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FINAL ACTION MEMORANDUM AREA OF CONCERN 2 DEXTROSE DUMP FISC WILLIAMSBURG VA

07/01/2015

CH2M HILL

Final

Action Memorandum
Area of Concern 2 – Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex
Williamsburg, Virginia

Contract Task Order WE38

July 2015

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

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Prepared by

CH2MHILL

Virginia Beach, Virginia

FINAL

ACTION MEMORANDUM FOR AREA OF CONCERN 2 – DEXTROSE DUMP

Naval Weapons Station Yorktown, Cheatham Annex
Williamsburg, Virginia

DATE: July 2015

SUBJECT: Non-Time-Critical Removal Action at Area of Concern 2, the Dextrose Dump, Naval Weapons Station Yorktown, Cheatham Annex

FROM: Commander, Mid-Atlantic Division, Naval Facilities Engineering Command

TO: Captain Paul C. Haebler
Commanding Officer
Naval Weapons Station Yorktown

This Action Memorandum documents approval for a surface soil and subsurface debris removal action as described herein for Area 2 within Area of Concern (AOC) 2, the Dextrose Dump, at Naval Weapons Station Yorktown, Cheatham Annex, in Williamsburg, Virginia. This Action Memorandum serves as the Decision Document for selection of the Non-Time-Critical Removal Action (NTCRA), as evaluated in the Engineering Evaluation/Cost Analysis for AOC 2, prepared under separate cover and developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, and is consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for the site. The NTCRA is not intended to represent the final remedial action decision for the site.

Conditions at AOC 2 Area 2 meet the NCP Section 300.415(b) (2) criteria for a removal action. The Naval Facilities Engineering Command Mid-Atlantic recommends approval of the proposed NTCRA. The total project ceiling, if approved, is estimated to be $947,000. Response actions should commence as soon as practical to expedite the removal of surface soil and subsurface debris at the site.

Approved by:

Paul C. Haebler
Captain, U.S. Navy
Commanding Officer
Naval Weapons Station Yorktown

7/16/15
Date

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Acronyms and Abbreviations

AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CAX	Cheatham Annex
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CLEAN	Comprehensive Long-term Environmental Action – Navy
EE/CA	Engineering Evaluation/Cost Analysis
ERP	Environmental Restoration Program
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NTCRA	Non-Time Critical Removal Action
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	Site Investigation
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
WPNSTA	Naval Weapons Station Yorktown
yd^3	cubic yards

I Purpose

This Action Memorandum documents approval for the non-time-critical removal action (NTCRA) to mitigate potential unacceptable human health and ecological risks from exposure to surface soil and subsurface debris at Area 2 within Area of Concern (AOC) 2, Dextrose Dump, at Naval Weapon Station Yorktown (WPNSTA), Cheatham Annex (CAX), in Williamsburg, Virginia. Groundwater requires No Further Action (NFA) (CH2M HILL, 2013), and, therefore, is not included in this Action Memorandum.

The Engineering Evaluation/Cost Analysis (EE/CA) for AOC 2 (**Attachment A**) focused on preventing exposure of human and ecological receptors to Area 2 debris and soil that are present with contaminant concentrations that may pose unacceptable risks, and preventing or minimizing transport of constituents of potential concern (COPCs) from buried debris and soil to site media.

This Action Memorandum serves as the Decision Document for the selection of the NTCRA, as formulated and evaluated in the EE/CA (**Attachment A**), and for the Department of the Navy (Navy) to conduct the work proposed therein. The alternatives evaluated in the EE/CA are summarized as follows:

- Alternative #1 – No action
- Alternative #2 – Removal and Offsite Disposal
- Alternative #3 – Low Permeability Soil Cover

This Action Memorandum was completed in accordance with the remedial program requirements defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, the Superfund Amendments and Reauthorization Act of 1986 (SARA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and the U.S. Environmental Protection Agency's (USEPA's) *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993).

The Navy has broad authority under CERCLA Section 104 and Executive Order 12580 to carry out removal actions when the release is on, or the sole source of the release is from, a Navy Installation. The Navy and Marine Corps Environmental Restoration Program (ERP) was initiated to identify, assess, characterize, and clean up or control contamination from past hazardous waste disposal operations and hazardous material spills at Navy and Marine Corps installations. This Action Memorandum follows the guidelines published in the Navy/Marine Corps Installation Restoration Manual (Naval Facilities Engineering Service Center, 2001) as well as the guidelines published in the *Navy Environmental Restoration Program Manual* (NAVFAC, 2006) and the *Superfund Removal Guidance for Preparing Action Memoranda* (USEPA, 2009).

II Site Conditions and Background

On January 2, 2001, CAX was placed on USEPA's National Priorities List (NPL) and is identified in the USEPA's Superfund Enterprise Management System (SEMS) as VA3170024605.

The following subsections describe the features and history of CAX and AOC 2. They also discuss the findings from previous site investigations and the detected contaminants that necessitated the preparation of the EE/CA.

A. Site Description

CAX (**Figure 1**) is located on the site of the former Penniman Shell Loading Plant, a large powder and shell loading facility operated by the DuPont Company during World War I, which closed in 1918 and was dismantled shortly thereafter. Between 1923 and 1943, the property was used for farming or

remained idle until CAX was commissioned in 1943 as a satellite unit of the Naval Supply Depot to provide bulk storage facilities and to serve as an assembly and overseas shipping point during World War II. The facility is divided into two separate parcels, with the larger parcel situated along the banks of the York River. Almost all of the activities at CAX (administration, training, maintenance, support, and housing) take place in the larger parcel. The smaller parcel is used mainly as a watershed protection area. In 1987, CAX was designated the Hampton Roads Navy Recreational Complex. In 1998, control of CAX was transferred from Fleet and Industrial Supply Center to WPNSTA Yorktown. The current mission of CAX includes supplying Atlantic Fleet ships and providing recreational opportunities to military and civilian personnel.

AOC 2 (**Figure 2**) was identified during site visits by the Navy, USEPA, VDEQ, and Baker Environmental, Inc. (Baker) in late 1997 and early 1998. Historical information indicates that AOC 2 was an unlined, non-permitted disposal area with unknown dates of debris disposal. In the eastern portion of the site are several rows of concrete foundation piers that at one time supported a shipping house associated with the former Penniman Shell Loading Plant (**Figure 3**). Partially buried glass intravenous (IV) bottles (labeled “dextrose”) and unlabeled, empty, 55-gallon drums, respirator cartridges, and surplus military clothing were discovered in the area. Several mounds also present in the area were suspected to contain buried debris (Baker, 2001). Based on the types of debris observed during test trenching activities, the site was separated into four areas: Areas 1a and 1b (surplus dextrose IV bottles), Area 2 (unused respirator cartridges and empty 55-gallon drums), and Area 3 (surplus military clothing) (**Figure 3**). The CAX Partnering Team agreed the nature of the debris in Areas 1a, 1b, and 3 (dextrose IV bottles and military clothing) is not a concern or a source regulated under CERCLA, as documented in the May 2011 Partnering Meeting minutes and Table 2-2 in the Site Management Plan (CH2M HILL, 2014); therefore, Areas 1a, 1b, and 3 are not addressed by this Action Memorandum.

1 Removal Site Evaluation

In October 1998, a field investigation was completed in Area 1a and Area 2 (**Figure 3**) that included geophysical surveying as well as soil and groundwater sampling via direct-push technology to gain a better understanding of the nature and extent of possible contamination at AOC 2. Based on the results of the geophysical survey, areas of significant magnetic anomalies were delineated that could potentially coincide with buried debris (Baker, 1999). The concentrations of several inorganic constituents in soil exceeded ecological screening criteria and the concentrations of iron indicated a potential (non-carcinogenic) risk to human health. There were no potential unacceptable risks identified for groundwater. Further investigation of the geophysical anomalies and potential sources of contamination was recommended (Baker, 1999).

In November 1999, six test pits were excavated and sampled at AOC 2 to determine the nature of the geophysical anomalies. Buried materials were encountered in each test pit and included empty drums, dextrose IV bottles, and unopened and unused respirator cartridge canisters. During this investigation, the debris that was unearthed or collected from the ground was later disposed offsite; however, the majority of the buried debris was not removed. One respiratory cartridge canister was submitted for analysis of full toxicity characteristic leaching procedure (TCLP) parameters and Resource Conservation and Recovery Act characterization. Because cadmium and lead concentrations exceeded TCLP levels, the Navy, in consultation with the USEPA and VDEQ, agreed to expand the test pit program to define the extent of buried debris and canisters.

In 2000, a supplemental test pit investigation was conducted and a total of 47 exploratory test pits were advanced at AOC 2, with 19 of the test pits located in Area 2. Materials encountered included respirator cartridge canisters, empty drums, dextrose IV bottles, and military clothing. In general, the test pits only

extended to the top of debris to avoid unearthing excessive amounts of waste. However, one Area 2 test hole was advanced to an average of 10 feet below ground surface (bgs) over an approximate 25 foot by 15 foot area in order to remove some of the buried respirator cartridges (**Figure 3**). The removal of cartridges from the test hole was stopped in late January 2000 due to snow, wet site conditions, and the large volume of waste that had been excavated. Eight thousand pounds of respirator cartridges and empty drums from Area 2 were removed for offsite disposal. The lateral extent of the buried debris was not completely defined. A limited geophysical investigation was recommended to delineate the lateral extent of buried respirator cartridge canisters and the location of the eastern perimeter of disposal along Deer Pit Road, and a test pit investigation was recommended to confirm the results of the geophysical investigation (Baker, 2001).

In 2001, a total of 15 trenches were excavated to confirm the presence or absence of buried respiratory cartridges along Deer Pit Road and to obtain additional information concerning subsurface materials potentially buried at AOC 2. Dextrose IV bottles, clothing, metal debris, and empty 55-gallon drums were observed in the trenches. Three of the trenches were excavated in Area 2, and buried drums were observed in two of the three trenches. No samples were collected for laboratory analysis. The horizontal and vertical extents of the dextrose IV bottle dump along Deer Pit Road were delineated and debris was observed to be confined primarily to beneath the road, with some surface debris outside the road area (Baker, 2002).

In 2012, a site inspection (SI) was conducted at multiple CAX AOCs, and included AOC 2 (CH2M HILL, 2012). For the SI, human health and ecological risk screenings of surface soil and subsurface soil samples collected in 1998 and 1999 were conducted. The risk screenings concluded exposure to surface soil at AOC 2 may result in potential unacceptable human health risks associated with arsenic and chromium and potential unacceptable ecological risks associated with 4,4'-DDT, iron, and mercury. The risk screenings also concluded exposure to subsurface soil at AOC 2 may result in potential unacceptable human health risks associated with Aroclor-1260, arsenic, chromium, copper, and thallium and potential unacceptable ecological risk associated with mercury. The SI Report recommended a removal action for Area 2 to remove the debris (respirator cartridges and empty 55-gallon drums) and the collection of post-removal soil samples. The removal would also address the human health COPCs in surface and subsurface soil, except for the arsenic and chromium exceedances outside of Area 2, and would address the potential ecological risk associated with 4,4'-DDT in surface soil and mercury in surface and subsurface soil, except for the mercury exceedances outside of Area 2. Regarding iron, it was identified as an ecological COPC in surface soil because it exceeded the background concentration and soil pH data were not historically available; the screening value for iron is pH-based. Therefore, the SI recommended, surface and subsurface soil sample collection prior to the removal action to determine whether the removal action proposed for Area 2 needs to also address soil "hot spots" outside of Area 2 related to potential human health risk to arsenic and chromium and potential ecological risk to mercury and to determine if iron should be retained as an ecological COPC for surface soil.

In May 2014, a supplemental soil investigation was conducted outside of Area 2 to augment the SI dataset for the purpose of updating the human health (arsenic and chromium) and ecological (iron and mercury) risk evaluations to determine whether these constituents pose potentially unacceptable risks to human health and the environment and to determine whether the removal action proposed for Area 2 needs to also address soil "hot spots" outside of Area 2, specifically in Area 1a. The supplemental investigation included the collection of surface soil (0- to 6-inch depth) samples and subsurface soil (various depths) samples in proximity to the historical sample locations outside of Area 2. The supplemental soil sample results concluded there are no soil "hot spots" outside of Area 2, thus only Area 2 needed to be addressed in the EE/CA. In addition, the pH values in surface and subsurface soil

were measured between 5 and 8, which are within the acceptable pH range for iron; therefore, iron was not retained as an ecological COPC for surface or subsurface soil within or outside of Area 2. The supplement soil investigation results are presented in the EE/CA (**Attachment A)**. Also, the human health risk summary presented in the EE/CA concluded copper and thallium are not human health COPCs in AOC 2 subsurface soil.

In June 2015, the EE/CA (**Attachment A**) was completed to address potential unacceptable human health and ecological risks from exposure to contaminants in surface soil, subsurface soil, and debris at Area 2. The EE/CA contains information concerning the nature and extent of contamination in the soil, as well as a description of the objectives of the NTCRA and analysis of various removal alternatives that were considered for Area 2.

2 Physical Location

CAX consists of approximately 2,300 acres of land on the York-James Peninsula, northwest of WPNSTA Yorktown (**Figure 1**). It is located on the south bank of the York River within Williamsburg, Virginia. AOC 2 is located within a wooded area of CAX, to the north of Garrison Road, along the southern perimeter of CAX (**Figure 2**).

3 Site Characteristics

AOC 2 is a less-than-1-acre site consisting of four debris disposal areas (**Figure 3**). The topography of AOC 2 is predominantly flat, and surface runoff from precipitation is anticipated to pond and infiltrate into the subsurface or evaporate. There are no wetlands or surface water bodies located within AOC 2. In general, the native soil is predominantly composed of clay and silt at AOC 2. As observed during test trenching activities in 2001, a sand fill layer was found to be present over buried materials in some areas of AOC 2 (Baker, 2002). The first encountered groundwater underlying AOC 2 is the Cornwallis Cave aquifer, at depths ranging from approximately 22 to 33 feet below ground surface (bgs); groundwater is expected to flow southeast toward King Creek (Baker, 1999).

4 Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant

Based on the data and results of the SI (CH2M HILL, 2012) and the 2014 supplemental soil sample collection and evaluation (included in **Attachment A**), it was determined there are potentially unacceptable risks to human health and the environment from exposure to surface and subsurface soil at Area 2 within AOC 2, specifically: arsenic and chromium in surface soil and arsenic, chromium, and Aroclor-1260 in subsurface soil related to human health and 4,4'-DDT and mercury in surface soil and mercury in subsurface soil related to the environment.

5 National Priorities List Status

On January 2, 2001, CAX was placed on USEPA's NPL, and AOC 2 is among the ERP sites being addressed under CERCLA at CAX.

6 Maps, Pictures, and Other Graphic Representations

Figure 1, Figure 2, and **Figure 3** illustrate the location of CAX, the location of AOC 2 within CAX, and the AOC 2 layout (including the debris disposal areas), respectively. **Figure 4** presents the proposed removal action area for AOC 2 Area 2 to be addressed during the NTCRA. Additional figures included as part of the EE/CA (**Attachment A**) are:

Figure 2-4 - Investigation Locations
Figure 2-5 – Location of Test Trenches
Figure 2-6 – AOC 2 SI Surface Soil Exceedance Results

Figure 2-7 – AOC 2 SI Subsurface Soil Exceedance Results
Figure 4-1 – Proposed Removal Action Alternatives Layout

B. Other Actions

1 Previous Actions

As described in Section II.A.1, the debris that was unearthed or collected from the ground surface during the 1999 field investigation activities was later disposed offsite, which included some debris from Area 2 (Baker, 2001). Following the 1999 Field Investigation, an additional 8,000 pounds of respirator cartridges from Area 2 were removed for offsite disposal during the 2000 Supplemental Test Pit Investigation (Baker, 2001).

2 Current Actions

No current actions are being completed for Area 2, specifically, or AOC 2 overall.

C. State and Local Authorities' Roles

1 State and Local Actions to Date

Under Executive Order 12580, the President delegates authority to undertake CERCLA response actions to the Department of Defense. Congress further outlined this authority in the Defense Environmental Restoration Program Amendments, under 10 United States Code Sections 2701 through 2705. CERCLA Section 120 requires the Navy to apply state removal and remedial action law requirements at its facilities.

2 Potential for Continued State/Local Response

The Navy will continue to be the lead agency, and the Navy's ERP will continue to be the exclusive source of funding for remedial actions on CAX property. As members of the CAX Tier 1 Partnering Team, USEPA and the Virginia Department of Environmental Quality (VDEQ) will continue to be consulted until all necessary actions are complete.

III Threats to Public Health or Welfare or the Environment, and Statutory and Regulatory Authorities

Section 300.415 of the NCP lists the factors to be considered in determining the appropriateness of an NTCRA. Paragraph (b)(2)(i)of Section 300.415 applies to the conditions as follows:

300.415(b)(2)(i) "Actual or potential exposures to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants."

Based on the data and results of the SI (CH2M HILL, 2012), it was determined there are potentially unacceptable risks to human health and the environment from exposure to arsenic, chromium, mercury, and 4,4'-DDT in surface soil and arsenic, chromium, mercury, and Aroclor-1260 in subsurface soil at Area 2 within AOC 2.

IV Endangerment Determination

Actual or threatened releases of hazardous substances from AOC 2 Area 2, if not addressed by implementing the NTCRA discussed in this Action Memorandum, may present an endangerment to human health and the environment.

V Proposed Actions and Estimated Costs

A. Proposed Actions

The scope of the removal action to be initiated at AOC 2 Area 2 consists of excavation of debris and impacted soil at Area 2 within AOC 2.

1 Proposed Action Description

The preferred removal action alternative for surface and subsurface soil and subsurface debris at Area 2, as presented in the EE/CA (**Attachment A**), is Alternative 2, which consists of excavation of debris and impacted soil, offsite disposal, and backfilling the excavation.

Alternative 2 includes pre-excavation waste characterization sampling, excavating Area 2 debris and impacted soil, offsite disposal of the excavated material, post-excavation confirmation sampling, backfilling the excavation areas, and site restoration, as summarized as follows and detailed in the EE/CA (**Attachment A**).

Pre-excavation waste characterization samples will be collected to profile and classify the waste for offsite disposal. The debris and impacted soil from Area 2 will be excavated to depths (based on previous test pitting) ranging from 6 to 9 feet bgs (**Figure 4**). For cost-estimating purposes, the size of the excavation area is estimated to be 3,700 ft^2, and an estimated total of 1,304 cubic yards (yd^3) of material will be excavated. Before backfilling of excavations occurs, post-excavation confirmation samples will be collected and analyzed for the site COPCs (Aroclor-1260, arsenic, hexavalent and total chromium, mercury, and 4,4-DDT) to confirm the horizontal and vertical extents of the excavations are sufficient; confirmation soil samples will be compared to the chemical-specific PRGs presented in the EE/CA (**Attachment A**). An estimated total of 1,630 loose yd^3 of fill material (1,525 yd^3 of imported general fill, 105 yd^3 of imported topsoil) will be used to backfill the excavation area to match the surrounding grade and restore pre-existing conditions to better support vegetation growth. Finally, areas disturbed during the removal action will be stabilized by seeding with native species of grasses.

2 Contribution to Remedial Performance

This NTCRA will mitigate the potential unacceptable human health and ecological risks from exposure to debris and impacted soil. Debris excavation will be deemed complete through visual confirmation that native soil has been reached. Soil excavation will be deemed complete when post-excavation confirmation soil samples collected from the horizontal and vertical extents of the excavations confirm that the human health and ecological COPC concentrations are below the chemical-specific preliminary remediation goals (PRGs) established in Section 2.6 of the EE/CA (**Appendix A**).

3 Description of Alternative Technologies

Three alternatives were assessed for addressing the soil and debris at Area 2 within AOC 2. These alternatives were evaluated and compared based upon their effectiveness, implementability, and cost. The EE/CA (**Attachment A**) describes the considered alternatives in greater detail, as well as the process by which the alternatives were selected, evaluated, and compared.

4 Applicable or Relevant and Appropriate Requirements

The NCP requires that removal actions attain federal and state applicable or relevant and appropriate requirements (ARARs) to the extent practicable, with limited exception. Analysis of the removal action alternatives for Area 2 with the applicable ARARs is presented in the attached EE/CA (**Attachment A**). The NTCRA set forth in this Action Memorandum will comply with ARARs to the extent practicable.

5 Project Schedule

The public notice of availability for the EE/CA was published on 5/16/15 and 5/17/15 in the *Virginia Gazette* and *Daily Press*, respectively. The EE/CA was made available for public review and comment from 5/16/15 through 6/16/15. The public notices and responsiveness summary are included as **Attachment B**. No public comments were received.

The proposed project schedule for the removal action is:

- Pre-excavation waste characterization sampling, subcontracting, work plan, and mobilization—10 months
- Removal action—2 months
- CERCLA documentation—8 months

B. Estimated Costs

The NCP 40 Code of Federal Regulations Part 300.415 dictates statutory limits of $2 million and 12 months for USEPA fund-financed removal actions, with statutory exemption for emergencies and actions consistent with the removal action to be taken. This removal action will not be USEPA fund-financed. The Navy's ERP does not limit the cost or duration of the removal action (Navy, 2006).

Response Action Contract

The Navy will contract with an environmental remediation contractor to perform the required work associated with Area 2. The estimated costs are itemized in **Table 1**. Detailed cost estimates are provided in the EE/CA (**Attachment A**). The estimated costs are provided to an accuracy of +50 percent and -30 percent.

TABLE 1
AOC 2 Area 2 Removal Action Cost – Alternative 2

Work Planning Documents	$82,000
Mobilization/Demobilization and Site Setup	$43,748
Site Support	$19,480
Post-Excavation Confirmation Sampling	$4,677
Excavation, Transportation, and Disposal	$225,918
Material Delivery and Placement	$45,641
Surveying	$6,320
Site Restoration	$5,073
Subtotal	**$432,857**
Contingency (25%)	$108,214
Construction Management (10%)	$43,286
Project Management (8%)	$34,629
Subtotal	**$618,986**
Performance Bond (2%)	$12,380
TOTAL CAPITAL COST of ALTERNATIVE 2	**$631,000**
-30 percent	$442,000
+50 percent	$947,000

VI Expected Change in the Situation Should Action Be Delayed or Not Taken

If the proposed NTCRA is not taken at this time or is delayed, the human health and ecological risks from soil and debris at Area 2 within AOC 2 will remain.

VII Outstanding Policy Issues

There are no outstanding policy issues regarding this action.

VIII Enforcement

The Navy can and will perform the proposed response actions promptly and properly.

IX Recommendation

This Action Memorandum documents the selected removal action for soil and debris at Area 2 within AOC 2 Area 2, CAX, in Williamsburg, Virginia, developed in accordance with CERCLA, as amended, and consistent with the NCP. The technical foundation for this decision is based on the results of an SI documented in the Administrative Record file for CAX.

Conditions at the site meet the NCP section 300.415(b)(2) criteria for a removal action. Naval Facilities Engineering Command Mid-Atlantic, in cooperation with USEPA Region III and VDEQ, recommends approval of the proposed removal action. If approved, the total project ceiling will be $947,000 (using +50 percent of the cost estimate as provided in the EE/CA). The response action is necessary due to the potential threat to human health and the environment from Area 2 within AOC 2 and should commence as soon as practical to mitigate potential unacceptable human health and ecological risks.

X References

Baker Environmental, Inc. (Baker). 1999. *Final Field Investigation Report, Site 1 and AOC 2, Naval Weapons Station Yorktown, Yorktown, Virginia, Cheatham Annex Site.* September.

Baker. 2001. *Final Field Investigation Report, Site 7 and AOC 2, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. March.

Baker. 2002. *Final Trenching Letter Report, Site 1, Site 4, and AOC 2, Naval Weapons Station Yorktown, Cheatham Annex Site, Williamsburg, Virginia.* June.

CH2M HILL, 2012. *Final Site Inspection Report for AOCs 1, 2, 6, 7, 8, Naval Weapons Station Yorktown, Cheatham Annex, Williamsburg, Virginia*. May.

CH2M HILL. 2013. *Final No Action Consensus Letter for Groundwater at AOC 2, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. August.

CH2M HILL. 2014*. Site Management Plan Fiscal Years 2015-2016, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. September.

Naval Facilities Engineering Service Center. 2001. *Navy/Marine Corps Installation Restoration Manual.*

Naval Facilities Engineering Command (NAVFAC). 2006. *Navy Environmental Restoration Program Manual.*

Department of the Navy (Navy). 2006. Department *of Navy Environmental Restoration Program Manual*. November.

United States Environmental Protection Agency (USEPA). 1993. *Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA,* PB93-963402. August 1993.

USEPA. 2009. *Superfund Removal Guidance for Preparing Action Memoranda*.

Figures

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE-1 BASE LOCATION MAP.MXD RLAFLEUR CH2MHILLENV 4/2/2015 5:52:57 AM

Legend

- CAX Boundary
- Study Area Boundary

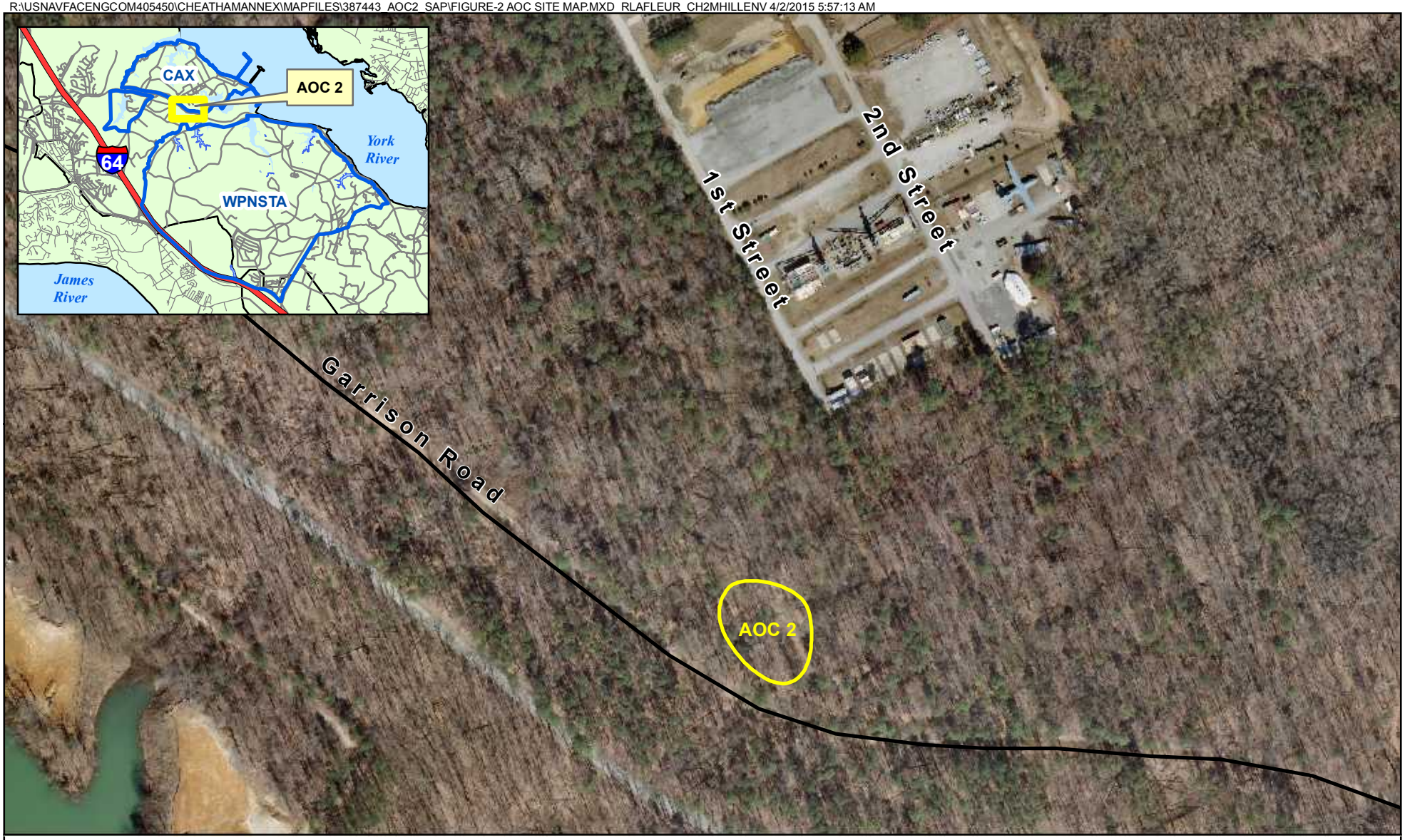
N
W E
S

0 1,000 2,000
Feet

Figure 1
Base Location Map
Action Memorandum for AOC 2
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE-2 AOC SITE MAP.MXD RLAFLEUR CH2MHILLENV 4/2/2015 5:57:13 AM



Legend

- CAX Boundary/Fenceline
- Study Area Boundary

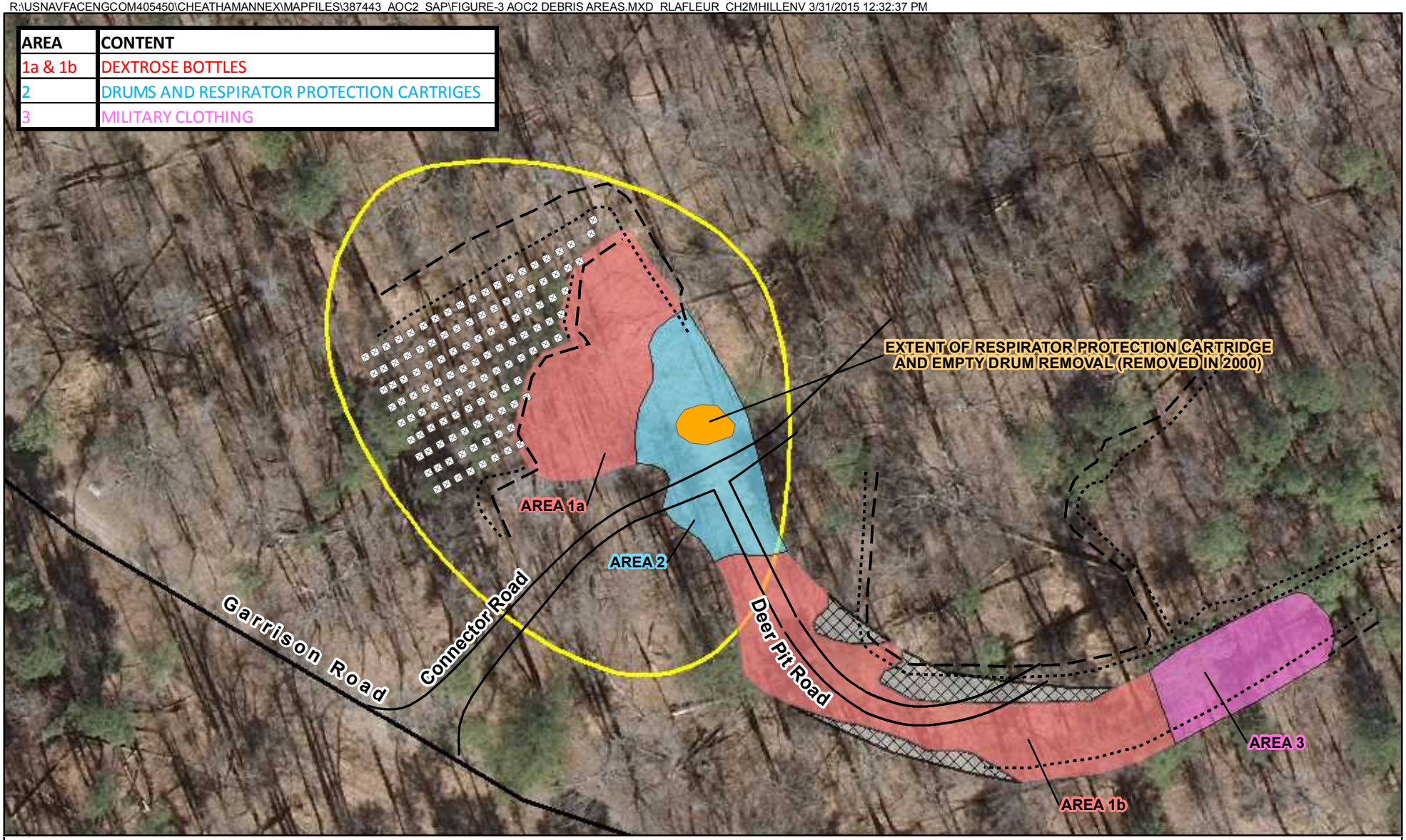
N
W E
S

0 150 300
Feet

Figure 2
AOC 2 Site Map
Action Memorandum for AOC 2
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE-3 AOC2 DEBRIS AREAS.MXD RLAFLEUR CH2MHILLENV 3/31/2015 12:32:37 PM



