treatment are ranked in the following order of decreasing volumes of soil treated: Alternative 4B (118,000 yd^3), Alternative 3B (11,600 yd^3), Alternative 4A (10,000 yd^3), and Alternative 3A (700 yd^3). However, only Alternatives 3B and 4B would reduce the volume and toxicity of soil COCs at the site by irreversible treatment. Alternative 3B would treat 11,600 yd^3 of contaminated soil to reduce BaPEq concentrations by over 90 percent and 700 yd^3 of high lead-content soil (included in the 11,600 yd^3) to attain the lead UTS, resulting in approximately 2,600 yd^3 (or 3,500 tons) of highly contaminated filter cake treatment residue being removed from the site. Alternative 4B would treat 118,000 yd^3 of contaminated soil to reduce BaPEq concentrations by over 99 percent and 10,000 yd^3 of high lead-content soil (included in the 118,000 yd^3) to attain the lead UTS, resulting in approximately 26,000 yd^3 (or 35,000 tons) of highly contaminated filter cake treatment residue being removed from the site. Alternatives 3A and 4A would reduce the mobility of COCs by off-site treatment of a portion of the excavated soil. Alternative 4A would treat 10,000 yd^3 of lead-contaminated soil compared to 700 yd^3 for Alternative 3A to achieve mobility reduction.

5.5 SHORT-TERM EFFECTIVENESS

All of the alternatives would be effective in the short term in terms of short-term risks to workers, the community, and the environment, except Alternative 1 for which there are no relevant issues to address. However, a greater potential for release of COCs exists under Alternatives 3B and 4B compared to the other alternatives. Alternative 2 employs the least volume of excavation and movement of contaminated soil and is likely to pose the least short-term risk. Alternative 3A is less likely to pose a short-term risk than Alternative 4A because of the lower volume of contaminated soil being excavated. Short-term risks for all alternatives, except Alternative 1, would be properly mitigated by application of engineering controls and adherence to OSHA requirements.

Alternative 1 would not achieve the soil RAOs. The approximate time frames for implementation and attainment of RAOs would be 1 year for Alternatives 2, 3A, and 3B; 2 years for Alternative 4A, and 3 years for Alternative 4B.

5.6 IMPLEMENTABILITY

Alternative 1 would be readily implementable because there is no action to implement. The other alternatives would be ranked in the following decreasing order of ease of implementability: Alternative 4A, Alternative 3A, Alternative 2, and Alternatives 3B and 4B. Alternative 4A would be the easiest to implement because no on-site treatment or long-term maintenance would be required. Alternative 3A would be expected to be somewhat more difficult to implement because of the need to maintain long-term site monitoring and LUCs. Alternative 2 would require maintenance of LUCs as well as maintenance of the cap. Alternatives 3B and 4B employ on-site treatment, which requires specialized engineering and trained technicians, and therefore they are likely to be more difficult to implement. Alternative 4B would require treatability studies and additional processing to meet more stringent on-site reuse requirements than Alternative 3B.

5.7 COST

The capital costs, NPW of O&M costs, and NPW costs of the alternatives are as follows. Costs have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. Detailed cost estimates are provided in Appendix G.

Alternative	Capital ($)	30-Year NPW of O&M ($)	30-Year NPW ($)
1	0	0	0
2	1,373,000	59,000	1,432,000
3A	1,882,000	35,000	1,917,000
3B	4,680,000	35,000	4,715,000
4A	15,804,000	0	15,804,000
4B	28,828,000	0	28,828,000

5.8 SUMMARY OF COMPARATIVE ANALYSIS OF SOIL REMEDIAL ALTERNATIVES

Table 5-1 summarizes the comparative analysis of the soil remedial alternatives.

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF SOIL REMEDIAL ALTERNATIVES
SITE 15 FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Soil Cover To Meet Recreational RAOs & LUCs	Alternative 3A: Excavation To Meet Recreational RAOs, Off-Site treatment & Disposal, & LUCs	Alternative 3B: Excavation To Meet Recreational RAOs, On-Site Treatment and Reuse, & LUCs	Alternative 4A: Excavation To Allow Unrestricted Site Use & Off-Site Treatment & Disposal	Alternative S4B: Excavation to Allow Unrestricted Site Use & On-Site Treatment & Reuse
Overall Protection of Human Health and Environment	Not protective	Protective	More protective than Alternative 2	Slightly more protective than Alternative 3A	More protective than Alternatives 3A and 3B	Slightly more protective than Alternative 4A
Compliance with ARARs and TBCs						
Compliance with ARARs and TBCs Chemical-Specific Location-Specific Action-Specific	 Would not comply Would not comply Not applicable	 Would not comply Would comply Would comply	 Would comply Would comply Would comply	 Would comply Would comply Would comply	 Would comply Would comply Would comply	 Would comply Would comply Would comply
Long-Term Effectiveness and Permanence	Not effective	Effective	More effective than Alternative 2	Similar to Alternative 3A	More effective than Alternatives 3A and 3B	Similar to Alternative 4A
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None	None	700 yd^3 treated for reduction of mobility to meet TCLP levels	11,600 yd^3 treated to reduce BaPEq concentrations by over 90 percent and to reduce lead concentrations to meet UTS. 2,600 yd^3 of highly contaminated treatment residue removed from site	10,000 yd^3 treated for reduction of mobility to meet TCLP levels	118,000 yd^3 treated to reduce BaPEq concentrations by over 99 percent, and to reduce lead concentrations to meet UTS. 26,000 yd^3 of highly contaminated treatment residue removed from site

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF SOIL REMEDIAL ALTERNATIVES
SITE 15 FEASIBILITY STUDY REPORT
NAS CECIL FIELD
JACKSONVILLE, FLORIDA

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Soil Cover To Meet Recreational RAOs & LUCs	Alternative 3A: Excavation To Meet Recreational RAOs, Off-Site treatment & Disposal, & LUCs	Alternative 3B: Excavation To Meet Recreational RAOs, On-Site Treatment and Reuse, & LUCs	Alternative 4A: Excavation To Allow Unrestricted Site Use & Off-Site Treatment & Disposal	Alternative S4B: Excavation to Allow Unrestricted Site Use & On-Site Treatment & Reuse
Short-Term Effectiveness	No relevant issues to address	Would be effective. Minimum potential for short-term risks. One year to attain RAOs.	Would be effective. Greater potential for short-term risks than Alternative 2. One year to attain RAOs.	Would be effective. Greater potential for short-term risks than Alternatives 3A and 4A. One year to attain RAOs.	Would be effective. Greater potential for short-term risks than Alternative 3A. Two years to attain RAOs.	Would be effective. Greatest potential for short-term risks. Three years to attain RAOs.
Implementability	Nothing to implement	More difficult to implement than Alternatives 4A and 3A.	Somewhat more difficult to implement than Alternative 4A	More difficult to implement than Alternative 3B.	Easiest to implement.	Most difficult to implement
Costs:						
Capital	$0	$1,373,000	$1,882,000	$4,680,000	$15,804,000	$28,828,000
NPW of O&M	$0	$59,000	$35,000	$35,000	$0	$0
NPW	$0	$1,432,000	$1,917,000	$4,715,000	$15,804,000	$28,828,000

yd^3	Cubic yards
ARARs	Applicable or Relevant and Appropriate Requirements
BaPEq	Benzo(a)pyrene equivalent
LUCs	Land use controls
NPW	Net present worth
O&M	Operation and maintenance
RAOs	Remedial Action Objectives
TBCs	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
UTS	Universal Treatment Standard

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