FINAL

Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA

DERP FUDS Project No. **C03VA004502**

Prepared for:
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Human Factors Applications, Inc. (HFA), a wholly-owned subsidiary of TerranearPMC, LLC (TPMC), prepared this Site Inspection Report for Former Nansemond Ordnance Depot, Formerly Used Defense Site (FUDS), Project No. C03VA004502. An independent technical review was conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Programmatic Work Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with existing Corps policy. In accordance with Corps requirements, significant authors to this report are presented below.

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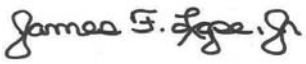
Jim Lape Risk Assessor Integral Consulting, Inc. (Under contract to TPMC/HFA)	1/9/12	
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Significant concerns and explanation of the resolutions are documented within the project file.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

Alion	Alion Science and Technology Corporation
AOC	Area Of Concern
ASR	Archives Search Report
AWQC	Ambient Water Quality Criteria
BG	Background
bgs	Below Ground Surface
CDQAR	Chemical Data Quality Assessment Report
CD-ROM	Compact Disk Read-Only Memory
CENAB	Corps of Engineers North Atlantic Division Baltimore District
CENAO	Corps of Engineers North Atlantic Division Norfolk District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Chain of Custody
COPC	Chemicals of Potential Concern
COPEC	Chemicals of Potential Ecological Concern
CQAR	Chemical Quality Assurance Report
CSM	Conceptual Site Model
CTT	Closed, Transferring, and Transferred
CWM	Chemical Warfare Materiel
CWS	Chemical Warfare Service
CX	Center of Expertise
DA	Department of the Army
DC	Design Center
DERP	Defense Environmental Restoration Program
DMM	Discarded Military Munitions
DNT	Dinitrotoluene
DoD	Department of Defense
DoI	Department of Interior
DQI	Data Quality Indicator
DQO	Data Quality Objective
Eco-SSL	Ecological Soil Screening Level
EDMS	Environmental Data Management System
EDS	Environmental Data Services, Inc.
EM	Engineering Manual
EOD	Explosive Ordnance Disposal
EP	Engineering Pamphlet
˚F	Degree (s) Fahrenheit
ft	Foot or Feet

LIST OF ACRONYMS AND ABBREVIATIONS

FDE	Findings and Determination of Eligibility
FNOD	Former Nansemond Ordnance Depot
FS	Feasibility Study
FUDS	Formerly Used Defense Site(s)
FUDSMIS	FUDS Management Information System
GIS	Geographic Information Systems
HFA	Human Factors Applications, Inc.
HHE	Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Hazard Quotient
HRS	Hazard Ranking System
HTRW	Hazardous Toxic and Radioactive Waste
ID	Identification
In.	Inch (es)
INPR	Inventory Project Report
K_{ow}	Octanol-Water Partitioning Coefficient
LLLP	Limited Liability Limited Partnership
LUC	Land Use Controls
m	meter
MC	Munitions Constituents
MCL	Maximum Contaminant Level
MD	Munitions Debris
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
mg/kg	Milligram per kilogram
MHT	Mean high tide
mi	mile(s)
mi^2	square mile
mm	millimeter(s)
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
msl	Mean Sea Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MQO	Measurement Quality Objective
MW	Molecular weight

LIST OF ACRONYMS AND ABBREVIATIONS

NAD	North American Datum
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAI	No Department of Defense Action Indicated
NG	Nitroglycerin
NOAA	National Oceanographic and Atmospheric Administration
NPL	National Priorities List
NTCRA	Non-Time Critical Removal Action
OEW	Ordnance and Explosives Waste
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons
PDT	Project Delivery Team
PGM	Program Manager
PM	Project Manager
PMMQL	Preferred Maximum Method Quantitation Limits
PP	Proposed Plan
PWP	Programmatic Work Plan
PWS	Performance Work Statement
QA	Quality Assurances
QC	Quality Control
QR	Qualitative Reconnaissance
QSM	Quality Systems Manual
RA	Remedial Action
RAB	Restoration Advisory Board
RAC	Risk Assessment Code
RBC	Risk Based Concentration
RD	Remedial Design
RDX	Cyclotrimethylenetrinitramine
REF	Real Estate Foundation
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
RMIS	Restoration Management Information System
ROD	Record of Decision
RPD	Relative Percent Difference
SA	Source Area
SB	Subsurface Soil Sample
SD	Sediment Sample
SI	Site Inspection

LIST OF ACRONYMS AND ABBREVIATIONS

SL	Screening Level
SLERA	Screening Level Ecological Risk Assessment
SS	Surface Soil Sample
SSFR	Site Specific Final Report
SSL	Soil Screening Level
SS-WP	Final Site-Specific Work Plan Addendum to the MMRP Programmatic Work Plan for the Site Inspection of the Former Nansemond Ordnance Depot
SW	Surface Water Sample
T&E	Threatened and Endangered
TCC	Tidewater Community College
TCLP	Toxicity Characteristics Leachate Procedure
TCRA	Time Critical Removal Action
TEC	Threshold Effects Concentration
TNRCC	Texas Natural Resources Conservation Commission
TNT	Trinitrotoluene
TPMC	TerranearPMC, LLC
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
VDEQ	Virginia Department of Environmental Quality
VDMME	Virginia Department of Mines, Minerals, and Energy
VDOT	Virginia Department of Transportation
WWI	World War I
WWII	World War II

GLOSSARY OF TERMS

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)— Congress enacted CERCLA, commonly known as Superfund, on 11 December 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment (USACE 2004b).

Discarded Military Munitions (DMM)—Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations. (10 USC 2710(e)(2)) (Department of the Army [DA] 2005).

Explosive Ordnance Disposal (EOD)—The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration (DA 2005).

Explosives Safety—A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of potential mishaps involving military munitions (DA 2005).

Formerly Used Defense Site (FUDS)— A FUDS is defined as a facility or site (property) that was under the jurisdiction of the Secretary of Defense and owned by, leased to, or otherwise possessed by the United States at the time of actions leading to contamination by hazardous substances. By the Department of Defense Environmental Restoration Program (DERP) policy, the FUDS program is limited to those real properties that were transferred from DoD control prior to 17 October 1986. FUDS properties can be located within the 50 States, District of Columbia, Territories, Commonwealths, and possessions of the United States. ER 200-3-1 (May 10, 2004).

Material Potentially Presenting an Explosive Hazard (MPPEH)—Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris); or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations). Excluded from MPPEH are munitions within DoD's established munitions management system and other hazardous items that may present explosion hazards (e.g., gasoline cans, compressed gas cylinders) that are not munitions and are not intended for use as munitions (DA 2005).

GLOSSARY OF TERMS

Military Munitions— All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents; chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges; and devices and components thereof. The term does not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components, other then nonnuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed. (10 USC 101(e)(4)(A) through (C)) (DA 2005).

Munitions and Explosives of Concern (MEC)—This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded ordnance (UXO), as defined in 10 USC 101(e)(5); (B) DMM, as defined in 10 USC 2710(e)(2); or (C) Munitions constituents (e.g., trinitrotoluene, hexahydro-1,3,5-trinitro-1,3,5-triazine), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard (DA 2005).

Munitions Constituents (MC)—Any materials originating from UXO, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 USC 2710(e)(3)) (DA 2005).

Munitions Debris (MD)—Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal (DA 2005).

Munitions Response Area—Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area is comprised of one or more munitions response sites (32 Code of Federal Regulations [CFR] 179.3).

Munitions Response Site (MRS)—A discrete location within a Munitions Response Area that is known to require a munitions response (32 CFR 179.3).

GLOSSARY OF TERMS

Munitions Response Site Prioritization Protocol (MRSPP)—The MRSPP was published as a rule on 5 October 2005. This rule implements the requirement established in Section 311(b) of the National Defense Authorization Act for Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each location in the DoD's inventory of defense sites known or suspected of containing UXO, DMM, or MC. The DoD adopted the MRSPP under the authority of 10 USC 2710(b). Provisions of 10 USC 2710(b) require that the DoD assign to each defense site in the inventory a relative priority for response activities based on the overall conditions at each location and taking into consideration various factors related to safety and environmental hazards.

Non-Time Critical Removal Action (NTCRA)—Actions initiated in response to a release or threat of a release that poses a risk to human health or the environment where more than six months planning time is available (USACE 2000).

Range—A designated land or water area that is set aside, managed, and used for range activities of the DoD. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 USC 101(e)(1)(A) and (B)) (DA 2005).

Range Activities—Research, development, testing, and evaluation of military munitions, other ordnance, and weapons systems; and the training of members of the armed forces in the use and handling of military munitions, other ordnance, and weapons systems. (10 USC 101(e)(2)(A) and (B)) (DA 2005).

Range Related Debris—Debris, other than munitions debris, collected from operational ranges or from former ranges (e.g. target debris, military munitions packaging, and crating material).

Risk Assessment Code (RAC)—An expression of the risk associated with a hazard. The RAC combines the hazard severity and accident probability into a single Arabic number on a scale from 1 to 5, with 1 being the greatest risk and 5 the lowest risk. The RAC is used to prioritize response actions (USACE 2004b).

Time Critical Removal Action (TCRA)—Removal actions conducted to respond to an imminent danger posed by the release or threat of a release, where cleanup or stabilization actions must be initiated within 6 months to reduce risk to public health or the environment (DA 2005).

Unexploded Ordnance (UXO)—Military munitions that (A) have been primed, fuzed, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded whether by malfunction, design, or any other cause. (10 USC 101(e)(5)(A) through (C)) (DA 2005).

EXECUTIVE SUMMARY

ES.1 Under contract with the United States Army Corps of Engineers (USACE), Alion Science and Technology Corporation (Alion) prepared this Site Inspection (SI) Report to document SI activities and findings for the Former Nansemond Ordnance Depot (FNOD) Formerly Used Defense Site (FUDS), Property No. C03VA0045, located in Suffolk City, Virginia. The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address potential munitions and explosives of concern (MEC) and munitions constituents (MC) remaining at FUDS. This SI was completed under MMRP Project No. C03VA004502 and addresses potential MMRP hazards remaining at FNOD.

ES.2 **Site Inspection Objectives and Scope**. The primary objective of the MMRP SI is to determine whether or not the FUDS project warrants further response action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The SI collects the minimum amount of information necessary to make this determination. The SI also (i) determines the potential need for a Time Critical Removal Action (TCRA); (ii) collects or develops additional data, as appropriate, for potential Hazard Ranking System (HRS) scoring by the United States Environmental Protection Agency (USEPA); and (iii) collects data, as appropriate, to characterize the hazardous substance release for effective and rapid initiation of the remedial investigation/feasibility study (RI/FS). An additional objective of the SI is to collect the additional data necessary to evaluate munitions response sites (MRSs) using the Munitions Response Site Prioritization Protocol (MRSPP).

ES.3 The scope of the SI is restricted to the evaluation of the presence of MEC or MC related to historical use of the FUDS prior to property transfer. Potential releases of hazardous, toxic, or radioactive waste (HTRW) are not within the SI scope.

ES.4 **Nansemond Ordnance Depot**. The FNOD FUDS is comprised of approximately 975.3 acres and is located on the northern coast of the City of Suffolk, Virginia. The FUDS was acquired by the Department of Army from 1917 to 1929 by deeds, easements, permits, and Declarations of Takings. Nansemond Ordnance Depot was constructed in 1917 to support the Port of Embarkation in Newport News, Virginia with the purpose of storing munitions and shipping the munitions overseas. Military use of the property ceased in 1960. The current property owners are Tidewater Community College (TCC) Real Estate Foundation (REF), Dominion Lands, Continental Bridgeway, Suffolk Towers LLC, Bridgeway LP, General Electric, Ashley Bridgeway, City of Suffolk, Virginia Department of Transportation (VDOT), Hampton Roads Sanitation District,

Lockheed Martin, and SYSCO Foods Services of Hampton Roads. However, the areas where activities occurred during this SI were in portions of the property owned by the TCC REF, VDOT, and Hampton Roads Sanitation District.

ES.5 **Technical Project Planning.** The SI approach was developed in concert with stakeholders through USACE's technical project planning (TPP) framework, which was applied at the initial TPP meeting on 4 June 2009. Stakeholders agreed to the SI approach, as presented during the TPP meeting and finalized in the Site-Specific Work Plan (SS-WP). In summary, these agreements were to complete an MRSPP for the Munitions Response Site (MRS) 1 (James River Beach Dump Area or S-2) and MRS 2 (TNT [trinitrotoluene] Disposal Area or S-1). Additionally, it was agreed that a site history would be included in the SI Report for these areas, including S-5, area of concern (AOC) 1, AOC 5, and AOC 7. Per USACE programmatic direction in April 2011, information pertaining to AOCs 1, 5, and 7, SA 5, and O-4 was removed from the Final SI Report. Information regarding these AOCs will be included in the FNOD PA being prepared by USACE. In addition to site history included in Section 2.1 of this SI Report, visual reconnaissance was performed at eight of the AOCs: 2, 8, 9, 10, 11, 12, 14, and 15. In addition to site history and visual reconnaissance, magnetometer-assisted reconnaissance and analytical samples were collected at three AOCs (AOC 2, 8, and 9) where previous investigations had not occurred. For the purposes of this MMRP SI, only analytes as a result of military munitions activities (metals and explosive constituents) were discussed in the SI Report for each of the areas.

ES.6 USACE programmatic range documents identified two MRSs at the FNOD: MRS 1, James River Beach Dump Area (C03VA004502M01); and MRS 2, TNT Disposal Area (C03VA004502M02). However, no field work was completed at MRS 1 and MRS 2 per stakeholder agreement and USACE direction due to the extensive cleanup already completed in these areas.

ES.7 **Qualitative Site Reconnaissance and Munitions and Explosives of Concern Assessment**. The SI field activities were performed on 22, 23 and 24 March 2010. A visual reconnaissance was completed at approximately 14.60 acres within AOCs 10, 11, 12, 14, and 15, where only visual observations were made, where possible. A qualitative site reconnaissance was performed over approximately 6.23 acres of land within AOCs 2, 8 and 9 during which analog geophysics was conducted and visual observations were made, where possible. The field sampling approach included magnetometer-assisted reconnaissance following a meandering path in and around sampling locations within AOC 2, 8, and 9 and to identify the presence/absence of MEC/munitions debris (MD). During the reconnaissance and sampling activities at AOCs 2, 8,

and 9, one subsurface anomaly was detected, and no MD/MEC items were found. During the visual reconnaissance at AOCs 10, 11, 12, 14 and 15, no MD/MEC was identified during field activities. However, cultural debris was observed at the surface throughout the aforementioned areas that were visited during the 2010 field event.

ES.8 A qualitative MEC screening level hazard assessment was conducted based on the SI qualitative reconnaissance, as well as historical data documented in the Inventory Project Report (INPR), Archives Search Report (ASR), ASR Supplement, and various other historical documents provided by USACE. Military use of the property ceased in 1960; however, munitions finds have been reported, historically and recently within the FUDS boundary. No munitions items have been reported historically in the areas visited during the 2010 Alion field event (AOCs 2, 8, 9, 10, 11, 12, 14, and 15). Additionally, no MEC and/or MD items were found during the 2010 SI field event.

ES.9 **Munitions Constituents Sampling and Risk Screening**. At Streeter Creek and Lakeview Drive Ground Scars (AOC 2), a total of one surface soil sample and one subsurface soil sample, two sediment samples, and two surface water samples were collected. At Track A Magazine Line (AOC 8), a total of seven surface soil samples and seven subsurface soil samples were collected, and at Track A&B Burning Ground (AOC 9), four surface soil samples and four subsurface soil samples were collected.

ES.10 Since the list of munitions potentially used and/or stored at AOCs 2, 8, and 9 is not known, a munitions-specific list of MC could not be generated for these AOCs; therefore, a full suite of explosives and metals MC was used to support analysis of results and the risk screening. The list of MC analyzed for at AOCs 2, 8, and 9 included explosive constituents (Nitroglycerin [NG], Dinitrotoluene [DNT], DNT breakdown products [2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-dinitrotoluene; 2-Nitrotoluene; 3-Nitrotoluene; 4-Nitrotoluene, 4-Amino-2,6-dinitrotoluene], TNT, TNT breakdown products [2,4,6-Trinitrotoluene; 2- Amino-4,6-dinitrotoluene; 4-Amino-2,6-dinitrotoluene; Nitrobenzene; 1,3-Dinitrobenzene; 2,6-dinitrotoluene; 1,3,5-trinitrobenzene], Nitrobenzene, Tetryl, Cyclotrimethylenetrinitramine [RDX], and Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine [HMX]) and metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc).

ES.11 **Recommendations.** Ten areas were assessed at varying levels during the FNOD SI including: MRSs 1 and 2; and AOCs 2, 8, 9, 10, 11, 12, 14 and 15.

No munitions (MEC/MD) have been found historically at the eight areas visited during the 2010 SI field event (AOCs 2, 8, 9, 10, 11, 12, 14 or 15), and none were observed during the 2010 SI field event. The potential for an explosive safety hazard at these AOCs is low based on the evaluation of the potential presence of three elements: a source (presence of MEC/MD), a receptor (person), and interaction (e.g., touching or picking up an item).

Based on the historical findings and current conditions (absence of MEC/MD during 2010 SI field event and historical analytical data indicates no unacceptable risks to receptors from explosive constituents), no additional study or other action under MMRP is recommended at AOCs 10, 11, 12, 14, and 15. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOCs. Elevated metals at AOCs 11, 12, and 15 should be addressed under an HTRW project, the establishment of which is pending the results of the preliminary assessment (PA) currently being conducted by USACE. If the PA finds that an AOC was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for the area for the purposes of conducting additional MMRP work.

At AOCs 2, 8, and 9, where analytical samples were collected for this SI, no explosive constituents were detected in any media. Metals were identified as Chemicals of Potential Concern (COPCs) and/or Chemicals of Potential Ecological Concern (COPECs) in every media sampled. Based on a weight-of-evidence approach, no unacceptable or additional human health or ecological risks from detected metals were identified in the media sampled at AOC 2 (surface soil, subsurface soil, sediment, and surface water). Based on a weight-of-evidence approach, the following potentially unacceptable risks were identified at AOC 8: arsenic in surface and subsurface soil (human health) and lead and vanadium in surface soil (ecological). Based on a weight-of-evidence approach, the following potentially unacceptable risks were identified at AOC 9: arsenic in surface soil (human health) and vanadium in surface soil (ecological).

Based on the historical findings, current conditions (absence of MEC/MD during the 2010 SI field event), and analytical results (metals detections cannot be attributed to a munitions source), no additional study or other action under MMRP is recommended at AOC 2, AOC 8, and AOC 9. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. If the PA finds that an AOC was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for the area for the purposes of conducting additional MMRP work.

Neither a TCRA nor a non-TCRA is recommended at AOCs 2, 8, 9, 10, 11, 12, 14, or 15 (Table ES-2).

As agreed to during the TPP Meeting, MRS 1 and MRS 2 were not inspected during this SI field event since cleanup has already occurred at these areas; however, MRSPPs were prepared for MRS 1 and MRS 2 (Appendix K). Per USACE guidance, the MRSPPs for each MRS were scored with an alternative rating of "No Longer Required" since the MRSs have already been sequenced for future actions. An NDAI designation recommended for MRS 1 and MRS 2 under MMRP. Ongoing investigations and remedial actions for MC should continue to be conducted under the HTRW program, as appropriate (Table ES-1).

Additional MRSs may be identified and subsequent SIs conducted if other MEC-related areas of the FUDS are presented in the ongoing supplemental PA being prepared by USACE Mississippi Valley St. Louis District.

Table ES-1. Summary of Findings for MRSs 1 and 2 at FNOD (FUDS Project No. C03VA004502)

MRS	Task Completed for SI	Findings and Recommendations	Ongoing/Future Work
MRS 1 - James River Beach Dump Area (SA-2)	Per stakeholder agreement, no field activities were completed during this SI given the cleanup that has occurred in this area. Historical documents were reviewed for this SI. Per USACE guidance, the MRSPP was scored with an alternative rating of "No Longer Required."	Used as a general disposal area during WWI. Numerous MD have been removed. NDAI designation for MMRP. Actions should continue under HTRW, as appropriate. Revise acreage in FUDSMIS from 1.5 acres to 2.1 acres based on extent of previous actions.	RI Report finalized after collection of supplemental sediment data. Included in 2011 geophysical survey of shoreline and bluff of FNOD.
MRS 2 - TNT Disposal Area (SA-1)	Per stakeholder agreement, no field activities were completed during this SI given the extensive work and cleanup that has occurred in this area. Historical documents were reviewed for this SI. Per USACE guidance, the MRSPP was scored with an alternative rating of "No Longer Required."	Suspected of being used as a disposal area during WWII. Crystalline TNT (MEC) and numerous MEC and MD have been removed. NDAI designation for MMRP. Actions should continue under HTRW, as appropriate. Revise acreage in FUDSMIS from 0.5 acres to 9.8 acres based on extent of previous actions.	Possible Revised RI Report based on sampling data gap. FS Report.

FNOD – Former Nansemond Ordnance Depot
FS – Feasibility Study
FUDS – Formerly Used Defense Site
FUDSMIS – FUDS Management Information System
HTRW – Hazardous, Toxic, and Radioactive Waste
MD – Munitions Debris
MEC – munitions and explosives of concern
MMRP – Military Munitions Response Program
MRS – Munitions Response Site
MRSPP – Munitions Response Site Prioritization Protocol
NDAI – No Department of Defense Action Indicated
RI – Remedial Investigation
SA – Source Area
SI – Site Inspection
TNT – Trinitrotoluene
USACE – United States Army Corps of Engineers
WWI – World War I
WWII – World War II

Table ES-2. Summary of Recommendations for AOCs 2, 8, 9, 10, 11, 12, 14, and 15 at FNOD (FUDS Project No. C03VA004502)

AOC	Recommendation[1]	Basis for Recommendation	
		MEC	MC
AOC 2 - Streeter Creek and Lakeview Drive Ground Scars	No additional study or other action under MMRP TCRA/NTCRA not recommended	MEC Assessment: Low hazard Historically, munitions were stored, not used at AOC 2 No munitions historically found at AOC 2 No MEC/MD observed during 2010 SI field activities	*Risk Screening Assessment:* No explosive constituents were detected in any media sampled during this SI (surface soil, subsurface soil, sediment, or surface water). No unacceptable risks or no additional risks to human or ecological receptors were identified from exposure to metal MC in the media sampled during this SI. *Surface Soil:* Arsenic and thallium exceeded human health screening criteria and were designated COPCs; however, they did not exceed background, so no additional risks from FUDS-related activities were identified. Lead and vanadium exceeded ecological screening criteria and were designated COPECs; however, they did not exceed background, so no additional risks from FUDS-related activities were identified. *Subsurface Soil:* Arsenic exceeded human health screening criteria and was designated a COPC; however, arsenic did not exceed background, so no additional risks from FUDS-related activities were identified. *Sediment:* Arsenic exceeded human health screening criteria and was designated as a COPC. Arsenic exceeded background; however, based on a weight-of-evidence evaluation, no unacceptable risks to human receptors were identified. Copper, iron, and lead exceeded ecological screening criteria and were designated COPECs; however, copper and lead did not exceed background, so no additional risks from FUDS-related activities are identified for these metals. Iron did exceed background, but based on a weight-of-evidence approach, no unacceptable risks to ecological receptors were identified. *Surface Water:* Arsenic exceeded human health screening criteria and was designated as a COPC. Arsenic concentrations were similar to background concentrations, and based on a weight-of-evidence evaluation, no unacceptable risks to human receptors were identified. Aluminum, barium, calcium, copper, iron, magnesium, manganese, potassium, silver, and sodium exceeded ecological screening criteria and were designated as COPECs. With the exception of aluminum, the COPECs exceeded background concentrations; however, based on a weight-of-evidence evaluation, no unacceptable FUDs-related

Table ES-2. Summary of Recommendations for AOCs 2, 8, 9, 10, 11, 12, 14, and 15 at FNOD (FUDS Project No. C03VA004502)

AOC	Recommendation[1]	Basis for Recommendation	
		MEC	**MC**
			risks to ecological receptors were identified.
AOC 8 – Track A Magazine Line	No additional study or other action under MMRP TCRA/NTCRA not recommended	MEC Assessment: Low hazard Historically, munitions were stored, not used No munitions historically found at AOC 8 No MEC/MD observed during 2010 SI field activities	*Risk Screening Assessment:* No explosive constituents were detected in the media sampled during this SI (surface soil and subsurface soil). Potentially unacceptable risks to human receptors were identified from arsenic in surface and subsurface soil. Potentially unacceptable risks to ecological receptors were identified from lead and vanadium in surface soil. However, due to the absence of explosive constituents detections, these metals detections cannot be attributed to a munitions source. *Surface Soil:* Aluminum, arsenic, cobalt, iron, manganese, and thallium exceeded human health screening criteria and were designated COPCs. The COPCs exceeded background concentrations; however, based on a weight-of-evidence evaluation, a potentially unacceptable risk to human receptors was identified only for arsenic.. Arsenic, copper, lead, mercury, selenium, vanadium, and zinc exceeded ecological screening criteria and were designated COPECs. With the exception of mercury, the COPECs exceeded background concentrations; however, based on a weight-of-evidence evaluation, a potentially unacceptable risk to ecological receptors was identified only for lead and vanadium. *Subsurface Soil:* Aluminum, arsenic, cobalt, iron, manganese, and thallium exceeded human health screening criteria and were designated COPCs. The COPCs exceeded background concentrations; however, based on a weight-of-evidence evaluation, a potentially unacceptable risk to human receptors was identified only for arsenic..
AOC 9 – Track A and B Burning Ground	No additional study or other action under MMRP TCRA/NTCRA not recommended	MEC Assessment: Low hazard Historically, munitions were stored, not used at AOC 9 No munitions historically found at AOC 9 No MEC/MD observed during	*Risk Screening Assessment:* No explosive constituents were detected in the media sampled during this SI (surface soil and subsurface soil). Potentially unacceptable risks to human receptors were identified from arsenic in surface soil. Potentially unacceptable risks to ecological receptors were identified from vanadium in surface soil. However, due to the absence of explosive constituents detections, these metals detections cannot be attributed to a munitions source. *Surface Soil:* Aluminum, arsenic, iron, and thallium exceeded human health screening criteria and were

Table ES-2. Summary of Recommendations for AOCs 2, 8, 9, 10, 11, 12, 14, and 15 at FNOD (FUDS Project No. C03VA004502)

AOC	Recommendation[1]	Basis for Recommendation	
		MEC	**MC**
		2010 SI field activities	designated as COPCs. The COPCs exceeded background concentrations; however, based on a weight-of-evidence evaluation, a potentially unacceptable risk to human receptors was identified only for arsenic. Lead, mercury, selenium, and vanadium exceeded ecological screening criteria and were designated COPECs. With the exception of mercury, the COPECs exceeded background concentrations; however, based on a weight-of-evidence evaluation, a potentially unacceptable risk to ecological receptors was identified only for vanadium. *Subsurface Soil:* Aluminum, arsenic, iron, and thallium exceeded human health screening criteria and were designated COPCs. The COPCs, except arsenic, exceeded background concentrations; however, based on a weight-of-evidence evaluation, no potentially unacceptable risk to human receptors was identified.
AOC 10 – Track G Magazine Line	No additional study or other action under MMRP TCRA/NTCRA not recommended	MEC Assessment: Low hazard Historically, munitions were stored, not used at AOC 10 No munitions historically found at AOC 10 No MEC/MD observed during the 2010 SI field activities	Per stakeholder agreements, no samples were collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by HydroGeoLogic, it was concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. USACE is performing an Expanded SI to determine the presence or absence of explosive constituents in groundwater.
AOC 11 – Track H&I Magazine Line	No additional study or other action under MMRP[2] TCRA/NTCRA not recommended	MEC Assessment: Low hazard Historically, munitions were stored, not used at AOC 11 No munitions historically found at AOC 11 No MEC/MD observed during the 2010 field work	Per stakeholder agreements, no samples collected during the 2010 SI field activities. However, based on the sampling results from the 2006/2007 sampling event conducted by HydroGeoLogic, HydroGeoLogic concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. HydroGeoLogic concluded that several metals may pose potentially unacceptable risks to human or ecological receptors. According to USACE, a Desktop RI Report, including human health and ecological risk assessments, will be prepared for AOC 11.

Table ES-2. Summary of Recommendations for AOCs 2, 8, 9, 10, 11, 12, 14, and 15 at FNOD (FUDS Project No. C03VA004502)

AOC	Recommendation[1]	Basis for Recommendation	
		MEC	MC
AOC 12 – Track J Magazine Line	No additional study or other action under MMRP[2] TCRA/NTCRA not recommended	MEC Assessment: Low hazard Historically, munitions were stored, not used at AOC 12 No munitions historically found at AOC 12 No MEC/MD observed during the 2010 SI field activities	Per stakeholder agreements, no samples collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by Cape Environmental, it was concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. In previous studies, arsenic and lead in surface soils and arsenic in subsurface soil exceeded USEPA screening values. USACE is in the process of developing a work plan to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required.
AOC 14 – Track K Magazine Line	No additional study or other action under MMRP TCRA/NTCRA not recommended	MEC Assessment: Low hazard Historically, munitions were stored, not used at AOC 14 No munitions historically found at AOC 14 No MEC/MD observed during the 2010 SI field activities.	Per stakeholder agreements, no samples collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by ICOR, Ltd., it was concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. USACE concluded that there may be potential risks to certain ecological receptors from select heavy metals. Based on the frequent detections of certain metals, PAHs and pesticide compounds in soil and groundwater throughout FNOD, USACE is in the process of developing a work plan to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required.
AOC 15 – Track K Magazine Line Landfill	No additional study or other action under MMRP[2] TCRA/NTCRA not recommended	MEC Assessment: Low hazard Historically, munitions were stored, not used at AOC 15 No munitions historically found at AOC 15 No MEC/MD observed during the 2010 SI field activities	Per stakeholder agreements, no samples collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by ICOR, Ltd., it was concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. USACE concluded that there may be potential risks to certain ecological receptors from select heavy metals. Based on the frequent detections of certain metals, PAHs and pesticide compounds in soil and groundwater throughout FNOD, USACE is in the process of developing a work plan to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required.

Table ES-2. Summary of Recommendations for AOCs 2, 8, 9, 10, 11, 12, 14, and 15 at FNOD (FUDS Project No. C03VA004502)

AOC	Recommendation[1]	Basis for Recommendation	
		MEC	MC
AOC – Area of Concern COPC – Chemical of Potential Concern COPEC – Chemical of Ecological Potential Concern FNOD – Former Nansemond Ordnance Depot FUDS – Formerly Used Defense Site MC – Munitions Constituents MD – Munitions Debris		MEC – Munitions and Explosives of Concern MMRP – Military Munitions Response Program NTCRA – Non-Time Critical Removal Action PAH – Polycyclic Aromatic Hydrocarbon TCRA – Time Critical Removal Action USACE – United States Army Corps of Engineers USEPA – United States Environmental Protection Agency	

[1] If the PA finds that an AOC was used for MEC disposal operations or MEC is discovered in an AOC in the future, USACE should establish an MRS for the area for the purposes of conducting additional MMRP work.
[2] Elevated metals should be addressed under an HTRW project, the establishment of which is pending the results of the PA currently being conducted by USACE.

1. INTRODUCTION

1.0.1 This report documents the findings of the Military Munitions Response Program (MMRP) Site Inspection (SI) performed at Former Nansemond Ordnance Depot[1] (FNOD) Formerly Used Defense Site (FUDS) located within Suffolk City, Virginia with the MMRP Project No. C03VA004502. Human Factors Applications, Inc. (HFA), a wholly-owned subsidiary of TerranearPMC, LLC (TPMC), along with support from its subcontractors (Environmental Data Services, Inc. [EDS]; Integral Consulting, Inc.; and TestAmerica, Inc.) prepared this report under contract to the United States Army Engineering and Support Center, Huntsville (USAESCH). This contract was transferred to TPMC from Alion Science and Technology Corporation (Alion) in February 2011; HFA was formerly a subsidiary of Alion. This work is being performed in accordance with Contract No. W912DY-04-D-0017, Task Order 00170001 for FUDS in the Northeast Region of the Continental United States. USAESCH transferred management of the contract to the Corps of Engineers North Atlantic Division Baltimore District (CENAB). CENAB is working with the Corps of Engineers North Atlantic Division Norfolk District (CENAO) and its contractor, TPMC/HFA, on the completion of this project in accordance with the SI Performance Work Statement (Appendix A).

1.0.2 The technical approach to this SI is based on the *Programmatic Work Plan for Formerly Used Defense Sites Military Munitions Response Program Site Inspections at Multiple Sites the Northeast Region* (Alion 2005 and 2009b) and the *Final Site-Specific Work Plan* (SS-WP) *Addendum to the MMRP Programmatic Work Plan for the Site Inspection of Nansemond Ordnance Depot* (Alion 2010).

1.1 Project Authorization

1.1.1 The Department of Defense (DoD) has established the MMRP to address DoD sites suspected of containing munitions and explosives of concern (MEC) or munitions constituents (MC). Under the MMRP, the U.S. Army Corps of Engineers (USACE) is conducting environmental response activities at the FUDS for the Army, as DoD's Executive Agent for the FUDS program.

1.1.2 Pursuant to USACE's Engineer Regulation 200-3-1 (USACE 2004b) and the *Management Guidance for the Defense Environmental Response Program (DERP)* (DoD 2001), USACE is

[1] The USACE's FUDS Management Information System (FUDSMIS) tracks this property as "Nansemond Ordnance Depot." For the purpose of this document and in accordance with previous reports/studies completed at this FUDS, the property name is referenced as "Former Nansemond Ordnance Depot" or "FNOD".

conducting FUDS response activities in accordance with the DERP statute (10 USC 2701 et seq.), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC Section 9620), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations Part 300). As such, USACE is conducting SIs, as set forth in the NCP, to evaluate hazardous substance releases or threatened releases from eligible FUDS.

1.1.3 While not every MEC/MC constitute CERCLA hazardous substances, pollutants, or contaminants, the DERP statute provides DoD the authority to respond to releases of MEC/MC, and DoD policy states that such responses shall be conducted in accordance with CERCLA and the NCP.

1.2 Project Scope and Objectives

1.2.1 The primary objective of the MMRP SI is to determine whether or not the FUDS project warrants further response action under CERCLA. The SI collects the minimum amount of information necessary to make this determination. The SI also (i) determines the potential need for a removal action; (ii) collects or develops additional data, as appropriate, for potential Hazard Ranking System (HRS) scoring by the U.S. Environmental Protection Agency (USEPA); and (iii) collects data, as appropriate, to characterize the hazardous substance release for effective and rapid initiation of the remedial investigation/feasibility study (RI/FS). An additional objective of the MMRP SI is to collect additional data necessary to evaluate munitions response sites (MRSs) using the Munitions Response Site Prioritization Protocol (MRSPP).

1.2.2 The scope of the SI is restricted to the evaluation of the presence or absence of MEC or MC, not nature and extent, related to historical use of this FUDS prior to property transfer. The evaluation is performed through records review, qualitative site reconnaissance to assess MEC presence/absence, and sampling where MC might be expected based on the conceptual site model (CSM). Evaluation of potential releases of hazardous, toxic, and radioactive waste (HTRW) is not within the scope of this SI.

1.2.3 Ten areas (MRSs 1 and 2, and AOCs 2, 8, 9, 10, 11, 12, 14 and 15) were identified by USACE for inclusion in the FNOD SI. These areas were assessed at varying levels depending on inspection and cleanup activities that have occurred previously. Per stakeholder agreement, a summary of previous investigations was provided for the ten areas; visual reconnaissance was completed at AOCs 2, 8, 9, 10, 11, 12, 14, and 15; and analog qualitative reconnaissance and analytical sampling were completed at AOCs 2, 8, and 9. CSMs were prepared for areas visited during the SI field event, and MRSPPs were prepared for the identified MRSs. Only two areas at

FNOD were identified as MRSs. MRSs were areas identified in the Archives Search Report (ASR) that were thought to contain MEC. The ASR was completed in 1993 and was based on limited historical information. Investigation of FNOD since that time has revealed many other areas of concern, which have not yet been designated as MRS's. USACE currently is conducting a preliminary assessment (PA) to encompass additional historical research and supplement existing studies to ensure that areas of concern are identified.

1.3 Project Location

1.3.1 The FNOD is located on the northern coast of the City of Suffolk, Virginia (Figure 2, Appendix A). The North American Datum (NAD) 1983 Universal Transverse Mercator (UTM) Zone 18N, easting (X) and northing (Y) coordinates for the approximate center of the FUDS are 372305.98 meters (m) and 4084391.36 m, respectively. This FUDS falls under the geographical jurisdiction of USACE, Norfolk District.

1.4 Munitions Response Site Prioritization Protocol

1.4.1 Only two MRSs have been officially named and identified in the DoD database, and therefore only two MRSPP evaluations were required for this SI. Draft MRSPP evaluations for MRS 1 (James River Beach Dump Area) and MRS 2 (TNT Disposal Area) are included in Appendix K and will be discussed with stakeholders during the second TPP session. Additional MRSPP scoring will be conducted when new MRSs are identified, as may occur after the ongoing supplemental PA is completed.

2. SITE DESCRIPTION

2.1 Site Description and History

2.1.1 The FNOD is approximately 975.3 acres. The FUDS was acquired by the Department of Army from 1917 to 1929 by deeds, easements, permits, and Declarations of Takings. The Nansemond Ordnance Depot began construction in 1917 to support the Hampton Roads Port of Embarkation operations in Newport News, Virginia. There were two phases of construction, the first from November 1917 to July 1918 and the second from July 1918 to December 1918. During the first construction phase, a few ammunition storage facilities, barracks for small component of guards, and a 4,800 ft. pier were constructed at the FUDS. Initially the FUDS was used for temporary storage and as a trans-shipment facility. At the end of the second construction phase, the FUDS was able to handle 1,300 tons of ammunition daily. The FUDS consisted of a standard ammunition magazine, high-explosive magazine, smokeless-powder magazine, primer and fuze magazines, warehouse, barracks buildings, officer quarters, hospital, garage, firehouse, machine shop, a salvage plant, quad towers, steel water tanks, and a pier (USACE 1993 and CAPE 2006).

2.1.2 The FNOD was known as Pig Point Ordnance Depot until 1929, when it became Nansemond Ordnance Depot. The mission of the FNOD was to function as a storage and distribution depot and perform reconditioning of ammunition. During the 1920s and 1930s, improvements to the FUDS were completed including erection of a guard tower and steel water tanks, building of a salvage plant, maintenance and laying additional railroad tracks, and making additional roads. From World War I (WWI) until 1950, the FUDS was used extensively by the U.S. Army as a location for ammunition storage and processing. Domestic, foreign, conventional, and chemical munitions passed through the FUDS throughout those years. Between WWI and World War II (WWII) the FUDS functions included preparing ammunition and components for permanent storage, painting and marking shells and containers, segregating certain lots of ammunition, transferring powder charges from fiber to metal containers, salvaging munitions parts, inspecting and disposing of unserviceable ammunition by defusing or burning. During WWII the FUDS was instrumental in supporting the operations at the Hampton Roads Port of Embarkation. During the later part of the war, FNOD became an intermediate and distribution depot and performed reconditioning of ammunition (USACE 1993).

2.1.3 In 1950, the property was transferred to the Department of the Navy and became known as the Marine Corps Supply Forwarding Annex (USACE 1993). The FUDS was declared surplus in 1960 and the Beazley Foundation Boys Academy acquired the FUDS for use as a private boy's

military academy, with the Virginia Department of Highways receiving right-of-way easement over a portion of the land. Virginia Electric Power Company (currently Dominion Lands) bought 207 acres of the FUDS. Five years later, 104 acres were conveyed to the General Electric Company, and 4.7 acres were leased to Nansemond County (currently the City of Suffolk) to construct a road. In 1968, the Beazley Foundation Boys Academy closed and the property was donated to the Virginia Department of Community Colleges. In 1977, approximately 80 acres were conveyed to the Hampton Roads Sanitation District (USACE 1993 and 2007c). In 1999, the FNOD was listed on the National Priorities List (NPL) (USEPA 2010a).

2.1.4 **MRS 1 – James River Beach Dump Area:** MRS 1 is approximately 1.5 acres in size according to the ASR Supplement; however, per the boundary shown on current figures for ongoing work at the FUDS, the acreage is actually 2.1 acres. It is located on the south bank of the James River west of Interstate 664 (USACE 2004a and 2008). This area is suspected of being used as a disposal area during WWII (Weston 2006). The area includes an approximately 500-ft section of shoreline along the James River. Per stakeholder agreement (Alion 2009a, Appendix B), MRS 1 was not inspected during the SI field event since cleanup has already occurred at this area; however, an MRSPP was prepared (Appendix K).

2.1.4.1 During the ASR site visit, construction debris and boating/fishing debris were observed on the beach. In 1993, civilians found artillery rounds on the beach, which were removed by an Explosive Ordnance Disposal (EOD) team. The ASR team found six inert 170mm German artillery rounds, three inert artillery fuzes, two 55 gallon drums, and three large steel containers similar to the one ton chemical containers on the beach or partially buried in a hill adjacent to the beach (USACE 1993).

2.1.4.2 A removal assessment was conducted by Roy F. Weston, Inc. (Weston) in 1995 during which ordnance was examined for potential hazards, soil was field screened and analyzed for explosive constituents, a geophysical survey was performed to delineate the disposal area, and a surface clearance and subsurface survey were performed by Navy EOD (USACE 2007c).

2.1.4.3 In 1993 and 1996, Foster Wheeler conducted site visits and noted the presence of building and civilian debris, 170 mm German artillery rounds and rusted containers. Geophysical investigations indicated the presence of "extensive disposal areas containing metallic debris." Foster Wheeler recommended Institutional Controls and surface MEC clearance followed by periodic surface sweeps. In June 1996, the previously observed debris was still present during a site visit. Additionally, small canisters were discovered that appeared to be conglomerated by

burning and were labeled "Explosive Danger." In 1996, the CENAO installed a chain-link fence around the beachfront and repaired the fence in 1999 and 2000 (USACE 2007c).

2.1.4.4 In 1998, CENAB conducted an SI and identified Chemicals of Potential Concern (COPCs) in surface soil, subsurface soil, and groundwater based on analytical sampling data. CENAB recommended closing the landfill in place and installing permanent shoreline stabilization. Weston developed risk-based remedial cleanup goal (USACE 2007c).

2.1.4.5 In 1998, archeological remains were discovered during construction of an access road, which after further study were removed in 2001. In 2001, a removal action was conducted where debris and anomalies were removed, including several 170 mm German projectiles, one 8-inch projectile, and a cannon ball, none of which were fuzed or contained explosives (Plexus 2002). Confirmatory geophysics was conducted and samples were collected. An additional 30-foot by 90-foot area was excavated to a depth of two feet and replaced with off-site fill material. Additionally, a stone revetment was constructed (USACE 2007c).

2.1.4.6 In 2003, a geophysical survey of the nearshore area was conducted to detect submerged anomalies and suggest locations for sediment coring. Twenty Areas of Interest were identified using different methods (i.e., magnetometry, electromagnetometry, visual observations) during the 2003 geophysical survey. Seven Areas of Interest were determined to be known structures, including piers, an outfall, the I-664 bridge, and a sewer line. These known structures were generally excluded as possible sediment sampling locations. The remaining Areas of Interest were evaluated for possible sediment sample locations. Twelve Areas of Interest consisting of large or concentrated anomalies were selected for sediment sampling (SAIC 2005). In 2004, twelve sediment cores, up to ten feet in length, were collected and submitted for laboratory analyses. Using the sediment core data and 2003 geophysical data, a Screening Level Ecological Risk Assessment (SLERA) was conducted, which concluded that no further action was necessary based on ecological exposure scenarios (USACE 2007c). However, the SLERA was refined to include additional data in the RI. The Revised Draft RI Report recommended additional sediment sampling and a Focused Feasibility Study for soil. In the future, USACE plans to collect additional sediment data and issue the Final RI in 2011, with a Feasibility Study to follow (USACE 2010b).

2.1.4.7 In 2011, the USACE completed a geophysical survey of the shoreline and bluff along the entire length of the FNOD property. The purpose of the survey was to supplement previously collected geophysical data to identify potential disposal areas along the FNOD shoreline and bluff. The recent geophysical investigation was also initiated in response to the recent

discoveries of MEC being washed out of the FNOD shoreline during large storm events. USACE will be using both the previous and recently collected geophysical data to identify anomalous areas that warrant intrusive investigation.

2.1.5 **MRS 2 – TNT Disposal Area:** MRS 2 is approximately 0.5 acres according to the ASR Supplement; however, per the boundary shown on current figures for ongoing work at the FUDS, the acreage is actually 9.8 acres. It is located on Tidewater Community College (TCC) property (USACE 2008). Historical abandoned burn pits used to dispose of miscellaneous ordnance and a "steaming out" area, which was used to remove trinitrotoluene (TNT) from projectiles or ordnance casings were observed in this area. It is roughly divided into two parts based on site use and possible contamination: the Soccer Field Area, which is east of College Drive and north of Jamestown Road, and the TNT Source Area, which is east of College Drive and south of Jamestown Road. Per stakeholder agreement (Alion 2009a, Appendix B), MRS 2 was not inspected during the SI field event since cleanup has already occurred at this area; however, an MRSPP was prepared (Appendix K).

2.1.5.1 In April 1987, Ordnance and Explosive Waste (OEW) was found within the original fenced area (approximately 1.87 acres). During a subsequent investigation in that area a slab of crystalline trinitrotoluene (TNT) was found weighing several tons. In May 1987, a MEC surface sweep was conducted during which ten pounds of high explosives, 170 pounds of ordnance-related material, and 400 pound of scrap metal were collected and removed. In the June/July 1987 Remedial Action Investigation and Ordnance Study, MEC was discovered in six of the 15 excavations (rifle ammunition, explosive boosters, tear gas canisters, fuzes, crystalline TNT) and several chemicals of concern (COCs) were detected in soil and groundwater (USACE 2007c).

2.1.5.2 Another surface and subsurface MEC clearance was conducted in December 1998, and MEC identified in the previous excavations was removed (approximately 5,500 pounds). Additionally, contaminated soil was bagged for future disposal and was later sifted on-site to separate hazardous and non-hazardous material. Some of the sifted soil was returned to a lined pit and some remained packaged on site (USACE 2007c).

2.1.5.3 An investigation to determine the physical characteristics of the site and extent of contamination began in November 1989. Additional soil and groundwater samples were collected and several COCs were detected in both media. In 1992, bagged contaminated soil and additional soil was screened (including soil previously returned to the lined pit). The MEC and contaminated soil were disposed of off-site and soil samples were collected that confirmed concentrations of COCs were below regulatory limits (USACE 2007c).

2.1.5.4 During the 1993 the ASR site visit, the team investigated the TCC Portsmouth Campus area where chunks of TNT were found (in 1987). There was no evidence of any TNT remaining in the area; however, the team discovered bullets and small arms cartridges in the area. It was also observed at that time that there was a difference in ground elevation north of the area where TNT was removed that appeared to be man made (USACE 1993).

2.1.5.5 In 1994, monitoring well soil borings and groundwater were sampled and COCs were detected in groundwater. In 1998, soil samples were collected from 18 locations in the original area and several COCs were detected. A TCRA was initiated in May 1999 at the TNT Source Area (USACE 2007c).

2.1.5.6 In July 1999 a geophysical investigation was completed where 26 magnetic anomalies were discovered. Four pits were excavated and in one of the pits MEC was found including: 396 British Stokes Mortar Fuzes, MK-2 hand grenade, projectiles, booster cups, burster tubes, 3-inch Stokes Mortar, other types of fuzes, black powder, and a small amount of TNT. Additionally, 13 adapter boosters, British MK 146 fuze, and shotgun shell were found in the vicinity of one of the pits. From January 2000 through July 2001, the field team investigated 25, 100-foot square grids in the TNT Source Area and removed 337 pounds of MEC scrap and 11 tons of non-MEC scrap. A solid slab of TNT was discovered, which was later removed (June 2003). From July 2001 to December 2002, 479 pieces of munitions and 616 pounds of TNT were removed from the TNT Source Area (CAPE 2006). Soil and groundwater samples were collected in the spring of 2003 to determine the extent of contamination. In June 2003, previously identified solid TNT was excavated (approximately 500 pounds), and the overlaying soil was analyzed using Toxicity Characteristics Leachate Procedure (TCLP). Several compounds exceeded the regulatory limits, which resulted in the soil being classified as hazardous waste. However, soil surrounding the excavation was also contaminated, so as a temporary solution, the excavation was lined and the soil was returned to the pit. A TCRA was implemented to address the contamination which resulted in a temporary cap over the pit (USACE 2007c). A TCRA was completed at the site by UXB and Zapata between 1999 and 2003. Numerous MEC (including bulk TNT) and MD were removed from the site. Details on the Removal Action can be found in the Final TCRA Report (Zapata 2006).

2.1.5.7 A Revised Draft RI Report was completed by Cape in 2008; several data gaps were identified that recommended further soil and groundwater sampling, which occurred in 2009. The results of the sampling will be used to determine if revised risk assessments and an RI Report are warranted. Additionally, the biodegradation of TNT in groundwater at the site is

being evaluated, and the results of the study will be used to develop an FS after which Remedial Design (RD) or Remedial Action (RA) can occur (USACE 2010b).

2.1.6 Four areas were identified at the Technical Project Planning (TPP) Meeting for which only a site history was to be provided in this SI Report. Per agreement at the TPP meeting, no field activities were performed at these areas during the SI field event (Alion 2009b). Per USACE programmatic direction in April 2011, information pertaining to AOCs 1, 5, and 7, SA 5, and O-4 was removed from the Final SI Report. Information regarding these AOCs will be included in the FNOD PA being prepared by USACE.

2.1.7 Per agreements at the TPP meeting, three areas were identified for which sampling and Qualitative Reconnaissance (QR) were performed during the SI field event (Alion 2009b). Additionally, a site history is provided in this SI Report. Below is a summary of the work performed to date.

2.1.7.1 **AOC 2 – Streeter Creek and Lakeview Drive Ground Scars** – AOC 2 is approximately 5.0 acres in size and is located on TCC property near the eastern boundary of the FUDS east of Interstate 664 (USACE 2008). In a 1948 aerial photograph, a thin line of ground scars was observed within and north of the AOC. In a 1958 aerial photograph, a possible fill area was observed along the creek bank (Micropact Engineers, Inc. 2002 and USACE 2007b). During the 1993 ASR site visit the team investigated the creek shore, small ponds, and some of the former bunkers in the eastern section of the FUDS. The bunkers were in poor condition and were used by locals as a location for drinking parties. The team also observed some illegal dumping activity; however, the debris was not munitions related. Additionally, there were areas of construction debris; however, no military MEC/MD or disposal was found in this area (USACE 1993). In 1997, Weston collected four surface water samples, three sediment samples, and one surface soil sample at Streeter Creek within and adjacent to the AOC. The samples were analyzed for explosives compounds and metals. Arsenic exceedances of USEPA Region 3 Risk Based Concentrations (RBCs) were found in the surface soil sample, one of the surface water samples, and three of the sediment samples. Additionally, iron exceedances of USEPA Region 3 RBCs were detected in one of the surface water samples and two of sediment samples. Arsenic was determined to be a COPC in surface soil, surface water and sediment, and iron was determined to be a COPC in surface water and sediment. During a 2000 site visit, abandoned structures, former magazines, and debris were observed (Micropact Engineers, Inc. 2002). USACE currently is evaluating the need for an HTRW SI at AOC 2 (USACE 2010b). No MEC or MD was observed during the 2010 SI field activities.

2.1.7.2 **AOC 8 – Track A Magazine Line** – AOC 8 is approximately 8.4 acres and is located within TCC property and Virginia Department of Transportation (VDOT) property east of Interstate 664 (USACE 2008). Track A Magazine Line was comprised of eight explosive magazines that were oriented east/west in a line. In a 1948 aerial photograph, mounded material and a possible pit were observed between two of the buildings. In a 1954 aerial photograph, ground scars were observed on the western boundary of the AOC. In a 1958 aerial photograph, graded area and debris were observed in the eastern corner of the AOC. In 1997, a geophysical survey was conducted and no MEC-related items were found (USACE 2007b). Additionally, areas west of Interstate 664 and outside of the boundary of AOC 8 were observed to have mounded material, debris, graded area, and stains in historical aerial photographs (Figure 3-1). Since these areas were along the former magazine line known as Track A, samples collected in this area were included as part of AOC 8. USACE currently is evaluating the need for an HTRW SI at AOC 8 (USACE 2010b). No MEC or MD was observed during the 2010 SI field activities.

2.1.7.3 **AOC 9 – Track A and B Burning Ground**: AOC 9 is approximately 10.0 acres in size and is located east of Interstate 664 on property owned by TCC (USACE 2008). The area consisted of explosive magazines in two lines. Ground scarring was identified between Tracks A and B in a 1954 aerial photograph, and debris was observed between the magazine lines in a photograph dated four years later. In 1997, Weston collected one soil sample in that area, and the results indicated trace levels of semi-volatile organic compounds. Additionally, a geophysical survey resulted in no MEC-related finds (USACE 2007b). USACE is currently evaluating the need for an HTRW SI at AOC 9 (USACE 2010b). No MEC or MD was observed during the 2010 SI field activities.

2.1.8 As discussed at the TPP meeting, only a site history and visual reconnaissance were performed for AOCs 10, 11, 12, 14, and 15, because sampling has already been conducted for these AOCs (Alion 2009b).

2.1.8.1 **AOC 10 – Track G Magazine Line**: AOC 10 is 3.9 acres in size and is located along the southeastern border of the TCC Lake (USACE 2008). According to a 1937 General Map, there was a Tetryl platform for loading rail cars, but no evidence of the platform was observed in historical aerial photographs or during site visits. The Tetryl platform was located in the eastern segment of AOC 10, while a primer and fuze magazine building was located on the western segment of AOC 10. In 2006, soil and groundwater samples were collected at this AOC. No explosive constituents were detected at AOC 10 in any of the 22 soil (surface and subsurface) samples collected. Three explosive constituents (1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and 2,4-dinitrotoluene) were detected at low levels in the duplicate groundwater samples and not the

parent sample (four groundwater samples collected). The detections were estimated values and substantially less than the screening levels for these analytes. Metals were detected above background in the soil and groundwater samples; however, no risks to human or ecological receptors were identified for metals or explosive constituents at AOC 10 (HydroGeoLogic, Inc. 2006). During the historical sampling activities, there were no MEC-related finds at AOC 10. Additional groundwater samples were proposed for collection in 2010 to determine the presence/absence of explosive constituents (USACE 2010b). In this SI Report, the results of the historical metals and explosive constituents sampling summarized above were used to populate the CSM for MC (Appendix J). No MEC or MD was observed during historical sampling activities or the 2010 SI field activities; however, cultural debris (including metallic debris) was observed throughout this AOC.

2.1.8.2 **AOC 11 – Track H & I Magazine Line**: AOC 11 is approximately 17.4 acres in size and is located along the eastern boundary of TCC Lake (HydroGeoLogic, Inc. 2007 and USACE 2008). It contained four Smokeless Powder Magazines and one Ammunition Magazine. Ground scars were observed in historical aerial photographs, as shown on Figure 3-2. In 2006 and 2007, soil and groundwater samples were collected. Various metals were detected above background in soil and groundwater samples. Two explosive constituents (2-nitrotoluene and 4-nitrotoluene) were detected in one of the 29 soil (surface and subsurface) samples collected at AOC 11. A total of six different explosive constituents (2-nitrotoluene, 4-nitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, and nitrobenzene) were detected in two groundwater wells in 2006 and 2007 sampling events. No risks to human or ecological receptors were identified for explosive constituents at AOC 11; however, arsenic was found to possibly present risks to residential receptors and several metals (chromium, copper, and zinc) were found to possibly present risks to certain ecological receptors (HydroGeoLogic, Inc. 2007). In 2009, a Draft Expanded SI Report was prepared by HydroGeoLogic that indicated elevated PAHs were detected at the locations of former drums. Based on this information, USACE determined an RI is warranted and a desktop RI will be prepared including a human and ecological risk assessment. In this SI Report, the results of the historical metals and explosive constituents sampling summarized above were used to populate the CSM for MC (Appendix J). During the historical sampling activities, there were no MEC-related finds at AOC 11. During the 2010 SI field activities, there were no MEC- or MD-related finds at AOC 11; however, cultural debris (mostly construction-related debris) was observed throughout the AOC.

2.1.8.3 **AOC 12 – Track J Magazine Line-Scar**: AOC 12 is approximately 6.3 acres in size and is located along the northeastern edge of the TCC Lake (USACE 2007b and 2008). The area housed an ammunition magazine and a ground scar was observed on historical aerial

photographs north of the building. Historical documents indicate that explosive constituents and solvents were stored at AOC 12. Railroad spurs ran along the east side of the ammunition magazine building; however, remnants of the spur have been removed. A field event was conducted in 2006 at AOC 12 where soil and groundwater samples were collected in areas of ground scarring and the materials storage area. Surface soil (zero to six inches bgs) and subsurface soil (four to six feet bgs) was collected from 25 discrete locations and one groundwater sample was collected from each of four temporary monitoring wells. Five explosive constituents (2,4-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene) were detected as estimated values in seven surface or subsurface soil samples. No explosive constituents were detected in groundwater samples. Several metals detections exceeded background concentrations in soil and groundwater. Arsenic (29 samples) and lead (one sample) in surface soils and arsenic (24 samples) in subsurface soil exceeded USEPA Region 3 RBCs. There were no exceedances of USEPA Region 3 RBCs for explosive constituents in surface soils or subsurface soil. Furthermore, there were no exceedances of USEPA Region 3 RBCs for explosive constituents or metals in groundwater (CAPE 2007). Based on the frequent detections of certain metals, PAHs and pesticide compounds in soil and groundwater throughout FNOD, a work plan is in the process of being developed to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required (USACE 2010b). In this SI Report, the results of the historical metals and explosive constituents sampling summarized above were used to populate the CSM for MC (Appendix J). During the historical sampling activities, there were no MEC-related finds at AOC 12. During the 2010 SI field activities, there were no MEC- or MD-related finds at AOC 12; however, cultural debris (including metallic debris) was observed throughout the AOC.

2.1.8.4 **AOC 14 –Track K Magazine Line Scars**: AOC 14 is approximately 10.9 acres in size and consists of a series of former magazine lines adjacent to the western boundary of the TCC Lake (USACE 2007b and 2008). There were four ammunition magazines oriented north/south at AOC 14. Ground scarring was observed at the area in aerial photographs dated 1948, 1954, and 1958 and disturbed ground was observed in 1956 aerial photographs. A 1997 geophysical survey of disturbed areas did not reveal any MEC. In 2006, 25 test pits and 46 test borings were completed and surface soil, subsurface soil, and groundwater samples were collected in AOCs 14 and 15. A total of 109 soil and 11 groundwater samples were submitted for laboratory analysis. Three explosive constituents and 23 metals were detected in either surface or subsurface soil. Several of the metals detected in surface and subsurface soil were above background concentrations. In groundwater, 21 total metals and 20 dissolved metals (no explosive constituents) were detected. Several of the metals detected in groundwater were above background concentrations. The results of the screening level risk assessment indicated that there

may be potential risk to certain ecological receptors from select heavy metals contamination (ICOR Ltd. 2007 and USACE 2007b). Based on the frequent detections of certain metals, PAHs and pesticide compounds in soil and groundwater throughout FNOD, a work plan is in the process of being developed to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required (USACE 2010b). In this SI Report, the results of the historical metals and explosive constituents sampling summarized above were used to populate the CSM for MC (Appendix J). During the historical sampling activities, there were no MEC-related finds at AOC 14. During the 2010 SI field activities there were no MEC- or MD-related finds at AOC 14; however, cultural debris (including metallic debris) was observed throughout the AOC.

2.1.8.5 **AOC 15 – – Track K Magazine Line Landfill:** AOC 15 is approximately 2.0 acres in size and is located north of AOC 14 along the boundary of TCC Lake and the James River (USACE 2007b and 2008). Ground scarring and disturbed areas were observed on historical aerial photographs. A 1997 geophysical survey of disturbed areas did not reveal any MEC. Soil and groundwater samples were collected in 2006 from AOC 14 and AOC 15 (as summarized previously in the AOC 14 section). Several metals were detected above background in surface soil, subsurface soil, and groundwater and several explosive constituents were detected in surface and subsurface soil. The results of the screening level risk assessment indicated that there may be potential risk to certain ecological receptors from select heavy metals contamination (ICOR Ltd. 2007 and USACE 2007b). Based on the frequent detections of certain metals, PAHs and pesticide compounds in soil and groundwater throughout FNOD, a work plan is in the process of being developed to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required (USACE 2010b). In this SI Report, the results of the historical metals and explosive constituents sampling summarized above were used to populate the CSM for MC (Appendix J). During the historical sampling activities, there were no MEC-related finds at AOC 15. During the 2010 SI field activities; there were no MEC- or MD-related finds at AOC 15; however, cultural debris (including metallic debris) was observed throughout the AOC.

2.2 Munitions Response Site Identification and Munitions Information

2.2.1 The ASR Supplement identified James River Beach Dump Area (MRS 1) and TNT Disposal Area (MRS 2) as the only MRSs at the FNOD FUDS (USACE 2004a) (Table 2-1 and Figure 2-3). Although MEC has been discovered at other areas at FNOD, these were the only two MRSs identified.

2.2.2 According to the ASR Supplement (USACE 2004a), MRS 1 is comprised of approximately 1.48 acres of land. MRS 2 is comprised of approximately 0.54 acres of land; however, during further remedial work in these areas, both of the MRS 1 and MRS 2 boundaries have expanded to include additional acreage. The expanded acreage provided by USACE (2008) is 2.1 acres for MRS 1 and 9.8 acres for MRS 2. No water acreage is associated with either range.

2.3 Physical Setting

2.3.0.1 The following sections provide a physical description of the FUDS property with respect to relief, vegetation, and climate as well as the local demographic and land uses.

2.3.1 Topography and Vegetation

2.3.1.1 The FNOD is located in the City of Suffolk, Virginia. The FUDS is bordered by the Nansemond River on the west, James River on the north and Streeter Creek on the east. Elevations at the FUDS vary from sea level at these aforementioned water bodies to about 25 feet (ft) above sea level along the southern boundary of the property (U.S. Geological Survey [USGS] 1994). A topographic map of the FNOD is included as Figures 2-3 and 2-4 of this report.

2.3.1.2 The FNOD is covered in a variety of vegetation. The northwestern portion of the property is developed with areas of open space and low, medium, and high intensity development. The water body known as TCC Lake separates the northwestern and northeastern portions of the property. The northeastern portion of the property, with the exception of Interstate 664, which is located in a northeast-southwest orientation in this area, is predominately vegetated with evergreen forest, with some deciduous forest present. The southeastern portion of the property is mostly developed with landscaped grassy areas. The southwestern portion of the property consists of a surface water retention pond and developed areas. The areas where field work was conducted were mostly treed and overgrown with some wetland vegetation (USACE 2008 and USGS 2001).

2.3.2 Climate

2.3.2.1 The FNOD is located in the middle of the eastern United States with a climate that is general marine. The FUDS is near the Atlantic Ocean, which affects the climate by tempering the summer heat with cool periods. The winter season is generally mild with typically no measurable amount of snowfall. The average yearly rainfall is 45.22 inches with an average

annual daily minimum temperature of 50.7 degrees Fahrenheit (˚F) and an average annual daily maximum temperature of 68.2 ˚F (USACE 1993).

2.3.3 Local Demographics

2.3.3.1 The FNOD is located in the city of Suffolk, Virginia. The 2000 Census, the most recent Decennial Census for which data is available, indicates that the population density of Suffolk City is 159.2 people per square mile (mi^2). The 2000 Census indicates that there are 63,677 people and 24,704 households in Suffolk, Virginia (U.S. Census Bureau 2000). According to the most recent population estimate available, the 2009 Population Estimate from the U.S. Census Bureau, there are 83,659 people in Suffolk, Virginia, which is a population density of 209.1 people per mi^2. The most recent housing estimate available, the 2006-2008 American Community Survey 3-Year Estimates, indicates that the population density of Suffolk City is 203 people per mi^2, and there are 81,188 people in 30,204 households (U.S. Census Bureau 2008). Based on recent aerial images, more than 26 inhabited structures are present within a two mile radius of the FUDS (Google Earth 2010).