Legend

- Concrete Piers
- Top of Bank
- Toe of Slope
- Area 1a and Area 1b Boundary
- Area 2 Boundary
- Area 3 Bundary
- Former Location of Surface Debris (removed in 1998)
- Study Area Boundary
- CAX Boundary / Fenceline

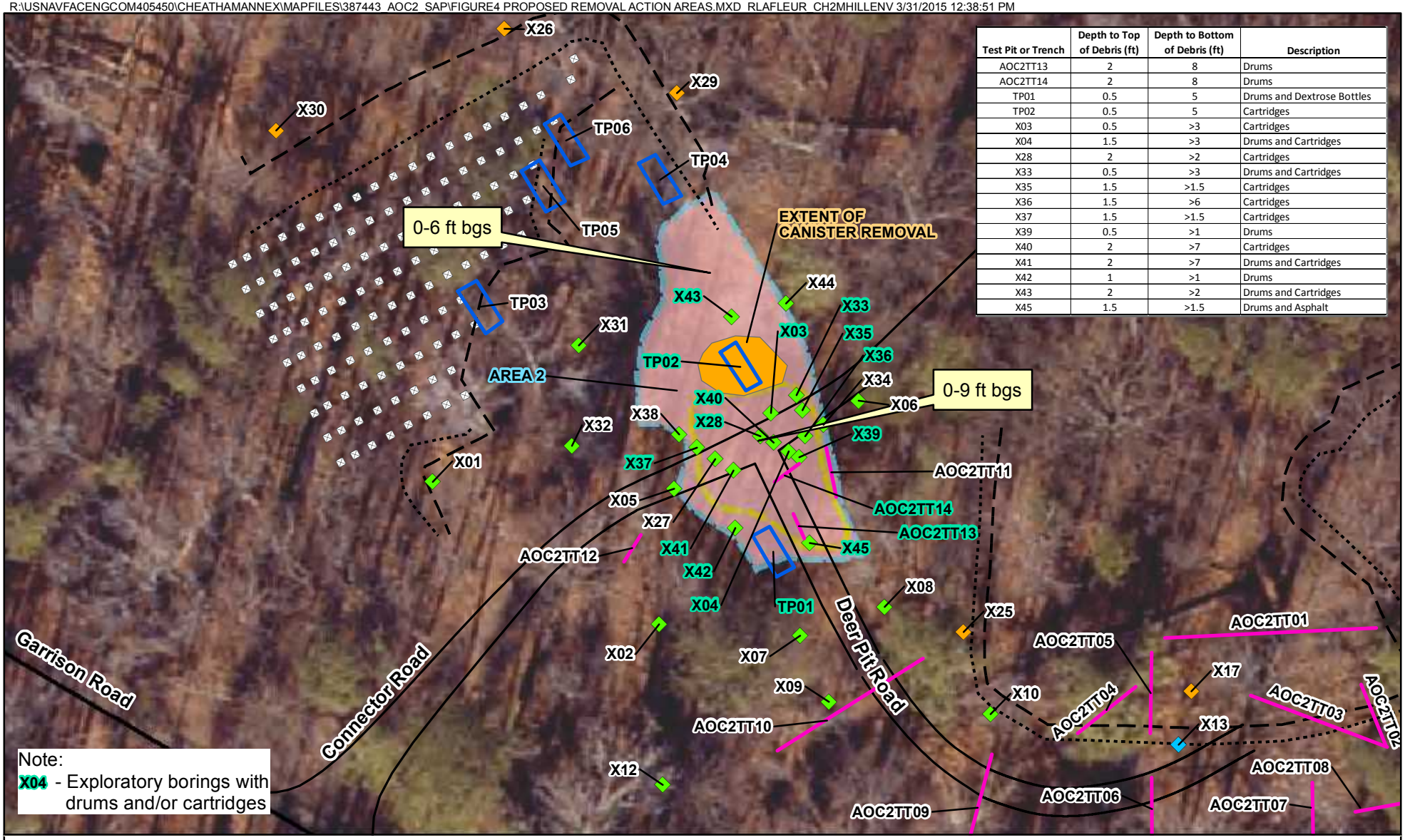
N W E S

0 30 60 Feet

Figure 3
AOC 2 Debris Areas
Action Memorandum for AOC 2
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE4 PROPOSED REMOVAL ACTION AREAS.MXD RLAFLEUR CH2MHILLENV 3/31/2015 12:38:51 PM



Test Pit or Trench	Depth to Top of Debris (ft)	Depth to Bottom of Debris (ft)	Description
AOC2TT13	2	8	Drums
AOC2TT14	2	8	Drums
TP01	0.5	5	Drums and Dextrose Bottles
TP02	0.5	5	Cartridges
X03	0.5	>3	Cartridges
X04	1.5	>3	Drums and Cartridges
X28	2	>2	Cartridges
X33	0.5	>3	Drums and Cartridges
X35	1.5	>1.5	Cartridges
X36	1.5	>6	Cartridges
X37	1.5	>1.5	Cartridges
X39	0.5	>1	Drums
X40	2	>7	Cartridges
X41	2	>7	Drums and Cartridges
X42	1	>1	Drums
X43	2	>2	Drums and Cartridges
X45	1.5	>1.5	Drums and Asphalt

Legend

- Concrete Piers
- Exploratory Test Pit (Jan./Feb. 2000)
- Exploratory Test Hole (January 2000)
- Exposure Observation Point (January 2000)
- Field Investigation Test Pit (November 1999)
- Potential 0-6ft bgs Debris Removal Area
- Potential 0-9ft bgs Debris Removal Area
- CAX Boundary / Fenceline
- Top of Bank
- Toe of Slope
- Test Trench (November 2001)

0 20 40 Feet

N W E S

Figure 4
Proposed Removal Action Areas
Action Memorandum for AOC 2
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

Attachment A
Final EE/CA AOC 2
(Dextrose Dump)

Final

Engineering Evaluation and Cost Analysis for Area of Concern 2—Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex Williamsburg, Virginia

Contract Task Order WE38

June 2015

Prepared for

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Prepared by

CH2MHILL

Virginia Beach, Virginia

Executive Summary

This report presents an Engineering Evaluation and Cost Analysis (EE/CA) for a Non-time-critical Removal Action (NTCRA) at Area of Concern (AOC) 2, Naval Weapons Station (WPNSTA) Yorktown, Cheatham Annex (CAX), Williamsburg, Virginia. AOC 2, the Dextrose Dump, is a less than 1 acre site located in a wooded area along the southern perimeter of CAX, north of Garrison Road. Based on the types of debris observed during previous investigations, AOC 2 was separated into three areas: Areas 1a and 1b contain dextrose intravenous (IV) bottles and minor debris, Area 2 contains unused respirator cartridges and empty 55-gallon drums, and Area 3 contains surplus military clothing.

The EE/CA for AOC 2 addresses only the Area 2 debris and soil. The CAX Partnering Team agreed the nature of the debris in Areas 1a, 1b, and 3 (dextrose IV bottles and military clothing) is not a concern or a source regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as documented in the May 2011 Partnering Meeting minutes and in Table 2-2 in the Site Management Plan (SMP) (CH2M HILL, 2014a). In addition, the supplemental soil investigation conducted in May 2014 confirmed that exposure to soil outside of and west of Area 2 (in and/or near Area 1a and at historic sample locations) does not pose unacceptable risks to human health and the environment. The details of this investigation and the associated risk evaluations are included as part of this EE/CA (**Appendix A**). Groundwater requires no further action (NFA), as documented in the *No Action Consensus Letter for Groundwater at AOC 2*, which was signed by the CAX Partnering Team (CH2M HILL, 2013).

The goals of the EE/CA are to identify the objectives of the removal action, identify removal action alternatives to achieve those objectives, and evaluate the effectiveness, implementability, and cost of those alternatives. The removal action objectives are to:

- Prevent exposure of human and ecological receptors to Area 2 debris and soil that are present with contaminant concentrations that may pose unacceptable risks.
- Prevent or minimize transport of constituents of potential concern (COPCs) from buried debris and soil to site media.

The following three removal action alternatives were identified and evaluated:

1. No Action: No action would be conducted; the site would remain "as is."
2. Removal and Offsite Disposal: Excavation of debris and impacted soil from Area 2 to depths ranging from 6 to 9 feet below ground surface, offsite disposal of the excavated material, post-excavation confirmation sampling, and backfilling the excavation areas with clean fill material.
3. Low-Permeability Soil Cover: Construction of a soil cover over the debris and impacted soil posing potential human and ecological risks at Area 2. Additional future actions would include periodic inspections and maintenance of the soil cover, implementation of land use controls (LUCs) to prevent unauthorized disturbance of the cover, and Five-Year Reviews to ensure that the remedy remains protective of human health and the environment.

Alternative 1 does not meet the objectives of the removal action; however, it is provided as a basis for comparison. Alternatives 2 and 3 are comparable in their ability to protect human health and the environment, ability to achieve the removal action objectives, ease of implementability, and compliance with applicable, relevant, and appropriate requirements. Alternative 2 is more expensive than Alternative 3. However, Alternative 3 results in debris and impacted soil posing a potential risk to human health and the environment being left in place, which requires post-removal site controls (PRSCs) (i.e., land use controls, operation and maintenance activities, and Five-Year Reviews) to ensure the removal action remains protective over time. With Alternative 3 there is also the potential for future exposure should the cover be disturbed. After evaluating the trade-offs associated with each alternative, Alternative 2, Removal and Offsite Disposal, is the recommended alternative

because it is a permanent solution that provides for unlimited use/unrestricted exposure and does not require PRSCs to ensure long-term protectiveness.

In accordance with the National Oil and Hazardous Substance Pollution Contingency Plan, this EE/CA will be placed in the Administrative Record and the CAX local Administrative Record document repository, and a notice of its availability for public review, along with a brief summary of the EE/CA, will be published in the local newspaper. The EE/CA will subsequently be available for review during a 30-day public comment period. A public information session may be held during or immediately following the public comment period, if requested. Following the public comment period, if comments are received, a Responsiveness Summary documenting responses to significant comments will be prepared and included in an Action Memorandum, which also will be placed in the Administrative Record.

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Acronyms and Abbreviations

µg/kg	micrograms per kilogram
AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CAX	Naval Weapons Station Yorktown Cheatham Annex
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	constituents of potential concern
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
E&S	erosion and sediment
EE/CA	Engineering Evaluation and Cost Analysis
ERA	Ecological Risk Assessment
ESV	ecological screening value
ft^2	square feet/foot
HHRS	human health risk screening
HI	hazard index
IV	intravenous
LUC	land use control
mg/kg	milligram per kilogram
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NFA	no further action
NTCRA	Non-time-critical Removal Action
O&M	operation and maintenance
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
PRSC	post-removal site control
PSLP	Penniman Shell Loading Plant
RSL	regional screening level
SARA	Superfund Amendments and Reauthorization Act
SI	site inspection
SVOC	semivolatile organic compound
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbon
USEPA	United States Environmental Protection Agency
UTL	upper tolerance level
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

WPNSTA	Naval Weapons Station
yd^3	cubic yard

SECTION 1

Introduction

This report presents an Engineering Evaluation and Cost Analysis (EE/CA) for a Non-time-critical Removal Action (NTCRA) to address potential unacceptable human health and ecological risks from exposure to contaminants in surface soil, subsurface soil, and debris at Area of Concern (AOC) 2, Dextrose Dump, Naval Weapons Station (WPNSTA) Yorktown, Cheatham Annex (CAX), Williamsburg, Virginia. Based on the types of debris observed during the previous investigations at AOC 2, AOC 2 was separated into three areas: Areas 1a and 1b contain dextrose intravenous (IV) bottles, Area 2 contains unused respirator cartridges and empty 55-gallon drums, and Area 3 contains surplus military clothing. The CAX Partnering Team agreed that the nature of the debris in Areas 1a, 1b, and 3 (dextrose IV bottles and military clothing) is not a concern or a source regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as documented in the May 2011 Partnering Meeting minutes and in Table 2-2 in the Site Management Plan (CH2M HILL, 2014a); therefore, Areas 1a, 1b, and 3 are not addressed by this EE/CA. Site investigations have indicated that groundwater requires no further action (NFA) as documented in the *No Action Consensus Letter for Groundwater at AOC 2*, which was signed by the CAX Partnering Team (CH2M HILL, 2013); therefore, groundwater is not addressed by this EE/CA. This EE/CA for AOC 2 addresses only Area 2 debris and soil.

This EE/CA has been prepared for Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic under Contract N62470-08-D-1000, Comprehensive Long-term Environmental Action - Navy 1000, Contract Task Order WE38.

1.1 Regulatory Background

This document is issued by the United States Department of the Navy (Navy), the lead agency responsible for environmental remediation at CAX, and thus, AOC 2, in partnership with the United States Environmental Protection Agency (USEPA) Region III and the Virginia Department of Environmental Quality (VDEQ), under Section 104 of CERCLA and the Superfund Amendments and Reauthorization Act (SARA) of 1986.

Section 104 of CERCLA and SARA allows an authorized agency to provide for remedial action and to remove, or arrange for removal of, hazardous substances, pollutants, or contaminants at any time, or to take any other response measures consistent with the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), as deemed necessary to protect public health or welfare and the environment. The NCP, Title 40 of the Code of Federal Regulations (CFR), Section 300, provides regulations for implementing CERCLA and SARA and regulations specific to removal actions. The NCP defines a removal action as:

> *[The] cleanup or removal of released hazardous substances from the environment, such actions as may be necessary to monitor, assess, and evaluate the threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release.*

A removal action is being considered for Area 2 to mitigate potential unacceptable human health and ecological risks from exposure to surface soil and subsurface debris. Under 40 CFR 300.415, the lead agency (Navy, in this case) is required to prepare an EE/CA when a removal action is planned for a site. The general goals of an EE/CA are to identify the objectives of the removal action, identify removal action alternatives to achieve those objectives, and evaluate the effectiveness, implementability, and cost of those alternatives. An EE/CA documents the removal action alternatives and selection process. Where the extent of the contamination is well defined and limited in extent, removal actions also allow for the expedited cleanup of sites in comparison to the remedial action process under CERCLA.

Community involvement requirements for removal actions include making the EE/CA available for public review in a comment period of 30 days. An announcement of the public review and comment period is required in a local newspaper. Written responses to significant comments are summarized in a Responsiveness Summary that is included in an Action Memorandum, which is placed in the Administrative Record file for CAX.

1.2 Purpose and Objectives

Submittal of this EE/CA is the first step in fulfilling the requirements for an NTCRA defined by CERCLA, SARA, and the NCP. This EE/CA has been prepared in accordance with *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993). The purposes of this EE/CA are to:

- Satisfy environmental review and public information requirements for removal actions
- Satisfy Administrative Record requirements for documenting the removal action selection
- Provide a framework for evaluating and selecting removal action alternative technologies

The goals of the EE/CA are to identify the objectives of the removal action, identify removal action alternatives to achieve those objectives, and evaluate the effectiveness, implementability, and cost of those alternatives. The removal action objectives are to:

- Prevent exposure of human and ecological receptors to Area 2 debris and soil that are present with contaminant concentrations that may pose unacceptable risks.
- Prevent or minimize transport of constituents of potential concern (COPCs) from buried debris and soil to site media.

Groundwater requires no further action (NFA), as documented in the *No Action Consensus Letter for Groundwater at AOC 2*, which was signed by the CAX Partnering Team (CH2M HILL, 2013).

This EE/CA compares the following three removal action alternatives based on their technical feasibility, ability to protect human health and the environment, ability to prevent the potential continued or future release of hazardous constituents, and cost:

- **Alternative 1**—No Action
- **Alternative 2—**Removal and Offsite Disposal
- **Alternative 3—**Low Permeability Soil Cover

SECTION 2

Site Characterization

This section provides background information on the facility and AOC 2, including environmental activities that have taken place at AOC 2, focusing on soil and subsurface debris. Additional detailed background information is provided in the *Final Site Inspection Report for AOCs 1, 2, 6, 7, 8, Naval Weapons Station Yorktown, Cheatham Annex, Williamsburg, Virginia* (CH2M HILL, 2012).

2.1 Site Background

2.1.1 Cheatham Annex

CAX is located on the site of the former Penniman Shell Loading Plant (PSLP), a large powder and shell loading facility operated by the DuPont Company during World War I. The PSLP closed in 1918 and was dismantled between 1918 and 1923. Between 1923 and 1943, the property was used for farming or remained idle. CAX was commissioned in 1943 as a satellite unit of the Naval Supply Depot to provide bulk storage facilities and to serve as an assembly and overseas shipping point during World War II. In 1987, CAX was designated the Hampton Roads Navy Recreational Complex. In 1998, control of CAX was transferred from Fleet and Industrial Supply Center to WPNSTA Yorktown. The current mission of CAX includes supplying Atlantic Fleet ships and providing recreational opportunities to military and civilian DoD personnel.

CAX consists of approximately 2,300 acres of land on the York-James Peninsula, northwest of WPNSTA Yorktown (**Figure 2-1**). The facility is divided into two separate parcels, with the larger parcel situated along the banks of the York River. Almost all of the activities at CAX (administration, training, maintenance, support, and housing) take place in the larger parcel. The smaller parcel is used mainly as a watershed protection area.

2.1.2 Area of Concern 2

AOC 2 is a less-than-1-acre wooded site located to the north of Garrison Road, along the southern perimeter of CAX (**Figure 2-2**). Historical information indicates that AOC 2 was an unlined, non-permitted disposal area with unknown dates of debris disposal. AOC 2 was identified during site visits by the Navy, USEPA, VDEQ, and Baker Environmental, Inc. (Baker) in late 1997 and early 1998, and consists of several rows of concrete foundation piers that at one time supported a shipping house associated with the former DuPont Company PSLP facility. The majority of structures associated with the PSLP facility were demolished between 1918 and 1925. Grass-covered lanes leading to the site area are likely remnants of former railroad lines that have been removed. Partially buried glass IV bottles (of which the majority were labeled “dextrose”) and unlabeled, empty, 55-gallon drums, respirator cartridges, deer carcasses, and surplus military clothing were discovered in the area. Several mounds also present in the area were suspected to contain buried debris (Baker, 2001). Based on the types of debris observed during test trenching activities, AOC 2 was separated into three areas: Areas 1a and 1b contain dextrose IV bottles, Area 2 contains unused respirator cartridges and empty 55-gallon drums, and Area 3 contains surplus military clothing (**Figure 2-3**). The CAX Partnering Team agreed that the nature of the debris in Areas 1a, 1b, and 3 (dextrose IV bottles and military clothing) is not a concern or a source regulated under CERCLA; therefore, Areas 1a, 1b, and 3 will not be addressed by this EE/CA. Also, since groundwater requires NFA (CH2M HILL, 2013), groundwater is not included in this EE/CA.

The topography of AOC 2 is predominantly flat. No wetlands or other surface water bodies are located at AOC 2, and there are no nearby water bodies downgradient of the site. Surface runoff at the site is anticipated to pond and infiltrate into the subsurface or evaporate. In general, the native soil is predominantly composed of clay and silt at AOC 2. As observed during test trenching activities in 2001, a sand fill layer was found to be present over buried materials in some areas of AOC 2 (Baker, 2002). The first encountered groundwater underlying AOC 2 is the Cornwallis Cave aquifer, at depths ranging from approximately 22 to 33 feet below ground surface (bgs); groundwater is expected to flow southeast toward King Creek (Baker, 1999).

2.2 Summary of Previous Investigations

This section summarizes previous investigations applicable to Area 2, as it is the focus of this EE/CA.

2.2.1 1998 Field Investigation

In October 1998, a field investigation was completed in Area 1a and Area 2 (**Figure 2-3**) that included geophysical surveying as well as soil and groundwater sampling via direct-push technology to gain a better understanding of the nature and extent of possible contamination at AOC 2 (**Figure 2-4**). During the field investigation, twelve 55-gallon drums were observed at the ground surface, partially buried and empty. Based on the results of the geophysical survey, areas of significant magnetic anomalies were delineated that could potentially coincide with buried debris (Baker, 1999).

The concentrations of several inorganic constituents in soil exceeded ecological screening criteria and the concentrations of iron indicated a potential (non-carcinogenic) risk to human health. There were no potential unacceptable risks identified for groundwater. It was recommended that the natures of the geophysical anomalies and potential sources of contamination be identified by excavating six shallow test pits in the vicinity of the most significant detected anomalies (Baker, 1999).

2.2.2 1999 Field Investigation/2000 Supplemental Test Pit Investigation

In November 1999, six test pits (A2TP01 through A2TP06) were excavated and sampled at AOC 2 to determine the natures of geophysical anomalies observed during the October 1998 field investigation (**Figure 2-4** and **Figure 2-5**). Buried materials were encountered in each test pit and included empty drums, dextrose IV bottles, and unopened and unused respirator cartridge canisters. At the two test pits excavated in Area 2 (A2TP01 and A2TP02), empty drums and respirator cartridge canisters were encountered. During this investigation, the debris that was unearthed or collected from the ground surface (including 43 empty 55-gallon drums, 280 empty dextrose IV bottles, and 8,000 pounds of respirator cartridges from Area 2) was disposed offsite; however, the majority of the buried debris was not removed. One respiratory cartridge canister was submitted for analysis of full toxicity characteristic leaching procedure (TCLP) parameters and Resource Conservation and Recovery Act characterization. Because cadmium and lead concentrations exceeded TCLP levels, the Navy, in consultation with the USEPA and VDEQ, agreed to expand the test pit program to define the extent of buried debris and canisters.

In 2000, a supplemental test pit investigation was conducted and a total of 47 exploratory test pits were advanced at AOC 2, with 19 of the test pits located in Area 2 (**Figure 2-5**). Materials encountered included respirator cartridge canisters, empty drums, dextrose IV bottles, and military clothing. In general, the test pits only extended to the top of debris to avoid unearthing excessive amounts of waste. However, the Area 2 test hole that was advanced in the same location as previous test pit TP02 was advanced to an average of 10 feet bgs over an approximate 25 foot by 15 foot area in order to remove some of the buried respirator cartridges. The cartridges appeared to have been deposited in excavated trenches. The removal of cartridges from the test hole was stopped in late January 2000 due to snow, wet site conditions, and the large volume of waste that had been excavated. Eight thousand pounds of respirator cartridges from Area 2 were removed for offsite disposal. The lateral extent of the buried debris was not completely defined. During this supplemental test pit investigation, four confirmatory soil samples (A2-CS01 through A2-CS04) were collected (**Figure 2-4**). Confirmatory sample analytical results indicated little, if any, impact to soil or groundwater at AOC 2. Based on the results of the supplemental test pit investigation, additional buried dextrose IV bottles, empty drums (some coated with tar), respiratory cartridge canisters, and unused military uniforms (quantities not documented) were observed at AOC 2.

A limited geophysical investigation was recommended to delineate the lateral extent of buried respirator cartridge canisters and the location of the eastern perimeter of disposal along Deer Pit Road, and a test pit investigation was recommended to confirm the results of the geophysical investigation (Baker, 2001).

2.2.3 2001 Trenching Activities

In 2001, a total of 15 trenches (AOC2TT01 through AOC2TT15) were excavated to confirm the presence or absence of buried respiratory cartridges along Deer Pit Road and to obtain additional information concerning subsurface materials potentially buried at AOC 2 (**Figure 2-5**). Dextrose IV bottles, clothing, metal debris, and empty 55-gallon drums were observed in the trenches. Three of the trenches (AOC2TT11, AOC2TT13, and AOC2TT14) were excavated in Area 2 and buried drums were observed in two of the three trenches. No samples were collected for laboratory analysis. The horizontal and vertical extents of the dextrose IV bottle dump along Deer Pit Road were delineated and debris was observed to be confined primarily to beneath the road, with some surface debris outside the road area (Baker, 2002).

2.2.4 2012 Multiple AOC Site Inspection

Human health and ecological risk screenings of surface soil and subsurface soil samples collected in 1998 and 1999 were conducted and concluded that there may be potentially unacceptable risks to human health and ecological receptors from exposure to surface and subsurface soil within Area 2. The Site Inspection (SI) Report recommended an interim removal action for Area 2 to remove the debris (respirator cartridges and empty 55-gallon drums) and the collection of post-removal soil samples.

2.2.5 2014 Site Investigation Supplemental Soil Sampling

In May 2014, a supplemental soil investigation was conducted outside of Area 2 to augment the SI dataset for the purpose of updating the human health (chromium and arsenic) and ecological (mercury and iron) risk evaluations to determine whether these constituents pose potentially unacceptable risks to human health and the environment, and to determine whether the removal action proposed for Area 2 needs to also address soil "hot spots" outside of Area 2, specifically in Area 1a. The supplemental investigation included the collection of surface soil (0- to 6-inch depth) samples (**Appendix A**, Figure A-1) and subsurface soil (various depths) samples (**Appendix A**, Figure A-2) via a hand auger in proximity to the historical sample locations outside of Area 2. The site investigation was conducted in accordance with the approved sampling and analysis plan (CH2M HILL, 2014b).

Two surface and two subsurface soil samples were analyzed for total and hexavalent chromium to determine the chromium valency, since chromium was the carcinogenic human health risk driver in the SI based on the assumption that all chromium was present in the more toxic, hexavalent form; if chromium is actually primarily in the less toxic, trivalent form, it would not be a constituent of potential concern (COPC) in either medium.

Four surface and four subsurface samples were collected and analyzed for mercury to replace the historical data, update the SI ecological risk screening, and determine whether mercury continues to be identified as a COPC, because there was some uncertainty regarding the historical data. In addition, due to the absence of pH analytical data in the SI data set, additional iron and pH surface soil data were warranted to determine whether iron is an ecological COPC in soil. The surface soil samples analyzed for mercury also were analyzed for iron and pH. Although iron was not identified in the SI as a refined ecological COPC in subsurface soil, based on the low magnitude of its background value exceedance (ratio of 1:31), subsurface soil samples were also collected and analyzed for iron and pH to determine whether iron poses a potential ecological risk. The analytical results from the supplemental soil sampling are presented in Tables A-1 and A-2 in **Appendix A**.

An evaluation of the results revealed no unacceptable human health risks in soil outside of Area 2. The maximum detected concentration of hexavalent chromium in surface soil (0.2 mg/kg) was below the residential soil Regional Screening Level (RSL) based on a carcinogenic risk of $1x10^{-6}$; however, the maximum detected concentration of hexavalent chromium in subsurface soil (0.49 mg/kg) exceeded the residential soil RSL. Although the subsurface soil concentration exceeds the RSL based on a carcinogenic risk of $1x10^{-6}$, it does not exceed the RSL based on a carcinogenic risk of $1x10^{-5}$ (3.0 mg/kg), and therefore, the concentration and associated potential risk falls within the acceptable risk range of $1x10^{-6}$ to $1x10^{-4}$. Furthermore, there is no known historic use of hexavalent chromium at the site, and chromium in soil is more likely to be in the trivalent form than the hexavalent form. If chromium is present largely in the trivalent form, there would be no unacceptable carcinogenic risk, and since chromium was the only COPC that alone contributed a carcinogenic risk above the screening benchmark level, arsenic would no longer be considered a COPC as well. The supplemental soil sample results confirmed that chromium

concentrations are composed predominantly of the trivalent form. Therefore, neither chromium nor arsenic are human health COPCs outside of Area 2.

Regarding ecological risk, there were no ecological screening value (ESV) exceedances for mercury or iron in the surface soil samples, and no ESV exceedances for mercury in the subsurface soil samples. Two of the four subsurface soil samples did not have pH data (due to a lab oversight), and the iron result for both of these samples slightly exceeded the background upper tolerance limit (UTL). While technically these two iron results are exceedances, the magnitude is not significant. Therefore, no final ecological COPCs were identified outside of Area 2; the ecological screening statistics are presented in Table A-3 in **Appendix A**.

Based on the results of the supplemental soil sampling, no soil "hot spots" outside of Area 2 were identified and only Area 2 will remain the focus of this EE/CA.