2.3.4 Current and Future Land Use

2.3.4.1 The current property owners of FNOD include TCC Real Estate Foundation (REF), Dominion Lands, Continental Bridgeway, Suffolk Towers LLC, Bridgeway LP, General Electric, Ashley Capital, the City of Suffolk, VDOT, Hampton Roads Sanitation District, Lockheed Martin, and SYSCO Foods Services of Hampton Roads. However, the areas where field activities were conducted (QR and/or sampling) were mostly undeveloped and located in portions of the property owned by the TCC REF or VDOT. Background surface water and sediment samples were collected within property owned by the Hampton Roads Sanitation District (USACE 2007c and 2008). Existing land uses include residential, industrial, educational, transportation (roads), and undeveloped. Future construction in remediated areas is likely (Alion 2009a).

2.3.5 Geologic Setting

2.3.5.1 The FNOD is located within the Atlantic Coastal Plain physiographic province, which is characterized by gently sloping land surfaces and lowland areas with unconsolidated or partially consolidated sediments (USACE 1993). The surficial geology of the property is generally Quaternary Period sand, mud, and gravel. The property is underlain by the Lynnhaven and Sedgefield Members of the Tabb Formation. The Lynnhaven Member is characterized by pebbly and cobbly fine to coarse gray sand grading upward into clayey and silty fine sand and sandy silt. The Sedgefield Member is characterized by pebbly to bouldery clayey sand and fine to medium

shelly sand that grades upward into sandy and clayey silt (Virginia Department of Mines, Minerals, and Energy [VDMME] 2003).

2.3.5.2 The majority of the soil at the FUDS, including the area where samples were collected, is Kalmia fine sandy loam, wet substratum soil. The Kalmia soil series occurs in areas with 0 to 6 percent slopes on marine terraces consisting of loamy marine deposit parent material. The depth to water table is approximately 48 to 60 inches. The typical soil profile is 0 to 22 inches fine sandy loam, 22 to 34 inches sandy clay loam, and 34 to 72 inches fine sandy loam. The series is well drained and not frequently flooded or ponded. Other prevalent soil series at FNOD are the Nansemond loamy fine sand and the Bohicket silty clay loam. The Nansemond soil series occurring in the sample area is characterized by 15 to 30 percent slopes on marine terraces consisting of loamy marine deposit parent material. The typical soil profile is 0 to 18 inches loamy fine sand, 18 to 29 inches fine sandy loam, and 29 to 70 inches loamy fine sand. The series is moderately well drained and not frequently flooded or ponded. The Bohicket soil series occurs in salt marshes with loamy and clayey marine deposit parent material. The series is very poorly drained and very frequently flooded, but not ponded. The typical soil profile is 0 to 13 inches silty clay loam and 13 to 60 inches silty clay (USDA 2009).

2.3.6 Hydrogeologic Setting

2.3.6.1 The FNOD is located in southeastern part of Virginia on the coast of the James and Nansemond Rivers in the City of Suffolk. The groundwater flows in a multiaquifer system consisting of an eastward-thickening wedge of unconsolidated sand and clay that unconformably rests on the basement rock. Aquifers in this area are the surface Columbia Formation and the deeper Yorktown Formation. The unconfined Columbia aquifer is a surficial aquifer and is made up of Holocene- and Pleistocene-age sediment that were deposited as channel fill and fluvial-marine terraces. It is composed of interbedded gravel, sand, silt, and clay and is a major source of recharge to the underlying confined flow system. The deeper Pliocene Yorktown Formation was deposited in a shallow marine to deltaic or estuarine environment. It is confined and is made up of eastward-thickening, interfingering, fine to coarse sand interbedded with clay, shell, and sandy clay (USACE 1993 and Weston 2004).

2.3.6.2 The lower James River is actually an estuary since movement of the river is influenced by the ocean tides. The shoreline water surfaces of the lower James River, Hampton Roads, and the Chesapeake Bay are controlled by the tidal influences and actions of the Atlantic Ocean. Additionally, the depth of the water along the coast and the shape of the coastline affect the tidal influences. The normal tide height varies from tide to tide and from month to month and year to year (USACE 1993).

2.3.7 Area Water Supply/Groundwater Use

2.3.7.1 Groundwater is not used as a drinking water source on the FUDS. The Virginia Department of Health, Office of Drinking Water monitors public drinking water supply wells in the area. The three types of public waterworks monitored by the Virginia Department of Health are community (serve at least 15 residential connections or at least 25 residential consumers), non-transient non-community (serves 25 or more of the same persons for six months or more each year), and transient non-community (serves 25 or more individuals daily, but the individuals served vary each day). Information regarding the location of these wells is not available to the general public, thus a figure could not be generated of the public water supply wells within a four-mile radius of the FNOD. HFA contacted Renee Hall of the Virginia Department of Health, Office of Drinking Water, Southeast Virginia Office, who is an engineer in charge of a geographic area that includes the City of Suffolk. According to Ms. Hall, there are no groundwater wells meeting the three previously described waterworks categories at FNOD or in the immediate vicinity (Appendix C). According to the City of Suffolk Department of Public Utilities, the residential neighborhoods of Burbage Grant, Respass Beach, and Water's Edge are served by public utilities; however, several of the residences within Respass Beach (located east of FNOD) may still use private groundwater wells. A GIS dataset of individual private groundwater wells is not available for inclusion in the SI Report.

2.3.7.2 According to the USGS National Water Information System Mapper, there are seven wells located on the FUDS. They are generally located near TCC REF bounded by Merrimac Avenue, Hartford Road, Jamestown Road, and the James River. The wells are located at altitudes ranging from nine to 14 feet above sea level. The depths of the wells are listed as 80 to 93 feet below ground surface (bgs) and completed in the Upper Chesapeake Group. Field groundwater level measurements were collected in 1918 from the seven wells; measurements ranged from 3.3 feet bgs to 6.5 feet bgs. There are no additional wells present within a two-mile radius of the FNOD (USGS 2010).

2.3.8 Sensitive Environments

2.3.8.0.1 The following subsections discuss the sensitive environments associated with the FUDS and the process used to determine the necessity for completing an ecological risk assessment at the FUDS.

2.3.8.1 Army Checklist for Important Ecological Places

2.3.8.1.1 In accordance with USACE Hazardous, Toxic, and Radioactive Waste Center of Expertise guidance, the Army Checklist for Important Ecological Places (USACE 2006b and 2007d) is completed (Table 2-4) to determine if a FUDS requires a screening-level ecological risk assessment. In the case of FNOD, the property contains wetland areas and is located within the Virginia Coastal Zone (Virginia Department of Environmental Quality [VDEQ] 2010). Consequently, a screening level ecological risk assessment was required.

2.3.8.2 Wetlands

2.3.8.2.1 There are wetlands present at the FNOD, including within some of the proposed sample areas. The primary wetland types are estuarine and marine wetlands and freshwater forested/shrub wetlands. The majority of the estuarine and marine deepwater and wetlands are located along the western, northern, and eastern boundaries of the FUDS. The freshwater forested/shrub wetlands and freshwater ponds are predominately located in the southern portion of the FUDS (USGS 2009). A wetlands map is provided as Figure 2-4.

2.3.8.3 Coastal Zones

2.3.8.3.1 The FNOD is located in the City of Suffolk. According to the VDEQ, who manages the Virginia Coastal Zone Management Program, the City of Suffolk is located within the Virginia Coastal Zone (VDEQ 2010). No adverse affects occurred to the coastal zone as a result of the SI field activities.

2.4 Previous Investigations for Munitions Constituents and Munitions and Explosives of Concern

2.4.0.1 A summary of previous historical investigations and related discoveries of MC and MEC is provided in the following subsections.

2.4.1 Inventory Project Report

2.4.1.1 USACE issued the Inventory Project Report (INPR) for the FNOD FUDS in 1996 (USACE 1996). The 1996 INPR determined that the present condition of the project site is the result of prior DoD ownership, utilization, or activity. In addition, the INPR determined that an environmental restoration project was an appropriate undertaking within the purview of the DERP for FUDS.

2.4.2 Archives Search Report (ASR)

2.4.2.1 The USACE St. Louis District prepared the ASR Findings (USACE 1993) for the FNOD. The ASR investigation included previous investigations at the site, property description, physical characteristics of the site, real estate, OEW/Chemical Warfare Materiel (CWM) site analysis, and evaluation of ordnance contamination. Historical documentation stated that 20 rounds of captured German Chemical Warfare Service (CWS) explosives were shipped to Nansemond Ordnance Depot. The ASR also included other reports/studies/letters/memorandums regarding the FUDS, interviews, newspaper and journal articles, site photographs, historical maps and drawings and report plates. A site visit was conducted by the USACE over the period from 29 November through 1 December 1993. MEC/MD were found during the site investigation. The team located six 170mm German artillery rounds, five 155mm shells, two partially buried suspected 55 gallon mustard agent barrels, two partially buried suspected one ton mustard agent containers, several inert artillery fuzes, and several bullets and many casings (USACE 1993).

2.4.2.2 The ASR identified four areas of interest; Area A-James River Beachfront, Area B- TNT Disposal Area, Area C – Streeter Creek and adjacent bunkers, and Area D- Large pond east of TCC. Areas A, B, and D are also known as Source Area 2 (S-2), S-1, and AOC 7, respectively. As these areas have already undergone investigation, no further field activities under this SI were conducted. This is in accordance with stakeholder agreements at the TPP meeting as documented in the TPP Memorandum (Alion 2009b). Area C, Streeter Creek, was designated AOC 2 for the purposes of this SI and, as agreed at the TPP meeting, work performed to date was summarized in Section 2 of this SI Report. Additionally, geophysical reconnaissance and sample collection and analysis were performed at AOC 2 during this SI.

2.4.3 2004 Archives Search Report Supplement

2.4.3.1 The ASR Supplement was prepared for the FUDS in 2004 (USACE 2004a). This report documented MRS boundaries and characteristics, as documented in the ASR. The ASR Supplement also assigned Risk Assessment Codes (RAC), a score designed to indicate the level of MEC risk, with a score of 1 being the highest to 5 being the lowest.

2.4.3.2 The ASR Supplement identified two MRSs at the FNOD: the James River Beach Dump Area (MRS 1), which was assigned a RAC score of 1, and TNT Disposal Area (MRS 2), which was given a RAC score of 2 (USACE 2004a). These two MRSs, also known as S-2 and S-1, respectively, have already undergone remedial action; therefore, no further work under this SI was completed. The work performed to date is summarized in Section 2.1.4 of this SI Report for

MRS 1 and in Section 2.1.5 for MRS 2. MRSPPs were prepared for MRS 1 and MRS 2 and are included in Appendix K.

2.5 Citizen Reports of Munitions and Explosives of Concern

2.5.1 MEC/MD has been found throughout the FNOD since military use ended in 1960. No MEC or MD has been reported found historically or during this SI in the areas visited during the 2010 SI field activities (AOCs 2, 8, 9, 10, 11, 12, 14, and 15).

2.6 Non-Department of Defense Contamination/Regulatory Status

2.6.1 Prior to being the location of Nansemond Ordnance Depot, the area housed an artillery battery to protect the Nansemond River entrance during the Civil War. There is no evidence, based on historical review and stakeholder comments, that activities occurring prior to or after DoD use of the area contributed to potential MEC, MD, or MC presence.

Table 2-1. Range Inventory (USACE 2004a)

Site Name	Range Name	RMIS Range Number	RAC Score	Acreage
Nansemond Ordnance Depot	MRS 1 – James River Beach Dump Area	C03VA004502M01	1	1.48*
	MRS 2 – TNT Disposal Area	C03VA004502M02	2	.54*

*Acreage reflects what was reported in the ASR Supplement; however, this has been increased due to additional finds and further studies in this area.
MRS = Munitions Response Site
RAC = Risk Assessment Code Score. The RAC allows a score of 1 (highest risk) to 5 (lowest risk).
RMIS = Restoration Management Information System

Table 2-2. FNOD MRS/AOC Summary

Area Name	Acreage[1]	2010 SI Tasks	Status[2]
MRS 1: James River Beach Dump Area (SA-2)	2.1 acres	MRS history provided in Section 2.1.4 and MRSPP in Appendix K of this SI Report.	HTRW & MMRP RI/FS
MRS 2: The TNT Disposal Area (SA-1)	9.8 acres	MRS history provided in Section 2.1.5 and MRSPP in Appendix K of this SI Report.	HTRW & MMRP RI/FS
AOC 2: Streeter Creek and Lakeview Drive Ground Scars	5.0 acres	AOC history provided in Section 2.1.7 of this SI Report. QR completed as discussed in Sections 3.3.1.2, 3.3.1.3, and 3.3.1.4. Multimedia samples collected. Analytical sample results discussed in Section 5 of this SI Report.	HTRW & MMRP SI
AOC 8: Track A Magazine Line	8.4 acres		HTRW & MMRP SI
AOC 9: Track A&B Burning Ground	10.0 acres		HTRW & MMRP SI
AOC 10: Track G Magazine Line	3.9 acres	AOC history provided in Section 2.1.8 of this SI Report. Visual reconnaissance completed as discussed in Sections 3.3.1.5, 3.3.1.6, 3.3.1.7, 3.3.1.8, and 3.3.1.9.	HTRW & MMRP SI
AOC 11: Track H&I Magazine Line	17.4 acres		HTRW & MMRP SI
AOC 12: Track J Magazine Line	6.3 acres		HTRW & MMRP SI
AOC 14: Track K Magazine Line	10.9 acres		HTRW & MMRP SI
AOC 15: Track K Magazine Line Landfill	2.0 acres		HTRW & MMRP SI

AOC – Area of Concern	QR – Qualitative Reconnaissance
HTRW – Hazardous, Toxic, and Radioactive Waste	RI/FS – Remedial Investigation/Feasibility Study
MMRP – Military Munitions Response Program	SA – Source Area
MRS – Munitions Response Site	SI – Site Inspection
MRSPP – Munitions Response Site Prioritization Protocol	TNT – Trinitrotoluene

[1] Acreages derived from USACE 2008.
[2] Status derived from USACE June 2010 Site Management Plan FNOD (USACE 2010b).

Table 2-3. Military Munitions Type and Composition

Area ID (AOC)	Munitions ID[1]	Munitions Type[1]	MC Analysis Justification[2]	Associated MC Analysis[6]
AOC 2 – Streeter Creek and Lakeview Drive Ground Scars	N/A	N/A	Previous studies reviewed historical aerial photographs of AOC 2 and observed historical ground scarring, as shown on Figure 3-1. Sample locations were biased toward the former presence of these ground scars.	**Explosive constituents:** ▪ TNT[4] ▪ DNT[3] ▪ NG ▪ Tetryl ▪ RDX (added after issuance of the Final SS-WP) ▪ HMX (added after issuance of the Final SS-WP) **Metals:** ▪ Aluminum ▪ Antimony ▪ Arsenic ▪ Barium[5] ▪ Beryllium ▪ Cadmium ▪ Calcium[5] ▪ Chromium ▪ Cobalt ▪ Copper ▪ Iron[5] ▪ Lead ▪ Magnesium[5] ▪ Manganese ▪ Mercury ▪ Nickel ▪ Potassium[5] ▪ Selenium ▪ Silver ▪ Sodium[5] ▪ Thallium ▪ Vanadium ▪ Zinc
AOC 8 – Track A Disposal Pit	N/A	N/A	Previous studies reviewed historical aerial photographs of AOC 8 and observed historical ground scarring, mounded material and possible pit, and graded area and debris, as shown on Figure 3-1. Sample locations were biased toward the former presence of these disturbed areas.	
AOC 9 – Track A and B Burning Ground	N/A	N/A	Previous studies reviewed historical aerial photographs of AOC 9 and observed historical ground scarring and graded area and debris, as shown on Figure 3-1. Sample locations were biased toward the former presence of these disturbed areas.	

ASR = Archives Search Report
AOC = Area of Concern
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
DNT = Dinitrotoluene
FNOD = Former Nansemond Ordnance Depot
FUDS = Formerly Used Defense Site
HMX = Octahydro-1,3,5,7-tetranitro-,3,5,7-tetrazocine
ID = Identification
MC = Munitions Constituents
N/A = Not Applicable
NG = Nitroglycerin
RDX = Cyclotrimethylenetrinitramine
RI/FS = Remedial Investigation/Feasibility Study
Tetryl = N-Metryl-N,2,4,6-tetranitroaniline
TNT = Trinitrotoluene
USACE = U.S. Army Corps of Engineers

Table 2-3. Military Munitions Type and Composition

[1] The ASR Supplement does not include information for AOCs; therefore, a munitions list is not available for the AOCs that were sampled during this SI. Additionally, historical documents do not identify specific munitions used or stored at the AOCs listed in this table; therefore, a specific list of munitions IDs or munitions type cannot be provided.

[2] Due to the absence of a specific list of munitions used/stored at these AOCs, the MC analysis was based on historical information regarding the types of activities that occurred at the AOCs and potential munitions that were used or stored during the timeframe at the FUDS when it was used as a munitions storage and as an intermediate and distribution depot and recondition ammunition.

[3] DNT and break down products currently on the approved PWP explosive constituents analysis list using method 8330A mod (including 2,4-Dinitrotoluene ; 2,6-Dinitrotoluene ; 2-Amino-4,6-dinitrotoluene; 2-Nitrotoluene; 3-Nitrotoluene; 4-Nitrotoluene, 4-Amino-2,6-dinitrotoluene) were analyzed.

[4] TNT and breakdown products currently on the approved PWP explosive constituents analysis list using method 8330A mod (including 2,4,6-Trinitrotoluene; 2- Amino-4,6-dinitrotoluene; 4-Amino-2,6-dinitrotoluene; Nitrobenzene; 1,3-Dinitrobenzene; 2,6-dinitrotoluene; 1,3,5-trinitrobenzene) were analyzed.

[5] Chemicals that are not CERCLA hazardous substances (e.g., magnesium, iron) are reported in the SI; however, the SI risk evaluation and conclusions includes a discussion of the limitations of the FUDS program to respond to such chemicals. Concentrations of chemicals that are not CERCLA hazardous substances do not provide the basis for a RI/FS recommendation for MC in this SI Report.

[6] Some of the munitions associated with the FNOD may have contained black powder, the major component of the munitions primer and/or spotting charge. Black powder consists of varying concentrations of charcoal, sulfur, and either potassium nitrate or sodium nitrate. Black powder easily dissolves when exposed to water, which renders it nonexplosive (Department of the Army [DA] 1984). Therefore, black powder is not expected to persist for a significant period of time after initial release in the environment, and no constituents of black powder were analyzed for in samples collected at this FUDS.

Table 2-4. Army Checklist for Important Ecological Places

No.	Checklist Item	Yes / No		Comments
1.	Locally important ecological place identified by the Integrated Natural Resource Management Plan, Base Realignment and Closure Act Cleanup Plan or Redevelopment Plan, or other official land management plans.		No	
2.	Critical habitat for Federally designated endangered or threatened species. See No. 12 below.		No	(U.S. Fish and Wildlife Service [USFWS] 2010)
3.	Marine Sanctuary		No	
4.	National Park		No	
5.	Designated Federal Wilderness Area		No	
6.	Areas identified under the Coastal Zone Management Act	Yes		The FNOD FUDS is within the Virginia Coastal Zone (VDEQ 2010).
7.	Sensitive Areas identified under the National Estuary Program or Near Coastal Waters Program		No	
8.	Critical areas identified under the Clean Lakes Program		No	
9.	National Monument		No	
10.	National Seashore Recreational Area		No	
11.	National Lakeshore Recreational Area		No	
12.	Habitat known to be used by Federally designated or proposed endangered or threatened species		No	(AH Environmental Consultants 2001)
13.	National preserve		No	
14.	National or State Wildlife Refuge		No	
15.	Unit of Coastal Barrier Resources System		No	(USFWS 2009)
16.	Coastal Barrier (undeveloped)		No	
17.	Federal land designated for protection of natural ecosystems		No	
18.	Administratively Proposed Federal Wilderness Area		No	
19.	Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters		No	
20.	Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which fish spend extended periods of time		No	
21.	Terrestrial areas utilized for breeding by large or dense aggregations of animals		No	
22.	National river reach designated as Recreational		No	
23.	Habitat known to be used by state designated endangered or threatened species		No	(AH Environmental Consultants 2001)
24.	Habitat known to be used by species under review as to its Federal endangered or threatened status		No	
25.	Coastal Barrier (partially developed)		No	
26.	Federally designated Scenic or Wild River		No	
27.	State land designated for wildlife or game management		No	
28.	State-designated Scenic or Wild River		No	

Table 2-4. Army Checklist for Important Ecological Places

No.	Checklist Item	Yes / No		Comments
29.	State-designated Natural Areas		No	
30.	Particular areas, relatively small in size, important to maintenance of unique biotic communities		No	
31.	State-designated areas for protection or maintenance of aquatic life		No	
32.	Wetlands	Yes		Wetlands have been identified within the FNOD FUDS boundary (USFWS 1998, Figure 2-4).
33.	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes	Yes		The FUDS is bordered by the James River, Nansemond River, and Streeter Creek (Paragraph 2.3.1.1).

Former Nansemond Ordnance Depot (FNOD)

City of Suffolk , VA

Legend

- MRS 1
- MRS 2
- AOC 10, 11, 12, 14 & 15
- AOC 2, 8 & 9
- FUDS Boundary

Imagery Source: USGS Aerial Archive 1959/12/08
Data Sources: (HydroGeoLogic, Inc. 2006), (ICOR, Ltd. 2007), (USACE 2004a), and (USACE 2008)

N
W E
S

0 500 1,000 2,000 Feet

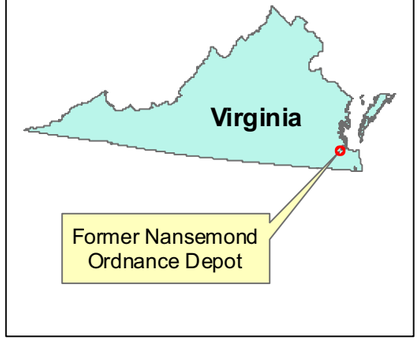
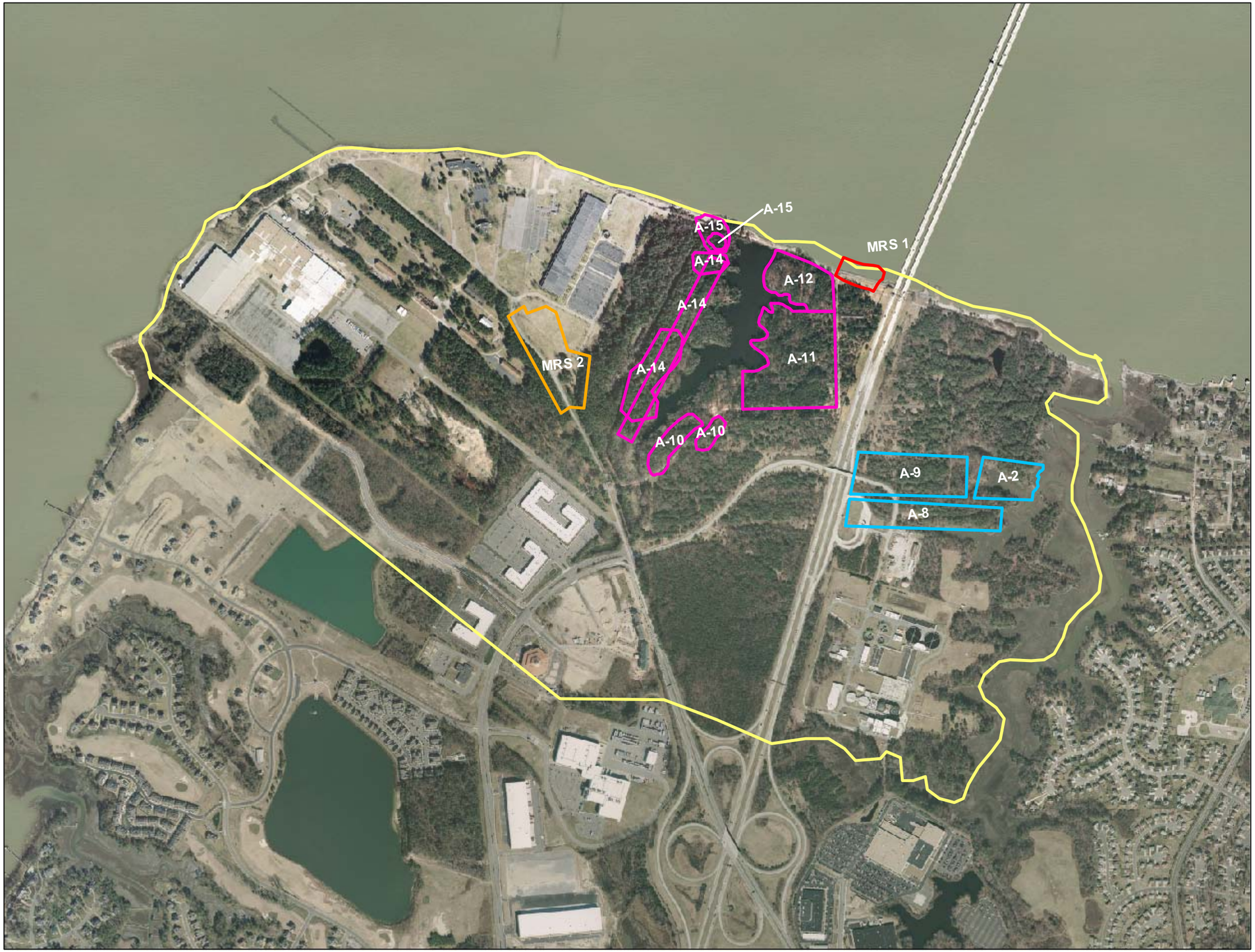


Figure 2-1. Historical Site Layout



Former Nansemond Ordnance Depot (FNOD)

City of Suffolk , VA

Legend

- MRS 1
- MRS 2
- AOC 10, 11, 12, 14 & 15
- AOC 2, 8 & 9
- FUDS Boundary

Imagery Source: USACE 2007
Data Sources: (HydroGeoLogic, Inc. 2006), (ICOR, Ltd. 2007), (USACE 2004a), and (USACE 2008)

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Feet
0 500 1,000 2,000

Figure 2-2. 2005 Property Layout

Former Nansemond Ordnance Depot (FNOD)

City of Suffolk , VA

Legend

- MRS 1
- MRS 2
- AOC 10, 11, 12, 14 & 15
- AOC 2, 8 & 9
- FUDS Boundary

Imagery Source: I Cubed Imagery Prime World Web Service (ESRI)
Data Sources: (HydroGeoLogic, Inc. 2006), (ICOR, Ltd. 2007), (USACE 2004a), and (USACE 2008)

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0 750 1,500 3,000

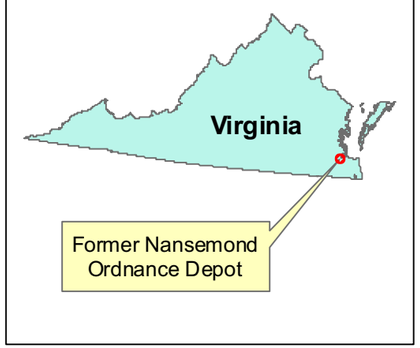


Figure 2-3. General Location of the FUDS Property, MRSs, and AOCs

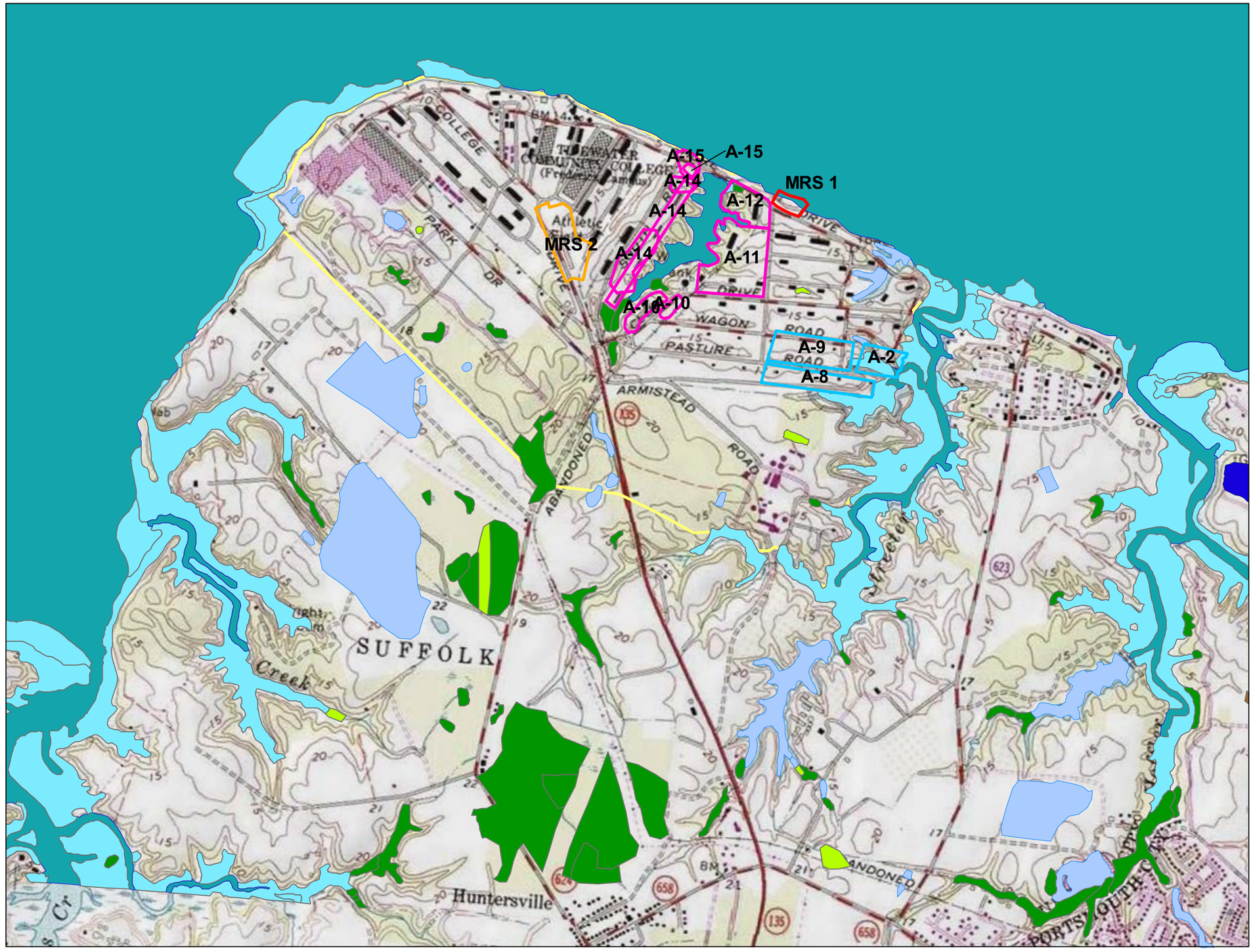


Figure 2-4. Topography and Wetlands in the vicinity of the FUDS.

3. SITE INSPECTION ACTIVITIES

3.1 Technical Project Planning

3.1.1 The first TPP Meeting for FNOD was conducted on 4 June 2009 at the Courtyard Marriott Hotel in Suffolk, Virginia. The Final TPP #1 Memorandum documenting the meeting was issued in July 2009 (Alion 2009a). The meeting participants included representatives from the Restoration Advisory Board (RAB) members (including representatives from Respass Beach, TCC, VDOT, Bennett's Creek, Greenbrier-Chesapeake, Burbage Grant, Dominion Resource Services, Inc., Malcolm Pirnie, and Weston), USEPA Region 3, VDEQ, CENAO, CENAB, and HFA. The TPP participants concurred with the technical approach for the planned SI activities discussed as documented in the TPP Memorandum (Alion 2009a). As documented in the TPP Memorandum (Introduction, Page 2), it was intended that groundwater analytical data would be obtained from CENAO for wells to be located/sampled near AOCs 2, 8, and 9 and presented in the SI Report. Subsequent to the TPP meeting, it was agreed by the Project Delivery Team (PDT) that any evaluation of the groundwater pathway would be deferred until completion of the ongoing Background Study. Therefore, no groundwater data are presented in this SI Report. The PDT also agreed that the collection of soil data would be sufficient to determine if further action (i.e., remedial investigation) was needed relative to the presence of munitions constituents. Therefore, the SS-WP, which was prepared after the TPP #1 Memorandum, clearly indicated that groundwater samples would not be collected as part of the MMRP SI.

3.1.2 **Data Quality Objective (DQO) 1 – Determine if the site requires additional investigation through an RI/FS or if the site may be recommended for No Department of Defense Action Indicated (NDAI) designation based on the presence or absence of MEC and MC.** The basis of an RI/FS recommendation is specified below:

- Historical data that indicate the presence of MEC or MD
- Visual evidence of MEC/MD or surface anomalies which are classified as MEC or MD
- One or more anomalies in a target area near historical or current MEC/MD finds or within an impact crater
- Physical evidence indicating the presence of MEC/MD (e.g., distressed vegetation, stained soil, ground scarring, bomb craters, burial pits)

3.1.2.1 The basis for an RI/FS recommendation related to the presence/absence of MC includes:

- Maximum concentrations at the FUDS exceed USEPA Regional Screening Values based on current and future land use.
- Maximum concentrations at the FUDS exceed USEPA interim ecological risk screening values.
- Maximum concentrations at the FUDS exceed site-specific background levels.
- Data indicating the presence or absence (less than the Reporting Limit [RL]) of analytes for which no screening criteria are available are to be used to support the weight-of-evidence evaluation of MC at the FUDS.

3.1.2.2 In each of these instances, lines of evidence (e.g., historical data, field data) are to be used to make a final recommendation for a NDAI designation or RI/FS. If none of the above scenarios occur, then the recommendation for NDAI designation for MEC/MC is a possible option.

3.1.3 **DQO 2 – Determine the potential need for a Time Critical Removal Action (TCRA) for MEC and MC by collecting data from previous investigations/reports, conducting site visits, performing analog geophysical activities, and by collecting MC samples.** The basis for recommendations is specified below:

- A TCRA **–** If there is a complete pathway between source and receptor and the MEC/MC and the situation are viewed as an imminent danger posed by the release or threat of a release. Cleanup or stabilization actions must be initiated within six months to reduce risk to public health or the environment.
- A non-TCRA (NTCRA) – If a release or threat of release that poses a risk where more than six months planning time is available.

3.1.3.1 In each of these instances, lines of evidence (e.g., historical data, field data) are to be used to make a final recommendation for a TCRA or NTCRA.

3.1.4 **DQO 3 – Collect the additional data necessary to complete the MRSPP.**

- Completion of the MRSPP for the MRS with available data and documentation of any data gaps for future annual MRSPP updates.

3.1.5 The TPP meeting participants concurred with the DQOs and the general technical approach for the planned SI activities discussed during the TPP and as revised and subsequently documented in the Final SS-WP (Alion 2010). In summary, these agreements were to inspect the cited areas of concern and conduct sampling in accordance with the Final SS-WP and complete the assessment in accordance with the DQOs (Appendix B). As part of this SI Report, TPMC/HFA evaluated the DQOs presented in the SS-WP (Alion 2010) and completed a DQO attainment verification worksheet to document completion of the DQOs (Appendix B).

3.2 Supplemental Records Review

3.2.0.1 Due to the extensive work completed at this FUDS and per USACE direction, state agencies were not contacted regarding threatened and endangered species and cultural and ecological resources at the FUDS property. In accordance with USACE recommendations and documented in the Final SS-WP, an existing site-specific study of FNOD was reviewed to determine the presence or absence of threatened and endangered species, and a project archaeologist for FNOD completed the cultural and archaeological review.

3.2.1 Threatened and Endangered Species

3.2.1.1 According to the "Final Baseline Ecological Survey and Inventory" completed at FNOD, no federal or state threatened or endangered species have been identified at the FUDS (AH Environmental Consultants 2001). Information on threatened or endangered species presented in various documents developed subsequent to the 2001 "Final Baseline Ecological Survey and Inventory" has corroborated the 2001 findings that no federal or state threatened or endangered species have been identified at the FUDS. Per USACE direction, supplemental agency requests for the presence of threatened and endangered (T&E) species is not required for this FUDS due to the extensive activities completed within the FUDS to date. Additionally, the field activities were minimally intrusive and therefore did not adversely impact any species or habitats potentially present at the FUDS. This report is provided in Appendix L of this SI Report.

3.2.2 Cultural and Archaeological Resources

3.2.2.1 There are no known cultural, archaeological, or water resources identified in the ASR, with the exception of the wetlands (USACE 1993). Per agreement at the TPP meeting and to ensure cultural, archaeological, and water resources were not present in the AOCs and/or were not disturbed during field activities, HFA provided a copy of the Draft SS-WP to the archaeologist under contract for work at the FNOD. After review of the Draft SS-WP, the archaeologist determined that the three AOCs proposed for sampling (AOCs 2, 8, and 9) are within areas of high and medium probability for containing archaeological resources; however,

no recorded archaeological sites were identified within these three AOCs (Versar 2010, Appendix L). No further action on the part of the archaeologist was required, and no archaeological resources were encountered during the 2010 SI field event (Appendix D).

3.3 Site Inspection Field Work

3.3.1 Site Inspection Munitions and Explosives of Concern Field Observations

3.3.1.1 On 22, 23, and 24 March 2010, the SI field team visited the FNOD to conduct SI field activities in accordance with the Programmatic Work Plan and the Final SS-WP (Alion 2005, 2009 and 2010). A qualitative magnetometer-assisted site reconnaissance for MEC and sample collection for analysis of potential MC contamination was completed at AOC 2, AOC 8, and AOC 9 (Figure 3-1). Additionally, visual reconnaissance (walk-over to determine surficial presence/absence of MEC) was completed at AOCs 10, 11, 12, 14, and 15 (Figure 3-2). Approximately 6.23 acres of land was assessed using analog and visual qualitative reconnaissance during the field event, and approximately 14.6 acres of land was assessed using only visual reconnaissance during the field event. Not including Quality Control (QC) samples, a total of 12 surface soil samples, 12 subsurface soil samples, two sediment samples, and two surface water samples were collected.

3.3.1.2 **AOC 2- Streeter Creek and Lakeview Drive Ground Scars:** The Streeter Creek and Lakeview Drive Ground Scars (AOC 2) is approximately 5 acres. HFA completed geophysical reconnaissance of 0.68 acres of AOC 2 along a meandering path and around sample locations using a metal detector (Whites XLT). Land reconnaissance was limited in this AOC due to the presence of water. Site reconnaissance findings are shown on Figure 3-1. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-4. Area observations are presented below.

- Some of this area is accessible by walking; however, large portions are wetland or Streeter Creek.
- Tall shrubs, grasses, and trees cover the majority of the land portions of the AOC.
- One structure (magazine) was observed along the central portion of the northern boundary of this AOC.
- At AOC 2, no anomalies were detected during the site walk over.
- No MEC or MD was observed.

- One surface soil, one subsurface soil, two surface water, and two sediment samples were collected at AOC 2. Additionally, field duplicates and background samples were collected.

3.3.1.3 **AOC 8 – Track A Magazine Line**: The Track A Magazine Line (AOC 8) encompasses a total of approximately 8.4 acres within the boundary provided by USACE (Figure 3-1). According to figures provided by USACE, the boundary for this AOC lies entirely east of Interstate 664; however, according to historical maps of FNOD, the former magazine line for which this AOC was named extended west of Interstate 664. Historical aerial photograph observations indicated the possible presence of mounded material, debris, graded areas, and stains associated with the portion of the magazine line lying west of the interstate. Therefore, HFA completed qualitative reconnaissance and sample collection in this area and associated it with AOC 8. HFA completed geophysical reconnaissance of 3.88 acres associated with AOC 8 along a meandering path and around sample locations using a metal detector (Whites XLT). Site reconnaissance findings are shown on Figure 3-1. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-4. Area observations are presented below.

- This area is accessible by walking and/or vehicles if the gates are unlocked.
- This area is mostly wooded and has some tall shrubs and grasses.
- Several structures (explosive magazines) were observed within the AOC boundary and areas west of Interstate 664.
- Mounded material and cultural debris (e.g., household debris, bottles, construction debris, asphalt, and shingles) were observed within this AOC during the 2010 SI field reconnaissance, especially concentrated west of Interstate 664.
- At AOC 8, one subsurface anomaly was detected at a proposed sample location. The sample location was moved slightly away from the anomaly.
- No MEC or MD was observed.
- A total of seven surface soil and seven subsurface soil samples were successfully collected at AOC 8. Additionally, field QC samples were collected.

3.3.1.4 **AOC 9 – Track A&B Burning Ground**: The Track A&B Burning Ground (AOC 9) encompasses approximately 10 acres. HFA completed geophysical reconnaissance of 1.67 acres of AOC 9 along a meandering path and around sample locations using a metal detector (Whites XLT). Site reconnaissance findings are shown on Figure 3-1. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-2. Area observations are presented below.

- This area is accessible by walking and/or vehicles if the gates are unlocked.
- This area is mostly wooded and has some tall shrubs and grasses.
- Several structures (explosive magazines) were observed within the AOC boundary.
- Cultural debris was observed within this AOC.
- At AOC 9, no anomalies were detected during the site walk over.
- No MEC or MD was observed.
- A total of four surface soil and four subsurface soil samples were successfully collected at AOC 9. Additionally, field QC samples were collected.

3.3.1.5 **AOC 10 – Track G Magazine Line**: The Track G Magazine Line (AOC 10) encompasses a total of approximately 3.9 acres. HFA completed visual reconnaissance of 2.55 acres of AOC 10 along a meandering path. Site reconnaissance findings are shown on Figure 3-2. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-4. Area observations are presented below.

- This area is accessible by walking. Vehicular access between the two portions of this AOC is possible via an overgrown asphalt-paved road if the gates are unlocked.
- This area is mostly wooded and has some tall shrubs and grasses.
- One structure (primer and fuze magazine) and a concrete pad (tetryl platform) were observed within this AOC. Cultural debris (tires, paint cans, drums, televisions, plastic, metal, mounds of asphalt, concrete, bricks) was observed within this AOC. A portion of railroad tracks was also observed.
- A large, tall mound of soil was observed bordering the eastern boundary of AOC 10, lying outside the AOC boundary.
- No MEC or MD was observed.
- No samples were collected at AOC 10.

3.3.1.6 **AOC 11 – Track H & I Magazine Line**: The Track H & I Magazine Line (AOC 11) encompasses a total of approximately 17.4 acres. HFA completed visual reconnaissance of 5.04 acres of AOC 11 along a meandering path. Site reconnaissance findings are shown on Figure 3-2. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-4. Area observations are presented below.

- This area is accessible by walking. Vehicular access via an overgrown asphalt-paved road to the southern and eastern boundaries of AOC is possible if the gates are unlocked.
- This area is mostly wooded and has some tall shrubs and grasses.
- Two large brick structures (one with a sheet metal roof and one without a roof), one smaller brick structure that appears to have been damaged by fire, and one small cinderblock structure containing equipment/pipes were observed within the AOC (smokeless powder and ammunition magazines). Several small mounds of gravel and large piles of concrete were observed.
- No MEC or MD was observed.
- No samples were collected at AOC 11.

3.3.1.7 **AOC 12 – Track J Magazine Line**: The Track J Magazine Line (AOC 12) encompasses a total of approximately 6.3 acres. HFA completed visual reconnaissance of 1.95 acres of AOC 12 along a meandering path. Site reconnaissance findings are shown on Figure 3-2. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-4. Area observations are presented below.

- This area is accessible by walking; however, the northwest portion is water or wetland. Vehicular access via an overgrown asphalt-paved road to the eastern boundary of AOC is possible if the gates are unlocked.
- This area is mostly wooded and has some tall shrubs and grasses. Burned trees were observed in portions of this AOC.
- A large structure with no roof (ammunition magazine) and cultural debris (piles of bricks, concrete, rusted metal furniture, tires, overturned rusted car) were observed in this AOC.
- No MEC or MD was observed.
- No samples were collected at AOC 12.

3.3.1.8 **AOC 14 – Track K Magazine Line**: The Track K Magazine Line (AOC 14) encompasses a total of approximately 10.9 acres. HFA completed visual reconnaissance of 4.56 acres of AOC 14 along a meandering path. Site reconnaissance findings are shown on Figure 3-2. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-4. Area observations are presented below.

- This area is accessible by walking.
- This area is mostly wooded and has some tall shrubs and grasses.

- Several structures (concrete platforms) (ammunition magazines) and cultural debris (8-foot by 8-foot sheets of metal, large piles of brick walls, concrete, tires, unmarked steel 55-gallon drums, paint cans) were observed in this AOC.

- No MEC or MD was observed.

- No samples were collected at AOC 14.

3.3.1.9 **AOC 15 – Track K Magazine Line Landfill**: The Track K Magazine Line Landfill (AOC 15) encompasses a total of approximately 2.0 acres. HFA completed visual reconnaissance of 0.54 acres of AOC 15 along a meandering path. Site reconnaissance findings are shown on Figure 3-2. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-4. Area observations are presented below.

- This area is accessible by walking. A chain link fence with locked gate and posted signs (keep out, environmental clean up area; no fishing in lake) is present just west of AOC 15 to prevent vehicular access to an asphalt road that runs through AOC 15.

- This area is mostly wooded and has some tall shrubs and grasses. It borders the James River on the north.

- Cultural debris (portions of brick walls, bricks, concrete, metal) and large riprap rocks were observed along the shoreline. Several fallen trees with burned bark were observed further inland in this AOC.

- No MEC or MD was observed.

- No samples were collected at AOC 15.

3.3.1.10 The drums observed during the SI field event were in poor condition including the presence of large and small holes, severely rusted and deteriorated, crushed, missing tops, and/or missing bottoms. None of the drums were intact; therefore, none were observed to contain material or residue. A count and specific location of each drum observed was not collected during the field event.

3.3.2 Site Inspection Munitions Constituents Samples Collected

3.3.2.1 A total of 12 surface soil (zero to 12 inches bgs), 12 subsurface soil (12 to 24 inches bgs), two sediment and two surface water samples were collected, not including field duplicates, for analysis of explosive constituents and metals. In addition to these samples, two background surface water samples and two background sediment samples were collected for metals comparison. Background results from previous studies at the FUDS were used for comparison of

surface and subsurface soil results. Sample locations are shown on Figure 3-1 and summarized below.

3.3.2.2 **AOC 2 – Streeter Creek and Lakeview Drive Ground Scars:** A total of one surface soil, one subsurface soil, two sediment, and two surface water samples were collected at AOC 2. The surface and subsurface soil samples were co-located and the sediment and surface water samples were co-located. The surface soil and subsurface soil sample location was biased toward historical aerial photography observations of ground scarring. The sediment and surface water samples were collected within AOC 2 where the sample media was accessible. The samples collected at AOC 2 were analyzed for the metals and explosive constituents identified in Table 2-3.

3.3.2.3 **AOC 8 – Track A Magazine Line:** A total of seven surface and seven subsurface soil samples were collected at AOC 8. The surface and subsurface soil samples were co-located. Sample locations were biased toward historical aerial photography observations of ground scarring, mounded material, possible pit, graded area, and debris. The samples collected at AOC 8 were analyzed for the metals and explosive constituents identified in Table 2-3.

3.3.2.4 **AOC 9 – Track A & B Burning Ground:** A total of four surface and four subsurface soil samples were collected at AOC 9. The surface and subsurface soil samples were co-located. Sample locations were biased toward historical aerial photography observations of ground scarring, graded area, and debris. The samples collected at AOC 9 were analyzed for the metals and explosive constituents identified in Table 2-3.

3.3.2.5 **Background Samples:** As agreed upon during the TPP meeting and presented in the Final SS-WP (Alion 2010), background soil sample results were compared to background data obtained from previous sampling events that occurred within the FUDS, specifically the analytical results from the Final Background Sampling Program that was issued in September 2004 (USACE 2004). Background sediment and surface water analytical results were not included in previous studies; therefore, two co-located sediment and surface water samples were collected during this SI and analyzed for metals only (Figure 3-3). The background sediment and surface water samples collected during the 2010 SI field event were located upstream of the AOC 2 sediment and surface water samples collected from Streeter Creek. No sites of interest related to the former uses of FNOD have been identified in the vicinity of the background sample locations (USACE 2008).

3.3.2.6 A MEC screening level hazard assessment and reconnaissance findings are discussed in Section 4. MC sample results are discussed in Section 5. As-collected sample locations, sample designations, sampling rationale, and field observations are summarized in Table 3-1. Sampling locations are depicted on Figures 3-1 and 3-3. Additional information pertaining to the field activities, including field notes, forms, and chains of custody are provided in Appendix D. A photo log is included in Appendix E and the photograph locations are shown on Figure 3-4.

3.4 Work Plan Deviations and Field Determinations

3.4.1 Deviations from the Final SS-WP (Alion 2010) occurred with respect to sample locations and sample analytes. Sample locations were moved slightly due to the topography (steep ravine), access issues (presence of barbed-wire fence, extensive thorny vegetation, building, or road), proximity to historical aerial photograph observations, and presence of a subsurface anomaly. Refer to the Daily Quality Control Reports and field notebook in Appendix D for additional information. Also, after the Final SS-WP was issued, USACE requested two additional explosive constituent analytes (HMX and RDX) be added to the samples collected. These deviations were minor in nature and did not affect the quality of data collected. Refer to the DQO Verification Worksheet included in Appendix B.

3.5 Site Inspection Laboratory Data Quality Indicators

3.5.1 This section summarizes the data quality assessment for the FNOD SI analytical data. Data were generated by TestAmerica under the 2006 DoD Quality Systems Manual (QSM) Version 4.1 (DoD 2009) and validated by a third-party validator (EDS) using USEPA Region III Functional Guidelines. The detailed TestAmerica and EDS reports are contained in Appendixes F and G, respectively. The data were also analyzed using the Automated Data Review Version 8.1 based on the DoD QSM Version 4.1 guidelines, and these results are included in the Environmental Data Management Systems (EDMS) database. Data Quality Indicators (DQIs) include precision, accuracy, representativeness, completeness, and comparability as well as sensitivity. At FNOD, no quality assurance split samples were collected in accordance with USACE direction since laboratory Quality Assurance (QA) has been established through previous SIs conducted under this task order. Therefore, the USACE Memorandum for Record-Chemical Quality Assurance Report (CQAR) of Quality Assurance Split Samples is not applicable to this SI Report. However, CENAB will provide a Chemical Data Quality Assessment Report (CDQAR) for inclusion in Appendix G of the Final SI Report.

3.5.2 Precision is a measure of the reproducibility of repetitive measurements of the same process under similar conditions. Precision is determined by measuring the agreement among

individual measurements of the same property, under similar conditions, and is calculated as an absolute value. The degree of agreement was expressed as the relative percent difference between the separate measurements (usually matrix spike/matrix spike duplicate [MS/MSD] pairs) and the observed relative percent difference compared to acceptable values. Any differences between MS/MSD pairs for the FNOD data were examined and any affected sample results qualified as discussed in the Region III Functional Guidelines. The MS/MSD percent recoveries for antimony in soil were low and did not meet the QC criterion, so the associated samples were qualified by EDS. Additionally, aluminum in water and manganese in soil were qualified and three explosive constituent analytes (4-amino-2,6-dinotrotolune; 2,6-dinitrotoluene, and 4-nitrotoluene) were qualified, where appropriate. All other MS/MSD percent recoveries and relative percent differences (RPD) achieved acceptable values and did not require qualification (Appendix G). Field precision is measured by the comparison of field duplicate samples. The field duplicate samples collected at this FUDS achieved acceptable values except several metals in water, which were qualified, as shown in Appendix G. The evaluation of the qualified analytical data and its validity for use in the risk assessment screening process is presented in Section 5.1.2.2. The precision DQI was achieved for most analytes except data that were rejected (21 occurrences of antimony in soil).

3.5.3 Accuracy is the degree of agreement of a measurement with an accepted reference or true value. Accuracy measures the bias or systematic error of the entire data collection process. To determine accuracy, a sample that has been spiked with a known concentration is analyzed by the laboratory as the MS, MSD, surrogate and blank spikes, or Laboratory Control Spike. EDS assessed accuracy according to Region III Functional Guidelines and assigned qualifiers as appropriate. The laboratory QA samples achieved acceptable values, except the MS/MSDs described in the previous section, 1,2-Dinitrobenzene surrogate, and selenium and mercury method blanks. The affected samples were qualified appropriately as shown in Appendix G. The evaluation of the qualified analytical data and its validity for use in the risk assessment screening process is presented in Section 5.1.2.2. The accuracy Data Quality Indicator (DQI) was achieved.

3.5.4 Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is achieved through proper development of the field sampling program during the TPP and work plan development. Deviations from the Final SS-WP were minor: sample locations were moved slightly due to site-specific conditions and RDX and HMX were added to the list of analytes for sample analysis. The samples were collected and analyzed as proposed; therefore, the representative DQI was achieved for FNOD.

3.5.5 Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Data are complete and valid if the data achieve every acceptance criteria including accuracy, precision, and any other criteria specified by the particular analytical method being used. Of the 1,308 total analyte results associated with this sample effort, 37 were rejected; therefore, the completeness indicator is 97.7 percent. The rejected data, as shown in the context of the risk assessment in Section 5, do not introduce significant uncertainties for the conclusions regarding risks to receptors at the FNOD; therefore, the completeness DQI was met.

3.5.6 Comparability expresses the confidence with which one data set can be compared to another. There are previous analyses of MC at FNOD for comparison of reported concentrations for this project. However, the comparability DQI was evaluated with respect to the comparability of sampling results within the data set based on analytical and data validation procedures prescribed in the DQOs. Standard methods for sampling and analyses were followed as documented in the SS-WP; therefore, the comparability DQI was achieved.

3.5.7 Sensitivity is a measure of the screening criteria as they compare to detection limits. If screening criteria are below detection limits (i.e., RL), the certainty of "non-detected" data to indicate that MCs are present at which no unacceptable risks may occur is called into question.

3.5.7.1 The laboratory reported to the RL, which represents the lowest concentration at which calibration standards were assessed, for organics and inorganics. Consequently, if sensitivity Measurement Quality Objectives (MQOs) were achieved for MCs, the RLs are adequate to detect risks at levels of concern for the identified receptor. In this instance, non-detected data sufficiently indicates that no unacceptable risk to receptors is present from the sample or group of samples.

3.5.7.2 The MQO for sensitivity was achieved for most analyte combinations with the exception of the explosive constituents nitroglycerin, 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, nitrobenzene, and tetryl and the metals beryllium, and cadmium, and selenium in select media for select receptors. The reporting limits for nitroglycerin in surface soil and subsurface soil are higher than their respective human health screening levels. The reporting limits for selenium in soil; 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, and nitrobenzene in sediment; and tetryl, beryllium, cadmium, and selenium in surface water are above their respective ecological screening levels. In addition, no human health screening values were available for calcium, magnesium, potassium, sodium, and thallium in soil, sediment, or surface water. No ecological screening values were available for tetryl in surface water; 1,3,5-trinitrobenzene, 1,3-

dinitrobenzene, and iron in soil; and nitroglycerin, calcium, magnesium, potassium, sodium, and thallium in soil and sediment. Uncertainties associated with the cases in which the MQO for sensitivity was not met, and with the absence of screening values, are discussed within the context of the analytical sample results in Section 5. The uncertainty discussions indicate that for this particular FUDS, the absence of screening values does not undermine the certainty with which the determinations of risk for human and ecological receptors can be made.

3.6 Second Technical Project Planning Meeting

3.6.1 Following the completion of the Draft Final SI Report, stakeholders had the opportunity to participate in a second TPP meeting to discuss the findings, conclusions, and recommendations of the Draft Final SI Report; review the MRSPP (Appendix K); and confirm that the project objectives and DQOs were achieved (Alion 2009a and 2010).

3.6.2 The second TPP meeting was held via teleconference on 1 December 2011. Refer to the TPP 2 Memorandum included in Appendix B of this SI Report for a summary of the information discussed during the second TPP meeting. In addition, responses to stakeholder comments regarding the Draft Final SI Report are included at the end of this Final SI Report.

Table 3-1. FNOD Sample Locations and Descriptions

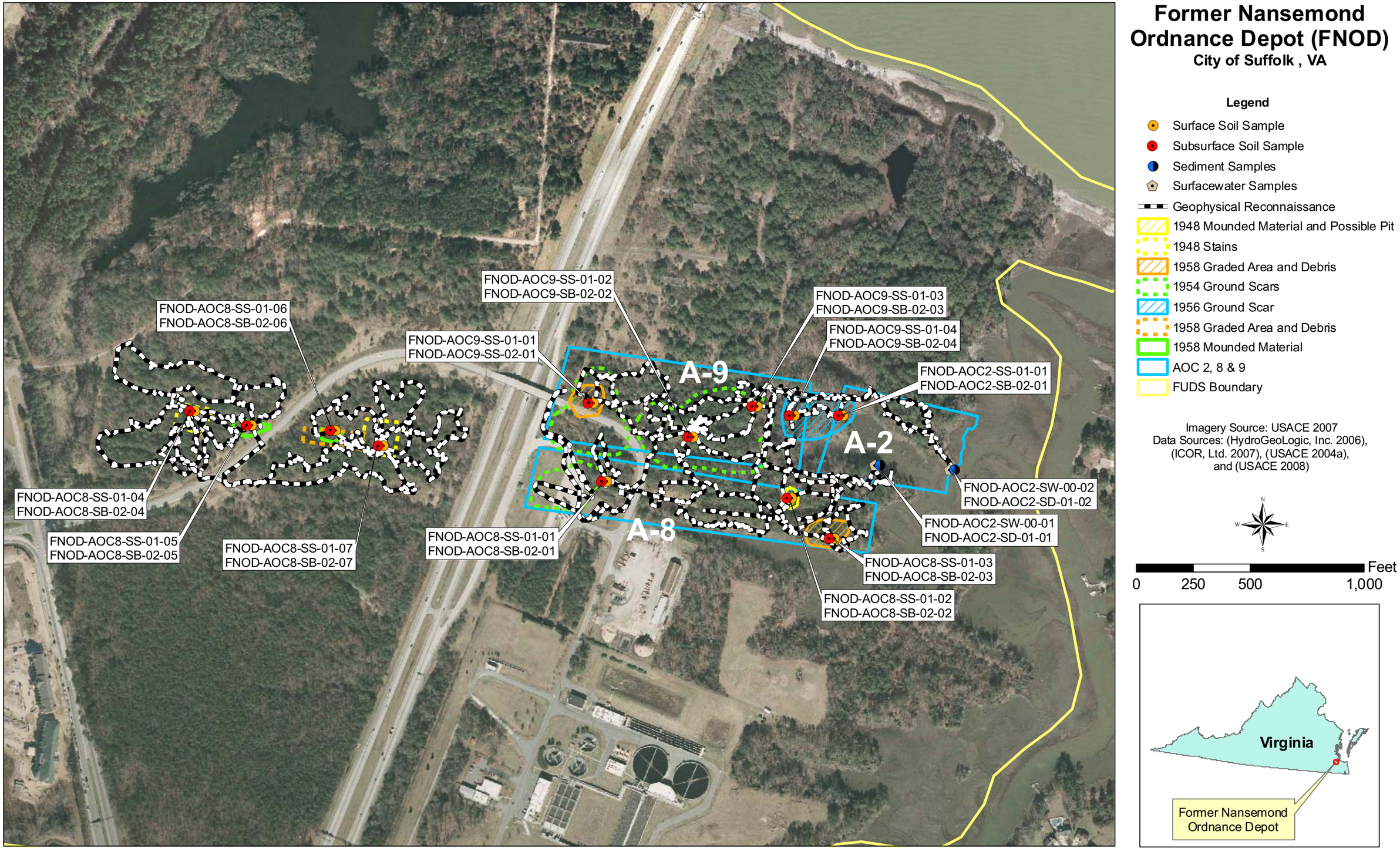
AOC Name	Sample ID	Coordinate System: UTM Zone: 18N Datum: NAD 1983 CONUS		Description of Sample Location*
		Easting(m)	Northing(m)	
AOC 2 – Streeter Creek & Lakeview Drive Ground Scars	FNOD-AOC2-SS-01-01	373424.49	4084391.66	Surface soil sample located in the western portion of AOC 2
	FNOD-AOC2-SB-02-01	373424.49	4084391.66	Subsurface soil sample co-located with sample FNOD-AOC2-SS-01-02 in the western portion of AOC 2.
	FNOD-AOC2-SW-00-01	373476.81	4084328.01	Surface water samples located in the central portion of AOC 2.
	FNOD-AOC2-SW-00-02	373576.46	4084329.09	Surface water sample located in the southeastern corner of AOC 2.
	FNOD-AOC2-SD-01-01	373476.81	4084328.01	Sediment sample co-located with sample, FNOD-AOC2-SW-00-01 in the central portion of the AOC.
	FNOD-AOC2-SD-01-02	373576.46	4084329.09	Sediment sample co-located with sample FNOD-AOC2-SW-00-02 in the southeastern corner of the AOC.
AOC 8 – Track A Disposal Line	FNOD-AOC8-SS-01-01	373115.51	4084284.16	Surface soil sample located in the western portion of the AOC.
	FNOD-AOC8-SS-01-02	373362.57	4084276.68	Surface soil sample located in the northeastern portion of AOC 8.
	FNOD-AOC8-SS-01-03	373422.28	4084227.89	Surface soil sample located in the eastern portion of AOC 8.
	FNOD-AOC8-SS-01-04	372561.98	4084342.67	Surface soil sample located west of AOC 8 along the former Track A.
	FNOD-AOC8-SS-01-05	372637.80	4084329.012	Surface soil sample located west of AOC 8 along the former Track A.
	FNOD-AOC8-SS-01-06	372749.89	4084328.20	Surface soil sample located west of AOC 8 along the former Track A.
	FNOD-AOC8-SS-01-07	372815.18	4084312.45	Surface soil sample located west of AOC 8 along the former Track A.
	FNOD-AOC8-SB-02-01	373115.51	4084284.16	Subsurface soil sample co-located with sample FNOD-AOC8-SS-01-01.
	FNOD-AOC8-SB-02-02	373362.57	4084276.68	Subsurface soil sample co-located with sample FNOD-AOC8-SS-01-02.
	FNOD-AOC8-SB-02-03	373422.28	4084227.89	Subsurface soil sample co-located with sample FNOD-AOC8-SS-01-03.
	FNOD-AOC8-SB-02-04	372561.98	4084342.67	Subsurface soil sample co-located with sample FNOD-AOC8-SS-01-04.
	FNOD-AOC8-SB-02-05	372637.80	4084329.012	Subsurface soil sample co-located with sample FNOD-AOC8-SS-01-05.
	FNOD-AOC8-SB-02-06	372749.89	4084328.20	Subsurface soil sample co-located with sample FNOD-AOC8-SS-01-06.
	FNOD-AOC8-SB-02-07	372815.18	4084312.45	Subsurface soil sample co-located with sample FNOD-AOC8,-SS-01-07.
AOC 9 – Track A & B Burning Ground	FNOD-AOC9-SS-01-01	373090.30	4084387.09	Surface soil sample located in the western portion of the AOC.
	FNOD-AOC9-SS-01-02	373225.97	4084350.68	Surface soil sample located in the central part of AOC 9.
	FNOD-AOC9-SS-01-03	373308.78	4084395.89	Surface soil sample located in the central part of AOC 9.
	FNOD-AOC9-SS-01-04	373359.07	4084386.82	Surface soil sample located in the central portion of the AOC.

Table 3-1. FNOD Sample Locations and Descriptions

AOC Name	Sample ID	Coordinate System: UTM Zone: 18N Datum: NAD 1983 CONUS		Description of Sample Location*
		Easting(m)	Northing(m)	
	FNOD-AOC9-SB-02-01	373090.30	4084387.09	Subsurface soil sample co-located with sample FNOD-AOC9-SS-01-01.
	FNOD-AOC9-SB-02-02	373225.97	4084350.68	Subsurface soil sample co-located with sample FNOD-AOC9-SS-01-02.
	FNOD-AOC9-SB-02-03	373308.78	4084395.89	Subsurface soil sample co-located with sample FNOD-AOC9-SS-01-03.
	FNOD-AOC9-SB-02-04	373359.07	4084386.82	Subsurface soil sample co-located with sample FNOD-AOC9-SS-01-04.
Background	FNOD-BG-SD-00-01/ FNOD-BG-SW-00-01	373333.75	4083505.45	Co-located sediment and surface water background sample collected South of AOC 2 for metals comparison.
	FNOD-BG-SD-00-02/ FNOD-BG-SW-00-02	373323.02	4083704.04	Co-located sediment and surface water background sample collected South of AOC 2 for metals comparison.

Note: See Table 2-3 for a list of analyses for each area.
* Most sample locations were biased toward areas previously identified as possibly disturbed based on 1940s and 1950s aerial photographs interpretation except for the surface water and sediment site and background samples which were collected where media was present. Several sample locations were moved slightly from their locations proposed in the Final SS-WP based on field conditions, as noted in Appendix D.

AOC= Area of Concern CONUS= Continental United States FNOD= Former Nansemond Ordnance Depot ID= Identification m= Meter (s) NAD= North American Datum	SB = Subsurface Soil Sample SD = Sediment SS= Surface Soil Sample SW= Surface Water UTM= Universal Transverse Mercator



Former Nansemond Ordnance Depot (FNOD)

City of Suffolk , VA

Legend

- Surface Soil Sample
- Subsurface Soil Sample
- Sediment Samples
- Surfacewater Samples
- Geophysical Reconnaissance
- 1948 Mounded Material and Possible Pit
- 1948 Stains
- 1958 Graded Area and Debris
- 1954 Ground Scars
- 1956 Ground Scar
- 1958 Graded Area and Debris
- 1958 Mounded Material
- AOC 2, 8 & 9
- FUDS Boundary

Imagery Source: USACE 2007
Data Sources: (HydroGeoLogic, Inc. 2006), (ICOR, Ltd. 2007), (USACE 2004a), and (USACE 2008)

N W E S

0 250 500 1,000 Feet

Figure 3-1. Sample Locations and Geophysical Reconnaissance Route for AOC 2, 8, 9

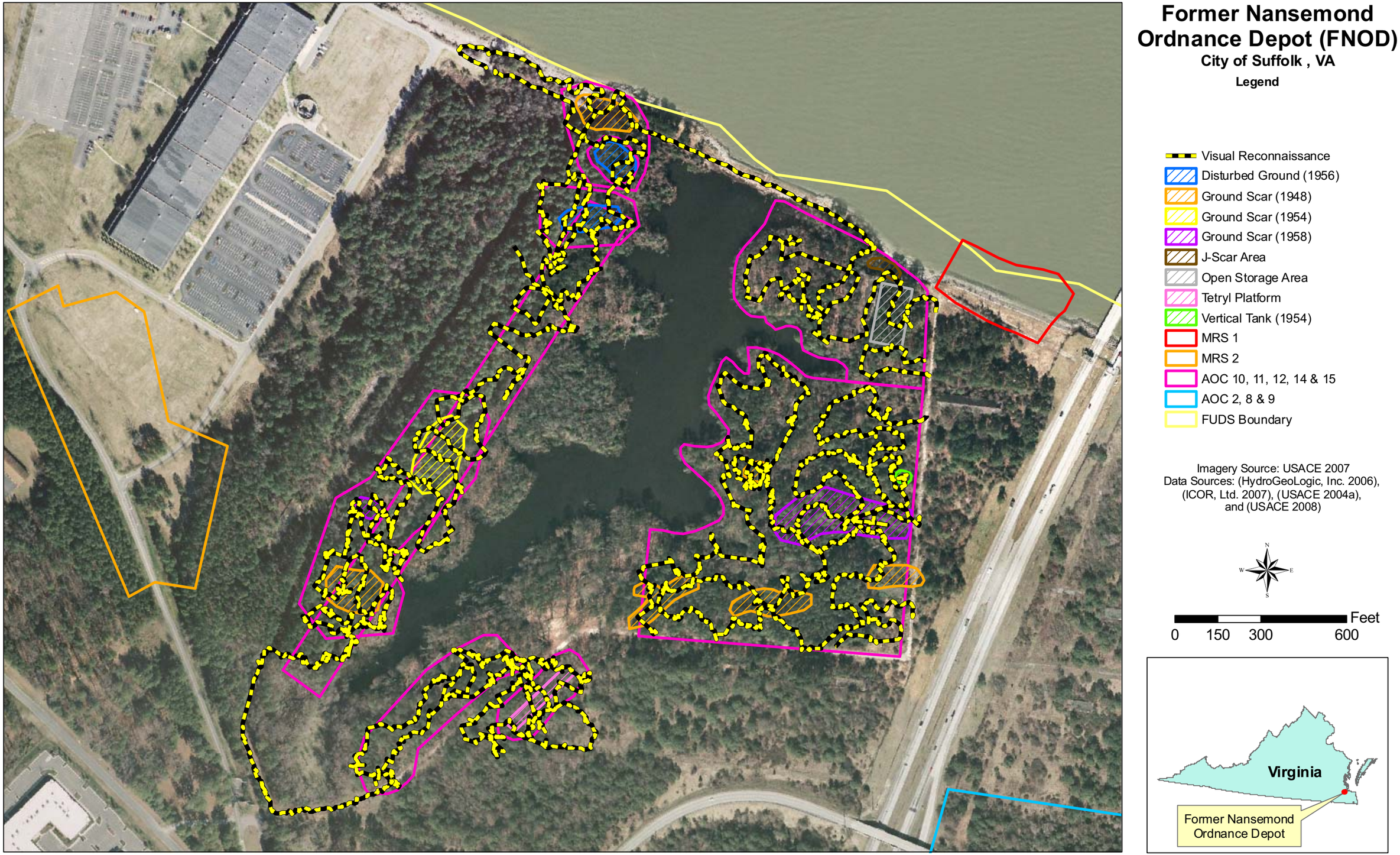
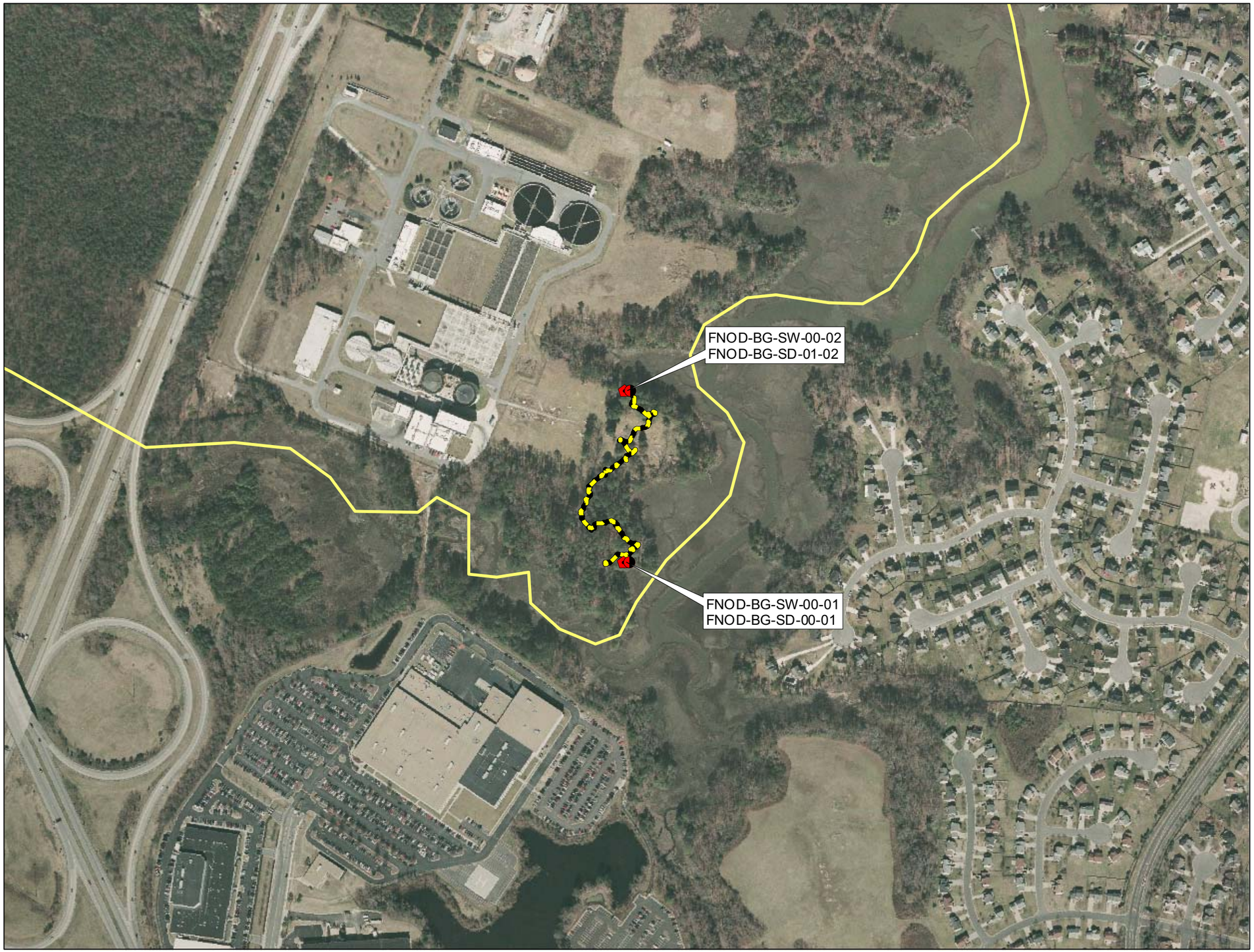


Figure 3-2. Visual Reconnaissance Routes for AOC 10, 11, 12, 14 and 15



Former Nansemond Ordnance Depot (FNOD)

City of Suffolk , VA

Legend

Sediment Samples

- Background Sediment Samples
- Background Surfacewater Samples
- Visual Reconnaissance
- FUDS Boundary

Imagery Source: USACE 2007
Data Sources: (HydroGeoLogic, Inc. 2006), (ICOR, Ltd. 2007), (USACE 2004a), and (USACE 2008)

N
W E
S

0 200 400 800 Feet

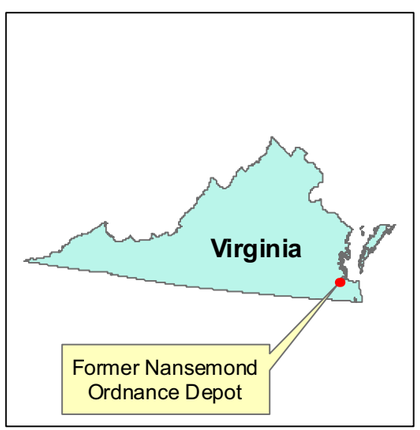
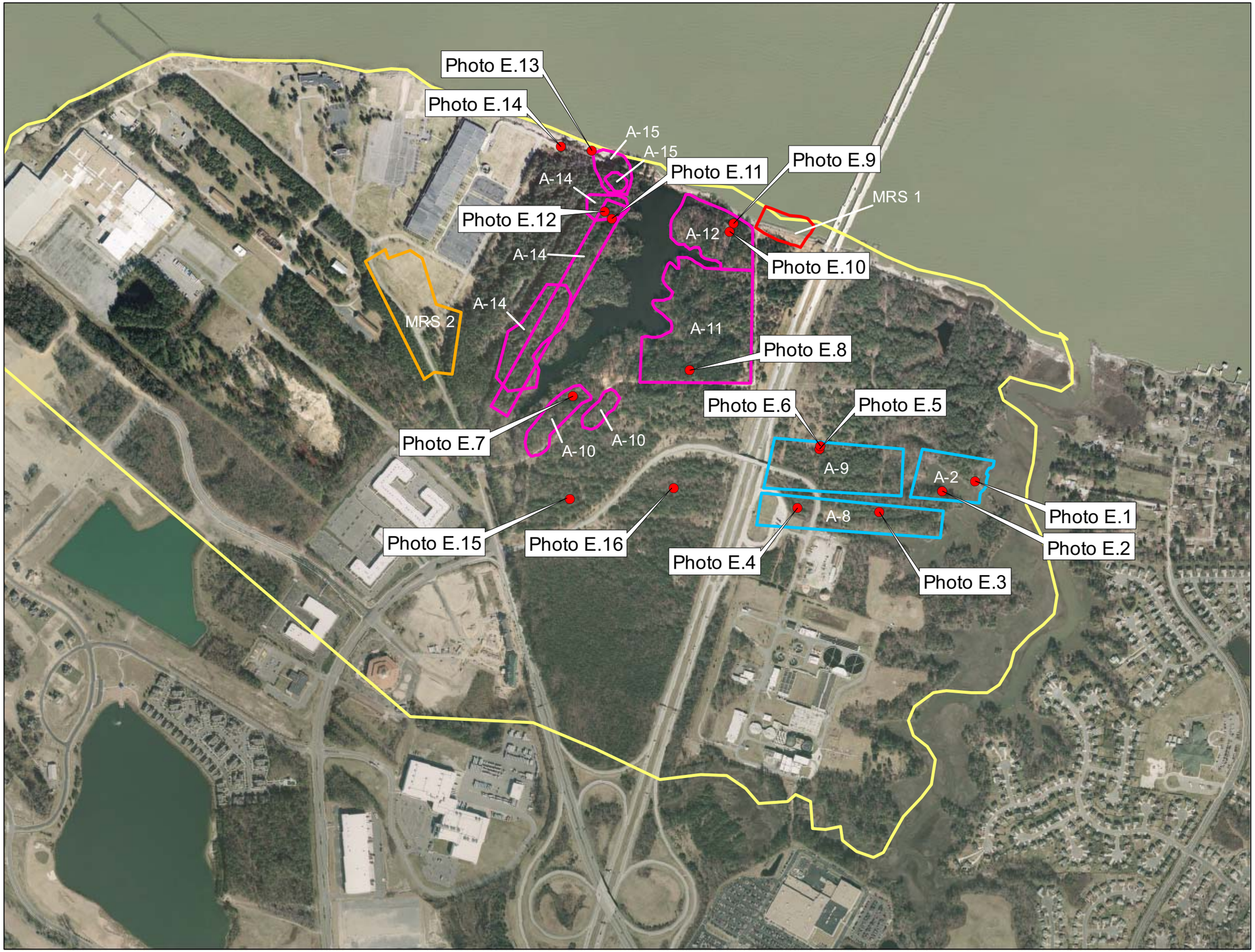


Figure 3-3. Background Sample Locations



Former Nansemond Ordnance Depot (FNOD)

City of Suffolk , VA

Legend

- Photo Locations
- MRS 1
- MRS 2
- AOC 10, 11, 12, 14 & 15
- AOC 2, 8 & 9
- FUDS Boundary

Imagery Source: USACE 2007
Data Sources: (HydroGeoLogic, Inc. 2006), (ICOR, Ltd. 2007), (USACE 2004a), and (USACE 2008)

N
W E
S

0 500 1,000 2,000 Feet

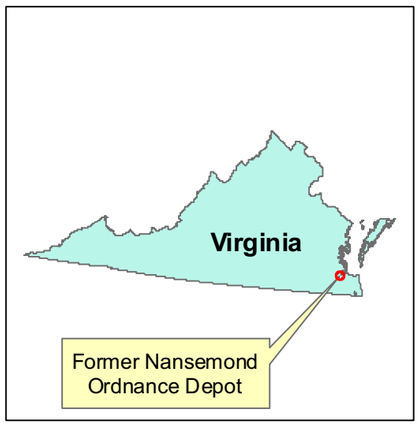


Figure 3-4. Photo Locations

4. MUNITIONS AND EXPLOSIVES OF CONCERN SCREENING LEVEL HAZARD ASSESSMENT

4.1 Munitions and Explosives of Concern Hazard Assessment Criteria

4.1.0.1 A qualitative MEC screening level hazard assessment was conducted based on the SI qualitative and visual reconnaissance, historical documents provided by USACE, and historical data documented in the INPR, ASR, and ASR Supplement (USACE 1993, 1996 and 2004a). A qualitative hazard evaluation assesses the potential explosive safety hazard at the FUDS and communicates the hazard that may exist at the FUDS and potential causes of this hazard that may exist at the FUDS and the potential causes of this hazard (USAESCH 2001).

4.1.0.2 An explosive safety hazard is the probability for an MEC item to detonate and potentially cause harm as a result of human activities. An explosive safety hazard exists if a person comes near or in contact with MEC and acts on it to cause a detonation. The potential for an explosive safety hazard depends on the presence of three elements (USAESCH 2001):

- Ordnance and Explosive Factors - a source (presence of MEC)
- Site Characteristics Factors – accessibility and stability
- Human Factors – a receptor (person) and interaction (e.g., touching or picking up an item).

4.1.0.3 Each of these primary hazard factors was used to evaluate the field and historical data to generate an overall hazard assessment rating of either low, moderate, or high (Table 4-1). The CSMs for AOCs 2, 8, 9, 10, 11, 12, 14 and 15 reflect this MEC assessment strategy (Appendix J).

4.1.0.4 The MEC source is based on the MEC type, sensitivity, density and depth distribution (Table 4-1). The type of MEC dictates the likelihood and severity of exposure, and thereby injury, if the MEC functions when encountered. MEC sensitivity affects the likelihood of an MEC item functioning as designed when encountered by a receptor (e.g. pressure from stepping on the item, fuze activation from moving the item, etc.). MEC quantity/density and depth are generally unknown during the SI and are evaluated during follow on studies (RI/FS), if necessary.

4.1.0.5 Site characteristics refer to the physical conditions of the property and natural events that occur in the area (Table 4-1). Site accessibility affects the likelihood of receptor contact with

MEC and include man-made (e.g., walls or fences) or natural barriers (e.g., terrain, topography, vegetation) that may prevent access to the property. A MEC item tends to remain in place unless disturbed through human or natural forces (e.g., frost heaving, erosion, tidal or wave action). If MEC movement occurs, the probability of direct human contact may increase, but not necessarily result in direct contact or exposure.

4.1.0.6 Human interaction includes the type of activities that exist at the FUDS, the population of people that may have access, and the frequency of that access (Table 4-1). Activities are generally classified as recreational (hiking, camping, etc.) and occupational (farming, industrial, etc.). Activities at a FUDS generate an exposure route for a MEC receptor. The MEC exposure route is typically direct contact with a MEC item on the surface or through subsurface activities (e.g., digging during construction). The area population and frequency of use determines the likelihood of a receptor to encounter MEC. The hazard to the surrounding population is based on the type and location of the FUDS, access restrictions, natural and/or man-made barriers, and the surrounding population.

Based on these criteria, low, moderate, and high MEC hazards are defined in Table 4-1.

4.2 Munitions and Explosives of Concern Hazard Assessment

4.2.0.1 The MEC Hazard Assessment was completed for areas visited by HFA during the 2010 field activities for this SI (AOCs 2, 8, 9, 10, 11, 12, 14, and 15).

4.2.1 AOCs 2, 8 and 9

4.2.1.1 As discussed in Sections 2.1.7.1 (AOC 2), 2.1.7.2 (AOC 8) and 2.1.7.3 (AOC 9), to date, no MEC or MD have been found in these areas historically or during this SI. The overall MEC hazard is low and is summarized in Table 4-2 and reflected as such in the CSMs (Appendix J).

4.2.2 AOCs 10, 11, 12, 14 and 15

4.2.2.1 As discussed in Sections 2.1.8.1 (AOC 10), 2.1.8.2 (AOC 11), 2.1.8.3 (AOC 12), 2.1.8.4 (AOC 14) and 2.1.8.5 (AOC 15), to date, no MEC or MD have been found in these areas historically or during this SI. The MEC Hazard Impact Assessments for AOCs 10, 11, 12, 14, and 15 are shown on one table due to their similarities (locations are in close proximity to each other and no MEC/MD found at any of the AOCs). The overall MEC hazard is low and is summarized in Table 4-3 and reflected as such in the CSMs (Appendix J).

4.3 FNOD FUDS MEC Hazard Summary

4.3.1 Tables 4-2 and 4-3 summarize the qualitative MEC hazard at each of the eight AOCs (2, 8, 9, 10, 11, 12, 14, and 15) visited during the 2010 SI field activities at the FNOD FUDS. Based on this qualitative MEC hazard evaluation, the hazard to human receptors via contact with MEC at the eight AOCs is low. Further evaluation of the MEC presence in these areas is not recommended.

Table 4-1. MEC Hazard Assessment Categories

Hazard	MEC Type	MEC Sensitivity	Access	Stability	Human Interaction
High	MEC that will cause an individual's death if detonated by an individual's activities	Very sensitive - Handling or movement may cause detonation	No Restriction - No man-made/natural barriers (e.g., no fence, gentle sloping terrain, no vegetation, water cover) restrict access	Unstable - MEC most likely will be exposed by natural events	High potential for and frequency of contact (e.g., general public has open and frequent access, high potential for surface/subsurface intrusive activity)
Moderate	MEC that will cause major injury to an individual if detonated by an individual's activities	Less sensitive - Fuzed but may be moved safely if identified as such by a UXO Technician	Limited Restriction - Man-made barriers and/or natural barriers (e.g., vegetation that restricts access, water, snow or ice cover, and/or terrain) restrict access	Moderately Stable - MEC may be exposed by natural events	Moderate potential for and frequency of contact (e.g., a limited number of the general public has open and somewhat frequent access, few uses, surface/ subsurface intrusive activity possible)
Low	MEC that will cause minor injury to an individual if detonated by an individual's activities	May have functioned correctly or is unfuzed but has a residual hazard	Every point of entry is controlled (man-made and /or natural barriers are present)	Stable - MEC should not be exposed by natural events	Low potential for and frequency of contact (e.g., no general public access, infrequent access primarily by personnel, no subsurface activity)
None	Inert MEC or scrap (MD), will cause no injury	Inert MEC or scrap (MD), will cause no injury	-	-	-
Unknown	Information regarding MEC is not known	Information regarding MEC is not known			

Table 4-2. AOCs 2, 8, and 9 MEC Hazard Assessment

	Historical Observations	SI Observations	Qualitative Hazard
MEC Type and Sensitivity			
Munitions Type	No historical record of the types of munitions on site; numerous types of munitions potentially stored and or disposed of at AOCs 2, 8 and 9	No MEC/MD observed during 2010 SI field activities. One subsurface anomaly detected in AOC 8 during field activities. No other subsurface anomalies detected. Extensive cultural debris present.	Unknown
MEC Sensitivity	Unknown	Unknown	Unknown
Access and Stability			
Accessibility	Unrestricted. Non-DoD control. During the ASR site visit it was noted that refuse was present from trespassers.	Partial restriction: Walking access between AOCs 2, 8, and 9 is possible. Portions of the AOCs are fenced (along I-664) and gated (vehicle entrance to AOC 8 at the intersection of Field Road and Armistead Road). Portions of these AOCs were observed to be open to the public in the immediate vicinity of the AOC boundaries.	Low to Moderate*
Stability	Stable	Stable	Low
Human Interaction			
Population, Frequency of Use, Types of Activities	No documented injuries or munitions finds. Unused land.	There are greater than 26 inhabited structures within two miles of AOCs 2, 8 and 9. Future residents, visitor/trespassers, employees and site workers have access to the AOCs 2, 8, and 9.	Low
Overall Hazard Ranking	Low Hazard		
*Although Accessibility was ranked as low to moderate since the barrier to access is not complete, the absence of historical munitions finds resulted in a low Overall Hazard Ranking for AOCs 2, 8 and 9.			
AOC – Area Of Concern ASR – Archive Search Report DoD – Department of Defense		MD – Munitions Debris MEC – Munitions of Explosive Concern SI – Site Inspection	

Table 4-3. AOCs 10, 11, 12, 14, and 15 Hazard Impact Assessment

	Historical Observations	SI Observations	Qualitative Hazard
MEC Type and Sensitivity			
Munitions Type	No historical record of the types of munitions on site; numerous types of munitions potentially stored and or disposed of at AOCs 10, 11, 12, 14 and 15	No MEC/MD observed during 2010 SI field activities. Extensive cultural debris observed.	Unknown
MEC Sensitivity	Unknown	Unknown	Unknown
Access and Stability			
Accessibility	Unrestricted. Non-DoD control.	Partial restriction: Walking access between AOCs 10, 11, 12, 14, and 15 is possible. Portions of the AOCs are fenced (along I-664) and gated (vehicle entrance at the intersection of Club Drive and College Drive near AOCs 10 and 14, vehicle entrance at intersection of Sandy Drive and Jamestown Road near AOC 15). Portions of these AOCs were observed to be open in the immediate vicinity of the AOC boundaries (along the James River).	Low to Moderate*
Stability	Stable, except for shoreline erosion	Stable (Low), except for AOC 15 (Moderate, due to shoreline erosion)	Low to Moderate (AOC 15) *
Human Interaction			
Population, Frequency of Use, Types of Activities	No documented injuries or munitions finds. Unused land.	There are greater than 26 inhabited structures within two miles of AOCs 10, 11, 12, 14 and 15. Future residents, visitor/trespassers, employees and site workers have access to these areas.	Low
Overall Hazard Ranking	Low Hazard		
*Although Accessibility and Stability were ranked as low to moderate since the barrier to access is not complete and there is shoreline erosion, the absence of historical munitions finds resulted in a low Overall Hazard Ranking for AOCs 10, 11, 12, 14 and 15.			
AOC – Area Of Concern DoD – Department of Defense		MD – Munitions Debris MEC – Munitions of Explosive Concern SI – Site Inspection	

5. MUNITIONS CONSTITUENTS SAMPLING AND ANALYSIS

5.0.1 A screening level human health risk assessment (HHRA) and SLERA were conducted to determine whether MCs in environmental media at AOCs 2, 8, and 9 (the AOCs sampled by HFA during this SI field event) may warrant a more detailed assessment of potential risk to current or future human and ecological receptors. The screening methodology, CSMs, analytical results for the MC sampling, and results of the screening assessment are presented below.

5.1 Data Evaluation Methodology

5.1.0.1 The following sections present the process used to evaluate the MC data collected by HFA for the FNOD. The methodology is designed to evaluate data for relevant MCs in the HHRA and SLERA using the appropriate risk-based screening criteria. The methodology also provides a means to evaluate uncertainty in the screening HHRA and SLERA process and provide context for the risk conclusions. This process is consistent with the decision rules outlined in Section 3.1 (TPP) of this report, and is described in more detail in the following sections.

5.1.1 Refinement of Munitions Constituents

5.1.1.1 Since the list of munitions potentially used and/or stored at AOCs 2, 8, and 9 is not known, a munitions-specific list of MC could not be generated for these AOCs; therefore, a full suite of explosives and metals MC was used to support analysis of results and the risk screening.

5.1.1.2 The list of MCs for evaluation for the three AOCs identified at the FNOD is provided below and presented in further detail in Table 2-3[2].

Streeter Creek and Lakeview Drive Ground Scars (AOC 2)

- Explosive constituents (DNT and DNT breakdown products {2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, and 4-nitrotoluene}, HMX[3], NG, RDX[2], tetryl, and TNT and TNT breakdown products {1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and NB}).

[2] A total of fourteen areas were identified for varying levels of investigation during this SI. The sampling completed focused on three areas where previous investigations had not occurred.
[3] HMX and RDX were not identified as MCs in the initial planning phases and not identified as such in the SS-WP Addendum. However, at the time of the sampling USACE requested these analytes be added to the list of MCs for AOC 2, 8, and 9.

- Metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc)[4].

Track A Disposal Pit (AOC 8)

- Explosive constituents (DNT and DNT breakdown products {2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, and 4-nitrotoluene}, HMX, NG, RDX, tetryl, and TNT and TNT breakdown products {1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and NB}).

- Metals (aluminum antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc)[1].

Track A and B Burning Ground (AOC 9)

- Explosive constituents (DNT and DNT breakdown products {2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, and 4-nitrotoluene}, HMX, NG, RDX, tetryl, and TNT and TNT breakdown products {1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and NB}).

- Metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc)[1].

5.1.2 Data Quality

5.1.2.1 Only validated data were used in the screening process. The validated data were composed of the following samples:

1. Twelve surface soil samples (collected 0-12 inches bgs)
2. One duplicate[5] surface soil sample
3. Twelve subsurface soil samples (collected 12-24 inches bgs)
4. One duplicate subsurface soil sample
5. Two sediment samples (collected approximately 0-6 inches bgs)
6. One duplicate sediment sample
7. Two background sediment samples
8. Two surface water samples

[4] Aluminum, barium, calcium, iron, magnesium, potassium, and vanadium are not classified as hazardous substances under CERCLA. As per USACE guidance regarding non-CERCLA hazardous substances, the screening results for these metals will not be used as the sole basis for determining a RI/FS recommendation for the site.

9. One duplicate surface water sample
10. Two background surface water samples

5.1.2.2 The first step in the risk assessment screening process was the evaluation of the analytical data. Inclusion or exclusion of data in the risk-screening process on the basis of analytical qualifiers assigned during data validation was performed in accordance with USEPA risk assessment guidance (USEPA 1989). Accordingly, data with a J, B, K or L qualifier, which indicates an uncertainty in the reported concentration for the chemical but not the assigned identity, were included in the risk screening at the reported concentrations. Data that were assigned an R qualifier during the data validation were considered unusable for the risk assessment as per USEPA risk assessment guidance. Data qualified with a U, UJ, or UL, indicating the chemical was not detected in the sample, were also retained in the risk-screening. Analytes that were not detected in any of the samples for a particular media within an MRS or AOC were eliminated from risk screening for that particular media and area, as per the USEPA (1989) risk assessment guidance. However, an analysis of the adequacy of the reporting limits for these analytes not detected in any sample from a risk assessment perspective is presented in Section 5.1.4. The following provides a listing of the qualifiers in the validated analytical data and their treatment in the risk assessment process:

- Analytical results bearing the B qualifier (indicating that the analyte was detected in the associated method blank at a level that is similar to the sample result) were retained in the dataset. The sample concentration provided by the laboratory was used for the samples.

- Analytical results bearing the J qualifier (indicating that the reported value was estimated) were retained in the dataset. The estimated concentration provided by the laboratory was used for the samples.

- Analytical results bearing the K qualifier (indicating that the analyte is present and that the reported value may be biased high) were retained in the dataset. The reported concentration provided by the laboratory was used for the samples.

- Analytical results bearing the L qualifier (indicating that the analyte is present and that the reported value may be biased low) were retained in the dataset. The reported concentration provided by the laboratory was used for the samples.

- Analytical results bearing the R qualifier (indicating that the result is not usable) were excluded from the dataset.

- Analytical results bearing the U qualifier (indicating that the analyte was not detected at the given detection limit) were retained in the dataset. The RL was used for non-detected samples.

[5] Duplicate samples were treated as discrete samples; duplicates were not averaged for the purpose of this risk screening.

- Analytical results bearing the UJ qualifier (indicating that the analyte was not detected and the quantitation limits may be inaccurate or imprecise) were retained in the dataset. The RL was used for non-detected samples.

- Analytical results bearing the UL qualifier (indicating that the analyte was not detected and the quantitation limit may actually be higher) were retained in the dataset. The RL was used for non-detected samples.

5.1.3 Screening Values

5.1.3.1 Screening concentrations were used in the HHRA and SLERA to support risk-based conclusions and recommendations regarding the FUDS property. Maximum property concentrations for relevant MCs were compared to the risk-based concentrations as part of the selection process for COPCs and chemicals of potential ecological concern (COPECs).

5.1.3.2 For the HHRA, USEPA regional screening levels (SLs) for residential soil, industrial soil, and tap water were selected as the screening criteria to identify COPCs (USEPA 2011). The SLs are referred to as "regional SLs" throughout the remainder of this section. The regional SLs are developed from toxicity values and standard exposure factors to estimate contaminant concentrations that are protective of humans, including sensitive subgroups, over a lifetime.

5.1.3.3 The regional SLs for residential and industrial soils consider exposures through direct contact (e.g., ingestion, dermal contact, and inhalation of particulates and vapors) and reflect exposure pathways identified for MCs in the SS-WP Addendum (Alion 2010) that could occur at the FUDS (i.e., potentially complete pathways). Therefore, they are determined to be appropriate screening tools for surface and subsurface soils for the HHRA. For sediment, potentially complete pathways identified in the SS-WP Addendum for human receptors included the ingestion and incidental ingestion of, and dermal contact with, MCs. Regional SLs or similar values are not available for screening risks from human exposure to sediments, and soil SLs are not directly applicable for screening sediment for human receptors given the likelihood of reduced exposure to sediment relative to soil. Therefore, for use in screening sediment concentrations of MCs in the HHRA, soil SLs were adjusted to account for the relatively lower exposure levels for human receptors to sediment. The adjustment is described in Section 5.1.3.7.

5.1.3.4 Potentially complete pathways identified for human receptors to surface water include dermal contact and incidental ingestion of MCs in surface water, as well as ingestion of fish exposed to MCs in surface water. The availability of screening values that specifically account for these exposures is limited. Regional tap water SLs available for screening groundwater reflect potential exposures via ingestion of drinking water and inhalation of volatile organic

chemicals released during use of contaminated groundwater. Human receptors' intake of surface water via the potentially complete pathways for this FUDS are likely to be significantly less than the two liters assumed in the derivation of the regional SLs for tap water. Therefore, the tap water SLs were adjusted to account for the anticipated differences in intake of surface water compared to tap water. The adjustment is described in Section 5.1.3.7.

5.1.3.5 In some cases, SLs are based on the toxicity, or relative toxicity of related compounds. The regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-DNT are based on toxicity information for 2,4-DNT. Because the amino-DNT isomers may behave differently from 2,4-DNT, the use of the regional SLs for these MCs may result in some uncertainty in the risk assessment.

5.1.3.6 The regional SLs for direct contact with soil and tap water correspond to typical risk thresholds of a one-in-one million (1E-06) cancer risk or a non-carcinogenic hazard quotient (HQ) of 1.0. The HHRA screening levels for explosive constituents 2,4,6-TNT, 2,4-DNT, 2-nitrotoluene, 4-nitrotoluene, NB, and RDX, and the metal arsenic are based on carcinogenic endpoints. The HHRA screening levels for the explosive constituents 1,3,5-TNB, 1,3-DNB, 2,6-DNT, 2-amino-4,6-DNT, 3-nitrotoluene, 4-amino-2,6-DNT, HMX, NG, and tetryl; and the metals aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc are based on non-carcinogenic endpoints. The toxicological endpoint for all of these non-carcinogenic MCs is not the same. Rather these MCs act at various different target organs including the spleen, kidney, GI, and liver (USEPA 2010a, USEPA 1997).

5.1.3.7 As discussed in the SS-WP Addendum (Alion 2010), the screening levels derived from non-carcinogenic endpoints were divided by ten to provide a means to account for potential occurrence of adverse non-carcinogenic health effects due to exposure to multiple non-carcinogens. The soil screening values used for the HHRA were increased by a factor of ten for application as sediment screening values to account for lower incidence of exposure to sediments relative to soils. Similarly, screening values for groundwater were increased by a factor of ten for application as surface water screening values to account for differences in exposure between tap water and those anticipated at the FUDS for surface water. The exception to the adjustment described is for lead. In the case of lead, regional SLs for soil are based on a blood lead level rather than a chronic daily intake, as is used for other non-carcinogens and; therefore, no adjustments were made to the lead regional SLs for use in evaluating soils, sediments, or surface water.

5.1.3.8 For some MCs no screening values were available across the environmental medium of interest; no screening values or appropriate surrogates were available for calcium, magnesium, potassium, sodium, and thallium in soil, sediment, and surface water. The application of HHRA screening values is described in Sections 5.1.3.17 and 5.1.3.18. Results of the HHRA are discussed in Sections 5.4 through 5.6, and are presented in Tables 5-1 through 5-3.

5.1.3.9 Screening for ecological-based COPECs was conducted by calculating an HQ, which represents the ratio of the maximum detected chemical concentration in the environmental medium to a medium-specific ecological screening level. Screening levels derived from studies in specific medium and environmentally similar conditions to those at the FUDS are the most relevant and appropriate for screening. In cases where screening values derived from environmentally specific testing environments are not available, alternative screening values may offer a sufficient screening tool.

5.1.3.10 Ecological soil screening levels (eco-SSLs) were used to screen for COPECs in soil. Eco-SSLs are screening level benchmark concentrations for contaminants in soil that have been determined to be protective of terrestrial-based ecological receptors that commonly come into contact with soil, or ingest biota that live in or on the soil. These benchmark concentrations are generally used for screening level purposes to identify COPECs in upland soils that may require further evaluation. Eco-SSLs are derived using information on toxicity and estimated ingestion exposure doses for terrestrial ecological receptors. As described in the SS-WP Addendum CSM diagrams for AOCs 2, 8, and 9, potentially complete transfer pathways for ecological receptors to surface soils at the FUDS include incidental ingestion of, and dermal contact with MCs in surface soil, inhalation of particulates from, and ingestion of vegetation and game exposed to MCs in surface soils. USEPA guidance (2005a) states that dermal and inhalation pathways are generally less significant compared to ingestion, and that therefore they do not warrant inclusion in the derivation of eco-SSLs. Therefore, the eco-SSLs derived using exposure assumptions for ingestion only are determined to be adequate for the purposes of the SLERA.

5.1.3.11 USEPA sanctioned sediment screening values were adopted for the SLERA where available; in the cases that no USEPA supported value was available, screening values were obtained from peer-reviewed literature and other regulatory and advisory programs. The FNOD has both freshwater and estuarine areas, however the surface water and sediment samples collected were obtained from estuarine areas; therefore, marine-specific sediment screening values were adopted where available. In the case that no marine derived value was available, sediment screening values derived in freshwater environments were adopted for use in the SLERA. In the instance where no sediment screening values were available, eco-SSLs were used

to screen for COPECs in sediment. USEPA states that eco-SSLs may provide utility for screening wetland soils like those found in AOC 2 (USEPA 2005a). The appropriateness of their use generally is determined by comparing the soil properties evaluated to the sediment properties in the site of interest, and the degree of flooding estimated to occur at the marsh. In general, USEPA considers the eco-SSLs to be conservative with respect to their use for wetlands, given that wetland sediments generally have conditions which limit bioavailability relative to upland soils (e.g., relatively higher total organic carbon present in sediments). Potentially complete pathways identified for ecological receptors to sediment at AOC 2 include incidental ingestion of, dermal contact with, and inhalation of particulates from MCs in sediment, as well as ingestion of benthos exposed to MCs in sediment. The sediment screening values and eco-SSLs described above were derived using assumptions of exposure via ingestion pathways. As described in Section 5.1.3.10, exposures via the dermal and inhalation pathways are generally less significant when compared to the ingestion pathway. Therefore, the sediment screening values and eco-SSLs derived using exposure assumptions for ingestion only are determined to be adequate for the purposes of sediment screening in the SLERA.

5.1.3.12 National Ambient Water Quality Criteria (AWQC) were used for screening COPECs in surface water. AWQC are derived from the results of laboratory tests completed under controlled conditions. Guidelines require that toxicity tests be completed on plants, invertebrates, and fish species. Species are normally submerged in freshwater or marine media, and, therefore, are exposed to the test chemical via multiple pathways (USEPA 1994). Second tier AWQC are derived using methods identical to those in the federal guidelines, but are rated as second tier because they have not been tested on the full suite of taxonomic groups specified under federal guidelines. Given that toxicity results for fewer taxonomic groups are available, uncertainty factors[6] are applied in determining the final screening value. Surface water in AOC 2 at the FNOD is characterized as estuarine, and therefore where available, marine AWQC were selected for screening criteria. In the case that no marine value was available, a value derived for freshwater organisms was adopted for the SLERA. As discussed in the SS-WP Addendum for the FNOD potentially complete transfer pathways for ecological receptors include incidental ingestion of, and dermal contact with MCs in surface water, and ingestion of fish exposed to MCs in surface water. Given that test organisms are submerged in media and exposed to chemicals via multiple routes of exposure, the use of AWQC are determined to be appropriate for screening surface water in the SLERA.

[6] Uncertainty factors are commonly applied in risk assessment practice to account for gaps in the data, and assure that uncertainties are dealt with in a conservative manner and health protective measures are derived

5.1.3.13 For the soil screening, eco-SSLs developed by USEPA were used for screening the metals aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, vanadium, and zinc. No eco-SSLs were available from USEPA for any of the explosive constituents being evaluated or for the metals calcium, iron, magnesium, mercury, potassium, sodium, and thallium. Consistent with previous SLERAs completed under this program, screening values were obtained from Talmage et al. (1999) for 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-nitrotoluene, 2-amino-4,6-DNT, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotoluene, HMX, RDX, and tetryl. The eco-SSLs for mercury and NB were obtained from Efroymson et al. (1997). No eco-SSLs, or appropriate alternative screening values, were available for the metals calcium, iron, magnesium, potassium, sodium, and thallium; or for the explosive constituents 1,3,5-TNB, 1,3-DNB, and NG.

5.1.3.14 In some cases eco-SSLs are based on the toxicity or relative toxicity of related compounds. The eco-SSL of 30 mg/kg for 2,4-DNT, 2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene is based on toxicity data for 2,4,6-TNT. There is no conclusive evidence on the dominant process by which 2,4,6-TNT is reduced in soil. One study indicated that bacterial degradation of 2,4,6-TNT to 2- and 4-amino-DNT occurs under aerobic and anaerobic conditions (Vorbeck et al. 1998). An *in vitro* study completed in a *Pseudomonas bacterium* species suggests that 2,4,6-TNT breaks down to 2,4-DNT (Haidour and Ramos 1996). Laboratory studies support the observations of Haidour and Ramos (1996) that bacteria strains can generate 2,4-DNT from TNT (Martin et al. 1997). These findings provide some support for the use of TNT as a surrogate for DNT and DNT breakdown products. In addition, the soil eco-SSL of 80 mg/kg for 4-amino-2,6-DNT is based on data for the chemical isomer 2-amino-4,6-DNT, and the soil eco-SSL of 100 mg/kg for HMX is based on data for RDX. There is some uncertainty associated with adopting surrogate screening values for the MCs from 2,4,6-TNT,2-amino-4,6-DNT, and RDX. In addition, some screening values are based on limited data. A limited amount of data were available for the derivation of the eco-SSL for 2-amino-4,6-DNT, RDX, and tetryl. Each of these eco-SSLs was derived using data from a single study in plants.

5.1.3.15 For the sediment screening, sediment-specific screening values derived for marine organisms were available for the metals antimony, arsenic, barium, beryllium, cadmium, copper, mercury, nickel, selenium, silver, and vanadium. In the absence of marine values, freshwater screening levels were adopted for aluminum, chromium, cobalt, iron, lead, manganese, and zinc. No sediment screening values were available for any of the explosive constituents being evaluated, or for the metals calcium, magnesium, potassium, sodium, and thallium. In the absence of sediment-specific screening values for these MCs, eco-SSLs derived by USEPA and interim eco-SSLs derived by Talmage et al. (1999) were applied where available (barium,

beryllium, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, HMX, RDX, and tetryl). Although the use of eco-SSLs for screening sediments introduces some uncertainty into the SLERA results, as discussed in Section 5.1.3.11, the use of soil screening values for wetland soils is likely to result in a conservative evaluation, and therefore, is considered an adequate screening tool for the SLERA. No sediment SLs, or appropriate alternative screening values, were available for NG, calcium, magnesium, potassium, sodium, or thallium.

5.1.3.16 Primary tier AWQC were available from USEPA for aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, and zinc. A primary tier screening value, meeting the same testing requirements as USEPA's AWQC, was available for 2,4,6-TNT. Second tier AWQC were available for the metals antimony, barium, beryllium, calcium, cobalt, magnesium, manganese, potassium, silver, sodium, thallium, and vanadium, and the explosive constituents 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotoluene, HMX, NB, NG, and RDX, and were adopted for surface water screening in the SLERA. The criteria for arsenic, cadmium, copper, lead, mercury, nickel, selenium, zinc, 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotloluene, HMX, RDX, and tetryl were derived for marine organisms; while the criteria for aluminum, antimony, barium, beryllium, calcium, chromium, cobalt, iron, magnesium, manganese, potassium, silver, sodium, thallium, vanadium, and NB were derived for freshwater organisms. The AWQC for 2,4-DNT is based on the value for 2,6-DNT and that for 4-amino-2,6-DNT is based on 2-amino-4,6-DNT. Because isomers of DNT and amino-DNT may behave differently, the use of the surrogate screening values may result in some uncertainty in the risk assessment. No AWQC or alternative surface water screening value was available for tetryl. The application of the ecological screening values is described in Sections 5.1.3.17 and 5.1.3.19. Results of the SLERA are discussed in Sections 5.4 through 5.6, and are presented in Tables 5-1 through 5-3.

5.1.3.17 Consistent with USEPA Guidance (1989), the following screening process was utilized.

1. The maximum concentration of each chemical detected in each medium is identified.

2. If a chemical was detected in at least one sample in a specific medium, it is retained for consideration in the screening of COPCs/COPECs.

3. If the maximum concentration of a specific chemical exceeds its screening value and its mean or maximum is above the respective mean or maximum background concentration, the chemical is retained as a COPC/COPEC.

4. If a screening concentration is not available for a specific chemical in a particular medium, the screening concentration for a structurally similar compound is used, if warranted. The screening tables list any surrogates that are used.

5. An analyte is eliminated from the list of COPCs/COPECs if it is an essential nutrient of low toxicity, and its reported maximum concentration is unlikely to be associated with adverse health impacts.

5.1.3.18 For the HHRA, the maximum detected concentration of all detected MCs was compared to the screening criteria determined for use in the HHRA. If the maximum concentration was less than the screening value, the target analyte was eliminated from consideration. If the maximum concentration exceeded the screening value, the analyte was retained as a COPC.

5.1.3.19 Under the SLERA, an HQ analysis was completed for each detected analyte. An HQ is defined as the measured concentration divided by the screening criteria. If the maximum concentration was less than the screening value (HQ < 1), the analyte was eliminated from consideration as a COPEC. If the maximum concentration exceeded the screening value (HQ > 1), the analyte was retained as a COPEC.

5.1.3.20 For both the HHRA and SLERA, in cases in which no screening criteria are available, any available information regarding the potential for the MCs to present a risk to receptors is presented.

5.1.4 Comparison of Screening Levels with Detection Limits for Non-Detected Analytes

5.1.4.1 The usability of the analytical data for making conclusions regarding risk was evaluated by comparing the RLs for samples that were not detected in any sample to their respective screening values used for human health (Table 5-4) and ecological (Table 5-5) risk screening. If a chemical was not detected, but the RL was higher than the screening value, then the MQO for sensitivity was not met. Such non-detects are not usable for determining whether contamination is greater or less than the detection limit (i.e., RL). Where no screening values are available, no conclusions can be drawn regarding the adequacy of the RLs for screening risk, and as a result, uncertainty is introduced into the risk assessment. In these instances, a weight-of-evidence approach is used in making risk-based decisions. The weight-of-evidence approach used in the absence of screening values includes an assessment of the fate and transport of the chemical, and the frequency of detection of MCs that are likely to have been co-derived from a munitions source.

5.1.4.2 Table 5-4 shows a comparison of the RLs and human health screening values for analytes not detected at any AOC in either surface soil, subsurface soil, sediment, or surface water. In surface and subsurface soils, all of the explosive constituents analyzed were never detected above their respective RLs in any AOC. Additionally, sodium was not detected in subsurface soils at any AOC. With the exception of NG, the RLs for non-detected explosive constituents for which screening levels were available were lower than the respective soil screening criteria adopted for the HHRA. The maximum RL of 2 mg/kg for NG exceeds the residential soil screening value of 0.61 mg/kg. The MQO for sensitivity for NG was not met and any reported non-detects (<RL) do not demonstrate that NG contamination is less than the selected screening criterion. However, as described in Section 5.1.3.8, the USEPA soil SLs for NG were reduced by a factor of ten for use in the HHRA to account for the potential cumulative effect of simultaneous exposure to multiple non-carcinogens. The underlying assumption to this methodology for cumulative non-carcinogenic risk is that ten chemicals are assumed to elicit toxic effects on the same target organ. Section 5.1.3.6 identifies the MC with non-carcinogenic endpoints. As described in Section 5.1.3.6 these MCs act at an array of target organs. Of the MCs detected in soil, all are not anticipated to act by the same non-carcinogenic mode of action or at the same target organ. Thus the adjusted screening value used in this HHRA for NG, which was developed by reducing the USEPA regional SL by a factor of ten, is likely to be overly conservative. Moreover, the difference between the adjusted screening value of 0.62 mg/kg, and the maximum RL of 2 mg/kg is relatively small. Considering these factors, the RL for NG is determined to be adequate for the HHRA screening at the FNOD. As described in Section 5.1.3.5, the regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-DNT are based on toxicity data for 2,4-DNT. The RL of 0.1 mg/kg in soil for the amino-DNT isomers is well below the residential and industrial screening criteria developed from regional SLs for use in the HHRA (15 and 200 mg/kg for 2-amino-4,6-DNT; 15 and 190 mg/kg for 4-amino-2,6-DNT). Any uncertainties in the application of these screening levels to the risk assessment are, therefore, determined not to be significant for the HHRA. No screening value is available for sodium in soil and therefore no conclusions regarding the adequacy of the RLs obtained for this MC can be made.

5.1.4.3 In sediment, all of the explosive constituents analyzed were never detected above their respective RLs. The maximum RLs for all never detected MCs were lower than the respective sediment screening criteria adopted for the HHRA. As described in Section 5.1.3.5, the regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-DNT are based on toxicity data for 2,4-DNT. The RL of 0.1 mg/kg in sediment for the amino-DNT isomers is well below the residential and industrial screening criteria developed from regional SLs for use in the HHRA (150 and 2,000 mg/kg for 2-amino-4,6-DNT; 150 and 1,900 mg/kg for 4-amino-2,6-DNT). Any uncertainties in

the application of these screening levels to the risk assessment are, therefore, determined not to be significant for the HHRA.

5.1.4.4 In surface water, all of the explosive constituents analyzed, and the metals beryllium, cadmium, and selenium were never detected above their respective RLs. The RLs for all non-detected MCs in surface water were below the respective screening criteria for surface water adopted for the HHRA. As described in Section 5.1.3.6, the regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-DNT are based on the toxicity of 2,4-DNT. The RL of 0.2 µg/L for these MCs are below the 73 µg/L screening criteria developed from regional tap water SLs for use in the HHRA. Any uncertainties regarding the application of these screening levels to the HRRA are determined not to be significant.

5.1.4.5 Table 5-5 shows a comparison of the detection limits and ecological screening values for analytes never detected in either surface soil, sediment, or surface water at any AOC. In surface soil, all of the explosive constituents analyzed were never detected above their respective RLs. The RLs for all non-detected explosive constituents were lower than the respective ecological soil screening criteria adopted for the SLERA. As described in Section 5.1.3.14, the adoption of screening values from surrogates introduces some uncertainty into the risk assessment. The eco-SSL for 2,4,6-TNT was adopted for 2,4-DNT, 2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene. The maximum RLs of 0.1 mg/kg for 2,4-DNT and 2,6-DNT, 0.2 mg/kg for 2-nitrotouluene, 3-nitrotoluene, and 4-nitrotoluene are all well below the ecological soil screening value of 30 mg/kg adopted for these MCs in the SLERA. The eco-SSL for 2-amino-4,6-DNT was adopted for 4-amino-2,6-DNT. The RL of 0.1 mg/kg for 4-amino-2,6-DNT is well below the ecological soil screening value of 80 mg/kg adopted for this MC in the SLERA. Lastly the eco-SSL for RDX was adopted for HMX. The RL of 0.1 mg/kg for HMX is well below the ecological soil screening value of 100 mg/kg adopted for this MC. Therefore, any uncertainties associated with the use of 2,4,6-TNT, 2-amino-4,6-DNT, and HMX as surrogates for the explosive MCs are determined not to be significant for the SLERA. No ecological screening values were available for 1,3,5-TNB, 1,3-DNB, or NG in soil. Therefore, no conclusions regarding the adequacy of the RLs obtained for these MCs can be made.

5.1.4.7 In sediment, all of the explosive constituents analyzed were never detected above their respective RLs. With the exception of 1,3,5-TNB, 1,3-DNB and NB, the RLs for all non-detected explosive constituents were lower than the respective ecological sediment screening criteria adopted for the SLERA. The maximum RLs for 1,3,5-TNB, 1,3-DNB and NB were above the screening values selected for the SLERA (1,3,5-TNB, SL-0.0024 mg/kg, maximum RL – 0.1 mg/kg; 1,3-DNB, SL – 0.0067 mg/kg, max RL – 0.1 mg/kg; NB, SL-0.021 mg/kg, max RL- 0.3

mg/kg). Therefore, the MQO for sensitivity was not met for these analytes and any reported non-detects do not demonstrate that contamination is less than the selected screening criterion. As described in Section 5.1.3.14, the use of surrogates for screening values introduces some uncertainty into the risk assessment. The screening criterion for 2,4-DNT, 2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene are based on toxicity data for 2,4,6-TNT. The RLs of 0.1 mg/kg for 2,4-DNT and 2,6-DNT, and 0.2 mg/kg for 2- nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene are all well below the ecological sediment screening value of 30 mg/kg adopted for these MCs in the SLERA. The screening value for 4-amino-2,6-DNT is based on information for 2-amino-4,6-DNT; however, the RL for 4-amino-2,6-DNT of 0.1 mg/kg is well below the ecological soil screening value of 80 mg/kg adopted for this explosive constituent. Lastly the screening value for RDX was adopted for HMX. The RL of 0.1 mg/kg for HMX is well below the screening value of 100 mg/kg adopted for the SLERA. Therefore, any uncertainties associated with the use of 2,4,6-TNT, 2-amino-4,6-DNT, and RDX as surrogates for the explosive MCs are determined not to be significant for the SLERA. No ecological screening value was available for NG in sediment. Therefore, no conclusions regarding the adequacy of the RL obtained for this MC can be made.

5.1.4.8 In surface water, all of the explosive constituents analyzed, and the metals beryllium, cadmium, and selenium, were never detected above their respective RLs. With the exception of cadmium and beryllium, the RLs for all non-detected MCs in surface water were lower than the respective ecological screening criteria for surface water adopted for the SLERA. For cadmium, only the maximum RL was above the SLERA screening value. Thus the MQO for sensitivity was not met for the two samples with the maximum RL, and the reported non-detects do not demonstrate that contamination is less than the selected screening criterion. The minimum and maximum RLs for beryllium were above the screening values selected for the SLERA (SL-0.66 µg/L, RL range from 5 – 10 µg/L) and the MQO for sensitivity was not met for this analyte. Therefore any reported non-detects do not demonstrate that contamination is less than the selected screening criterion. As described in Section 5.1.3.16, the use of surrogates for screening values introduces some uncertainty into the risk assessment. The AWQC for 2,4-DNT is based on toxicity data for 2,6-DNT. The RL of 0.4 µg/L for 2,4-DNT is well below the surface water screening value of 310 µg/L adopted for this MC in the SLERA. In addition, the surface water eco-SSL for 4-amino-2,6-DNT is based on toxicity data for 2-amino-4,6-DNT. The RL of 0.2 µg/L for this MC is well below the 20 µg/L surface water screening criteria adopted for the SLERA. Therefore, any uncertainties regarding the application of these screening levels to the SLERA are determined not to be significant. No ecological screening value was available for tetryl in surface water. Therefore, no conclusions regarding the adequacy of the RL obtained for this MC can be made.

5.2 Conceptual Site Model

5.2.0.1 The CSM diagrams for AOCs 2, 8, 9, 10 11, 12, 14, and 15 at the FNOD are provided in Appendix J. Information from historical sampling events was used to complete the MC pathways in the CSMs for AOCs 10, 11, 12, 14, and 15. The results/conclusions of the historical sampling events and references to the CSM are summarized in Section 2.1.8 for each AOC. Additionally, historical and 2010 field event MEC/MD observations are also presented in Sections 2.1.8 and 4.2.2 and Table 4-3 of the SI Report. Each CSM defines the source(s) (e.g., the secondary source/media), interaction (e.g., secondary release mechanism, tertiary source, exposure route), and receptors at the FUDS and provides an overview of complete and potentially complete pathways. The CSMs are limited to those areas identified by USACE that were potentially impacted by MEC and/or MCs based on the site use and history and had not been investigated (AOCs 2, 8, and 9). These areas are shown in Figure 3-1. In this SI Report, the CSMs have been revised from the version presented in the SS-WP Addendum to reflect the results of the human and ecological risk screening.

5.2.0.2 Current and future potential human receptors for AOCs 2, 8, and 9 at the FNOD are expected to be visitors/trespassers, construction workers, and employees, as depicted in the CSM diagrams in Appendix J. Employees are conservatively assumed to be outdoor workers responsible for maintenance activities (e.g., moderate digging, landscaping). Residential receptors are evaluated for the site, but under future land use only. In the HHRA, the soil and sediment screening values used for trespassers/visitors were based on regional SLs for direct contact with residential soil[7]. The soil and sediment screening values used for construction workers and employeess were based on the regional SLs for direct contact with industrial soil. Screening values for surface water for all human receptors were based on the regional tap water SLs.

The ecological receptors of concern for the FUDS are plants, soil and benthic invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds. Screening values selected for the SLERA were applied uniformly to all ecological receptors.

5.2.0.3 Potentially complete pathways for human and ecological receptors are based on the presence of MEC/MC and interactions, including transport and release mechanisms, and receptor use patterns.

[7] Although the trespassers and visitors are anticipated to have a lower frequency and duration of exposure than the assumptions USEPA assumes for deriving residential SLs, it is anticipated that this receptor group might include some susceptible subpopulations (i.e., children, elderly), and therefore in order to be conservative with the screening level assessment the residential SLs were used for screening risks to this population.

5.2.0.4 A pathway is complete if all of the following conditions are present:

1. Source and mechanism of chemical release (e.g. a munitions-related organic chemical is detected or a munitions-related inorganic chemical is detected and the levels exceed maximum and/or mean site background sample concentrations)[8].

2. Transfer mechanisms (e.g. overland flow of contaminants into an adjacent stream, advection of contaminants with groundwater flow).

3. Point of contact (exposure point, e.g., drinking water, soil).

4. Exposure route to receptor (e.g., ingestion, inhalation, etc.).

5.2.0.5 Comparisons of maximum detected site concentrations to risk-based screening values are used to determine if the MC is a COPC or COPEC, depending on the risk screening being conducted (human health or ecological, respectively). In the case that complete pathways exist between media and receptors, and a COPC and/or COPEC is identified, a weight-of-evidence approach may be used to further evaluate the potential risk. The weight-of-evidence approach considers multiple aspects of the MCs presence including the frequency of detection, magnitude, and comparison to background, as well as the applicability of the screening criteria selected to the specific receptor groups and exposures that are likely to occur at the FUDS. The weight-of-evidence evaluation is shown after select COPCs and COPECs in Section 5 as a bulleted list with a paragraph following that summarizes the MC risk. An RI/FS may be recommended for MC where COPC and/or COPEC are determined to represent the potential for risks to an exposed receptor population. An NDAI designation may be recommended for MCs if no COPCs or COPECs are identified through the risk screening process, or if the weight-of-evidence evaluation indicates that COPCs/COPECs do not pose an unacceptable risk to the exposed receptors.

5.2.0.6 In conclusion, pathway completeness will result in a RI/FS recommendation for MCs only in the instance where risk screening criteria exceedances occur. A pathway can be complete but a RI/FS is not recommended if there are no exceedances of risk screening criteria, or if identified risks are determined to be at acceptable risk levels. When a pathway is incomplete, a RI/FS recommendation is not made.

[8] In the case that an MC is not detected in any sample and the MQO for sensitivity is not met (i.e., the RL is greater than the respective screening level for human or ecological receptors) the pathway remains potentially complete.

5.3 Background Data Evaluation

5.3.0.1 During the SI field sampling, two co-located sediment and surface water samples were collected south of MRS 2 near Streeter Creek for background comparisons. No background soil samples were collected as part of this field effort; however, background soil data was obtained from prior sampling efforts aimed at characterizing background concentrations for the FNOD. Specifically, two sampling efforts completed in 1999 and 2002 yielded 48 soil samples appropriate for comparing to on-site surface and subsurface soils (Weston 2004). Samples were obtained from two distinct depths (surface and deeper soils). Statistical and qualitative comparisons concluded that all of the surface and deeper soil samples can be combined for use in completing background comparisons with on-site data (Weston 2004). Therefore the entire data set was used to compare to the surface and subsurface soil samples collected for this SI at the FNOD. Comparisons of concentrations of metals in background soil to on-site surface and subsurface soil for AOCs 2, 8, and 9 are shown in Tables 5-6, 5-7, and 5-8, respectively. Comparisons of concentrations in background sediment and surface water to on-site sediment and surface water for AOC 2 are shown in Tables 5-9 and 5-10, respectively. A revised statistical evaluation of the FNOD background samples collected in 1999 and 2002 currently is under development. Once completed and approved, the revised study will replace the FNOD background study that was used in this SI. Conclusions drawn on the basis of the background screening presented in this SI Report may be revised by USACE once the revised site-wide background values are developed.

5.3.0.2 In the single surface soil sample within AOC 2, none of the metals analyzed had a detected concentration that was greater than the respective detected maximum concentration in background. Antimony, cadmium, silver, and thallium were detected in the surface soil sample obtained from AOC 2 but not in background, which would indicate that these analytes may be elevated in site soils. Sodium was never detected in either the AOC 2 or background soil samples, thus the sodium background comparison is not meaningful for the SI evaluation. In subsurface soils none of the detected metals analyzed for AOC 2 had concentrations that were greater than the respective maximum detected concentrations in background. Cadmium and thallium were detected in the subsurface soil sample obtained from AOC 2 but not in background, which would indicate that these analytes may be elevated in site soils. Additionally, the data validation qualified the antimony result for the AOC 2 subsurface sample as rejected (i.e., R qualifier), which as discussed in Section 5.1.2.2 means that no usable data for antimony was obtained for AOC 2 subsurface soil for risk assessment purposes, thus the background comparison in this case is not meaningful for the SI evaluation. Silver and sodium were never detected in either the AOC 2 or background soil samples, thus the background comparison for these analytes is not meaningful for the SI evaluation.

5.3.0.3 In surface soil within AOC 8, aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, vanadium, and zinc were detected in both site and background soil samples, and the site mean and/or maximum concentrations were greater than the respective mean and maximum concentrations in background. Antimony, cadmium, silver, sodium, and thallium were detected in the surface soil samples obtained from AOC 8 but not in background, which would indicate that these analytes may be elevated in site soils. In subsurface soils at AOC 8, the same 17 MCs detected in both site and background surface soils were also detected in both site and background soils, and site soil concentrations were elevated compared to background soil. Antimony, cadmium, silver, and thallium were detected in subsurface soils from AOC 8 but not in background, which would indicate that these analytes may be elevated in site soils. Sodium was never detected in either the AOC 8 subsurface or background soil samples, thus the background comparison is not meaningful for the SI evaluation.

5.3.0.4 In surface soil within AOC 9, aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, vanadium, and zinc were detected in both site and background soil samples. Of these anlytes, all but mercury had site mean and/or maximum concentrations that were greater than the respective mean and maximum concentrations in background. Cadmium, silver, and thallium were detected in the surface soil samples obtained from AOC 9 but not in background, which would indicate that these analytes may be elevated in site soils. Sodium was never detected in surface soil obtained from AOC 9 or in background, thus no meaningful comparison can be made. The data validation qualified all of the antimony results for the AOC 9 surface samples as rejected (i.e., R qualifier), which as discussed in Section 5.1.2.2 means that no usable data for antimony was obtained for AOC 9 surface soil for risk assessment purposes, thus the background comparison in this case is not meaningful for the SI evaluation. In subsurface soils at AOC 9, the same analytes were detected in both site and background soils. Of these anlytes, all but mercury and arsenic had site maximum and/or mean concentrations that were greater than the respective background concentrations. Cadmium and thallium were detected in the subsurface soil samples obtained from AOC 9 but not in background, which would indicate that these analytes may be elevated in site soils. Sodium and silver were never detected in surface soil obtained from AOC 9 or in background, thus no meaningful comparison can be made. The data validation qualified all of the antimony results for the AOC 9 subsurface samples as rejected (i.e., R qualifier), which as discussed in Section 5.1.2.2 means that no usable data for antimony was obtained for AOC 9 subsurface soil for risk assessment purposes, thus the background comparison in this case is not meaningful for the SI evaluation.