2.3 Nature and Extent of Contamination

During the 1998 and 1999 field investigations, two surface soil samples and seven subsurface soil samples were collected from Area 2 (**Figures 2-6 and 2-7, respectively**). During the removal of some of the respirator cartridges from Area 2 in January 2000 (orange circular area on **Figure 2-6** or **Figure 2-7**), three additional subsurface soil samples were collected. Soil constituent concentrations were screened against USEPA RSLs for residential soil and/or ecological screening values (USEPA, 2015). The following summarizes the Area 2 results (exceedances of screening criteria are shown in **Figures 2-6** and **2-7**):

- Two pesticides (dichlorodiphenyldichloroethylene [4,4'-DDE] and 4,4' dichlorodiphenyltrichloroethane [DDT]) were detected in surface soil (0-6 inches bgs) and one pesticide (4,4'-DDE) was detected in subsurface soil (6-12 inches bgs) at concentrations above their ESVs. All exceedances were detected in the same soil boring (CAA02-A2HA02). The pesticide 4,4'-DDE was detected at an estimated concentration below the ESV in the field duplicate for subsurface soil sample CAA02-A2TP01F and in the soil sample collected from test pit X45 (A2-CS04). Pesticides were not detected in any other surface or subsurface soil samples in Area 2.
- One polychlorinated biphenyl (PCB) (Aroclor-1260) was detected in two subsurface soil samples above its residential RSL. Aroclor-1260 was detected in soil collected from within the debris zone at test pit TP01 (CAA02-A2TP01F) and from test pit X45 (A2-CS04). However, Aroclor-1260 was not detected in the duplicate soil sample collected at CAA02-A2TP01F nor in the subsurface soil collected beneath the debris in the test pit (CAA02-A2TP01N). PCBs were not detected in any other soil samples.
- Three inorganic constituent concentrations exceeded at least one screening criterion in surface soil. Arsenic and chromium exceeded background values and the residential and industrial RSLs in one sample (CAA002-A2HA02), while mercury exceeded its background value and ESV in both surface soil samples.
- Nine inorganic constituent concentrations exceeded at least one screening criterion in subsurface soil. Aluminum, cadmium, cobalt, copper, iron, thallium, and vanadium exceeded their background value and residential RSL; iron had exceedances in three samples, aluminum and cobalt had exceedances at two locations, and cadmium, copper, thallium, and vanadium had an exceedance in only one sample. Arsenic and chromium concentrations exceeded their background values, residential RSLs, and industrial RSLs; arsenic had exceedances in seven subsurface soil samples; and chromium had exceedances in three samples. Mercury exceeded its background and ESV in one subsurface soil sample.

The potential migration pathways from the Area 2 source area primarily involve leaching of contaminants from the buried debris caused by infiltration of precipitation. Any constituents that are leached from the source area debris have the potential to contaminate soil immediately adjacent to or underneath the waste based on the fact that contaminant concentrations in Area 2 soil pose potential unacceptable risks to human health and the environment. Leaching to groundwater is considered to be a negligible migration pathway based on the fact there are no unacceptable risks from exposure to chemical concentrations in groundwater. Furthermore, the pesticides and PCBs detected in soil above their ESVs or RSLs were not detected in groundwater even though the debris was likely buried over 50 years ago. If infiltration into the subsurface is reduced, this should further reduce future risk of contaminant leaching in the subsurface. The transport of surface soil by surface runoff or wind dispersion is

unlikely to be significant because the area is relatively flat and heavily vegetated. No wetlands or other surface water bodies are located at AOC 2, and there are no nearby water bodies downgradient of the site. Surface runoff at the site is anticipated to pond and infiltrate into the subsurface or evaporate.

2.4 Risk Summary

2.4.1 Human Health Risk Summary

As part of the SI, a human health risk screening (HHRS) was performed using the analytical results from the 1998 and 1999 field investigations. The HHRS consisted of a three-step process using a risk ratio technique. The following are the results for Area 2:

- Exposure to Area 2 surface soil may result in unacceptable human health risks associated with arsenic and chromium. For the HHRS, it was assumed that chromium is present entirely in the hexavalent form as a conservative measure. However, most natural sources of chromium in the subsurface (such as the mineral chromite) are in the trivalent form rather than the hexavalent state. In the trivalent form, chromium would pose no unacceptable carcinogenic risk, and because chromium is the only COPC that alone contributes a carcinogenic risk above the screening benchmark level, arsenic would also no longer be considered a COPC. The soil samples collected just outside of Area 2 during the 2014 supplemental soil sampling confirmed that chromium concentrations in surrounding soil were composed predominantly of the trivalent form. However, because no soil samples were collected within Area 2 during the 2014 sampling event, the form of chromium within Area 2 cannot be confirmed, and arsenic and chromium are retained as Area 2 surface soil COPCs.
- Exposure to Area 2 subsurface soil may result in unacceptable human health risks associated with Aroclor-1260, arsenic, and chromium. Similar to surface soil, chromium is the only COPC that alone contributes a carcinogenic risk above the screening benchmark level. If chromium is actually present in the trivalent form, there would be no unacceptable carcinogenic risk and Aroclor-1260, arsenic, and chromium would no longer be considered COPCs. However, as with the surface soil, because there is no hexavalent chromium data available for Area 2, Aroclor-1260, arsenic, and chromium are retained as Area 2 subsurface soil COPCs.
- Iron is not considered a COPC in Area 2 as discussed in the Final Site Inspection Report for Areas of Concern 1, 2, 6, 7, and 8 (CH2M HILL, 2012). During HHRS calculations, iron in surface and subsurface soil and copper in subsurface soil were initially identified as posing potential unacceptable non-carcinogenic hazards. However, upon further evaluation, it was concluded that it is unlikely there would be any adverse effects associated with exposure to iron in soil at the site because the ingestion of soil (at the maximum detected concentration of iron) would result in an ingestion rate below the tolerable upper intake level for adults and children. Iron is also considered an essential human nutrient.
- Copper is not considered a COPC in Area 2. The hazard index (HI) for copper alone is below the risk-ratio screening benchmark of 0.5.When iron is not considered a COPC, copper does not contribute to a target organ HI above the risk-ratio benchmark of 0.5.
- Thallium was not included in the HHRS because toxicity values were still in development while the HHRS was being conducted. Thallium was not detected in surface soil and was only detected in 1 out of 23 subsurface soil samples collected during the 1998 and 1999 field investigations. The detected concentration of 0.84 mg/kg at CAA02-A2TP02N was just slightly above the residential soil RSL of 0.78 mg/kg (HI of 1). In addition, thallium was not detected in the soil sample collected within the buried debris at this same test pit (TP02). Given this low detection frequency, and the fact that there is no known source of thallium at the site, thallium was not carried forward as a COPC for Area 2 soil.

Based on the results of the HHRS, arsenic and chromium in surface soil and Aroclor-1260, arsenic, and chromium in subsurface soil have been identified as the human health COPCs that will require action within Area 2.

2.4.2 Ecological Risk Summary

An ecological risk screening was performed to determine the potential for ecological risks associated with direct exposure to surface and shallow subsurface soil. The following are identified as the refined COPCs for Area 2:

- Exposure to Area 2 surface soil may result in unacceptable ecological risks associated with 4,4'-DDT and mercury.
- Exposure to Area 2 subsurface soil may result in unacceptable ecological risks from mercury.

During the SI ecological risk screening, iron was identified as a COPC because it exceeded the background concentration and soil pH data were not historically available; the screening value for iron is pH-based. As part of the 2014 supplemental soil investigation, which was conducted outside of Area 2, soil samples were collected for pH analysis. The pH values in surface and subsurface soil were measured between 5 and 8, within the acceptable pH range for iron. It is assumed that pH values are relatively consistent across the site because there is no change in lithology. Therefore, iron was not retained as a COPC for surface or subsurface soil in Area 2.

2.5 Determination of Removal Action Area

The Area 2 removal action area is approximately 4,100 square feet (ft^2) in size and was identified during previous investigations as posing potential human health and ecological risks from exposure to debris and site soil COPCs (Aroclor-1260, arsenic, chromium, 4-4'-DDT, and mercury) in surface and subsurface soil. The initial volume of debris in Area 2 was estimated as 445 cubic yards (yd^3) (Baker, 2002). However, upon further evaluation of the test pit logs, the vertical and horizontal extents of debris and impacted soil to be addressed under this removal action are estimated to consist of the limits of debris and impacted soil shown on **Figure 2-8**. The total footprint area and volume of Area 2 to be addressed by this removal action are 3,700 ft^2 and 1,304 yd^3, respectively. The total volume includes additional excavation for sloping of the removal areas for excavations deeper than 5 feet bgs. For cost estimating purposes, it is assumed that no excavated soil will be reused as topsoil or general fill. The assumed excavation depths and total footprint areas for Area 2 are 1,400 ft^2 to a depth of 9 feet bgs and 2,300 ft^2 to a depth of 6 feet bgs (**Figure 2-8**). The depths of 6 and 9 ft bgs assume that up to 1 additional foot of soil beneath the debris will need to be excavated. This assumption is based on previous investigations indicating the approximate depth of debris.

2.6 Development of Cleanup Goals

To meet the removal action objectives, preliminary remediation goals (PRGs) were established for the soil within Area 2. The human health-based PRGs for the site COPCs were based on the USEPA Residential Soil RSLs and are summarized in **Table 2-1**. The RSLs based on carcinogenic effects were adjusted to a carcinogenic risk of 10^{-5} to ensure the cumulative risk associated with concentrations remaining at the site does not exceed USEPA's target level of 10^{-4}. The RSLs based on non-carcinogenic effects were set a levels to ensure the cumulative target organ HI does not exceed USEPA's target level of 1. Therefore, as there was only one PRG based on non-carcinogenic effects, it is based on an HI of 1. The human health-based PRGs were compared to the facility-specific background threshold values (BTVs) for soil (if available for a COPC), and since the human health-based PRGs were higher than the available BTVs, the human health-based PRGs were identified as the PRGs.

The soil PRGs for the protection of ecological receptors are summarized in **Table 2-2**. Because site-specific studies of terrestrial ecological receptors were not conducted at Area 2, the only existing data on which to base ecological soil PRGs within Area 2 are the literature-based soil ESVs and the facility-specific background soil data. These values, where available, are summarized in **Table 2-2**. For 4,4'-DDT, the ecological soil PRG is the soil ESV (100 micrograms per kilogram [µg/kg]). Because 4,4'-DDT was only identified as an ecological soil COPC in surface soil (0 to 6 inch), the PRG is only applicable to 0- to 6-inch soil depth. For mercury, the ecological soil PRG is based on the maximum surface soil background value (0.24 mg/kg). Because mercury was identified as an ecological soil COPC in both surface (0 to 6 inch) and shallow subsurface (6 to 24 inch) soil, this PRG applies to soil in the depth range of 0 to 24 inches bgs.

TABLE 2-1
Summary of Human Health Based Preliminary Remediation Goals

Constituent	PRG (mg/kg)	Basis of PRG
Surface Soil		
Arsenic	6.7	RSL, CR = 10-5
Chromium (hexavalent)	3.0	RSL, CR = 10-5
Chromium (total)	120,000	HI = 1
Subsurface Soil		
Aroclor-1260	2.4	RSL, CR = 10^{-5}
Arsenic	6.7	RSL, CR = 10^{-5}
Chromium (hexavalent)	3.0	RSL, CR = 10^{-5}
Chromium (total)	120,000	HI = 1

Notes:

For PRGs based on RSLs from carcinogenic effects, cancer risk of 10-5 selected so that cumulative risk does not exceed 10-4.

For PRGs based on RSLs from non-carcinogenic effects, HI selected so that cumulative target organ HI does not exceed 1.

The RSLs are the residential soil RSLs from the January 2015 Risk Based Screening Level Summary Table (USEPA, 2015).

CR - cancer risk; HI - hazard index

TABLE 2-2
Summary of Ecologically Based Preliminary Remediation Goals

Chemical	Ecological Soil Screening Value	Reference	Receptor	Background - Surface Soil		Selected PRG
				95% UTL	Maximum	
Mercury (mg/kg)	0.10	Efroymson et al. 1997	Soil invertebrates	0.111	0.24	**0.24**[a]
4,4'-DDT (µg/kg)	100	MHSPE 2000; 2001	--	--	--	**100**[b]

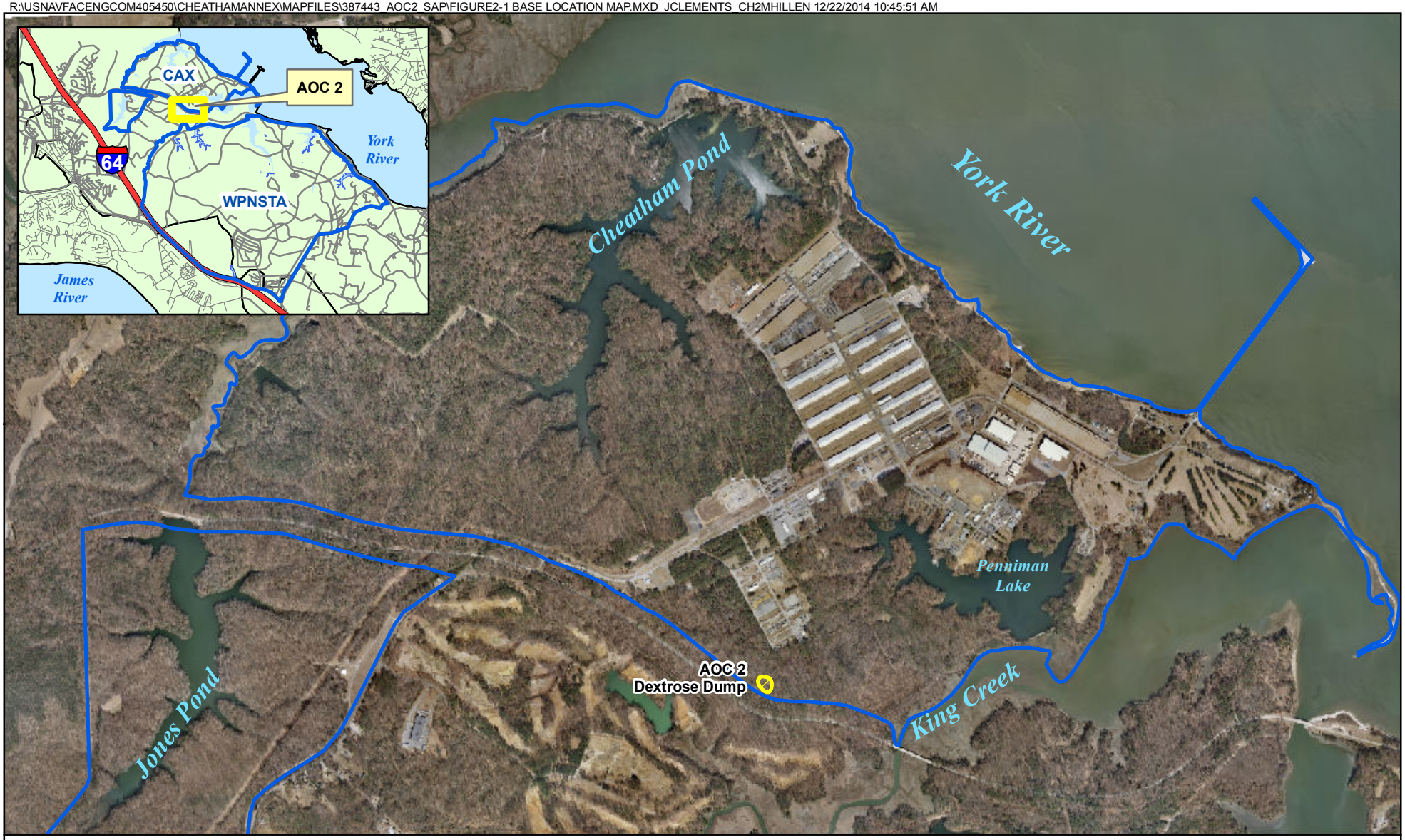
Notes:

[a] Applies only to soil within the 0 - 24 inch depth range

[b] Applies only to soil within the 0 - 6 inch depth range

(Efroymson, Will, and Suter, 1997), (MHSPE, 2001), (MHSPE, 2000)

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE2-1 BASE LOCATION MAP.MXD JCLEMENTS_CH2MHILLEN 12/22/2014 10:45:51 AM



Legend

- CAX Boundary
- Study Area Boundary

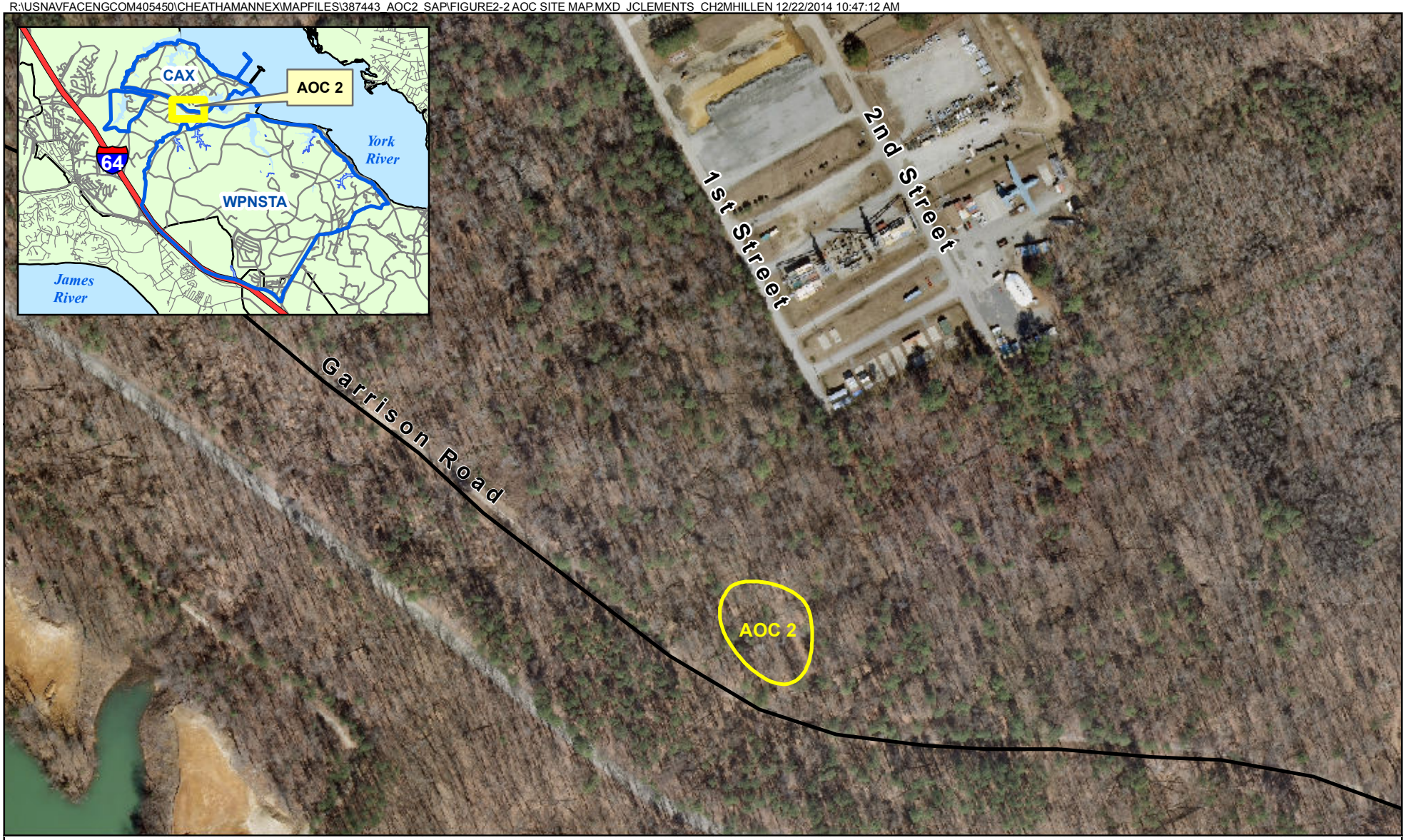
N
W E
S

0 1,000 2,000
Feet

Figure 2-1
Base Location Map
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE2-2 AOC SITE MAP.MXD JCLEMENTS_CH2MHILLEN 12/22/2014 10:47:12 AM



Legend

- CAX Boundary/Fenceline
- Study Area Boundary

N
W E
S

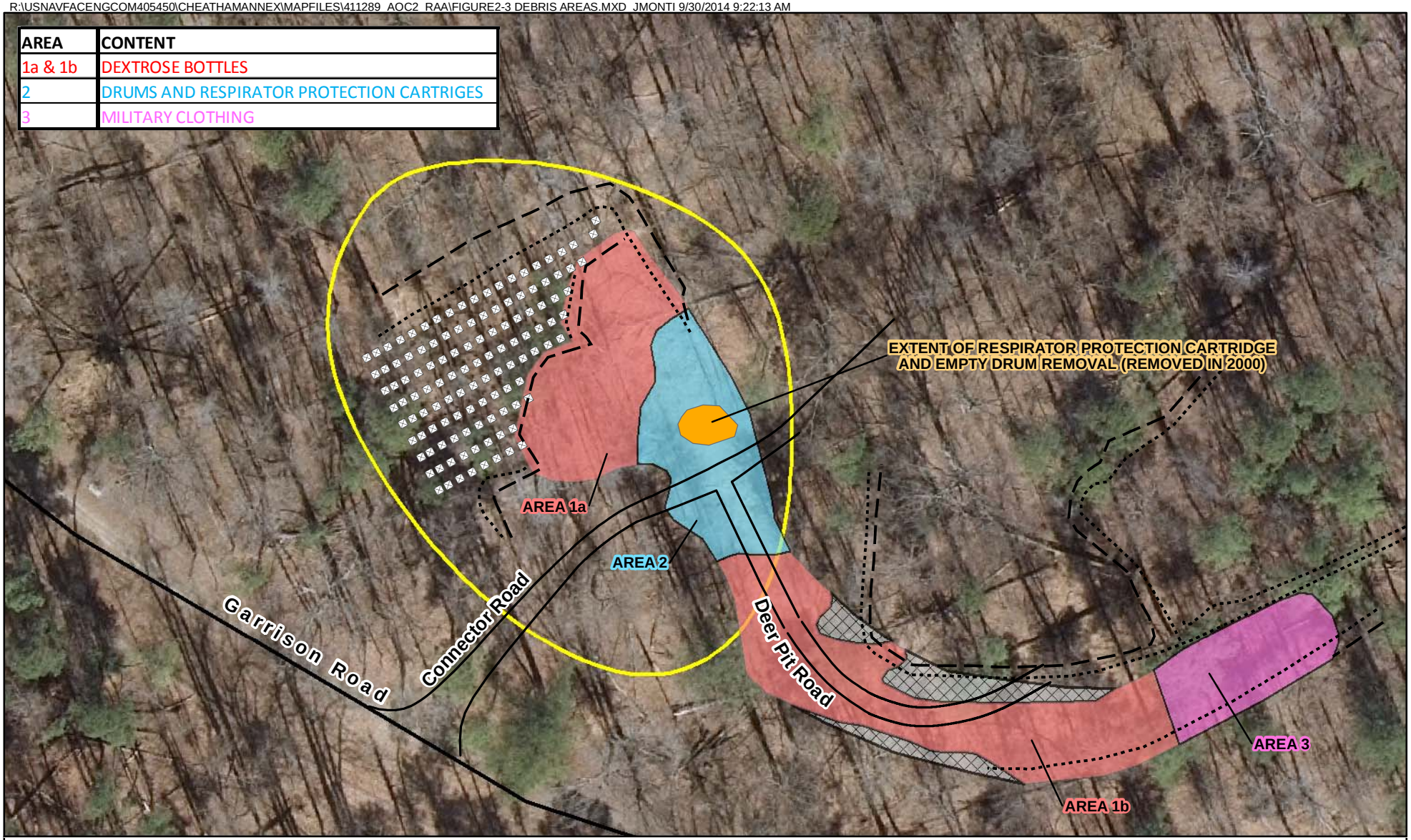
0 150 300
Feet

Figure 2-2
AOC 2 Site Map
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\411289_AOC2_RAA\FIGURE2-3 DEBRIS AREAS.MXD JMONTI 9/30/2014 9:22:13 AM

AREA	CONTENT
1a & 1b	DEXTROSE BOTTLES
2	DRUMS AND RESPIRATOR PROTECTION CARTRIGES
3	MILITARY CLOTHING



Legend

- Concrete Piers
- Top of Bank
- Toe of Slope
- Area 1a and Area 1b Boundary
- Area 2 Boundary
- Area 3 Bundary
- Former Location of Surface Debris (removed in 1998)
- Study Area Boundary
- CAX Boundary / Fenceline

N W E S

0 30 60 Feet

Figure 2-3
Debris Areas
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\AOC SI REPORT\2011\SECTION4_AOC2\FIGURE2-4 INVESTIGATION LOCATIONS.MXD JCLEMENTS_CH2MHILLEN 12/23/2014 1:34:40 PM

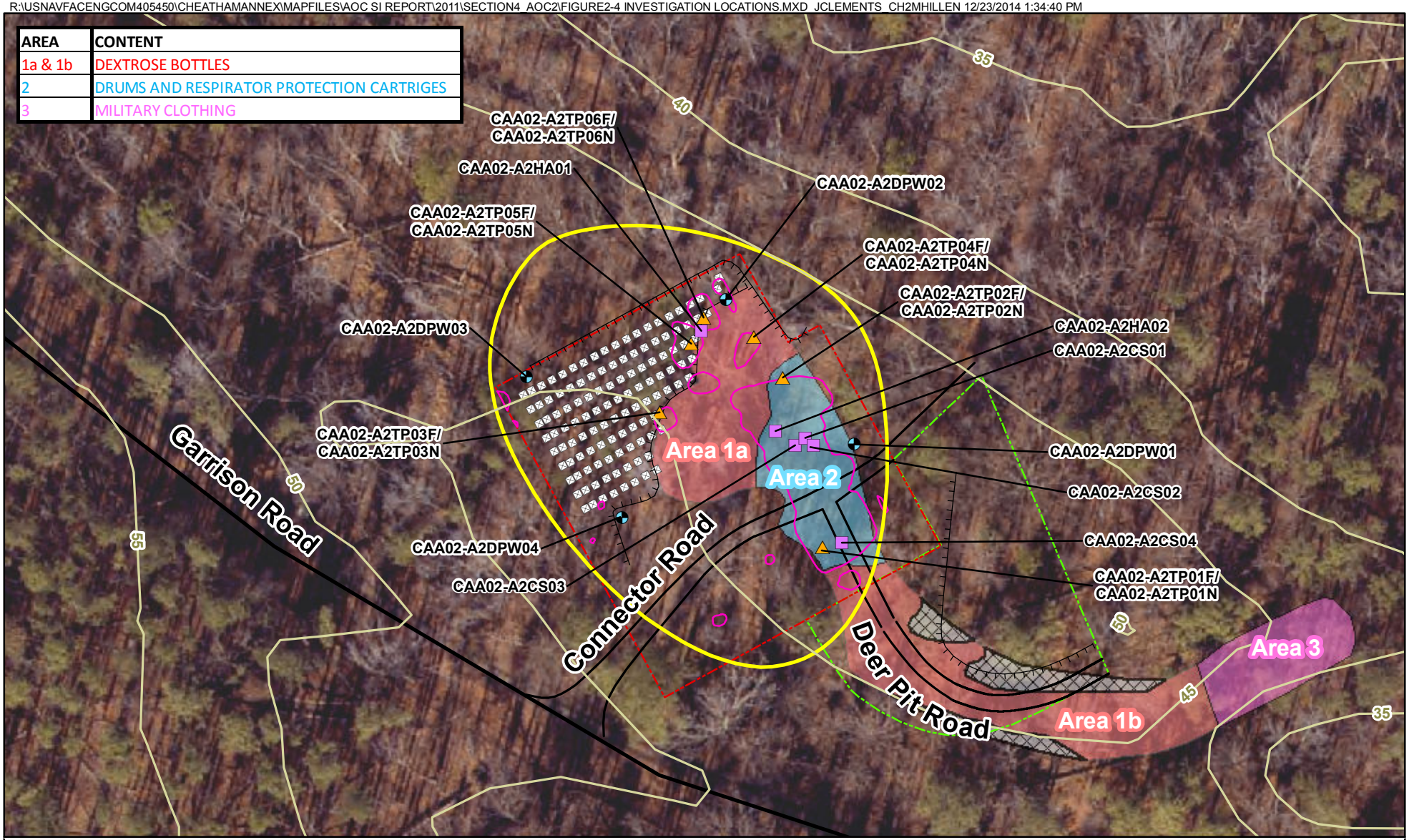
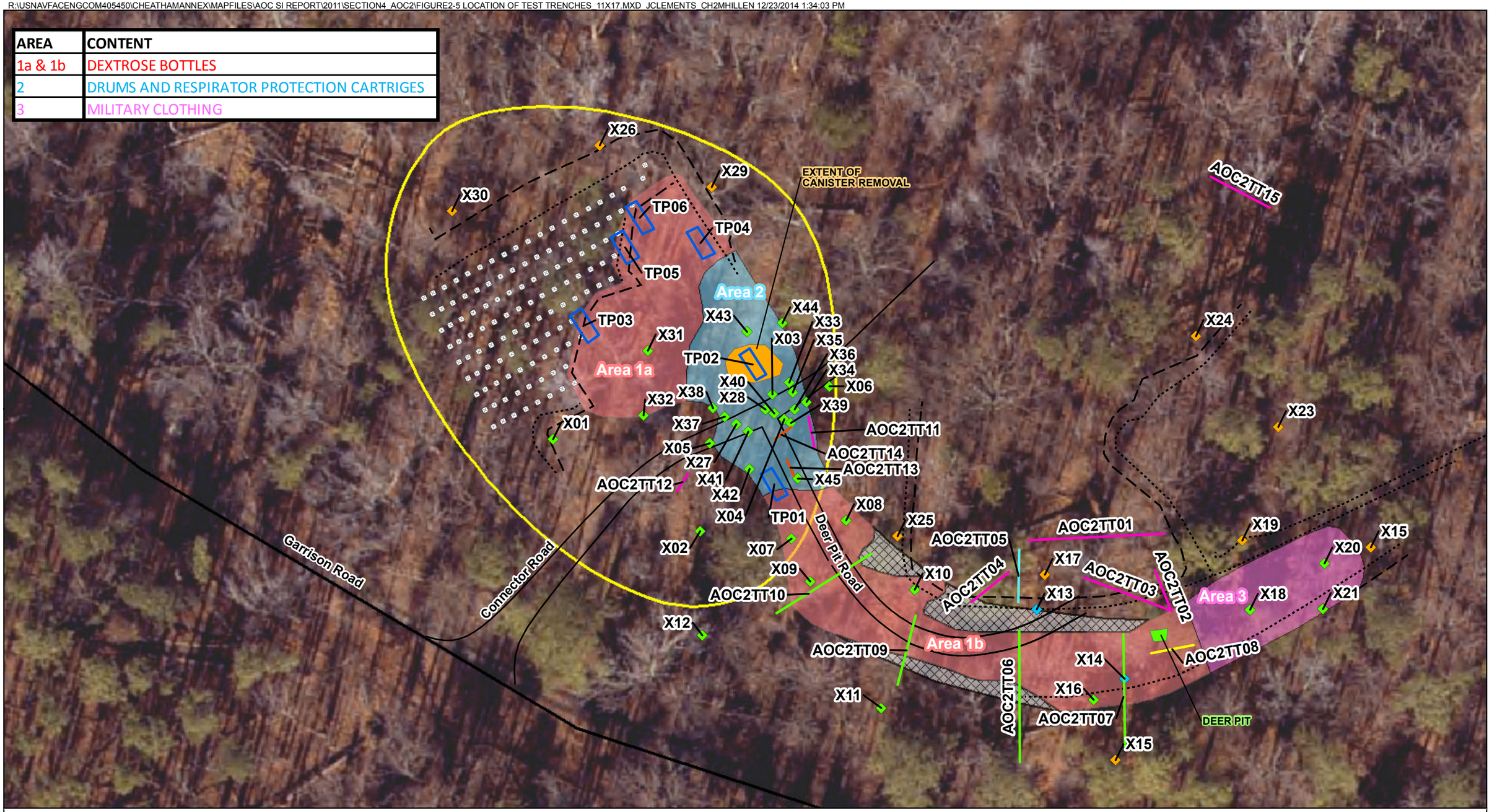


Figure 2-4
Investigation Locations
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\AOC SI REPORT\2011\SECTION4_AOC2\FIGURE2-5 LOCATION OF TEST TRENCHES_11X17.MXD JCLEMENTS_CH2MHILLEN 12/23/2014 1:34:03 PM

AREA	CONTENT
1a & 1b	DEXTROSE BOTTLES
2	DRUMS AND RESPIRATOR PROTECTION CARTRIGES
3	MILITARY CLOTHING



Legend

- Concrete Piers
- Exploratory Test Pit (Jan./Feb. 2000)
- Exploratory Test Hole (January 2000)
- Exposure Observation Point (January 2000)
- Study Area Boundary
- Field Investigation Test Pit (November 1999)
- CAX Boundary / Fenceline
- Former Location of Surface Debris (removed in 1998)

Test Trench (November 2001)

- No debris present
- Glass on surface. No debris present
- Dextrose bottles present
- Dextrose bottles and uniforms present
- Empty 55-gallon drums present

N W E S

0 50 100 Feet

Figure 2-5
Location of Test Trenches
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE2-6-AOC 2 SI SURFACE_SOIL_EXCEEDANCE_RESULTS.MXD JCLEMENTS_CH2MHILLEN 12/22/2014 12:55:16 PM

Contaminant of Potential Concern	CLEAN CAX BKG SS	Eco Surface Soil Screening Value	CLEAN RSLs Industrial Soil Adjusted	CLEAN RSLs Residential Soil Adjusted
Pesticides/PCBs (UG/KG)				
4,4'-DDE	--	114	5,100	1,400
4,4'-DDT	--	100	7,000	1,700
Total Metals (MG/KG)				
Arsenic	6.36	18.0	1.6	0.39
Chromium	18.2	64.0	5.6	0.29
Iron	19,900	pH < 5 or pH > 8	72,000	5,500
Mercury	0.111	0.10	31	2.3
Selenium	0.51	0.52	510	39
Vanadium	27.9	130	520	39

Station ID	CAA002-A2HA01
Sample ID	CAA02-A2-HA01-00-1098*
Sample Date	10/22/98
Depth	0-6"
Organic Compounds (UG/KG)	
No Exceedances	
Total Metals (MG/KG)	
Arsenic	**14**
Chromium	**39**
Iron	**28,600**

Station ID	CAA002-A2DPB02
Sample ID	CAA02-A2-DPB02-00-1098
Sample Date	10/22/98
Depth	0-6"
Organic Compounds (UG/KG)	
No Exceedances	
Total Metals (MG/KG)	
Mercury	**1.4**

Station ID	CAA002-A2HA02
Sample ID	CAA02-A2-HA02-00-1098
Sample Date	10/22/98
Depth	0-6"
Pesticides/PCBs (UG/KG)	
4,4'-DDE	**520 J**
4,4'-DDT	**640 J**
Total Metals (MG/KG)	
Arsenic	**6.6**
Chromium	**15.3**
Mercury	**0.96 J**

Station ID	CAA002-A2DPB03
Sample ID	CAA02-A2-DPB03-00-1098
Sample Date	10/22/98
Depth	0-6"
Organic Compounds (UG/KG)	
No Exceedances	
Total Metals (MG/KG)	
Arsenic	**20**
Chromium	**29.4**
Iron	**44,000**
Mercury	**1.2 J**
Selenium	**0.64 K**
Vanadium	**42.3**

Station ID	CAA002-A2DPB01
Sample ID	CAA02-A2-DPB01-00-1098
Sample Date	10/22/98
Depth	0-6"
Organic Compounds (UG/KG)	
No Exceedances	
Total Metals (MG/KG)	
Mercury	**1.8**

Station ID	CAA002-A2DPB04
Sample ID	CAA02-A2-DPB04-00-1098
Sample Date	10/22/98
Depth	0-6"
Organic Compounds (UG/KG)	
No Exceedances	
Total Metals (MG/KG)	
Mercury	**1.3**
Selenium	**0.71 K**

Notes:
Exceeds BKG and ECO
Exceeds BKG and Res RSL
Exceeds BKG, Res, and Ind RSLs
Exceeds BKG, ECO, Res and Ind RSLs
* Indicates duplicate sample was collected at this location. Values presented are the higher of the two.
-- - No value available
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
UG/KG - Micrograms per kilogram
MG/KG - Milligrams per kilogram

AREA 1a
AREA 2
AREA 3
AREA 1b
DEER PIT
EXTENT OF PARTIAL RESPIRATOR PROTECTION CARTRIDGE AND EMPTY DRUM REMOVAL (2000)
Garrison Road
Connector Road
Deer Pit Road

Legend
- Soil Sample Location
- Proposed Surface Soil Sample Location
- Hex and Total Chromium
- Concrete Piers
- Top of Bank
- Toe of Slope
- Deer Pit
- Extent of Partial Respirator Protection Cartridge and Empty Drum Removal (2000)
- Area 1a and Area 1b Boundary - Dextrose Bottles
- Area 2 Boundary - Drums and Respirator Cartridges
- Area 3 Bundary - Military Clothing
- Former Location of Surface Debris (removed in 1998)
- CAX Boundary / Fenceline
- Study Area Boundary

N W E S

0 40 80 Feet

Figure 2-6
AOC 2 SI Surface Soil Exceedance Results
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE2-7- AOC 2 SI SURFACE SOIL EXCEEDANCE RESULTS.MXD JCLEMENTS_CH2MHILLEN 12/24/2014 7:19:17 AM

Station ID	CAA02-A2TP05F	CAA02-A2TP05N
Sample ID	CAA02-A2-TP05-F-1199	CAA02-A2-TP05-N-1199*
Sample Date	11/12/99	11/12/99
Depth	1.5-2'	3.75-4'
Organic Compounds (UG/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Arsenic	1.9 J	16
Chromium	9.2	38.8
Cobalt	2.7 J	6.3 J
Iron	10,800 L	36,700

Station ID	CAA02-A2HA01
Sample ID	CAA02-A2-HA01-02-1098*
Sample Date	10/22/98
Depth	1-2'
Organic Compounds (UG/KG)	No Exceedances
Total Metals (MG/KG)	
Arsenic	31.1
Chromium	43.2
Cobalt	7 J
Iron	42,000
Mercury	0.89 J
Selenium	0.68 K

Station ID	CAA02-A2TP06F	CAA02-A2TP06N
Sample ID	CAA02-A2-TP06-F-1199	CAA02-A2-TP06-N-1199
Sample Date	11/12/99	11/12/99
Depth	2-2.5'	3.5-4'
Organic Compounds (UG/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Arsenic	4.3	21.2
Cobalt	3.8 J	9.2 J
Iron	25,800 L	34,300

Contaminant of Potential Concern	CLEAN CAX BKG SB	Eco Surface Soil Screening Value	CLEAN RSLs Industrial Soil Adjusted	CLEAN RSLs Residential Soil Adjusted
Pesticide/PCBs (UG/KG)				
4,4'-DDE	--	114	5,100	1,400
Aroclor-1260	--	--	740	220
Total Metals (MG/KG)				
Aluminum	13,000	pH < 5.5	99,000	7,700
Arsenic	5.54	18.0	1.6	0.39
Cadmium	--	32.0	80	7
Chromium	33.7	64.0	5.6	0.29
Cobalt	5.18	13.0	30	2.3
Copper	3.17	70.0	4,100	310
Iron	32,000	pH < 5 or pH > 8	72,000	5,500
Lead	8.79	120	800	400
Mercury	0.14	0.10	31	2.3
Selenium	0.64	0.52	510	39
Thallium	--	--	1[1]	0.078[1]
Vanadium	48.3	130	520	39

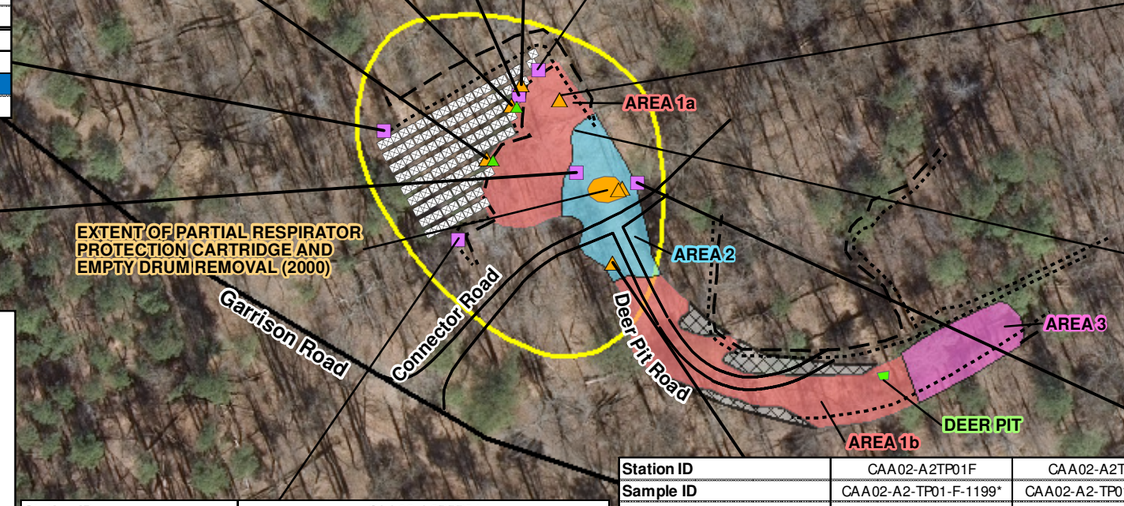
Station ID	CAA02-A2TP03F	CAA02-A2TP03N
Sample ID	CAA02-A2-TP03-F-1199	CAA02-A2-TP03-N-1199
Sample Date	11/12/99	11/12/99
Depth	2-3'	3.5-4'
Organic Compounds (UG/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Aluminum	9,960 L	16,100 L
Arsenic	7.9	36.5
Chromium	24.5	44
Cobalt	5.5 J	10.2 J
Iron	24,300 L	38,800 L
Vanadium	31.4	69.2 J

Station ID	CAA02-A2DPB02	
Sample ID	CAA02-A2-DPB02-03-1098	CAA02-A2-DPB02-10-1098
Sample Date	10/22/98	10/22/98
Depth	6-8'	20-22'
Organic Compounds (UG/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Arsenic	24.7	10.6
Cobalt	10.1 J	2.3 J

Station ID	CAA02-A2DPB03	
Sample ID	CAA02-A2-DPB03-03-1098	CAA02-A2-DPB03-09-1098
Sample Date	10/22/98	10/22/98
Depth	6-8'	18-20'
Organic Compounds (UG/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Arsenic	17.4	9.3
Cobalt	5.3 J	2.5 J

Station ID	CAA02-A2TP04F	CAA02-A2TP04N
Sample ID	CAA02-A2-TP04-F-1199	CAA02-A2-TP04-N-1199
Sample Date	11/12/99	11/12/99
Depth	2.5-3'	3.5-4'
Organic Compounds (UG/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Arsenic	9.2	36.1
Chromium	15.1	43.3

Station ID	CAA02-A2HA02
Sample ID	CAA02-A2-HA02-01-1098
Sample Date	10/22/98
Depth	0.5-1'
Pesticide/PCBs (UG/KG)	
4,4'-DDE	120 J
Total Metals (MG/KG)	
Mercury	1



Station ID	CAA02-A2TP02F	CAA02-A2TP02N
Sample ID	CAA02-A2-TP02-F-1199	CAA02-A2-TP02-N-1199
Sample Date	11/12/99	11/12/99
Depth	3.5-4'	6-7'
Organic Compounds (UK/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Aluminum	6,160 L	13,700 L
Cadmium	12.3	0.16 U
Chromium	94.5	60.3
Cobalt	3.4 J	6.6 J
Copper	318	137 J
Iron	21,100 L	38,400 L
Thallium	0.64 B	0.84 L

Station ID	CAA02-A2DPB04	
Sample ID	CAA02-A2-DPB04-03-1098	CAA02-A2-DPB04-09-1098
Sample Date	10/23/98	10/23/98
Depth	6-8'	18-20'
Organic Compounds (UG/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Arsenic	2.7	7.2
Iron	11,000	45,300

Station ID	CAA02-A2TP01F	CAA02-A2TP01N
Sample ID	CAA02-A2-TP01-F-1199*	CAA02-A2-TP01-N-1199
Sample Date	11/12/99	11/12/99
Depth	3.5-4'	4.8-5.4'
Pesticide/PCBs (UG/KG)		
Aroclor-1260	310	No Detections
Total Metals (MG/KG)		
Arsenic	5	9.4
Chromium	37.5	23.3
Iron	37,500 L	20,700 L

Station ID	CAA02-A2DPB01	
Sample ID	CAA02-A2-DPB01-03-1098	CAA02-A2-DPB01-15-1098
Sample Date	10/22/98	10/22/98
Depth	6-8'	30-32'
Organic Compounds (UG/KG)	No Exceedances	No Exceedances
Total Metals (MG/KG)		
Arsenic	7.6	9.2
Cobalt	1.7 U	5.5 J
Vanadium	54.4	14.6

Notes:
Exceeds BKG and ECO
Exceeds BKG and Res RSL
Exceeds BKG, Res and Ind RSLs
Exceeds BKG, ECO, Res and Ind RSLs
Samples collected at a depth greater than 2 feet below ground surface were not included in the ecological risk screening.
[1]Adjusted June 2011 RSL
* Indicates duplicate sample was collected at this location. Values presented are the higher of the two.
-- - No value available
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - Analyte not detected
UG/KG - Micrograms per kilogram
MG/KG - Milligrams per kilogram

Legend

- Soil Sample Location
- Test Pit Locations
- Concrete Piers
- Top of Bank
- Toe of Slope
- Deer Pit
- Extent of Partial Respirator Protection Cartridge and Empty Drum Removal (2000)
- Area 1a and Area 1b Boundary - Dextrose Bottles
- Area 2 Boundary - Drums and Respirator Cartridges
- Area 3 Bundary - Military Clothing
- Former Location of Surface Debris (removed in 1998)
- CAX Boundary / Fenceline
- Study Area Boundary

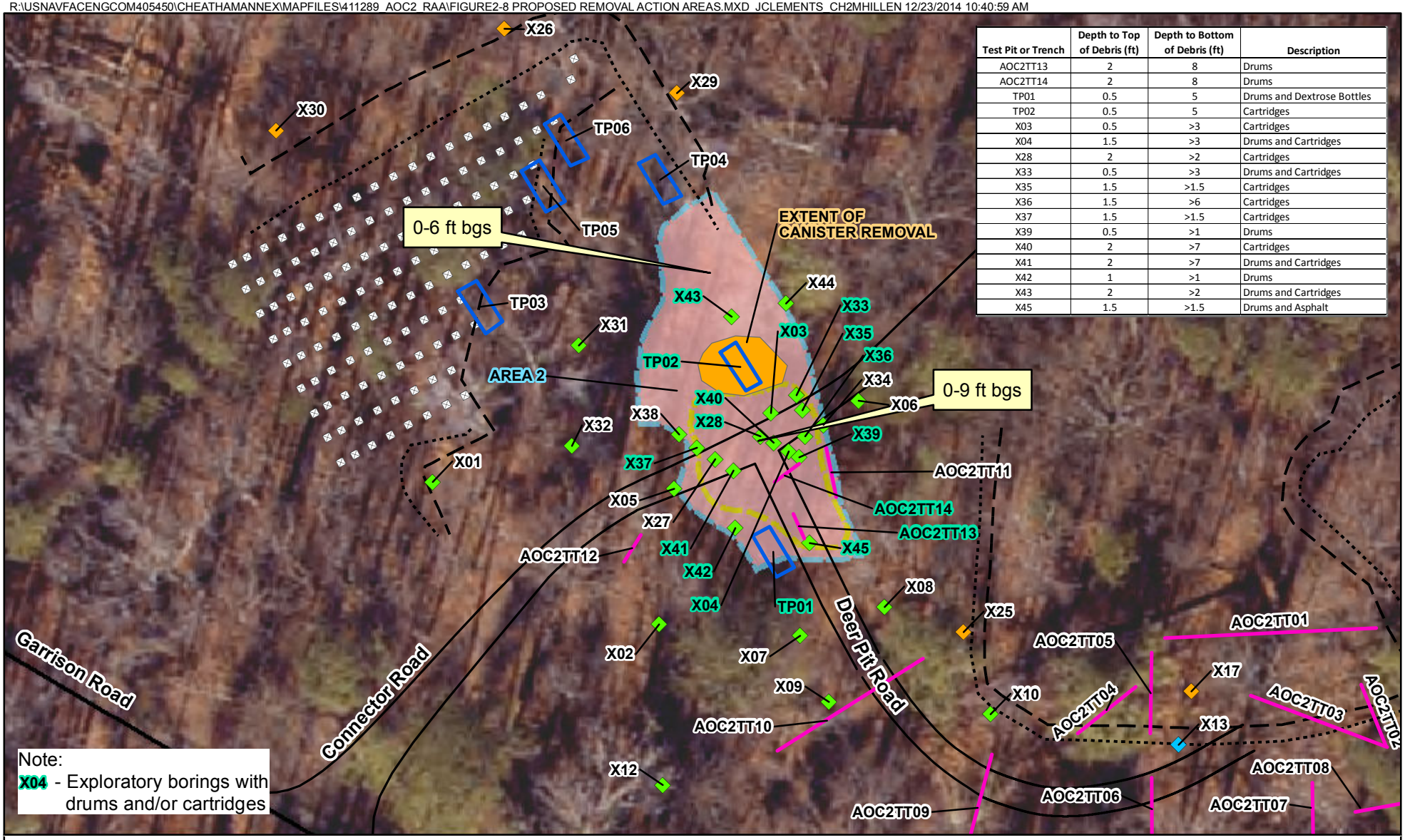
N W E S

0 50 100 Feet

Figure 2-7
AOC 2 SI Subsurface Soil Exceedance Results
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\411289_AOC2_RAA\FIGURE2-8 PROPOSED REMOVAL ACTION AREAS.MXD JCLEMENTS_CH2MHILLEN 12/23/2014 10:40:59 AM



Test Pit or Trench	Depth to Top of Debris (ft)	Depth to Bottom of Debris (ft)	Description
AOC2TT13	2	8	Drums
AOC2TT14	2	8	Drums
TP01	0.5	5	Drums and Dextrose Bottles
TP02	0.5	5	Cartridges
X03	0.5	>3	Cartridges
X04	1.5	>3	Drums and Cartridges
X28	2	>2	Cartridges
X33	0.5	>3	Drums and Cartridges
X35	1.5	>1.5	Cartridges
X36	1.5	>6	Cartridges
X37	1.5	>1.5	Cartridges
X39	0.5	>1	Drums
X40	2	>7	Cartridges
X41	2	>7	Drums and Cartridges
X42	1	>1	Drums
X43	2	>2	Drums and Cartridges
X45	1.5	>1.5	Drums and Asphalt

Legend

- Concrete Piers
- Exploratory Test Pit (Jan./Feb. 2000)
- Exploratory Test Hole (January 2000)
- Exposure Observation Point (January 2000)
- Field Investigation Test Pit (November 1999)
- Potential 0-6ft bgs Debris Disposal Area
- Potential 0-9ft bgs Debris Disposal Area
- CAX Boundary / Fenceline
- Top of Bank
- Toe of Slope
- Test Trench (November 2001)

0 20 40 Feet

N W E S

Figure 2-8
Proposed Removal Action Areas
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

SECTION 3

Identification of Removal Action Objectives

3.1 Statutory Limits on Removal Action

The NCP, 40 CFR Part 300.415, dictates statutory limits of $2 million and a 12-month duration for USEPA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the remedial action to be taken. However, this removal action will not be USEPA fund-financed. The Navy and Marine Corps installation restoration manual does not limit the cost or duration of removal actions; nonetheless, cost-effectiveness is a recommended criterion for the evaluation of removal action alternatives and is considered in Sections 4 and 5.

3.2 Removal Action Objectives and Scope

The removal action objectives are as follows:

- Prevent exposure of human and ecological receptors to Area 2 debris and soil that are present with contaminant concentrations that may pose unacceptable risks.
- Prevent or minimize transport of COPCs from buried debris and soil to site media.

3.3 Determination of Removal Action Schedule

This EE/CA will be made available for a 30-day public comment period. Notice of its availability for public review, along with a brief summary of the EE/CA, will be published in two local newspapers – *Daily Press* and *The Virginia Gazette*. The public comment period is scheduled to be from May 5, 2015 to June 3, 2015. A public information session will be held during or immediately following the public comment period, if requested. If public comments are received during the public comment period, a Responsiveness Summary documenting responses to significant comments will be prepared and included in the Action Memorandum, which will be placed in the Administrative Record for CAX. The Administrative Record file can be found on the CAX Public Environmental Restoration Program web site at http://go.usa.gov/DynP. The Administrative Record is also available for public review by appointment through the NAVFAC Mid-Atlantic Public Affairs Office[1].

Because this removal action has been designated non-time-critical, the start date of the removal action will be determined by factors other than the urgency of the threat. Possible factors include weather, the availability of resources, and site constraints. The total project period is anticipated to last 12 months from the beginning of the public comment period to completion of the associated construction completion documentation. Critical milestone periods for the removal action are as follows:

- EE/CA public comment period—30 days
- Subcontracting, work plan, and mobilization—6 months
- Removal action—4 weeks (for Alternative 2) or 2 weeks (for Alternative 3)
- CERCLA documentation—4 months

3.4 Applicable or Relevant and Appropriate Requirements

The removal action will, to the extent practicable, comply with applicable or relevant and appropriate requirements (ARARs) under federal and state environmental laws, as described in 40 CFR 300.415. Other federal

[1] NAVFAC Mid-Atlantic
Public Affairs Office
9742 Maryland Avenue
Norfolk, VA 23511-3095
(757) 445-8732, ext. 3096
wpnsta.pao@navy.mil

and state advisories, criteria, and/or guidance will be considered as appropriate in formulating the removal action. Applicable requirements are those requirements specific to AOC 2 that satisfy all jurisdiction prerequisites of the law or requirements. Relevant and appropriate requirements are those that do not have jurisdiction authority over the particular circumstances at AOC 2, but are meant to address similar situations, and therefore are suitable for use at the AOC. Federal ARARs are determined by the lead agency, which in this case is the Navy. As outlined by 40 CFR 300.415(j), the lead agency may consider the urgency of the situation and the scope of the removal action to be conducted in determining whether compliance with ARARs is practicable. The NCP, 40 CFR 300.400(g)(2), specifies factors to consider in determining which requirements of other environmental laws are relevant and appropriate:

- The purpose of the requirement in relation to the purpose of CERCLA
- The media regulated by the requirement
- The substance(s) regulated by the requirement
- The actions or activities regulated by the requirement
- Variations, waivers, or exemptions of the requirement
- The type of place regulated and the type of place affected by the release or CERCLA action
- The type and size of the facility or structure regulated by the requirement or affected by the release
- Consideration of the use or potential use of affected resources in the requirement

In some circumstances, a requirement may be relevant to the particular site-specific situation, but may not be appropriate because of differences in the purpose of the requirement, the duration of the regulated activity, or the physical size or characteristic of the situation it is intended to address. There is more discretion in the judgment of relevant and appropriate requirements than in the determination of applicable requirements.

Three classifications of requirements are defined by USEPA in the ARAR determination process: chemical-specific, location-specific, and action-specific.

- ***Chemical-specific ARARs*** are health- or risk-management-based numbers or methodologies that result in the establishment of numerical values for a given medium that would meet the NCP threshold criterion of overall protection of human health and the environment. These requirements generally set protective cleanup concentrations for the constituents of concern in the designated medium. No federal or Virginia chemical-specific ARARs have been identified for AOC 2 (**Appendix B, Table B-1,** and **Table B-2**).
- ***Location-specific ARARs*** restrict remedial activities and media concentrations based on the characteristics of the surrounding environments. Location-specific ARARs may include restrictions on remedial actions within wetlands or coastal areas, near locations of known endangered species, or on protected waterways. The federal location-specific ARARs for AOC 2 are summarized in **Appendix B, Table B-3**. No Virginia location-specific ARARs for AOC 2 have been identified (**Appendix B, Table B-4)**.
- ***Action-specific ARARs*** are requirements that define acceptable treatment and disposal procedures for hazardous substances. The federal and Virginia action-specific ARARs for AOC 2 are summarized in **Appendix B, Table B-5,** and **Table B-6**).

3.5 General Disposal Requirements

Waste disposal procedures implemented for the removal action will be in accordance with applicable laws and regulations. For the purposes of this EE/CA, the cost estimates were based on the assumption that excavated soil and drums will be non-hazardous and filter cartridges will be hazardous. Waste characterization testing will be conducted in accordance with the requirements of the disposal facility. Any materials classified as hazardous will be appropriately transported and disposed of in accordance with applicable requirements. All materials will be disposed in a state-permitted disposal facility that is approved by the Navy and is permitted to accept CERCLA waste.

SECTION 4

Description and Evaluation of Removal Action Alternatives

The alternatives for this removal action were considered using professional judgment and information from previous environmental activities. Alternatives were evaluated based on effectiveness, implementability, and cost. The no action alternative was evaluated for comparative purposes.

4.1 Description of Removal Action Alternatives

4.1.1 Alternative 1: No Action

With this alternative, no action would be conducted and no controls would be implemented. The area would be left as it currently exists, leaving the debris and impacted soil posing potential human health and ecological risks in place. Therefore, in accordance with CERCLA (Section 121[c]), as amended by SARA, the site would be reviewed every 5 years. It is assumed that the current level of maintenance would be sustained.

4.1.2 Alternative 2: Removal and Offsite Disposal

This alternative consists of excavation of debris and impacted soil and backfilling in Area 2 (**Figure 4-1**). No land use controls (LUCs) or operation and maintenance (O&M) activities are required for this alternative because the debris and impacted soil would be removed from the site. Green and sustainable remediation best management practices that can be implemented with this alternative include truck and equipment idling control, use of backfill material that is sourced nearby to minimize emissions from truck transportation, vegetating the backfill surface with locally available and low-maintenance grasses and plants, using a nearby disposal facility to minimize truck emissions, and recovering metal debris that can be recycled to avoid disposal.

Site Preparation

Site preparation activities would include a pre-excavation topographic survey, setup of a staging area and facilities, installation of erosion and sediment (E&S) controls, vegetation clearance for the construction of material handling/staging areas and a construction entrance, and installation of a construction entrance. Before construction begins, typical temporary E&S controls would be implemented, such as silt fence and hay bales installed around areas to be disturbed at topographic lows and soil stockpiles. Permanent E&S controls after construction would include appropriate grading and site vegetation. Specific details would be provided in an E&S control plan to be included with the removal action work plan.

Pre-Excavation Waste Characterization Sampling

Before excavation or offsite disposal of debris and impacted soil from the removal areas occur, pre-excavation waste characterization samples would be collected. For cost estimating purposes, it is assumed that pre-excavation waste characterization sampling would be conducted at a frequency of one sample per 1,000 yd^3 of soil, one sample from the drums, and one sample from the filter cartridges for full TCLP (volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], metals, herbicides, and pesticides), reactivity (cyanide and sulfide), ignitability, corrosivity, total petroleum hydrocarbons (TPH)-diesel range organics, and TPH-gasoline range organics with a 28-day turnaround time. Additional waste characterization samples would be necessary if post-excavation confirmation samples collected from the removal areas indicate that additional excavation is required (see the Post-Excavation Confirmation Sampling section below). The additional samples would be collected at the same frequency and be analyzed for the same analytical parameters as the pre-excavation waste characterization samples.

Excavation and Offsite Disposal

The debris and impacted soil from Area 2 would be excavated to assumed depths ranging from 6 to 9 feet bgs, based on previous investigations indicating the approximate depth of debris. Actual excavation depths will be based on the visible limit of debris, plus an additional one foot of soil excavation below the visible extent.

An estimated total of 1,304 yd^3 of material would be excavated, which includes additional material removed from excavations deeper than 5 feet bgs. For excavations deeper than 5 feet bgs, sloping or shoring would be required to ensure safety. For cost estimating purposes, it was assumed that the excavations deeper than 5 feet bgs are in Occupational Safety and Health Administration Type A soil at a 0.75H:1V slope, which would result in an additional volume of 326 yd^3 to be removed as a result of sloping or shoring. For cost estimating purposes, it was assumed that the additional volume of soil removed will be disposed offsite. The water table at the site is approximately 22 to 33 feet bgs and should not be encountered during excavation; therefore, no dewatering is anticipated. The excavated drums and soil, which were assumed to be non-hazardous for cost estimating purposes, and filter cartridges, assumed to be hazardous for cost estimating purposes, would be transported offsite to a USEPA offsite rule-approved disposal facility. The excavation, offsite disposal, and backfilling would be performed using mechanical earthwork equipment (such as excavators, bulldozers, front end loaders, and dump trucks). Exact details would be provided during the development of the Removal Action Work Plan.

Post-Excavation Confirmation Sampling

Before backfilling of excavations occurs, post-excavation confirmation samples would be collected to confirm the horizontal and vertical extents of the excavations are sufficient. For cost estimating purposes, it was assumed the confirmation sampling would be conducted at a frequency of one floor sample per every 625 ft^2 (25- by 25-foot grid) and one wall sample per every 50 linear feet, resulting in a total of 12 (6 floor and 6 wall) confirmation samples. The disposal area confirmation samples would be analyzed for the site COPCs (Aroclor-1260, arsenic, hexavalent and total chromium, mercury, and 4,4-DDT). Confirmation soil samples will be compared to the chemical-specific PRGs.

Backfill

Following completion of the excavation activities, a topographic survey of the site would be completed to capture the spatial coordinates of the lateral and vertical extents of the excavation areas.

An estimated total of 1,630 loose yd^3 of fill material (105 yd^3 of imported topsoil, 1,525 yd^3 of imported general fill) would be used to backfill the excavation area to match the surrounding grade. General fill would be used to bring the grade to within 6 inches of the final grade, followed by the placement of a 6-inch topsoil layer to support vegetation growth.

General fill and topsoil would be delivered to the site from an offsite source meeting the requirements agreed upon in the CAX Tier 1 Partnering Team's Consensus Statement for Certifying Clean Fill (**Appendix C**).

Following completion of backfilling activities, a topographic survey of the site would be conducted to confirm that the post-backfill elevations are consistent with the pre-existing grade.

Site Restoration

Areas disturbed during the removal action would be stabilized by seeding with native species of grasses. Once site restoration is complete and vegetation has re-established, there would be no changes to the ground surface under Alternative 2. All equipment, materials, and temporary E&S controls would be removed from the site. More specific details would be provided in the Removal Action Work Plan.