5.3.0.5 In sediment, aluminum, arsenic, beryllium, cadmium, chromium, cobalt, iron, magnesium, manganese, nickel, potassium, selenium, sodium, thallium, and vanadium within AOC 2 exhibited mean and/or maximum concentrations that were greater than the respective mean and maximum concentrations in background. During data validation all of the on-site antimony samples, and one of the two background antimony samples were flagged with an R qualifier, which as discussed in Section 5.1.2.2 means the data are unusable for the purposes of risk assessment; therefore, no background comparison for this MC can be completed.

5.3.0.6 In surface water, antimony, arsenic, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, silver, sodium, vanadium, and zinc within AOC 2 exhibited mean and/or maximum concentrations greater than the respective mean and maximum concentrations in background. Beryllium and cadmium were not detected in on-site or background surface water and therefore the background comparison for these MCs is not meaningful. Selenium was detected in background surface water but not surface water obtained from AOC 2; however, the RLs for the non-detected samples are elevated above the detected concentrations and therefore do not allow for a meaningful comparison between on-site and background surface water for this MC. Additionally, thallium was detected on-site, but not in background. However, similarly the RLs for the non-detected samples were elevated above the detected concentrations, and therefore no meaningful background comparison can be completed for this MC.

5.4 Streeter Creek and Lakeview Drive Ground Scars (AOC 2)

5.4.0.1 As presented in Section 5.1.1, the explosive constituents DNT and DNT breakdown products, HMX, NG, RDX, tetryl, and TNT and TNT breakdown products, and the metals aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc were identified as MCs at AOC 2. Surface soil, subsurface soil, sediment, surface water, and groundwater were identified as media of concern for this area. The results of the screening level analysis in surface and subsurface soil, sediment, and surface water are presented in Tables 5-1, 5-2, and 5-3, respectively. No groundwater samples were obtained from AOC 2.

5.4.1 Soil Pathway and Screening Results

5.4.1.1 Surface soil was identified as a medium with potentially complete pathways for human and ecological receptors. Additionally subsurface soil was identified as a medium with a

potentially complete pathway for human receptors. A total of two soil samples were collected from AOC 2; one surface soil sample and one subsurface soil sample. Table 5-1 presents the analytical results for surface and subsurface soil, along with the human health and ecological screening values described previously in Section 5.1.3. The soil samples were collected from the only disturbed area identified from historical aerial photographs. Although only a single sample was collected from surface and subsurface soil to characterize this AOC, the biased nature of the sampling location will likely ensure that the area is adequately characterized.

AOC 2 HHRA: Surface Soil

5.4.1.2 Ingestion, dermal contact, and inhalation were identified as potentially complete transfer mechanisms for MCs in surface soils to visitors/trespassers, construction workers, employees, and future residents at AOC 2. An identical set of potential transfer mechanisms was identified for ecological receptors at AOC 2. A single surface soil sample was collected from AOC 2. The sample was analyzed for the full suite of explosive constituents and metals specified in Section 5.4.0.1.

5.4.1.3 No explosive constituents were detected at concentrations above their respective RLs in surface soil at AOC 2. With the exception of NG, the RLs for all of the explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. Because the RL for NG was above the soil screening criterion of 0.61 mg/kg adopted for screening risks to future residents, visitors and trespassers, the MQO for sensitivity was not met and any reported non-detects for NG do not demonstrate that the MC is present at concentrations less than the selected screening criterion. However, as described in Section 5.1.4.2, the RL for NG is determined to be adequate for the HHRA screening at the FNOD. No explosive constituent COPCs were identified in surface soils at AOC 2.

5.4.1.4. The full suite of metals analyzed, with the exception of sodium, were detected in surface soil at AOC 2. As described in Section 5.3.0.2, no metals detected in both AOC 2 surface soil and background soil samples exhibited site concentrations exceeding background; however, several metals (i.e., antimony, cadmium, silver, and thallium) were detected in site soils but not background samples. Sodium was never detected in surface soil at AOC 2; however, no screening level is available for the MC and therefore no conclusion regarding the ability for the analytical techniques used to detect sodium at levels sufficient to screen for risks to human receptors can be made. Some uncertainty is introduced into the assessment as a result.

Calcium, magnesium, and potassium were detected in surface soils; however, no HHRA SLs were available for any of these inorganics. All three were detected at concentrations below background. Furthermore, these three inorganics are not CERCLA hazardous substances. The lack of HHRA SLs to screen detections of calcium, magnesium and potassium is not expected to introduce an unacceptable level of uncertainty in the HHRA for AOC 2 surface soils, primarily because the detections were below background.

Of the analytes detected in the AOC 2 surface soil sample, only the concentrations of arsenic and thallium exceeded the human health screening criteria, and both were identified as COPCs for AOC 2 surface soil. The arsenic concentration exceeded the screening criteria for visitors/trespassers, future residents, construction workers, and employees. However, as discussed in Section 5.3.0.2, the site value of arsenic was not elevated compared to background. Therefore, no additional risk to human receptors from exposure to this MC from FUDS-related activities is identified. The thallium site concentration exceeded only the visitor/trespasser and future resident screening level. Thallium was not detected in the background soil data, so no meaningful comparison could be made. The site thallium concentration of 0.12 mg/kg was only slightly elevated above the most restrictive screening level used in this HHRA evaluation (i.e., 0.078 mg/kg). This value was derived by reducing the USEPA regional screening levels for residential soil by a factor of ten, as described in Section 5.1.3.6, to account for possible simultaneous exposure to multiple non-carcinogenic compounds. The use of this construct in this instance leads to an overestimation of the potential for an adverse health effect from exposure to the site thallium concentration. The great majority of detected concentrations for MC with non-carcinogenic HHRA screening levels (i.e., USEPA residential soil levels reduced by a factor or ten) were more than ten times lower than their respective screening levels, indicating they would have a negligible contribution to a cumulative non-carcinogenic health effect. Only four of the detected non-carcinogenic MCs, excluding thallium, were within one tenth of their respective HHRA screening levels, and none of those have the same toxicological endpoint as thallium. Thus, it is not necessary to reduce the USEPA soil residential screening level for thallium by a factor of ten to provide a health protective value for the HHRA of surface soils at AOC 2. The thallium concentration of 0.12 mg/kg in the AOC 2 surface soil is well less than the USEPA residential soil screening level of 0.78 mg/kg, indicating that no unacceptable risks are expected.

The HHRA for AOC 2 surface soil is based upon a single sample, which introduces uncertainty into the risk assessment conclusions. The magnitude of this uncertainty was reduced by collecting the soil sample from the only disturbed area identified from historical aerial photographs. Furthermore, the HHRA for this sample yielded similar results as a previous

investigation by Weston in 1997, as described in Section 2.1.7.1. Weston conducted analyses of explosive constituents and metals in surface soil from AOC 2 and identified arsenic as the only COPC.

AOC 2 SLERA: Surface Soil

5.4.1.5 As described above in Section 5.4.1.3, no explosive MCs were detected in the surface soil at AOC 2. The RLs for 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotluene, HMX, nitrobenzene, RDX, and tetryl were below the screening criteria selected for the SLERA, and confirm the ability of the analytical techniques to detect the MCs at levels sufficient to screen for unacceptable risks to ecological receptors.

No ecological surface soil screening value was available for 1,3,5-TNB, 1,3-DNB, or NG, so no definitive statement regarding the adequacy of the techniques utilized to detect these MCs at levels that may cause risks to ecological receptors can be made. 1,3,5-TNB, 1,3-DNB, NB, and NG have relatively low K_{ows} (<2) (US NLM 2008, Talmage et al. 1999, USEPA 2011). In general, a K_{ow} <2 indicates inefficient partitioning into the lipid component of organisms and a low ability to bioconcentrate or biomagnify up the food chain (USEPA 2005a and USEPA 2008a). Based on the fact that 1,3,5-TNB, 1,3-DNB, NB, and NG were not detected above their respective analytical RLs, and considering fate and transport characteristics, these MCs were not identified as COPECs in sediment at AOC 2. The decision is not expected to introduce an unacceptable level of uncertainty into the SLERA. No explosive constituent COPECs were identified in surface soil at AOC 2.

5.4.1.6 As described in Section 5.4.1.4, the full suite of metals analyzed, with the exception of sodium, were detected in surface soil at AOC 2. As described in Section 5.3.0.2, no metals detected in both AOC 2 surface soils and background soil samples had site concentrations exceeding background; however, several metals (i.e., antimony, cadmium, silver, and thallium) were detected in site soils but not background samples. Lead and vanadium were the only analytes detected in the AOC 2 surface soil sample at a concentration exceeding their respective eco-SSL and are therefore the only COPECs identified for AOC 2 surface soils. The measured concentration of lead in the single surface soil sample obtained at AOC 2 exceeded the eco-SSL of 11 mg/kg (HQ = 1.4). Similarly, the detection of vanadium in surface soil was above the eco-SSL of 7.8 mg/kg (HQ = 1.3). However, as described above neither lead nor vanadium were present at concentrations elevated above background. Therefore, no additional risk to ecological receptors from exposure to lead or vanadium from FUDS related activities is identified.

AOC 2 HHRA: Subsurface Soil

5.4.1.7 Incidental ingestion, dermal contact, and inhalation were identified as potentially complete transfer mechanisms for MCs in subsurface soils to future residents, visitors/trespassers, construction workers, and employees at AOC 2. A single subsurface soil sample was collected from AOC 2. The sample was analyzed for the full suite of explosive constituents and metals specified in Section 5.4.0.1.

5.4.1.8 No explosive constituents were detected at concentrations above their respective RLs in subsurface soil at AOC 2. With the exception of NG, the RLs for all of the explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. The MQO for sensitivity was not met for NG and any reported non-detects do not demonstrate that the MC is present at concentrations less than the selected screening criterion. However, as described in Section 5.1.4.2, the RL for NG is determined to be adequate for the HHRA screening at the FNOD. No explosive constituent COPCs were identified in surface soils at AOC 2.

5.4.1.9. The full suite of metals analyzed, with the exception of silver and sodium, were detected in subsurface soil at AOC 2. As described in Section 5.1.4.2, the maximum RL for silver was below the screening level adopted for the HHRA, confirming the ability of the analytical techniques to detect the MC at levels sufficient to screen for unacceptable risks to human receptors. No screening level is available for sodium and therefore no similar conclusion regarding the ability for the analytical techniques used to detect sodium at levels sufficient to screen for risks to human receptors can be made, and some uncertainty is introduced into the HHRA.

Calcium, magnesium, and potassium were detected in subsurface soils; however, no HHRA SLs were available for any of these inorganics. All three were detected at concentrations below background. Furthermore, these three inorganics are not CERCLA hazardous substances. The lack of HHRA SLs to screen detections of calcium, magnesium and potassium is not expected to introduce an unacceptable level of uncertainty in the HHRA for AOC 2 subsurface soils, primarily because the detections were below background.

Of the remaining metals detected in subsurface soils at AOC 2 that have HHRA SLs, only arsenic exceeded the screening criteria used for screening risks to future residents, visitors/trespassers, construction workers, and employees. Arsenic is therefore identified as a COPC for subsurface soil at AOC 2. As described previously in Section 5.3.0.2 arsenic was not

present at elevated concentrations compared to background. Therefore no additional risk to human receptors from exposure to this MC due to FUDS related activities is identified.

The HHRA for AOC 2 subsurface soil is based upon a single sample, which introduces uncertainty into the risk assessment conclusions. The magnitude of this uncertainty was reduced by collecting the subsurface soil sample from the only disturbed area identified from historical aerial photographs. Furthermore, the HHRA for this sample yielded similar results as a previous investigation by Weston in 1997, as described in Section 2.1.7.1. Weston conducted analysis of explosive constituents and metals in surface soil from AOC 2 and identified arsenic as the only COPC.

5.4.2 Sediment Pathway and Screening Results

5.4.2.1 Sediment was identified as a medium with potentially complete pathways for human and ecological receptors at AOC 2. A total of three sediment samples were collected from AOC 2; two sediment samples and one duplicate sediment sample. Samples were collected from the shore of Streeter Creek. Table 5-2 presents the analytical results for sediment, along with the human health and ecological screening values described previously in Section 5.1.3.

AOC 2 HHRA: Sediment

5.4.2.2 Incidental ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in sediment to future residents, visitors/trespassers, construction workers, and employees at AOC 2. Ingestion of benthos exposed to MCs in sediment, and incidental ingestion and dermal contact with MCs in sediment were identified as potentially complete pathways for ecological receptors at AOC 2. Three sediment samples (two site samples and one duplicate sample) were collected from the shore of Streeter Creek. All three samples were analyzed for the full suite of explosive constituents and metals specified in Section 5.4.0.1.

5.4.2.3 No explosive constituents were detected in concentrations above their respective RLs in sediment at AOC 2. The RLs for all of the non-detected explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. No explosive constituent COPCs were identified in sediment at AOC 2.

5.4.2.4 With the exception of antimony, all of the inorganics analyzed for at AOC 2 were detected in sediment. As described in Section 5.3.0.5, concentrations of aluminum, arsenic, beryllium, cadmium, chromium, cobalt, iron, magnesium, manganese, nickel, potassium, selenium, sodium, thallium, and vanadium were elevated in AOC 2 sediment above background.

Of these detected inorganic MCs, only arsenic exceeded the HHRA SL as was identified as a COPC. Calcium, magnesium, potassium, and sodium have no HHRA SLs with which to evaluate the risk significance of the detections. Of these four inorganics, only calcium was below background levels. Calcium, magnesium, and potassium are not CERCLA hazardous substances, so the lack of HHRA SLs is not expected to introduce an unacceptable level of uncertainty in the HHRA for AOC 2 sediments. No such statement can be made for sodium.

All three of the antimony sample results were rejected due to QA/QC exceedances. Following USEPA guidance on risk assessment (USEPA 1989) the rejected data are not usable for the quantitative risk assessment, and therefore no definitive statements regarding the potential for human receptors to be exposed to unacceptable levels of antimony can be made. In the absence of usable data to screen AOC 2 sediment for antimony, uncertainty is introduced into the risk assessment. However, antimony data in other media sampled within AOC 2 was used to qualitatively evaluate the related uncertainty. In surface soil, the single valid detection of antimony was approximately 100 times lower than the HHRA SL for residential exposures to soils. Additionally, antimony was not detected in two of the three surface water samples obtained from AOC 2. The single detected value of 1.2 µg/L was approximately 10 times lower than the screening criterion adopted for evaluating surface water risks to humans (15 µg/L). Based on the collective evidence the absence of valid antimony sediment data for AOC 2 is not anticipated to introduce an unacceptable amount of uncertainty into the HHRA.

The maximum concentration of arsenic exceeded the screening criteria selected for evaluating risks to future residents and visitors/trespassers in the HHRA, and therefore this MC is identified as COPC for AOC 2 sediment. The following factors were considered as part of the weight-of-evidence approach for determining the risk significance for arsenic in sediment at AOC 2:

- Two of the three sediment sample concentrations exceeded the HHRA screening criterion selected for future residents and visitors/trespassers (site samples: 7.6 and 7.4 mg/kg; screening criterion: 3.9 mg/kg).
- None of the three sediment sample concentrations exceeded the HHRA screening criterion selected for construction workers and employees (screening criterion: 16 mg/kg).
- Neither of the two background sediment sample concentrations exceeded the HHRA screening criteria selected for future residents, visitors/ trespassers, construction workers, and employees.
- Three of the three site sediment sample concentrations exceeded the maximum background concentration.

- Three of the three site sediment sample concentrations exceeded the mean background concentration.

The maximum concentration of arsenic is approximately twice the HHRA SL for future residents and visitors/trespassers and below the HHRA SL for construction workers and employees. The selected HHRA SLs for arsenic are conservative in nature for assessing risks from concentrations of arsenic found in sediment at AOC 2 for several reasons. First, the SLs are based on studies evaluating adverse health effects following exposure to drinking water. Due to the relatively low bioavailability of arsenic from sediment compared to drinking water (Roberts et al. 2007) the resulting screening criteria likely overestimate risks for exposure to arsenic in sediment. In addition, the toxicity criteria for arsenic was derived using a linear, low-dose model. The model assumes that toxicity increases incrementally with dose. However, substantial evidence exists that arsenic acts via a toxic mechanism in the body that would exhibit a threshold (i.e., that there is some level of arsenic that does not cause toxicity) (NRC 2001; Schoen et al. 2004). The use of the low-dose linear model results in a toxicity criterion that likely over predicts risk to human populations exposed to arsenic. Together these factors result in SLs that are conservative for screening risks from exposures in sediment. Considering the conservative SLs and the fact that concentrations exceeded the SLs by two-fold, arsenic in sediment at AOC 2 is not determined to represent an unacceptable risk to human receptors.

AOC 2 SLERA: Sediment

5.4.2.5 As described above in Section 5.4.2.3, no explosive MCs were detected in sediment at AOC 2. The RLs for 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotoluene, HMX, tetryl, and RDX were below the screening criteria selected for the SLERA, and confirm the ability of the analytical techniques employed to detect these MCs at levels sufficient to screen for unacceptable risks to ecological receptors. Because the RLs for 1,3,5-TNB, 1,3-DNB, and NB were above the sediment screening values selected for the SLERA, the MQO for sensitivity was not met for these analytes and any reported non-detects do not demonstrate that contamination is less than the selected screening criterion.

No ecological sediment screening value was available for NG, so no definitive statement regarding the adequacy of the techniques utilized to detect NG at levels that may cause risks to ecological receptors can be made. 1,3,5-TNB, 1,3-DNB, NB, and NG have relatively low K_{ows} (<2) (US NLM 2008, Talmage et al. 1999, USEPA 2011). As described in Section 5.4.1.5 K_{ow} in this range indicate a low ability to bioconcentrate or biomagnify up the food chain (USEPA 2005a, USEPA 2008a). Based on the fact that 1,3,5-TNB, 1,3-DNB, NB, and NG were not detected above their respective analytical RLs, and considering fate and transport characteristics,

these MCs were not identified as COPECs in sediment at AOC 2. The decision is not anticipated to introduce an unacceptable degree of uncertainty into the SLERA. No explosive constituent COPECs were identified in sediment at AOC 2.

5.4.2.6 All of the inorganics analyzed for in AOC 2 sediment, with the exception of antimony, were detected. Calcium, magnesium, potassium, sodium and thallium have no SLERA screening values, and all but calcium are elevated relative to background. Calcium, magnesium and potassium are not CERCLA hazardous substances, thus the lack of screening values is not expected to introduce an unacceptable level of uncertainty in the SLERA for AOC 2 sediments. No such statement can be made for sodium and thallium. Once again the detections for thallium are estimated values, which adds to the uncertainty.

All three of the antimony sample results were rejected due to QA/QC exceedances, and these data are not usable for the quantitative risk assessment; therefore, some uncertainty is introduced into the risk assessment. In the absence of medium-specific data, the analytical results for antimony in soil and surface water sampled at AOC 2 were used to address this data gap and qualitatively evaluate the uncertainty. The single detection of antimony in AOC 2 surface soil (0.03 mg/kg, L), although potentially biased low, was well below the eco-SSL for antimony (0.27 mg/kg). Antimony was not detected in two of the three surface water samples obtained from AOC 2. The single detected value of 1.2 μg/L was below the screening criterion adopted for evaluating surface water risks to ecological receptors (15 μg/L). Based on the collective evidence, the absence of sediment data is not anticipated to introduce an unacceptable level of uncertainty into the SLERA for AOC 2 sediment.

The maximum concentrations of most of the remaining detected metals in AOC 2 sediments were below their respective eco-SSLs and therefore they were not selected as COPECs (i.e., aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, manganese, mercury, nickel, selenium, silver, vanadium and zinc). Maximum concentrations of copper, iron, and lead measured in sediment at AOC 2 exceeded the screening criteria selected for the SLERA (maximum HQs, copper – 1.3, iron – 2, lead – 1.3). Therefore copper, iron, and lead are determined as COPECs for sediment at AOC 2. Copper and lead at AOC 2 were not elevated above background; therefore, there is no additional site-related risk to ecological receptors from exposure to these COPECs.

On-site iron did exceed background, and the following factors were considered as part of the weight-of-evidence approach for determining the risk significance for iron in sediment at AOC 2.

- One of the three site sediment samples had a detected concentration that exceeded the

ecological screening value (maximum HQ = 2).

- Neither of the two sediment background samples had a detected concentration that exceeded the ecological screening value.
- Three of the three site sediment samples had detected concentrations exceeded the maximum background concentration.
- Three of the three site sediment samples had detected concentrations that exceeded the mean background concentration.
- Iron is not defined as a hazardous substance under CERCLA.

Only one of three on-site samples exceeded the screening criterion for iron, and the exceedance was minimal (max HQ=2). The remaining two samples measured concentrations well below the screening criterion of 20,000 mg/kg for iron (9,600 mg/kg, 16,000 mg/kg (J qualified)). In addition, iron is not defined as a hazardous substance under CERCLA. Based on the weight-of-evidence evaluation, although iron is considered a COPEC in sediment, it is not anticipated to represent an unacceptable risk to ecological receptors at AOC 2.

5.4.3 Surface Water Pathway and Screening Results

5.4.3.1 Surface water was identified as a medium with potentially complete pathways for human and ecological receptors at AOC 2. A total of three surface water samples were collected from AOC 2; two surface water samples and one duplicate surface water sample. Samples were collected from Streeter Creek. Table 5-3 presents the analytical results for surface water, along with the human health and ecological screening values described previously in Section 5.1.3.

AOC 2 HHRA: Surface Water

5.4.3.2 Incidental ingestion of and dermal contact with MCs in surface water and ingestion of fish exposed to MCs in surface water were identified as potentially complete pathways for human receptors including future residents, visitors/trespassers, construction workers, and employees, and ecological receptors at AOC 2. Three surface water samples (two site samples and one duplicate sample) were collected from Streeter Creek. All three samples were analyzed for the full suite of explosive constituents and metals specified in Section 5.4.0.1.

5.4.3.3 No explosive constituents were detected in concentrations above their respective RLs in surface water at AOC 2. The RLs for all of the non-detected explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical

techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. No explosive constituent COPCs were identified in surface water at AOC 2.

5.4.3.4 Aluminum, antimony, arsenic, barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, silver, sodium, thallium, vanadium, and zinc were detected in the surface water at AOC 2. Beryllium, cadmium, and selenium were not detected in AOC 2 surface water. The RLs for beryllium, cadmium, and selenium were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques used to detect the MCs at levels sufficient to screen for unacceptable risk to human receptors.

Calcium, magnesium, potassium, and sodium were all detected in AOC 2 surface water at elevated concentrations relative to background, but do not have HHRA SLs. Calcium, magnesium and potassium are essential nutrients that are not CERCLA hazardous substances. Sodium is also considered an essential nutrient but is a CERCLA hazardous substance. The lack of SLs for these inorganics is not expected to introduce an unacceptable level of uncertainty in the HHRA for AOC 2 surface water.

The remainder of the detected metals in AOC 2 surface water (i.e., aluminum, antimony, arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, silver, thallium, vanadium, and zinc) have HHRA SLs. Of these detected metals, only the maximum concentration of arsenic exceeded the screening criteria selected for evaluating risks to human receptors. Arsenic is identified as a COPC for AOC 2 surface water. The following factors were considered as part of the weight-of-evidence approach for determining the risk significance for arsenic in surface water at AOC 2:

- Three of the three surface water samples had detected concentrations that exceeded the HHRA screening criterion selected for all human receptor groups (site samples: 4.5, 2.6, and 2.6 μg/L; screening criterion: 0.45 μg/L).
- Two of the two background surface water samples had detected concentrations that exceeded the HHRA screening criteria selected for all human receptors (background samples : 4.3 and 2.6 μg/L)
- One of the three site surface water samples had a detected concentration that exceeded the maximum background concentration.
- One of the three site surface water samples had a concentration that exceeded the mean background concentration.

Because the AOC 2 arsenic surface water concentrations were similar to background it is not assumed to present an unacceptable FUDS related risk.

AOC 2 SLERA: Surface Water

5.4.3.5 As described above in Section 5.4.3.3, no explosive constituent MCs were detected in surface water at AOC 2. The RLs for all of the explosive constituents with available screening levels, were below the screening criteria selected for the SLERA, and confirm the ability of the analytical techniques employed to detect these MCs at levels sufficient to screen for unacceptable risks to ecological receptors.

No ecological screening value for surface water was available for tetryl, and therefore no definitive statement regarding the adequacy of the techniques utilized to detect the MC at levels that may cause risks to ecological receptors can be made. Tetryl has a low K_{ow} of 1.6 (USEPA 2011), and chemicals with K_{ow} in this range have a low ability to bioconcentrate or accumulate in the food chain (USEPA 2005a, USEPA 2008a). Accordingly, the lack of a SLERA screening value for tetryl is not expected to introduce unreasonable uncertainties into the SLERA.

5.4.3.6. As stated in Section 5.4.3.4, with the exception of beryllium, cadmium, and selenium, all of the metals analyzed for in surface water from AOC 2 were detected. The minimum and maximum RLs for selenium were below the screening criteria selected for the SLERA, which confirms the ability of the analytical techniques used to detect the MCs at levels sufficient to screen for unacceptable risk to ecological receptors. The maximum RL for cadmium and all RLs for beryllium were above their respective surface water screening values selected for the SLERA, and therefore the MQO for sensitivity was not met for these analytes. Reported non-detects do not consistently demonstrate that contamination is less than the selected screening criteria, and therefore some uncertainty is introduced into the assessment.

Of the detected metals in AOC 2 surface water, the maximum concentrations for antimony, arsenic, chromium, cobalt, lead, mercury, nickel, thallium, vanadium and zinc were below the eco-SSLs and were therefore not considered COPECs. Conversely, maximum concentrations of aluminum, barium, calcium, copper, iron, magnesium, manganese, potassium, silver, and sodium in surface water at AOC 2 exceeded the screening criteria selected for the SLERA (maximum HQs, aluminum – 29, barium – 14, calcium – 1.3, copper – 1.3, iron – 29, magnesium – 5.5, manganese – 1.5, potassium – 2.8, silver – 1.05, and sodium – 6). These MCs are identified as COPECs for surface water at AOC 2. Of these COPECs, only aluminum exhibited on-site concentrations that were not elevated relative to both the mean and maximum background concentrations. Therefore, aluminum is retained as a COPEC, but there is no additional risk from

FUDS related activities. For the remainder of the COPECs, the following factors were considered as part of the weight-of-evidence approach for determining the risk significance for the surface water SLERA at AOC 2.

- Barium

  - Three of the three site surface water samples had detected concentrations that exceeded the ecological screening value (maximum HQ = 14).
  - Two of the two surface water background samples had detected concentrations that exceeded the ecological screening value (maximum HQ = 13).
  - One of the three site surface water samples had a detected concentration that exceeded the maximum background concentration.
  - One of the three site surface water samples had a detected concentration that exceeded the mean background concentration.
  - Barium is not defined as a hazardous substance under CERCLA.

Because the AOC 2 barium surface water concentrations were similar to background, it is not assumed to present an unacceptable FUDS-related risk.

- Calcium

  - Three of the three site surface water samples had detected concentrations that exceeded the ecological screening value (maximum HQ = 1.3).
  - One of the two surface water background samples had a detected concentration that exceeded the ecological screening value (maximum HQ = 1.2)
  - Three of the three site surface water samples had detected concentrations that exceeded the maximum background concentration.
  - Three of the three site surface water samples had detected concentrations that exceeded the mean background concentration.
  - Calcium is not defined as a hazardous substance under CERCLA.

Because the AOC 2 calcium surface water concentrations were similar to background, it is not assumed to present an unacceptable FUDS-related risk.

- Copper

  - One of the three site surface water samples had a detected concentration that exceeded the ecological screening value (maximum HQ = 1.3).

  - Two of the two surface water background samples had detected concentrations that exceeded the ecological screening value (HQ=1.8).

  - None of the three site surface water samples had a detected concentration that exceeded the maximum background concentration.

  - None of the three site surface water samples had a detected concentration that exceeded the mean background concentration (the determination of mean exceedance was influenced heavily by RLs for non-detected samples).

Because the AOC 2 copper surface water concentrations were similar to background, it is not assumed to present an unacceptable FUDS-related risk.

- Iron

  - One of the three site surface water samples had a detected concentration that exceeded the ecological screening value (maximum HQ = 3.9).

  - One of the two surface water background samples had a detected concentration that exceeded the ecological screening value (maximum HQ = 3.6).

  - One of the three site surface water samples had a detected concentration that exceeded the maximum background concentration.

  - One of the three site surface water samples had a detected concentration that exceeded the mean background concentration.

  - Iron is not defined as a hazardous substance under CERCLA.

Because the AOC 2 iron surface water concentrations were similar to background, it is not assumed to present an unacceptable FUDS-related risk.

- Magnesium

  - Three of the three site surface water samples had detected concentrations that exceeded the ecological screening value (maximum HQ = 5.5).

  - Two of the two surface water background samples had detected concentrations that exceeded the ecological screening value (maximum HQ = 5).

- Three of the three site surface water samples had detected concentrations that exceeded the maximum background concentration.
- Three of the three site surface water samples had detected concentrations that exceeded the mean background concentration.
- Magnesium is not defined as a hazardous substance under CERCLA.

Because the AOC 2 magnesium surface water concentrations were similar to background, it is not assumed to present an unacceptable FUDS-related risk.

- Manganese
- One of the three site surface water samples had a detected concentration that exceeded the ecological screening value (maximum HQ = 1.5).
- One of the two surface water background samples had a detected concentration that exceeded the ecological screening value (maximum HQ = 1.2).
- One of the three site surface water samples had a detected concentration that exceeded the maximum background concentration.
- One of the three site surface water samples had a detected concentration that exceeded the mean background concentration.

Because the AOC 2 manganese surface water concentrations were similar to background, it is not assumed to present an unacceptable FUDS-related risk.

- Potassium
- Three of the three site surface water samples had detected concentrations that exceeded the ecological screening value (maximum HQ = 2.8).
- Both of the two surface water background samples had detected concentrations that exceeded the ecological screening value (maximum HQ = 2.6).
- Three of the three site surface water samples had detected concentrations that exceeded the maximum background concentration.
- Three of the three site surface water samples had detected concentrations that exceeded the mean background concentration.
- Potassium is not defined as a hazardous substance under CERCLA.

Because the AOC 2 potassium surface water concentrations were similar to background, it is not assumed to present an unacceptable FUDS-related risk.

- Silver

  - One of the three site surface water samples had a detected concentration that exceeded the ecological screening value (maximum HQ = 1.1).
  - Neither of the two surface water background samples had detected concentrations that exceeded the ecological screening value.
  - One of the three site surface water samples had a detected concentration that exceeded the maximum background concentration.
  - One of the three site surface water samples had a detected concentration that exceeded the mean background concentration.

Because silver was only detected in one of three site samples and at a concentration that was approximately the same as the screening value, it is not assumed to present an unacceptable risk.

- Sodium

  - Three of the three site surface water samples had a detected concentration that exceeded the ecological screening value (maximum HQ = 6.8).
  - Two of the two surface water background samples had concentrations that exceeded the ecological screening value (5.3).
  - Three of the three site surface water samples had detected concentrations that exceeded the maximum background concentration.
  - Three of the three site surface water samples had detected concentrations that exceeded the mean background concentration.

Because the maximum HQs for surface water concentrations from AOC 2 and background were similar, it is not assumed to present an unacceptable FUDS-related risk.

In summary, ten COPECs were identified for AOC 2 surface water based on the maximum HQs. However, for all but the case of silver, the maximum background HQs were similar indicating that unacceptable risks from FUDS related activities are not likely. Silver was only detected in one of three site surface water samples and the maximum HQ was approximately 1.

5.4.4 Groundwater Pathway

5.4.4.1 Ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in groundwater to future residents, visitors/trespassers, construction workers, and employees at AOC 2. As described in Section 5.4.0.1, no groundwater samples were collected from AOC 2. The groundwater pathway therefore remains potentially complete for human receptors at AOC 2. While the groundwater pathway may be potentially complete for AOCs investigated during this SI, any evaluation of the groundwater pathway has been deferred until completion of the ongoing Background Study. Therefore, no analyses of the groundwater pathway are presented in this SI Report.

5.5 Track A Magazine Line (AOC 8)

5.5.0.1 As presented in Section 5.1.1, the explosive constituents DNT and DNT breakdown products, HMX, NG, RDX, tetryl, and TNT and TNT breakdown products, and the metals aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc were identified as MCs at AOC 8. Surface soil, subsurface soil, and groundwater were identified as media of concern for this area. The results of the screening level analyses in surface and subsurface soil are presented in Table 5-1. No groundwater samples were obtained from AOC 8.

5.5.1 Soil Pathway and Screening Results

5.5.1.1 Surface soil was identified as a medium with potentially complete pathways for human and ecological receptors. Additionally subsurface soil was identified as a medium with a potentially complete pathway for human receptors. A total of 15 soil samples were collected from AOC 8; eight surface soil samples and seven subsurface soil samples. Table 5-1 presents the analytical results for surface and subsurface soil, along with the human health and ecological screening values described previously in Section 5.1.3.

5.5.1.2 Ingestion, dermal contact, and inhalation were identified as potentially complete transfer mechanisms for MCs in surface soils to human receptors including future residents, visitors/trespassers, construction workers, and employees, as well as ecological receptors at AOC 8. Eight surface soil samples (seven site samples and one duplicate sample) were collected from AOC 8. The samples were analyzed for the full suite of explosive constituents and metals specified in Section 5.4.0.1.

AOC 8 HHRA: Surface Soil

5.5.1.3 No explosive constituents were detected at concentrations above their respective RLs in surface soil at AOC 8. With the exception of NG, the RLs for all of the explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. Because the RL for NG was above the soil screening criterion of 0.61 mg/kg adopted for screening risks to future residents, visitors, and trespassers, the MQO for sensitivity was not met and any reported non-detects for NG do not demonstrate that the MC is present at concentrations less than the selected screening criterion. However, as described in Section 5.1.4.2, the RL for NG is determined to be adequate for the HHRA screening at the FNOD. No explosive constituent COPCs were identified in surface soils at AOC 8.

5.5.1.4 The full suite of metals analyzed were detected in surface soil at AOC 8. The maximum concentrations for antimony, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, vanadium and zinc were below the HHRA SLs and are therefore not considered COPCs. However, the maximum concentrations of aluminum, arsenic, cobalt, iron, manganese, and thallium exceeded SLs used for screening risks to human receptors and are therefore identified as COPCs for AOC 8 surface soil.

No screening criteria were available for calcium, magnesium, potassium, and sodium; therefore, no definitive statements regarding the risks associated with exposure to these metals in surface soil can be made. All four of these metals were elevated relative to maximum and/or mean background concentrations. The site and background sampling were conducted as separate investigations, which may introduce uncertainty related to the comparability of the sampling and analytical methods used in each investigation. All of these metals are considered essential nutrients that play a key role in human physiological or biochemical processes. In addition, calcium, magnesium, and potassium are not CERCLA hazardous substances. The lack of screening criterion for these metals introduces uncertainty, but does not prevent the HHRA from being used for risk-based management decisions.

Although some of the antimony sample results were determined to be unusable for the quantitative risk assessment, three of eight samples were usable. The usable antimony results were from sample locations that exhibited the highest exceedances of the HHRA SLs for other MCs in AOC 8 surface soil (i.e., arsenic and thallium). However, the antimony concentrations at these locations were more than ten times lower than the most restrictive antimony HHRA SL. Given the usable antimony data for AOC 8 surface soil were from some of the most impacted

sampled locations but exhibited concentrations that were well below the HHRA SLs, the uncertainty associated with the limited number of antimony results is not considered significant.

COPCs for AOC 8 surface soil are aluminum, arsenic, cobalt, iron, manganese, and thallium. The following factors were considered as part of the weight-of-evidence approach for determining the risk significance for these COPCs in surface soil at AOC 8:

- Aluminum

  - Six of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 9,600, 12,000, 11,000, 8,800, 11,000, and 13,000 mg/kg; screening criterion: 7,700 mg/kg).

  - None of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 99,000 mg/kg).

  - The mean background soil concentration did not exceed the screening criteria adopted for human receptors (mean background: 5,650 mg/kg). The maximum concentration detected in background soil was above the screening criterion adopted for future residents and visitors/trespassers but below the screening criterion used for construction workers and employees (maximum detected background: 16,200 mg/kg).

  - None of the eight site surface soil samples had detected concentrations that exceeded the maximum background soil concentration.

  - Seven of the eight site surface soil samples had detected concentrations that exceeded the mean background soil concentration.

  - Aluminum is not defined as a hazardous substance under CERCLA.

Aluminum is not considered to present an unacceptable human health risk at AOC 8. The maximum concentration is less than twice the most restrictive HHRA SL and, as discussed earlier, the HHRA SL used for aluminum was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Arsenic

  - Eight of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 5.4, 8.0, 2.6, 2.5, 4.5, 6.1, 19, and 11 mg/kg; screening criterion: 0.39 mg/kg).

- Eight of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 1.6 mg/kg).
- The mean and maximum background soil concentrations exceeded the screening criteria adopted for all human receptors (mean background: 4.5 mg/kg; maximum background: 22.7 mg/kg).
- None of the eight site surface soil samples had detected concentrations that exceeded the maximum background soil concentration.
- Five of the eight site surface soil samples had detected concentrations that exceeded the mean background soil concentration.

Arsenic is assumed to represent a potentially unacceptable risk for human receptors because of the frequency and magnitude by which site samples exceed the HHRA SLs as well as the arsenic background.

- Cobalt
- One of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site sample: 2.5 mg/kg; screening criterion: 2.3 mg/kg).
- None of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 30 mg/kg).
- The maximum background soil concentration did not exceed the screening criteria adopted for human receptors (maximum background: 1.6 mg/kg).
- Two of the eight site surface soil samples had detected concentrations that exceeded the maximum background soil concentration.
- Eight of the eight site surface soil samples had detected concentrations that exceeded the mean background soil concentration.

Cobalt is not considered to present an unacceptable human health risk at AOC 8, because the maximum concentration is only slightly greater than the most restrictive HHRA SL. The HHRA SL used for cobalt was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Iron

  - Four of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 6,700, 6,800, 6,100, 12,000 mg/kg; screening criterion: 5,500 mg/kg).

  - None of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 72,000 mg/kg).

  - The mean background soil concentration did not exceed the screening criteria adopted for human receptor (mean background: 3,970 mg/kg). The maximum concentration detected in background soil was above the screening criterion adopted for future residents and visitors/trespassers but below the screening criterion used for construction workers and employees (maximum detected background: 10,100 mg/kg).

  - One of the eight site surface soil samples had detected concentrations that exceeded the maximum background soil concentration.

  - Eight of the eight site surface soil samples had detected concentrations that exceeded the mean background soil concentration.

  - Iron is not defined as a hazardous substance under CERCLA.

Iron is not considered to present an unacceptable human health risk as AOC 8, because the maximum concentration is only twice the most restrictive HHRA SL. As discussed earlier, the HHRA SL used for iron was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Manganese

  - One of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site sample: 210 mg/kg; screening criterion: 180 mg/kg).

  - None of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 2,300 mg/kg).

  - The maximum concentration detected in background soil was below the screening criteria adopted for human receptors (maximum detected background: 83 mg/kg).

- Three of the eight site surface soil samples had detected concentrations that exceeded the maximum detected background soil concentration.
- Five of the eight site surface soil samples had detected concentrations that exceeded the mean background soil concentration.

Manganese is not considered to present an unacceptable human health risk as AOC 8, because the maximum concentration is only slightly greater than the most restrictive HHRA SL. The HHRA SL used for manganese was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Thallium

- Seven of eight surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 0.09, 0.10, 0.09, 0.10, 0.11, 0.16, 0.27 mg/kg; screening criterion: 0.078 mg/kg).
- None of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 1.0 mg/kg).
- Thallium was not detected in background soil.

Thallium is not considered to present an unacceptable human health risk as AOC 8, because the maximum concentration is only slightly greater than the most restrictive HHRA SL. The HHRA SL used for thallium was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

The following six metals were selected as COPCs based on comparison to the HHRA SLs: aluminum, arsenic, cobalt, iron, manganese, and thallium. Of these, aluminum, cobalt, iron, manganese, and thallium are not likely to present an unacceptable risk because of the conservatism in the screening evaluation. Arsenic represents a potentially unacceptable risk based on the frequency and magnitude with which the site concentrations exceed the HHRA SLs and background.

AOC 8 SLERA: Surface Soil

5.5.1.5 As described above in Section 5.5.1.3, no explosive MCs were detected in the surface soil at AOC 8. The RLs for 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotluene, HMX, nitrobenzene, RDX, and tetryl were below the screening criteria selected for the SLERA, and confirm the ability of the analytical techniques to detect the MCs at levels sufficient to screen for unacceptable risks to ecological receptors.

No eco-SSL value was available for 1,3,5-TNB, 1,3-DNB, or NG, so no definitive statement regarding the adequacy of the techniques utilized to detect these MCs at levels that may cause risks to ecological receptors can be made. 1,3,5-TNB, 1,3-DNB, and NG have relatively low K_{ows} (<2) (US NLM 2008, Talmage et al. 1999, USEPA 2011). In general, a K_{ow} <2 indicates inefficient partitioning into the lipid component of organisms and a low ability to bioconcentrate or biomagnify up the food chain (USEPA 2005a, USEPA 2008a). Based on the fact that 1,3,5-TNB, 1,3-DNB, and NG were not detected above their respective analytical RLs, and considering fate and transport characteristics, these MCs were not identified as COPECs in sediment at AOC 8. This decision is not expected to introduce an unacceptable level of uncertainty into the SLERA. No explosive constituent COPECs were identified in surface soil at AOC 8.

5.5.1.6 As described in Section 5.5.1.4, the full suite of metals analyzed were detected in surface soil at AOC 8. The maximum concentrations for aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, manganese, and nickel were below their respective eco-SSL and were therefore not considered COPECs. The maximum concentrations of arsenic, copper, lead, mercury, selenium, vanadium and zinc exceeded their respective eco-SSLs and were therefore selected as COPECs for AOC 8 surface soil.

No screening values were available for calcium, iron, magnesium, potassium, sodium and thallium; therefore, no definitive statements regarding the risks to biota associated with exposure to these metals in surface soil can be made. All of these metals were elevated relative to maximum and/or mean background concentrations. The site and background sampling were conducted as separate investigations, which may introduce uncertainty related to the comparability of the sampling and analytical methods used in each investigation. Five of these metals are considered essential nutrients (i.e., calcium, iron, magnesium, potassium and sodium). In addition, calcium, iron, magnesium and potassium are not CERCLA hazardous substances. The lack of screening criterion for these metals introduces uncertainty, but does not prevent the SLERA from being used for risk-based management decisions.

Although some of the antimony sample results were determined to be unusable for the quantitative risk assessment, three of eight samples were usable. The antimony concentrations in all three samples were below the SLERA screening criterion. However, other MC detected at these three locations did exceed their respective SLERA criteria. Antimony was not detected in the background soil samples. The uncertainty associated with the limited antimony dataset are not considered significant because the usable antimony results were elevated above background and reflected potentially impacted areas, given the SLERA exceedances for other MC.

Based on the maximum concentrations in AOC 8 surface soil, the following COPECs have been identified: arsenic, copper, lead, mercury, selenium, vanadium, and zinc. Mercury in AOC 8 surface soils was not elevated relative to background, and therefore no additional risk to ecological receptors from exposure to mercury from FUDS-related activities was identified. The following factors were considered as part of the weight-of-evidence approach for determining the risk significance for the remaining COPECs in surface soil at AOC 8.

- Arsenic

  - One of the eight site surface soil samples had detected concentrations that exceeded the ecological screening value (maximum HQ, 1.05).

  - The mean background soil concentration was lower than the ecological screening value (mean background: 4.5 mg/kg). The maximum concentration detected in background soil was above the screening value (HQ, 1.3).

  - None of the eight site surface soil samples had a detected concentration that exceeded the maximum background concentration.

  - Five of the eight site surface soil samples had detected concentrations that exceeded the mean background soil concentration.

Arsenic is not likely to present an unacceptable risk to ecological receptors given the maximum concentration is only slightly elevated above the eco-SSL.

- Copper

  - One of the eight site surface soil samples had detected concentrations that exceeded the ecological screening value (HQ, 1.8).

  - The maximum background soil concentration was lower than the ecological screening value (maximum background: 13 mg/kg).

- Two of the eight site surface soil samples had detected concentrations that exceeded the maximum background concentration.
- Six of the eight site surface soil samples had a detected concentration that exceeded the mean background concentration.

Copper is not assumed to present an unacceptable risk to ecological receptors because of the very low frequency and magnitude by which sample results exceeded the eco-SSL. The maximum HQ was less than two, and the other seven samples ranged from one-half to one-tenth of the eco-SSL.

- Lead
- Seven of the eight site surface soil samples had detected concentrations that exceeded the ecological screening value (maximum HQ, 18).
- The mean background soil concentration was lower than the ecological screening value (mean background: 10.5 mg/kg). The maximum concentration detected in background soil was above the screening value (HQ, 2.5).
- Four of the eight site surface soil samples had detected concentrations that exceeded the maximum background concentration.
- Seven of the eight site surface soil samples had a detected concentration that exceeded the mean background concentration.

Lead in AOC 8 surface soils could potentially pose an unacceptable risk to ecological receptors given that three of the samples were on the order of ten times higher than the eco-SSL and significantly elevated relative to background levels.

- Selenium
- One of the eight site surface soil samples had detected concentrations that exceeded the ecological screening value (maximum HQ, 1.7).
- The single detected concentration in background soil exceeded the ecological screening value (HQ, 1.4).
- One of the eight site surface soil samples had a detected concentration that exceeded the background detection.

Selenium is not assumed to present an unacceptable risk to ecological receptors because of the very low frequency and magnitude by which sample results exceeded the eco-SSL. Only the maximum detected concentration exceeded the eco-SSL and the HQ was less than two.

- Vanadium

  - Eight of the eight site surface soil samples had detected concentrations that exceeded the ecological screening value (maximum HQ, 2.8).
  - The mean and maximum background soil concentration exceeded the ecological screening value (HQ, 1.3 and 3.3 respectively).
  - None of the eight site surface soil samples had a detected concentration that exceeded the maximum background concentration.
  - Eight of the eight site surface soil samples had detected concentrations that exceeded the mean background concentration.

Vanadium is considered to represent a potential risk to ecological receptors given the frequency and magnitude with which site concentrations exceed the eco-SSL and are elevated relative to background.

- Zinc

  - One of the eight site surface soil samples had a detected concentration that exceeded the ecological screening value (maximum HQ, 1.8).
  - The mean and maximum background soil concentrations were below the ecological screening value (mean, 8.1 mg/kg and 31.2 mg/kg respectively).
  - One of the eight site surface soil samples had a detected concentration that exceeded the maximum background concentration.
  - Seven of the eight site surface soil samples had a detected concentration that exceeded the mean background concentration.

Zinc is not assumed to present an unacceptable risk to ecological receptors because of the very low frequency and magnitude by which sample results exceeded the eco-SSL. The maximum HQ was less than two and the other seven samples were approximately one-half or lower than the eco-SSL.

Seven COPECs were identified for AOC 8 surface soils. The risks for arsenic, copper, selenium, and zinc were assumed to be acceptable based on the low frequency and magnitude with which

site concentrations exceeded the respective eco-SSLs. Mercury concentrations in site soils were below background, and therefore there were no additional risks to ecological receptors from FUDS activities. Lead and vanadium were determined to present an unacceptable ecological risk based on the surface soil results for AOC 8.

AOC 8 HHRA: Subsurface Soil

5.5.1.7 Incidental ingestion, dermal contact, and inhalation were identified as potentially complete transfer mechanisms for MCs in subsurface soils to future residents, visitors/trespassers, construction workers, and employees at AOC 8. Seven subsurface soil samples were collected from this area. The samples were analyzed for the full suite of explosive constituents and metals specified in Section 5.4.0.1.

5.5.1.8 No explosive constituents were detected at concentrations above their respective RLs in subsurface soil at AOC 8. With the exception of NG, the RLs for all of the explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. The MQO for sensitivity was not met for NG and any reported non-detects do not demonstrate that the MC is present at concentrations less than the selected screening criterion. However, as described in Section 5.1.4.2, the RL for NG is determined to be adequate for the HHRA screening at the FNOD. No explosive constituent COPCs were identified in subsurface soils at AOC 8.

5.5.1.9. The full suite of metals analyzed were detected in subsurface soil at AOC 8, except for sodium. Of these detected metals, antimony, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, vanadium and zinc were below their respective HHRA SLs and were therefore not considered COPCs. The maximum concentrations for aluminum, arsenic, cobalt, iron, manganese, and thallium were above one or both of their respective HHRA SLs and were therefore selected as COPCs. The site results for AOC 8 COPCs in subsurface soils were determined to be elevated to the respective maximum and/or mean background concentrations.

No screening level is available for sodium; therefore, no conclusion can be made regarding the ability for the analytical techniques used to detect sodium at levels sufficient to screen for risks to human receptors can be made, and some uncertainty is introduced into the risk assessment. Some of the antimony sample results were determined to be unusable for the quantitative risk assessment. Specifically, five of the seven antimony samples collected for AOC 8 subsurface soil were usable for the HHRA. The antimony results in these usable samples were elevated above

background levels. Although the antimony levels in these usable samples were below the HHRA SLs, the concentrations for other MC at these locations exhibited some of the highest exceedances of their respective HHRA SLs. The uncertainty associated with the limited antimony dataset are not considered significant because the usable antimony results were elevated above background and reflected potentially impacted areas, given the HHRA exceedances for other MC.

No screening criteria were available for calcium, magnesium, and potassium; therefore, no definitive statements regarding the risks associated with exposure to these metals in surface soil can be made. All three of these metals were elevated relative to maximum and/or mean background concentrations. The site and background sampling were conducted as separate investigations, which may introduce uncertainty related to the comparability of the sampling and analytical methods used in each investigation. All of these metals are considered essential nutrients that play a key role in human physiological or biochemical processes. In addition, they are not CERCLA hazardous substances. The lack of screening criteria for these metals introduces uncertainty but does not prevent the HHRA from being used for risk-based management decisions.

Maximum concentrations of aluminum, arsenic, cobalt, iron, manganese and thallium were detected at concentrations at AOC 8 that exceeded the screening criteria adopted for the HHRA. The following factors were considered as part of the weight-of-evidence approach for determining the risk significance for the COPCs in subsurface soil at AOC 8.

- Aluminum

  - Five of the seven subsurface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 11,000, 19,000, 9,500, 14,000, and 10,000 mg/kg; screening criterion: 7,700 mg/kg).

  - None of the seven subsurface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 99,000 mg/kg).

  - The mean background soil concentration did not exceed the screening criteria adopted for human receptors (mean background: 5,650 mg/kg). The maximum concentration detected in background soil was above the screening criterion adopted for future residents and visitors/trespassers, but below the screening criterion used for construction workers and employees (maximum detected background: 16,200 mg/kg).

  - One of the seven site subsurface soil samples had detected concentrations that exceeded the maximum background soil concentration.

- Seven of the seven site subsurface soil samples had detected concentrations that exceeded the mean background soil concentration.
- Aluminum is not defined as a hazardous substance under CERCLA.

Aluminum is not considered to present an unacceptable human health risk at AOC 8 given the maximum concentration is just over twice the most restrictive HHRA SL. As discussed earlier, the HHRA SL used for aluminum was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Arsenic
- Seven of the seven subsurface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 4.8, 6.5, 2.0, 6.4, 4.9, 11, and 14 mg/kg; screening criterion: 0.39 mg/kg).
- Seven of the seven subsurface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 1.6 mg/kg).
- The mean background soil concentration exceeded the screening criteria adopted for all human receptors (mean background: 4.5 mg/kg). The minimum concentration detected in background soil was above the screening criterion used for future residents and visitors/trespassers, but below the screening criterion used for construction workers and employees (minimum detected background: 0.93 mg/kg).
- None of the eight site subsurface soil samples had a detected concentration that exceeded the maximum background soil concentration.
- Six of the seven site subsurface soil samples had detected concentrations that exceeded the mean background soil concentration.

Arsenic is assumed to represent a potentially unacceptable risk for human receptors because of the frequency and magnitude by which site samples exceed both of the HHRA SLs as well as the arsenic background.

- Cobalt
- One of the seven subsurface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site sample: 3.3 mg/kg; screening criterion: 2.3 mg/kg).

- None of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 30 mg/kg).
- The maximum background soil concentration did not exceed the screening criteria adopted for human receptors (maximum background: 1.6 mg/kg).
- Four of the seven site subsurface soil samples had detected concentrations that exceeded the maximum background soil concentration.
- Seven of the seven site subsurface soil samples had detected concentrations that exceeded the mean background soil concentration.

Cobalt is not considered to present an unacceptable human health risk at AOC 8, because the maximum concentration is only slightly greater than the most restrictive HHRA SL. The HHRA SL used for cobalt was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Iron

- Five of the seven subsurface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 7,400, 8,600, 5,600, 7,500, and 23,000 mg/kg; screening criterion: 5,500 mg/kg).
- None of the seven subsurface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 72,000 mg/kg).
- The mean background soil concentration did not exceed the screening criteria adopted for human receptor (mean background: 3,970 mg/kg). The maximum concentration detected in background soil was above the screening criterion adopted for future residents and visitors/trespassers, but below the screening criterion used for construction workers and employees (maximum detected background: 10,100 mg/kg).
- One of the seven site subsurface soil samples had detected concentrations that exceeded the maximum background soil concentration.
- Seven of the seven site subsurface soil samples had detected concentrations that exceeded the mean background soil concentration.
- Iron is not defined as a hazardous substance under CERCLA.

Iron is not considered to present an unacceptable human health risk at AOC 8. Although the maximum concentration is approximately four times the most restrictive of the HHRA SLs, this

SL value reflects a factor of ten margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance. All other detections are less than twice this conservative SL.

- Manganese

  - One of the seven subsurface soil samples had a detected concentration that exceeded the screening criterion selected for future residents and visitors/trespassers (site sample: 510 mg/kg; screening criterion: 180 mg/kg). The single exceedance was K qualified, and the reported result is potentially biased high.

  - None of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 2,330 mg/kg).

  - The maximum background soil concentration did not exceed the screening criteria adopted for human receptors (maximum background: 83 mg/kg).

  - Two of the seven site subsurface soil samples had detected concentrations that exceeded the maximum background soil concentration.

  - Five of the seven site subsurface soil samples had detected concentrations that exceeded the mean background soil concentration.

Manganese is not assumed to present an unacceptable risk for human receptors for AOC 8 subsurface soils, because only the maximum detected concentration exceeds the most restrictive HHRA SL. The maximum sample result, which was biased high, was approximately three times higher than the most restrictive HHRA SL. This HHRA SL includes a factor of ten margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance. All other detections ranged form one-half to one-tenth of this conservative SL.

- Thallium

  - Five of seven surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 0.16, 0.11, 0.12, 0.15, 0.71 mg/kg; screening criterion: 0.078 mg/kg).

- None of the eight surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 1.0 mg/kg).
- Thallium was not detected in background soil.

Thallium is not considered to present an unacceptable human health risk at AOC 8, because the maximum concentration is only slightly greater than the most restrictive HHRA SL. The HHRA SL used for thallium was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

Six metals were selected as COPCs for AOC 8 subsurface soils based on comparison to the HHRA SLs: aluminum, arsenic, cobalt, iron, manganese, and thallium. Of these, aluminum, cobalt, iron manganese, and thallium are not likely to present an unacceptable risk because of the conservatism in the screening evaluation. Arsenic represents a potentially unacceptable risk to human receptors based on the frequency and magnitude with which the site concentrations exceed the HHRA SLs and background.

5.5.2 Groundwater Pathway

5.5.2.1 Ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in groundwater to future residents, visitors/trespassers, construction workers, and employees at AOC 8. As described in Section 5.5.0.1, no groundwater samples were collected from AOC 8. Therefore, the groundwater pathway remains potentially complete for human receptors at AOC 8. While the groundwater pathway may be potentially complete for AOCs investigated during this SI, any evaluation of the groundwater pathway has been deferred until completion of the ongoing Background Study. Therefore, no analyses of the groundwater pathway are presented in this SI Report.

5.6 Track A & B Burning Ground (AOC 9)

5.6.0.1 As presented in Section 5.1.1, the explosive constituents DNT and DNT breakdown products, HMX, NG, RDX, tetryl, and TNT and TNT breakdown products, and the metals aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc were identified as MCs at AOC 9. Surface soil, subsurface soil, and groundwater were identified as media of concern for this area. The results of the screening level

analysis in surface and subsurface soil is presented in Tables 5-1. No groundwater samples were collected from AOC 9.

5.6.1 Soil Pathway and Screening Results

5.6.1.1 Surface soil was identified as a medium with potentially complete pathways for human and ecological receptors. Additionally, subsurface soil was identified as a medium with a potentially complete pathway for human receptors. A total of nine soil samples were collected from AOC 9; four surface soil samples and five subsurface soil samples. Table 5-1 presents the analytical results for surface and subsurface soil, along with the human health and ecological screening values described previously in Section 5.1.3.

5.6.1.2 Ingestion, dermal contact, and inhalation were identified as potentially complete transfer mechanisms for MCs in surface soils to human receptors including future residents, visitors/trespassers, construction workers, and employees, and ecological receptors at AOC 9. Four surface soil samples were collected from AOC 9. The samples were analyzed for the full suite of explosive constituents and metals specified in Section 5.4.0.1.

AOC 9 HHRA: Surface Soil

5.6.1.3 No explosive constituents were detected at concentrations above their respective RLs in surface soil at AOC 9. With the exception of NG, the RLs for all of the explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. The RL for NG was above the soil screening criterion of 0.61 mg/kg adopted for screening risks to future residents, visitors, and trespassers; therefore, the MQO for sensitivity was not met and any reported non-detects for NG do not demonstrate that the MC is present at concentrations less than the selected screening criterion. However, as described in Section 5.1.4.2, the RL for NG is determined to be adequate for the HHRA screening at the FNOD. No explosive constituent COPCs were identified in surface soils at AOC 9.

5.6.1.4 With the exception of antimony and sodium, the full suite of metals analyzed were detected in surface soil at AOC 9. The maximum concentrations of barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc were below their respective HHRA SLs and were therefore not considered COPCs. The maximum concentrations of aluminum, arsenic, iron, and thallium exceeded their respective HHRA SL and were selected as COPCs for AOC 9 surface soils. The site results for the COPCs in AOC 9 surface soils were determined to be elevated to the respective maximum and/or mean background concentrations.

For antimony, all four of the surface samples collected yielded results that were not usable for the purposes of the quantitative risk assessment. This data gap introduces uncertainty into the risk assessment. No human health screening level is available for sodium; therefore, no conclusion can be made regarding the ability for the analytical techniques used to detect sodium at levels sufficient to screen for risks to human receptors can be made, and some uncertainty is introduced into the risk assessment.

No screening criterion was available for calcium, magnesium, and potassium; therefore, no definitive statements regarding the risks associated with exposure to these metals in surface soil can be made. All three of these metals were elevated relative to maximum and/or mean background concentrations. The site and background sampling were conducted as separate investigations, which may introduce uncertainty related to the comparability of the sampling and analytical methods used in each investigation. All of these metals are considered essential nutrients that play a key role in human physiological or biochemical processes. In addition, they are not CERCLA hazardous substances. The lack of screening criterion for these metals introduces uncertainty, but does not prevent the HHRA from being used for risk-based management decisions.

The COPCs for AOC 9 surface soil are aluminum, arsenic, iron, and thallium. The following factors were considered as part of the weight-of-evidence approach for determining the risk significance for the COPCs.

- Aluminum

  - Three of the four surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 14,000, 10,000, and 13,000 mg/kg; screening criterion: 7,700 mg/kg).

  - None of the four surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 99,000 mg/kg).

  - The mean background soil concentration was below the screening criteria adopted for all human receptors (mean background concentration: 5,650 mg/kg). The maximum detected background soil concentration was above the screening level selected for future residents and visitors/trespassers, but not for construction workers and employees (maximum detected background concentration: 16,200 mg/kg).

  - None of the four site surface soil samples had detected concentrations that exceeded the maximum background soil concentration.

- Four of the four site surface soil samples had detected concentrations that exceeded the mean background soil concentration.
- Aluminum is not defined as a hazardous substance under CERCLA.

Aluminum is not considered to present an unacceptable human health risk as AOC 9, because the maximum concentration is less than twice the most restrictive HHRA SL. As discussed earlier, the HHRA SL used for aluminum was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Arsenic
- Four of the four surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 5.6, 4.6, 2.4, and 7.6 mg/kg; screening criterion: 0.39 mg/kg).
- Four of the four surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 1.6 mg/kg).
- The mean background soil concentration exceeded the screening criteria adopted for all human receptors (mean background: 4.5 mg/kg). The minimum concentration detected in background soil was above the screening criterion used for future residents and visitors/trespassers but below the screening criterion used for construction workers and employees (minimum detected background: 0.93 mg/kg).
- None of the four site surface soil samples had detected concentrations that exceeded the maximum background soil concentration.
- Three of the four site surface soil samples had detected concentrations that exceeded the mean background soil concentration.

Arsenic is assumed to represent a potentially unacceptable risk for human receptors because of the frequency and magnitude by which site samples exceed both of the HHRA SLs.

- Iron
- Three of the four surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 7,700, 6,100, and 6,700 mg/kg; screening criterion: 5,500 mg/kg).

- None of the four surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 72,000 mg/kg).
- The mean background soil concentration did not exceed the screening criteria adopted for human receptor (mean background: 3,970 mg/kg). The maximum concentration detected in background soil was above the screening criterion adopted for future residents and visitors/trespassers, but below the screening criterion used for construction workers and employees (maximum detected background: 10,100 mg/kg).
- None of the four site surface soil samples had a detected concentration that exceeded the maximum background soil concentration.
- Four of the four site surface soil samples had detected concentrations that exceeded the mean background soil concentration.
- Iron is not defined as a hazardous substance under CERCLA.

Iron is not considered to present an unacceptable human health risk in AOC 9 surface soils, because the maximum concentration is only slightly elevated above the most restrictive HHRA SL. As discussed earlier, the HHRA SL used for iron was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Thallium
- Four of four surface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 0.09, 0.16, 0.13, 0.09 mg/kg; screening criterion: 0.078 mg/kg).
- None of the four surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 1.0 mg/kg).
- Thallium was not detected in background soil.

Thallium is not considered to present an unacceptable human health risk at AOC 9 surface soils, because the maximum concentration is only slightly greater than the most restrictive HHRA SL. The HHRA SL used for thallium was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

A total of four COPCs were identified for AOC 9 surface soils: aluminum, arsenic, iron and thallium. Aluminum, iron, and thallium are not considered to represent unacceptable human health risks, because maximum concentrations were only slightly elevated above the HHRA SLs even with the conservatism in the screening approach. Arsenic in surface soil is determined to represent a potentially unacceptable risk for human receptors at AOC 9 because of the magnitude and frequency with which HHRA SLs were exceeded. As discussed earlier, the site antimony data was not usable for the risk assessment, which does introduce uncertainties for the conclusions regarding risks to human receptors from AOC 9 surface soils. Because there is no specific list of MEC historically used and/or stored at AOC 9, it is not possible to determine to what extent FUDS activities would have included antimony. Ultimately, the presence of metals in AOC 9 soils, including antimony, may be from a non-munitions source; therefore, multiple lines of evidence are presented in Section 7 to determine the need for further action under this program.

AOC 9 SLERA: Surface Soil

5.6.1.5 As described above in Section 5.6.1.3, no explosive MCs were detected in the surface soil at AOC 9. The RLs for 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotluene, HMX, nitrobenzene, RDX, and tetryl were below the screening criteria selected for the SLERA, and confirm the ability of the analytical techniques to detect the MCs at levels sufficient to screen for unacceptable risks to ecological receptors.

No eco-SSL was available for 1,3,5-TNB, 1,3-DNB, or NG, so no definitive statement regarding the adequacy of the techniques utilized to detect these MCs at levels that may cause risks to ecological receptors can be made. 1,3,5-TNB, 1,3-DNB, and NG have relatively low K_{ows} (<2) (US NLM 2008, Talmage et al. 1999, USEPA 2011). In general, a K_{ow} <2 indicates inefficient partitioning into the lipid component of organisms and a low ability to bioconcentrate or biomagnify up the food chain (USEPA 2005a and USEPA 2008a). Based on the fact that 1,3,5-TNB, 1,3-DNB, and NG were not detected above their respective analytical RLs, and considering fate and transport characteristics, these MCs were not identified as COPECs in soil at AOC 9. This decision is not expected to introduce an unacceptable level of uncertainty into the SLERA. No explosive constituent COPECs were identified in surface soil at AOC 9.

5.6.1.6 As described in Section 5.6.1.4, with the exception of antimony and sodium, the full suite of metals analyzed were detected in surface soil at AOC 9. The maximum detected concentrations of aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, manganese, nickel, silver, and zinc were below their respective eco-SSLs and were therefore not

selected as COPECs. Maximum concentrations of lead, mercury, selenium and vanadium exceeded their respective eco-SSLs and were therefore selected as COPECs for AOC 9 surface soil.

All four surface samples collected yielded antimony results that were not usable for the purposes of the quantitative risk assessment, which introduces uncertainty into the risk assessment. No screening level is available for sodium; therefore, no conclusion can be made regarding the ability for the analytical techniques used to detect sodium at levels sufficient to screen for risks to ecological receptors can be made, and some uncertainty is introduced into the risk assessment.

No screening values were available for calcium, iron, magnesium, potassium, sodium and thallium and therefore no definitive statements regarding the risks to biota associated with exposure to these metals in surface soil can be made. All of these metals were elevated relative to maximum and/or mean background concentrations. The site and background sampling were conducted as separate investigations, which may introduce uncertainty related to the comparability of the sampling and analytical methods used in each investigation. Four of these metals are considered essential nutrients (i.e., calcium, iron, magnesium, and potassium). In addition, calcium, iron, magnesium and potassium are not CERCLA hazardous substances. The lack of screening criterion for these metals introduces uncertainty, but does not prevent the SLERA from being used for risk-based management decisions.

Based on the maximum concentrations in AOC 9 surface soil, the following COPECs have been identified: lead, mercury, selenium, and vanadium. Mercury in AOC 9 surface soils were not elevated relative to background; therefore, no additional risk to ecological receptors from exposure to mercury from FUDS-related activities was identified. The following factors were considered as part of the weight-of-evidence approach for determining the risk significance for the remaining COPECs in surface soil at AOC 9.

- Lead
  - Three of the four site surface soil samples had detected concentrations that exceeded the ecological screening value (maximum HQ, 1.5).
  - The mean background soil concentration was lower than the ecological screening value (mean background: 10.5 mg/kg). The maximum concentration detected in background soil was above the screening value (HQ, 2.5).

- None of the four site surface soil samples had a detected concentration that exceeded the maximum background concentration.
- Three of the four site surface soil samples had a detected concentration that exceeded the mean background concentration.

Lead is not likely to present an unacceptable risk to ecological receptors given the maximum concentration is only slightly elevated above the eco-SSL.

- Selenium
- Two of the four site surface soil samples had detected concentrations that exceeded the ecological screening value (maximum HQ, 1.4).
- The single detected concentration in background soil exceeded the ecological screening value (HQ, 1.4).
- None of the four site surface soil samples had a detected concentration that exceeded the single background concentration. The stated exceedance of background in Section 5.3.0.4 is heavily reliant on the RLs obtained for background.

Selenium is not likely to present an unacceptable risk to ecological receptors given the maximum concentration is only slightly elevated above the eco-SSL.

- Vanadium
- Four of the four site surface soil samples had detected concentrations that exceeded the ecological screening value (maximum HQ, 2.6).
- The mean and maximum background soil concentration exceeded the ecological screening value (HQ, 1.3 and 3.3, respectively).
- None of the four site surface soil samples had a detected concentration that exceeded the maximum background concentration.
- Four of the four site surface soil samples had a detected concentration that exceeded the mean background concentration.

Vanadium is considered to represent a potential risk to ecological receptors given the frequency and magnitude with which site concentrations exceed the eco-SSL and are elevated relative to background.

Four COPECs were identified for AOC 9 surface soils: lead, mercury, selenium, and vanadium. For mercury there is no additional risk from FUDS-related activities because the site soil concentrations were not elevated relative to background. Lead and selenium surface soil concentrations were elevated relative to background, however; the magnitude by which these COPECs exceeded their respective eco-SSLs was marginal. Therefore, unacceptable risks for ecological receptors are not expected for lead and selenium exposures to surface soils. Conversely, vanadium could represent an unacceptable risk for ecological receptors based on the magnitude and frequency with which the eco-SSL is exceeded by AOC 9 surface soil concentrations. No definitive statement regarding potential ecological risks from exposure to antimony in AOC 9 soil because of a lack of usable site data. To address this uncertainty in the risk assessment, multiple lines of evidence are presented in Section 7 to determine the need for further action under this program.

AOC 9 HHRA: Subsurface Soil

5.6.1.7 Incidental ingestion, dermal contact, and inhalation were identified as potentially complete transfer mechanisms for MCs in subsurface soils to future residents, visitors/trespassers, construction workers, and employees at AOC 9. Five subsurface soil samples (four site samples and one duplicate) were collected from this area. The sample was analyzed for the full suite of explosive constituents and metals specified in Section 5.4.0.1.

5.6.1.8 No explosive constituents were detected at concentrations above their respective RLs in subsurface soil at AOC 9. With the exception of NG, the RLs for all of the explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. The MQO for sensitivity was not met for NG and any reported non-detects do not demonstrate that the MC is present at concentrations less than the selected screening criterion. However, as described in Section 5.1.4.2, the RL for NG is determined to be adequate for the HHRA screening at the FNOD. No explosive constituent COPCs were identified in subsurface soils at AOC 9.

5.6.1.9. The full suite of metals analyzed, with the exception of silver, sodium, and antimony, were detected in subsurface soil at AOC 9. The maximum concentrations of barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc were their respective HHRA SLs and were therefore not considered COPCs. Maximum concentrations of aluminum, arsenic, iron, and thallium exceeded their respective HHRA SL and were selected as COPCs for AOC 9 subsurface soils. The site results for the

COPCs in AOC 9 subsurface soils, except arsenic, were determined to be elevated to the respective maximum and/or mean background concentrations.

For antimony, all five of the surface samples collected yielded results that were not usable for the purposes of the quantitative risk assessment, which introduces some uncertainty into the risk assessment. No human health screening level is available for sodium and therefore no conclusion can be made regarding the ability for the analytical techniques used to detect sodium at levels sufficient to screen for risks to human receptors can be made, and some uncertainty is introduced into the risk assessment.

No screening criterion were available for calcium, magnesium, and potassium; therefore, no definitive statements regarding the risks associated with exposure to these metals in surface soil can be made. All three of these metals were elevated relative to maximum and/or mean background concentrations. The site and background sampling were conducted as separate investigations, which may introduce uncertainty related to the comparability of the sampling and analytical methods used in each investigation. All of these metals are considered essential nutrients that play a key role in human physiological or biochemical processes. In addition, they are not CERCLA hazardous substances. The lack of screening criterion for these metals introduces uncertainty but does not prevent the HHRA from being used for risk-based management decisions.

The COPCs for AOC 9 subsurface soil are aluminum, arsenic, iron, and thallium. Arsenic concentrations in AOC 9 subsurface soils were not elevated relative to background; therefore, no additional risk to human receptors from exposure to arsenic from FUDS-related activities was indentified. The following factors were considered as part of the weight-of-evidence approach for determining the risk significance for the remaining COPCs.

- Aluminum

  - Five of the five subsurface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 15,000, 14,000, 11,000, 11,000, and 10,000 mg/kg; screening criterion: 7,700 mg/kg).

  - None of the five surface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 99,000 mg/kg).

  - The mean background soil concentration was below the screening criteria adopted for all human receptors (mean background concentration: 5,650 mg/kg). The maximum detected background soil concentration was above the screening level selected for future residents

and visitors/trespassers, but below the screening level for construction workers and employees (maximum detected background concentration: 16,200 mg/kg).

- None of the four site subsurface soil samples had detected concentrations that exceeded the maximum background soil concentration.
- Four of the four site subsurface soil samples had detected concentrations that exceeded the mean background soil concentration.
- Aluminum is not defined as a hazardous substance under CERCLA.

Aluminum is not considered to present an unacceptable human health risk as AOC 9, because the maximum concentration is less than twice the most restrictive HHRA SL. As discussed earlier, the HHRA SL used for aluminum was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Iron
- Five of the five subsurface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 7,600, 6,800, 6,000, 6,000, and 6,000 mg/kg; screening criterion: 5,500 mg/kg).
- None of the five subsurface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 72,000 mg/kg).
- The mean background soil concentration did not exceed the screening criteria adopted for human receptors (mean background: 3,970 mg/kg). The maximum concentration detected in background soil was above the screening criterion adopted for future residents and visitors/trespassers, but below the screening criterion used for construction workers and employees (maximum detected background: 10,100 mg/kg).
- None of the five site subsurface soil samples had detected concentrations that exceeded the maximum background soil concentration.
- Five of the five site surface soil samples had detected concentrations that exceeded the mean background soil concentration.
- Iron is not defined as a hazardous substance under CERCLA.

Iron is not considered to present an unacceptable human health risk in AOC 9 surface soils, because the maximum concentration is only slightly elevated above the most restrictive HHRA SL. As discussed earlier, the HHRA SL used for iron was reduced by a factor of ten to provide a

margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

- Thallium

  - Five of five subsurface soil samples had detected concentrations that exceeded the screening criterion selected for future residents and visitors/trespassers (site samples: 0.11, 0.13, 0.15, 0.12, 0.13 mg/kg; screening criterion: 0.078 mg/kg).

  - None of the five subsurface soil samples had detected concentrations that exceeded the screening criterion selected for construction workers and employees (screening criterion: 1.0 mg/kg).

  - Thallium was not detected in background soil.

Thallium is not considered to present an unacceptable human health risk at AOC 9 subsurface soils, because the maximum concentration is only slightly greater than the most restrictive HHRA SL. The HHRA SL used for thallium was reduced by a factor of ten to provide a margin of safety for simultaneous exposure to multiple non-carcinogenic compounds, which tends to overestimate risks in this instance.

Four COPCs were identified for AOC 9 subsurface soils: aluminum, arsenic, iron, and thallium. For arsenic, there is no additional risk from FUDS-related activities because the site subsurface soil concentrations were not elevated relative to background. Aluminum, iron, and thallium are not considered to represent unacceptable human health risks because maximum concentrations were only slightly elevated above the HHRA SLs despite the conservatism in the screening approach. No definitive statement regarding potential human health risks from exposure to antimony in AOC 9 subsurface soil because of a lack of usable site data. To address this uncertainty in the risk assessment, multiple lines of evidence are presented in Section 7 to determine the need for further action under this program.

5.6.2 Groundwater Pathway

5.6.2.1 Ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in groundwater to future residents, visitors/trespassers, construction workers, and employees at AOC 9. As described in Section 5.6.0.1, no groundwater samples were collected from AOC 9. The groundwater pathway therefore remains potentially complete for human receptors at AOC 9. While the groundwater pathway may be potentially complete for AOCs investigated during this SI, any evaluation of the groundwater pathway has been deferred

until completion of the ongoing Background Study. Therefore, no analyses of the groundwater pathway are presented in this SI Report.

Table 5-1 Summary of Soil Analytical Results

			Screening Levels Residential Soil Direct Contact [a,b]	Screening Levels Industrial Soil Direct Contact[a,b]	Interim Eco Screening Levels						
		Sample Name:				FNOD-AOC2-SS-01-01	FNOD-AOC2-SB-02-01	FNOD-AOC8-SS-01-01	FNOD-AOC8-SS-01-02	FNOD-AOC8-SS-01-03	FNOD-AOC8-SS-01-FD
		Sample Date:				3/22/2010	3/22/2010	3/22/2010	3/22/2010	3/22/2010	3/22/2010
		Parent Name:									FNOD-AOC8-SS-01-03
		AOC:				AOC 2	AOC 2	AOC 8	AOC 8	AOC 8	AOC 8
Analyte	**CAS**	**Unit**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**						
Explosives											
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	220	2,700	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,3-DINITROBENZENE	99-65-0	mg/kg	0.61	6.2	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	19	79	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	1.6	5.5	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,6-DINITROTOLUENE	606-20-2	mg/kg	6.1	62	30	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	15	200	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2-NITROTOLUENE	88-72-2	mg/kg	2.9	13	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
3-NITROTOLUENE	99-08-1	mg/kg	0.61	6.2	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	15	190	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
4-NITROTOLUENE	99-99-0	mg/kg	30	110	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
HMX	2691-41-0	mg/kg	380	4,900	100 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
NITROBENZENE	98-95-3	mg/kg	4.8	24	40 [d]	0.29 U	0.30 U	0.30 U	0.30 U	0.29 U	0.29 U
NITROGLYCERIN	55-63-0	mg/kg	0.61	6.2	NSL	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
RDX	121-82-4	mg/kg	5.6	24	100 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
TETRYL	479-45-8	mg/kg	24	250	25	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Metals											
ALUMINUM	7429-90-5	mg/kg	7,700	99,000	pH < 5.5 [e]	5,400.00	4,200.00	7,200.00	**9,600.00**	**12,000.00**	**11,000.00 J**
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27 [f]	0.03 L	-- R	0.04 L	-- R	-- R	-- R
ARSENIC	7440-38-2	mg/kg	0.39	1.6	18 [g]	**7.60**	**3.70**	**5.40**	**8.00**	**2.60**	**2.50**
BARIUM	7440-39-3	mg/kg	1,500	19,000	330 [h]	18.00	13.00	35.00	26.00	14.00	13.00
BERYLLIUM	7440-41-7	mg/kg	16	200	21 [i]	0.12	0.07 J	0.21	0.22	0.13	0.11
CADMIUM	7440-43-9	mg/kg	7.0	80	0.36 [j]	0.02 J	0.02 J	0.13 J	0.05 J	0.07 J	0.05 J
CALCIUM	7440-70-2	mg/kg	NSL	NSL	NSL	76.00 J	59.00 J	1,900.00	210.00	48.00 J	41.00 J
CHROMIUM	7440-47-3	mg/kg	12,000 [k]	150,000 [k]	26 [l]	4.90	3.70	8.50	9.60	13.00	13.00
COBALT	7440-48-4	mg/kg	2.3	30	13 [m]	0.62	0.43	1.10	0.91	1.10	1.10
COPPER	7440-50-8	mg/kg	310	4,100	28 [n]	6.80	3.40	11.00	4.00	3.00	3.10
IRON	7439-89-6	mg/kg	5,500	72,000	NSL	3,400.00	2,900.00	4,900.00	4,400.00	**6,700.00**	**6,800.00 J**
LEAD	7439-92-1	mg/kg	400	800	11 [o]	*15.00*	7.20	*15.00*	*31.00*	*100.00*	*100.00*
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	350.00	260.00	770.00	540.00	510.00	500.00
MANGANESE	7439-96-5	mg/kg	180	2,300	220 [p]	12.00	7.90	87.00	11.00	17.00	17.00 K
MERCURY	7439-97-6	mg/kg	1.00	4.3	0.10 [d]	0.07	0.03	0.08	0.04	0.02	0.02
NICKEL	7440-02-0	mg/kg	150	2,000	38 [q]	1.80	1.30	3.00	2.70	3.30	3.30
POTASSIUM	7440-09-7	mg/kg	NSL	NSL	NSL	260.00 J	190.00 J	640.00	520.00	500.00	470.00
SELENIUM	7782-49-2	mg/kg	39	510	0.52 [r]	0.18 J	0.27 J	0.71 U	0.27 J	0.56 U	0.56 U
SILVER	7440-22-4	mg/kg	39	510	4.2 [s]	0.03 J	0.11 U	0.03 J	0.11 U	0.11 U	0.11 U
SODIUM	7440-23-5	mg/kg	NSL	NSL	NSL	600.00 U	590.00 U	120.00 J	590.00 U	580.00 U	560.00 U
THALLIUM	7440-28-0	mg/kg	0.078	1	NSL	**0.12**	0.08 J	0.08 J	**0.09 J**	**0.10 J**	**0.09 J**
VANADIUM	7440-62-2	mg/kg	39.00	520.0	7.8 [t]	*10.00*	*8.10*	*11.00*	*12.00*	*22.00*	*21.00*
ZINC	7440-66-6	mg/kg	2,300	31,000	46 [u]	7.30	5.60	25.00	8.70	19.00	17.00

Table 5-1 Summary of Soil Analytical Results (continued)

			Screening Levels Residential Soil Direct Contact [a,b]	Screening Levels Industrial Soil Direct Contact [a,b]	Interim Eco Screening Levels						
Sample Name:						**FNOD-AOC8-SS-01-04**	**FNOD-AOC8-SS-01-05**	**FNOD-AOC8-SS-01-06**	**FNOD-AOC8-SS-01-07**	**FNOD-AOC8-SB-02-01**	**FNOD-AOC8-SB-02-02**
Sample Date:						**3/23/2010**	**3/23/2010**	**3/23/2010**	**3/23/2010**	**3/22/2010**	**3/22/2010**
Parent Name:											
AOC:						AOC 8	AOC 8	AOC 8	AOC 8	AOC 8	AOC 8
Analyte	**CAS**	**Unit**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**						
Explosives											
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	220	2,700	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,3-DINITROBENZENE	99-65-0	mg/kg	0.61	6.2	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	19	79	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	1.6	5.5	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,6-DINITROTOLUENE	606-20-2	mg/kg	6.1	62	30	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	15	200	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2-NITROTOLUENE	88-72-2	mg/kg	2.9	13	30 [c]	0.19 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
3-NITROTOLUENE	99-08-1	mg/kg	0.61	6.2	30 [c]	0.19 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	15	190	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
4-NITROTOLUENE	99-99-0	mg/kg	30	110	30 [c]	0.19 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
HMX	2691-41-0	mg/kg	380	4,900	100 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
NITROBENZENE	98-95-3	mg/kg	4.8	24	40 [d]	0.29 U	0.30 U	0.30 U	0.30 U	0.29 U	0.30 U
NITROGLYCERIN	55-63-0	mg/kg	0.61	6.2	NSL	1.90 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
RDX	121-82-4	mg/kg	5.6	24	100 [c]	0.19 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
TETRYL	479-45-8	mg/kg	24	250	25	0.19 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Metals											
ALUMINUM	7429-90-5	mg/kg	7,700	99,000	pH < 5.5 [e]	**8,800.00**	**11,000.00**	**13,000.00**	5,400.00	**11,000.00 J**	**19,000.00**
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27 [f]	-- R	-- R	0.03 L	0.20 L	-- R	0.04 L
ARSENIC	7440-38-2	mg/kg	0.39	1.6	18 [g]	**4.50**	**6.10**	***19.00***	**11.00**	**4.80**	**6.50**
BARIUM	7440-39-3	mg/kg	1,500	19,000	330 [h]	26.00	38.00	83.00	52.00	21.00	34.00
BERYLLIUM	7440-41-7	mg/kg	16	200	21 [i]	0.14	0.20	0.53	0.32	0.25	0.24
CADMIUM	7440-43-9	mg/kg	7.0	80	0.36 [j]	0.08 J	0.05 J	0.16	0.21	0.08 J	0.11
CALCIUM	7440-70-2	mg/kg	NSL	NSL	NSL	340.00	350.00	560.00	1,000.00	440.00	320.00
CHROMIUM	7440-47-3	mg/kg	12,000 [k]	150,000 [k]	26 [l]	9.30	12.00	16.00	5.70	12.00	19.00
COBALT	7440-48-4	mg/kg	2.3	30	13 [m]	1.10	1.50	2.20	**2.50**	1.10	1.50
COPPER	7440-50-8	mg/kg	310	4,100	28 [n]	7.60	4.10	15.00	*52.00*	6.50	6.40
IRON	7439-89-6	mg/kg	5,500	72,000	NSL	5,400.00	**6,100.00**	4,700.00	**12,000.00**	**7,400.00 J**	**8,600.00**
LEAD	7439-92-1	mg/kg	400	800	11 [o]	*22.00*	9.20	*22.00*	*200.00*	8.90	12.00
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	620.00	710.00	860.00	750.00	760.00	870.00
MANGANESE	7439-96-5	mg/kg	180	2,300	220 [p]	22.00	43.00	**210.00**	160.00	29.00	14.00
MERCURY	7439-97-6	mg/kg	1.00	4.3	0.10 [d]	0.04	*0.16*	*0.13*	0.04	0.03	0.06
NICKEL	7440-02-0	mg/kg	150	2,000	38 [q]	2.90	4.10	6.00	2.90	3.40	4.80
POTASSIUM	7440-09-7	mg/kg	NSL	NSL	NSL	480.00	570.00	530.00	490.00	830.00	880.00
SELENIUM	7782-49-2	mg/kg	39	510	0.52 [r]	0.17 J	0.37 J	*0.88*	0.48 J	0.52 U	0.29 J
SILVER	7440-22-4	mg/kg	39	510	4.2 [s]	0.09 J	0.11 U	0.04 J	0.56	0.02 J	0.03 J
SODIUM	7440-23-5	mg/kg	NSL	NSL	NSL	550.00 U	490.00 U	630.00 U	580.00 U	550.00 U	600.00 U
THALLIUM	7440-28-0	mg/kg	0.078	1	NSL	**0.10**	**0.11**	**0.16**	**0.27**	0.08 J	**0.16**
VANADIUM	7440-62-2	mg/kg	39.00	520.0	7.8 [t]	*12.00*	*16.00*	*14.00*	*11.00*	16.00	25.00
ZINC	7440-66-6	mg/kg	2,300	31,000	46 [u]	17.00	12.00	27.00	*85.00*	12.00	13.00

Table 5-1 Summary of Soil Analytical Results (continued)

			Screening Levels Residential Soil Direct Contact [a,b]	Screening Levels Industrial Soil Direct Contact[a,b]	Interim Eco Screening Levels						
Sample Name:						FNOD-AOC8-SB-02-03	FNOD-AOC8-SB-02-04	FNOD-AOC8-SB-02-05	FNOD-AOC8-SB-02-06	FNOD-AOC8-SB-02-07	FNOD-AOC9-SS-01-01
Sample Date:						3/22/2010	3/23/2010	3/23/2010	3/23/2010	3/23/2010	3/22/2010
Parent Name:											
AOC:						AOC 8	AOC 8	AOC 8	AOC 8	AOC 8	AOC 9
Analyte	**CAS**	**Unit**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**						
Explosives											
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	220	2,700	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,3-DINITROBENZENE	99-65-0	mg/kg	0.61	6.2	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	19	79	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	1.6	5.5	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,6-DINITROTOLUENE	606-20-2	mg/kg	6.1	62	30	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 UL
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	15	200	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2-NITROTOLUENE	88-72-2	mg/kg	2.9	13	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.19 U
3-NITROTOLUENE	99-08-1	mg/kg	0.61	6.2	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.19 U
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	15	190	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 UL
4-NITROTOLUENE	99-99-0	mg/kg	30	110	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.19 UL
HMX	2691-41-0	mg/kg	380	4,900	100 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
NITROBENZENE	98-95-3	mg/kg	4.8	24	40 [d]	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U	0.29 U
NITROGLYCERIN	55-63-0	mg/kg	0.61	6.2	NSL	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	1.90 U
RDX	121-82-4	mg/kg	5.6	24	100 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.19 U
TETRYL	479-45-8	mg/kg	24	250	25	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.19 U
Metals											
ALUMINUM	7429-90-5	mg/kg	7,700	99,000	pH < 5.5 [e]	**9,500.00**	6,500.00	**14,000.00**	**10,000.00 J**	5,800.00 J	6,800.00 J
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27 [f]	0.02 L	0.02 L	-- R	0.02 L	0.20 L	-- R
ARSENIC	7440-38-2	mg/kg	0.39	1.6	18 [g]	**2.00**	**6.40**	**4.90**	**11.00**	**14.00**	**5.60**
BARIUM	7440-39-3	mg/kg	1,500	19,000	330 [h]	13.00	26.00	42.00	72.00	150.00	28.00
BERYLLIUM	7440-41-7	mg/kg	16	200	21 [i]	0.12	0.17	0.27	0.40	0.34	0.22
CADMIUM	7440-43-9	mg/kg	7.0	80	0.36 [j]	0.07 J	0.08 J	0.09 J	0.10 J	1.00	0.09 J
CALCIUM	7440-70-2	mg/kg	NSL	NSL	NSL	77.00 J	260.00	420.00	320.00	390.00	610.00
CHROMIUM	7440-47-3	mg/kg	12,000 [k]	150,000 [k]	26 [l]	11.00	9.10	15.00	10.00	13.00	11.00
COBALT	7440-48-4	mg/kg	2.3	30	13 [m]	1.10	1.10	2.00	1.80	**3.30**	2.00
COPPER	7440-50-8	mg/kg	310	4,100	28 [n]	2.50 J	7.10	4.30	7.60	220.00	8.40
IRON	7439-89-6	mg/kg	5,500	72,000	NSL	**5,600.00**	4,900.00	**7,500.00**	3,500.00 J	**23,000.00 J**	4,900.00 J
LEAD	7439-92-1	mg/kg	400	800	11 [o]	200.00	17.00	13.00	9.50	320.00	*15.00*
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	440.00	460.00	790.00	760.00	460.00	500.00
MANGANESE	7439-96-5	mg/kg	180	2,300	220 [p]	17.00	31.00	36.00	110.00 K	**510.00 K**	68.00 K
MERCURY	7439-97-6	mg/kg	1.00	4.3	0.10 [d]	0.02	0.05	0.05	0.06	0.07	0.09
NICKEL	7440-02-0	mg/kg	150	2,000	38 [q]	2.90	2.70	5.30	5.40	3.60	3.80
POTASSIUM	7440-09-7	mg/kg	NSL	NSL	NSL	420.00	470.00	600.00	420.00	330.00 J	460.00
SELENIUM	7782-49-2	mg/kg	39	510	0.52 [r]	0.39 J	0.23 J	0.46 J	0.75 B	0.47 B	*0.53 B*
SILVER	7440-22-4	mg/kg	39	510	4.2 [s]	0.11 U	0.09 J	0.02 J	0.04 J	3.50	0.02 J
SODIUM	7440-23-5	mg/kg	NSL	NSL	NSL	510.00 U	570.00 U	550.00 U	580.00 U	570.00 U	620.00 U
THALLIUM	7440-28-0	mg/kg	0.078	1	NSL	0.08 J	**0.11**	**0.12**	**0.15**	**0.71**	**0.09 J**
VANADIUM	7440-62-2	mg/kg	39.00	520.0	7.8 [t]	16.00	12.00	20.00	11.00	33.00	*13.00*
ZINC	7440-66-6	mg/kg	2,300	31,000	46 [u]	20.00	18.00	12.00	20.00	250.00	21.00

Table 5-1 Summary of Soil Analytical Results (continued)

			Screening Levels Residential Soil Direct Contact [a,b]	Screening Levels Industrial Soil Direct Contact [a,b]	Interim Eco Screening Levels								
Sample Name:						**FNOD-AOC9-SS-01-02**	**FNOD-AOC9-SS-01-03**	**FNOD-AOC9-SS-01-04**	**FNOD-AOC9-SB-02-01**	**FNOD-AOC9-SB-02-02**	**FNOD-AOC9-SB-02-03**	**FNOD-AOC9-SB-02-FD**	**FNOD-AOC9-SB-02-04**
Sample Date:						**3/22/2010**	**3/22/2010**	**3/22/2010**	**3/22/2010**	**3/22/2010**	**3/22/2010**	**3/22/2010**	**3/22/2010**
Parent Name:												**FNOD-AOC9-SB-02-03**	
AOC:						AOC 9	AOC 9	AOC 9	AOC 9	AOC 9	AOC 9	AOC 9	AOC 9
Analyte	**CAS**	**Unit**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**								
Explosives													
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	220	2,700	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,3-DINITROBENZENE	99-65-0	mg/kg	0.61	6.2	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	19	79	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	1.6	5.5	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2,6-DINITROTOLUENE	606-20-2	mg/kg	6.1	62	30	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	15	200	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
2-NITROTOLUENE	88-72-2	mg/kg	2.9	13	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
3-NITROTOLUENE	99-08-1	mg/kg	0.61	6.2	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	15	190	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
4-NITROTOLUENE	99-99-0	mg/kg	30	110	30 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
HMX	2691-41-0	mg/kg	380	4,900	100 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
NITROBENZENE	98-95-3	mg/kg	4.8	24	40 [d]	0.29 U	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U
NITROGLYCERIN	55-63-0	mg/kg	0.61	6.2	NSL	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
RDX	121-82-4	mg/kg	5.6	24	100 [c]	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
TETRYL	479-45-8	mg/kg	24	250	25	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Metals													
ALUMINUM	7429-90-5	mg/kg	7,700	99,000	pH < 5.5 [e]	**14,000.00 J**	**10,000.00 J**	**13,000.00 J**	**15,000.00 J**	**14,000.00 J**	**11,000.00 J**	**11,000.00 J**	**10,000.00 J**
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27 [f]	-- R	-- R	-- R	-- R	-- R	-- R	-- R	-- R
ARSENIC	7440-38-2	mg/kg	0.39	1.6	18 [g]	**4.60**	**2.40**	**7.60**	**3.90**	**3.30**	**2.50**	**2.20**	**7.70**
BARIUM	7440-39-3	mg/kg	1,500	19,000	330 [h]	43.00	43.00	35.00	27.00	45.00	57.00	48.00	47.00
BERYLLIUM	7440-41-7	mg/kg	16	200	21 [i]	0.25	0.26	0.31	0.26	0.31	0.36	0.28	0.28
CADMIUM	7440-43-9	mg/kg	7.0	80	0.36 [j]	0.06 J	0.07 J	0.06 J	0.09 J	0.06 J	0.08 J	0.08 J	0.09 J
CALCIUM	7440-70-2	mg/kg	NSL	NSL	NSL	230.00	220.00	470.00	540.00	200.00	190.00	200.00	290.00
CHROMIUM	7440-47-3	mg/kg	12,000 [k]	150,000 [k]	26 [l]	13.00	11.00	12.00	13.00	14.00	13.00	12.00	14.00
COBALT	7440-48-4	mg/kg	2.3	30	13 [m]	1.60	1.50	1.40	1.80	1.80	2.00	1.70	1.80
COPPER	7440-50-8	mg/kg	310	4,100	28 [n]	7.60	2.60	11.00	6.00	5.80	2.80 J	2.40 J	8.40
IRON	7439-89-6	mg/kg	5,500	72,000	NSL	**7,700.00 J**	**6,100.00 J**	**6,700.00 J**	**7,600.00 J**	**6,800.00 J**	**6,000.00 J**	**6,000.00 J**	**6,000.00 J**
LEAD	7439-92-1	mg/kg	400	800	11 [o]	*16.00*	10.00	*15.00*	35.00	13.00	10.00	9.00	12.00
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	780.00	650.00	730.00	770.00	710.00	630.00	710.00	570.00
MANGANESE	7439-96-5	mg/kg	180	2,300	220 [p]	29.00 K	23.00 K	73.00 K	38.00 K	23.00 K	32.00 K	27.00 K	50.00 K
MERCURY	7439-97-6	mg/kg	1.00	4.3	0.10 [d]	0.06	0.03	*0.12*	0.03	0.05	0.03	0.02	0.13
NICKEL	7440-02-0	mg/kg	150	2,000	38 [q]	5.00	4.40	3.20	4.20	5.00	5.00	4.20	5.10
POTASSIUM	7440-09-7	mg/kg	NSL	NSL	NSL	520.00	410.00	710.00	800.00	520.00	400.00	440.00	370.00
SELENIUM	7782-49-2	mg/kg	39	510	0.52 [r]	*0.71 B*	0.44 B	0.27 B	0.22 B	0.58 B	0.88 B	0.64 B	0.44 B
SILVER	7440-22-4	mg/kg	39	510	4.2 [s]	0.03 J	0.10 U	0.02 J	0.10 U	0.11 U	0.12 U	0.11 U	0.12 U
SODIUM	7440-23-5	mg/kg	NSL	NSL	NSL	530.00 U	590.00 U	540.00 U	520.00 U	540.00 U	540.00 U	530.00 U	570.00 U
THALLIUM	7440-28-0	mg/kg	0.078	1	NSL	**0.16**	**0.13**	**0.09 J**	**0.11**	**0.13**	**0.15**	**0.12**	**0.13**
VANADIUM	7440-62-2	mg/kg	39.00	520.0	7.8 [t]	*20.00*	*17.00*	*11.00*	16.00	19.00	20.00	17.00	18.00
ZINC	7440-66-6	mg/kg	2,300	31,000	46 [u]	15.00	12.00	13.00	14.00	13.00	12.00	11.00	16.00

Table 5-1 Summary of Soil Analytical Results (continued)

[a] Screening levels for residential and industrial soils are derived from USEPA (2011) Regional Screening Levels. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Accessed September 2011.

[b] For non-carcinogens, with the exception of lead, screening levels were divided by 10 to account for potential exposure to multiple non-carcinogens. No adjustment was made for carcinogens.

[c] Talmage et al. 1999. Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, M. Cretella, P.H. Reno, and F.B. Daniel. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.

[d] Efroymson et al. 1997a. Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997. Toxicological benchmarks for contaminants of potential concern for effects on soil and litter invertebrates and heterotrophic processes: 1997 revision. ES/ER/TM-126/R2. U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN.

[e] USEPA. 2003. Ecological Soil Screening Level for Aluminum. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_aluminum.pdf. Accessed 15 July 2008.

[f] USEPA. 2005b. Ecological Soil Screening Level for Antimony. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_antimony.pdf. Accessed 15 July 2008.

[g] USEPA. 2005c. Ecological Soil Screening Level for Arsenic. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_arsenic.pdf. Accessed 15 July 2008.

[h] USEPA. 2005d. Ecological Soil Screening Level for Barium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_barium.pdf. Accessed 15 July 2008.

[i] USEPA. 2005e. Ecological Soil Screening Level for Beryllium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_beryllium.pdf. Accessed 8 June 2009.

[j] USEPA. 2005f. Ecological Soil Screening Level for Cadmium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_cadmium.pdf. Accessed 8 June 2009.

[k] Basis for value is Chromium III

[l] Basis for value is Chromium III. USEPA. 2008b. Ecological Soil Screening Level for Chromium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_chromium.pdf. Accessed 15 July 2008.

[m] USEPA. 2005g. Ecological Soil Screening Level for Cobalt. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_cobalt.pdf. Accessed 12 July 2010.

[n] USEPA. 2007a. Ecological Soil Screening Level for Copper. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf. Accessed 15 July 2008.

[o] USEPA. 2005h. Ecological Soil Screening Level for Lead. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf. Accessed 15 July 2008.

[p] USEPA. 2007b. Ecological Soil Screening Levels for Manganese. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_manganese.pdf

[q] USEPA. 2007c. Ecological Soil Screening Level for Nickel. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_nickel.pdf. Accessed 15 July 2008.

[r] USEPA. 2007d. Ecological Soil Screening Level for Selenium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_selenium.pdf. Accessed 10 December 2009.

[s] USEPA. 2006. Ecological Soil Screening Level for Silver. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_silver.pdf. Accessed 10 December 2009.

[t] USEPA. 2005i. Ecological Soil Screening Level for Vanadium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_vanadium.pdf. Accessed 10 December 2009.

[u] USEPA. 2007e. Ecological Soil Screening Level for Zinc. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_zinc.pdf. Accessed 8 June 2009.

AOC = Area of Concern.
B = The analyte was found in the associated method blank at a level that is similar to the sample result.
CAS = Chemical Abstract Service.
J = The associated value is an estimated quantity.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
L = The analyte is present. The reported values may be biased low. The actual value is expected to be higher than reported.
mg/kg = Milligram per kilogram.
NSL = No screening level.
R = The data are unusable. (Note: The analyte may or may not be present).
U = The analyte was analyzed form but was not detected above the method reporting limit.
UL = The analyte was not detected, and the reported quanititation limit is probably higher than reported.
USEPA = United States Environmental Protection Agency.
-- = Not analyzed.

Non-detected concentrations are method reporting limits.
Screening level exceedances were only identified for receptors for which the medium had a potentially completed pathway identified in the SS-WP Addendum.

Shaded and bold values represent detected values that exceed human health screening criteria.
Shaded and italicized values represent detected values that exceed ecological screening criteria.
Shaded and bold italicized values represent detected values that exceed human health and ecological screening criteria.

Table 5-2 Summary of Sediment Analytical Results

Analyte	CAS	Unit	Screening Levels Residential Sediment Direct Contact [a,b] (mg/kg)	Screening Levels Industrial Sediment Direct Contact [a,b] (mg/kg)	Interim Eco Screening Levels [c] (mg/kg)	FNOD-AOC2-SD-01-01 3/23/2010 AOC 2	FNOD-AOC2-SD-01-02 3/23/2010 AOC 2	FNOD-AOC2-SD-01-FD 3/23/2010 FNOD-AOC2-SD-01-02 AOC 2	FNOD-BG-SD-01-01 3/23/2010	FNOD-BG-SD-01-02 3/23/2010
Explosives										
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	2,200	27,000	0.0024 [d]	0.10 U	0.10 U	0.10 U	--	--
1,3-DINITROBENZENE	99-65-0	mg/kg	6.1	62	0.0067 [d]	0.10 U	0.10 U	0.10 U	--	--
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	190	790	30 [d]	0.10 U	0.10 U	0.10 U	--	--
2,4-DINITROTOLUENE	121-14-2	mg/kg	16	55	30 [d]	0.10 U	0.10 U	0.10 U	--	--
2,6-DINITROTOLUENE	606-20-2	mg/kg	61	620	30 [d]	0.10 U	0.10 U	0.10 U	--	--
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	150	2,000	80 [d]	0.10 U	0.10 U	0.10 U	--	--
2-NITROTOLUENE	88-72-2	mg/kg	29	130	30 [d]	0.20 U	0.20 U	0.20 U	--	--
3-NITROTOLUENE	99-08-1	mg/kg	6.1	62	30 [d]	0.20 U	0.20 U	0.20 U	--	--
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	150	1,900	80 [d]	0.10 U	0.10 U	0.10 U	--	--
4-NITROTOLUENE	99-99-0	mg/kg	300	1,100	30 [d]	0.20 U	0.20 U	0.20 U	--	--
HMX	2691-41-0	mg/kg	3,800	49,000	100 [d]	0.10 U	0.10 U	0.10 U	--	--
NITROBENZENE	98-95-3	mg/kg	48	240	0.021 [e]	0.29 U	0.30 U	0.30 U	--	--
NITROGLYCERIN	55-63-0	mg/kg	6.1	62	NSL	2.00 U	2.00 U	2.00 U	--	--
RDX	121-82-4	mg/kg	56	240	100 [d]	0.20 U	0.20 U	0.20 U	--	--
TETRYL	479-45-8	mg/kg	240	2,500	25 [d]	0.20 U	0.20 U	0.20 U	--	--
Metals										
ALUMINUM	7429-90-5	mg/kg	77,000	990,000	58,000 [f]	6,600.00	16,000.00	13,000.00 J	7,000.00 J	4,300.00 J
ANTIMONY	7440-36-0	mg/kg	31	410	2.0 [g]	-- R	-- R	-- R	0.09 L	-- R
ARSENIC	7440-38-2	mg/kg	3.9	16	8.2 [h]	3.90	**7.60**	**7.40**	3.20	2.70
BARIUM	7440-39-3	mg/kg	15,000	190,000	330 [i]	9.30	26.00	24.00	66.00	31.00
BERYLLIUM	7440-41-7	mg/kg	160	2,000	21 [j]	0.30	0.52	0.46	0.21	0.22
CADMIUM	7440-43-9	mg/kg	70	800	1.2 [h]	0.14	0.26	0.19	0.19	0.07 J
CALCIUM	7440-70-2	mg/kg	NSL	NSL	NSL	560.00	1,000.00	1,100.00	1,700.00	570.00
CHROMIUM	7440-47-3	mg/kg	120,000 [k]	1,500,000 [k]	43 [e,l]	9.80	24.00	21.00	16.00	6.60
COBALT	7440-48-4	mg/kg	23	300	50 [e]	2.10	4.10	3.60	1.50	0.79
COPPER	7440-50-8	mg/kg	3,100	41,000	34 [f]	6.40	*39.00*	*43.00*	*62.00*	7.00
IRON	7439-89-6	mg/kg	55,000	720,000	20,000 [m]	9,600.00	*40,000.00*	16,000.00 J	4,800.00 J	2,700.00 J
LEAD	7439-92-1	mg/kg	400	800	36 [l]	13.00	*39.00*	*46.00*	*240.00*	*44.00*
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	1,500.00	3,000.00	2,700.00	1,700.00	770.00
MANGANESE	7439-96-5	mg/kg	1,800	23,000	460 [m]	52.00	98.00	82.00 K	33.00 K	14.00 K
MERCURY	7439-97-6	mg/kg	10.0	43	0.15 [h]	0.04	0.09	0.10	*0.46*	*0.72*
NICKEL	7440-02-0	mg/kg	1,500	20,000	21 [h]	4.60	9.90	9.10	6.20	2.50
POTASSIUM	7440-09-7	mg/kg	NSL	NSL	NSL	1,100.00	2,300.00	2,100.00	810.00	490.00
SELENIUM	7782-49-2	mg/kg	390	5,100	1.0 [e]	0.71 U	0.50 J	0.66 B	0.39 B	0.35 B
SILVER	7440-22-4	mg/kg	390	5,100	1.0 [h]	0.03 J	0.07 J	0.07 J	0.21	0.04 J
SODIUM	7440-23-5	mg/kg	NSL	NSL	NSL	3,000.00	4,200.00	3,600.00	3,100.00	1,500.00
THALLIUM	7440-28-0	mg/kg	0.78	10.00	NSL	0.07 J	0.15 J	0.14 J	0.07 J	0.05 J
VANADIUM	7440-62-2	mg/kg	390.0	5,200	57 [e]	14.00	34.00	30.00	14.00	9.50
ZINC	7440-66-6	mg/kg	23,000	310,000	121 [l]	38.00	66.00	72.00	*140.00*	73.00

[a] Screening levels for residential and industrial sediments are derived from USEPA (2011) Regional Screening Levels. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Accessed September 2011.
[b] For non-carcinogens, with the exception of lead, screening levels for soils were divided by 10 to account for potential exposure to multiple non-carcinogens. No initial adjustment was made for carcinogens. The resulting values were multiplied by 10 to account for reduced exposures to sediment compared to soil. No adjustments were made for lead.
[c] Ecological screening levels are for marine environments, except for aluminum, chromium, cobalt, iron, lead, manganese, and zinc. Marine screening levels for aluminum, chromium, cobalt, iron, lead, manganese, and zinc were not available; freshwater screening levels were adopted.
[d] Talmage et al. 1999. Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, M. Cretella, P.H. Reno, and F.B. Daniel. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.
[e] Buchman, M.F. 2008. Screening Quick Reference Tables (SQuiRTs), NOAA OR&R Report 08-1, Seattle, WA, Office of Response and Restoration Division, National Oceanographic and Atmospheric Administration. 34p.
[f] USEPA. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod Hyalella azteca and the midge Chironomus riparius. EPA 905/R96/008. U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago, IL.
[g] Long, E.R., and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program. NOAA Technical Memorandum NOS OMA 52.
[h] Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Caulder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environ. Manage. 19: 81-97.
[i] USEPA. 2005d. Ecological Soil Screening Level for Barium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_barium.pdf. Accessed 15 July 2008.
[j] USEPA. 2005e. Ecological Soil Screening Level for Beryllium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_beryllium.pdf. Accessed 8 June 2009.
[k] Basis for value is Chromium III.
[l] MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.
[m] Persaud, D. , R. Jaagumagi, and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment and Energy. August. ISBN 0-7729-9248-7.

AOC = Area of Concern.
B = The analyte was found in the associated method blank at a level that is similar to the sample result.
CAS = Chemical Abstract Service.
J = The associated value is an estimated quantity.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
L = The analyte is present. The reported values may be biased low. The actual value is expected to be higher than reported.
mg/kg = Milligram per kilogram.
NSL = No screening level.
R = The data are unusable. (Note: The analyte may or may not be present).
U = The analyte was analyzed form but was not detected above the method reporting limit.
USEPA = United States Environmental Protection Agency.
-- = Not analyzed.

Non-detected concentrations are method reporting limits.
Screening level exceedances were only identified for receptors for which the medium had a potentially completed pathway identified in the SS-WP Addendum.

Shaded and bold values represent detected values that exceed human health screening criteria.
Shaded and italicized values represent detected values that exceed ecological screening criteria.
Shaded and bold italicized values represent detected values that exceed human health and ecological screening criteria.

Table 5-3 Summary of Surface Water Analytical Results

Analyte	CAS	Unit	Screening Levels Human Health Direct Contact [a,b] (µg/L)	Interim Eco Screening Levels [c] (µg/L)	Sample Name: FNOD-AOC2-SW-00-01 Sample Date: 3/23/2010 Parent Name: AOC: AOC 2	Sample Name: FNOD-AOC2-SW-00-FD Sample Date: 3/23/2010 Parent Name: FNOD-AOC2-SW-00-01 AOC: AOC 2	Sample Name: FNOD-AOC2-SW-00-02 Sample Date: 3/23/2010 Parent Name: AOC: AOC 2	Sample Name: FNOD-BG-SW-00-01 Sample Date: 3/23/2010 Parent Name: AOC:	Sample Name: FNOD-BG-SW-00-02 Sample Date: 3/23/2010 Parent Name: AOC:
Explosives									
1,3,5-TRINITROBENZENE	99-35-4	µg/L	1,100	11 [d]	1.10 UJ	1.00 U	1.00 U	--	--
1,3-DINITROBENZENE	99-65-0	µg/L	3.7	20 [d]	0.43 UJ	0.41 U	0.40 U	--	--
2,4,6-TRINITROTOLUENE	118-96-7	µg/L	22	90 [d]	0.43 UJ	0.41 U	0.40 U	--	--
2,4-DINITROTOLUENE	121-14-2	µg/L	2.2	310 [e]	0.43 UJ	0.41 U	0.40 U	--	--
2,6-DINITROTOLUENE	606-20-2	µg/L	37	310 [e]	0.22 UJ	0.20 U	0.20 U	--	--
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	µg/L	73	20 [d]	0.22 UJ	0.20 U	0.20 U	--	--
2-NITROTOLUENE	88-72-2	µg/L	3.1	440 [f]	0.43 UJ	0.41 U	0.40 U	--	--
3-NITROTOLUENE	99-08-1	µg/L	3.7	375 [f]	0.43 UJ	0.41 U	0.40 U	--	--
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	µg/L	73	20 [d]	0.22 UJ	0.20 U	0.20 U	--	--
4-NITROTOLUENE	99-99-0	µg/L	42	950 [f]	1.10 UJ	1.00 U	1.00 U	--	--
HMX	2691-41-0	µg/L	1,800	330 [d]	0.43 UJ	0.41 U	0.40 U	--	--
NITROBENZENE	98-95-3	µg/L	1.2	67 [e]	0.43 UJ	0.41 U	0.40 U	--	--
NITROGLYCERIN	55-63-0	µg/L	3.7	69 [f]	3.30 UJ	3.10 U	3.00 U	--	--
RDX	121-82-4	µg/L	6.1	190 [d]	0.22 UJ	0.20 U	0.20 U	--	--
TETRYL	479-45-8	µg/L	150	NSL	0.26 UJ	0.25 U	0.24 U	--	--
Metals									
ALUMINUM	7429-90-5	µg/L	37,000	87 [g]	*2,500.00 J*	*380.00 J*	*500.00 K*	*2,500.00 J*	*600.00 J*
ANTIMONY	7440-36-0	µg/L	15	30 [h]	1.20 J	30.00 U	60.00 U	0.58 J	0.42 J
ARSENIC	7440-38-2	µg/L	0.45	36 [g]	**4.50 J**	**2.60 J**	**2.60 J**	**4.30 J**	**2.60 J**
BARIUM	7440-39-3	µg/L	7,300	4.0 [i]	*57.00*	*38.00*	*34.00*	*51.00*	*47.00*
BERYLLIUM	7440-41-7	µg/L	73	0.66 [i]	10.00 U	5.00 U	10.00 U	5.00 U	5.00 U
CADMIUM	7440-43-9	µg/L	18	8.8 [g]	10.00 U	5.00 U	10.00 U	5.00 U	5.00 U
CALCIUM	7440-70-2	µg/L	NSL	120,000 [i]	*160,000.00*	*150,000.00*	*150,000.00*	110,000.00	*140,000.00*
CHROMIUM	7440-47-3	µg/L	55,000 [j]	74 [g,j]	8.20 J	2.50 J	100.00 U	6.60 J	2.90 J
COBALT	7440-48-4	µg/L	11	23 [i]	1.20 J	0.36 J	0.39 J	1.20 J	0.48 J
COPPER	7440-50-8	µg/L	1,500	3.1 [g]	20.00 U	*3.90 J*	20.00 U	*7.10 J*	*5.20 J*
IRON	7439-89-6	µg/L	26,000	1,000 [g]	*3,900.00 J*	560.00 J	700.00	*3,600.00*	870.00
LEAD	7439-92-1	µg/L	15	8.1 [g]	4.70 J	15.00 U	30.00 U	5.50 J	1.10 J
MAGNESIUM	7439-95-4	µg/L	NSL	82,000 [i]	*450,000.00*	*440,000.00*	*440,000.00*	*280,000.00*	*410,000.00*
MANGANESE	7439-96-5	µg/L	880	120 [i]	*180.00*	120.00	100.00 J	*140.00*	120.00
MERCURY	7439-97-6	µg/L	0.63	0.94 [g]	0.06 B	0.04 B	0.04 B	0.06 B	0.04 B
NICKEL	7440-02-0	µg/L	730	8.2 [g]	4.00 J	1.80 J	4.10 J	3.30 J	2.20 J
POTASSIUM	7440-09-7	µg/L	NSL	53,000 [i]	*150,000.00*	*150,000.00*	*150,000.00*	*100,000.00*	*140,000.00*
SELENIUM	7782-49-2	µg/L	180	71 [g]	50.00 U	25.00 U	50.00 U	5.00 J	3.50 J
SILVER	7440-22-4	µg/L	180	0.36 [j]	*0.38 J*	25.00 U	50.00 U	0.10 J	25.00 U
SODIUM	7440-23-5	µg/L	NSL	680,000 [i]	*4,100,000.00*	*3,900,000.00*	*3,900,000.00 J*	*2,600,000.00*	*3,600,000.00*
THALLIUM	7440-28-0	µg/L	0.37	12 [i]	0.25 J	5.00 U	10.00 U	5.00 U	5.00 U
VANADIUM	7440-62-2	µg/L	180.0	20 [i]	7.70 J	2.30 J	2.90 J	8.40 J	2.90 J
ZINC	7440-66-6	µg/L	11,000	81 [g]	21.00 J	100.00 U	200.00 U	20.00 J	100.00 U

[a] Human health screening levels for surface water are derived from USEPA (2011) Regional Screening Levels. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Accessed September 2011.

[b] For non-carcinogens, with the exception of lead, screening levels for tap water were divided by 10 to account for potential exposure to multiple non-carcinogens. The resulting values were multiplied by 10 to account for reduced exposures to surface water compared to tap water. No adjustments were made for lead.

[c] Ecological screening levels are for marine environments, except for the following analytes:
- All explosives except nitrobenzene
- Aluminum, antimony, barium, beryllium, calcium, chromium, cobalt, iron, magnesium, manganese, potassium, silver, sodium, thallium, and vanadium

Marine screening levels for the analytes listed above were not available; freshwater screening levels were applied.

[d] Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, M. Cretella, P.H. Reno, and F.B. Daniel. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.

[e] USEPA. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated November 30, 2001: http://www.epa.gov/region4/waste/ots/ecolbul.htm

[f] TNRCC (Texas Natural Resources Conservation Commission). 2006. Guidance for conducting ecological risk assessments at remediation sites in Texas. RG-263. January 2006 version. 83 pp.

[g] USEPA. 2009. National recommended water quality criteria. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, DC.

[h] Ambient water quality criteria for antimony (III). Draft. August 30th, 1988. U.S. Environmental Protection Agency, Washington, DC.

[i] Suter, G. and C. Tsao. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota: 1996 revision. ES/ER/TM-96/R2. U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN.

[j] Value is for Chromium III.

AOC = Area of Concern.
B = The analyte was found in the associated method blank at a level that is similar to the sample result.
CAS = Chemical Abstract Service.
J = The associated value is an estimated quantity.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
µg/kg = Microgram per kilogram.
NSL = No screening level.
U = The analyte was analyzed form but was not detected above the method reporting limit.
UJ = Not detected. The associated detection limit is an estimate and may be inaccurate or imprecise. Values listed are reporting limits (RLs).
USEPA = United States Environmental Protection Agency.
-- = Not analyzed.

Non-detected concentrations are method reporting limits.
Screening level exceedances were only identified for receptors for which the medium had a potentially completed pathway identified in the SS-WP Addendum.

Shaded and bold values represent detected values that exceed human health screening criteria.
Shaded and italicized values represent detected values that exceed ecological screening criteria.

Table 5-4
Non-Detection Concentrations and Screening Values for Human Receptors for Non-Detected Analytes

Analyte	CAS	Units	Minimum Non-Detect Concentration [a]	Maximum Non-Detect Concentration [a]	Screening Value - Visitor/Trespasser [b]	Screening Value - Construction Worker, Employee/Student [c]
Surface Soil						
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.1	0.1	220	2,700
1,3-DINITROBENZENE	99-65-0	mg/kg	0.1	0.1	0.61	6.2
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	0.1	0.1	19	79
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.1	0.1	1.6	5.5
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.1	0.1	6.1	62
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.1	0.1	15	200
2-NITROTOLUENE	88-72-2	mg/kg	0.2	0.2	2.9	13
3-NITROTOLUENE	99-08-1	mg/kg	0.2	0.2	0.61	6.2
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.1	0.1	15	190
4-NITROTOLUENE	99-99-0	mg/kg	0.2	0.2	30	110
HMX	2691-41-0	mg/kg	0.1	0.1	380	4,900
NITROBENZENE	98-95-3	mg/kg	0.3	0.3	4.8	24
NITROGLYCERIN	55-63-0	mg/kg	2	2	0.61	6.2
RDX	121-82-4	mg/kg	0.2	0.2	5.6	24
TETRYL	479-45-8	mg/kg	0.2	0.2	24	250
SODIUM	7440-23-5	mg/kg	530	620	NSL	NSL
Subsurface Soil						
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.1	0.1	220	2,700
1,3-DINITROBENZENE	99-65-0	mg/kg	0.1	0.1	0.61	6.2
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	0.1	0.1	19	79
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.1	0.1	1.6	5.5
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.1	0.1	6.1	62
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.1	0.1	15	200
2-NITROTOLUENE	88-72-2	mg/kg	0.2	0.2	2.9	13
3-NITROTOLUENE	99-08-1	mg/kg	0.2	0.2	0.61	6.2
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.1	0.1	15	190
4-NITROTOLUENE	99-99-0	mg/kg	0.2	0.2	30	110
HMX	2691-41-0	mg/kg	0.1	0.1	380	4,900
NITROBENZENE	98-95-3	mg/kg	0.3	0.3	4.8	24
NITROGLYCERIN	55-63-0	mg/kg	2	2	0.61	6.2
RDX	121-82-4	mg/kg	0.2	0.2	5.6	24
TETRYL	479-45-8	mg/kg	0.2	0.2	24	250
SILVER	7440-22-4	mg/kg	0.1	0.1	39	510
SODIUM	7440-23-5	mg/kg	510	600	NSL	NSL
Sediment						
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.1	0.1	2,200	27,000
1,3-DINITROBENZENE	99-65-0	mg/kg	0.1	0.1	6.1	62
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	0.1	0.1	190	790
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.1	0.1	16	55
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.1	0.1	61	620
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.1	0.1	150	2,000
2-NITROTOLUENE	88-72-2	mg/kg	0.2	0.2	29	130
3-NITROTOLUENE	99-08-1	mg/kg	0.2	0.2	6.1	62
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.1	0.1	150	1,900
4-NITROTOLUENE	99-99-0	mg/kg	0.2	0.2	300	1,100
HMX	2691-41-0	mg/kg	0.1	0.1	3,800	49,000
NITROBENZENE	98-95-3	mg/kg	0.3	0.3	48	240
NITROGLYCERIN	55-63-0	mg/kg	2	2	6.1	62
RDX	121-82-4	mg/kg	0.2	0.2	56	240
TETRYL	479-45-8	mg/kg	0.2	0.2	240	2,500
Surface Water						
1,3,5-TRINITROBENZENE	99-35-4	µg/L	1	1	1,100	1,100
1,3-DINITROBENZENE	99-65-0	µg/L	0.4	0.4	3.7	3.7
2,4,6-TRINITROTOLUENE	118-96-7	µg/L	0.4	0.4	22	22
2,4-DINITROTOLUENE	121-14-2	µg/L	0.4	0.4	2.2	2.2
2,6-DINITROTOLUENE	606-20-2	µg/L	0.2	0.2	37	37
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	µg/L	0.2	0.2	73	73
2-NITROTOLUENE	88-72-2	µg/L	0.4	0.4	3.1	3.1
3-NITROTOLUENE	99-08-1	µg/L	0.4	0.4	3.7	3.7
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	µg/L	0.2	0.2	73	73
4-NITROTOLUENE	99-99-0	µg/L	1	1	42	42
HMX	2691-41-0	µg/L	0.4	0.4	1,800	1,800
NITROBENZENE	98-95-3	µg/L	0.4	0.4	1.2	1.2
NITROGLYCERIN	55-63-0	µg/L	3	3	3.7	3.7
RDX	121-82-4	µg/L	0.2	0.2	6.1	6.1
TETRYL	479-45-8	µg/L	0.2	0.3	150	150
BERYLLIUM	7440-41-7	µg/L	5	10	73	73
CADMIUM	7440-43-9	µg/L	5	10	18	18
SELENIUM	7440-43-9	µg/L	25	50	180	180

Shading indicates cases where the non-detected concentration exceeds the screening level.

[a] Detection limits are reporting limits (RLs).

[b] Derived from USEPA (2011) Regional Screening Levels (RSL). Soil and sediment values based on residential soil RSLs. Surface water values based on tap water RSLs. See Section 5.1.3 for details.

[c] Derived from USEPA (2011) Regional Screening Levels (RSL). Soil and sediment values based on industrial soil RSLs. Surface water values based on tap water RSLs. See Section 5.1.3 for details.

CAS = Chemical Abstract Service.
mg/kg = Milligram per kilogram.
NSL = No screening level.
µg/L = Microgram per liter.

Table 5-5
Non-Detection Concentrations and Screening Values for Ecological Receptors for Non-Detected Analytes

Analyte	CAS	Units	Minimum Non-Detect Concentration [a]	Maximum Non-Detect Concentration [a]	Screening Value - Biota [b]
Surface Soil					
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.1	0.1	NSL
1,3-DINITROBENZENE	99-65-0	mg/kg	0.1	0.1	NSL
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	0.1	0.1	30
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.1	0.1	30
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.1	0.1	30
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.1	0.1	80
2-NITROTOLUENE	88-72-2	mg/kg	0.2	0.2	30
3-NITROTOLUENE	99-08-1	mg/kg	0.2	0.2	30
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.1	0.1	80
4-NITROTOLUENE	99-99-0	mg/kg	0.2	0.2	30
HMX	2691-41-0	mg/kg	0.1	0.1	100
NITROBENZENE	98-95-3	mg/kg	0.3	0.3	40
NITROGLYCERIN	55-63-0	mg/kg	2	2	NSL
RDX	121-82-4	mg/kg	0.2	0.2	100
TETRYL	479-45-8	mg/kg	0.2	0.2	25
SODIUM	7440-23-5	mg/kg	530	620	NSL
Sediment					
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.1	0.1	0.0024
1,3-DINITROBENZENE	99-65-0	mg/kg	0.1	0.1	0.0067
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	0.1	0.1	30
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.1	0.1	30
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.1	0.1	30
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.1	0.1	80
2-NITROTOLUENE	88-72-2	mg/kg	0.2	0.2	30
3-NITROTOLUENE	99-08-1	mg/kg	0.2	0.2	30
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.1	0.1	80
4-NITROTOLUENE	99-99-0	mg/kg	0.2	0.2	30
HMX	2691-41-0	mg/kg	0.1	0.1	100
NITROBENZENE	98-95-3	mg/kg	0.3	0.3	0.021
NITROGLYCERIN	55-63-0	mg/kg	2	2	NSL
RDX	121-82-4	mg/kg	0.2	0.2	100
TETRYL	479-45-8	mg/kg	0.2	0.2	25
Surface Water					
1,3,5-TRINITROBENZENE	99-35-4	µg/L	1	1	11
1,3-DINITROBENZENE	99-65-0	µg/L	0.4	0.4	20
2,4,6-TRINITROTOLUENE	118-96-7	µg/L	0.4	0.4	90
2,4-DINITROTOLUENE	121-14-2	µg/L	0.4	0.4	310
2,6-DINITROTOLUENE	606-20-2	µg/L	0.2	0.2	310
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	µg/L	0.2	0.2	20
2-NITROTOLUENE	88-72-2	µg/L	0.4	0.4	440
3-NITROTOLUENE	99-08-1	µg/L	0.4	0.4	375
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	µg/L	0.2	0.2	20
4-NITROTOLUENE	99-99-0	µg/L	1	1	950
HMX	2691-41-0	µg/L	0.4	0.4	330
NITROBENZENE	98-95-3	µg/L	0.4	0.4	67
NITROGLYCERIN	55-63-0	µg/L	3	3	69
RDX	121-82-4	µg/L	0.2	0.2	190
TETRYL	479-45-8	µg/L	0.2	0.3	NSL
BERYLLIUM	7440-41-7	µg/L	5	10	0.66
CADMIUM	7440-43-9	µg/L	5	10	8.8
SELENIUM	7440-43-9	µg/L	25	50	71

Shading indicates cases where the non-detected concentration exceeds the screening level.

[a] Detection limits are reporting limits (RLs).

[b] Sources and derivations of screening levels for all receptors and environmental media are detailed in Tables 5-1 through 5-3.

CAS = Chemical Abstract Service.
mg/kg = Milligram per kilogram.
NSL = No screening level.
µg/L = Microgram per liter.