4.1.3 Alternative 3: Low Permeability Soil Cover

This alternative consists of construction of a low permeability soil cover over Area 2 (**Figure 4-1**). As a result of debris and impacted soil remaining onsite, LUCs, O&M, and Five-Year Reviews would be required and would be implemented indefinitely. Green and sustainable remediation best management practices that can be implemented with this alternative include truck and equipment idling control, use of cover material that is sourced nearby to minimize emissions resulting from truck transportation, and vegetating the cover with locally available, low-maintenance grasses and plants.

Pre-Soil Cover Delineation Sampling

Prior to placing the soil cover, samples would be collected to delineate the horizontal extent of the debris and impacted soil at Area 2. For cost estimating purposes, it was assumed discrete co-located surface and subsurface samples would

be collected along the perimeter of Area 2 at a frequency of one sample per every 50 linear feet and be analyzed for the site surface and subsurface soil COPCs (Aroclor-1260, arsenic, hexavalent chromium, total chromium, mercury, and 4,4-DDT). The sample results would be compared to the PRGs in **Table 2-2** and **Table 2-3**. If the perimeter results exceed the cleanup goals, additional sampling would be conducted until the perimeter results are below the cleanup goals and the extent of the removal action area has been defined. The sampling details would be established in a sampling and analysis plan.

Site Preparation

Site preparation activities would include a pre-soil cover topographic survey, setup of a staging area and facilities, installation of E&S controls, vegetation clearance for construction of material handling/staging areas and a construction entrance, and installation of a construction entrance. Before construction begins, typical temporary E&S controls would be implemented, such as a silt fence and hay bales installed around areas to be disturbed at topographic lows. Permanent E&S controls after construction would include appropriate grading and site vegetation. Additional details would be provided in an E&S control plan to be included with the removal action work plan.

Soil Cover

A soil cover would be installed over the surface of an approximate 4,100-ft^2 area that includes the entirety of Area 2. For cost estimating purposes, a 2-foot-thick soil cover consisting of 18 inches of general fill, topped by 6 inches of topsoil, would be placed over the surface area of Area 2 and seeded. The final desired as-built slope of the soil cover would be constructed to promote positive drainage off the soil cover and to provide a smooth transition to the surrounding native ground surface. Hauling and backfilling would be performed using mechanical earthwork equipment (such as bulldozers and dump trucks). Specific details would be added during the development of the removal action work plan.

Following completion of soil cover placement activities, a topographic survey of the site would be conducted to confirm that the soil cover elevations result in a minimum of 2 feet of soil cover over the entirety of Area 2.

Site Restoration

Areas disturbed during the removal action would be stabilized by seeding with native species of grasses. Alternative 3 would permanently alter the topography of the site. All equipment, materials, and temporary E&S controls would be removed from the site. More specific details will be provided in the removal action work plan.

Land Use Controls, Operation and Maintenance, and Five-Year Reviews

As a result of debris and impacted soil remaining onsite, LUCs, O&M, and Five-Year Reviews will be required to ensure the following:

- Soil cover remains in place and continues to be protective of human health and the environment
- Land use remains the same and the cover is not disturbed without appropriate notification/authorization

The established LUC boundary would be included in the CAX master plan and geographic information system. For cost estimating purposes, the LUCs would include signs at designated locations along the site boundary prohibiting unauthorized disturbances of the soil cover, and the O&M would include quarterly inspections of the cover for the first 2 years, followed by annual inspections, and soil cover and vegetative maintenance as required (assumed to be every 5 years). The LUCs, O&M, and Five-Year Reviews would be implemented indefinitely; however, a period of 30 years was used for cost-estimating purposes.

4.2 Evaluation of Alternatives

4.2.1 Evaluation Criteria

The criteria used to evaluate the removal action alternatives are based on *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, PB93-963402 (USEPA, 1993).

4.2.2 Effectiveness

The *effectiveness* criterion addresses the expected results of the removal action alternatives. It includes two major subcategories: protectiveness and ability to achieve the removal objectives.

- Protectiveness
  - Protective of public health and community
  - Protective of workers during implementation
  - Protective of the environment
  - Complies with ARARs
- Ability to Achieve Removal Objectives
  - Level of treatment/containment expected
  - No residual effect concerns
  - Will maintain control until long-term solution implemented

In addition to the protectiveness and ability to achieve the removal action objectives subcategories, sustainability should be considered. Therefore, a sustainability assessment was conducted using SiteWise, a stand-alone tool that assesses the environmental footprint of a remedial alternative to compare the overall life-cycle environmental impacts of each remedy (Battelle, 2011). The sustainability assessment provides an additional comparison criterion that may allow options with smaller environmental impacts to be selected when all other criteria are met. The sustainability assessment is included in **Appendix D**.

4.2.3 Implementability

The *implementability* criterion encompasses the technical and administrative feasibility of the removal action. It includes three subcategories: technical feasibility, availability of resources, and administrative feasibility.

- Technical feasibility
  - Construction and operational consideration
  - Demonstrated performance and useful life
  - Adaptability to environmental conditions
  - Contribution to performance of long-term removal actions
  - Implementation within the allotted time
- Availability of resources
  - Availability of equipment
  - Availability of personnel and services
  - Laboratory testing capacity
  - Offsite treatment and disposal capacity
  - Post-removal action site control
- Administrative feasibility
  - Required permits and/or easement or rights-of-way
  - Impacts on adjoining property
  - Ability to impose institutional controls
  - Likelihood of obtaining exemptions from statutory limits (if needed)

4.2.4 Cost

The *cost* criterion encompasses the life-cycle costs of a project, including the projected implementation costs and the long-term O&M costs of an action. For the detailed cost analysis, the expenditures required to complete each alternative were estimated in terms of capital costs, including direct and indirect costs, to complete initial construction activities.

Direct costs include the cost of construction, equipment, land and site development, treatment, transportation, and disposal. Indirect costs include engineering expenses and contingency allowances.

Future post-construction costs (that is, periodic inspections and maintenance) would be required to ensure the continued effectiveness of Alternative 3 (Low Permeability Soil Cover). The future costs were calculated using an assumed inflation rate of 3.9 percent for a 30-year timeframe. After inflating the future costs, they were analyzed using present worth, which discounts all future costs to a common base year (2014). Present-worth analysis allows the cost of the removal action to be compared on the basis of a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the life of the removal action. The present-worth calculations included an assumed discount rate of 3.9 percent (White House OMB, 2013).

The estimated costs are provided to an expected accuracy of +50 percent and -30 percent. The alternative cost estimates are in 2014 dollars and the unit pricing is based on costs from similar projects, vendor quotes, or engineering estimates. The enclosed Engineer's Estimate (**Appendix E**) is only an estimate of possible construction costs for budgeting purposes.

4.2.5 Evaluation of Alternatives

Table 4-1 summarizes the results of the alternative evaluation with respect to effectiveness, ease of implementation, and cost.

TABLE 4-1
Evaluation of Removal Action Alternatives

Alternative	Description	Effectiveness	Implementability	Cost
Alternative 1 - No Action	No removal action work performed; site left "as is."	Alternative 1 leaves soil posing unacceptable risk in place; therefore, it will not meet removal action objectives, reduce volume or mobility of contamination, provide any short- or long-term protectiveness, or pose any short-term environmental impacts.	No action to implement	$0
Alternative 2 - Removal and Offsite Disposal	The debris and impacted soil from AOC 2 Area 2 would be excavated to assumed depths ranging from 6 to 9 feet bgs. Excavated material would be transported offsite for disposal. Post-excavation confirmation sampling would be completed followed by backfilling the excavation areas.	Protective of human health and community and the environment because removal of debris and impacted soil posing potential risks eliminates direct exposure and risk; potential short-term risks to site workers exposed to contaminated material during implementation would be managed through training and use of personal protective equipment; potential short-term risks to the community as a result of the debris and impacted soil being transported offsite would be managed by ensuring that trucks are not overloaded and are covered prior to leaving the site. Complies with the ARARs. Although there are no chemical-specific ARARs, the contaminant concentrations pose potential unacceptable risk, which Alternative 2 would remove. Achieves the removal objective. No residual effect concerns, because no debris or impacted soil posing potential risk would remain onsite. Provides a permanent, long-term solution. Poses a potential, but unlikely, environmental impact, primarily associated with the transportation and disposal of the excavated debris and impacted soil.	Is technically feasible - components are well established, available, and can be completed with conventional equipment in a relatively short timeframe (less than a year). Would be more difficult to implement than Alternative 3 because it involves excavation to an assumed depth of 9 feet bgs. However, it requires no post-removal site control (PRSC) and associated cost since debris and impacted soil would be removed.	$631,000
Alternative 3 - Low Permeability Soil Cover	Construct a soil cover over the entirety of AOC 2 Area 2. Future actions include LUCs, O&M, and Five-Year Reviews to ensure the soil cover remains in place and continues to be protective of human health and the environment, land use remains the same, and the cover is not disturbed without appropriate notification/ authorization.	Protective of human health and the environment because it prevents direct exposure to debris and impacted soil posing potential risks; potential short-term risks to site workers exposed to contaminated materials during construction would be managed through training and use of personal protective equipment. Complies with the ARARs. Although there are no chemical-specific ARARs, the contaminant concentrations pose potential unacceptable risk, which Alternative 3 would cover and isolate to prevent exposure; however, the contaminants would remain in place. Achieves the removal objective. Long-term protectiveness is achieved, provided the soil cover is maintained and LUCs are in place. However, because it does not remove debris and impacted soil, there are residual effect concerns. Poses a potential, but unlikely, environmental impact, primarily associated with the transportation and operation of the mechanical earthwork equipment.	Is technically feasible - components are well established, available, and can be completed with conventional equipment in a relatively short timeframe (less than a year). Would be less difficult to implement than Alternative 2, but cover technology is not as effective at reducing risk as complete removal, because debris and impacted soil remains onsite. PRSC (i.e., LUCs, O&M, and Five-Year Reviews) will be required.	$556,000 Capital Cost: $225,000 Present Value of LUCs, O&M, and Five-Year Reviews: $331,000 Total Present Value of Alternative: $556,000

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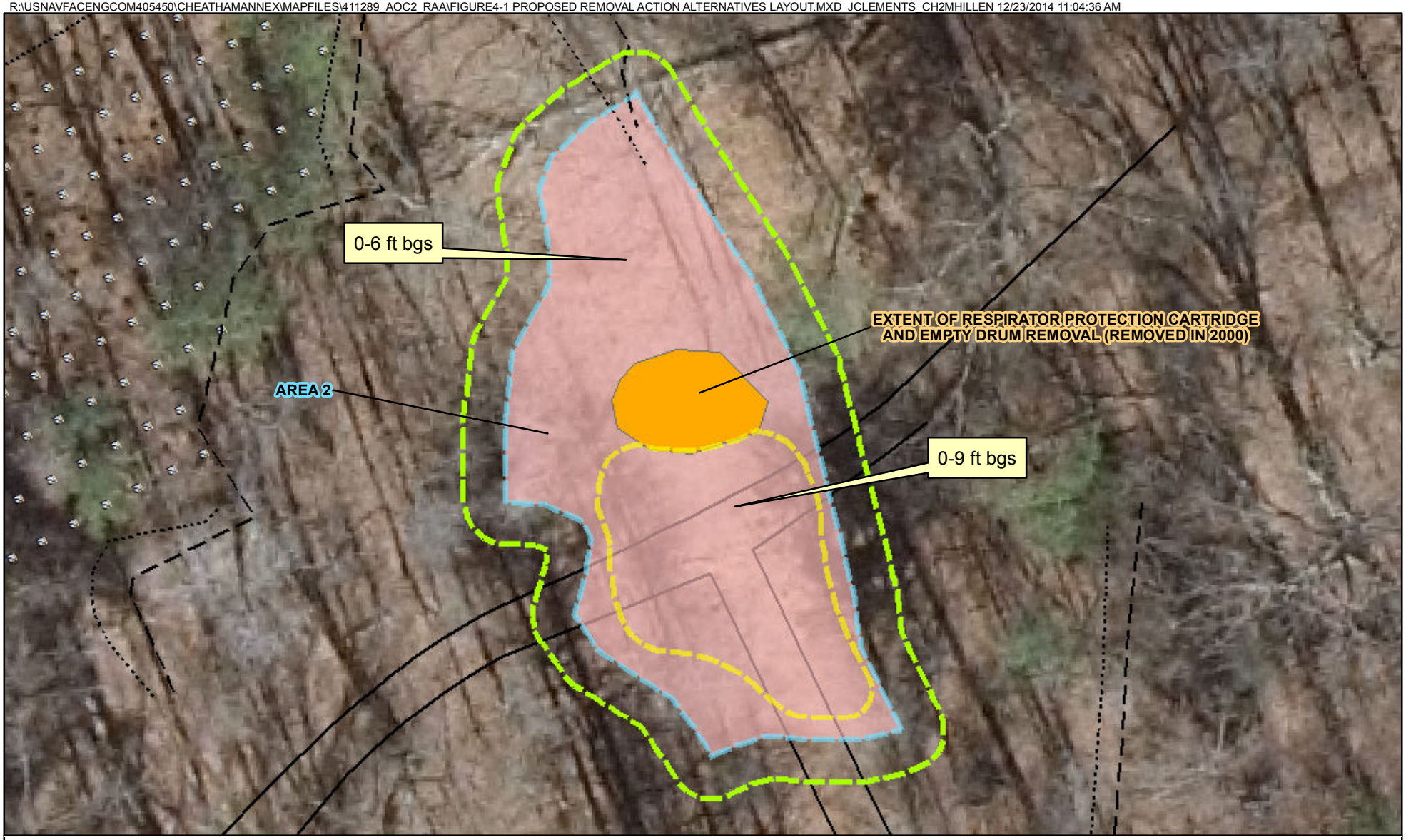

Legend

- Concrete Piers
- Top of Bank
- Toe of Slope
- CAX Boundary / Fenceline
- Area 2 Boundary
- Approximate Extent of Removal (Alternative 2) or Soil Cover (Alternative 3)
- Potential 0-6 ft Debris Disposal Area
- Potential 0-9 ft Debris Disposal Area

0 30 60 Feet

N W E S

Figure 4-1
Proposed Removal Action Alternatives Layout
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

SECTION 5

Comparative Analysis of Removal Action Alternatives

Section 5 expands on the evaluation of the alternatives by providing a comparative analysis to assist the decision-making process by which a removal action will be selected. In Section 4, these alternatives were described according to their effectiveness, ease of implementation, and cost. In this section, the alternatives are compared to one another for each of the three criteria.

Table 5-1 summarizes the results of the alternatives comparison. Comparative terms used in **Table 5-1** are defined relative to the other alternatives.

TABLE 5-1
Removal Action Alternative Comparison

Alternative	Effectiveness	Implementation	Cost
Alternative 1 – No Action	Least Effective	Easiest	Least Expensive
Alternative 2 – Removal and Offsite Disposal	Most Effective	Moderately Easy, but Most Difficult of the Three Alternatives	Moderately Expensive and Most Expensive of the Three Alternatives
Alternative 3 – Low Permeability Soil Cover	Effective	Moderately Easy	Moderately Expensive

5.1 Effectiveness

Alternative 1 would not be effective, because it would not be protective of human health and the environment and would not achieve the removal objectives of this EE/CA. Alternatives 2 and 3 would be effective because they would both be protective of human health and the environment, comply with ARARs, and be able to achieve the removal objectives.

Alternative 2 is the most effective alternative in reducing toxicity, mobility, and volume, because it results in the removal and offsite disposal of debris and impacted soil. It eliminates any residual effect concern and the potential for contaminants to migrate to the surrounding media, thus there is no risk of control failure that could result in exposure. Alternative 2 provides a permanent, long-term solution.

As a result of the debris remaining onsite as part of Alternative 3, there is a residual effect concern and the lingering potential for contaminants from debris and impacted soil to migrate to the surrounding media over time. In addition, if the cover was disturbed, there is the potential for exposure.

Alternative 3 had lower footprints for all of the sustainability metrics compared with Alternative 2 (**Appendix D**) because it involves less transportation of materials and waste. However, it should be noted that while this analysis compares the environmental footprints of each of the alternatives, the alternatives differ with respect to other evaluation criteria, and a comparison of the results of the alternatives needs to be made in the context of the benefits (e.g., ARAR compliance, contaminant reduction, site reuse, and etc.) of each alternative. In this case, Alternative 2 results in removal of the waste from the site, whereas Alternative 3 involves waste being managed onsite. In addition, the footprint of the selected alternative may be further evaluated in the design phase of the project to explore opportunities to optimize the environmental footprint of the project and integrate sustainable remediation best practices in the design, construction, and operation of the removal action. A potential best practice for Alternative 2 may be sourcing a landfill or waste receptor that is closer to the site, while potential best practices for Alternative 3 may include using equipment with emissions control devices or managing work such that engine idle time is minimized; these same potential best practices would apply for Alternative 2 as well.

In conclusion, Alternative 2 does not rely on controls to prevent exposure and has no residual effect concerns; therefore, it is more effective than Alternative 3.

5.2 Implementability

Alternative 1 requires no implementation and is, therefore, the easiest to implement. Alternatives 2 and 3 would both be moderately easy to implement because they are technically and administratively feasible and the resources needed to implement the alternatives are readily available. Both alternatives would be completed using common construction practices and in a short timeframe (less than a year). However, because Alternative 2 would include excavation to an assumed maximum depth of 9 feet bgs, resulting in the need for additional measures to maintain excavation stability, it would be more difficult to implement than Alternative 3. However, Alternative 2 would not require post-removal site controls (PRSCs) following completion of the removal action due to the removal of debris and impacted soil, whereas Alternative 3 would require PRSCs (LUCs, O&M, and Five-Year Reviews) to maintain protectiveness.

5.3 Cost

Alternative 1 is the least expensive alternative and Alternative 2 is the most expensive alternative. However, Alternative 2 has a one-time cost that results in the complete removal of debris and impacted soil, while Alternative 3 has, at a minimum, 30 years of PRSC costs, which creates greater uncertainty in the Alternative 3 cost estimate. The detailed cost estimates for the alternatives are provided in **Appendix E** and summarized in **Table 4-1**.

SECTION 6

Recommended Removal Action Alternative

Alternatives 2 and 3 are comparable in their ability to protect human health and the environment, ability to achieve the removal objectives, ease of implementability, and compliance with ARARs. Alternative 2 is more expensive than Alternative 3. However, Alternative 3 results in debris and impacted soil posing a potential risk to human health and the environment being left in place, which necessitates PRSCs (LUCs, O&M, and Five-Year Reviews) to ensure the removal action remains protective over time, and which creates greater uncertainty in the Alternative 3 cost estimate. There is also the potential for future exposure under Alternative 3, should the cover be disturbed.

Based on the evaluation of the trade-offs between the alternatives, the recommended removal alternative is Alternative 2, Removal and Offsite Disposal. Alternative 2 consists of excavating AOC 2 Area 2 to depths ranging from 6 to 9 feet bgs, offsite disposal of the excavated material, post-excavation confirmation sampling, and backfilling the excavation areas. The end result of Alternative 2 is a permanent solution that provides for unlimited use/unrestricted exposure and does not require PRSCs (inspection and maintenance activities) to ensure long-term protectiveness.

Navy, USEPA, and VDEQ representatives were involved with the development of the recommended alternative through the Tier I Partnering Team process and will have the opportunity to comment on the recommendation during the regulatory review period for this EE/CA. Following the regulatory review period, a 30-day public comment period will be held to assess public acceptance of the recommended alternative. If comments are received, a Responsive Summary addressing significant comments will be prepared as part of the Action Memorandum and included in the Administrative Record, along with the final EE/CA.

SECTION 7

References

Baker Environmental, Inc. (Baker). 1999. *Final Field Investigation Report, Site 1 and AOC 2, Naval Weapons Station Yorktown, Yorktown, Virginia, Cheatham Annex Site.* September.

Baker. 2001. *Final Field Investigation Report, Site 7 and AOC 2, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. March.

Baker. 2002. *Final Trenching Letter Report, Site 1, Site 4, and AOC 2, Naval Weapons Station Yorktown, Cheatham Annex Site, Williamsburg, Virginia.* June

Battelle. 2011. *SiteWise™ Version 2 User Guide. NAVFAC Engineering Service Center, UG-2092-ENV*. June.

CH2M HILL. 2012. *Final Site Inspection Report for AOCs 1, 2, 6, 7, 8, Naval Weapons Station Yorktown, Cheatham Annex, Williamsburg, Virginia*. May.

CH2M HILL. 2013. *Final No Action Consensus Letter for Groundwater at AOC 2, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. August.

CH2M HIL. 2014a. *Site Management Plan, Fiscal Years 2015-2016, Naval Weapons Station Yorktown, Cheatham Annex, Williamsburg, Virginia.* September.

CH2M HILL. 2014b. *Final Tier II Sampling and Analysis Plan, AOC 2 – Dextrose Dump, Site Inspection Supplemental Soil Sample Collection, Naval Weapons Station Yorktown, Cheatham Annex, Williamsburg, Virginia.* May.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997. *Toxicological benchmarks for screening contaminants of potential concern for effects on soil and litter invertebrates and heterotrophic process: 1997 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-126/R2.

Ministry of Housing, Spatial Planning, and Environment (MHSPE). 2001. Technical evaluation of the intervention values for soil/sediment and groundwater. RIVM Report 711701 023. February.

MHSPE. 2000. *Circular on target values and intervention values for soil remediation.* Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. DBO/1999226863. February.

United States Environmental Protection Agency (USEPA). 1993. *Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA, PB93-963402.* August.

USEPA. 2015. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May. Available online: http://www.epa.gov/region9/superfund/prg/.

White House Office of Management and Budget (White House OMB). 2013. *Circular No. A-94 Appendix C, Revised December 2013. Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses – Real Discount Rates: Real Interest Rates on Treasury Notes and Bonds of Specified Maturities.* Available at: http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html.

Appendix A
2014 Supplemental SI Soil Data

TABLE A-1

2014 Site Investigation Supplemental Surface Soil Sampling

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS**	**ESV**	**RSLs Industrial Soil Adjusted May 2014**	**RSLs Residential Soil Adjusted May 2014**	CAA02-A2DPB02	CAA02-A2DPB03	CAA02-A2DPB04	CAA02-A2HA01	
Sample ID					CAA02-A2-DPB02-00-0514	CAA02-A2-DPB03-00-0514	CAA02-A2-DPB04-00-0514	CAA02-A2-HA01-00-0514	CAA02-A2-HA01-00P-0514 (Duplicate)
Sample Depth					0-6" bgs	0-6" bgs	0-6" bgs	0-6" bgs	0-6" bgs
Sample Date					05/06/14	05/06/14	05/06/14	05/06/14	05/06/14
Chemical Name									
Total Metals (mg/kg)									
Chromium (hexavalent)	--	0.4	6.3	0.3	NA	0.06 J	NA	0.2 J	0.06 J
Chromium	18.2	64	6.3	0.3	NA	**24**	NA	**17.2**	**20.7**
Iron	19,900	5 < pH > 8	82,000	5,500	12,600	31,500	13,000	16,600	21,000
Mercury	0.111	0.1	35	2.3	0.041 B	0.058 B	0.06 B	0.05 B	0.049 B
Wet Chemistry									
pH (pH units)	--	--	--	--	6.7	6.7	6.5	6.6	6.5

Notes:

Shading indicates exceedance of the 95% UTL background concentration for surface soil

Italicized text indicates exceedance of the ESV

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

mg/kg - milligrams per kilogram

bgs - below ground surface

TABLE A-2

2014 Site Investigation Supplemental Subsurface Soil Sampling

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SB**	**ESV**	**Adjusted Industrial Soil RSLs May 2014**	**Adjusted Residential Soil RSLs May 2014**	CAA02-A2DPB02	CAA02-A2DPB03	CAA02-A2DPB04	CAA02-A2HA01		CAA02-A2TP03N	
Sample ID					CAA02-A2-DPB02-03-0514	CAA02-A2-DPB03-03-0514	CAA02-A2-DPB04-03-0514	CAA02-A2-HA01-0102-0514	CAA02-A2-HA01-0H02-0514	CAA02-A2-TP03-N-0514	CAA02-A2-TP03-NP-0514 (Duplicate)
Sample Depth					6-24" bgs	6-24" bgs	6-24" bgs	1.0-2.0' bgs	6-24" bgs	3.5-4.0' bgs	3.5-4.0' bgs
Sample Date					05/06/14	05/06/14	05/06/14	05/06/14	05/06/14	05/06/14	05/06/14
Chemical Name											
Total Metals (mg/kg)											
Chromium (hexavalent)	--	0.4	6.3	0.3	NA	NA	NA	0.33 J	NA	*0.49 J*	*0.47 J*
Chromium	33.7	64	6.3	0.3	NA	NA	NA	**19.4**	NA	**38.5**	**51.1**
Iron	32,000	5 < pH > 8	82,000	5,500	15,100	33,900	32,200	NA	29,700	NA	NA
Mercury	0.14	0.1	35	2.3	0.03 B	0.025 B	0.0578 B	NA	0.045 B	NA	NA
Wet Chemistry											
pH (pH units)	--	--	--	--	5.3	NA	NA	NA	6.4	NA	NA

Notes:

Shading indicates exceedance of the 95% UTL background concentration for subsurface soi

Italicized text indicates exceedance of the ESV

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

mg/kg - milligrams per kilogram

bgs - below ground surface

TABLE A-3

Ecological Screening Statistics - AOC 2, Outside of Area 2 Soil - May 2014

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	Ecological Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Ecological COPC?
SURFACE SOIL SAMPLES											
Inorganics (MG/KG)											
Chromium (hexavalent)	-- - --	2 / 2	0.06	0.20	CAA02-A2-HA01-00-0514	0.13	0.10	0.40	0 / 2	0.50	NO
Chromium	-- - --	2 / 2	20.7	24.0	CAA02-A2-DPB03-00-0514	22.4	2.33	64.0	0 / 2	0.38	NO
Iron	-- - --	4 / 4	12,600	31,500	CAA02-A2-DPB03-00-0514	19,525	8,871	5 < pH > 8	0 / 4	--	NO
Mercury	0.041 - 0.060	0 / 4	--	--	--	0.026	0.004	0.10	-- / --	0.60	NO
Other Parameters											
pH	-- - --	4 / 4	6.50	6.70	CAA02-A2-DPB02-00-0514	6.63	0.10	--	-- / --	--	--
SHALLOW SUBSURFACE SOIL SAMPLES											
Inorganics (MG/KG)											
Chromium (hexavalent)	-- - --	1 / 1	0.33	0.33	CAA02-A2-HA01-0102-0514	0.33	--	0.40	0 / 1	0.83	NO
Chromium	-- - --	1 / 1	19.4	19.4	CAA02-A2-HA01-0102-0514	19.4	--	64.0	0 / 1	0.30	NO
Iron	-- - --	4 / 4	15,100	33,900	CAA02-A2-DPB03-03-0514	27,725	8,592	5 < pH > 8	0 / 4	--	NO
Mercury	0.025 - 0.058	0 / 4	--	--	--	0.020	0.007	0.10	-- / --	0.58	NO
Other Parameters											
pH	-- - --	2 / 2	5.30	6.40	CAA02-A2-HA01-0H02-0514	5.85	0.78	--	-- / --	--	--
pH[3]	-- - --	2 / 2	6.50	6.70	CAA02-A2-DPB03-00-0514	6.60	0.14	--	-- / --	--	--

Notes:

1 - Count of detected samples exceeding or equaling the Ecological Screening Value

2 - Shaded cells indicate hazard quotient based on reporting limits

3 - Soil pH data were missing for two of the shallow subsurface soil samples; the surface soil pH data were used for these two samples

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE A-1 - AOC 2 SUPPLEMENTAL SI SURFACE SOIL EXCEEDANCE RESULTS.MXD JMONTI 10/28/2014 7:33:44 AM

	CLEAN CAX 95% UTL BKG SS	ESV	RSLs Industrial Soil Adjusted May 2014	RSLs Residential Soil Adjusted May 2014
Total Metals (mg/kg)				
Chromium	18.2	64	6.3	0.3
Iron	19,900	5 < pH > 8	82,000	5,500

Station ID	CAA02-A2HA01*
Sample ID	CAA02-A2-HA01-00-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Chromium	**20.7**
Iron	21,000

Station ID	CAA02-A2DPB02
Sample ID	CAA02-A2-DPB02-00-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Iron	12,600

Station ID	CAA02-A2DPB03
Sample ID	CAA02-A2-DPB03-00-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Chromium	**24**
Iron	31,500

Station ID	CAA02-A2DPB04
Sample ID	CAA02-A2-DPB04-00-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Iron	13,000

AREA 1a

EXTENT OF PARTIAL RESPIRATOR PROTECTION CARTRIDGE AND EMPTY DRUM REMOVAL (2000)

AREA 2

Garrison Road

Connector Road

Deer Pit Road

AREA 3

DEER PIT

AREA 1b

Notes:
Shading indicates exceedance of the 95% UTL background concentration for surface soil
Italicized text indicates exceedance of the ESV
Bold text indicates exceedance of Adjusted Industrial Soil RSLs
Underline indicates exceedance of Adjusted Residential Soil RSLs
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
mg/kg - Milligrams per kilogram
* - A duplicate sample was collected and the higher of the two results is shown

Legend

- Surface Soil Sample Location
- Concrete Piers
- Top of Bank
- Toe of Slope
- Deer Pit
- Extent of Partial Respirator Protection Cartridge and Empty Drum Removal (2000)
- Area 1a and Area 1b Boundary - Dextrose Bottles
- Area 2 Boundary - Drums and Respirator Cartridges
- Area 3 Bundary - Military Clothing
- Former Location of Surface Debris (removed in 1998)
- CAX Boundary / Fenceline
- Study Area Boundary

N
W E
S

0 70
Feet

Figure A-1
AOC 2 SI Supplemental Surface Soil Exceedance Results
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

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R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\387443_AOC2_SAP\FIGURE A-2 - AOC 2 SUPPLEMENTAL SI SUBSURFACE SOIL EXCEEDANCE RESULTS.MXD JMONTI 10/28/2014 7:41:03 AM

Station ID	CAA02-A2HA01
Sample ID	CAA02-A2-HA01-0102-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Chromium (hexavalent)	0.33 J
Chromium	**19.4**
Iron	29,700

Station ID	CAA02-A2DPB02
Sample ID	CAA02-A2-DPB02-03-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Iron	15,100

	CLEAN CAX 95% UTL BKG SB	ESV	Adjusted Industrial Soil RSLs May 2014	Adjusted Residential Soil RSLs May 2014
Total Metals (mg/kg)				
Chromium (hexavalent)	--	0.4	6.3	0.3
Chromium	33.7	64	6.3	0.3
Iron	32,000	5 < pH > 8	82,000	5,500

Station ID	CAA02-A2TP03N*
Sample ID	CAA02-A2-TP03-N-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Chromium (hexavalent)	*0.49* J
Chromium	**51.1**

Station ID	CAA02-A2DPB03
Sample ID	CAA02-A2-DPB03-03-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Iron	33,900

Station ID	CAA02-A2DPB04
Sample ID	CAA02-A2-DPB04-03-0514
Sample Date	05/06/14
Total Metals (mg/kg)	
Iron	32,200

AREA 1a
AREA 2
AREA 3
AREA 1b
DEER PIT
EXTENT OF PARTIAL RESPIRATOR PROTECTION CARTRIDGE AND EMPTY DRUM REMOVAL (2000)
Garrison Road
Connector Road
Deer Pit Road

Notes:
Shading indicates exceedance of the 95% UTL background concentration for subsurface soil
Italicized text indicates exceedance of the ESV
Bold text indicates exceedance of Adjusted Industrial Soil RSLs
Underline indicates exceedance of Adjusted Residential Soil RSLs
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
J - Analyte present, value may or may not be accurate or precise
mg/kg - Milligrams per kilogram
* - A duplicate sample was collected and the higher of the two results is shown

Legend
- Soil Sample Location
- Study Area Boundary
- Concrete Piers
- Top of Bank
- Toe of Slope
- Deer Pit
- Extent of Partial Respirator Protection Cartridge and Empty Drum Removal (2000)
- Area 1a and Area 1b Boundary - Dextrose Bottles
- Area 2 Boundary - Drums and Respirator Cartridges
- Area 3 Bundary - Military Clothing
- Former Location of Surface Debris (removed in 1998)
- CAX Boundary / Fenceline

N W E S

0 100 Feet

Figure A-2
AOC 2 Supplemental SI Subsurface Soil Exceedance Results
AOC 2 Engineering Evaluation/Cost Analysis
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

Appendix B
Applicable or Relevant and Appropriate Requirements Tables

Acronyms and Abbreviations

ARAR	Applicable or relevant and appropriate requirement
BTAG	Biological Technical Assistance Group
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
DCR	Virginia Department of Conservation and Recreation
DNH	Division of Natural Heritage
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NAAQS	National Ambient Air Quality Standards
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NSDWRs	National Secondary Drinking Water Regulations
NSPS	New Source Performance Standards
PCB	Polychlorinated biphenyls
PMCL	Primary Maximum Contaminant Level
POTW	Publicly Owned Treatment Works
ppm	Parts per Million
RBC	Risk-Based Concentrations
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act
SMCL	Secondary Maximum Contaminant Level
TBC	To Be considered
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substance Control Act
USACE	US Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
VA	Virginia
VAC	Virginia Administrative Code
VMRC	Virginia Marine Resource Commission
VPA	Virginia Pollutant Abatement
VPDES	Virginia Pollutant Discharge Elimination System

References

Commonwealth of Virginia, 2013. Preliminary Identification, Applicable or Relevant and Appropriate Requirements (ARARs).