Table 5-6
Comparison of Onsite and Background Soil Concentrations for Metals at AOC 2

	Onsite: AOC 2				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/ Qualifier (mg/kg) [a]	Maximum Concentration/ Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Detection Frequency	Minimum Concentration/ Qualifier (mg/kg) [a]	Maximum Concentration/ Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Site Maximum > Background Maximum	Site Mean > Background Mean
Surface Soil										
ALUMINUM	1/1	5,400	5,400	NA	48/48	1,290	16,200	5,650	NO	NA
ANTIMONY	1/1	0.03 L	0.03 L		0/48	ND	ND	0.33	--	--
ARSENIC	1/1	7.60	7.60	NA	39/48	0.93	22.7	4.45	NO	NA
BARIUM	1/1	18.0	18.0	NA	48/48	3.30	46.0	19.8	NO	NA
BERYLLIUM	1/1	0.12	0.12	NA	44/48	0.05	0.37	0.16	NO	NA
CADMIUM	1/1	0.02 J	0.02 J	NA	0/48	ND	ND	0.03	--	--
CALCIUM	1/1	76.0 J	76.0 J	NA	30/48	68.5	1,070	184	NO	NA
CHROMIUM	1/1	4.90	4.90	NA	48/48	2.30	19.5	8.56	NO	NA
COBALT	1/1	0.62	0.62	NA	46/48	0.18	1.60	0.64	NO	NA
COPPER	1/1	6.80	6.80	NA	37/48	0.75	13.0	3.45	NO	NA
IRON	1/1	3,400	3,400	NA	48/48	1,220	10,100	3,970	NO	NA
LEAD	1/1	15.0	15.0	NA	48/48	1.50	27.9	10.2	NO	NA
MAGNESIUM	1/1	350	350	NA	40/48	129	851	319	NO	NA
MANGANESE	1/1	12.0	12.0	NA	48/48	4.50	83.0	19.9	NO	NA
MERCURY	1/1	0.07	0.07	NA	24/45	0.03	0.88	0.07	NO	NA
NICKEL	1/1	1.80	1.80	NA	48/48	0.32	5.30	1.94	NO	NA
POTASSIUM	1/1	260 J	260 J	NA	48/48	94.6	671	256	NO	NA
SELENIUM	1/1	0.18 J	0.18 J	NA	1/48	0.75	0.75	0.23	NO	NA
SILVER	1/1	0.03 J	0.03 J	NA	0/48	ND	ND	0.08	--	--
SODIUM	0/1	ND	ND	NA	0/48	ND	ND	32.2	--	--
THALLIUM	1/1	0.12	0.12	NA	0/48	ND	ND	0.41	--	--
VANADIUM	1/1	10.0	10.0	NA	48/48	2.40	25.9	10.5	NO	NA
ZINC	1/1	7.30	7.30	NA	48/48	3.20	31.2	8.13	NO	NA
Sub-Surface Soil										
ALUMINUM	1/1	4,200	4,200	NA	48/48	1,290	16,200	5,650	NO	NA
ANTIMONY	NA [d]	NA	NA	NA	0/48	ND	ND	0.33	--	--
ARSENIC	1/1	3.70	3.70	NA	39/48	0.93	22.7	4.45	NO	NA
BARIUM	1/1	13.0	13.0	NA	48/48	3.30	46.0	19.8	NO	NA
BERYLLIUM	1/1	0.07 J	0.07 J	NA	44/48	0.05	0.37	0.16	NO	NA
CADMIUM	1/1	0.02 J	0.02 J	NA	0/48	ND	ND	0.03	--	--
CALCIUM	1/1	59.0 J	59.0 J	NA	30/48	68.5	1,070	184	NO	NA
CHROMIUM	1/1	3.70	3.70	NA	48/48	2.30	19.5	8.56	NO	NA
COBALT	1/1	0.43	0.43	NA	46/48	0.18	1.60	0.64	NO	NA
COPPER	1/1	3.40	3.40	NA	37/48	0.75	13.0	3.45	NO	NA
IRON	1/1	2,900	2,900	NA	48/48	1,220	10,100	3,970	NO	NA
LEAD	1/1	7.20	7.20	NA	48/48	1.50	27.9	10.2	NO	NA
MAGNESIUM	1/1	260	260	NA	40/48	129	851	319	NO	NA
MANGANESE	1/1	7.90	7.90	NA	48/48	4.50	83.0	19.9	NO	NA
MERCURY	1/1	0.03	0.03	NA	24/45	0.03	0.88	0.07	NO	NA
NICKEL	1/1	1.30	1.30	NA	48/48	0.32	5.30	1.94	NO	NA
POTASSIUM	1/1	190 J	190 J	NA	48/48	94.6	671	256	NO	NA
SELENIUM	1/1	0.27 J	0.27 J	NA	1/48	0.75	0.75	0.23	NO	NA
SILVER	0/1	ND	ND	NA	0/48	ND	ND	0.08	--	--
SODIUM	0/1	ND	ND	NA	0/48	ND	ND	32.2	--	--
THALLIUM	1/1	0.08 J	0.08 J	NA	0/48	ND	ND	0.41	--	--
VANADIUM	1/1	8.10	8.10	NA	48/48	2.40	25.9	10.5	NO	NA
ZINC	1/1	5.60	5.60	NA	48/48	3.20	31.2	8.13	NO	NA

[a] Minimum concentration of analyte detected.
[b] Maximum concentration of analyte detected.
[c] Nondetects are carried forth as one-half of the sample quantitation limit (SQL) in the calculation of the mean concentration.
[d] Antimony data was rejected due to QA/QC exceedences and is not useful for the quantitative assessment

AOC = Area of Concern.
J = Analyte is present. Reported value may not be accurate or precise.
mg/kg = Milligram per kilogram.
NA = Not applicable, only one sample, or no usable data was obtained
ND = Not detected.
-- = Chemical not detected in site or background samples therefore comparison is not meaningful.

Table 5-7
Comparison of Onsite and Background Soil Concentrations for Metals at AOC 8

	Onsite: AOC 8				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/ Qualifier (mg/kg) [a]	Maximum Concentration/ Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Detection Frequency	Minimum Concentration/Qualifier (mg/kg) [a]	Maximum Concentration/Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Site Maximum > Background Maximum	Site Mean > Background Mean
Surface Soil										
ALUMINUM	8/8	5,400	13,000	9,750	48/48	1,290	16,200	5,650	NO	YES
ANTIMONY	3/3 [d]	0.03 L	0.20 L	0.09	0/48	ND	ND	0.33	--	--
ARSENIC	8/8	2.50	19.0	7.39	39/48	0.93	22.7	4.45	NO	YES
BARIUM	8/8	13.0	83.0	35.9	48/48	3.30	46.0	19.8	YES	YES
BERYLLIUM	8/8	0.11	0.53	0.23	44/48	0.05	0.37	0.16	YES	YES
CADMIUM	8/8	0.05 J	0.21	0.10	0/48	ND	ND	0.03	--	--
CALCIUM	8/8	41.0 J	1,900	556	30/48	68.5	1,070	184	YES	YES
CHROMIUM	8/8	5.70	16.0	10.9	48/48	2.30	19.5	8.56	NO	YES
COBALT	8/8	0.91	2.50	1.44	46/48	0.18	1.60	0.64	YES	YES
COPPER	8/8	3.00	52.0	12.5	37/48	0.75	13.0	3.45	YES	YES
IRON	8/8	4,400	12,000	6,370	48/48	1,220	10,100	3,970	YES	YES
LEAD	8/8	9.20	200	62.4	48/48	1.50	27.9	10.2	YES	YES
MAGNESIUM	8/8	500	860	658	40/48	129	851	319	YES	YES
MANGANESE	8/8	11.0	210	70.9	48/48	4.50	83.0	19.9	YES	YES
MERCURY	8/8	0.02	0.16	0.07	24/45	0.03	0.88	0.07	NO	NO
NICKEL	8/8	2.70	6.00	3.53	48/48	0.32	5.30	1.94	YES	YES
POTASSIUM	8/8	470	640	525	48/48	94.6	671	256	NO	YES
SELENIUM	5/8	0.17 J	0.88	0.39	1/48	0.75	0.75	0.23	YES	YES
SILVER	4/8	0.03 J	0.56	0.12	0/48	ND	ND	0.08	--	--
SODIUM	1/8	120 J	120 J	264	0/48	ND	ND	32.2	--	--
THALLIUM	8/8	0.08 J	0.27	0.13	0/48	ND	ND	0.41	--	--
VANADIUM	8/8	11.0	22.0	14.9	48/48	2.40	25.9	10.5	NO	YES
ZINC	8/8	8.70	85.0	26.3	48/48	3.20	31.2	8.13	YES	YES
Sub-surface Soil										
ALUMINUM	7/7	5,800 J	19,000	10,800.00	48/48	1,290	16,200	5,650	YES	YES
ANTIMONY	5/5 [d]	0.02 L	0.20 L	0.06	0/48	ND	ND	0.33	--	--
ARSENIC	7/7	2.00	14.0	7.09	39/48	0.93	22.7	4.45	NO	YES
BARIUM	7/7	13.0	150	51.1	48/48	3.30	46.0	19.8	YES	YES
BERYLLIUM	7/7	0.12	0.40	0.26	44/48	0.05	0.37	0.16	YES	YES
CADMIUM	7/7	0.07 J	1.00	0.22	0/48	ND	ND	0.03	--	--
CALCIUM	7/7	77.0 J	440	318	30/48	68.5	1,070	184	NO	YES
CHROMIUM	7/7	9.10	19.0	12.7	48/48	2.30	19.5	8.56	NO	YES
COBALT	7/7	1.10	3.30	1.70	46/48	0.18	1.60	0.64	YES	YES
COPPER	7/7	2.50 J	220	36.3	37/48	0.75	13.0	3.45	YES	YES
IRON	7/7	3,500 J	23,000 J	8,640	48/48	1,220	10,100	3,970	YES	YES
LEAD	7/7	8.90	320	82.9	48/48	1.50	27.9	10.2	YES	YES
MAGNESIUM	7/7	440	870	649	40/48	129	851	319	YES	YES
MANGANESE	7/7	14.0	510 K	107	48/48	4.50	83.0	19.9	YES	YES
MERCURY	7/7	0.02	0.07	0.05	24/45	0.03	0.88	0.07	NO	NO
NICKEL	7/7	2.70	5.40	4.01	48/48	0.32	5.30	1.94	YES	YES
POTASSIUM	7/7	330 J	880	564	48/48	94.6	671	256	YES	YES
SELENIUM	6/7	0.23 J	0.75 B	0.41	1/48	0.75	0.75	0.23	NO	YES
SILVER	6/7	0.02 J	3.50	0.62	0/48	ND	ND	0.08	--	--
SODIUM	0/7	ND	ND	281	0/48	ND	ND	32.2	--	--
THALLIUM	7/7	0.08 J	0.71	0.20	0/48	ND	ND	0.41	--	--
VANADIUM	7/7	11.0	33.0	19.0	48/48	2.40	25.9	10.5	YES	YES
ZINC	7/7	12.0	250	49.3	48/48	3.20	31.2	8.13	YES	YES

[a] Minimum concentration of analyte detected.
[b] Maximum concentration of analyte detected.
[c] Nondetects are carried forth as one-half of the sample quantitation limit (SQL) in the calculation of the mean concentration.
[d] A portion of the antimony samples were rejected due to QA/QC exceedences and are not included within the statistics shown.

AOC = Area of Concern.
B = The analyte was found in the associated method blank at a level that is similar to the sample result.
J = Analyte is present. Reported value may not be accurate or precise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
L = The analyte is present. The reported values may be biased low. The actual value is expected to be higher than reported.
mg/kg = Milligram per kilogram.
ND = Not detected.
-- = Chemical not detected in site or background samples therefore comparison is not meaningful.

Table 5-8
Comparison of Onsite and Background Soil Concentrations for Metals at AOC 9

	Onsite: AOC 9				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/ Qualifier (mg/kg) [a]	Maximum Concentration/ Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Detection Frequency	Minimum Concentration/ Qualifier (mg/kg) [a]	Maximum Concentration/ Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Site Maximum > Background Maximum	Site Mean > Background Mean
Surface Soil										
ALUMINUM	4/4	6,800 J	14,000 J	10,900	48/48	1,290	16,200	5,650	NO	YES
ANTIMONY	NA [d]	NA	NA	NA	0/48	ND	ND	0.33	--	--
ARSENIC	4/4	2.40	7.60	5.05	39/48	0.93	22.7	4.45	NO	YES
BARIUM	4/4	28.0	43.0	37.3	48/48	3.30	46.0	19.8	NO	YES
BERYLLIUM	4/4	0.22	0.31	0.26	44/48	0.05	0.37	0.16	NO	YES
CADMIUM	4/4	0.06 J	0.09 J	0.07	0/48	ND	ND	0.03	--	--
CALCIUM	4/4	220	610	383	30/48	68.5	1,070	184	NO	YES
CHROMIUM	4/4	11.0	13.0	11.8	48/48	2.30	19.5	8.56	NO	YES
COBALT	4/4	1.40	2.00	1.63	46/48	0.18	1.60	0.64	YES	YES
COPPER	4/4	2.60	11.0	7.40	37/48	0.75	13.0	3.45	NO	YES
IRON	4/4	4,900 J	7,700 J	6,350	48/48	1,220	10,100	3,970	NO	YES
LEAD	4/4	10.0	16.0	14.0	48/48	1.50	27.9	10.2	NO	YES
MAGNESIUM	4/4	500	780	665	40/48	129	851	319	NO	YES
MANGANESE	4/4	23.0 K	73.0 K	48.3	48/48	4.50	83.0	19.9	NO	YES
MERCURY	4/4	0.03	0.12	0.07	24/45	0.03	0.88	0.07	NO	NO
NICKEL	4/4	3.20	5.00	4.10	48/48	0.32	5.30	1.94	NO	YES
POTASSIUM	4/4	410	710	525	48/48	94.6	671	256	YES	YES
SELENIUM	4/4	0.27 B	0.71 B	0.49	1/48	0.75	0.75	0.23	NO	YES
SILVER	3/4	0.02 J	0.03 J	0.03	0/48	ND	ND	0.08	--	--
SODIUM	0/4	ND	ND	285	0/48	ND	ND	32.2	--	--
THALLIUM	4/4	0.09 J	0.16	0.12	0/48	ND	ND	0.41	--	--
VANADIUM	4/4	11.0	20.0	15.3	48/48	2.40	25.9	10.5	NO	YES
ZINC	4/4	12.0	21.0	15.3	48/48	3.20	31.2	8.13	NO	YES
Sub-surface Soil										
ALUMINUM	5/5	10,000 J	15,000 J	12,200	48/48	1,290	16,200	5,650	NO	YES
ANTIMONY	NA [d]	NA	NA	NA	0/48	ND	ND	0.33	--	--
ARSENIC	5/5	2.20	7.70	3.92	39/48	0.93	22.7	4.45	NO	NO
BARIUM	5/5	27.0	57.0	44.8	48/48	3.30	46.0	19.8	YES	YES
BERYLLIUM	5/5	0.26	0.36	0.30	44/48	0.05	0.37	0.16	NO	YES
CADMIUM	5/5	0.06 J	0.09 J	0.08	0/48	ND	ND	0.03	--	--
CALCIUM	5/5	190	540	284	30/48	68.5	1,070	184	NO	YES
CHROMIUM	5/5	12.0	14.0	13.2	48/48	2.30	19.5	8.56	NO	YES
COBALT	5/5	1.70	2.00	1.82	46/48	0.18	1.60	0.64	YES	YES
COPPER	5/5	2.40 J	8.4	5.08	37/48	0.75	13.0	3.45	NO	YES
IRON	5/5	6,000 J	7,600 J	6,480	48/48	1,220	10,100	3,970	NO	YES
LEAD	5/5	9.00	35.0	15.8	48/48	1.50	27.9	10.2	YES	YES
MAGNESIUM	5/5	570	770	678	40/48	129	851	319	NO	YES
MANGANESE	5/5	23.0 K	50.0 K	34.0	48/48	4.50	83.0	19.9	NO	YES
MERCURY	5/5	0.02	0.13	0.05	24/45	0.03	0.88	0.07	NO	NO
NICKEL	5/5	4.20	5.10	4.70	48/48	0.32	5.30	1.94	NO	YES
POTASSIUM	5/5	370	800	506	48/48	94.6	671	256	YES	YES
SELENIUM	5/5	0.22 B	0.88 B	0.55	1/48	0.75	0.75	0.23	YES	YES
SILVER	0/5	ND	ND	0.06	0/48	ND	ND	0.08	--	--
SODIUM	0/5	ND	ND	270	0/48	ND	ND	32.2	--	--
THALLIUM	5/5	0.11	0.15	0.13	0/48	ND	ND	0.41	--	--
VANADIUM	5/5	16.0	20.0	18.0	48/48	2.40	25.9	10.5	NO	YES
ZINC	5/5	11.0	16.0	13.2	48/48	3.20	31.2	8.13	NO	YES

[a] Minimum concentration of analyte detected.
[b] Maximum concentration of analyte detected.
[c] Nondetects are carried forth as one-half of the sample quantitation limit (SQL) in the calculation of the mean concentration.
[d] Antimony data was rejected due to QA/QC exceedences and is not useful for the quantitative assessment
AOC = Area of Concern.
B = The analyte was found in the associated method blank at a level that is similar to the sample result.
J = Analyte is present. Reported value may not be accurate or precise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
mg/kg = Milligram per kilogram.
NA = Not applicable, no usable data was obtained
ND = Not detected.
-- = Chemical not detected in site or background samples therefore comparison is not meaningful.

Table 5-9
Comparison of Onsite and Background Sediment Concentrations for Metals at AOC 2

	Onsite: AOC 2				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/ Qualifier (mg/L) [a]	Maximum Concentration/ Qualifier (mg/L) [b]	Mean Concentration [c] (mg/L)	Detection Frequency	Minimum Concentration/ Qualifier (mg/L) [a]	Maximum Concentration/ Qualifier (mg/L) [b]	Mean Concentration [c] (mg/L)	Site Maximum > Background Maximum	Site Mean > Background Mean
ALUMINUM	3/3	6,600	16,000	11,866	2/2	4300 J	7000 J	5650	YES	YES
ANTIMONY	NA [d]	NA	NA	NA	1/1 [d]	0.09 L	0.09 L	0.09	NA	NA
ARSENIC	3/3	3.90	7.60	6.30	2/2	2.70	3.20	2.95	YES	YES
BARIUM	3/3	9.30	26.0	19.8	2/2	31.0	66.0	48.5	NO	NO
BERYLLIUM	3/3	0.30	0.52	0.43	2/2	0.21	0.22	0.22	YES	YES
CADMIUM	3/3	0.14	0.26	0.20	2/2	0.07 J	0.19	0.13	YES	YES
CALCIUM	3/3	560	1,100	887	2/2	570	1,700	1,135	NO	NO
CHROMIUM	3/3	9.80	24.0	18.3	2/2	6.60	16.0	11.3	YES	YES
COBALT	3/3	2.10	4.10	3.27	2/2	0.79	1.50	1.15	YES	YES
COPPER	3/3	6.40	43.0	29.5	2/2	7.00	62.0	34.5	NO	NO
IRON	3/3	9,600	40,000	21,867	2/2	2,700 J	4,800 J	3,750	YES	YES
LEAD	3/3	13.0	46.0	32.7	2/2	44.0	240	142	NO	NO
MAGNESIUM	3/3	1,500	3,000	2,400	2/2	770	1,700	1,235	YES	YES
MANGANESE	3/3	52.0	98.0	77.3	2/2	14.0 K	33.0 K	23.5	YES	YES
MERCURY	3/3	44.0	95.0	76.3	2/2	72.0	460	266	NO	NO
NICKEL	3/3	4.60	9.90	7.87	2/2	2.50	6.20	4.35	YES	YES
POTASSIUM	3/3	1,100	2,300	1,833	2/2	490	810	650	YES	YES
SELENIUM	2/3	0.50 J	0.66 B	0.51	2/2	0.35 B	0.39 B	0.37	YES	YES
SILVER	3/3	0.03 J	0.07 J	0.06	2/2	0.04 J	0.21	0.12	NO	NO
SODIUM	3/3	3,000	4,200	3,600	2/2	1,500	3,100	2,300	YES	YES
THALLIUM	3/3	0.07 J	0.15 J	0.12	2/2	0.05 J	0.07 J	0.06	YES	YES
VANADIUM	3/3	14.0	34.0	26.0	2/2	9.50	14.0	11.8	YES	YES
ZINC	3/3	38.0	72.0	58.7	2/2	73.0	140	107	NO	NO

[a] Minimum concentration of analyte detected.

[b] Maximum concentration of analyte detected.

[c] Nondetects are carried forth as one-half of the reporting limit (RL) in the calculation of the mean concentration.

[d] A portion of the antimony samples were rejected due to QA/QC exceedences and are not included within the statistics shown.

AOC = Area of Concern.
B = The analyte was found in the associated method blank at a level that is similar to the sample result.
J = Analyte is present. Reported value may not be accurate or precise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
L = The analyte is present. The reported values may be biased low. The actual value is expected to be higher than reported.
mg/L = Milligram per liter.
NA = Not applicable, sufficient usable data was obtained
ND = No detected results.
R = The data are unusable. (Note: The analyte may or may not be present).

Table 5-10
Comparison of Onsite and Background Surface Water Concentrations for Metals at AOC 2

	Onsite: AOC 2				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/ Qualifier (µg/L) [a]	Maximum Concentration/ Qualifier (µg/L) [b]	Mean Concentration [c] (µg/L)	Detection Frequency	Minimum Concentration/ Qualifier (µg/L) [a]	Maximum Concentration/ Qualifier (µg/L) [b]	Mean Concentration [c] (µg/L)	Site Maximum > Background Maximum	Site Mean > Background Mean
ALUMINUM	3/3	380 J	2,500 J	1,127	2/2	600 J	2,500 J	1,550	NO	NO
ANTIMONY	1/2	1.20 J	1.20 J	15.4	2/2	0.48 J	0.58 J	0.50	YES	YES
ARSENIC	3/3	2.60 J	4.50 J	3.23	2/2	2.60 J	4.30 J	3.45	YES	NO
BARIUM	3/3	34.0	57.0	43.0	2/2	47.0	51.0	49.0	YES	NO
BERYLLIUM	0/3	ND	ND	4.17	0/2	ND	ND	2.50	NA	NA
CADMIUM	0/3	ND	ND	4.17	0/2	ND	ND	2.50	NA	NA
CALCIUM	3/3	150,000	160,000	153,333	2/2	110,000	140,000	125,000	YES	YES
CHROMIUM	2/3	2.50 J	8.20 J	20.2	2/2	2.90 J	6.60 J	4.75	YES	YES
COBALT	3/3	0.36 J	1.20 J	0.65	2/2	0.48 J	1.20 J	0.84	NO	NO
COPPER	1/3	3.90 J	3.90 J	7.97	2/2	5.20 J	7.10 J	6.15	NO	YES
IRON	3/3	560 J	3,900 J	1,720	2/2	870	3,600	2,235	YES	NO
LEAD	1/3	4.70 J	4.70 J	9.07	2/2	1.10 J	5.50 J	3.30	NO	YES
MAGNESIUM	3/3	440,000	450,000	443,333	2/2	280,000	410,000	345,000	YES	YES
MANGANESE	3/3	100 J	180	133	2/2	120	140	130	YES	YES
MERCURY	3/3	0.04 B	0.06 B	0.05	2/2	0.04 B	0.06 B	0.05	NO	NO
NICKEL	3/3	1.80 J	4.10 J	3.30	2/2	2.20 J	3.30 J	2.75	YES	YES
POTASSIUM	3/3	150,000	150,000	150,000	2/2	100,000	140,000	120,000	YES	YES
SELENIUM	0/3	ND	ND	20.8	2/2	3.50 J	5.00 J	4.25	--	--
SILVER	1/3	0.38 J	0.38 J	10.6	1/2	0.10 J	0.10 J	6.30	YES	YES
SODIUM	3/3	4,000,000 J	4,000,000	4,000,000	2/2	2,600,000	3,600,000	3,100,000	YES	YES
THALLIUM	1/3	0.25 J	0.25 J	2.58	0/2	ND	ND	2.50	--	--
VANADIUM	3/3	2.30 J	7.70 J	4.30	2/2	2.90 J	8.40 J	5.65	NO	YES
ZINC	1/3	21.0 J	21.0 J	57.0	1/2	20.0 J	20.0 J	35.0	YES	YES

[a] Minimum concentration of analyte detected.
[b] Maximum concentration of analyte detected.
[c] Nondetects are carried forth as one-half of the reporting limit (RL) in the calculation of the mean concentration.

AOC = Area of Concern.
B = The analyte was found in the associated method blank at a level that is similar to the sample result.
J = Analyte is present. Reported value may not be accurate or precise.
NA = Not available, no detected values.
ND = No detected results.
µg/L = Microgram per liter.
-- = Chemical not detected in site samples and/or background; therefore comparison to background is not meaningful.

6. SUMMARY AND CONCLUSIONS

6.0.1 The FNOD is located in the city of Suffolk, Virginia. The FNOD is approximately 975.3 acres and was used by the Army as an ordnance depot from 1917 to 1950 and by the Navy as the Marine Corps Supply Forwarding Annex from 1950 to 1960. A summary of the results and conclusions is presented below, and is summarized in Table 6-1.

6.0.2 Two MRSs were identified at the FNOD ASR Supplement, as shown below. Field activities were not conducted at MRS 1 or MRS 2 during this SI per USACE direction due to extensive studies already completed or ongoing in these areas. An MRSPP ranking was completed for each MRS based on historical data provided by USACE.

- MRS 1 – James River Beach Dump Area (S-2)
- MRS 2 – TNT Disposal Area (S-1)

6.0.3 For this SI, USACE identified the following AOCs where HFA collected analytical samples and completed qualitative reconnaissance during the 2010 SI field activities.

- AOC 2 – Streeter Creek and Lakeview Drive Ground Scars
- AOC 8 – Track A Magazine Line
- AOC 9 – Track A & B Burning Ground

6.0.4 For this SI, USACE identified the following AOCs where HFA completed visual reconnaissance during the 2010 SI field activities.

- AOC 10 – Track G Magazine Line
- AOC 11 – Track H & I Magazine Line
- AOC 12 – Track J Magazine Line
- AOC 14 – Track K Magazine Line
- AOC 15 – Track K Magazine Line Landfill

6.1 James River Beach Dump Area (MRS 1)

6.1.1 Potential human receptors for MRS 1 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors include soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds. MRS 1 was suspected of being used as a disposal area circa WWI. Since military use of Nansemond Ordnance Depot ceased, MD has been found at and removed from MRS 1. Additional sediment sampling is planned during the RI. In 2011, the USACE completed a geophysical survey of the shoreline and bluff along the entire length of the FNOD property. The purpose of the survey was to supplement previously collected

geophysical data to identify potential disposal areas along the FNOD shoreline and bluff. The recent geophysical investigation was also initiated in response to the recent discoveries of MEC being washed out of the FNOD shoreline during large storm events. USACE will be using both the previous and recently collected geophysical data to identify anomalous areas that warrant intrusive investigation.

6.1.2 An MRSPP was prepared for MRS 1 indicating an overall alternative rating of "No Longer Required" based on the cleanup efforts previously conducted and ongoing.

6.2 TNT Disposal Area (MRS 2)

6.2.1 Potential human receptors for MRS 2 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors include soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds. MRS 2 is suspected of being used as a disposal area during WWII. Since military use of Nansemond Ordnance Depot ceased, crystalline TNT (MEC), and numerous MEC and MD have been found at and removed from MRS 2. A TCRA was completed at the site by UXB and Zapata between 1999 and 2003. Details on the Removal Action can be found in the Final TCRA Report completed by Zapata in 2006. A Revised RI Report may be issued based on an analytical data gap. An FS Report will be conducted in 2011.

6.2.2 An MRSPP was prepared for MRS 2 indicating an overall alternative rating of "No Longer Required" based on the cleanup efforts previously conducted and ongoing.

6.3 Streeter Creek and Lakeview Drive Ground Scars (AOC 2)

6.3.1 Potential human receptors for AOC 2 include future residents, visitors/trespassers, employees, and employees. Potential ecological receptors include soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.3.2 AOC 2 was used historically for storage of munitions. No subsurface anomalies were detected during the 2010 SI field event. Since military use at Nansemond Ordnance Depot ceased, no MEC or MD has been observed at AOC 2 historically or during the 2010 SI field activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction.

6.3.3 In the SS-WP, surface soils, subsurface soils, sediment, surface water, and groundwater were media with potentially complete exposure pathways for human receptors in AOC 2. Surface

soils, sediment, and surface water were media with potentially complete pathways for ecological receptors in this area.

6.3.4 Based on analytical sample results, the surface soil pathway was determined to be potentially complete for human receptors due to the failure for NG to meet the MQO for sensitivity. The maximum on-site concentrations of arsenic and thallium exceeded their respective screening criterion used for assessing risks to human receptors, and these MCs were determined to be COPCs for surface soil at AOC 2. Since these MC were detected below background concentrations, no additional risks due to FUDS-related activities were determined for humans exposed to surface soil in this area.

6.3.5 Based on analytical sample results, the surface soil pathway was determined to be incomplete for ecological receptors. Lead and vanadium exceeded their respective screening criterion adopted for the SLERA and these MCs were identified as COPECs in surface soil at AOC 2. However, these COPECs were not present at concentrations elevated above background. Therefore, no additional risks due to FUDS-related activities were determined for ecological receptors exposed to surface soil at AOC 2.

6.3.6 Based on analytical sample results, the subsurface soil pathway was determined to be potentially complete for human receptors due to the failure for NG to meet the MQO for sensitivity. The maximum on-site concentration of arsenic exceeded the screening criterion used for evaluating risks to human receptors, and this MC was identified as COPC for subsurface soil at AOC 2. However, this MC was present at concentrations below background concentrations; therefore, no additional risks due to FUDS-related activities were determined for human receptors exposed to subsurface soil at AOC 2.

6.3.7 The sediment pathway was determined to be complete for human receptors due to elevated concentrations of several MCs in on-site sediment compared to background concentrations. Arsenic was determined to be a COPC in sediment at AOC 2 due to the exceedance of onsite concentrations relative to the selected screening criteria. Based on the weight-of-evidence evaluation, it is determined that no unacceptable risk to human receptors from arsenic is present.

6.3.8 Sediment was also determined to be a medium with a complete pathway for ecological receptors due to the elevated concentrations of several metals in on-site sediment compared to background. Due to the exceedance of the MCs in sediment compared to screening criteria, iron, copper, and lead were determined to be COPECs for AOC 2 sediment. Of these COPCs, only

iron exceeded background levels. Based on the weight-of-evidence evaluation, no unacceptable risk to ecological receptors from iron in sediment at AOC 2 was determined.

6.3.9 The surface water pathway was determined to be complete for human receptors due to the exceedance of several MCs in on-site surface water compared to background concentrations. Arsenic was identified as a COPC in surface water at AOC 2 due to the exceedance of onsite concentrations relative to the HHRA screening criterion. However, based on the weight-of-evidence evaluation, no unacceptable risk to human receptors from exposure to this COPC is present.

6.3.10 The surface water pathway was also determined to be complete for ecological receptors due to the exceedance of metals detected on-site compared to background concentrations. Due to the exceedance of the MCs in on-site surface water compared to their respective screening criterion, aluminum, barium, calcium, copper, iron, magnesium, manganese, potassium, silver, and sodium were determined COPECs for surface water at AOC 2. The weight-of-evidence evaluation determined that no unacceptable risks from FUDS-related activities were present from exposure to these COPECs in this area.

6.3.11 No groundwater samples were obtained at AOC 2. The groundwater pathway therefore remains potentially complete for human receptors at AOC 2. The absence of groundwater analytical data does not introduce significant uncertainty for the conclusions regarding potential risks to human receptors at this AOC. No additional potential MC risks due to FUDS-related activities were determined based on samples collected at this AOC and no MEC has been found at this AOC (i.e., absence of a munitions related source). Therefore, groundwater is not likely to contain MC related to the former munitions use of this AOC. However, due to the physical characteristics of groundwater (i.e., its ability to move within the aquifer between other sites of interest related to the former uses of FNOD), it remains a potentially complete pathway.

6.4 Track A Magazine Line (AOC 8)

6.4.1 Potential human receptors for AOC 8 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors are soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.4.2 AOC 8 was used historically for storage of munitions. Since military use at Nansemond Ordnance Depot ceased, no MEC or MD has been observed at AOC 8 historically or during the 2010 SI visit. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction.

6.4.3 In the SS-WP, surface soils, subsurface soil, and groundwater were media with potentially complete exposure pathways for human receptors in AOC 8. Surface soil was a medium with a potentially complete pathway for ecological receptors in this area.

6.4.4 The surface soil pathway was determined to be complete for human receptors due to the exceedance of the majority of the metals analyzed in on-site surface soils compared to background concentrations. Maximum on-site concentrations of aluminum, arsenic, cobalt, iron, manganese and thallium exceeded the screening criteria used for assessing risks to human receptors, and these MCs were determined to be COPCs for surface soil at AOC 8. Based on the weight-of-evidence evaluation, a potentially unacceptable risk for humans from exposure to arsenic in surface soils at AOC 8 was determined.

6.4.5 The surface soil pathway was also determined to be complete for ecological receptors due to the exceedance of several metals in soil samples collected on-site versus background soils. Maximum concentrations of arsenic, copper, lead, mercury, selenium, vanadium, and zinc on-site exceeded their respective screening criterion used for the SLERA and these MCs were determined to be COPECs in surface soil at AOC 8. The weight-of-evidence evaluation determined that lead and vanadium in surface soils at AOC 8 pose potentially unacceptable risks to ecological receptors.

6.4.6 The subsurface soil pathway was determined to be complete for human receptors due to the exceedance of a number of metals in on-site subsurface soils compared to background soils. Maximum concentrations of aluminum, arsenic, cobalt, iron, manganese, and thallium exceeded the screening criterion used for the risk assessment, and were determined as COPCs for subsurface soil at AOC 8. Based on the weight-of-evidence evaluation, a potentially unacceptable risk to humans exposed to arsenic in subsurface soils was determined.

6.4.7 No groundwater samples were obtained at AOC 8. The groundwater pathway therefore remains potentially complete for human receptors at AOC 8. The absence of groundwater analytical data does not introduce significant uncertainty for the conclusions regarding potential risks to human receptors at this AOC. No additional potential MC risks due to FUDS-related activities were determined based on samples collected at this AOC and no MEC has been found at this AOC (i.e., absence of a munitions related source). Therefore, groundwater is not likely to contain MC related to the former munitions use of this AOC. However, due to the physical characteristics of groundwater (i.e., its ability to move within the aquifer between other sites of interest related to the former uses of FNOD), it remains a potentially complete pathway.

6.5 Track A&B Burning Ground (AOC 9)

6.5.1 Potential human receptors for AOC 9 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors are soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.5.2 AOC 9 was used historically for storage of munitions. Since military use at Nansemond Ordnance Depot ceased, no MEC or MD has been observed at AOC 9 historically or during the 2010 SI visit. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction.

6.5.3 In the SS-WP, surface soils, subsurface soil, and groundwater were media with potentially complete exposure pathways for human receptors in AOC 9. Surface soil was a medium with a potentially complete pathway for ecological receptors in this area.

6.5.4 The surface soil pathway was determined to be complete for human receptors due to the exceedance of several metals detected in on-site surface soil samples compared to background soil samples. Maximum on-site concentrations of aluminum, arsenic, iron, and thallium exceeded the screening criteria used for assessing risks to human receptors, and these MCs were determined to be COPCs for surface soil at AOC 9. Based on the weight-of-evidence evaluation, a potentially unacceptable risk for humans from exposure to arsenic in surface soils at AOC 9 was determined.

6.5.5 The surface soil pathway was also determined to be complete for ecological receptors due to the exceedance of several metals in on-site samples compared to background concentrations. Maximum concentrations of lead, mercury, selenium, and vanadium in on-site surface soil exceeded the screening criteria used for the SLERA and these MCs were determined to be COPECs in surface soil at AOC 9. The weight-of-evidence evaluation determined that the presence of vanadium in surface soil at AOC 9 presents a potentially unacceptable risk to ecological receptors.

6.5.6 The subsurface soil pathway was determined to be complete for human receptors due to the exceedance of metals in on-site subsurface soil compared to background concentrations. Maximum concentrations of aluminum, arsenic, iron, and thallium exceeded the screening criteria used for the risk assessment, and these MCs were determined as COPCs for subsurface soil at AOC 9. Arsenic concentrations in subsurface soil were below background; therefore, no additional risk from FUDS-related activities were determined. Based on the weight-of-evidence

evaluation, no unacceptable risk to human receptors from exposure to the remaining COPCs is present.

6.5.7 No groundwater samples were obtained at AOC 9. The groundwater pathway therefore remains potentially complete for human receptors at AOC 9. The absence of groundwater analytical data does not introduce significant uncertainty for the conclusions regarding potential risks to human receptors at this AOC. No additional potential MC risks due to FUDS-related activities were determined based on samples collected at this AOC and no MEC has been found at this AOC (i.e., absence of a munitions related source). Therefore, groundwater is not likely to contain MC related to the former munitions use of this AOC. However, due to the physical characteristics of groundwater (i.e., its ability to move within the aquifer between other sites of interest related to the former uses of FNOD), it remains a potentially complete pathway.

6.6 Track G Magazine Line (AOC 10)

6.6.1 Potential human receptors for AOC 10 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors are soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.6.2 AOC 10 was used historically for storage of munitions. Since military use at Nansemond Ordnance Depot ceased, no MEC or MD has been observed at AOC 10 historically or during the 2010 SI field activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction.

6.6.3 Per stakeholder agreements, no samples were collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by HydroGeoLogic, HydroGeoLogic concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. USACE is performing an Expanded SI to determine the presence or absence of explosive constituents in groundwater.

6.7 Track H & I Magazine Line (AOC 11)

6.7.1 Potential human receptors for AOC 11 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors are soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.7.2 AOC 11 was used historically for storage of munitions. Since military use at Nansemond Ordnance Depot ceased, no MEC or MD has been observed at AOC 11 historically or during the 2010 SI field activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction.

6.7.3 Per stakeholder agreements, no samples were collected during the 2010 SI field activities. However, based on the sampling results from the 2006/2007 sampling event conducted by HydroGeoLogic, HydroGeoLogic concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. HydroGeoLogic concluded that several metals may pose potentially unacceptable risks to human or ecological receptors. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. According to USACE, a Desktop RI Report, including human health and ecological risk assessments, will be prepared for AOC 11 in 2010.

6.8 Track J Magazine Line (AOC 12)

6.8.1 Potential human receptors for AOC 12 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors are soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.8.2 AOC 12 was used historically for storage of munitions. Since military use at Nansemond Ordnance Depot ceased, no MEC or MD has been observed at AOC 12 historically or during the 2010 SI field activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction.

6.8.3 Per stakeholder agreements, no samples were collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by Cape Environmental, Cape Environmental concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. In previous studies, arsenic and lead in surface soils and arsenic in subsurface soil exceeded USEPA screening values. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. USACE is in the process of developing a work plan to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required.

6.9 Track K Magazine Line (AOC 14)

6.9.1 Potential human receptors for AOC 14 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors are soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.9.2 AOC 14 was used historically for storage of munitions. Since military use at Nansemond Ordnance Depot ceased, no MEC or MD has been observed at AOC 14 historically or during the 2010 SI field activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction.

6.9.3 Per stakeholder agreements, no samples were collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by ICOR, Ltd., it was concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. USACE concluded that there may be potential risks to certain ecological receptors from select heavy metals. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. Based on the frequent detections of certain metals, PAHs and pesticide compounds in soil and groundwater throughout FNOD, USACE is in the process of developing a work plan to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required.

6.10 Track K Magazine Line Landfill (AOC 15)

6.10.1 Potential human receptors for AOC 15 include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors are soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.10.2 AOC 15 was used historically for storage of munitions. Since military use at Nansemond Ordnance Depot ceased, no MEC or MD has been observed at AOC 15 historically or during the 2010 SI field activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction.

6.10.3 Per stakeholder agreements, no samples were collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by ICOR, Ltd., it was concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. USACE concluded that there may be potential risks to certain ecological receptors from select heavy metals. During the 2010 SI

field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. Based on the frequent detections of certain metals, PAHs and pesticide compounds in soil and groundwater throughout FNOD, USACE is in the process of developing a work plan to conduct a site-wide soil and groundwater study to determine if the detections are related to site activities and if further action is required.

Table 6-1
Summary of Human Health and Ecological Screening Level Risk Assessment Results at FNOD

AOC	AOC 2		AOC 8		AOC 9	
Medium	**Human Health COPCs (HHRA) [a]**	**Ecological COPECs (SLERA) [a]**	**Human Health COPCs (HHRA) [a]**	**Ecological COPECs (SLERA) [a]**	**Human Health COPCs (HHRA) [a]**	**Ecological COPECs (SLERA) [a]**
Surface Soil	Arsenic and thallium exceed screening criteria. COPCs Arsenic does not exceed background and therefore no additional risks from FUDS related activities are determined. No unacceptable thallium risk based on WOE.	Lead and vanadium exceed screening criteria. COPECs Lead and vanadium do not exceed background and therefore no additional risks from FUDS related activities are determined.	Aluminum, arsenic, cobalt, iron, manganese, and thallium exceed screening criteria. COPCs. Listed COPCs exceed background. Potentially unacceptable risk from arsenic based on WOE.	Arsenic, copper, lead, mercury, selenium, vanadium, and zinc exceed screening criteria. COPECs. Listed COPECs with the exception of mercury exceed background. Potentially unacceptable risk from lead and vanadium based on WOE.	Aluminum, arsenic, iron, and thallium exceed screening criteria. COPCs. Listed COPCs exceed background. Potentially unacceptable risk from arsenic based on WOE.	Lead, mercury, selenium, and vanadium exceed screening criteria. COPECs. Listed COPECs with the exception of mercury exceed background. Potentially unacceptable risk from vanadium based on WOE
Subsurface Soil	Arsenic exceeds screening criteria. COPC Arsenic does not exceed background and therefore no additional risks from FUDS related activities are determined.	--	Aluminum, arsenic, cobalt, iron, manganese, and thallium exceed screening criteria . COPCs. Listed COPCs exceed background. Potentially unacceptable risk from arsenic based on WOE.	--	Aluminum, arsenic, iron, and thallium exceed screening criteria. COPCs. Listed COPCs except arsenic exceed background. No potentially unacceptable risk based on WOE.	--
Sediment	Arsenic exceeds screening criteria. COPC Arsenic exceeds background. No unacceptable risk determined by WOE.	Copper, iron, and lead exceed screening criteria. COPECs Iron, but not copper or lead, exceeds background. No unacceptable risk from iron determined by WOE.	--	--	--	--
Surface Water	Arsenic exceeds screening criteria. COPC Arsenic exceeds background. No unacceptable risk determined by WOE.	Aluminum, barium, calcium, copper, iron, magnesium, manganese, potassium, silver, and sodium exceed screening criteria. COPECs Listed COPECs with the exception of aluminum exceed background. No unacceptable FUDS related risk determined by WOE.	--	--	--	--
Groundwater	--	--	--	--	--	--

[a] Sources and derivations of screening levels for all receptors and environmental media in the HHRA and SLERA are detailed in Tables 5-1 through 5-3.

AOC= Area of concern
COPC = Chemical of potential concern.
COPEC = Chemical of potential environmental concern.
HHRA = Human health risk assessment.
SLERA = Screening level ecological risk assessment.
WOE = Weight-of-evidence evaluation

-- = Samples not analyzed for specific receptors within specific AOC, in accordance with CSM and SS-WP Addendum. In the case of groundwater the potentially completed pathways were identified in the SS-WP Addendum, however no sampling was completed. While the groundwater pathway may be potentially complete for AOCs investigated during this SI, any evaluation of the groundwater pathway has been deferred until completion of the ongoing Background Study. Therefore, no analyses of the groundwater pathway are presented in this SI Report.

7. RECOMMENDATIONS FOR FURTHER ACTION

7.0.1 Two MRSs were identified at the FNOD FUDS. MRS 1, James River Beach Dump Area, is comprised of approximately 2.1 acres of land. MRS 2, TNT Disposal Area, is comprised of approximately 9.8 acres of land; however, both areas have had extensive remedial work completed and some studies are ongoing. MRSPPs were prepared for each MRS indicating "No Longer Required," since the MRSs have already been sequenced for future actions.

7.0.2 Therefore, the focus of this SI was on AOC 2, Streeter Creek and Lakeview Drive Ground Scars; AOC 8, Track A Magazine Line; and AOC 9, Track A&B Burning Ground. Additionally, AOCs 10, 11, 12, 14, and 15 were inspected visually during this SI. The ten areas (two MRSs and eight AOCs) also were assessed by reviewing previous studies and historical documents.

7.0.3 Based on the results and conclusions of this SI, the following recommendations are provided:

MRS 1 (James River Beach Dump Area, S-2) – An NDAI designation for MMRP is recommended at MRS 1. Ongoing investigations and remedial actions for MC should continue to be conducted under the HTRW program, as appropriate. The acreage for this MRS should be changed in FUDSMIS from 1.5 acres to 2.1 acres based on the extent of previous removal and remedial actions.

MRS 2 (TNT Disposal Area, S-1) – An NDAI designation for MMRP is recommended at MRS 2. Ongoing investigations and remedial actions for MC should continue to be conducted under the HTRW program, as appropriate. The acreage for this MRS should be changed in FUDSMIS from 0.5 acres to 9.8 acres based on the extent of previous removal and remedial actions.

AOC 2 (Streeter Creek and Lakeview Drive Ground Scars) - No additional study or other action under MMRP is recommended at AOC 2. No MEC/MD have been observed at AOC 2 historically or during the 2010 SI activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction. No explosive constituents were detected in any media sampled at AOC 2 during this SI (surface soil, subsurface soil, sediment, or surface water). No unacceptable risks or no additional risks to human or ecological receptors were identified

from exposure to metal MC in the media sampled at AOC 2 during this SI. If the PA finds that this area was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for this area for the purposes of conducting additional MMRP work.

AOC 8 (Track A Magazine Line) - No additional study or other action under MMRP is recommended at AOC 8. No MEC/MD have been observed at AOC 8 historically or during the 2010 SI activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction. No explosive constituents were detected in the media sampled at AOC 8 during this SI (surface soil and subsurface soil). Potentially unacceptable risks to human receptors were identified from arsenic in surface and subsurface soil. Potentially unacceptable risks to ecological receptors were identified from lead and vanadium in surface soil. However, due to the absence of explosive constituents detections, these metals detections cannot be attributed to a munitions source. If the PA finds that this area was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for this area for the purposes of conducting additional MMRP work.

AOC 9 (Track A&B Burning Ground) - No additional study or other action under MMRP is recommended at AOC 9. No MEC/MD have been observed at AOC 9 historically or during the 2010 SI activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction. No explosive constituents were detected in the media sampled at AOC 9 during this SI (surface soil and subsurface soil). Potentially unacceptable risks to human receptors were identified from arsenic in surface soil. Potentially unacceptable risks to ecological receptors were identified from vanadium in surface soil. However, due to the absence of explosive constituents detections, these metals detections cannot be attributed to a munitions source. If the PA finds that this area was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for this area for the purposes of conducting additional MMRP work.

AOC 10 (Track G Magazine Line) - No additional study or other action under MMRP is recommended at AOC 10. No MEC/MD have been observed at AOC 10 historically or during the 2010 SI activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction. Per stakeholder agreements, no samples were collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by

HydroGeoLogic, it was concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. If the PA finds that this area was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for this area for the purposes of conducting additional MMRP work.

AOC 11 (Track H&I Magazine Line) - No additional study or other action under MMRP is recommended at AOC 11. No MEC/MD have been observed at AOC 11 historically or during the 2010 SI activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction. Per stakeholder agreements, no samples collected during the 2010 SI field activities. However, based on the sampling results from the 2006/2007 sampling event conducted by HydroGeoLogic, HydroGeoLogic concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. HydroGeoLogic concluded that several metals may pose potentially unacceptable risks to human or ecological receptors. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. Elevated metals should be addressed under an HTRW project, the establishment of which is pending the results of the PA currently being conducted by USACE. If the PA finds that this area was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for this area for the purposes of conducting additional MMRP work.

AOC 12 (Track J Magazine Line) - No additional study or other action under MMRP is recommended at AOC 12. No MEC/MD have been observed at AOC 12 historically or during the 2010 SI activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction. Per stakeholder agreements, no samples collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by Cape Environmental, Cape Environmental concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. In previous studies, arsenic and lead in surface soils and arsenic in subsurface soil exceeded USEPA screening values. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. Elevated metals should be addressed under an HTRW project, the establishment of which is pending the results of the PA currently being conducted by USACE. If the PA finds that this area was used for MEC disposal operations or MEC is

discovered in these areas in the future, USACE should establish an MRS for this area for the purposes of conducting additional MMRP work.

AOC 14 (Track K Magazine Line) - No additional study or other action under MMRP is recommended at AOC 14. No MEC/MD have been observed at AOC 14 historically or during the 2010 SI activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction. Per stakeholder agreements, no samples collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by ICOR, Ltd., ICOR, Ltd. concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. USACE concluded that there may be potential risks to certain ecological receptors from select heavy metals. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. Elevated metals should be addressed under an HTRW project, the establishment of which is pending the results of the PA currently being conducted by USACE. If the PA finds that this area was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for this area for the purposes of conducting additional MMRP work.

AOC 15 (Track K Magazine Line Landfill) - No additional study or other action under MMRP is recommended at AOC 15. No MEC/MD have been observed at AOC 15 historically or during the 2010 SI activities. The overall MEC hazard was evaluated as low based on the absence of a MEC source, site characteristics, and potential for human interaction. Per stakeholder agreements, no samples collected during the 2010 SI field activities. However, based on the sampling results from the 2006 sampling event conducted by ICOR, Ltd., it was concluded that there were no risks to human or ecological receptors from explosive constituents in surface soil, subsurface soil, or groundwater. USACE concluded that there may be potential risks to certain ecological receptors from select heavy metals. During the 2010 SI field event, extensive cultural debris (including construction and metallic debris) was noted throughout the AOC. Elevated metals should be addressed under an HTRW project, the establishment of which is pending the results of the PA currently being conducted by USACE. If the PA finds that this area was used for MEC disposal operations or MEC is discovered in these areas in the future, USACE should establish an MRS for this area for the purposes of conducting additional MMRP work.

7.0.4 Neither a TCRA nor a NTCRA are recommended for AOCs 2, 8, 9, 10, 11, 12, 14, or 15 at Nansemond Ordnance Depot.

7.0.5 Additional MRSs may be identified and subsequent SIs conducted if other MEC-related areas of the site are presented in the ongoing supplemental PA being prepared by USACE Mississippi Valley St. Louis District.

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APPENDIX A – SCOPE OF WORK

Located on CD-ROM.

APPENDIX B – TECHNICAL PROJECT PLANNING MEMORANDUM

- Data Quality Objective Verification Worksheets
- Technical Project Planning #1 Memorandum (Located on CD-ROM)
- Technical Project Planning #2 Memorandum (Located on CD-ROM)
- Public Notice of Availability of Munitions Response Site Prioritization Protocol (Located on CD-ROM)

Data Quality Objective Verification Worksheet

Site: **Former Nansemond Ordnance Depot (FNOD), Suffolk, VA**
Project: FUDS MMRP SI Project Number: **C03VA004502**
DQO Statement Number: **1 of 3**

DQO Element Description	Site-Specific DQO Statement	Attained?	Required Corrective Action
Intended Data Use(s):			
Project Objective(s) Satisfied	Determine if the site requires additional investigation through a remedial investigation/feasibility study (RI/FS) or if the site may be recommended for No Department of Defense Action Indicated (NDAI) designation based on the presence or absence of munitions and explosives of concern (MEC) and munitions constituents (MC). (Per stakeholder agreement, previous investigations for all 14 areas; visual reconnaissance completed by Alion at AOCs 2, 8, 9, 10, 11, 12, 14, and 15; and analog qualitative reconnaissance and analytical sampling completed by Alion at AOCs 2, 8, and 9 will be used to meet this DQO.)	Yes ☒ No ☐	
Data Needs Requirements:			
Data User Perspective(s)	Risk-MEC and MC, Compliance	Yes ☒ No ☐	
Contaminant or Characteristic of Interest	MEC or Material Potentially Presenting an Explosive Hazard (MPPEH) and MC.	Yes ☒ No ☐	
Media of Interest	MEC: Surface and subsurface MC: Surface and subsurface soil, sediment, and surface water	Yes ☒ No ☐	
Required Sampling Locations or Areas	MEC and MC: Areas where military munitions-related operations occurred and/or where MEC or MPPEH has been identified historically based on existing documentation and interviews.	Yes ☒ No ☐	
Number of Samples Required	**MEC**: Analog geophysical and visual reconnaissance data will be collected to accomplish this objective at AOC 2, 8, and 9. These data will be collected using "meandering path" to and from the sampling points. The UXO Technician will collect data on an approximate 6-ft wide path using the geophysical equipment. Once at the individual sampling point, the geophysical equipment will be used to assess an approximately 25-ft diameter circle for anomalies around the sampling point as site conditions permit. The estimated visual reach of observations is up to 12 ft, but may be limited by the presence of vegetation. Only visual reconnaissance data will be collected to accomplish this objective at AOC 10, 11, 12, 14 and 15. In some areas, there may be limitations to the ability to complete geophysical and visual observations. The total estimated area on the paths to/from the sampling locations is approximately 34,264 ft^2 and the area around the sampling locations is approximately 5,887 ft^2 *(Figure 8 and 9 in the SS-WP).* The total estimated area along the proposed visual reconnaissance paths is approximately 99,204 ft^2 assuming 12 feet of visibility *(Figure 9 in the SS-WP).*	Yes ☒ No ☐	

Data Quality Objective Verification Worksheet			
Site: **Former Nansemond Ordnance Depot (FNOD), Suffolk, VA** Project: FUDS MMRP SI Project Number: **C03VA004502** DQO Statement Number: **1 of 3**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
	MC: Twelve subsurface soil samples, twelve surface soil samples, two sediment samples and two surface water samples will be collected at AOC 2, 8, and 9. In addition, QC samples also will be collected. No background soil samples are proposed as background analytical data from previous studies will be obtained from USACE. Two background co-located surface water and sediment samples will be collected.		
Reference Concentration of Interest or Other Performance Criteria	**MEC:** If historic data indicate the presence of MEC and one anomaly classified as of MPPEH, or confirmed MEC is found with the magnetometer, or if physical evidence indicating the presence of MEC is found during the visual inspection, then an RI/FS may be recommended. If no anomalies, MPPEH, or confirmed MEC are found, or if the UXO Technician indicates that there is no potential hazard from past use of munitions or MEC discoveries, then an NDAI designation may be recommended. In each of these instances, all lines of evidence (*e.g.*, historic data, field data, etc.) will be used to make a final decision for an NDAI designation or RI/FS. In both instances (RI/FS or NDAI designation), all lines of evidence (*e.g.*, historic data, field data, background concentration of metals, etc. for both MEC and MC) will be used to make a final decision for an NDAI designation or RI/FS. **MC:** If the maximum concentrations measured at the site exceed USEPA Regional Screening Levels based on current and future land use, or USEPA interim ecological risk screening values, or site-specific background levels (highest value and mean value), then an RI/FS may be recommended for the site. If the maximum concentrations measured at the site do not exceed the USEPA regional screening levels or ecological risk screening values, then an NDAI designation may be recommended. In summary, all lines of evidence including secondary lines of evidence, such as historic data, field data, comparison to regional and/or site background concentration ranges for metals, and comparison to state screening/cleanup criteria, will be used to make a final decision for an NDAI designation or RI/FS. Screening values selected for comparison at this site are specified in the chemical-specific measurement quality objective (MQO) tables.	Yes ☒ No ☐	
Appropriate Sampling and Analysis Methods:			
Sampling Method and Depths	**MEC:** Geophysics with a handheld analog magnetometer, which will be used to collect related data, is accurate to an approximate depth of 2 ft.	Yes ☒ No ☐	

Data Quality Objective Verification Worksheet			
Site: **Former Nansemond Ordnance Depot (FNOD), Suffolk, VA** Project: FUDS MMRP SI Project Number: **C03VA004502** DQO Statement Number: **1 of 3**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
	Global Positioning System (GPS) equipment will be used to log locations of MEC items encountered by the magnetometer. Visual observations will provide a continuous source of additional information which will be noted in the field log book with GPS coordinates. Photographs also will be used as an additional documentation method. Geophysical methods/procedures are described in detail in Section 3 of the SS-WP, and the Field Activities section of the programmatic field sampling plan (PFSP). **MC:** Sampling methods for MC are described in detail in Section 4 of the SS-WP and Field Activities section of the PFSP.		
Analytical Method	**MEC:** Analytical methods are not used with analog magnetometry. However, trained UXO professionals, engineers, and scientists will review all data to determine whether evidence gathered indicates the presence or absence of MEC. This analysis will be subject to an independent review within the Alion Team, by the USACE North Atlantic Norfolk (CENAO), USACE Baltimore District Design Center (CENAB), and USACE Center of Expertise. **MC:** The methods that can be used for analysis include the following: Explosives Methods– 8330A, Metals Methods–6010C, 6020A, 7471B (soil) and 7470A (water); Explosives Prep Methods –8330A; Metals Prep Method – 3050B.	Yes ☒ No ☐	

Data Quality Objective Verification Worksheet			
Site: **FNOD, Suffolk, VA** Project: FUDS MMRP SI Project Number: **C03VA004502** DQO Statement Number: **2 of 3**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
Intended Data Use(s):			
Project Objective(s) Satisfied	Determine the potential need for a Time-Critical Removal Action (TCRA) for MEC and MC by collecting data from previous investigations/reports, conducting site visits, performing analog geophysical activities, and by collecting MC samples. (Per stakeholder agreement, previous investigations for all 14 areas; visual reconnaissance completed by Alion at AOCs 2, 8, 9, 10, 11, 12, 14, and 15; and analog qualitative reconnaissance and analytical sampling completed by Alion at AOCs 2, 8, and 9 will be used to meet this DQO.)	Yes ☒ No ☐	
Data Needs Requirements:			
Data User Perspective(s)	Risk-MEC/MC, Compliance	Yes ☒ No ☐	
Contaminant or Characteristic of Interest	MEC or Material Potentially Presenting an Explosive Hazard (MPPEH) and MC.	Yes ☒ No ☐	
Media of Interest	MEC: Surface and subsurface MC: Surface and subsurface soil, sediment, and surface water	Yes ☒ No ☐	
Required Sampling Locations or Areas	Areas where military munitions-related operations occurred and/or where MEC or MPPEH has been identified historically based on existing documentation and interviews *[Figure 8 in the SS-WP]*.	Yes ☒ No ☐	
Number of Samples Required	Refer to DQO 1 for MC/MEC sampling parameters.	Yes ☒ No ☐	
Reference Concentration of Interest or Other Performance Criteria	If MC is reported in samples collected at the FUDS at concentrations exceeding screening criteria and those exceedances result in unacceptable risk and an imminent threat to receptors as identified through human health and ecological risk assessments or if one piece of confirmed MEC is found with the magnetometer or if physical evidence indicating the presence of MEC is found during the visual inspection, and if the item(s) is determined by a qualified UXO Technician, explosive ordnance disposal (EOD) unit, and/or the USACE to be an immediate or imminent threat, then one of two actions may be initiated: ***TCRA***: If there is a complete pathway between source and receptor and the MEC and the situation is viewed as an "imminent danger threat posed by the release or threat of a release, where cleanup or stabilization actions must be initiated within six months to reduce risk to public health or the environment", the Alion Team will immediately notify the Military Munitions Design Center Project Manager at USACE and the property owner. USACE will determine, with input	Yes ☒ No ☐	

Data Quality Objective Verification Worksheet			
Site: **FNOD, Suffolk, VA** Project: FUDS MMRP SI Project Number: **C03VA004502** DQO Statement Number: **2 of 3**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
	from the Alion Team and stakeholders, whether or not a TCRA will be implemented. ***Non-TCRA***: A non-TCRA (NTCRA) may be initiated in response to a release or threat of release that poses a risk where more than six months planning time is available.		
Appropriate Sampling and Analysis Methods:			
Sampling Method and Depths	**MEC:** Geophysical methods/procedures are described in detail in Section 3 of the SS-WP and the Field Activities section of the programmatic field sampling plan (PFSP). **MC:** Sampling methods for MC are described in detail in Section 4 of the SS-WP and Field Activities section of the PFSP.	Yes ☒ No ☐	
Analytical Method	Refer to DQO 1 for MEC and MC analytical methods to be incorporated.	Yes ☒ No ☐	

Data Quality Objective Verification Worksheet

Site: **FNOD, Suffolk, VA**

Project: FUDS MMRP SI Project Number: **C03VA004502**

DQO Statement Number: **3 of 3**

DQO Element Description	Site-Specific DQO Statement	Attained?	Required Corrective Action
Intended Data Use(s):			
Project Objective(s) Satisfied	Collect the additional data necessary to the complete the Munitions Response Site Prioritization Protocol (MRSPP). (Per stakeholder agreements, no analytical sampling or reconnaissance will be completed by Alion at MRS 1 or MRS 2. The MRSPP will be completed for MRS 1 and MRS 2 using data from previous studies completed in these areas. Alion will complete analytical sampling and reconnaissance at AOCs 2, 8, and 9 and visual reconnaissance at AOCs 9, 10, 11, 14, and 15. Per USACE guidance, an MRSPP score is not completed for AOCs.)	Yes ☒ No ☐	
Data Needs Requirements:			
Data User Perspective(s)	Risk-MEC and MC, Compliance	Yes ☒ No ☐	
Contaminant or Characteristic of Interest	Explosive Hazard Evaluation (EHE), Chemical Warfare Materiel Hazard Evaluation (CHE), and Health Hazard Evaluation (HHE). For the EHE and CHE modules, factors evaluated include the details of the hazard, accessibility to the Munitions Response Site (MRS), and receptor information. HHE factors include an evaluation of MC and any non-munitions-related incidental contaminants present, receptor information, and details pertaining to environmental migration pathways. Typical information compiled includes details pertaining to historical use, current/future use and ownership, cultural/ecological resources, and structures.	Yes ☒ No ☐	
Media of Interest	Surface and subsurface soil, sediment, and surface water	Yes ☒ No ☐	
Required Sampling Locations or Areas	Areas where MEC has been identified historically and where MC sampling is recommended. Per stakeholder agreements, samples will be collected only at AOCs 2, 8, and 9.	Yes ☒ No ☐	
Number of Samples Required	Refer to DQOs 1and 2 for related sampling required.	Yes ☒ No ☐	
Reference Concentration of Interest or Other Performance Criteria	An MRS priority is determined by USACE based on integrating the ratings from the EHE, CHE, and HHE modules. Refer to Federal Register/Vol. 70, No. 192/Wednesday, October 5, 2005/Rules and Regulations.	Yes ☒ No ☐	
Appropriate Sampling and Analysis Methods:			
Sampling Method and Depths	Data gathering prior to field activities as well as additional data gathered during field reconnaissance and sampling (DoD 2005).	Yes ☒ No ☐	
Analytical Method	Refer to DQOs 1and 2 for associated methods.	Yes ☒ No ☐	

APPENDIX C – INTERVIEW DOCUMENTATION

ALION
SCIENCE AND TECHNOLOGY

COMMUNICATIONS RECORD FORM

Date: 6 August 2010

Contract Number:W912DY-04-D-0017

Delivery Order #: 00170001

Distribution: FUDS MMRP SI of Former Nansemond Ordnance Depot

Person Contacted: Renee Hall, Engineer representing the City of Suffolk

Affiliation: Virginia Department of Health, Office of Drinking Water, Southeast Virginia Office

Type of Contact: Telephone conversation (757-683-2000)

Person Making Contact: Cheryl Gannon, Alion Science and Technology

Communications Summary: The purpose of this phone call was to determine if public groundwater wells are present on the Former Nansemond Ordnance Depot (FNOD) or in the vicinity of FNOD. Ms. Hall indicated that that information is not publicly available, but she could check her database to see if there are any wells monitored by the Virginia Department of Health (VDH) on FNOD or in the vicinity. Ms. Hall indicated that there were not any wells presently monitored by VDH. Ms. Gannon inquired as to the types of groundwater wells that would be monitored by VDH. She indicated that community (serve at least 15 residential connections or at least 25 residential consumers), non-transient non-community (serves 25 or more of the same persons for six months or more each year), and transient non-community (serves 25 or more individuals daily, but the individuals served vary each day) waterworks are monitored by VDH.