USEPA, 1998. *CERCLA Compliance with Other Laws Manual: Interim Final* . Office of Emergency and Remedial Response. EPA/540/G-89/006.

USEPA, 1998. *CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes.* Office of Emergency and Remedial Response. EPA/540/G-89/009.

USEPA, 1998. RCRA, Superfund & EPCRA Hotline Training Manual. Introduction to Applicable or Relevant and Appropriate Requirements. EPA540-R-98-020.

TABLE B-1

Federal Chemical-Specific ARARs

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Media	Requirement	Prerequisite	Citation	Alternative	ARAR/TBC Determination	Comment

No Federal Chemical-Specific ARARs apply.

TABLE B-2

Virginia Chemical-Specific ARARs

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Media	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment

No Virginia Chemical-Specific ARARs apply.

TABLE B-3

Federal Location-Specific ARARs

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Migratory Bird Treaty Act						
Migratory bird area	Protects almost all species of native birds in the United States from unregulated taking.	Presence of migratory birds.	16 USC 703	2, 3	Applicable	The site is located in the Atlantic Migratory Flyway. If migratory birds, or their nests or eggs, are identified at the site, operations will not destroy the birds, nests, or eggs.
Coastal Zone Management Act						
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with, to the area that will affect maximum extent practicable, State coastal zone management programs. Federal agencies must supply the State with a consistency determination.	Wetland, flood plain, estuary, beach, dune, barrier island, coral reef, and fish and wildlife and their habitat, within the coastal zone.	15 CFR 930.33(a)(1), (c); .36(a), (b); .39(b)(c)	2, 3	Applicable	Activities at AOC 2 that will affect Virginia's coastal zone will be consistent to the maximum extent practicable with Virginia's enforceable policies. Activites performed on-site and in compliance with CERCLA are not subject to adminsitrative review; however the substantive requirements of making a consistency determination will be met.

TABLE B-4

Virginia Location-Specific ARARs

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment

No Virginia Location-Specific ARARs apply.

TABLE B-5

Federal Action-Specific ARARs

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Installing soil cover at an open dump	Design requriements are provided for the closure of solid waste sites	Closure of a municipal solid waste site	40 CFR 258.60(a)	2	Relevant and Appropriate	Requriements are relevant and appropriate because there are no provisions for open dumps in the state of Virginia that apply to open dumps. These requriements are not applicable to facilities that did not receive waste after 1991.

TABLE B-6

Virginia Action-Specific ARARs

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Erosion and Sediment Control						
Erosion and deposits of soil/sediment caused by land disturbing activities	Regulations for the effective control of soil erosion, sediment deposition and nonagricultural runoff which must be met in any control program to prevent the unreasonable degradation of properties, stream channels, waters and other natural resources.	Construction activities that will disturb more than 10,000 square feet of land.	4 VAC 50-30-40(1); (2); (3); (4); (17); (18); (19)(h), (i)	2, 3	Relevant and Appropriate	The site covers less than 10,000 square feet, but erosion control measures will be implemented for the construction activities.
	Establishes required plans and best management practices to prevent storm water pollution from discharges related to construction activity. Properties and receiving waterways downstream of any land-disturbing activity shall be protected from erosion and damage due to changes in runoff rate of flow and hydrologic characteristics, including but not limited to, changes in volume, velocity, frequency, duration, and peak flow rate of stormwater runoff.	Construction activities that will disturb more than one acre of land or that have a the potential to significantly contribute to a violation of a water quality standard or for significant contribution of pollutants to surface waters.	Stormwater Management Regulations, 4 VAC 50-60-300 (4), 310(A), 310(B), 380(A)(8)(2), 380(B)(1), 420, 1170, 1180, 1182, and 1186	2, 3	Relevant and Appropriate	Site activities have the potential to impact to the downgradient unnamed tributary and wetland. Storm water pollution prevention best management practices will be implemented during construction.
Fugitive Dust Control						
Generation of fugitive dust	Regulations regarding reasonable precautions to prevent particulate matter from becoming airborne.	Conducting any activity which may cause particulate matter to become airborne.	9 VAC 5-50-90	2 , 3	Applicable	Dust control measures will be implemented during activities at the site.
Waste Management						
Management of non-hazardous solid waste in containers	Establishes standards and procedures pertaining to the management of non-hazardous solid wastes in containers. Nonputrescible wastes must be stored in appropriate containers and not staged for more than 90 days.	Generation of non-hazardous solid waste that is managed onsite in containers.	9 VAC 20-81-95(D)(10)(b)	3	Applicable	It is anticipated that some wastes (such as decontamination fluids) may be generated and managed onsite in containers. Based on the analytical results from previous investigations, it is expected that these wastes will be non-hazardous solid waste. Wastes will be characterized prior to offsite disposal.

TABLE B-6

Virginia Action-Specific ARARs

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Management of non-hazardous solid waste in waste piles	Establishes standards and procedures pertaining to the construction,management, and closure of waste piles being used to manage non-hazardous solid wastes.	Generation of non-hazardous solid waste that is managed onsite in piles.	9 VAC 20-81-330(F), 340(F), 360(1)(a)	3	Applicable	It is anticipated that soil will be excavated and managed in a waste pile prior to disposal offsite. Based on the analytical results from previous investigations, it is anticipated that excavated soil will be characterized as non-hazardous solid waste. The regulations are relevant and appropriate because waste will be consolidated within the existing area of contamination and a new unit will not be established. Soil will be characterized prior to disposal offsite.
Accumulation of hazardous waste in containers onsite for less than 90 days	Hazardous waste may be accumulated on site in containers for up to 90 days so long as the containers are in good condition, compatible with the waste being stored, and labeled with the words “Hazardous Waste” and the date that accumulation began. The containers must also be kept closed unless adding or removing waste and inspected weekly.	Accumulation of hazardous waste in containers onsite.	9 VAC 20-60-262 only as it incorporates 40 CFR 262.34 (a) (1)(i), (2), (3)	2,3	Applicable	This requirement is only applicable if hazardous waste is generated and managed onsite in containers. Containers will be managed in accordance with these requirements.
Accumulation and/or treatment of hazardous waste in staging piles onsite	A staging pile must me designed constructed and maintained to prevent the migration of hazardous constituents other media. The design must consider location, hydrogeology, and any other factors that may reasonably influence the migration of hazardous constituents. Closure requirements are also included.	Accumulation or treatment of hazardous wastes in staging piles onsite	9 VAC 25-840-40(1); (2); (3); (4); (17); (18); (19)(h), (i) [these are covered under the "et seq" of 9-VAC-25-840-10 et seq] and 9 VAC 25-870-54 (A, B and D), 55 (B)(1-8)	2, 3	Applicable	This requirement is only applicable if hazardous waste is generated and managed onsite in staging piles. Piles will be designed and managed in accordance with these requirements.

Appendix C
Cheatham Annex Consensus Statement #01-08-15-49

CHEATHAM ANNEX CONSENSUS STATEMENT

CONSENSUS STATEMENT # 01-08-15-49 **Site Name:** All CAX ER Sites

Date: January 8, 2015

Site Description:

This consensus statement applies to all current and future Cheatham Annex (CAX) Environmental Restoration (ER) sites, but is not retroactive to CAX ER sites that have had previous remedial/removal actions and/or are closed.

Consensus Topic:

This consensus statement has been prepared to ensure that fill material used as backfill at CAX ER sites is properly sampled to document that it is "clean" and appropriate for onsite placement at CAX. This consensus statement is applicable only to terrestrial areas. Aquatic and wetland backfill requirements will be handled on a site-specific basis.

Consensus Statement:

Fill material suitable for use as backfill at CAX ER sites undergoing remedial action is limited to topsoil and backfill material (collectively referred to in this document as fill material) in compliance with ASTM D2487 *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)* (ASTM International, 2011). Specifically, suitable fill material from soil classification groups GW, GP, GM, SW, SP, SM, SC, and ML[i], or any combination of these groups, that is free of the following: rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. To ensure that potentially suitable fill material obtained from off-base sources and/or from sources within the base that are outside of the boundaries of the proposed site (on-base sources) for placement is "clean," all fill material will be analyzed at an environmental laboratory for the specific parameters listed below in Table 1, prior to consideration for transport to, and use at, any CAX ER site.

Table 1
Fill Material Sampling Parameters

Constituent	Analytical Method
TCL VOCs	EPA SW-846 Method 8260B
TCL SVOCs	EPA SW-846 Method 8270C
TCL Pesticides	EPA SW-846 Method 8081
PCBs	EPA SW-846 Method 8082
Explosives	EPA SW-846 Method 8330B
Herbicides	EPA SW-846 Method 8151
Total Petroleum Hydrocarbons	EPA 600/4-79/020 Method 418.1
Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)	EPA SW-846.3-3 Method 5030/8020
TAL Metals (including mercury and cyanide)	SW-846 3050B/6010C/6020A/7471A

Prior to bringing any backfill material to a CAX ER site, the CAX Tier 1 Partnering Team must agree the fill material is "clean" based on the sampling results and is suitable for use at the CAX ER site. The remedial/removal action contractor will collect samples of the fill material (at the source, whether it be from an on-base or off-base source) for laboratory analyses (Table 1 parameters), prior to consideration for transport to the CAX ER site. One sample per fill material type per source will be collected. Each collected sample will be a five-point composite sample that is representative of the fill material to be consideredfor transportation to, and use at, the CAX ER site. Alternatively, if fill material is from an off-base source, the fill material provider may provide the remedial/removal action contractor with fill material analytical results; however, they must provide results for a five-point composite sample that is representative of the fill material to be transported to CAX, and was analyzed within one year of the date of transport to CAX, for the parameters listed in Table 1.

Upon receipt of the analytical data, a chemist (Navy and/or contractor) will review the data to ensure their usability. The remedial/removal action contractor will prepare a table comparing the fill material analytical results to the screening values listed in Tables 2 and 3 (attached). The comparison table will then be forwarded to the CAX Navy RPM, who will forward the results to the CAX Tier 1 Partnering Team for review. Within two workdays of receipt of the analytical results, the CAX Tier 1 Partnering Team will collaborate (via email and/or conference call) and decide if the proposed fill material is "clean" and can be used as backfill at the CAX ER site. The CAX Tier 1 Partnering Team will use the decision analysis outlined in Figure 1 (attached) to determine if the fill material can be used at the CAX ER site; however, ultimately, it will be at the discretion of the CAX Tier 1 Partnering Team to accept or reject usability of "clean" fill at the CAX ER site.

Upon CAX Tier 1 Partnering Team agreement on the use of fill material, the Team will document their agreement in an email and forward it to the remedial/removal action contractor for notification that they may proceed with transporting and using the fill material at the CAX ER site. The remedial/removal action contractor's Construction Closeout Report will include the fill material analytical results, a comparison of these results to the screening values listed in Tables 2 and 3, text that reflects that the analytical results were evaluated, and the CAX Tier 1 Partnering Team's agreement the material is "clean" and suitable for use.

CAX Tier 1 Partnering Team:

NAME	ORGANIZATION	SIGNATURE & DATE
Scott Park	NAVFAC Mid-Atlantic	Scott R. Park 1-9-15
Gerald Hoover	USEPA Region III	Gerald F. Hoover 1/12/15
Wade Smith	VDEQ	01/14/2015
Marlene Ivester	CH2M HILL	Digitally signed by Marlene Ivester DN: cn=Marlene Ivester, o=CH2M HILL, ou, email=marlene.ivester@ch2m.com, c=US Date: 2015.01.15 12:27:11 -05'00'
Stephanie Sawyer	CH2M HILL	Digitally signed by Stephanie Sawyer DN: cn=Stephanie Sawyer, o=CH2M HILL, ou, email=stephanie.sawyer@ch2m.com, c=US Date: 2015.01.15 12:29:45 -05'00'

ASTM International. 2011. *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*. Designation: D-2487-11 (current version). Available at: www.astm.org (or earlier versions available for free on the Internet).

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Soil Classification[1]	
Group Symbol	**Group Name**
GW	Well-graded gravel
GP	Poorly graded gravel
GM	Silty gravel
SW	Well-graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt

[1]From Table 1 (Soil Classification Chart) of ASTM D2487; the table provides a more detailed description of each type.

Table 2
Backfill Screening Criteria - Organic Compounds
Cheatham Annex
Williamsburg, Virginia

Chemical Name	BTAG (EPA Region 3 Eco Protective Backfill Value)	Residential Soil RSL	Backfill Screening Criterion
Volatile Organic Compounds (UG/KG)			
1,1,1-Trichloroethane	--	640,000	640,000
1,1,2,2-Tetrachloroethane	--	600	600
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	--	910,000	910,000
1,1,2-Trichloroethane	--	150	150
1,1-Dichloroethane	--	3,600	3,600
1,1-Dichloroethene	--	23,000	23,000
1,2,3-Trichlorobenzene	--	4,900	4,900
1,2,4-Trichlorobenzene	20,000	5,800	5,800
1,2-Dibromo-3-chloropropane	--	5.3	5.3
1,2-Dibromoethane	--	36	36
1,2-Dichlorobenzene	--	180,000	180,000
1,2-Dichloroethane	--	460	460
1,2-Dichloropropane	--	1,000	1,000
1,4-Dichlorobenzene	20,000	2,600	2,600
2-Butanone	--	2,700,000	2,700,000
2-Hexanone	--	20,000	20,000
4-Methyl-2-pentanone	--	530,000	530,000
Acetone	--	6,100,000	6,100,000
Benzene	--	1,200	1,200
Bromochloromethane	--	15,000	15,000
Bromodichloromethane	--	290	290
Bromoform	--	67,000	67,000
Bromomethane	--	680	680
Carbon disulfide	--	77,000	77,000
Carbon tetrachloride	--	650	650
Chlorobenzene	50	28,000	50
Chloroethane	--	1,400,000	1,400,000
Chloroform	--	320	320
Chloromethane	--	11,000	11,000
cis-1,2-Dichloroethene	--	16,000	16,000
cis-1,3-Dichloropropene	--	1,800	1,800
Cyclohexane	--	120,000	120,000
Dibromochloromethane	--	730	730
Dichlorodifluoromethane (Freon-12)	--	8,700	8,700
ETHYL BENZENE	50	--	50
Isopropylbenzene	--	190,000	190,000
m- and p-Xylene	--	55,000	55,000
Methyl acetate	--	7,800,000	7,800,000
Methylene chloride	--	35,000	35,000
Methyl-tert-butyl ether (MTBE)	--	47,000	47,000
o-Xylene	--	65,000	65,000
Styrene	100	600,000	100
Tetrachloroethene	--	8,100	8,100
Toluene	50	490,000	50
trans-1,2-Dichloroethene	--	160,000	160,000
trans-1,3-Dichloropropene	--	1,800	1,800
Trichloroethene	--	410	410
Trichlorofluoromethane (Freon-11)	--	73,000	73,000
Vinyl chloride	--	59	59
Xylene, total	50	58,000	50

Table 2
Backfill Screening Criteria - Organic Compounds
Cheatham Annex
Williamsburg, Virginia

Chemical Name	BTAG (EPA Region 3 Eco Protective Backfill Value)	Residential Soil RSL	Backfill Screening Criterion
Semivolatile Organic Compounds (UG/KG)			
1,1-Biphenyl	60,000	4,700	4,700
1,2,4,5-Tetrachlorobenzene	--	1,800	1,800
1,4-Dioxane	--	5,300	5,300
2,2'-Oxybis(1-chloropropane)	--	4,900	4,900
2,3,4,6-Tetrachlorophenol	20,000	180,000	20,000
2,4,5-Trichlorophenol	4,000	620,000	4,000
2,4,6-Trichlorophenol	9,000	6,200	6,200
2,4-Dichlorophenol	20,000	18,000	18,000
2,4-Dimethylphenol	--	120,000	120,000
2,4-Dinitrophenol	20,000	12,000	12,000
2,4-Dinitrotoluene	--	1,700	1,700
2,6-Dinitrotoluene	--	360	360
2-Chloronaphthalene	--	630,000	630,000
2-Chlorophenol	7,000	39,000	7,000
2-Methylnaphthalene	--	23,000	23,000
2-Methylphenol	--	310,000	310,000
2-Nitroaniline	--	61,000	61,000
2-NITROPHENOL	7,000	--	7,000
3- and 4-Methylphenol	--	310,000	310,000
3,3'-Dichlorobenzidine	--	1,200	1,200
4,6-Dinitro-2-methylphenol	--	490	490
4-Chloro-3-methylphenol	--	620,000	620,000
4-Chloroaniline	20,000	2,700	2,700
4-Nitroaniline	--	25,000	25,000
4-NITROPHENOL	7,000	--	7,000
Acenaphthene	20,000	350,000	20,000
Acenaphthylene	--	350,000	350,000
Acetophenone	--	780,000	780,000
Anthracene	100	1,700,000	100
Atrazine	--	2,300	2,300
Benzaldehyde	--	780,000	780,000
Benzo(a)anthracene	--	150	150
Benzo(a)pyrene	100	15	15
Benzo(b)fluoranthene	--	150	150
Benzo(k)fluoranthene	--	1,500	1,500
bis(2-Chloroethoxy)methane	--	18,000	18,000
bis(2-Chloroethyl)ether	--	230	230
bis(2-Ethylhexyl)phthalate	--	38,000	38,000
Butylbenzylphthalate	--	280,000	280,000
Caprolactam	--	3,100,000	3,100,000
Chrysene	--	15,000	15,000
Dibenz(a,h)anthracene	--	15	15
Dibenzofuran	--	7,200	7,200
Diethylphthalate	100,000	4,900,000	100,000
DIMETHYLPHTHALATE	200,000	--	200,000
Di-n-butylphthalate	200,000	620,000	200,000
Di-n-octylphthalate	--	62,000	62,000
Fluoranthene	100	230,000	100
Fluorene	30,000	230,000	30,000
Hexachlorobenzene	--	330	330
Hexachlorobutadiene	--	6,200	6,200
Hexachlorocyclopentadiene	10,000	37,000	10,000
Hexachloroethane	--	4,300	4,300
HMW PAHs	11,000	--	11,000
Indeno(1,2,3-cd)pyrene	--	150	150
Isophorone	--	560,000	560,000
LMW PAHs	29,000	--	29,000
Naphthalene	100	3,800	100
Nitrobenzene	40,000	5,100	5,100
n-Nitroso-di-n-propylamine	--	76	76
n-Nitrosodiphenylamine	20,000	110,000	20,000
Pentachlorophenol	5,000	990	990
Phenanthrene	100	--	100
Phenol	30,000	1,800,000	30,000
Pyrene	100	170,000	100

Table 2
Backfill Screening Criteria - Organic Compounds
Cheatham Annex
Williamsburg, Virginia

Chemical Name	BTAG (EPA Region 3 Eco Protective Backfill Value)	Residential Soil RSL	Backfill Screening Criterion
Pesticide/Polychlorinated Biphenyls (UG/KG)			
4,4'-DDD	210	2,200	210
4,4'-DDE	210	1,600	210
4,4'-DDT	210	1,900	210
Aldrin	--	31	31
alpha-BHC	--	85	85
alpha-Chlordane	--	1,800	1,800
Aroclor-1016	--	400	400
Aroclor-1221	--	150	150
Aroclor-1232	--	150	150
Aroclor-1242	--	240	240
Aroclor-1248	--	240	240
Aroclor-1254	--	110	110
Aroclor-1260	--	240	240
beta-BHC	--	300	300
delta-BHC	--	300	300
Dieldrin	49	33	33
Endosulfan I	--	37,000	37,000
Endosulfan II	--	37,000	37,000
Endosulfan sulfate	--	37,000	37,000
Endrin	--	1,800	1,800
Endrin aldehyde	--	1,800	1,800
Endrin ketone	--	1,800	1,800
gamma-BHC (Lindane)	--	560	560
gamma-Chlordane	--	1,800	1,800
Heptachlor	--	120	120
Heptachlor epoxide	--	59	59
Methoxychlor	--	31,000	31,000
Total PCBs	371	240	240
Toxaphene	--	480	480
Herbicides (UG/KG)			
2,4,5-T	--	62,000	62,000
2,4,5-TP (Silvex)	--	49,000	49,000
2,4-D	--	69,000	69,000
2,4-DB	--	49,000	49,000
Dalapon	--	180,000	180,000
Dicamba	--	180,000	180,000
Dinoseb	--	6,200	6,200
MCPA	--	3,100	3,100
MCPP	--	6,200	6,200
Explosives (UG/KG)			
1,3,5-Trinitrobenzene	--	220,000	220,000
1,3-Dinitrobenzene	--	620	620
2,4,6-Trinitrotoluene	--	3,600	3,600
2-Amino-4,6-dinitrotoluene	--	15,000	15,000
2-Nitrotoluene	--	3,200	3,200
3-Nitrotoluene	--	620	620
4-Amino-2,6-dinitrotoluene	--	15,000	15,000
4-Nitrotoluene	--	25,000	25,000
HMX	--	380,000	380,000
Nitroglycerin	--	620	620
PETN	--	12,000	12,000
RDX	--	6,000	6,000
Tetryl	--	12,000	12,000
9VAC20-80-700(D)(5) (MG/KG)	**SCREENING CONCENTRATION**		
BTEX (EPA SW-846.3-3 Method 5030/8020)	10		
TPH (EPA 600/4-79/020 Method 418.1)	50		

Notes:
MG/KG - Milligrams per kilogram
UG/KG - Micrograms per kilogram

Table 3
Backfill Screening Criteria - Metals
Cheatham Annex
Williamsburg, Virginia

Chemical Name	CLEAN CAX 95% UTL BKG SB	CLEAN CAX 95% UTL BKG SS	Residential Soil RSL	BTAG (EPA Region 3 Eco Protective Backfill Value)	Backfill Screening Criterion*	Backfill Screening Criterion, Including Background
Total Metals (MG/KG)						
Aluminum	13,000	12,200	7,700	pH < 5.5	7,700	13,000
Antimony	--	11.0	3.1	2.7	2.7	11.0
Arsenic	5.54	6.36	0.67	18	0.67	6.36
Barium	84.5	52.9	1,500	330	330	330
Beryllium	0.52	0.587	16	40	16	16
Cadmium	--	1.50	7	3.6	3.6	3.6
Calcium	2,380	2,290	--	--	--	2,380
Chromium	33.7	18.2	0.3	260	0.3	33.7
Cobalt	5.18	9.93	2.3	13	2.3	9.93
Copper	3.17	4.25	310	70	70	70.0
Cyanide	2.70	--	2.1	5	2.1	2.70
Iron	32,000	19,900	5,500	2,000	2,000	32,000
Lead	8.79	17.4	400	110	110	110
Magnesium	1,120	1,070	--	--	--	1,120
Manganese	176	324	180	220	180	324
Mercury	0.14	0.111	2.3	0.00051	0.00051	0.14
Nickel	17.6	9.52	150	38	38	38.0
Potassium	901	708	--	--	--	901
Selenium	0.64	0.51	39	0.5	0.5	0.64
Silver	1.10	2.10	39	42	39	39.0
Sodium	811	521	--	--	--	811
Thallium	--	--	0.078	1.00	0.078	0.078
Vanadium	48.3	27.9	39	78	39	48.3
Zinc	28	26.5	2,300	120	120	120

*Backfill Screening Criterion if the background UTL is exceeded

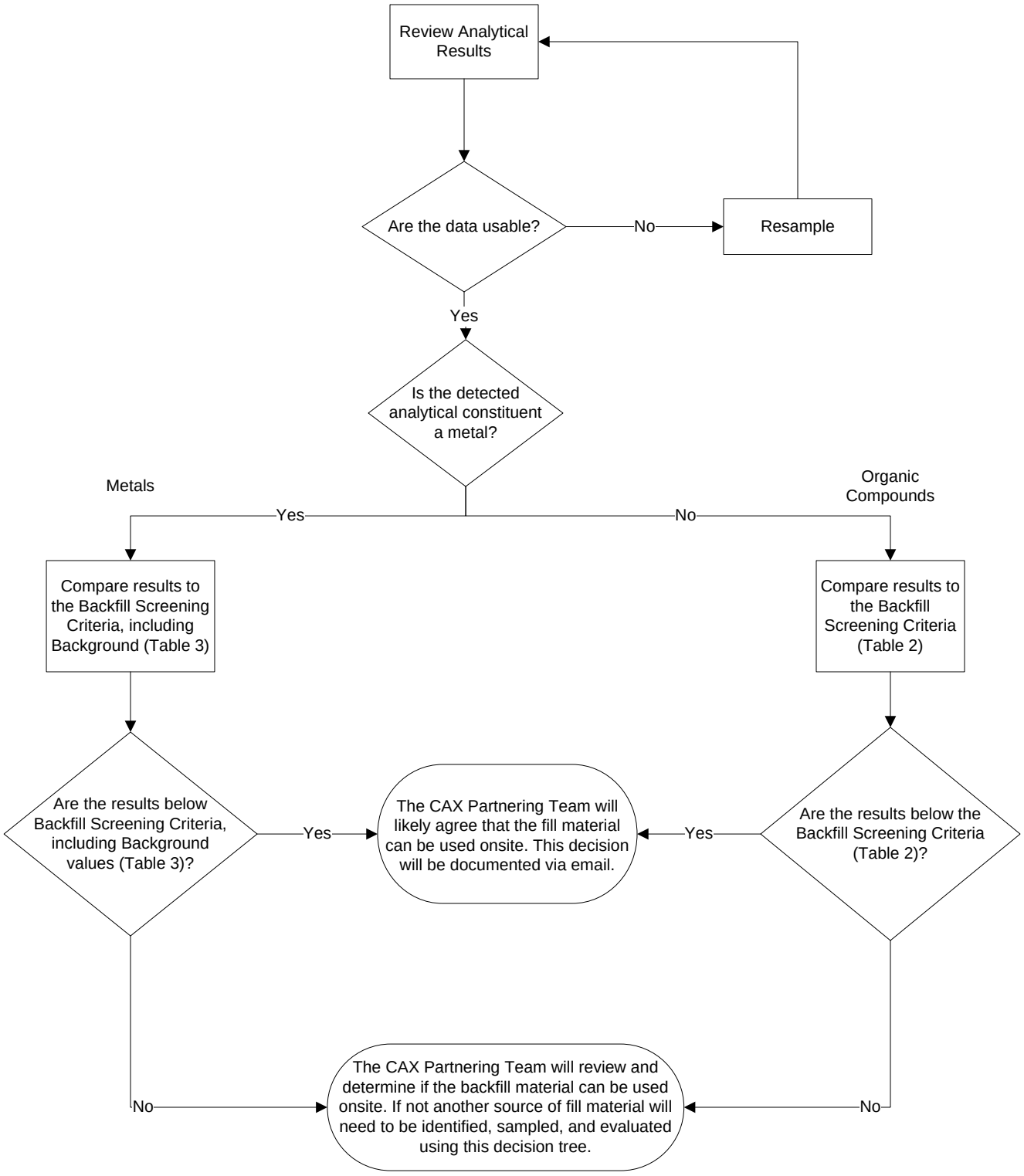


Figure 1
Clean Fill Decision Tree
Cheatham Annex
Williamsburg, Virginia

Appendix D
SiteWise Evaluation

APPENDIX D

Sustainability Analysis for AOC 2 – Dextrose Dump

Introduction

This appendix presents the approach taken and results obtained from a sustainability analysis performed for Area of Concern (AOC) 2 – Dextrose Dump, Cheatham Annex (CAX), Williamsburg, Virginia. A site description and history of AOC 2 is provided in the Engineering Evaluation/Cost Analysis (EE/CA). The following removal actions were developed to address potential risks to human health and the environment from exposure to impacted surface soil and subsurface debris. A detailed summary of the removal actions is provided in the EE/CA.

- Alternative 1 – No Action
- Alternative 2 – Removal and Offsite Disposal
- Alternative 3 – Low Permeability Soil Cover

The purpose of this analysis is to provide a quantitative assessment of the potential environmental and social impact of each removal action. The sustainability analysis was performed using SiteWise Version 3.0 (Battelle, 2013) for Alternatives 2 and 3. Although the No Action alternative (Alternative 1) has no actions that would impact sustainability, it is not considered a viable alternative and will not be further discussed in this analysis.

Method and Assumptions

The SiteWise tool consists of a series of Excel-based spreadsheets used to conduct a baseline assessment of sustainability metrics. The assessment is carried out using a spreadsheet-based building block approach, where every remedial alternative can be broken down into components for discrete phases of work (such as construction, operation, long-term monitoring), or different systems for more complex remedial actions.