APPENDIX D – FIELD NOTES AND FIELD FORMS

- Daily Quality Control Reports
- Field Forms
- Logbook
- Chain of Custody

Alion Science and Technology
DAILY QUALITY CONTROL REPORT

Report Number:	03-22-10-01	Date:	03-22-10
Project Name:	Nansemond Ordnance Depot C03VA004502	Contract Number:	W912DY-04-D-0017
Location of Work:	Former Nansemond Ordnance Depot, Suffolk, VA		
Description of Work: Geophysical and visual reconnaissance and surface soil and subsurface soil sampling.			
Weather: overcast	**Rainfall**: light	**Temperature:** Min. 60	Max. 65

1. Work performed today by Alion.

The Alion field team (John Healey-UXO Technician and Cheryl Gannon in the morning and John Healey, Cheryl Gannon, and Maria Borejsza-Wysocka in the afternoon) discussed objectives and health and safety concerns related to field work upon arrival at FUDS. John Healey and Cheryl Gannon performed visual reconnaissance (meandering paths) in the morning. John Healey briefed the safety plan to Maria Borejsza-Wysocka in the early afternoon upon her arrival and the three team members performed analog reconnaissance and sample clearance (with Whites XLT) and sample collection in the afternoon.

Reconnaissance Acreage / Discussion

John Healey and Cheryl Gannon conducted visual reconnaissance in a meandering path fashion at AOCs 12, 14, and 15 in the morning totaling 3.25 acres.

John Healey, Cheryl Gannon, and Maria Borejsza-Wysocka conducted visual and analog reconnaissance in a meandering path (totaling 3.27 acres with the Whites XLT) and collected surface and subsurface soil samples at AOCs 2, 8, and 9 in the afternoon. Additionally, analog reconnaissance was conducted around the sample locations on approximately 0.09 acres.

Total reconnaissance performed today (including visual and analog equipment) was 6.61 acres.

Samples Collected:

FNOD-AOC8-SS-01-01	FNOD-AOC8-SB-02-01	FNOD-AOC9-SS-01-01
FNOD-AOC9 SB-02-01	FNOD-AOC9-SS-01-02	FNOD-AOC9-SB-02-02
FNOD-AOC8-SS-01-02	FNOD-AOC8-SB-02-02	FNOD-AOC9-SS-01-03
FNOD-AOC9 SB-02-03	FNOD-AOC9 SB-02-FD	FNOD-AOC9-SS-01-04
FNOD-AOC9-SB-02-04	FNOD-AOC2-SS-01-01	FNOD-AOC2-SB-02-01
FNOD-AOC8-SS-01-03	FNOD-AOC8-SS-01-FD	FNOD-AOC8-SB-02-03

2. Work performed today by Subcontractors.

None.

3. Type and results of Control Phases and Inspection. (Indicate whether Preparatory – P, Initial – I, or Follow-Up – F and include satisfactory work completed or deficiencies with actions to be taken)

No preparatory phase inspections for field work were necessary prior to mobilizing to Nansemond Ordnance Depot. Initial phase of inspections were completed upon site arrival. No follow-up inspections were completed today. Satisfactory work completed.

4. List type and location of tests performed and results of these tests.

Two Whites XLT units were checked prior to arriving at FUDS and were in working order. Both analog detectors were checked upon arrival at FUDS prior to beginning field work and one unit was not able to be calibrated. The other unit was used today and for the remainder of the field event for analog reconnaissance at this FUDS.

GPS Benchmark control point coordinates were collected in the morning and then again after the completion of fieldwork in the afternoon (see below).

Benchmark is “Z 282” (PID FX0194) located east of Garland Drive and south of High Street West in

Portsmouth, VA. The benchmark is located in the road right-of-way of High Street West and is marked by a benchmark disk set in a concrete monument. The benchmark is located in the Bowers Hill (1986) USGS Quadrangle.

Benchmark Coordinates: 36 51 32. North, 076 23 20. West (Latitude, Longitude). Benchmark is a vertical order benchmark (a horizontally controlled benchmark was not available in the vicinity of the field area). Alion converted to UTM Northing 4080119 meters (m), Easting 376191 m (UTM, Zone 18N, Conus 1983).

Morning GPS reading: Northing 4080113.997 meters (m), Easting 376179.715 m, (UTM, Zone 18N, Conus 1983).

Afternoon GPS reading: Northing 4080114.627 m, Easting 376179.585 m, (UTM, Zone 18N, Conus 1983). Margin of error is acceptable.

5. List material and equipment received.

Soil and water bottle ware was provided by TestAmerica.
All other equipment (GPS unit, sampling equipment) supplied by Alion.

6. Submittals reviewed. (Include Transmittal No., Item No., Spec/Plan Reference, by whom, and any action.

None.

7. Off-site surveillance activities, including action taken.

None.

8. Job Safety. (Report safety violations observed and actions taken)

No safety violations.

9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)

Performed meandering visual reconnaissance in and around AOCs 12, 14, and 15. Performed meandering analog reconnaissance with Whites XLT all-metals detector in and around AOCs 2, 8, and 9 including surrounding sample locations. One co-located surface soil and subsurface soil sample location was moved to be located in proximity to historical aerial photograph observations and one co-located surface soil and subsurface soil sample location was moved slightly due to extensive vegetation (thorns). No subsurface anomalies were detected with the Whites XLT. Surface cultural debris was noted in several locations at the FUDS.

No health and safety issues and/or violations occurred during field work. No confirmed MEC or MD was found. Photos were taken in various areas within the study area as well as at sampling locations.

Per USACE direction on 22 March 2010, HMX and RDX were added to the list of analytes at the FUDS.

Alion Science and Technology Verification: On behalf of Alion, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

Curtis Mitchell
Quality Control System Manager

DAILY SITE SAFETY JOURNAL
Page 1 of 2

DATE: March 22, 2010	PROJECT: Nansemond Ordnance Depot
Field UXO Technician: John Healey	

AREA / ITEMS INSPECTED	SAT	UNSAT
Proper work attire (PPE)	✓	
Vehicle condition	✓	
Emergency equipment	✓	
Safe demolition procedures	N/A	
Field office, inside	✓	
Field office grounds	✓	

[ ] Last Work Days Events
[ ] Site Description
[ ] Work Area Description
[ ] Work Area Hazards
[ ] On-Site Emergency
[ ] Site Evacuation Procedures
[ ] Emergency Response Personnel
[ ] Emergency Telephone Numbers
[ ] Directions to Hospital
[ ] First Aid
[ ] Heat / Cold Stress
[ ] Asbestos Awareness & ID
[ ] Ticks
[ ] Safety Concerns
[ ] Personnel Protective Equipment
[ ] Safe Work Practices
[ ] Emergency Response Plan
[ ] Chemical Hazards
[ ] Emergency Equipment, Location
[ ] Emergency Equipment, by Type
[ ] Emergency Decontamination
[ ] Safe Work Practices - General
[ ] Site specific OE Safety Precautions
[ ] Site specific OE Identification Features
[ ] Liquid Contaminates / Landfill Material
[ ] Other _____

Comments:

UXO Technician in Field SIGNATURE:

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 3/22/10

	Name	Affiliation
1	Cheryl Gannon	Alion
2	[illegible]	~~HPA~~
3	Maria Borejsza-Wysocka	Alion
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HEALTH AND SAFETY PLAN REVIEW RECORD

SITE: Nansemond Ordnance Depot

ALION Project No. C03VA004502

I have read the Health and Safety Plan (s) and have been briefed on the nature, level, and degree of exposure likely as a result of participation of field activities. I agree to conform to all the requirements of this Plan.

Name	Signature	Affiliation	Date
Cheryl Gannon		Alion	3/22/10
JoAn Heaney		APS	3-22-10
Maria Bonifaza-Wyatt		Alion	3/22/2010

SITE ENTRY AND EXIT LOG

Project/Site : Nansemond Ordnance Depot

Project No.: C03VA004502

Date	Name	Representing	Time In	Time Out
3/22/10	Cheryl Gannon	Alion	08:00	10:40
3·22·10	JOAN HEALEY	~~HPA~~	0800	1040
3/22/10	Cheryl Gannon	Alion	12:00	17:35
3·22·10	JOAN HEALEY	~~HPA~~	1200	1735
3/22/2010	Monika Danuta Wypych	Alion	~~08:00~~ 12:00 MBW	~~17:35~~ MBW

Alion Science and Technology
DAILY QUALITY CONTROL REPORT

Report Number:	03-23-10-01	Date:	03-23-10
Project Name:	Nansemond Ordnance Depot C03VA004502	Contract Number:	W912DY-04-D-0017
Location of Work:	Former Nansemond Ordnance Depot, Suffolk, VA		
Description of Work: Geophysical and visual reconnaissance and surface soil, subsurface soil, sediment, and surface water sampling.			
Weather: overcast	**Rainfall**: None	**Temperature:** Min. 45	Max. 55

1. Work performed today by Alion.

The Alion field team (John Healey-UXO Technician, Cheryl Gannon, and Maria Borejsza-Wysocka) discussed objectives and health and safety concerns related to field work upon arrival at FUDS. The Alion field team performed analog reconnaissance and sample clearance (with Whites XLT) and sample collection.

Reconnaissance Acreage / Discussion

John Healey, Cheryl Gannon, and Maria Borejsza-Wysocka conducted visual and analog reconnaissance in a meandering path (totaling 2.83 acres with the Whites XLT), collected surface and subsurface soil, surface water, and sediment samples at AOCs 2 and 8, and collected background surface water and sediment samples. Additionally, analog reconnaissance was conducted around the surface and subsurface soil sample locations on approximately 0.04 acres.

Total reconnaissance performed today (including visual and analog) was 2.87 acres.

Samples Collected:

FNOD-AOC8-SS-01-04	FNOD-AOC8-SB-02-04	FNOD-AOC8-SS-01-05
FNOD-AOC8 SB-02-05	FNOD-AOC8-SS-01-06	FNOD-AOC8-SB-02-06
FNOD-AOC8-SS-01-07	FNOD-AOC8-SB-02-07	FNOD-AOC2-SW-00-01
FNOD-AOC2-SW-00-FD	FNOD-AOC2-SD-01-01	FNOD-AOC2-SW-00-02
FNOD-AOC2-SD-01-02	FNOD-BG-SW-00-01	FNOD-BG-SD-01-01
FNOD-BG-SW-00-02	FNOD-BG-SD-01-02	

2. Work performed today by Subcontractors.

None.

3. Type and results of Control Phases and Inspection. (Indicate whether Preparatory – P, Initial – I, or Follow-Up – F and include satisfactory work completed or deficiencies with actions to be taken)

No preparatory phase inspections for field work were necessary prior to mobilizing to Nansemond Ordnance Depot. Initial phase of inspections were completed upon site arrival. No follow-up inspections were completed today. Satisfactory work completed.

4. List type and location of tests performed and results of these tests.

The Whites XLT unit was checked upon arrival at FUDS prior to beginning field work and was found to be in working order. It was used for analog reconnaissance at this FUDS.

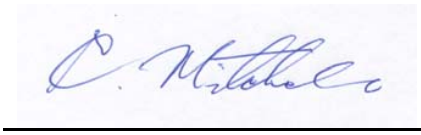
GPS Benchmark control point coordinates were collected in the morning and then again after the completion of fieldwork in the afternoon (see below).

Benchmark is “Z 282” (PID FX0194) located east of Garland Drive and south of High Street West in Portsmouth, VA. The benchmark is located in the road right-of-way of High Street West and is marked by a benchmark disk set in top of a concrete monument. The benchmark is located in the Bowers Hill (1986) USGS Quadrangle.

Benchmark Coordinates: 36 51 32. North, 076 23 20. West (Latitude, Longitude). Benchmark is a vertical order

benchmark (a horizontally controlled benchmark was not available in the vicinity of the field area). Alion converted to UTM Northing 4080119 meters (m), Easting 376191 m (UTM, Zone 18N, Conus 1983).
Morning GPS reading: Northing 4080114.809 meters (m), Easting 376179.116 m, (UTM, Zone 18N, Conus 1983).
Afternoon GPS reading: Northing 4080114.473 m, Easting 376179.366 m, (UTM, Zone 18N, Conus 1983). Margin of error is acceptable.
5. List material and equipment received.
Soil and water bottle ware was provided by TestAmerica. All other equipment (GPS unit, sampling equipment) supplied by Alion.
6. Submittals reviewed. (Include Transmittal No., Item No., Spec/Plan Reference, by whom, and any action.
None.
7. Off-site surveillance activities, including action taken.
None.
8. Job Safety. (Report safety violations observed and actions taken)
No safety violations.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
Performed meandering analog reconnaissance with Whites XLT all-metals detector in and around AOCs 2 and 8 including surrounding sample locations. Two co-located surface soil and subsurface soil sample locations were moved due to the presence of a building and a road where the samples were proposed. One co-located surface water and sediment sample was moved slightly due to access issues (steep ravine). One co-located surface water and sediment background sample was moved due to site access issues (barbed wire fencing). One subsurface anomaly was detected with the Whites XLT at a sample location so the sample was moved slightly. Surface cultural debris was noted in several locations at the FUDS. No health and safety issues and/or violations occurred during field work. No confirmed MEC or MD was found. Photos were taken in various areas within the study area as well as at sampling locations.

Alion Science and Technology Verification: On behalf of Alion, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.



Curtis Mitchell
Quality Control System Manager

DAILY SITE SAFETY JOURNAL
Page 1 of 2

DATE: March 23, 2010	PROJECT: Nansemond Ordnance Depot
Field UXO Technician: John Healey	

AREA / ITEMS INSPECTED	SAT	UNSAT
Proper work attire (PPE)	✓	
Vehicle condition	✓	
Emergency equipment	✓	
Safe demolition procedures	N/A	
Field office, inside	✓	
Field office grounds	✓	

[ ] Last Work Days Events
[ ] Site Description
[ ] Work Area Description
[ ] Work Area Hazards
[ ] On-Site Emergency
[ ] Site Evacuation Procedures
[ ] Emergency Response Personnel
[ ] Emergency Telephone Numbers
[ ] Directions to Hospital
[ ] First Aid
[ ] Heat / Cold Stress
[ ] Asbestos Awareness & ID
[ ] Ticks
[ ] Safety Concerns
[ ] Personnel Protective Equipment
[ ] Safe Work Practices
[ ] Emergency Response Plan
[ ] Chemical Hazards
[ ] Emergency Equipment, Location
[ ] Emergency Equipment, by Type
[ ] Emergency Decontamination
[ ] Safe Work Practices - General
[ ] Site specific OE Safety Precautions
[ ] Site specific OE Identification Features
[ ] Liquid Contaminates / Landfill Material
[ ] Other _____

Comments:

UXO Technician in Field SIGNATURE:

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 3/23/10
Page 2 of 2

	Name	Affiliation
1	Cheryl Gannon	Alion
2	John Hensley	~~HPA~~
3	Monica Bowejko-Wysocka	Alion
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HEALTH AND SAFETY PLAN REVIEW RECORD

SITE: Nansemond Ordnance Depot

ALION Project No. C03VA004502

I have read the Health and Safety Plan (s) and have been briefed on the nature, level, and degree of exposure likely as a result of participation of field activities. I agree to conform to all the requirements of this Plan.

Name	Signature	Affiliation	Date
Cheryl Gannon		Alion	3/23/10
Jordan Heaberg		Alion	3-23-10
Marva Tompkins-Wyatt		Alion	3/23/2010

SITE ENTRY AND EXIT LOG

Project/Site : Nansemond Ordnance Depot

Project No.: C03VA004502

Date	Name	Representing	Time In	Time Out
3/23/10	Cheryl Gannon	Alion	08:00	15:20
3.23.10	Jordan Heaven	~~AEA~~	0800	1520
3/23/2010	Maria Teresa Laporta	Alion	0800	15:20

Chain of Custody Record

Sampler ID _____

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☐

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124-280 (0508)

Client	Project Manager	Date	Chain of Custody Number
Alion Science and Technology	Cheryl Gannon	3/23/10	120975
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 1 of 3**
3975 Fair Ridge Drive, Suite 125 South	703-217-1626		
City / **State** / **Zip Code**	**Site Contact**	**Lab Contact**	
Fairfax / VA / 22033			
Project Name and Location (State)	**Carrier/Waybill Number**		
Nansemond Ordnance Depot (FNOD), VA			
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: 8330A *1 (see note)	6010C *2 (see note)	6020A *3 (see note)	7471A mercury	7471B mercury	7470A mercury	7471B mercury	Special Instructions/ Conditions of Receipt
FNOD-AOC2-SS-01-01	3/22/10	16:15				X	2						X	X	X	X	X		X	Notes: *1-8330A-Analytes
FNOD-AOC2-SB-02-01	3/22/10	16:30				X	2												X	2,4-DNT; 2,6-DNT; 2Am-4,6 DNT; 2-NT; 3-NT; 4-NT; 4-am
FNOD-AOC2-SW-00-01	3/23/10	13:00		X			2		1									X		2,6-DNT; 2,4,6-TNT;
FNOD-AOC2-SW-00-02	3/23/10	13:30		X			6		3									X		MS/MSD
FNOD-AOC2-SD-01-01	3/23/10	13:10			X		2												X	1,3-DNB; 1,3,5-TNB; NG;
FNOD-AOC2-SD-01-02	3/23/10	13:40			X		2												X	NB; Tetryl
FNOD-AOC8-SS-01-01	3/22/10	12:30				X	2												X	*2-6010C-Analytes Al, Ca, Fe; Mg, K; Na
FNOD-AOC8-SS-01-02	3/22/10	14:40				X	2												X	
FNOD-AOC8-SS-01-03	3/22/10	16:55				X	2												X	*3-6020A-Analytes Sb; As; Ba; Be; Cd; Cr; Co; Cu; Pb; Mn; Ni; Se; Ag; Tl; V; Zn
FNOD-AOC8-SS-01-04	3/23/10	08:25				X	2												X	
FNOD-AOC8-SS-01-05	3/23/10	08:55				X	2												X	
FNOD-AOC8-SS-01-06	3/23/10	09:30				X	2												X	

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	3/23/10	18:30	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Chain of Custody Record

Sampler ID _____

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☐

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124-280 (0508)

Client	Project Manager	Date	Chain of Custody Number
Alion Science and Technology	Cheryl Gannon	3/23/10	120976
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 2 of 3**
398 Fair Ridge Drive, Suite 125 South	703-217-1626		
City / **State** / **Zip Code**	**Site Contact**	**Lab Contact**	
Fairfax / VA / 22033			
Project Name and Location (State)	**Carrier/Waybill Number**		
Nansemond Ordnance Depot (FNOD), VA			
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Analysis: 8330A *1 see note	6010C *2 see note	6020A *3 see note	7470A-mercury	7471B-mercury	Special Instructions/ Conditions of Receipt
FNOD-AOC8-SS-01-07	3/23/10	10:05				X	2						X	X	X		X	
FNOD-AOC8-SB-02-01	3/22/10	12:50				X	6											MS/MSD
FNOD-AOC8-SB-02-02	3/22/10	14:55				X	2											
FNOD-AOC8-SB-02-03	3/22/10	17:10				X	2											
FNOD-AOC8-SB-02-04	3/23/10	08:40				X	2											
FNOD-AOC8-SB-02-05	3/23/10	09:10				X	2											
FNOD-AOC8-SB-02-06	3/23/10	09:45				X	2											
FNOD-AOC8-SB-02-07	3/23/10	11:20				X	2											
FNOD-AOC8-SS-01-01	3/22/10	13:15				X	6											MS/MSD
FNOD-AOC9-SS-01-02	3/22/10	13:55				X	2											
FNOD-AOC9-SS-01-03	3/22/10	15:30				X	2											
FNOD-AOC9-SS-01-04	3/22/10	15:55				X	2						↓	↓	↓		↓	

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other_____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	3/23/10	18:30	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Chain of Custody Record

Sampler ID _____

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☐

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124-280 (0508)

Client	Project Manager	Date	Chain of Custody Number
Alion Science and Technology	Cheryl Gannon	3/23/10	120977
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 3 of 3**
3975 Fair Ridge Drive, Suite 125 South	703-217-1626		
City / **State** / **Zip Code**	**Site Contact** / **Lab Contact**		
Fairfax / VA / 22033			
Project Name and Location (State)	**Carrier/Waybill Number**		
Nansemond Ordnance Depot (FNOD), VA			
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis (Attach list if more space is needed): 8330A #1 see note	6010C #2 see note	6020A #3 see note	7470A-mercury	7471B-mercury	Special Instructions/ Conditions of Receipt
FNOD-AOC9-SB-02-01	3/22/10	13:25				X	2						X	X	X		X	
FNOD-AOC9-SB-02-02	3/22/10	14:10				X	2						X	X	X		X	
FNOD-AOC9-SB-02-03	3/22/10	15:45				X	2						X	X	X		X	
FNOD-AOC9-SB-02-04	3/22/10	16:10				X	2						X	X	X		X	
FNOD-BG-SD-01-01	3/23/10	14:55			X		2							X	X		X	
FNOD-BG-SW-00-01	3/23/10	14:50		X			1		1					X	X	X		
FNOD-BG-SD-01-02	3/23/10	15:10			X		2							X	X		X	
FNOD-BG-SW-00-02	3/23/10	15:05		X			1		1					X	X	X		
FNOD-AOC9-SB-02-FD	3/22/10	15:50				X	2						X	X	X		X	
FNOD-AOC8-SS-01-FD	3/22/10	17:00				X	2						X	X	X		X	
FNOD-AOC2-SW-00-FD	3/23/10	13:05		X			2		1				X	X	X	X		

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	3/23/10	18:30	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Nansemond Ordnance Depot Chain-of-Custody and Sample Analyses Updates/Corrections:

25 March 2010:
Per USACE direction on 22 March 2010, HMX and RDX were added to the list of analytes at the FUDS, which was a deviation from the Final SS-WP. HMX and RDX were inadvertently left off the chain-of-custody. Alion contacted TestAmerica and confirmed the addition of these two analytes for all samples to be analyzed by Method 8330A.

26 March 2010:
Sample FNOD-AOC2-SD-01-FD was collected and shipped to the laboratory, but was inadvertently left off the chain-of-custody. TestAmerica confirmed with Alion that this sample should be analyzed for all analytes by Methods 8330A, 6010C, 6020A and 7471B.

Alion Science and Technology
DAILY QUALITY CONTROL REPORT

Report Number:	03-24-10-01	Date:	03-24-10
Project Name:	Nansemond Ordnance Depot C03VA004502	Contract Number:	W912DY-04-D-0017
Location of Work:	Former Nansemond Ordnance Depot, Suffolk, VA		
Description of Work: Visual reconnaissance.			
Weather: clear	**Rainfall**: None	**Temperature:** Min. 45	Max. 65

1. Work performed today by Alion.

Maria Borejsza-Wysocka of the Alion team demobilized after completion of environmental sampling effort. The remaining Alion field team (John Healey-UXO Technician and Cheryl Gannon) discussed objectives and health and safety concerns related to field work upon arrival at FUDS. John Healey and Cheryl Gannon performed visual reconnaissance (meandering paths).

Reconnaissance Acreage / Discussion

John Healey and Cheryl Gannon conducted visual reconnaissance in a meandering path fashion at AOCs 10, 11, 12 and 14 totaling 11.35 acres.

Samples Collected:

None.

2. Work performed today by Subcontractors.

None.

3. Type and results of Control Phases and Inspection. (Indicate whether Preparatory – P, Initial – I, or Follow-Up – F and include satisfactory work completed or deficiencies with actions to be taken)

No preparatory phase inspections for field work were necessary prior to mobilizing to Nansemond Ordnance Depot. Initial phase of inspections were completed upon site arrival. No follow-up inspections were completed today. Satisfactory work completed.

4. List type and location of tests performed and results of these tests.

GPS Benchmark control point coordinates were collected in the morning and then again after the completion of fieldwork in the afternoon (see below).

Benchmark is "Z 282" (PID FX0194) located east of Garland Drive and south of High Street West in Portsmouth, VA. The benchmark is located in the road right-of-way of High Street West and is marked by a benchmark disk set in top of a concrete monument. The benchmark is located in the Bowers Hill (1986) USGS Quadrangle.

Benchmark Coordinates: 36 51 32. North, 076 23 20. West (Latitude, Longitude). Benchmark is a vertical order benchmark (a horizontally controlled benchmark was not available in the vicinity of the field area). Alion converted to UTM Northing 4080119 meters (m), Easting 376191 m (UTM, Zone 18N, Conus 1983).

Morning GPS reading: Northing 4080114.604 meters (m), Easting 376179.602 m, (UTM, Zone 18N, Conus 1983).

Afternoon GPS reading: Northing 4080114.271 m, Easting 376179.443 m, (UTM, Zone 18N, Conus 1983).

Margin of error is acceptable.

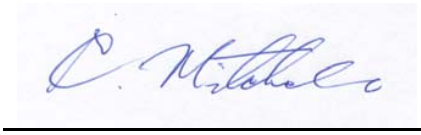
5. List material and equipment received.

All equipment (GPS unit) supplied by Alion.

Alion Science and Technology
DAILY QUALITY CONTROL REPORT

6. Submittals reviewed. (Include Transmittal No., Item No., Spec/Plan Reference, by whom, and any action.
None.
7. Off-site surveillance activities, including action taken.
None.
8. Job Safety. (Report safety violations observed and actions taken)
No safety violations.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
Performed meandering visual reconnaissance in and around AOCs 10, 11, 12 and 14. Surface cultural debris was noted in several locations at the FUDS. No health and safety issues and/or violations occurred during field work. No confirmed MEC or MD was found. Photos were taken in various areas within the study area as well as at sampling locations.

Alion Science and Technology Verification: On behalf of Alion, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.



Curtis Mitchell
Quality Control System Manager

DAILY SITE SAFETY JOURNAL
Page 1 of 2

DATE: March 24, 2010	PROJECT: Nansemond Ordnance Depot
Field UXO Technician: John Healey	

AREA / ITEMS INSPECTED	SAT	UNSAT
Proper work attire (PPE)	✓	
Vehicle condition	✓	
Emergency equipment	✓	
Safe demolition procedures	N/A	
Field office, inside	✓	
Field office grounds	✓	

[ ] Last Work Days Events
[ ] Site Description
[ ] Work Area Description
[ ] Work Area Hazards
[ ] On-Site Emergency
[ ] Site Evacuation Procedures
[ ] Emergency Response Personnel
[ ] Emergency Telephone Numbers
[ ] Directions to Hospital
[ ] First Aid
[ ] Heat / Cold Stress
[ ] Asbestos Awareness & ID
[ ] Ticks
[ ] Safety Concerns
[ ] Personnel Protective Equipment
[ ] Safe Work Practices
[ ] Emergency Response Plan
[ ] Chemical Hazards
[ ] Emergency Equipment, Location
[ ] Emergency Equipment, by Type
[ ] Emergency Decontamination
[ ] Safe Work Practices - General
[ ] Site specific OE Safety Precautions
[ ] Site specific OE Identification Features
[ ] Liquid Contaminates / Landfill Material
[ ] Other _____

Comments:

UXO Technician in Field SIGNATURE:

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 3/24/10
Page 2 of 2

	Name	Affiliation
1	Cheryl Gannon	Alion
2	John Hessley	WPA
3		
4		
5		
6		
7		
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25		

HEALTH AND SAFETY PLAN REVIEW RECORD

SITE: Nansemond Ordnance Depot

ALION Project No. C03VA00450 2

I have read the Health and Safety Plan (s) and have been briefed on the nature, level, and degree of exposure likely as a result of participation of field activities. I agree to conform to all the requirements of this Plan.

Name	Signature	Affiliation	Date
Cheryl Gannon		Alion	3/24/10
John Healey		~~HPA~~	3·24·10

SITE ENTRY AND EXIT LOG

Project/Site : Nansemond Ordnance Depot

Project No.: C03VA004502

Date	Name	Representing	Time In	Time Out
3/24/10	Cheryl Gannon	Alion	0815	1420
3.24.10	John Healey	~~HHA~~	0815	1420

CONTENTS VALUABLE
Please Return To:

Roger Azar
Alion Science & Technology
3975 Fair Ridge Drive
Suite 125 South
Fairfax, VA 22033
703-259-5274

50% cotton-content paper
water resistant surface
50 sheets. . . . 4⅞" X 7¼"

Nansemond Ordnance Depot
C03VA004502

E L A N

Field Book
E 64-8x4 S

Contract No. W912DY-04-D-0017
Delivery Order # 0017 0001

CURVE FORMULAS

$T = R \tan \frac{1}{2} I$

$T = \frac{50 \tan \frac{1}{2} I}{\text{Sin. } \frac{1}{2} D}$

$\text{Sin. } \frac{1}{2}D = \frac{50}{R}$

$\text{Sin. } \frac{1}{2}D = \frac{50 \tan \frac{1}{2} I}{T}$

$R = T \cot \frac{1}{2} I$

$R = \frac{50}{\text{Sin. } \frac{1}{2} D}$

$E = R \text{ ex. sec } \frac{1}{2} I$

$E = T \tan \frac{1}{4} I$

$\text{Chord def.} = \frac{\text{chord}^2}{R}$

$\text{No. chords} = \frac{I}{D}$

$\text{Tan. def.} = \frac{1}{2} \text{ chord def.}$

The square of any distance, divided by twice the radius, will equal the distance from tangent to curve, very nearly.

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft.) and divide given deflection by the product.

Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance.

To find deflection for a given angle and distance. Multiply the angle by .01745, and the product by the distance.

GENERAL DATA

RIGHT ANGLE TRIANGLES. Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt. $10.10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. $25.25^2 \div 200 = 3.125$. $100 - 3.125 = 96.875$ = Base.

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

LEVELING. The correction for curvature and refraction, in feet and decimals of feet is equal to $0.574\ d^2$, where d is the distance in miles. The correction for curvature alone is closely, $\frac{2}{3}d^2$. The combined correction is negative.

PROBABLE ERROR. If d_1, d_2, d_3, etc. are the discrepancies of various results from the mean, and if Σd^2 = the sum of the squares of these differences and n = the number of observations, then the probable error of the mean = $\pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n-1)}}$

MINUTES IN DECIMALS OF A DEGREE

1'	.0167	11'	.1833	21'	.3500	31'	.5167	41'	.6833	51'	.8500
2	.0333	12	.2000	22	.3667	32	.5333	42	.7000	52	.8667
3	.0500	13	.2167	23	.3833	33	.5500	43	.7167	53	.8833
4	.0667	14	.2333	24	.4000	34	.5667	44	.7333	54	.9000
5	.0833	15	.2500	25	.4167	35	.5833	45	.7500	55	.9167
6	.1000	16	.2667	26	.4333	36	.6000	46	.7667	56	.9333
7	.1167	17	.2833	27	.4500	37	.6167	47	.7833	57	.9500
8	.1333	18	.3000	28	.4667	38	.6333	48	.8000	58	.9667
9	.1500	19	.3167	29	.4833	39	.6500	49	.8167	59	.9833
10	.1667	20	.3333	30	.5000	40	.6667	50	.8333	60	1.0000

INCHES IN DECIMALS OF A FOOT

1/16	3/32	1/8	5/16	1/4	5/16	3/8	1/2	5/8	3/4	7/8
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729

1	2	3	4	5	6	7	8	9	10	11
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

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1

Signature Page

Print | Sign | Initials

Cheryl Gannon

John Healey

Table of Contents

Contact Information

Alion Science & Technology Corporation (Alion)
- Roger Azar 301-399-7304 cell
- Cheryl Gannon 703-217-1626 cell
- John Healey 267-312-9150 cell
- Maria Borejsza-Wysocka 315-945-7772 cell

FUDS Owners

Tidewater Community College
- David Guglielmo 757-822-1177

Virginia Dept. of Transportation (VDOT)
- David Wilson 804-786-5588

USACE-Norfolk District
- Jeff Zoeckler 804-301-9139 cell

TestAmerica Laboratory-Denver
- Elaine Walker 303-736-0156 off.
  303-471-7171 fax
  4955 Yarrow St., Arvada, CO 80002

Benchmark

Designation: Z 282
PID: FX0194
Portsmouth, VA, E of Earland Drive
S of High Street West
Benchmark Coordinates
36 51 32 N/076 23 20 W (Lat/Long)
Vertical order, horiz. order not available
converted to UTM 18N
4080119 m N, 376191 m E
22 March 2010 07:20
4080113.627 mN, 376179.715 mE
22 March 2010 17:55
4080114.627 mN, 376179.585 mE
23 March 2010 07:45
4080114.809 mN, 376179.116 mE
23 March 2010 15:30
4080114.473 mN, 376179.366 mE
24 March 2010 08:00
4080114.604 mN, 376179.602 mE
24 March 2010 14:40
4080114.271 mN, 376179.443 mE

22 March 2010

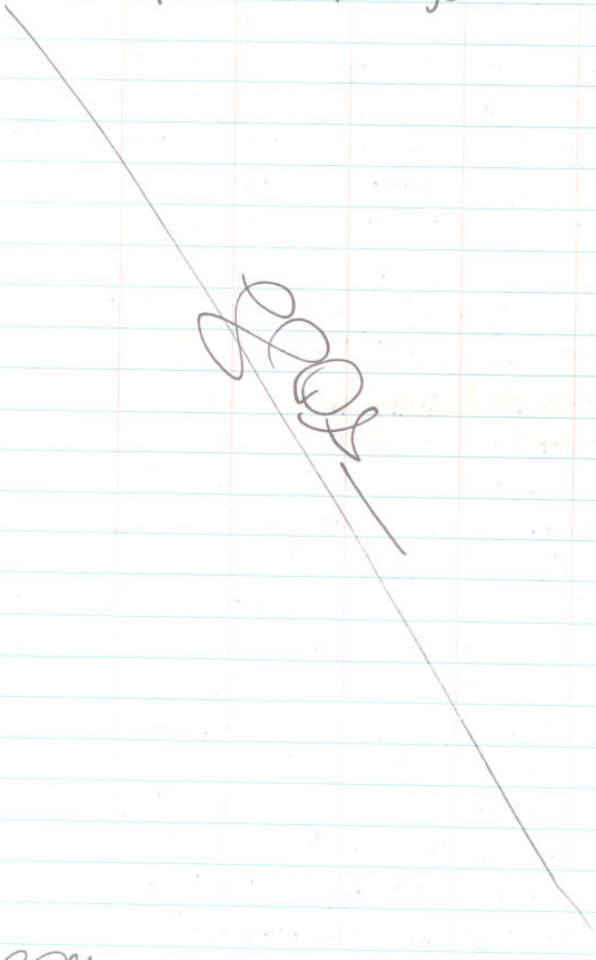
08:00 arrive at gate to FNOD AOCs 10, 11, 12, 14, 15
John Delivers Health & Safety briefing
Alion: Cheryl Gannon & John Healey (UXO Tech)
Weather: overcast, 60-65°F, forecast rain & thunderstorms
08:15 arrive by vehicle at AOC12, begin visual reconnaissance
08:30 first open storage area in AOC12 looks like evidence of burned trees. large structure present west, missing roof. piles of rotten tires, burning around bldg partial trees burned/downed
08:55 Wetlands present bordering northern shoreline of AOC12
09:15 enter AOC15 & begin visual recon. lots of bricks,
09:30 cross outside AOC15 on beach, peer through fence/locked gate near northwest corner of AOC15
09:40 enter "disturbed area 1956" in AOC15. burned trees/bark
09:50 enter AOC14, burned trees in "disturbed area 1956"
09:55 large debris pile - bricks, tile, concrete in AOC14 & tires, paint, drum

10:40 Depart FUDS-lock gate, to AOC 10, 11, 12, 14, 15
12:00 Arrive FUDS gate AOCS 2, 8, 9 east of I-664. Align Team→ John Healey (UXOTech), Cheryl Gannon & Maria Borejsza-Wysocka. John delivers H&S briefing to Maria
12:20 Mobilize to samples in AOC8
12:30 collect FNOD-AOC8-SS-01-01 7wheel grab 12" depth metals & expl.
12:50 collect FNOD-AOC8-SB-02-01 grab, 24" depth metals & explosives extra volume for MS/MSD, dark presence of tree roots for SS, sandy yellow SB co-located SS-SB sample
1300 QR w. Whites in western portion of AOC8, Area is level-
13:15 collect FNOD-AOC9-SS-01-01 extra volume for MS/MSD
13:25 collect FNOD-AOC9-SB-02-01
13:55 collect FNOD-AOC9-SS-01-02 fill?
14:10 collect FNOD-AOC9-SB-02-02
14:40 collect FNOD-AOC8-SS-01-02
14:55 collect FNOD-AOC8-SB-02-02 seems like native soil, sandy to clayey lt. brwn-yellow, co-located sample

moved to be within "1948 mounded material & possible pit"
15:30 collect FNOD-AOC9-SS-01-03
15:45 collect FNOD-AOC9-SB-02-03
15:50 collect FNOD-AOC9-SB-02-FD is field duplicate of FNOD-AOC9-SB-02-03
15:55 collect FNOD-AOC9-SS-01-04
16:10 collect FNOD-AOC9-SB-02-04 Rocky soil, looks like fill
16:15 collect FNOD-AOC2-SS-01-01
16:30 collect FNOD-AOC2-SB-02-01 co-located sample moved slightly due to extensive vegetation (thorns)
16:35 reconnaissance AOC2, northwest east corner of AOC2 is flooded water southwest corner of AOC2 is a pond
16:50 southern boundary of AOC8 is creek 8"x8" square concrete pillars w/ L-shaped metal post & some rusted chain link fence between, approx. 9 in a row parallel to creek
16:55 collect FNOD-AOC8-SS-01-03
17:00 collect FNOD-AOC8-SS-01-FD is field duplicate of FNOD-AOC8-SS-01-03
17:10 collect FNOD-AOC8-SB-02-03 thick vegetation cover over soil

8

17:30 Finish AOC8 QR w/ Whites
17:35 Depart FUDS, lock gate



9

23 March 2010

08:00 Arrive at FUDS: John Healey, Cheryl Gannon, Maria Borejsza-Wysocka
John delivers health & safety briefing
enter gate to AOCs 10, 11, 12, 14, 15
mobilize toward AOC 8 samples west of I-664. Weather overcast, chance of rain 45-55°F
08:25 collect FNOD-AOC8-SS-01-04
08:40 collect FNOD-AOC8-SB-02-04 co-located sample. Moved slightly due to presence of structure where sample should be located. lots of cultural debris in vicinity (household debris, bottles, construction debris). Analyze for explosives & metals.
08:45 two distinct areas of mounded material walked around w/ GPS to delineate extent. One near bldg noted previously & one area between last sample location & this one Whites did not detect any metal. Seems to be dirt piles w/ some containing concrete or asphalt or shingles (asphalt)
08:55 collect FNOD-AOC8-SS-01-05
09:10 collect FNOD-AOC8-SB-02-05 moved slightly away from road

09:30 collect FNOD-AOC8-SS-01-06
09:45 collect FNOD-AOC8-SB-02-06
soil is very rocky, likely fill
10:05 collect FNOD-AOC8-SS-01-07
10:20 collect FNOD-AOC8-SB-02-07
near structure, first attempt cleared w/ Whites, at 6" depth found metal suspected, had John clear again w/ Whites and confirmed metal moved sample location 10ft east rocky top 6", then 8" native soil
11:00 finish QR w/ Whites throughout AOC8 west of I-664.
12:00 Depart FUDS AOC 10, 11, 12, 14, 15 lock gate behind us
12:10 arrive at gate to AOCs 8, 9, & 2. to collect surface water & sediment samples
12:30 short amber 500 mL jars for explosive analysis in water. called Elaine Walker at TestAmerica and she said to note it on Chain of custody have too many nitric preserved polys for metals analysis in water

13:00 collect FNOD-AOC2-SW-00-01
moved slightly due to steep ravine (access)
13:05 collect FNOD-AOC2-SW-00-FD is field duplicate of FNOD-AOC2-SW-00-01 changed field dup. to this sample location instead of AOC2-SW-00-02 since that will be MS/MSD
13:10 collect FNOD-AOC2-SD-01-01
13:30 collect FNOD-AOC2-SW-00-02
extra volume for MS/MSD
13:40 collect FNOD-AOC2-SD-01-02
~~13:45 collect FNOD-AOC2-SD-01-FD is field duplicate of FNOD-AOC2-SD-01-02~~ not needed
14:15 depart AOC 2, 8, 9, gate locked behind
14:20 enter Hampton Roads Sanitation District facility to collect BG SW & SD
14:50 collect FNOD-BG-SW-00-01
14:55 collect FNOD-BG-SD-01-01
moved co-located sample location due to access issues (barbed wire fence)
15:05 collect FNOD-BG-SW-00-02
15:10 collect FNOD-BG-SD-01-02
15:20 depart FUDS

Sample ID	Date	Time	Notes	Easting	Northing
FNOD-AOC8-SS-01-01	3/22	12:30		373115.51	4084284.16
FNOD-AOC8-SB-02-01		12:50	MS/MSD	373115.51	4084284.16
FNOD-AOC9-SS-01-01		13:15	MS/MSD	373090.30	4084387.09
FNOD-AOC9-SB-02-01		13:25		373090.30	4084387.09
AOC9-SS-01-02		13:55		373225.97	4084350.68
AOC9-SB-02-02		14:10		373225.97	4084350.68
AOC8-SS-01-02		14:40		373362.57	4084276.68
SB-02-02		14:55		373362.57	4084276.68
AOC9-SS-01-03		15:30		373308.78	4084395.89
SB-02-03		15:45		373308.78	4084395.89
SB-02-FD		15:50	Dup of	373309.79	4084395.89
SS-01-04		15:55		373359.07	4084386.82
SB-02-04		16:10		373359.07	4084386.82
AOC2-SS-01-01		16:15		373424.49	4084391.66
SB-02-01		16:30		373424.49	4084391.66
AOC8-SS-01-03		16:55		373422.28	4084227.89
SS-01-FD		17:00	Dup of	373422.28	4084227.89
SB-02-03		17:10		373422.28	4084227.89

Sample ID	Date	Time	Notes	Easting	Northing
FNOD-AOC8-SS-01-04	3/23	08:25		372561.98	4084342.67
FNOD-AOC8-SB-02-04		08:40		372561.98	4084342.67
SS-01-05		08:55		372837.30	4084329.01
SB-02-05		09:10		372637.30	4084329.01
SS-01-06		09:30		372749.89	4084328.20
SB-02-06		09:45		372749.89	4084328.20
SS-01-07		10:05		372815.18	4084312.45
SB-02-07		10:20		372815.18	4084312.45
AOC2-SW-00-01		13:00		373476.81	4084328.01
SW-00-FD		13:05	Dup of	373476.81	4084328.01
SD-01-01		13:10		373476.81	4084328.01
SW-00-02		13:30	MS/MSD	373576.46	4084329.09
SD-01-02		13:40		373576.46	4084329.09
AOC2-SD-01-FD		13:45	Dup of	373576.46	4084329.09
BG-SW-00-01		14:50		373333.75	4083505.45
SD-01-01		14:55		373333.75	4083505.45
SW-00-02		15:05		373323.02	4083704.04
SD-00-02		15:10		373323.02	4083704.04

24 March 2010

08:15 enter FUDS via gate to AOCs 10, 11, 12, 14, 15; John Delivers H&S briefing; All on Team: John Healey (UXO) and Cheryl Gannon; (visual recon. only today); Weather: clear, 45-65F

08:30 begin visual recon of of AOC 10

08:40 large structure w/ loading platform? on eastern side; cultural debris area northeast of structure (tires, paint cans, drums, tvs, plastic, metal, mound of ~~asphalt~~ (~4ft high, soft in semi-circle) concrete chunks & slabs w/ brick

08:50 AOC 10 eastern portion visual recon. small pile of concrete blocks, huge soil mound

09:00 railroad tracks marked on southern end of AOC 10-eastern portion. soil mound extends east-west in & outside of AOC 10 east cultural debris east & road.

09:10 concrete platform/slab noted east of AOC 10 east & south

09:45 begin visual recon of AOC 14 starting in southern end. 8'x8' slabs (2) of metal, trash-cultural, concrete blocks in pile gravel piles near by

10:15 concrete culvert & basin to lake concrete structure, long, parallel to lake, platform remains, construction debris on top.

10:25 concrete blocks & bricks on ~~eastern~~ western boundary of AOC ~~12~~ 14

10:40 concrete platform w/ no construction debris on top. ~~some asphalt paving~~ not asphalt, just discolored concrete, (black looking on top)

11:10 reach southern end of structure (platform w/ bricks/concrete on top) where finished visual recon 3/22/10

11:20 finish visual recon of AOC 14 walk back to vehicle along utility easement

12:00 begin visual recon of AOC 11 from southwestern corner of AOC

12:10 brick bldg foundation in SW corner of AOC 11 appears to have fire damage to wooden cross-beams on floor

12:20 brick foundation bldg, sheet metal roof, collapsed

12:30 huge brick bldg, no roof, sliding large doors on east side w/ concrete

platform
13:10 Brick & sheet metal bldg w/ roof, platform on northside
13:30 mounds of gravel & chunks of concrete, area noted
13:40 Finish AOC 11 visual recon.
13:45 Finish end of AOC 12 visual recon. from Monday; areas of cultural debris in southern portion of AOC 12
14:00 Additional areas of visual in AOC 11; small cinder block shack w/ equipment inside (pipes, valves)
14:20 Depart FUDS via gate to AOCs 10, 11, 12, 14, 15

No Further Entries

APPENDIX E – PHOTO DOCUMENTATION LOG

APPENDIX E – PHOTOGRAPHIC LOG

Project/Site: Former Nansemond Ordnance Depot

Project No.: C03VA004502

Date	Photo ID	Description
3/22/2010	E.1	Wetlands and metal cultural debris observed within AOC 2.
3/23/2010	E.2	Collection of sample FNOD-AOC2-SW-00-01 within AOC 2.
3/23/2010	E.3	Metal cultural debris observed within AOC 8.
3/22/2010	E.4	Collection of co-located samples FNOD-AOC8-SS-01-01 and FNOD-AOC8-SB-02-01 near fence in AOC 8.
3/22/2010	E.5	Existing structure at AOC 9.
3/22/2010	E.6	Cultural debris observed during field activities within AOC 9.
3/24/2010	E.7	Current condition and cultural debris observed during field activities at AOC 10.
3/24/2010	E.8	Current condition and cultural debris observed during field activities at AOC 11.
3/22/2010	E.9	Existing structure at AOC 12.
3/22/2010	E.10	Cultural debris observed during field activities at AOC 12.
3/22/2010	E.11	Existing concrete platform structure at AOC 14.
3/22/2010	E.12	Cultural debris observed during field activities at AOC 14.

3/22/2010	E.13	Current site condition showing cultural debris at AOC 15 along coastline of James River.
3/22/2010	E.14	Locked gate restricting accessing to asphalt-paved road leading to AOC 15.
3/23/2010	E.15	Mounded material observed west of Interstate 664 (AOC 8).
3/23/2010	E.16	Former magazine structure located west of Interstate 664 (AOC 8).

Former Nansemond Ordnance Depot – Field Photographs

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	Area Of Concern (AOC) 2
GPS Coordinates: (UTM Zone 18N)	N 4084351.39 E 373560.31
Direction of Photo:	East
Comments:	Wetlands and metal cultural debris observed within AOC 2.
Photograph No.:	E.1 Date: 3/22/2010 Time: 16:30

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 2
GPS Coordinates: (UTM Zone 18N)	N 4084328.01 E 373476.81
Direction of Photo:	East
Comments:	Collection of sample FNOD-AOC2-SW-00-01 within AOC 2.
Photograph No.:	E.2 Date: 3/23/2010 Time: 13:00

Former Nansemond Ordnance Depot – Field Photographs

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 8
GPS Coordinates: (UTM Zone 18N)	N 4084273.292 E 373320.53
Direction of Photo:	Ground
Comments:	Metal cultural debris observed within AOC 8.
Photograph No.:	E.3 Date: 3/23/2010 Time: 14:35

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 8
GPS Coordinates: (UTM Zone 18N)	N 4084284.16 E 373115.51
Direction of Photo:	West
Comments:	Collection of co-located samples FNOD-AOC8-SS-01-01 and FNOD-AOC8-SB-02-01 near fence in AOC 8.
Photograph No.:	E.4 Date: 3/22/2010 Time: 12:54

Former Nansemond Ordnance Depot – Field Photographs

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 9
GPS Coordinates: (UTM Zone 18N)	N 4084431.9 E 373168.72
Direction of Photo:	West
Comments:	Existing structure at AOC 9.
Photograph No.:	E.5 Date: 3/22/10 Time: 13:29

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 9
GPS Coordinates: (UTM Zone 18N)	N 4084439.64 E 373171.18
Direction of Photo:	West
Comments:	Cultural debris observed during field activities within AOC 9.
Photograph No.:	E.6 Date: 3/22/10 Time: 13:28

Former Nansemond Ordnance Depot – Field Photographs

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 10
GPS Coordinates: (UTM Zone 18N)	N 4084565.69 E 372550.60
Direction of Photo:	Toward the ground
Comments:	Current condition and cultural debris observed during field activities at AOC 10.
Photograph No.:	E.7 Date: 3/24/10 Time: 08:41

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 11
GPS Coordinates: (UTM Zone 18N)	N 4084628.35 E 372845.42
Direction of Photo:	Toward the ground
Comments:	Current condition and cultural debris observed during field activities at AOC 11.
Photograph No.:	E.8 Date: 3/24/10 Time: 13:03

Former Nansemond Ordnance Depot – Field Photographs

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 12
GPS Coordinates: (UTM Zone 18N)	N 4084996.03 E 372953.78
Direction of Photo:	West
Comments:	Existing structure at AOC 12.
Photograph No.:	E.9 Date: 3/22/10 Time: 07:43

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 12
GPS Coordinates: (UTM Zone 18N)	N 4084977.22 E 372945.01
Direction of Photo:	Toward the ground
Comments:	Cultural debris observed during field activities at AOC 12.
Photograph No.:	E.10 Date: 3/22/10 Time: 07:43

Former Nansemond Ordnance Depot – Field Photographs

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 14
GPS Coordinates: (UTM Zone 18N)	N 4085010.544 E 372649.86
Direction of Photo:	Southwest
Comments:	Existing concrete platform structure at AOC 14.
Photograph No.:	E.11 Date: 3/22/10 Time: 09:56

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 14
GPS Coordinates: (UTM Zone 18N)	N 4085026.06 E 372630.78
Direction of Photo:	Toward the ground
Comments:	Cultural debris observed during field activities at AOC 14.
Photograph No.:	E.12 Date: 3/22/10 Time: 10:05

Former Nansemond Ordnance Depot – Field Photographs

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	AOC 15
GPS Coordinates: (UTM Zone 18N)	N 4085181.01 E 372598.37
Direction of Photo:	Northwest
Comments:	Current site condition showing cultural debris at AOC 15 along coastline of James River.
Photograph No.:	E.13 Date: 3/22/10 Time: 09:27

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	West of AOC 15
GPS Coordinates: (UTM Zone 18N)	N 4085190.17 E 372521.85
Direction of Photo:	East
Comments:	Locked gate restricting accessing to asphalt-paved road leading to AOC 15.
Photograph No.:	E.14 Date: 3/22/10 Time: 09:34

Former Nansemond Ordnance Depot – Field Photographs

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	West of I-664 (AOC 8)
GPS Coordinates: (UTM Zone 18N)	N 4084307.87 E 372543.87
Direction of Photo:	South
Comments:	Mounded material observed west of Interstate 664 (AOC 8).
Photograph No.:	E.15 Date: 3/23/10 Time: 08:34

Site:	Former Nansemond Ordnance Depot
Photographer:	Cheryl Gannon
Location of Photograph:	West of I-664 (AOC 8)
GPS Coordinates: (UTM Zone 18N)	N 4084334.41 E 372805.45
Direction of Photo:	North
Comments:	Former magazine structure located west of Interstate 664 (AOC 8).
Photograph No.:	E.16 Date: 3/23/10 Time: 09:47

APPENDIX F – ANALYTICAL DATA

- Automated Data Review Library
- Automated Data Review Electronic Data Deliverables
- Electronic Database Management System Files
- Analytical Summary Reports
- Analytical Data Reports
- Staged Electronic Data Deliverable Files

Located on CD-ROM.

APPENDIX G – ANALYTICAL DATA QUALITY ASSURANCE/ QUALITY CONTROL REPORT

- Validated Data
- USACE Memorandum for Record, Quality Assurance Split Samples. (Split Samples not collected in accordance with CENAB direction.)
- Chemical Data Quality Assurance Report

Located on CD-ROM.

APPENDIX H – GEOGRAPHIC INFORMATION SYSTEMS DATA

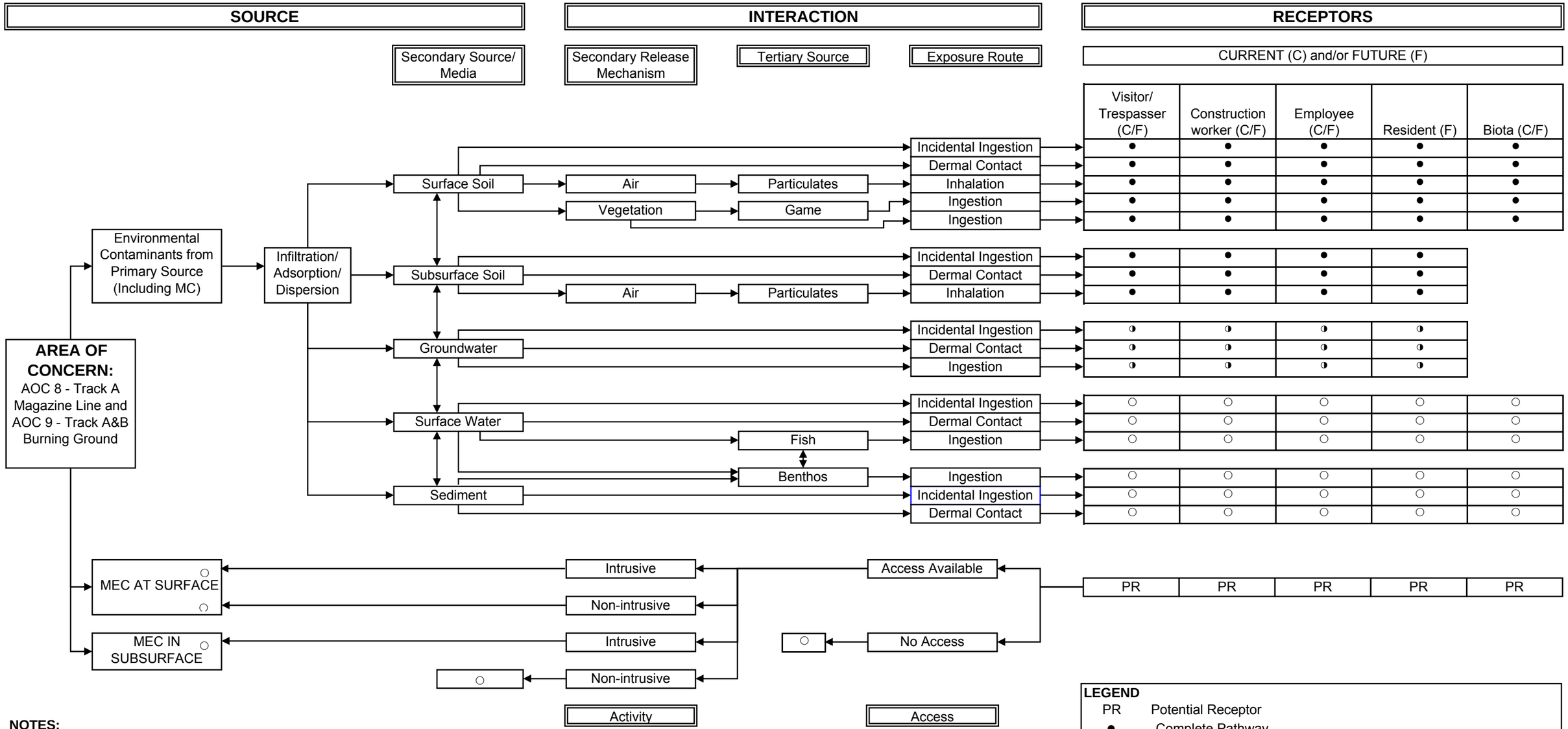
Located on CD-ROM.

APPENDIX I – GEOPHYSICAL DATA

Appendix not used.

APPENDIX J – CONCEPTUAL SITE MODEL

- AOCs 8 and 9
- AOC 2
- AOC 10
- AOC 11
- AOC 12
- AOCs 14 and 15



NOTES:

1. For the MMRP SI at the Former Nansemond Ordnance Depot, this CSM summarizes the potential risk exposure scenarios for AOC 8 - Track A Magazine Line and AOC 9 - Track A&B Burning Ground. For a pathway to be complete, it must include a source, an exposure medium, an exposure route, and a receptor. A complete pathway may also include a release mechanism and a transport medium. Interaction between a potential receptor and MEC has two components: access and activity.

2. No MEC or MD has been found at AOC 8 or AOC 9 historically or during the 2010 SI field activities. Therefore, the pathway for MEC in surface and subsurface for the potential receptors is incomplete.

3. Surface soil and subsurface soil were the only media sampled at AOCs 8 and 9. The analytical data indicates that no explosives were detected in these media; however, metals were detected above background at both AOCs. Therefore, the pathway is complete for these media at both AOCs. Surface water and sediment are not present in these AOCs; therefore, they are not media of concern and are shown as incomplete pathways in this CSM. Groundwater was not sampled during this SI and no previously collected analytical results were available for these AOCs, so the groundwater pathway remains potentially complete. The FNOD Project Delivery Team agreed that any evaluation of the groundwater pathway would be deferred until completion of the ongoing Background Study.

LEGEND

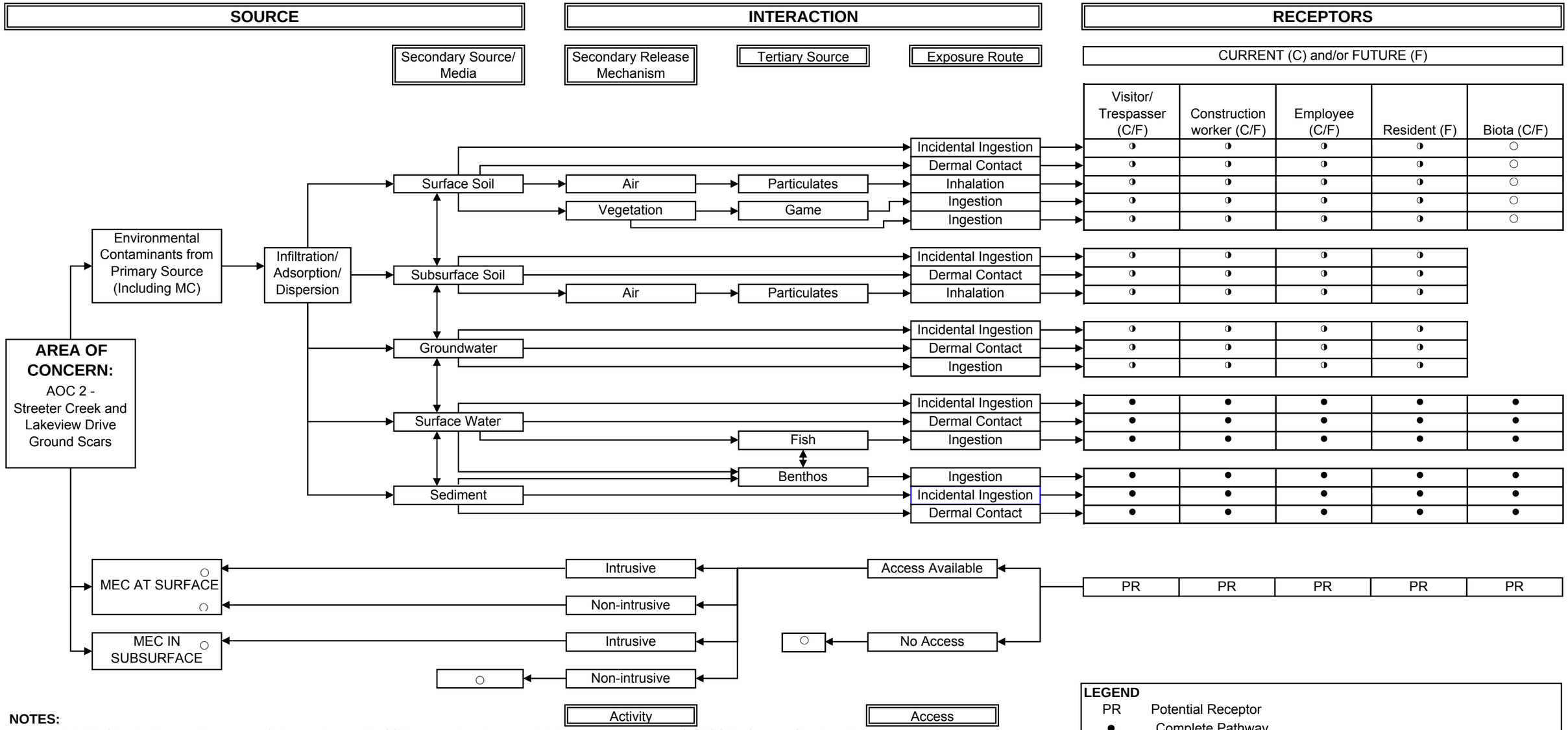
PR	Potential Receptor
●	Complete Pathway
◑	Potentially Complete Pathway
○	Incomplete Pathway (no expected exposure)

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR
Former Nansemond Ordnance Depot [1, 2 and 3]
AOC 8 (Track A Magazine Line) & AOC 9 (Track A&B Burning Ground)

Revised September 2011

J-1

Source: U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects.* EM 1110-1-1200.



NOTES:

1. For the MMRP SI at the Former Nansemond Ordnance Depot, this CSM summarizes the potential risk exposure scenarios for AOC 2 - Streeter Creek and Lakeview Drive Ground Scars. For a pathway to be complete, it must include a source, an exposure medium, an exposure route, and a receptor. A complete pathway may also include a release mechanism and a transport medium. Interaction between a potential receptor and MEC has two components: access and activity.

2. No MEC or MD has been found at AOC 2 historically or during the 2010 SI field activities. Therefore, the pathway for MEC in surface and subsurface for the potential receptors is incomplete.

3. Surface soil, subsurface soil, surface water, and sedimet were sampled at AOC 2. The analytical data indicates that no explosive constituents were detected in these media; however, metals were detected above background in sediment and surface water. Therefore, the pathway is complete for these media at AOC 2. Although no explosives were detected and no metals were detected above background in surface or subsurface soil at AOC 2, nitroglycerin did not meet the Measurement Quality Objective for sensitivity to human receptors in surface or subsurface soil, so these pathways remain potentially complete. Groundwater was not sampled during this SI and no previously collected analytical results were available for this AOC, so the groundwater pathway remains potentially complete. The FNOD Project Delivery Team agreed that any evaluation of the groundwater pathway would be deferred until completion of the ongoing Background Study.