SiteWise uses various emission factors from governmental or non-governmental research sources to determine the environmental impact of each activity. The quantitative metrics calculated by the tool include:

1) Greenhouse gases (GHGs) reported as metric tons of carbon dioxide equivalents (CO_2e), consisting of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)
2) Energy usage (expressed as millions of British Thermal Units [MMBTU])
3) Water usage (gallons of water)
4) Air emissions of criteria pollutants consisting of metric tons of nitrogen (NO_x), sulfur oxides (SO_x), and particulate matter (PM_{10})
5) Accident risk (risk of injury and risk of fatality)

For the purpose of this discussion the term footprint will be used to describe the quantified emissions or quantities for each metric. To estimate the sustainability footprint for each removal action alternative, only those elements possessing important sustainability impacts were included in the assessment. A lower footprint indicates lower deleterious impacts to environmental and social metrics, which collectively make up the SiteWise sustainability metrics. Conversely, a higher footprint indicates higher deleterious impacts associated with the SiteWise metrics. The major conclusions of this sustainability analysis are incorporated into the effectiveness criteria evaluation of the EE/CA.

The following is a description of the major activities for each alternative.

- Alternative 2 –Removal and Offsite Disposal
  - Production of soil for backfilling (industry averages for heavy equipment operation to dig soil from the ground)
  - Transportation of personnel and equipment for excavation and backfilling activities

  - Equipment use to excavate impacted soil and backfill excavated area
  - Transportation and disposal of residuals to hazardous (for respirator cartridges) and non-hazardous landfills
  - Onsite labor hours for estimate of accident risks during excavation and backfilling activities
- Alternative 3 – Low Permeability Soil Cover
  - Production of soil for cover (industry averages for heavy equipment operation to extract soil from the ground)
  - Transportation of personnel and equipment for cover installation activities
  - Equipment use to install cover
  - Onsite labor hours for estimate of accident risks during cover installation
  - Cover Maintenance – includes quarterly inspections for 2 years, annual inspections for 28 years, and minor cover repairs

General Assumptions

The specific assumptions made for the individual remedies are presented in **Tables C-1** and **C-2**. The following general assumptions are used for the SiteWise tool evaluation:

- The complete environmental footprint for production of equipment used, or production of the vehicles used for transportation, is not considered in this analysis.
- Daily local transportation is assumed to consist of 25 miles of driving a light duty truck per day.
- Water use is approximately 500 gallons per day for dust control.
- Nonhazardous landfill is located 50 miles away from the site.
- Hazardous waste landfill is located 300 miles away from the site.
- The environmental impacts associated with the life cycle of the landfill are not included, as reliable footprint factors are not available for this element of the project
- Negligible waste will be generated for long-term monitoring.
- The following weights and distance for delivery are used for equipment:
  - Bulldozer, Loader, off-road dump truck – 20 tons, 50 miles round trip
  - Excavator – 30 tons, 50 miles round trip

Results and Conclusions

A comparative analysis for Alternatives 2 and 3 is summarized in **Figure C-1**. **Table C-3** presents a comparison of the quantitative environmental footprint metrics evaluated for each of the removal action alternatives. Alternative 3 had lower footprints for all of the sustainability metrics compared with Alternative 2 because it involves less transportation of materials and waste. Even with long-term maintenance and monitoring, Alternative 3 has a significantly smaller footprint than Alternative 2.

A qualitative relative impact summary is also provided in **Table C-3**. The relative impact is a qualitative assessment of the relative footprint of each alternative, a rating of high, medium, or low is assigned to each alternative based on its performance against the other alternatives. The tool assigns a ranking of high to the highest footprint in each category and assigns the rankings of other alternatives based on the difference in the data between alternatives. The ranking is based on a 30 percent difference, for example, if the footprints of two alternatives are within 30 percent of each other they will be given the same rating. This allows for some uncertainty inherent in the assumptions used in the model.

It should be noted that while this analysis compares the environmental footprints of each of the alternatives, the alternatives may differ with respect to other evaluation criteria. Therefore, a comparison of the results of the alternatives needs to be made in the context of the benefits (e.g., ARAR compliance, contaminant reduction, site reuse, cost effectiveness, and etc.) of each of the alternatives. In this case, Alternative 2 results in removal of the waste from the site, whereas Alternative 3 involves waste being managed onsite.

The following is a summary of the individual alternatives:

Alternative 2 — Removal and Offsite Disposal

GHG and Energy Use – The majority of the GHG and energy use was associated with material production and waste disposal. Material production and residual handling contributed approximately 90 percent of the total potential GHG and energy use footprints. Personnel, material, and equipment transportation, and equipment use contributed slightly more than 10 percent of the GHG and energy footprints combined.

Criteria Air Pollutants (NO_X, SO_X, PM_{10}) – Similar to GHG and energy use, the majority of the criteria air pollutant footprints were from material production and waste disposal activities. Material production accounted for over 50 percent of the NO_X, over 75 percent of the SO_X, and approximately 20 percent of the PM_{10} footprints. Waste handling accounted for almost 40 percent of the NO_X, approximately 20 percent of the SO_X, and over 75 percent of the PM_{10} footprints.

Accident Risks – The majority of each accident risk footprint (risk of injury and risk of fatality) are from onsite labor hours which contributes approximately 30 and 60 percent of the injury and fatality footprints, respectively, and waste management and disposal which contributes approximately 50 and 30 percent of the injury and fatality footprints, respectively. Transportation of personnel contributes approximately 5 and 3 percent of the injury and accident risk footprints and transportation of equipment/materials contributes approximately 10 and 6 percent.

Water Use – all of the water use was accounted for under equipment use and miscellaneous. The water use footprint is from dust suppression during removal and backfilling activities.

Results are provided in **Table C-4** and **Figure C-1**.

Alternative 3 – Low Permeability Soil Cover

GHG and Energy Use – More than 85 percent of the GHG and energy footprints are from construction of the cover with approximately 15 percent contribution from cover maintenance. Approximately 60 to 70 percent of the potential GHG and energy use footprints are from material production. Material and equipment transportation and equipment use each contributed approximately 5 to 15 percent of the remaining GHG and energy footprints. Less than 2 percent of each footprint is from personnel transportation.

Criteria Air Pollutants (NO_X, SO_X, PM_{10}) – More than 90 percent of the criteria air pollutant footprints are from construction of the cover. Approximately 75 percent of the NO_X footprint and 90 percent of the SO_X and PM_{10} footprints are from material production. Equipment transportation contributes slightly less than 15 percent of the NO_X footprints and less than 3 percent of the SO_X and PM_{10} footprints. Personnel transportation and material and equipment transportation each contribute less than 1 percent of the criteria air pollutant footprints. Cover maintenance contribute less than 10 percent of the total criteria air pollutant footprints.

Accident Risks – Approximately 45 percent of the fatality risk is from construction of the cover and the remaining 55 percent is from cover maintenance. The majority of the fatality footprint during the construction phase is from equipment use and onsite hours, whereas the majority of the cover maintenance is from personnel transportation with a lesser contribution from onsite labor hours. The distribution of the injury risk footprint is similar for construction of the cover but has a higher contribution from onsite labor hours for cover maintenance.

Results are provided in **Table C-5** and **Figure C-1**.

Uncertainty

The SiteWise tool calculates environmental and risk footprints based on industry averages, published emissions factors, and generalized data sources. The footprint results are not representative of actual emissions and should be used for comparative purposes only.

Recommendations

The estimates from the SiteWise tool were used to estimate the environmental footprint of the alternatives. Once the alternative is selected, it is recommended that the footprint of the selected alternative be further evaluated in the design phase of the projects to explore opportunities to optimize the environmental footprint of the project and integrate sustainable remediation best practices in the design, construction, and operation of the removal action.

If Alternative 2 is selected, a potential best practice may be sourcing a landfill or waste receptor that is closer to the site. If Alternative 3 is selected, potential best practices may include using equipment with emissions control devices or managing work such that engine idle time is minimized.

References

Battelle. 2013. *SiteWise Version 3*. NAVFAC Engineering Service Center. August.

Tables

TABLE D-1

Alternative 2 - Removal and Offsite Disposal

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Sitewise Tab	Assumptions
Removal Action Construction	**Debris and soil excavation, backfill (approximate values)**
Material Production - Fill/Backfill/Topsoil/Access Road	Access Road (gravel) - 200 square yard, 6 inches deep. 33 cy x 1.4 ton/cy = 50 tons Fill material (soil) - 1,525 cy x 1.5 ton/cy = 2,300 tons = 4,600,000 lbs Topsoil - 105 cy x 1.5 ton/cy = 160 tons = 320,000 lbs
Personnel Transportation - Road	Daily local travel: 5 people, 25 miles round trip, 13 days, 1 person per vehicle (65 total trips)
Equipment/Material Transportation - Road	General assumption: 25 miles one way, ~20 ton loads, diesel powered Fill Material - 2,300 tons total, 115 trips, 25 miles = 2,875 miles full, same empty Topsoil - 160 tons, 8 trips, 25 miles x 7 trips = 200 miles full, same empty Gravel - 50 tons, 3 trips, 17 tons each, 25 miles x 3 trips = 75 miles full, same empty Heavy Equipment to site - Excavator (30 tons), Dozer (20 tons), Front End Loader (20 tons) each transported 25 miles to site, 25 miles from site at end of work
Equipment Use	Vegetation Clearance - 12 hrs operation, internal combustion diesel engine with 3 gallon per hour fuel consumption Excavator - remove 1,300 cy material Dozer - backfill 1,525 cy fill, 105 cy topsoil = 1,630 cy Front-end loader - assume moves all soil/gravel once - 1,630+33 = 1,663 cy material Grading (proxy roller) - 629 sy x 9 = 5,700 sf
IDW transportation/disposal	1,700 tons of nonhazardous soil to landfill located 50 miles away, 85 trips, 20 tons each 300 tons hazardous waste to landfill located 300 miles away, 15 trips, 20 tons (empty return trips to site)
Labor Hours Onsite	800 hours (assumes 13 x 10 hr days to complete - 1 site superintendent, 2 heavy equipment operator, 2 laborers, 1 health and safety manager, 20 hrs confirmation sampling) - all construction laborers

TABLE D-2

Alternative 3 - Low Permeability Soil Cover

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Sitewise Tab	Assumptions
Removal Action Construction	**Cover installation, hot spot excavation, backfill, LUCs**
Material Production - Cover/Access Road	Access Road (gravel) - 200 square yard, 6 inches deep. 33 cy x 1.4 ton/cy = 50 tons Fill material for cover (soil) - 285 cy x 1.5 ton/cy = 430 tons = 860,000 lbs
	Topsoil - 95 cy x 1.5 ton/cy = 140 tons = 280,000 lbs
Personnel Transportation - Road	Daily local travel: 5 people, 25 miles round trip, 5 days, 1 person per vehicle (25 total trips)
Equipment/Material Transportation - Road	General assumption: 25 miles one way, ~20 ton loads, diesel powered
	Fill Material - 430 tons total, 22 trips, 25 miles x 22 trips = 550 miles full, same empty
	Topsoil - 140 tons, 7 trips, 25 miles x 7 trips = 175 miles full, 175 miles empty Gravel - 50 tons, 3 trips, 17 tons each, 25 miles x 3 trips = 75 miles full, same empty Heavy Equipment to site - Dozer (20 tons), Front End Loader (20 tons), Roller (10 tons) each transported 25 miles to site, 25 miles from site at end of work
Equipment Use	Vegetation Clearance - 12 hrs operation, internal combustion diesel engine with 3 gallon per hour fuel consumption
	Front-end loader and Dozer - assume each moves all soil/gravel once - 285+95+33 = 413 cy material
	Roller - 456 sy x 2 passes x 9 sq ft per sy = 8,200 sf
Labor Hours Onsite	200 hours (assumes 4 x 10 hr days to complete - 1 site superintendent, 1 heavy equipment operator, 2 laborers, 1 health and safety manager) - all construction laborers
O&M Personnel Transportation - Road	2 years of quarterly inspections, annual groundwater LTM, 28 years of annual inspections Personnel transport: 1 vehicle, 2 people, 36 trips, 50 miles round trip (assume inspections completed at the same time as groundwater sampling)
Labor Hours Onsite	128 hours (assumes 1 x 10 hr day per inspection for quarterly, 2 x 10 hr days per sampling x 2 people) - all construction laborers
Cover repairs	20 tons soil every 10 years x 30 years = 120,000 lbs soil brought onsite for repairs Backhoe for repair (20 ton transport, 25 miles x 3 events = 75 miles) Backhoe use = ~13 cy per event x 3 events = 39 cy

Notes:
R/T = round trip

TABLE D-3

Quantitative and Relative Impact of Alternatives

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Quantative Impact

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Alternative 2 - Removal and Offsite Disposal	118	1,995	6,500	3.65E-01	3.33E-01	4.76E-01	2.52E-04	3.35E-02
Alternative 3 - Low Permeability Soil Cover	20	337	2,000	6.63E-02	7.06E-02	2.88E-02	7.39E-05	1.15E-02

Relative Impact

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
Alternative 2 - Removal and Offsite Disposal	High	High	High	High	High	High	High	High
Alternative 3 - Low Permeability Soil Cover	Low	Low	Low	Low	Low	Low	Low	Low

The relative impact is a qualitative assessment of the relative footprint of each alternative, a rating of High for an alternative is assigned if it is at least 70 percent of the maximum footprint, a rating of Medium is assigned if it is between 30 and 70 percent of the maximum footprint, and a rating of Low is assigned if it is less than 30 percent of the maximum footprint.

Notes:

MMBTU - million British Thermal Unit
NOx - Nitrogen Oxides
SOx - Sulfur Oxides
LUCs - land use controls
PM10 - Particulate Matter
GHG - Greenhouse Gases
NA - Not applicable

TABLE D-4

Alternative 2 - Removal and Offsite Disposal Results

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	Sox Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	52	965	NA	2.1E-01	2.6E-01	1.0E-01	NA	NA
	Transportation-Personnel	1	11	NA	3.7E-04	1.2E-05	5.3E-05	1.3E-05	1.0E-03
	Transportation-Equipment	11	142	NA	3.4E-03	6.0E-05	3.0E-04	2.6E-05	2.1E-03
	Equipment Use and Misc	2	31	6.5E+03	1.5E-02	3.3E-03	1.9E-03	7.7E-05	1.9E-02
	Residual Handling	52	847	NA	1.4E-01	6.9E-02	3.7E-01	1.4E-04	1.1E-02
	Total	**118**	**1,995**	**6.50E+03**	**3.65E-01**	**3.33E-01**	**4.76E-01**	**2.52E-04**	**3.35E-02**

Notes:
MMBTU - million British Thermal Unit
NOx - Nitrogen Oxides
SOx - Sulfur Oxides
PM10 - Particulate Matter
NA - Not Applicable
GHG - Greenhouse Gases

TABLE D-5

Alternative 3 - Low Permeability Soil Cover Results

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x E missions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Construction	Consumables	13	233	NA	5.1E-02	6.3E-02	2.5E-02	NA	NA
	Transportation-Personnel	0	4	NA	1.4E-04	4.5E-06	2.0E-05	4.9E-06	3.9E-04
	Transportation-Equipment	3	39	NA	9.3E-04	1.6E-05	8.3E-05	7.4E-06	6.0E-04
	Equipment Use and Misc	1	19	2,000	8.9E-03	1.0E-03	8.1E-04	2.1E-05	5.2E-03
	Residual Handling	0	0	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Subtotal	**17**	**295**	**2,000**	**6.07E-02**	**6.43E-02**	**2.62E-02**	**3.29E-05**	**6.18E-03**
Long-term Monitoring	Consumables	1	23	NA	5.0E-03	6.3E-03	2.5E-03	NA	NA
	Transportation-Personnel	1	13	NA	4.1E-04	1.3E-05	5.9E-05	2.8E-05	2.3E-03
	Transportation-Equipment	1	7	NA	1.6E-04	2.8E-06	1.4E-05	1.2E-06	9.4E-05
	Equipment Use and Misc	0	0	0	4.9E-05	1.1E-05	9.4E-06	1.2E-05	3.0E-03
	Residual Handling	0	0	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Subtotal	**3**	**42**	**0**	**5.63E-03**	**6.29E-03**	**2.59E-03**	**4.10E-05**	**5.31E-03**
	Total	**20**	**337**	**2,000**	**6.63E-02**	**7.06E-02**	**2.88E-02**	**7.39E-05**	**1.15E-02**

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

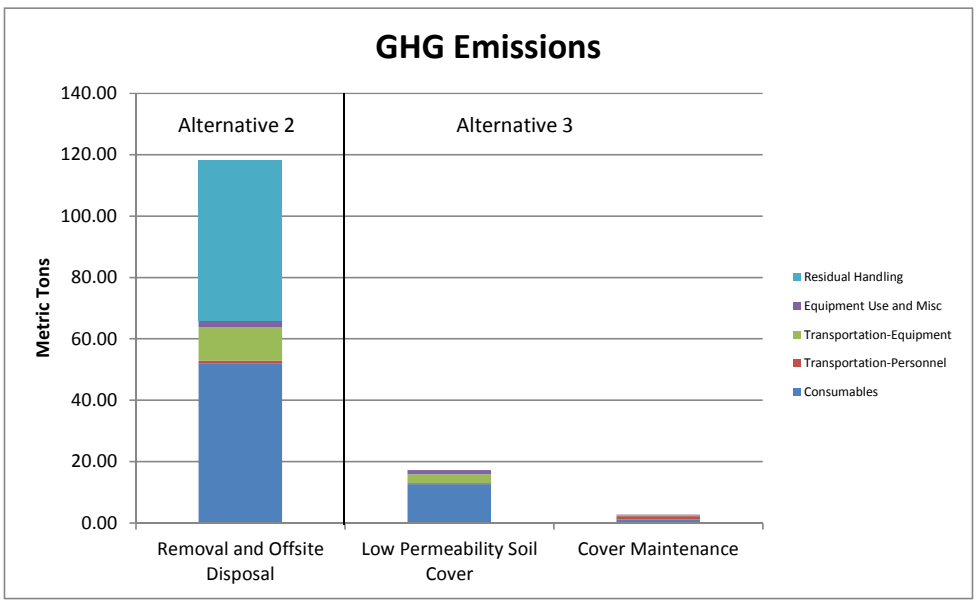
PM10 - Particulate Matter

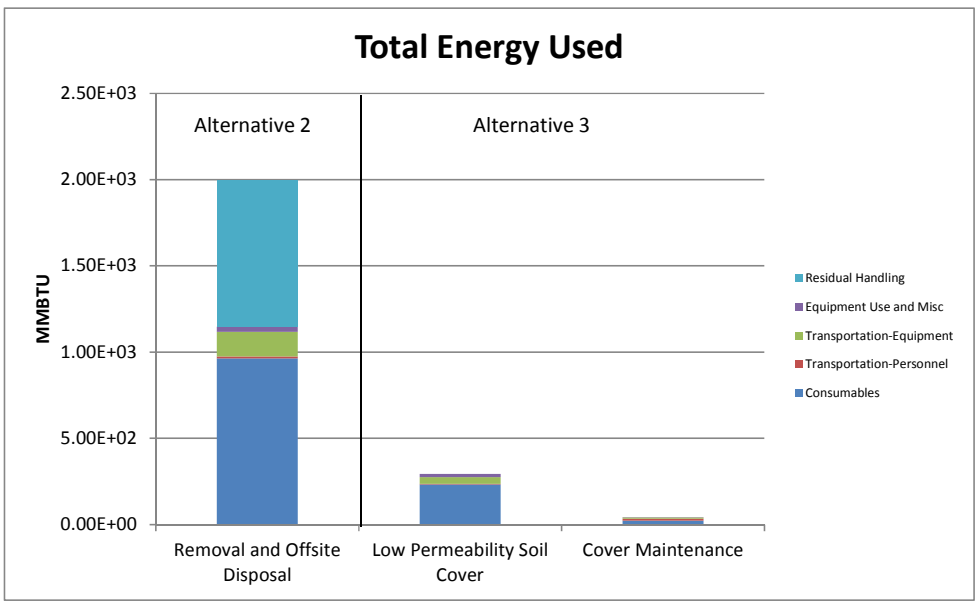
NA - Not Applicable

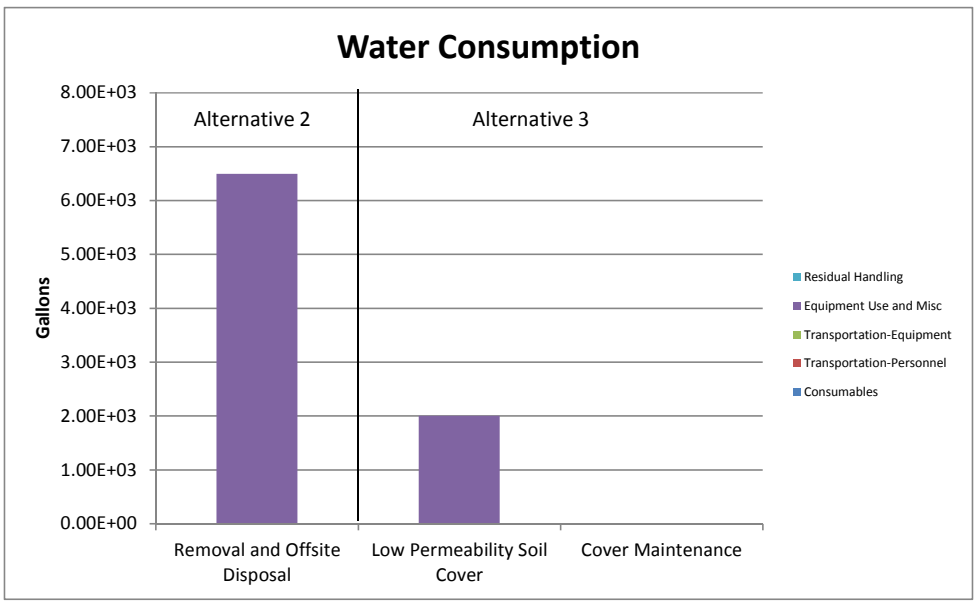
GHG - Greenhouse Gases

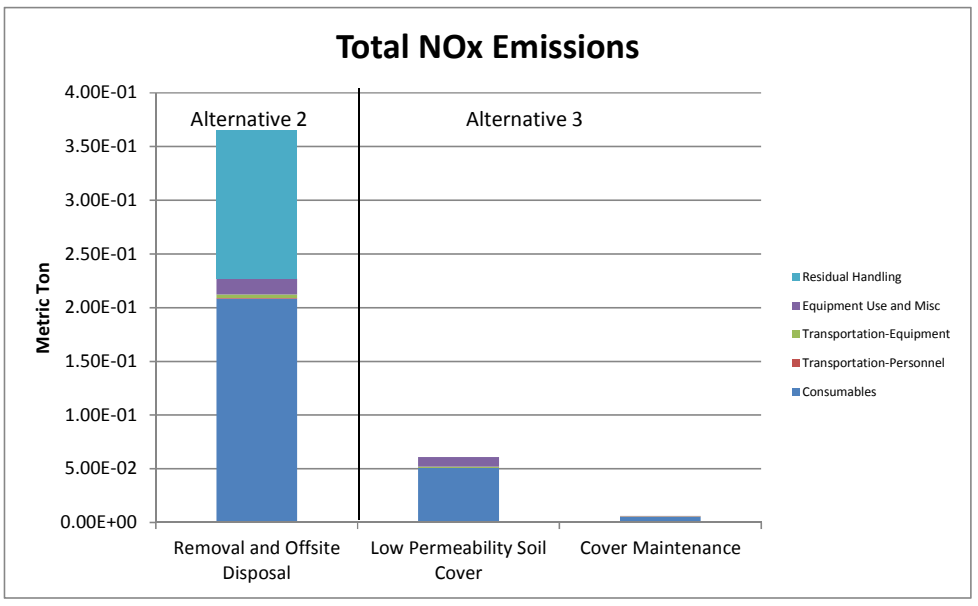
NA - not applicable

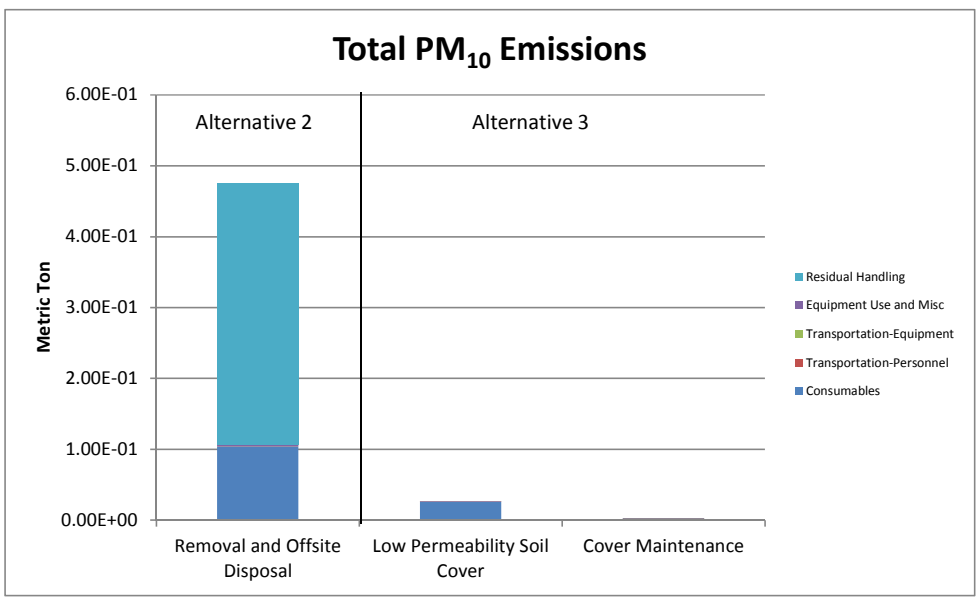
Figure

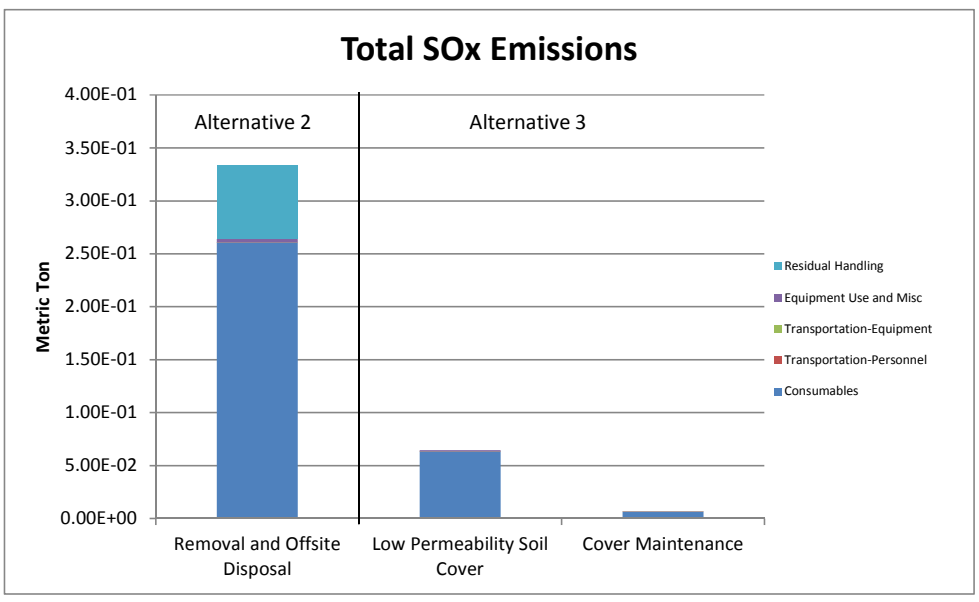


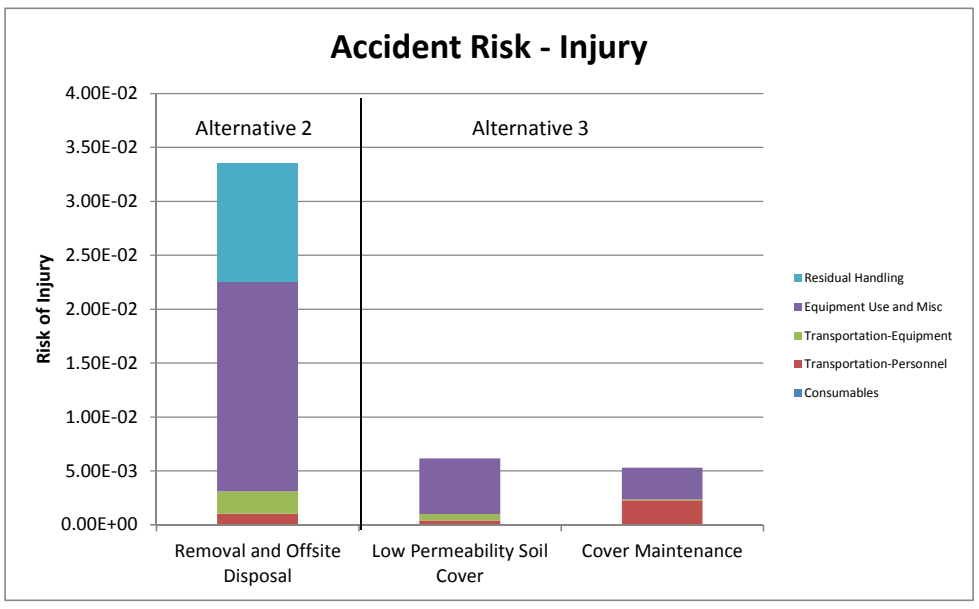


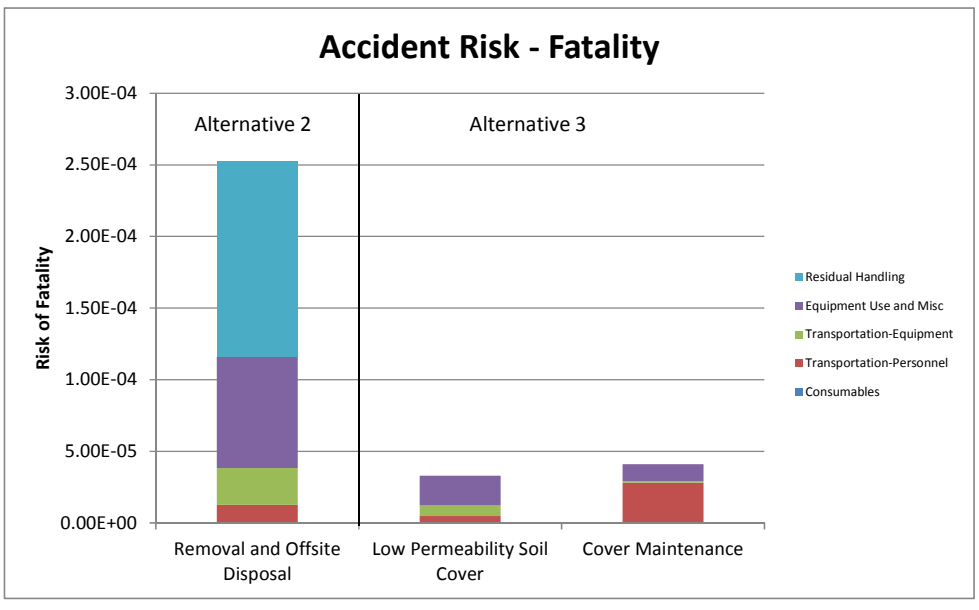












Alternative 2 - Removal and Offsite Disposal Results
Alternative 3 - Low Permeability Soil Cover Results

Figure C-1
Site Wise Results
Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump
Naval Weapons Station Yorktown Cheatham Annex
Williamsburg, Virginia

Appendix E
Cost Estimates

TABLE E-1

Engineer's Cost Estimate for Alternative 2: Removal and Offsite Disposal

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Description: Alternative 2 consists of excavation and offsite disposal of debris and impacted soil from Area 2 and backfilling Area 2 with imported clean fill material. A total of 978 yd ^{3} of material will be excavated from Area 2. The Area 2 removal area consists of a 2,300 ft ^{2} removal area at a depth of 6 ft bgs and a 1,400 ft ^{2} removal area at a depth of 9 ft bgs.

Description of Service/Items	Unit	Quantity	Unit Price	Total	Assumptions
Work Planning Documents					
Construction Work Plan	Lump Sum	1	$20,000.00	$20,000.00	Includes draft and final submission and Erosion and Sediment Control Plan
UFP-SAP	Lump Sum	1	$30,000.00	$30,000.00	Includes scoping plus pre-draft, draft, and final submission of UFP-SAP.
EM385 Health and Safety Plan	Lump Sum	1	$12,000.00	$12,000.00	Includes draft and final submission and AHAs
Construction Completion Report	Lump Sum	1	$20,000.00	$20,000.00	Includes draft and final submission
Work Planning Documents Total				***$82,000***	
Mobilization/Demobilization and Site Setup					
Mobilization/Demobilization	Each	2	$5,823.59	$11,647.17	Includes mobilization and demobilization of all equipment and materials necessary to perform the work. [RSMeans Crew #B-1, #B-10L, #B-10T, and #B-12A]
Construction Entrance Temporary Road	square yard	200	$15.34	$3,067.19	One 150'x12' and 6" thick with #1 VDOT stone. [RSMeans #01-55-23.50 (0100)]
Non-Hazardous Material Handling Area (for soil)	Lump Sum	1	$3,500.00	$3,500.00	Assumes 75' x 75' area. Includes impermeable liner, straw bale berm, sandbags, and 3" layer of sand over the impermeable liner to protect the liner; setup and removal included. Based on recent similar project.
Hazardous Material Handling Area (for respirator cartridges)	Lump Sum	1	$2,500.00	$2,500.00	Assumes 30' x 30' area. Includes impermeable liner, straw bale berm, and sandbags; setup and removal included. Based on recent similar project.
Material Staging Area for Fill Material	Lump Sum	1	$1,080.00	$1,080.00	Assumes 50' x 50' area. Includes silt fence; removal included.
Vegetation Clearance	Day	2	$5,800.00	$11,600.00	Includes all labor, equipment, and materials for clearing for material handling area, material staging area, and along Connector Road to provide space for construction entrance. Assumes all cleared vegetation remains onsite. Based on recent similar project.
Silt Fence	Linear Feet	275	$4.50	$1,237.50	Includes all labor, equipment, and materials. Assumes installation around Area 2 boundary. Based on quote from recent similar project.
Portable Toilet and Handwash Station	Week	4	$100.00	$400.00	Based on quote from recent similar project.
Trimble GPS	Week	1	$525.00	$525.00	For identifying soil removal areas. Based on quote from recent similar project.
Pre-Excavation Topographic Survey	Day	1	$3,160.00	$3,160.00	Assumes 1 10-hour day to complete the survey. Includes mobilization/demobilization, survey data evaluation/reporting, and all labor, equipment, and materials. Assumes 2-man surveying crew. BOA rates used.
Waste Characterization Sampling	Each	4	$1,257.70	$5,030.81	Assumes 1 sample per 1,000 cy of soil, 1 sample from drums, and 1 sample from filter cartridges for full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), reactivity (cyanide and sulfide), ignitability, corrosivity, TPH-DRO, and TPH-GRO with 7 day TAT. BOA rates.
Mobilization/Demobilization and Site Setup Total				***$43,748***	
Site Support					
Sample Technician/Site Labor	Hour	170	$67.50	$11,475.00	17 10-hr work days
Site Trailer	Lump Sum	1	$5,025.00	$5,025.00	Includes mobilization, setup, demobilization, and rental.
Project Vehicle (Pickup Truck)	Week	4	$745.00	$2,980.00	Includes fuel and rental vehicle. Assumes 1 truck for Site Management [Hertz Equipment Rental = 1 each @ $605/week plus 1 each @ $140/week (35 gallons @ $4/gallon for fuel). Onsite for duration of field work.
Site Support Total				***$19,480***	
Post-Excavation Confirmation Sampling					
Floor Confirmation Sampling	each	6	$256.63	$1,539.78	Assumes 7 day TAT; 1 floor sample per every 625 ft^2 (25' x 25' grid). Samples analyzed for subsurface soil COPCs (Aroclor-1260, arsenic, chromium, and mercury). BOA rates used.
Wall Confirmation Sampling	each	6	$522.87	$3,137.22	Assumes 7 day TAT; 1 sample per 50 linear feet of excavation wall. Samples analyzed for surface soil COPCs (arenic, chromium, 4,4-DDT, and mercury) and subsurface soil COPCs (Aroclor-1260, arsenic, chromium, and mercury). BOA rates used.
Post-Excavation Confirmation Sampling Total				***$4,677***	
Excavation					
Excavate and Load Material	Ton	1,956	$7.50	$14,670.00	Engineer's Estimate. Assumes 1.5 tons/cy for soil with debris and production rate of 400 tons per day. Includes labor and equipment. Assumes OSHA Type A soil with sloping at 0.75H:1V for excavations deeper than 5 ft bgs.
Transportation and Disposal					
T&D of Non-Hazardous Soil and Waste	Ton	1,663	$60.00	$99,756.00	Assumes 1.5 tons/cy; non-hazardous soil accounts for 85% of total volume. Includes labor and equipment. Based on recent similar project.
T&D of Hazardous Waste (respirator cartridges)	Ton	293	$380.00	$111,492.00	Assumes 1.5 tons/cy; filter cartidges are hazardous and account for 15% of total volume. Includes labor and equipment. BOA rates.

TABLE E-1

Engineer's Cost Estimate for Alternative 2: Removal and Offsite Disposal

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Description: Alternative 2 consists of excavation and offsite disposal of debris and impacted soil from Area 2 and backfilling Area 2 with imported clean fill material. A total of 978 yd ^{3} of material will be excavated from Area 2. The Area 2 removal area consists of a 2,300 ft ^{2} removal area at a depth of 6 ft bgs and a 1,400 ft ^{2} removal area at a depth of 9 ft bgs.

Description of Service/Items	Unit	Quantity	Unit Price	Total	Assumptions
Excavation, Transportation, and Disposal Total				***$225,918***	
Material Delivery and Placement					
Fill Material Source Sampling	Each	2	$593.00	$1,186.00	Assumes 7 day TAT and 1 sample per offsite borrow source. Samples analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. BOA rates
Topsoil material and delivery	cubic yard	105	$35.00	$3,675.00	Includes 6" of topsoil over a 5,660 ft^2 area to include sloped excavations for areas deeper than 5 ft bgs; assume 1.25 cy loose/in-place and production rate of 400 cy per day. Based on recent similar projects.
General fill material and delivery	cubic yard	1,525	$23.00	$35,075.00	Includes general fill to within 6" of pre-excavation elevation to include sloped excavations for areas deeper than 5 ft bgs. Assumes 1.25 cy loose/in-place and production rate of 400 cy per day. Based on recent similar projects.
Topsoil and General Fill Placement	cubic yard	1,630	$3.50	$5,705.00	Engineer's Estimate. Includes labor and equipment. Assumes 1.25 cy loose/in-place and production rate of 400 cy per day.
Material Delivery and Placement Total				***$45,641***	
Surveying					
Post-Excavation Topographic Survey	Day	1	$3,160.00	$3,160.00	Assumes 1 10-hour day to complete the survey. Includes mobilization/demobilization, survey data evaluation/reporting, and all labor, equipment, and materials. Assumes 2-man surveying crew. BOA rates used.
As-Built Topographic Survey	Day	1	$3,160.00	$3,160.00	Assumes 1 10-hour day to complete the survey. Includes mobilization/demobilization, survey data evaluation/reporting, and all labor, equipment, and materials. Assumes 2-man surveying crew. BOA rates used.
Surveying Total				***$6,320***	
Site Restoration					
Grading	square yard	629	$2.91	$1,833.12	Includes grading the backfilled areas. [RSMeans #31-22-16.10 (1050)]
Seeding	Lump Sum	1	$3,240.30	$3,240.30	Includes 1 application of seed and straw for all disturbed areas. Assumes the area to be restored is less than 1 acre. [RSMeans #32-92-19.14 (0800)]
Site Restoration Total				***$5,073***	
Subtotal				$432,857	
Contingency (25%)			*25.0%*	$108,214	
Construction Management (10%)			*10.0%*	$43,286	
Project Management (8%)			*8.0%*	$34,629	
Subtotal				$618,986	
Performance Bond (2%)			2.0%	$12,380	Industry Average
TOTAL CAPITAL COST				**$631,000**	
			+50%	**$947,000**	
			-30%	**$442,000**	

References and Source Notes

- Base costs used are 2014 dollars.
- RS Means: Facilities Construction Cost Data, 2013 + 1.9% average 2014 escalation (Golbal Insight)

- Recent similar projects include construction projects in Weapons Naval Station Yorktown and Cheatham Annex in Williamsburg, VA; JEB Little Creek in Virginia Beach, VA; NAS Oceana in Virginia Beach, VA; SJCA in Chesapeake, VA; and NSN in Norfolk, VA.

Assumptions and Exclusions

1. Mobilization includes utility clearance.

2. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained. This is an order-of-magnitude cost estimate that is expected to be within +50 to -30 percent of the anticipated costs in the EE/CA.

TABLE E-2

Engineer's Cost Estimate for Alternative 3: Low Permeability Soil Cover

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Description: Alternative 3 consists of installing a 2 ft soil cover, consisting of 18 inches of general fill followed by 6 inches of topsoil and permanent seeding, over a 4,100 ft ^{2} area which includes the entirety of AOC 2 Area 2. LUCs, O&M, and five-year reviews would be implemented for the soil cover area.

Description of Service/Items	Unit	Quantity	Unit Price	Total	Assumptions
Work Planning Documents					
Construction Work Plan	Lump Sum	1	$20,000.00	$20,000.00	Includes draft and final submission and Erosion and Sediment Control Plan.
UFP-SAP	Lump Sum	1	$30,000.00	$30,000.00	Includes scoping plus pre-draft, draft, and final submission of UFP-SAP.
EM385 Health and Safety Plan	Lump Sum	1	$12,000.00	$12,000.00	Includes draft and final submission and AHAs.
Construction Completion Report	Lump Sum	1	$20,000.00	$20,000.00	Includes draft and final submission.
Work Planning Documents Total				***$82,000***	
Mobilization/Demobilization and Site Setup					
Mobilization/Demobilization	Each	2	$5,823.59	$11,647.17	Includes mobilization and demobilization of all equipment and materials necessary to perform the work. [RSMeans Crew #B-1, #B-10L, #B-10T, and #B-12A]
Construction Entrance Temporary Road	square yard	200	$15.34	$3,067.19	One 150'x12' and 6" thick with #1 VDOT stone. [RSMeans #01-55-23.50 (0100)]
Material Staging Area for Fill Material	Lump Sum	1	$2,000.00	$2,000.00	Assumes 50' x 50' area. Includes 3 rolls of poly sheeting and silt fence; removal included.
Vegetation Clearance	Day	2	$5,800.00	$11,600.00	Includes all labor, equipment, and materials for clearing for material handling area, material staging area, and along Connector Road to provide space for construction entrance. Assumes all cleared vegetation remains onsite. Based on recent similar project.
Silt Fence	Linear Feet	275	$4.50	$1,237.50	Includes all labor, equipment, and materials. Assumes installation around Area 2 boundary. Based on quote from recent similar project.
Portable Toilet and Handwash Station	Week	2	$100.00	$200.00	Based on quote from recent similar project.
Pre-Soil Cover Topographic Survey	Day	1	$3,160.00	$3,160.00	Assumes 1 10-hour day to complete the survey. Includes mobilization/demobilization, survey data evaluation/reporting, and all labor, equipment, and materials. Assumes 2-man surveying crew. BOA rates used.
Pre-Soil Cover Delineation Sampling	each	6	$522.87	$3,137.22	Assumes 7 day TAT; 1 sample per 50 linear feet of soil cover limits. Samples analyzed for surface soil COPCs (arenic, chromium, 4,4-DDT, and mercury) and subsurface soil COPCs (Aroclor-1260, arsenic, chromium, and mercury). BOA rates used.
Mobilization/Demobilization and Site Setup Total				***$36,049***	
Site Support					
Sample Technician/Site Labor	Hour	70	$67.50	$4,725.00	7 10-hr work days
Project Vehicle (Pickup Truck)	Week	2	$745.00	$1,490.00	Includes fuel and rental vehicle. Assumes 1 truck for Site Management [Hertz Equipment Rental = 1 each @ $605/week plus 1 each @ $140/week (35 gallons @ $4/gallon for fuel). Onsite for duration of field work.
Site Support Total				***$6,215***	
Material Delivery and Placement					
Topographic Survey Support	Day	7	$3,160.00	$22,120.00	Assumes full-time survey support to place grade stakes/maintain control during cover installation.
Fill Material Source Sampling	Each	2	$593.00	$1,186.00	Assumes 7 day TAT and 1 sample per offsite borrow source. Samples analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. BOA rates
Topsoil material and delivery	cubic yard	95	$35.00	$3,325.00	Includes 6" of topsoil over a 4,100 ft^2 area; assume 1.25 cy loose/in-place and production rate of 400 cy per day. Based on recent similar projects.
General fill material and delivery	cubic yard	285	$23.00	$6,555.00	Includes 1.5' of general fill over a 4,100 ft^2 area; assume 1.25 cy loose/in-place and production rate of 400 cy per day. Based on recent similar projects.
Topsoil and General Fill Placement	cubic yard	380	$3.50	$1,330.00	Engineer's Estimate. Includes labor and equipment. Assumes 1.25 cy loose/in-place and production rate of 400 cy per day.
Material Delivery and Placement Total				***$34,516***	
Surveying					
As-Built Topographic Survey	Day	1	$3,160.00	$3,160.00	Assumes 1 10-hour day to complete the survey. Includes mobilization/demobilization, survey data evaluation/reporting, and all labor, equipment, and materials. Assumes 2-man surveying crew. BOA rates used.
Surveying Total				***$3,160***	
Site Restoration					
Grading	square yard	456	$2.91	$1,328.94	Includes grading the soil cover areas. [RSMeans #31-22-16.10 (1050)]
Seeding	Lump Sum	1	$3,240.30	$3,240.30	Includes 1 application of seed and straw for all disturbed areas. Assumes the area to be restored is less than 1 acre. [RSMeans #32-92-19.14 (0800)]
Site Restoration Total				***$4,569***	

TABLE E-2

Engineer's Cost Estimate for Alternative 3: Low Permeability Soil Cover

Engineering Evaluation and Cost Analysis for AOC 2 - Dextrose Dump

Naval Weapons Station Yorktown Cheatham Annex

Williamsburg, Virginia

Description: Alternative 3 consists of installing a 2 ft soil cover, consisting of 18 inches of general fill followed by 6 inches of topsoil and permanent seeding, over a 4,100 ft ^{2} area which includes the entirety of AOC 2 Area 2. LUCs, O&M, and five-year reviews would be implemented for the soil cover area.

Description of Service/Items	Unit	Quantity	Unit Price	Total	Assumptions
LUCs					
Sign (small)	Each	2	$90.00	$180.00	Assumes 24" x 24" white sign with black lettering.
Survey Plat	Each	1	$6,000.00	$6,000.00	Includes field surveying, data evaluation, reporting, filing fees, and labor.
LUCs Total				***$6,180***	
Subtotal				$172,689	
Contingency (10%)			*10.0%*	$17,269	
Construction Management (10%)			*10.0%*	$17,269	
Project Management (8%)			*8.0%*	$13,815	
Subtotal				$221,042	
Performance Bond (2%)			2.0%	$4,421	Industry Average
TOTAL CAPITAL COST				**$225,000**	
Operations and Maintenance (O&M) for Soil Cover (1 to 30 Years)					
LUC and Cover Quarterly Inspections	Each	8	$3,500.00	$28,000.00	Assumes 2 years of quarterly inspections. Includes reporting. Engineer's estimate based on recent similar projects.
Annual LUC and Cover Inspections	Each	28	$3,500.00	$98,000.00	Engineer's estimate based on recent similar projects.
5-Year Review and Report	Each	6	$50,000.00	$300,000.00	Engineer's estimate based on recent similar projects. Includes soil cover and vegetative maintenance consisting of repairs of any monitoring well and soil cover defects noted during the Five-Year Review site inspections.
Subtotal				$426,000	
Contingency (25%)			*25.0%*	$106,500	
Project Management (8%)			*8.0%*	$34,080	
TOTAL O&M COST				**$567,000**	
Total O&M Cost Per Year				$18,900	
Total Years of O&M				30	
Discount Rate				3.90%	
Discount Factor				17.50	
Total Present Value of O&M Cost				**$331,000**	
TOTAL PRESENT VALUE of ALTERNATIVE				**$556,000**	
			+50%	**$834,000**	
			-30%	**$389,000**	

References and Source Notes

- Base costs used are 2014 dollars.
- RS Means: Facilities Construction Cost Data, 2013 + 1.9% average 2014 escalation factor (Global Insight).

- Recent similar projects include construction projects in Weapons Naval Station Yorktown and Cheatham Annex in Williamsburg, VA; JEB Little Creek in Virginia Beach, VA; NAS Oceana in Virginia Beach, VA; SJCA in Chesapeake, VA; and NSN in Norfolk, VA.
- Discount factor established per "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis", OSWER Directive No. 9355.3-20,December 26, 2013.

Assumptions and Exclusions

1. Mobilization includes utility clearance.

2. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained. This is an order-of-magnitude cost estimate that is expected to be within +50 to -30 percent of the anticipated costs in the EE/CA.

Regulatory Acceptance

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

May 5, 2015

Mr. Scott Park
NAVFAC MIDLANT, Building N-26, Room 3208
Attention: Code OPHE3, Mr. Scott Park
9742 Maryland Avenue
Norfolk, VA 23511-3095

Subject: Draft Engineering Evaluation and Cost Analysis (EECA) for Area of Concern (AOC) 2 – Dextrose Dump, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia, January 2015

Mr. Park:

Thank you for the opportunity to review the subject document. EPA's draft comments on the document have been adequately addressed. EPA has no further comments on the document. Please submit a final copy of the subject document for our records. If you have any questions, please contact me at 215-814-2077.

Sincerely,

Gerald F. Hoover

Gerald F. Hoover, RPM
NPL/BRAC Federal Facilities Branch

cc: Wade Smith, VDEQ

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 1105, Richmond, Virginia 23218
www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

April 29, 2015

Mr. Scott Park
NAVFAC MIDLANT, Building N-26
Hampton Roads Restoration Product Line, Code OPHREV4
9742 Maryland Avenue
Norfolk, VA 23511-3095

Engineering Evaluation/Cost Analysis
Area of Concern 2: Dextrose Dump
Naval Weapons Station Yorktown
Cheatham Annex
Williamsburg, Virginia

Dear Mr. Park:

The Virginia Department of Environmental Quality (DEQ) has received the *Response to Comments* (RTCs) and *Draft Final Engineering Evaluation/Cost Analysis* (EE/CA) for Area of Concern 2 (AOC 2) at Naval Weapons Station Yorktown, Cheatham Annex, Williamsburg, Virginia. The RTCs and EE/CA, prepared by CH2M HILL, were received by the DEQ on April 21, 2015 and April 23, 2015, respectively.

Thank you for providing the DEQ's Office of Remediation Programs the opportunity to review the above-referenced RTCs and EE/CA. Subsequent to DEQ's internal review, this office concurs with the recommended removal action alternative that provides for unlimited use/unrestricted exposure. Additionally, this office accepts the revisions to the previously reviewed ARARs tables and has no additional comments.

Please contact me at (804) 698-4125 or wade.smith@deq.virginia.gov with any additional questions.

Sincerely,

Wade M. Smith
Remediation Project Manager
Office of Remediation Programs

cc: Jerry Hoover, EPA
Michelle Hollis, DEQ

Attachment B
Public Notices and Responsiveness Summary

PHOTO COURTESY OF THE VIRGINIA COOPERATIVE EXTENSION

Master Gardeners donate funds to garden

The Virginia Cooperative Extension James City County/Williamsburg Master Gardeners presented Karen Jamison, board of directors chairwoman of the Williamsburg Botanical Garden a check for $1,000 in recognition of the relationship of the two groups. James City County/ Williamsburg Master Gardener Patsy McGrady, who leads tree tours at the WBG, made the presentation at the May Master Gardener meeting.

Grafton man charged in February hit-and-run

By Sarah J. Ketchum
sketchum@vagazette.com

A Grafton man is charged in connection with a Feb. 1 hit-and-run that killed a York County woman and seriously injured another person, an official said.

Alyssa Lynne Rhoades, 23, of Yorktown, died from injuries sustained when she was hit by a vehicle on Route 17 in York County. The driver did not stop, according to Virginia State Police spokeswoman Sgt. Michelle Anaya.

Kevin Anthony Boone, 56, was identified in connection with the incident and arrested May 6 according to Anaya.

Boone is charged with DUI manslaughter, DUI maiming, felony murder, felony DUI, revocation of license for multiple convictions of DUI, felony hit-and-run injury and involuntary manslaughter, according to Anaya.

NAVFAC
Naval Facilities Engineering Command

Notice of Navy's Invitation for Public Comment on the

Engineering Evaluation/Cost Analysis Report
for
AOC 2 – Dextrose Dump
Naval Weapons Station Yorktown, Cheatham Annex

The Department of the Navy invites public comment on the Area of Concern (AOC) 2 (Dextrose Dump) Draft Final Engineering Evaluation/Cost Analysis (EE/CA) Report that presents information pertaining to a proposed debris and soil removal action at Naval Weapons Station Yorktown, Cheatham Annex, Williamsburg, Virginia. AOC 2 is located within a wooded area of Cheatham Annex (CAX), north of Garrison Road, along the southern perimeter of CAX. This removal action is being considered to address potential unacceptable risk to human health and the environment posed by exposure to contaminants in subsurface debris and soil and is not considered time critical. The purpose of the proposed non-time-critical removal action is to mitigate potential risks to human health and the environment by reducing exposures to soil contaminated with a polychlorinated biphenyl (Aroclor-1260), a pesticide (4,4'-DDT), and metals (i.e., arsenic, chromium, and mercury) at the site. The removal action will involve the excavation and off-site disposal at an appropriate disposal facility of subsurface debris and contaminated soil from the area identified as Area 2.

AOC 2 was identified in late 1997 and early 1998 when various debris areas were discovered. Based on the types of debris observed, AOC 2 was separated into three areas: Areas 1a and 1b contain dextrose intravenous (IV) bottles and minor debris, Area 2 contains unused respirator cartridges and empty 55-gallon drums, and Area 3 contains surplus military clothing. The EE/CA for AOC 2 addresses only the Area 2 debris and soil since the nature of the debris in Areas 1a, 1b, and 3 (dextrose IV bottles and military clothing) is not a concern or a source regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Site investigations have indicated that groundwater requires no further action (NFA); therefore, groundwater is not addressed by this EE/CA.

The EE/CA examined three alternatives based on effectiveness, implementability, and cost. Alternative 1 for Area 2, no action, assumes no action will be taken and the site would be left as it currently exists. Alternative 1 is only considered in order to provide a baseline from which to compare the other alternatives. Alternative 2 includes excavation and backfill in Area 2. Alternative 3, construction of a soil cover at Area 2 and land use controls, would be implemented to assure that the soil cover remain in place. Alternative 2 is the recommended removal action alternative because it is a permanent solution that provides for unlimited use/ unrestricted exposure and does not require post-removal site controls to ensure long-term protectiveness.

The Draft Final EE/CA Report for AOC 2 is available for public review at the following location during normal business hours:

York County Public Library – Yorktown
8500 George Washington Memorial Highway
Yorktown, Virginia
(757) 890-5207

The public is invited to provide written comments on the Draft Final EE/CA Report for AOC 2. Written comments will be accepted until Tuesday, June 16, 2015 at the following address:

Naval Weapons Station Yorktown
Attn: Public Affairs Officer
160 Main Road
Yorktown, Virginia 23691-0160
Phone: (757) 887-4939
E-mail: mark.piggott@navy.mil

JANE FLAVELL COLLINS/EPA

A sketch shows convicted Boston Marathon bomber Dzhokhar Tsarnaev walking from the courtroom after a jury on Friday voted to impose the death penalty.

Tsarnaev's final battle may be long, even on death row

By Richard A. Serrano
Tribune Washington Bureau

BOSTON — At 21, Dzhokhar Tsarnaev is about to become the youngest, most notorious inmate on federal death row. Convicted last month in the 2013 Boston Marathon bombing, a jury on Friday voted to sentence the Russian immigrant to death for his role in the worst terror attack on U.S. soil since 9/11.

When Tsarnaev is formally sentenced this summer, it may be the last time he is seen in public, but the legal battle over his case is certain to drag on for years before any execution is carried out.

For now he remains in the custody of U.S. marshals in Boston. After his formal sentencing, he will be turned over to the Federal Bureau of Prisons and eventually deposited at the death house in Terre Haute, Ind. From there, over the next 10 years or more, his defense team will wage the final fight for his life.

His current defense lawyers, led by widely known anti-death penalty advocate Judy Clarke, were unable to keep Tsarnaev from death row. The next legal battle will be with a new team of appellate lawyers who will try to win, at a minimum, a new hearing on whether life without parole is the more appropriate punishment.

"It will be a very slow, torturous process," said Charles Ewing, a SUNY University at Buffalo law professor.

Interviews with several attorneys and experts on capital litigation suggest there is little chance Tsarnaev will see his conviction set aside. But experts say Tsarnaev does have a reasonably good chance of getting the death sentence set aside, based largely on his lawyers' repeated requests to move the trial out of Boston. The defense contended for months that the Boston community was too deeply scarred and that no local jury could give him a fair and impartial trial. The judge refused to hold a hearing on the matter, and a local appellate court declined to intervene.

The Tsarnaev appellate team also might have a shot at vacating the death sentence if it can show the judge did not properly instruct the jurors, specifically in not telling them that if they deadlocked it would not result in a new trial.

"The best would be to get him a new punishment phase," said John Blume, a Cornell University law professor and director of the law school's Death Penalty Project. "There have been other cases that sometimes produce a death sentence because some jurors were leaning toward life and the other jurors beat them up (verbally) and said, 'If we don't do this, if we don't do our duty and give him death, another jury will have to listen to this brutal, gory testimony.' "

Tsarnaev's appellate lawyers also could challenge the constitutionality of the death penalty and question whether his trial attorneys performed effectively. But most lawyers watching the case praised Clarke's decision to admit his guilt, saying such honesty was likely appreciated by the jury.

rserrano@tribune.com

Vital rail corridor shows its age

Record passenger traffic taxes old tunnels, bridges

By David B. Caruso and Justin Pritchard
Associated Press

NEW YORK — The trains that link global centers of learning, finance and power on the East Coast lumber through tunnels dug just after the Civil War, and cross century-old bridges that sometimes jam when they swing open to let tugboats pass. Hundreds of miles of overhead wires that deliver power to locomotives were hung during the Great Depression.

The rails of the Northeast Corridor are decaying, increasingly strained — and moving more people than ever around the nation's most densely populated region.

The railroad's importance became all the more apparent after Amtrak Train 188 derailed Tuesday as it sped around a curve in Philadelphia, killing eight passengers and injuring more than 200.

The wreck closed part of the corridor all of last week. On a normal weekday, 2,000 trains run by Amtrak and eight other passenger rail systems carry 750,000 riders on railways between Washington and Boston, making it a vital link for both intercity travelers and suburban commuters. Federal investigators will take months to determine the cause of the crash. Speed, not equipment failure, has emerged as a key factor.

Still, the crash refocused attention on the slow-motion deterioration of vital infrastructure with a seemingly endless to-do list. By one estimate, it would take $21 billion just to replace parts still in use beyond their intended lives.

"The stakes are enormous," Amtrak's president, Joseph Boardman, warned in his 2015 request to Congress for funding. He said the corridor faced a "crisis brought on by decades of chronic underfunding."

Some federal lawmakers want to give Amtrak less, not more. A day after the accident, the House Appropriations Committee voted to cut Amtrak's federal subsidy for next year by $251 million, to $1.1 billion.

"There just isn't enough money to go around," said Rebecca Reyes-Alicea of the Federal Railroad Administration. As the agency's Northeast Corridor program manager, Reyes-Alicea has been helping states pool their clout and push for federal money all along the corridor.

Amtrak's ridership on the corridor is up 50 percent since 1998, thanks to the introduction of high-speed trains now favored by travelers who used to fly between New York, Washington and Boston. Amtrak carried a record 11.6 million riders on the corridor in fiscal year 2014.

Reyes-Alicea ticks off a list of needs, from a station in Boston to bridges along the 450-mile route that ends near Capitol Hill.

Half of the route's 1,000 bridges are around a century old. In Baltimore, trains pass through a 1.4-mile tunnel built in 1873 — one so narrow, decrepit and leak-prone that speeds are limited to 30 mph.

"These problems are not going away," U.S. Secretary of Transportation Anthony Foxx said of the nation's most important rail corridor. "They're going to be there and we've got to own up to it and figure out a way forward as a country."

LIBRARY OF CONGRESS

The Norwalk River railroad bridge in Connecticut is more than a century old. Railroad officials want it replaced.

Order for speed control system

PHILADELPHIA — Amtrak says it will immediately abide by an order by federal regulators to expand use of a speed restriction system in the area of Tuesday's deadly train derailment that killed eight people and injured more than 200 others.

The Federal Railroad Administration said Saturday it wants Amtrak to put in effect the automatic train control system for northbound trains approaching the curve where the train derailed. The system is already in effect for southbound trains.

The system notifies the engineer when a train is above the speed limit and automatically applies the brakes if the engineer doesn't slow the train down.

The agency also ordered Amtrak to analyze curves on the Northeast Corridor and install appropriate technology where needed and increase speed limit signs. Amtrak has said it plans to install a next-generation speed control system by year's end.