LEGEND

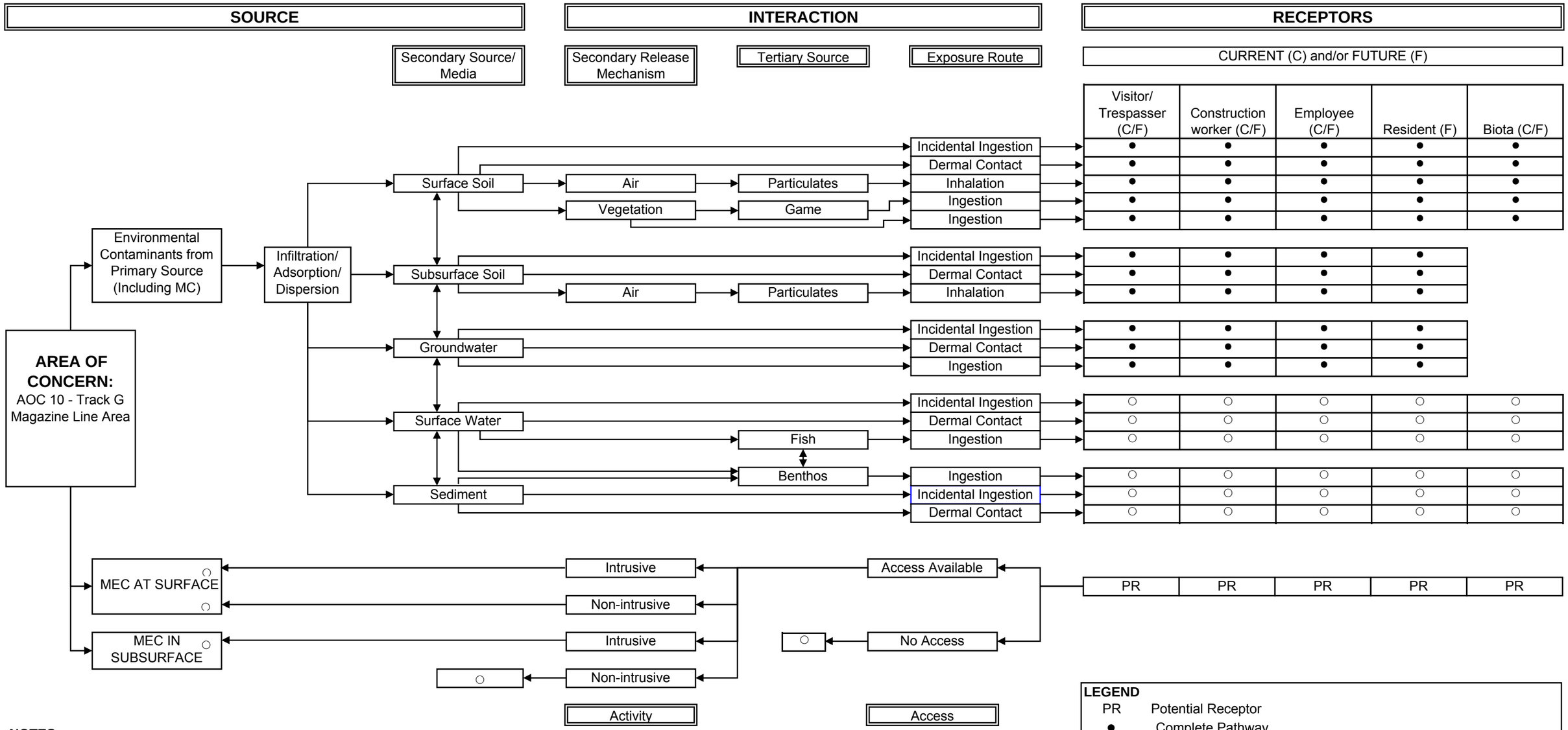
PR	Potential Receptor
●	Complete Pathway
◑	Potentially Complete Pathway
○	Incomplete Pathway (no expected exposure)

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR
Former Nansemond Ordnance Depot [1, 2 and 3]
AOC 2 (Streeter Creek & Lakeview Drive Ground Scars)

Revised September 2011

J-2

Source: U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects.* EM 1110-1-1200.



NOTES:

1. For the MMRP SI at the Former Nansemond Ordnance Depot, this CSM summarizes the potential risk exposure scenarios for AOC 10 - Track G Magazine Line. For a pathway to be complete, it must include a source, an exposure medium, an exposure route, and a receptor. A complete pathway may also include a release mechanism and a transport medium. Interaction between a potential receptor and MEC has two components: access and activity. Per stakeholder agreement at the TPP meeting and as shown in DQOs, only visual reconnaissance was conducted at this area to detemine the presence/absence of MEC.

2. No MEC or MD has been found at AOC 10 historically or during the 2010 SI field activities. Therefore, the pathway for MEC in surface and subsurface for the potential receptors is incomplete.

3. Surface soil, subsurface soil, and groundwater are present at AOC 10. However, per agreement at the TPP meeting, no samples were collected at this AOC during this SI. Metals and explosives analytical data obtained from previous studies at AOC 10 were reviewed to determine pathway completeness for media present/sampled at AOC 10. Surface soil, subsurface soil, and groundwater are shown as complete pathways due to detections of metals greater than background in all three media and detections of explosives in groundwater. Surface water and sediment are not present in this AOC; therefore, they are not media of concern and are shown as incomplete pathways in this CSM.

LEGEND

PR	Potential Receptor
●	Complete Pathway
◑	Potentially Complete Pathway
○	Incomplete Pathway (no expected exposure)

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR

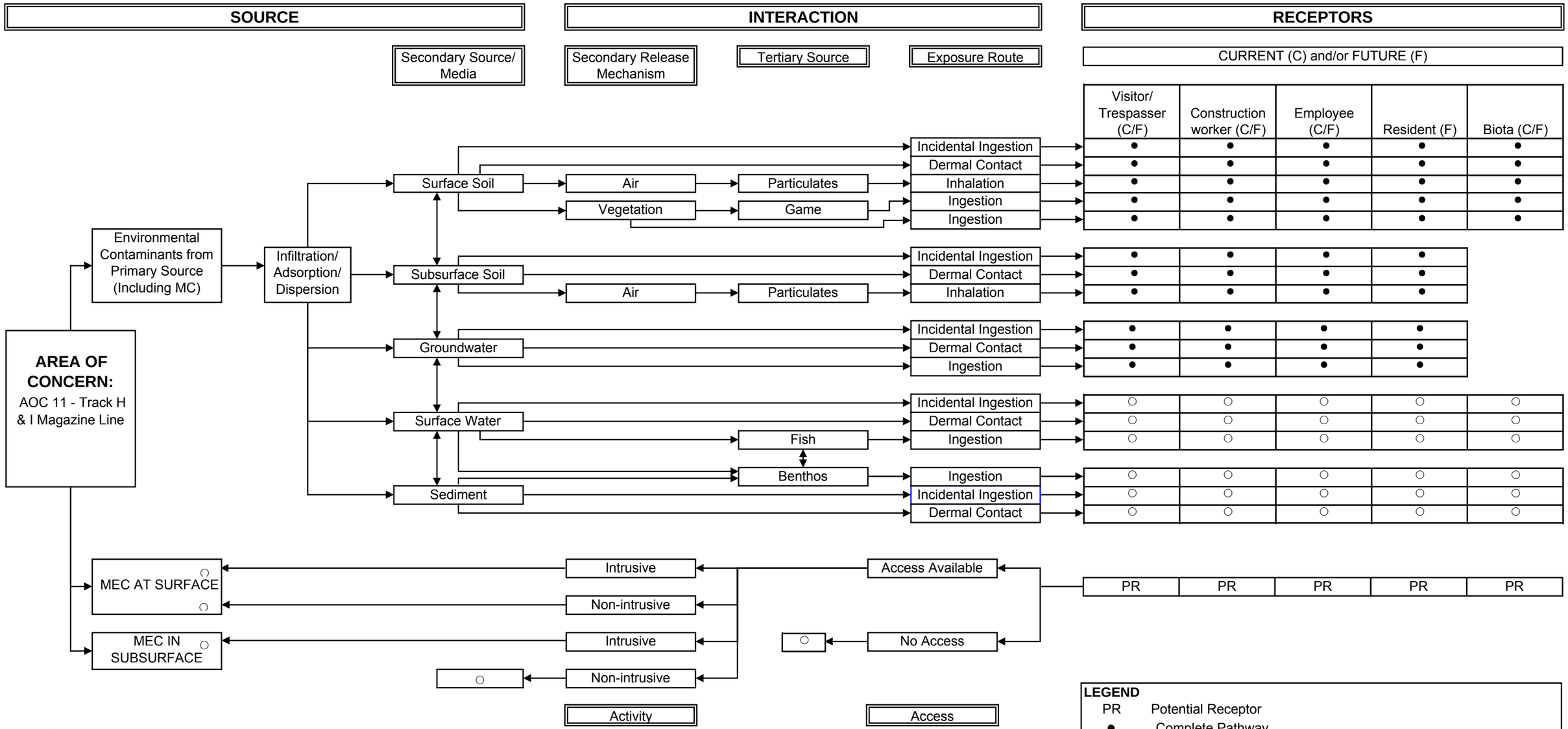
Former Nansemond Ordnance Depot [1, 2 and 3]

AOC 10 (Track G Magazine Line Area)

Revised September 2011

J-3

Source: U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects.* EM 1110-1-1200.



NOTES:

1. For the MMRP SI at the Former Nansemond Ordnance Depot, this CSM summarizes the potential risk exposure scenarios for AOC 11 - Track H & I Magazine Line. For a pathway to be complete, it must include a source, an exposure medium, an exposure route, and a receptor. A complete pathway may also include a release mechanism and a transport medium. Interaction between a potential receptor and MEC has two components: access and activity. Per stakeholder agreement at the TPP meeting and as shown in DQOs, only visual reconnaissance was conducted at this area to detemine the presence/absence of MEC.

2. No MEC or MD has been found at AOC 11 historically or during the 2010 SI field activities. Therefore, the pathway for MEC in surface and subsurface for the potential receptors is incomplete.

3. Surface soil, subsurface soil, and groundwater are present at AOC 11. However, per agreement at the TPP meeting, no samples are proposed at this AOC during this SI. Metals and explosives analytical data obtained from previous studies at AOC 11 were reviewed to determine pathway completeness for media present/sampled at AOC 11. Surface soil, subsurface soil, and groundwater are shown as complete pathways due to detections of metals greater than background and detections of explosives. Surface water and sediment are not present in this AOC; therefore, they are not media of concern and are shown as incomplete pathways in this CSM.

LEGEND

PR	Potential Receptor
●	Complete Pathway
◑	Potentially Complete Pathway
○	Incomplete Pathway (no expected exposure)

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR

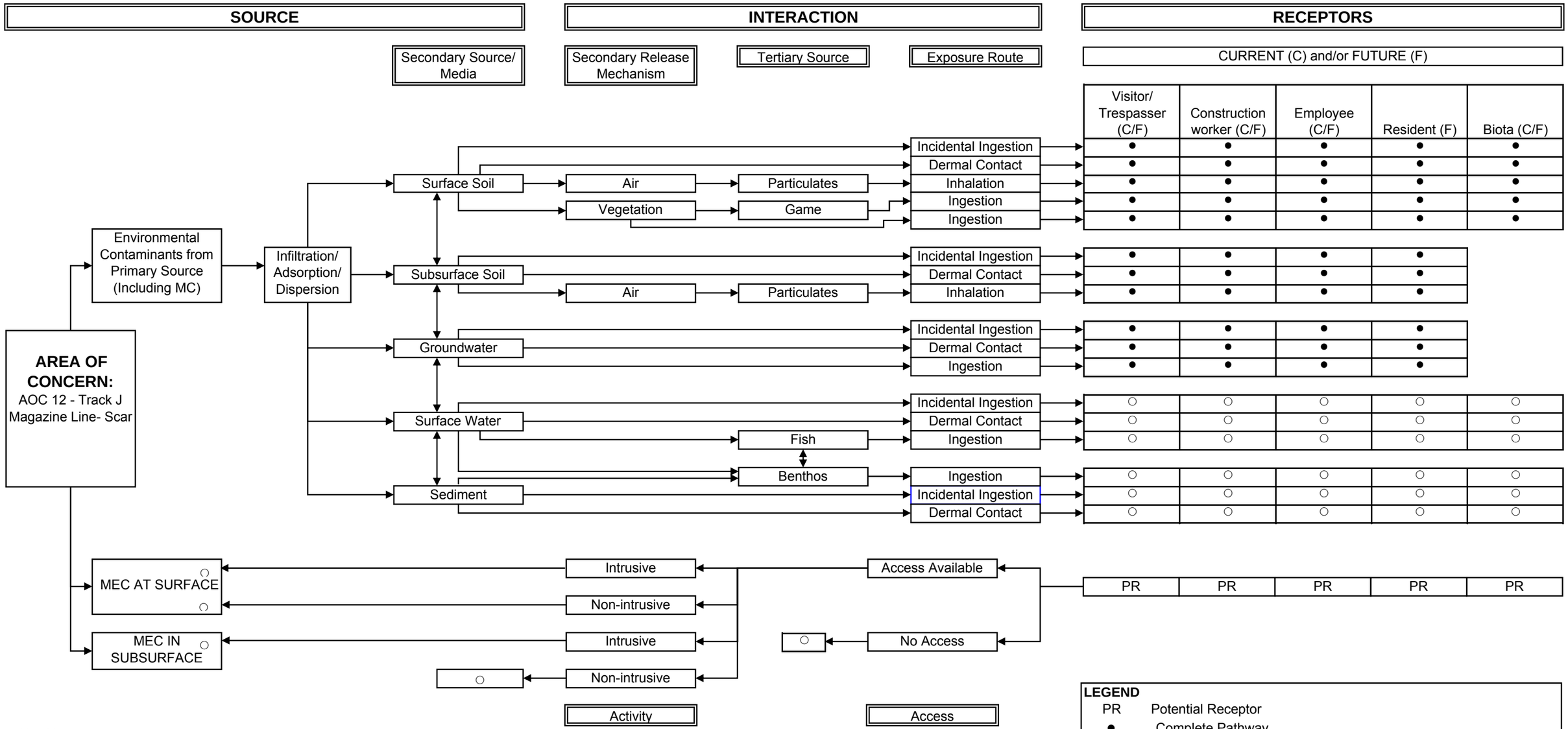
Former Nansemond Ordnance Depot [1, 2 and 3]

AOC 11 (Track H & I Magazine Line)

Revised September 2011

J-4

Source: U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects.* EM 1110-1-1200.



NOTES:

1. For the MMRP SI at the Former Nansemond Ordnance Depot, this CSM summarizes the potential risk exposure scenarios for AOC 12 - Track J Magazine Line-Scar. For a pathway to be complete, it must include a source, an exposure medium, an exposure route, and a receptor. A complete pathway may also include a release mechanism and a transport medium. Interaction between a potential receptor and MEC has two components: access and activity. Per stakeholder agreement at the TPP meeting and as shown in DQOs, only visual reconnaissance was conducted at this area to detemine the presence/absence of MEC.

2. No MEC or MD has been found at AOC 12 historically or during the 2010 SI field activities. Therefore, the pathway for MEC in surface and subsurface for the potential receptors is incomplete.

3. Surface soil, subsurface soil, and groundwater are present at AOC 12. However, per agreement at the TPP meeting, no samples were collected at this AOC during this SI. Metals and explosives analytical data obtained from previous studies at AOC 12 were reviewed to determine pathway completeness for media present/sampled at AOC 12. Surface soil, subsurface soil, and groundwater are shown as complete pathways due to detections of metals greater than background in the three media and detections of explosives in surface and subsurface soil. Surface water and sediment are not present in this AOC; therefore, they are not media of concern and are shown as incomplete pathways in this CSM.

LEGEND

PR	Potential Receptor
●	Complete Pathway
◑	Potentially Complete Pathway
○	Incomplete Pathway (no expected exposure)

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR

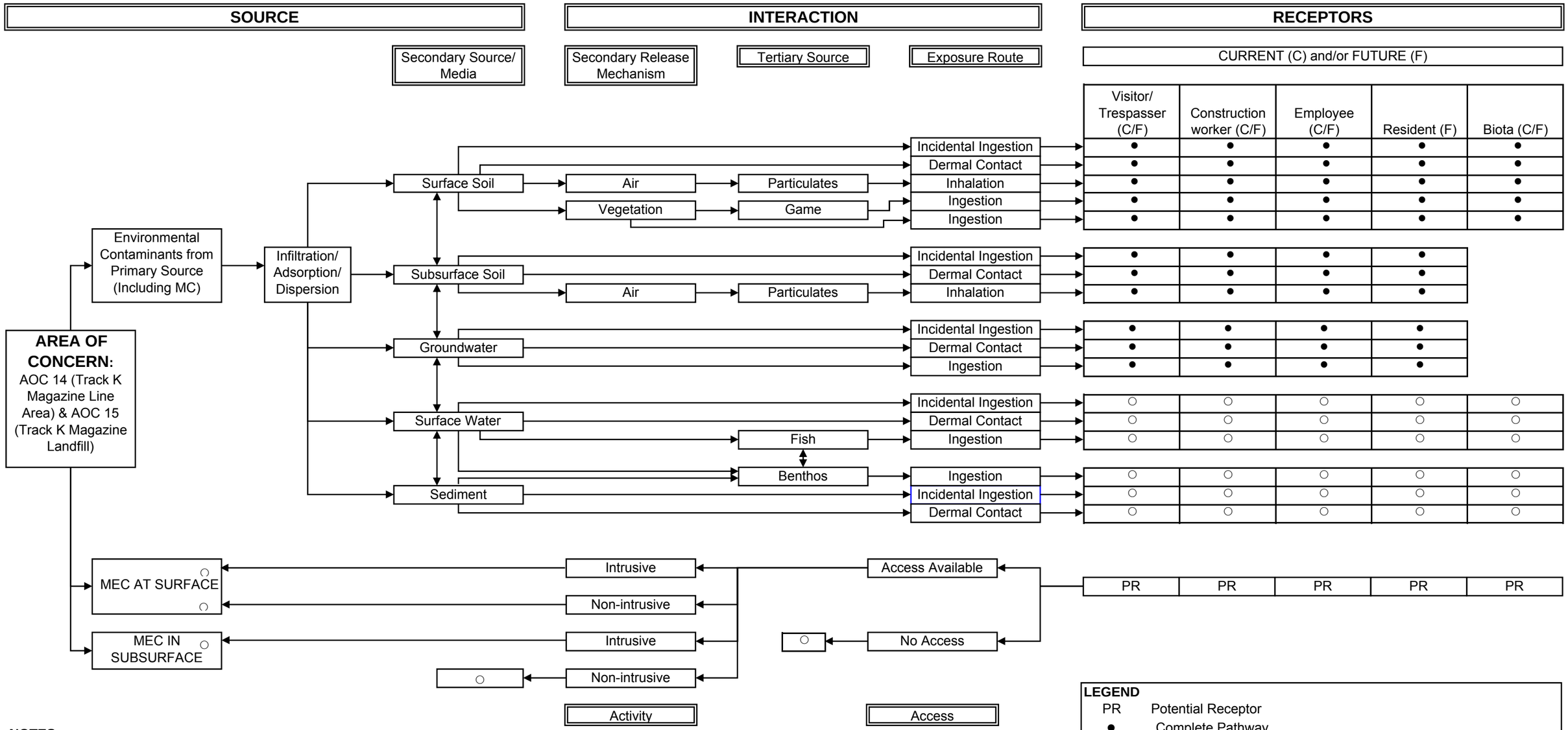
Former Nansemond Ordnance Depot [1, 2 and 3]

AOC 12 (Track J Magazine Line- Scar)

Revised September 2011

J-5

Source: U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects.* EM 1110-1-1200.



NOTES:

1. For the MMRP SI at the Former Nansemond Ordnance Depot, this CSM summarizes the potential risk exposure scenarios for AOC 14 - Track K Magazine Line and AOC 15 - Track K Magazine Line Landfill. For a pathway to be complete, it must include a source, an exposure medium, an exposure route, and a receptor. A complete pathway may also include a release mechanism and a transport medium. Interaction between a potential receptor and MEC has two components: access and activity. Per stakeholder agreement at the TPP meeting and as shown in DQOs, only visual reconnaissance was conducted at these areas to detemine the presence/absence of MEC.

2. No MEC or MD has been found at AOC 14 and AOC 15 historically or during the 2010 SI field activities. Therefore, the pathway for MEC in surface and subsurface for the potential receptors is incomplete.

3. Surface soil, subsurface soil, and groundwater are present at AOCs 14 and 15. However, per agreement at the TPP meeting, no samples were collected at these AOCs during this SI. Metals and explosives analytical data obtained from previous studies at AOCs 14 and 15 were reviewed to determine pathway completeness for media present/sampled at AOCs 14 and 15. Surface soil, subsurface soil, and groundwater are shown as complete pathways due to detections of metals greater than background and detections of explosives in surface soil and subsurface soil. Surface water and sediment are not present in these AOCs; therefore, they are not media of concern and are shown as incomplete pathways in this CSM.

LEGEND

PR	Potential Receptor
●	Complete Pathway
◑	Potentially Complete Pathway
○	Incomplete Pathway (no expected exposure)

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR

Former Nansemond Ordnance Depot [1, 2 and 3]

AOC 14 (Track K Magazine Line Area) & AOC 15 (Track K Magazine Landfill)

Revised September 2011

J-6

Source: U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects.* EM 1110-1-1200.

APPENDIX K – MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL RESULTS

- MRS 1
- MRS 2

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the MRS summary, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: James River Beach Dump Area

Component: U.S. Army

Installation/Property Name: Nansemond Ordnance Depot (FFID VA39799F156700)

Location (City, County, State): City of Suffolk, (no county), Virginia

Site Name/Project Name (Project No.): James River Beach Dump Area (C03VA004502M01)/Nansemond Ordnance Depot (C03VA0045)

Date Information Entered/Updated: 8/23/2010 2:53:38 AM

Point of Contact (Name/Phone): Sher Zaman (410-962-3134)

Project Phase (check only one):

o PA	n SI	o RI	o FS	o RD
o RA-C	o RIP	o RA-O	o RC	o LTM

Media Evaluated (check all that apply):

o Groundwater	o Sediment (human receptor)
o Surface soil	o Surface Water (ecological receptor)
o Sediment (ecological receptor)	o Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

MRS 1, James River Beach Dump Area, is also known as Source Area 2 (S-2) and James River Beachfront. MRS 1 is approximately 1.5 acres and is located on Tidewater Community College Property bounded by the James River on the north and Interstate 664 on the east. The area is suspected to have been used as a disposal area during World War II and for several years after. Numerous MD has been removed historically from this area, including 170-mm German projectiles, 8-inch projectile, cannon ball, and inert artillery fuzes. No MEC items have been found. Refer to Sections 2.1.4, 2.1.4.1, 2.1.4.2, 2.1.4.3, 2.1.4.4, 2.1.4.5, 2.1.4.6, and 2.1.4.7 for a summary of the work performed to date within MRS 1. The overall score for this MRS is "No Longer Required" per EM CX recommendation since this MRS has already been sequenced for future action. The EHE module is rated as no longer required because cleanup of explosives hazards has already occured, and the HHE module is rated as no longer required because the residual constituent hazards are being addressed under an HTRW project.

Description of Pathways for Human and Ecological Receptors:

Description of Receptors (Human and Ecological):

TABLES 1 THROUGH 9 EXCLUDED PER ARMY GUIDANCE

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1		
Source of Hazard	Table 2		
Accessibility Factor Data Elements			
Location of Munitions	Table 3		
Ease of Access	Table 4		
Status of Property	Table 5		
Receptor Factor Data Elements			
Population Density	Table 6		
Population Near Hazard	Table 7		
Types of Activities/ Structures	Table 8		
Ecological and /or Cultural Resources	Table 9		
EHE MODULE TOTAL			

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	***No Longer Required***

TABLES 11 THROUGH 19 EXCLUDED PER ARMY GUIDANCE

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11		
Sources of CWM	Table 12		
Accessibility Factor Data Elements			
Location of CWM	Table 13		
Ease of Access	Table 14		
Status of Property	Table 15		
Receptor Factor Data Elements			
Population Density	Table 16		
Population Near Hazard	Table 17		
Types of Activities/ Structures	Table 18		
Ecological and /or Cultural Resources	Table 19		
CHE MODULE TOTAL			

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	***No Longer Required***

TABLES 21 THROUGH 27 EXCLUDED PER ARMY GUIDANCE

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the Contaminant Hazard, Migration Pathway, and Receptor Factors for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the Three-Letter Combination boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the HHE Ratings provided below, determine each media's rating (A-G) and record the letter in the corresponding Media Rating box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)					
Surface Water/Human Endpoint (Table 22)					
Sediment/Human Endpoint (Table 23)					
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)					
Surface Soil (Table 26)					

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the HHE Module Rating box.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	*No Longer Required*

HHE Ratings (for reference only)	
Combination	**Rating**
HHH	A
HHM	B
HHL	C
HMM	
HML	D
MMM	
HLL	E
MML	
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending ***No Longer Required*** ~~No Known or~~ Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter rating for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical priority for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the MRS Prioriy or Alternative MRS Rating at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		*No Longer Required*		*No Longer Required*	
No Known or Suspected Explosive Hazard		No Known or Suspected CWM Hazard		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				*No Longer Required*	

Table A

MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the MRS summary, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: TNT Disposal Area

Component: U.S. Army

Installation/Property Name: Nansemond Ordnance Depot (FFID VA39799F156700)

Location (City, County, State): City of Suffolk, (no county), Virginia

Site Name/Project Name (Project No.): TNT Disposal Area (C03VA004502M02)/Nansemond Ordnance Depot (C03VA0045)

Date Information Entered/Updated: 8/23/2010 3:02:01 AM

Point of Contact (Name/Phone): Sher Zaman (410-962-3134)

Project Phase (check only one):

o PA	n SI	o RI	o FS	o RD
o RA-C	o RIP	o RA-O	o RC	o LTM

Media Evaluated (check all that apply):

o Groundwater	o Sediment (human receptor)
o Surface soil	o Surface Water (ecological receptor)
o Sediment (ecological receptor)	o Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

MRS 2, TNT Disposal Area, is also known as Source Area 1 (S-1), TNT Source Area, and TNT Area. MRS 2 is approximately 0.5 acres and is located on Tidewater Community College Property. Historical investigations revealed the existence of abandoned burn pits used to dispose of miscellaneous ordnance and a “steaming out” area, which was used to remove TNT from projectiles or ordnance casings. Hundreds of pounds of crystalline TNT have been removed from this area (MEC). Historically, items discovered and removed from this area have been described as: small caliber rifle ammunition, boosters from British 3-inch explosive projectiles, powder train time fuses, British point detonating fuse, British 3-inch projectiles, 30-inch projectiles, fuses, boosters, bullets and shell casings, adaptor boosters, and rifle grenades. These items are identified as MEC, but based on the context of the use of “MEC”, it appears that this may be incorrect in some cases. Additionally, one report states that approximately 15 CS/smoke canisters were removed from this area in 1987, although no further information is provided as to whether they were empty (MD) or full (MEC). Refer to Sections 2.1.5, 2.1.5.1, 2.1.5.2, 2.1.5.3, 2.1.5.4, 2.1.5.5, 2.1.5.6, and 2.1.5.7 for a summary of the work performed to date within MRS 2. The overall score for this MRS is "No Longer Required" per EM CX recommendation since this MRS has already been sequenced for future action. The EHE module is rated as no longer required because cleanup of explosives hazards has already occured, and the HHE module is rated as no longer required because the residual constituent hazards are being addressed under an HTRW project.

Description of Pathways for Human and Ecological Receptors:
Description of Receptors (Human and Ecological):

TABLES 1 THROUGH 9 EXCLUDED PER ARMY GUIDANCE

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1		
Source of Hazard	Table 2		
Accessibility Factor Data Elements			
Location of Munitions	Table 3		
Ease of Access	Table 4		
Status of Property	Table 5		
Receptor Factor Data Elements			
Population Density	Table 6		
Population Near Hazard	Table 7		
Types of Activities/ Structures	Table 8		
Ecological and /or Cultural Resources	Table 9		
EHE MODULE TOTAL			

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	***No Longer Required***

TABLES 11 THROUGH 19 EXCLUDED PER ARMY GUIDANCE

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11		
Sources of CWM	Table 12		
Accessibility Factor Data Elements			
Location of CWM	Table 13		
Ease of Access	Table 14		
Status of Property	Table 15		
Receptor Factor Data Elements			
Population Density	Table 16		
Population Near Hazard	Table 17		
Types of Activities/ Structures	Table 18		
Ecological and /or Cultural Resources	Table 19		
CHE MODULE TOTAL			

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	***No Longer Required***

TABLES 21 THROUGH 27 EXCLUDED PER ARMY GUIDANCE

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the Contaminant Hazard, Migration Pathway, and Receptor Factors for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the Three-Letter Combination boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the HHE Ratings provided below, determine each media's rating (A-G) and record the letter in the corresponding Media Rating box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)					
Surface Water/Human Endpoint (Table 22)					
Sediment/Human Endpoint (Table 23)					
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)					
Surface Soil (Table 26)					

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the HHE Module Rating box.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	*No Longer Required*

HHE Ratings (for reference only)	
Combination	**Rating**
HHH	A
HHM	B
HHL	C
HMM	
HML	D
MMM	
HLL	E
MML	
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter rating for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical priority for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the MRS Prioriy or Alternative MRS Rating at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		*No Longer Required*		*No Longer Required*	
No Known or Suspected Explosive Hazard		No Known or Suspected CWM Hazard		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				*No Longer Required*	

APPENDIX L – REFERENCE COPIES

Located on CD-ROM.

FINAL

Response to Stakeholder Comments, Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA

DERP FUDS Project No. **C03VA004502**

Prepared for:

U.S. Army Engineering and Support Center, Huntsville
4280 University Square
Huntsville, AL 35807

U.S. Army Corps of Engineers, Baltimore District
City Crescent Building
10 S. Howard St. 10th Floor
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U.S. Army Corps of Engineers, Norfolk District
803 Front Street
Norfolk, Virginia 23510

January 2012

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
1	General	Section 3.2.1 (Threatened and Endangered Species) indicates that no federal or state threatened or endangered species have been identified at the Formerly Used Defense Site(s) (FUDS) based on the Final Baseline Ecological Survey and Inventory. However, this assessment was conducted in 2001. As such, it is unclear if the information provided in the Final Baseline Ecological Survey and Inventory is representative of current site conditions at FNOD and current state and federal threatened and endangered species listings. Please revise the SI to clarify whether threatened or endangered species have been identified at the FUDS based on current listings.	A-ACCEPTED/CONCUR. The following text was added to Paragraph 3.2.1.1: *"Information on threatened or endangered species presented in various documents developed subsequent to the 2001 "Final Baseline Ecological Survey and Inventory" has corroborated the 2001 findings that no federal or state threatened or endangered species have been identified at the FUDS."*
2	General	Based on Section 3.3.2.5 (Background Samples) on Page 3-9, "Background sediment and surface water analytical results were not included in previous studies; therefore, two co-located sediment and surface water samples were collected during this SI and analyzed for metals only (Figure 3-3)." Background sediment and surface water data are shown on Figure 3-3 (Background Sample Locations); however, it is unclear if these two sample locations are representative of background. Please revise Section 3.3.2.5 to clarify whether any additional FNOD areas of concern (AOC) or other sites of interest are located in the vicinity of these background samples, and discuss how the two co-located sediment and surface water samples are representative of background.	A-ACCEPTED/CONCUR. The "background" samples were not intended to establish a statistical background data set for this SI Report. The purpose of the upstream samples was to provide an upstream frame of reference for comparison of the two sediment and two surface water samples collected during the SI. The following statement was added to Paragraph 3.3.2.5: *"The background sediment and surface water samples collected during the 2010 SI field event were located upstream of the AOC 2 sediment and surface water samples collected from Streeter Creek. No sites of interest related to the former uses of FNOD have been identified in the vicinity of the background sample locations (USACE 2008)."*
3	General	The Technical Project Planning (TPP) Meeting Memorandum for the site, included in Appendix B, states, "Alion will obtain groundwater analytical data from CENAO [Corps of Engineers North Atlantic Division Norfolk District] for wells to be located/sampled near	N-NON-CONCUR. As agreed during the June 2011 FNOD PDT meeting, existing issues relating to the site groundwater are on hold until the Background Study is complete. Therefore, existing groundwater data from

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: DATE: NAME:	FNOD Draft Final SIR (January 2011) 30 March 2011 Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
		AOCs 2, 8, and 9; Alion will not perform groundwater well sampling for this SI" (Introduction, Page 2). As noted in the TPP, groundwater samples were not collected as part of the SI field investigation, but no groundwater results for wells near AOCs 2, 8, and 9 have been presented in the SI Report. Since the Conceptual Site Models (CSMs) for these three AOCs identify groundwater as a potentially complete exposure pathway, groundwater data in the vicinity of the sites may be used to evaluate this pathway. Please revise the SI to include existing groundwater data from wells near AOCs 2, 8, and 9.	wells near AOCs 2, 8, and 9 are not included in the SI Report. The following text has been added to Paragraphs 5.4.4.1, 5.5.2.1, and 5.6.2.1, and Table 6-1: *"While the groundwater pathway may be potentially complete for AOCs investigated during this SI, any evaluation of the groundwater pathway has been deferred until completion of the ongoing Background Study. Therefore, no analyses of the groundwater pathway are presented in this SI Report."* Additionally, the following text has been added to Paragraph 3.1.1: *"As documented in the TPP Memorandum (Introduction, Page 2), it was intended that groundwater analytical data would be obtained from CENAO for wells to be located/sampled near AOCs 2, 8, and 9 and presented in the SI Report. Subsequent to the TPP meeting, it was agreed by the Project Delivery Team (PDT) that any evaluation of the groundwater pathway would be deferred until completion of the ongoing Background Study. Therefore, no groundwater data are presented in this SI Report. The PDT also agreed that the collection of soil data would be sufficient to determine if further action (i.e., remedial investigation) was needed relative to the presence of munitions constituents. Therefore, the SS-WP, which was prepared after the TPP #1 Memorandum, clearly indicated that groundwater samples would not be collected as part of the*

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
			MMRP SI." The following note was added to the CSMs for AOCs 2, 8, and 9: *"The FNOD Project Delivery Team agreed that any evaluation of the groundwater pathway would be deferred until completion of the ongoing Background Study."*
4	General	It is unclear why industrial soil regional screening levels (RSLs) were utilized for construction workers and employees/students while residential soil RSLs were utilized for trespassers/visitors. Based on Section 5.2.0.2 (Conceptual Site Model), "In the HHRA [Human Health Risk Assessment], the soil and sediment screening values used for trespassers/visitors were based on regional SLs [screening levels] for direct contract with residential soil. The soil and sediment screening values used for construction workers and employees/students were based on the regional SLs [screening levels] for direct contact with industrial soil." Please revise the SI to clarify why industrial RSLs were utilized for construction workers and employees/students and not residential RSLs.	A-ACCEPTED/CONCUR. Visitors and trespassers could include more sensitive receptors (e.g., children, and elderly) than would be expected for employee receptor populations. Therefore, the residential RSLs were used for the visitor/trespasser receptors to provide an element of conservatism relative to using the industrial RSLs. The SI Report was revised to reflect this assumption.
5	General	Several of the recommendations provided in Section 7 (Recommendations for Further Action) do not appear appropriate. For example, the AOC 2 (Streeter Creek and Lakeview Drive Ground Scars) subsection of Section 7 states that, "No unacceptable risks or no additional risks to human or ecological receptors were identified from exposure to metal MC [Munitions Constituents] in the media sampled at AOC 2 during this SI." This statement does not address groundwater even though the groundwater pathway for this AOC remains potentially complete for human receptors, as stated in Section 6.3.11, Page 6-4. Please revise Section 7 to discuss the	A-ACCEPTED/CONCUR. The following statement was added to Paragraphs 6.3.11, 6.4.7, and 6.5.7: *"The absence of groundwater analytical data does not introduce significant uncertainty for the conclusions regarding potential risks to human receptors at this AOC. No additional potential MC risks due to FUDS-related activities were determined based on samples collected at this AOC and no MEC has been found at this AOC (i.e., absence of a munitions related source). Therefore,*

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
		impact of any media not evaluated in the SI and revise the recommendations accordingly.	*groundwater is not likely to contain MC related to the former munitions use of this AOC. However, due to the physical characteristics of groundwater (i.e., its ability to move within the aquifer between other sites of interest related to the former uses of FNOD), it remains a potentially complete pathway."*
6	General	Sections 6.3 through 6.10 identify the potential human and ecological receptors for the individual AOCs discussed in these sections (AOC 2, AOC 8, AOC 9, AOC 10, AOC 11, AOC 12, AOC 14, and AOC 15). However, Sections 6.1, 6.2, 6.11 through 6.15 do not identify the potential human and ecological receptors for the individual AOCs and sites of interest discussed in these sections (Munitions Response Site [MRS] 1, MRS 2, AOC 1, AOC 5, AOC 7, Source Area [SA] 5, and O-4). Please revise Sections 6.1, 6.2, and 6.11 through 6.15 to identify the potential human and ecological receptors for the individual AOCs and sites of interest.	A-ACCEPTED/CONCUR. The following statement was added to Sections 6.1 and 6.2: *"Potential human receptors for MRS (#) include future residents, visitors/trespassers, construction workers, and employees. Potential ecological receptors include soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds."* Per USACE programmatic direction in April 2011, information pertaining to AOCs 1, 5, and 7, SA 5, and O-4 was removed from the Final SI Report. Information regarding these AOCs will be included in the FNOD PA being prepared by USACE. Therefore, Sections 6.11 through 6.15 were removed from the Final SI Report.
7	General	Section 2.1.4.6 (MRS 1 – James River Beach Dump Area), Page 2-3 indicates that a geophysical survey of the nearshore area was conducted in 2003 to detect submerged anomalies. However, the SI does not indicate whether any anomalies were detected. Similarly, Section 2.1.6.4 (AOC 7 – Area J Lake), Page 2-7 indicates that geophysical surveys have occurred at AOC 7; however, the text does not indicate whether anomalies were detected. As such, the basis of No Department of Defense Action Indicated (NDAI) designation for the Military Munitions Response Program (MMRP) is unclear.	A-ACCEPTED/CONCUR. The following text was added to Paragraph 2.1.4.6: *"Twenty Areas of Interest were identified using different methods (i.e., magnetometry, electromagnetometry, visual observations) during the 2003 geophysical survey. Seven Areas of Interest were determined to be known structures, including piers, an outfall, the I-664 bridge, and a sewer line. These known structures were generally*

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: DATE: NAME:	FNOD Draft Final SIR (January 2011) 30 March 2011 Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
		Please revise the appropriate subsections of Section 2.1 (Site Description and History) to clarify whether anomalies were discovered during geophysical surveys. If necessary, please adjust the recommendations for further action based on the MMRP designation.	*excluded as possible sediment sampling locations. The remaining Areas of Interest were evaluated for possible sediment sample locations. Twelve Areas of Interest consisting of large or concentrated anomalies were selected for sediment sampling (SAIC 2005)."* The following text was added as Paragraph 2.1.4.7 and to the end of Paragraph 6.1.1: *"In 2011, the USACE completed a geophysical survey of the shoreline and bluff along the entire length of the FNOD property. The purpose of the survey was to supplement previously collected geophysical data to identify potential disposal areas along the FNOD shoreline and bluff. The recent geophysical investigation was also initiated in response to the recent discoveries of MEC being washed out of the FNOD shoreline during large storm events. USACE will be using both the previous and recently collected geophysical data to identify anomalous areas that warrant intrusive investigation."* Per USACE programmatic direction in April 2011, information pertaining to AOCs 1, 5, and 7, SA 5, and O-4 was removed from the Final SI Report. Information regarding these AOCs will be included in the FNOD PA being prepared by USACE.
8	General	Section 5 (Munitions Constituents Sampling and Analysis) presents the screening level human health risk assessment (HHRA) as well as the screening level ecological risk assessment (SLERA). The methodology used for the assessments and the results for each	A-ACCEPTED/CONCUR. The suggested format changes were incorporated in the Final SI Report.

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
		assessment are not clearly divided in this section. Furthermore, many of the subsections within Section 5 (e.g., Section 5.1.2.2) do not include descriptive headings, which contribute to further confusion regarding what information is being presented (i.e., HHRA or SLERA). Please revise Section 5 to clearly separate the HHRA and the SLERA, and to include descriptive headers for all subsections so that the information is presented in a more user-friendly format.	
9	General	Only one surface soil sample and one subsurface soil sample were collected at AOC 2. The limited number of samples introduces considerable uncertainty into the risk assessment process, particularly since the basis of further investigation is based on these samples alone. Please revise the HHRA to address the uncertainties associated with the limited data set at AOC 2.	A-ACCEPTED/CONCUR. The SI is a limited scope study. Sample locations are biased toward areas where MC is most likely to be detected. For FNOD, as noted in Table 2-3 of the SI Report, sample locations were biased toward disturbed areas indentified from historical aerial photograph interpretation. For AOC 2, only one area (ground scar) was observed in the historical aerial photographs. Therefore, a surface and subsurface soil sample (co-located) were collected from this location, as proposed in the SS-WP and shown in the SI Report (Figure 3-1). The SI Report was revised to clarify the intent of the SI was to determine presence or absence of MEC and MC and not determine nature and extent. The report was also revised to provide a discussion of the related uncertainties associated with the limited data set at AOC 2. The following text was inserted at end of Section 5.4.1.1: "*The soil samples were collected from the only disturbed area identified from historical aerial photographs. Although only a single sample was collected from surface and subsurface soil to*

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
			characterize this AOC, the biased nature of the sampling location will likely ensure that the area is adequately characterized." The following text was inserted at end of Sections 5.4.1.4 and 5.4.1.9: "*The HHRA for AOC 2 surface soil is based upon a single sample, which introduces uncertainty into the risk assessment conclusions. The magnitude of this uncertainty was reduced by collecting the soil sample from the only disturbed area identified from historical aerial photographs. Furthermore, the HHRA for this sample yielded similar results as a previous investigation by Weston in 1997, as described in Section 2.1.7.1. Weston conducted analysis of explosive constituents and metals in surface soil from AOC 2 and identified arsenic as the only COPC."*
10	General	All of the antimony results in surface and subsurface soil at AOC 9 were rejected by data validation, and therefore, not used in the HHRA (Section 5.3.0.4). The HHRA concludes, on Page 5-53, that the "absence of surface soil data for antimony in this area does not introduce significant uncertainties for the conclusions regarding risks to human receptors from AOC 9 surface soils," but the rationale for this assessment is unclear. The same paragraph on Page 5-53 indicates that four COPCs were identified in surface soils at AOC 9, two of which were determined to pose potentially unacceptable risks to human receptors (arsenic and vanadium). However, it is unclear how this determination relates to the lack of usable data for antimony. Please revise the HHRA to support the conclusion that the lack of useable soil data for antimony at AOC 9 does not introduce uncertainties into the risk assessment and should not be viewed as a	A-ACCEPTED/CONCUR. The lack of antimony data does introduce some uncertainty into the risk assessment. However, as noted in the comment, the data gap was not assumed to introduce significant uncertainties in the conclusions of the risk assessment because potentially unacceptable risks had already been identified for other COPCs at AOC 9. If all other MC in the AOCs had been below the risk-based screening levels, then the antimony data gap would be considered more significant. The SI Report was revised to clarify this position.

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
		data gap.	
11	General	In 2006, field reconnaissance identified slag material deposited on the James River Beachfront east of I-664, on the Streeter Creek side of the FNOD. Please see the photos below: This slag material is similar to the slag material found on the original James River Beachfront disposal area before the removal action occurred. Such slag material appears to be related to steam-out operations and/or demilitarization of munitions during the operational phase of the FNOD. While the draft FNOD SI did not directly evaluate the shoreline area of the FNOD, it is recommended that future investigations at the FNOD investigate the slag material found along the shoreline areas of the FNOD, including the area east of I-664.	A-ACCEPTED/CONCUR. This area is not within MRS 1 or 2, or AOC 2, 8, 9, 10, 11, or 12. Per USACE programmatic direction in April 2011, information pertaining to areas outside these MRSs/AOCs is not included in the Final SI Report. Information regarding other additional areas will be included in the PA for FNOD being prepared by USACE.
12 (specific cmt 1)	Section 2.1.6.3, AOC 5 – TCC Lake, Page 2-6:	This section states that, "USACE is currently evaluating whether further action is warranted at AOC 5 and a decision is expected in 2010 (USACE 2010b)." However, Section 7.0.3, Page 7-5 states that, "USACE should evaluate whether future investigation/action is warranted at AOC 5 under HTRW [Hazardous Toxic and Radioactive Waste]." As such, it is unclear if a decision has been made regarding the site or if the site remains under evaluation. Please revise the SI to provide a clear indication of the status of the site.	A-ACCEPTED/CONCUR. Per USACE programmatic direction in April 2011, information pertaining to AOC 5 was removed from the Final SI Report. Information regarding this AOC will be included in the FNOD PA being prepared by USACE.
13	Section 2.2.2, Munitions Response Site Identification and Munitions Information, Page 2-12:	The text indicates that the boundaries of MRS 1 (James River Beach Dump Area, S-2) and MRS 2 (TNT Disposal Area, S-1) have expanded. However, Section 2.2.2 does not specify the updated acreage. Based on Section 7 (Recommendations for Further Action), the acreage for MRS 1 has changed from 1.5 acres to 2.1 acres while the acreage for MRS 2 has changed from 0.5 acres to 9.8 acres. Please revise Section 2.2.2 to clarify the expanded acreage for MRS	A-ACCEPTED/CONCUR. The recommended expanded acreage was already cited in Paragraphs 2.1.4 (MRS 1), 2.1.5 (MRS 2), 7.0.3, and Table 2-2. Per the commenter's request, the following sentence was added to Paragraph 2.2.2: *"The expanded acreage provided by USACE (2008) is 2.1 acres for MRS 1 and 9.8 acres for*

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
		1 and MRS 2.	*MRS 2."*
14	Section 2.3.7.1, Area Water Supply/Groundwater Use, Page 2-15:	This section indicates that there are no groundwater monitoring wells monitored by the Virginia Department of Health at FNOD or in the immediate vicinity of the site. However, based on the descriptions provided, the Virginia Department of Health does not appear to monitor groundwater wells that serve fewer than 15 residential connections or 25 individuals or residential customers. It is unknown whether private supply wells serving individual residences are utilized at or in the vicinity of FNOD. Please revise Section 2.3.7.1 to clarify whether it is known that individual private supply wells are in use at or in the vicinity of FNOD, or clarify whether this information could be obtained from another source.	A-ACCEPTED/CONCUR. The following statement was added to 2.3.7.1 of the Final SI Report: *"According to the City of Suffolk Department of Public Utilities, the residential neighborhoods of Burbage Grant, Respass Beach, and Water's Edge are served by public utilities; however, several of the residences within Respass Beach (located,east of FNOD) may still use private groundwater wells. A GIS dataset of individual private groundwater wells is not available for inclusion in the SI Report."*
15	Table 2-3, Military Munitions Type and Composition, Page 2-22:	Note 6 of Table 2-3 indicates that constituents of black powder (notable nitrates) were not analyzed during the recent SI sampling event even though some of the munitions at FNOD may have contained black powder. The SI states, "The constituents of black powder are not expected to persist in the environment for a significant period of time after initial release. Black powder is not anticipated to be present or detected after the operations ceased 60 years ago…" Please revise the SI to provide a source for this information.	A-ACCEPTED/CONCUR. Footnote 6 of Table 2-3 was revised to the following: *"Some of the munitions associated with the FNOD may have contained black powder, the major component of the munitions primer and/or spotting charge. Black powder consists of varying concentrations of charcoal, sulfur, and either potassium nitrate or sodium nitrate. Black powder easily dissolves when exposed to water, which renders it nonexplosive (Department of the Army [DA] 1984). Therefore, black powder is not expected to persist for a significant period of time after initial release in the environment, and no constituents of black powder were analyzed for in samples collected at this FUDS."*

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
16	Section 3.3.1, Site Inspection Field Work, Pages 3-4 through 3-8:	The subsections presented under Section 3.3.1 describe observations made at each of the AOCs during the SI field work. Structures were observed within the boundaries of several AOCs, but further detail on the types of structures observed, including details on current and/or historical use of the structures, if known, has not been provided. To support the current understanding of potential site receptors and the CSM, please revise Section 3.3.1 to provide further detail on structures observed during the SI field work, and clarify whether these structures are currently used or occupied by receptors.	A-ACCEPTED/CONCUR. The general types of structures observed during the SI field event were added to Section 3.3.1. These general uses included the following: AOC 2: Streeter Creek and Lakeview Drive Ground Scars (magazine) AOC 8: Track A Magazine Line (explosive magazines) AOC 9: Track A&B Burning Ground (explosive magazines) AOC 10: Track G MagazineLine (primer and fuze magazine and tetryl platform) AOC 11: Track H&I Magazine Line (smokeless powder and ammunition magazines) AOC 12: Track J Magazine Line (ammunition magazine) AOC 14: Track K Magazine Line (ammunition magazines) There are no known current uses of the structures within the AOCs visited and they were observed to be in poor condition, as noted in Section 3.3.1. The historical uses of the AOCs were summarized in Section 2.1 of the SI Report.
17	Section 3.3.1.5, AOC 10 – Track G Magazine Line, Page 3-6:	The third bulleted item indicates that cultural debris, including drums, was observed at AOC 10. However, no further description of the drums has been provided. Please revise Section 3.3.1.5 to comment on the current status of the drums. The number of drums observed, the construction and current state of the drums (rusted, empty, etc.), and contents of the drums, if known, should be	A-ACCEPTED/CONCUR. A separate ESI Report addressing the disposition of drums within AOC 10 is being prepared by USACE. The following paragraph was added to the Final SI Report as Paragraph 3.3.1.10. *"The drums observed during the SI field event were in poor condition including the presence of large*

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
		described.	*and small holes, severely rusted and deteriorated, crushed, missing tops, and/or missing bottoms. None of the drums were intact; therefore, none were observed to contain material or residue. A count and specific location of each drum observed was not collected during the field event."*
18	Figure 3-4, Photo Locations:	This figure shows that only two photographs were taken at AOC 8, both of which were located within the current boundaries of the site on the east side of Interstate 664. Figure 3-1 (Sample Locations and Geophysical Reconnaissance Route) shows that multiple samples for AOC 8 were collected and a geophysical reconnaissance was conducted on the west side of Interstate 664; however, no photographs appear to have been taken in this portion of the site. Please revise the SI to provide photographic documentation of the areas west of Interstate 664, if available, or clarify why photographs were not taken.	A-ACCEPTED/CONCUR. Numerous photographs were taken throughout the SI field event; however, the photographs included in Appendix E were chosen as the most representative of the current conditions. Two additional photographs were included in Appendix E of the area west of I-664, per the commenter's request.
19	Table 4-2, AOC 2, AOC 8, and AOC 9 Hazard Impact Assessment, Page 4-5 and Table 4-3, AOC 10, AOC 11, AOC 12, AOC 14, and AOC 15 Hazard Impact Assessment, Page 4-6:	The Munitions and Explosives of Concern (MEC) Sensitivity category information presented in Tables 4-2 and 4-3 does not correspond with the risk criteria presented in Table 4-1 (MEC Risk Assessment Categories). For example, the MEC Sensitivity listed in Table 4-2 is "Unknown." However, unknown is not a risk criteria option in Table 4-1. Please revise the MEC Sensitivity category information in Tables 4-2 and 4-3 to correspond with the risk criteria presented in Table 4-1.	A-ACCEPTED/CONCUR. A row was added to Table 4-1 to show "unknown" as a possible "MEC Type" and "MEC Sensitivity" category.

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: DATE: NAME:	FNOD Draft Final SIR (January 2011) 30 March 2011 Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
20	Table 4-2, AOC 2, AOC 8, and AOC 9 Hazard Impact Assessment, Page 4-5 and Table 4-3, AOC 10, AOC 11, AOC 12, AOC 14, and AOC 15 Hazard Impact Assessment, Page 4-6:	Multiple AOCs are evaluated in Tables 4-2 and 4-3. For clarity, individual Hazard Impact Assessment tables should be prepared for each AOC. For example, accessibility of AOC 2, AOC 8, and AOC 9 are discussed together in Table 4-2. The table indicates that fencing, gates, and signs surround portions of AOC 2, AOC 8, and AOC 9; however, it is unclear how much fencing exists around individual AOCs to restrict access. Please revise the SI to include a Hazard Impact Assessment table for each individual AOC.	N-NON-CONCUR. The AOCs grouped together in the SI Report are located in close proximity to each other and share similar characteristics; therefore, a single MEC Hazard Impact Assessment table for each group is appropriate. Separate tables for each AOC were not prepared since they would portray similar information. A complete survey of the entire perimeter of each AOC was not performed during the SI field event. Locked gates that prevented vehicle access to the AOCs were located far outside of the AOC boundaries. It is possible that partial fences also exist further outside the AOC boundaries that limit access to the AOCs. The "Accessibility" categories for "Site Inspection Observations" were revised in Tables 4-2 and 4-3 to provide more detail of where fences and gates were observed: Table 4-2: *"Partial restriction: Walking access between AOCs 2, 8, and 9 is possible. Portions of the AOCs are fenced (along I-664) and gated (vehicle entrance to AOC 8 at the intersection of Field Road and Armistead Road). Portions of these AOCs were observed to be open to the public in the immediate vicinity of the AOC boundaries."* Table 4-3: *"Partial restriction: Walking access between AOCs 10, 11, 12, 14, and 15 is possible. Portions of the AOCs are fenced (along I-664) and gated (vehicle entrance at the intersection of Club Drive and College Drive near AOCs 10 and 14, vehicle entrance at intersection of Sandy Drive and Jamestown Road near AOC 15). Portions of these*

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
			AOCs were observed to be open in the immediate vicinity of the AOC boundaries (along the James River).”
21	Section 5.1.3.1, Page 5-4:	This section states, “Maximum property concentrations for relevant [munitions constituents] were compared to the risk-based concentrations as part of the selection process for [chemicals of potential concern] COPCs…” None of the tables provided in Section 5 include a comparison of the maximum detected concentrations to the applicable screening criteria. Instead, all of the detected concentrations are presented in the tables and compared to screening criteria, as in Table 5-1, Summary of Soil Analytical Results. Please revise the HHRA to include a table that specifically screens maximum detected concentrations of constituents in each media against the relevant evaluation criteria, so that the screening process for COPCs is consistent throughout the text and tables.	N-NON-CONCUR. Tables 5-1, 5-2, and 5-3 provide a list of the sample results, including the detected concentrations. The data, including the maximum, were screened against the relevant ecological and human health SLs, and exceedances were highlighted according to the key provided at the bottom of the Table. This presentation provides a greater sense of the frequency and magnitude of SL exceedances, which is useful in evaluating the risk assessment conclusions. No changes were made to the tables as a result of this comment.
22	Section 5.1.3.2, Page 5-4:	It appears the USEPA Regional Screening Level (RSL) table, dated May 2010, was used for the HHRA evaluation. Please be advised that the RSL table was last updated in November 2010. The most recent version of the RSL table should be utilized at the time of report preparation.	A-ACCEPTED/CONCUR. The RSL update occurred after the draft had been completed. The USEPA RSL website is consulted just prior to when the risk assessment portions of the SI are submitted. Accordingly, the RSL table in the SI was updated with the values available in September 2011.
23	Section 5.1.3.17, Page 5-9:	This section begins, “In accordance with USEPA Guidance, the following screening process is utilized.” The specific guidance is not cited. Please specify the USEPA Guidance that was followed for this portion of the risk assessment.	A-ACCEPTED/CONCUR. The text has been revised as follows: *“Consistent with USEPA Guidance (1989), the following screening process was utilized.”*
24	Section 5.1.3.17,	The third item states, “If the concentration of a specific chemical	A-ACCEPTED/CONCUR. The noted Section of the SI

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
	Page 5-10:	exceeds its screening value and is above the maximum and/or mean background concentration, the chemical is retained as a COPC…" The HHRA does not clarify when the maximum background concentration will be used in the assessment and when the mean background concentration will be used in the assessment. Based on the evaluations completed, it does not appear that one or the other was consistently applied in the evaluations. Please revise the HHRA to clearly specify when maximum background concentrations will be utilized as evaluation criteria, and when mean background concentrations will be utilized.	Report was revised as follows. *"If the maximum concentration of a specific chemical exceeds its screening value and its mean or maximum is above the respective mean or maximum background concentration, the chemical is retained as a COPC/COPEC."*
25	Section 5.1.3.17, Page 5-10:	This section describes the COPC selection process utilized in the HHRA. However, the description does not include the weight of evidence approach that was applied to eliminate some constituents which were detected above the applicable RSL and relevant background concentrations. For example, Section 5.5.1.9, Pages 5-45 and 5-46, describes the weight of evidence that was used to eliminate cobalt as a COPC, even though the maximum detected concentration exceeded the residential RSL, as well as both the mean and maximum background concentrations. If a weight of evidence approach will also be applied to the selection/elimination of COPCs, it should be clearly defined in the HHRA. Please revise Section 5.1.3.17 to define the weight of evidence approach, and describe what additional considerations will be taken into account.	N-NON-CONCUR. The weight of evidence (WOE) approach does not affect the selection of COPCs. The process described in the noted section is used exclusively in the COPC selection. The WOE approach was used to evaluate the risk significance of the COPCs once identified. A variety of site and chemical specific factors are employed in the WOE evaluation and conclusion. As such, it is not possible to specify a set of criteria that would be employed consistently, as is done for the selection of COPCs. The WOE approach is discussed in Paragraphs 5.1.4.1 (analytes with no screening levels) and 5.2.0.5 (general). The following information was added to Paragraph 5.2.0.5: *"The weight-of-evidence evaluation is shown after select COPCs and COPECs in Section 5 as a bulleted list with a paragraph following that summarizes the MC risk."*
26	Table 5-4, Non-Detection Concentrations	This table does not highlight or otherwise differentiate those constituents for which the reporting limits exceeded a screening value (such as for nitroglycerin). To increase the utility of this table,	A-ACCEPTED/CONCUR. The requested highlights were added to show cases where the reporting limits

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
	and Screening Values for Human Receptors for Never-Detected Analytes:	please highlight or otherwise differentiate those constituents for which the reporting limits exceeded a screening value.	exceeded the screening levels.
27	Section 5.2, Conceptual Site Model, Page 5-14:	The first sentence states that, "The CSM diagrams for AOCs 2, 8, and 9 at the FNOD are provided in Appendix J." However, AOCs 10, 11, 12, 14, and 15 are also included in Appendix J (Conceptual Site Model). Please revise Section 5.2 to discuss all CSMs included in Appendix J.	A-ACCEPTED/CONCUR. The following text was added after the first sentence of Paragraph 5.2.0.1. *"Information from historical sampling events was used to complete the MC pathways in the CSMs for AOCs 10, 11, 12, 14, and 15. The results/conclusions of the historical sampling events and references to the CSM are summarized in Section 2.1.8 for each AOC. Additionally, historical and 2010 field event MEC/MD observations are also presented in Sections 2.1.8 and 4.2.2 and Table 4-3 of the SI Report."*
28	Section 5.2.0.2, Page 5-14:	The first sentence states, "Current and future potential human receptors for AOCs 2, 8, and 9 at the FNOD are expected to be visitors/trespassers, construction workers, and employees/students, as depicted in the [conceptual site model] CSM diagrams in Appendix J." The HHRA does not state whether residents could potentially occupy these sites in the future. If institutional controls are not already in place restricting residential use, residential receptors should be considered potential future receptors. Also, the HHRA does not clarify what types of employees may come in contact with the site (i.e., maintenance personnel, indoor workers, etc.) Although the addition of these receptors would not change the selection of the initial screening criteria, since both residential and industrial RSLs were utilized, they should be identified, if	A-ACCEPTED/CONCUR. Since residential use is possible at FNOD in the future, residential receptors were added to the CSMs. Additionally, the CSMs and Section 5.2.0.2 were clarified to state that visitors/trespassers, employees, construction workers, and biota are possible current and future receptors, and residents are possible future receptors. Students were removed from the Final SI Report as possible receptors because portions of AOCs 2, 8, and 9 are owned by the Tidewater Community College Real Estate Foundation and no longer used as school facilities. The specific types of activities that current employees might participate in at these areas are possibly outdoor

PROJECT: Draft Final Site Inspection Report for Former Nansemond Ordnance Depot, Suffolk, VA, FUDS Project No. C03VA004502 STAKEHOLDER REVIEW COMMENTS			
		REVIEW: FNOD Draft Final SIR (January 2011) DATE: 30 March 2011 NAME: Robert Thomson, U.S. EPA - Region 3, Office of Federal Facility Remediation (3HS11)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
		applicable, to provide a more specific CSM. Please revise the HHRA to clarify whether additional receptor populations need to be considered. Also, please clearly separate the receptors into either current receptors or future receptors.	maintenance. No additional receptors were identified at FNOD.
29	Section 5.4.2.4, Page 5-23:	Arsenic was detected in sediment at concentrations that exceed the residential RSLs as well as background concentrations. However, the HHRA concludes, on Page 5-24, that arsenic in sediment is not considered to represent an unacceptable risk to human receptors. The rationale provided for its exclusion from further evaluation is not sufficient. The primary reason cited is that "due to the relatively low bioavailability of arsenic from sediment compared to drinking water…the screening criteria for arsenic are considered conservative in nature and likely to overestimate risks for exposure to arsenic in sediment." If arsenic is detected above the initial screening level and background, it is recommended that a more site-specific risk evaluation be conducted to better determine risks associated with this constituent. The evaluation should consider site-specific exposure factors and utilize the most recent toxicity information for arsenic. Please revise the HHRA to provide further substantial justification for not considering arsenic in sediment to represent an unacceptable risk to human receptors based on the initial screening, or provide a more site-specific evaluation for this chemical.	A-ACCEPTED/CONCUR. The SI Report was revised to provide additional justification to support the conclusion that arsenic in sediment does not represent an unacceptable risk to human receptors. The additional text expands the discussion of the toxicity information available for arsenic, and discusses how the site-specific exposure factors mitigate the risk predicted through the use of the conservative screening level.
30	Section 5.4.4, Groundwater Pathway, Page 5-33	This section indicates that the groundwater pathway at AOC 2 is potentially complete, yet no groundwater samples were analyzed at AOC 2. This appears to be a data gap unless additional justification for not assessing groundwater in consideration of potential exposure pathways can be provided. Please revise the HHRA to address this concern. This comment also applies to AOC 8 and 9, at which a potentially complete exposure pathway was identified for groundwater but no groundwater samples were collected.	A-ACCEPTED/CONCUR. Refer to the response to Comment 3 for information added to Paragraphs 5.4.4.1, 5.5.2.1, and 5.6.2.1, and refer to the response to Comment 5 for information added to Paragraphs 6.3.11, 6.4.7, and 6.5.7.

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ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
31	Section 6.11, Nansemond River Beachfront (AOC 1), Page 6-9	The text states that, "An RI [Remedial Investigation] Report will be conducted in 2010 or 2011." It is unclear if the RI Report was conducted. Similarly, Sections 6.14 [Main Burning Ground and Steamout Pond (SA-5)] and 6.15 [North Athletic Field (O-4)] indicate that a RI Report will be finalized in 2010 for SA-5 and a geophysical study of the Nansemond River and James River shorelines are planned for 2010 at O-4. However, the text does not indicate whether these reports/studies were conducted. Please revise the SI to clarify whether the referenced reports/studies were conducted. If the conclusions/results from the reports/studies are available, please revise the SI to include applicable information.	A-ACCEPTED/CONCUR. Per USACE programmatic direction in April 2011, information pertaining to AOCs 1, 5, and 7, SA 5, and O-4 was removed from the Final SI Report. Information regarding these AOCs will be included in the FNOD PA being prepared by USACE.

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Mail Code: 3HS11

Date: November 14, 2011

Mr. Sher Zaman
US Army Corps of Engineers
HTRW Branch, Engineering Division
CENAB-EN-HN
10 S Howard Street
Baltimore, MD 21201

Re: Former Nansemond Ordnance Depot NPL site
Draft MMRP *Site Inspection Report for the Former Nansemond Ordnance Depot*
Review of Corps' 10/18/11 response to EPA's 03/30/11 letter

Dear Mr. Zaman:

The U.S. Environmental Protection Agency (EPA) has reviewed the U.S. Army Corp's of Engineers (Corp's) October 18, 2011 response to EPA's March 30, 2011 letter pertaining to the Corps' January 2011 draft MMRP *Site Inspection Report for the Former Nansemond Ordnance Depot* (SI Report). Based upon that review, EPA finds the Corps' responses to be acceptable given the following:

(1) The Corps of Engineers will continue the ongoing investigation of the shoreline and bluff areas along the entire length of the former Nansemond Ordnance Depot property boundary.
(2) The deferred evaluation of groundwater will be conducted in a future investigation.
(3) The Corps of Engineers will submit the separate ESI for AOC 10 addressing the disposition of the identified drums.

Please make the appropriate corrections/insertions/deletions to the *SI Report* as outlined in the Corps' response letter, and send two final hardcopies of the *SI Report* to EPA for insertion into the project files.

If you have any questions, please feel free to call me at (215) 814-3357,

Sincerely,

Robert Thomson, PE, REM
Office of Federal Facility Remediation (3HS11)