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Final

Engineering Evaluation/Cost Analysis (EE/CA) For Sites 3 & 6

St. Juliens Creek Annex

Chesapeake, Virginia

Prepared for

Department of the Navy

Atlantic Division
Naval Facilities Engineering Command
Norfolk Virginia

Contract N62470-95-D-6007
CTO Task Order 0028

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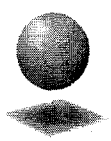

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Executive Summary

This report presents an Engineering Evaluation and Cost Analysis (EE/CA) for a non-time-critical removal action (NTCRA) of soil at Installation Restoration (IR) Site 3 (Disposal Area) and IR Site 6 (Small Arms Pit), at St. Juliens Creek Annex (SJCA) Chesapeake, Virginia. The SJCA is situated at the confluence of St. Juliens Creek and the Elizabeth River in the city of Chesapeake, located in southeastern Virginia. The facility covers approximately 490 acres and includes administrative buildings, wharf areas to the Elizabeth River, a central heating plant, numerous non-operational industrial facilities, and miscellaneous structures.

Sites 3 and 6 are currently undergoing a Remedial Investigation (RI) to determine potential risk to human health and the environment. Field investigations have confirmed the presence of physical and chemical waste at these sites. Based upon preliminary findings, the Navy has chosen to conduct a NTCRA to remove waste and mitigate potential risks present at these sites. The EE/CA selection process explored several different options for addressing the NTCRA at these sites. The options were narrowed down to three potentially acceptable alternatives, which were examined in more detail. Existing information indicates that all waste present at Site 3 and 6 is characteristically non-hazardous and therefore alternatives where excavation is considered incorporates a non-hazardous waste disposal scenario.

The three potentially acceptable alternatives for mitigating the potential risks posed by these sites to human health and ecological receptors are presented in this EE/CA. These alternatives are:

- Alternative 1 - Importing clean soil fill as cover material; excavation of sediment.
- Alternative 2 - Excavation of burnt/stained soils and debris at Sites 3 and 6; excavation of sediment; import clean soil fill as cover material for surface soil sample location SJS03-SS15 and soils adjacent to the removed waste area at Site 3 that pose a potential risk to human health or ecological receptors.
- Alternative 3 - Excavation of burnt/stained soils and debris at Sites 3 and 6; excavation of sediment (as presented in Alternative 2); and excavation of soil at surface soil location SJS03-SS15 and soils adjacent to the removed waste at Site 3 that pose a potential risk to human health or ecological receptors.

The objective of the NTCRA is to eliminate potential risks to human health and the environment posed by Sites 3 and 6. All of these options are effective in meeting the removal action objective. The main difference between the alternatives is the likelihood of future remedial action required to address residual soil contamination, continued environmental monitoring, and future land use controls. Alternative 1 mitigates potential risk by preventing direct exposure of potential receptors to the contaminants of potential concern (COPCs), and would require restrictions on future land use and continued monitoring with the potential for future additional remedial actions. Through the excavation of waste material (burnt/stained soils and debris) at Site 3 and 6, Alternative 2 eliminates risk from potential exposure to the waste. However, there remains a moderate likelihood of requiring future remedial action and environmental monitoring/land use

controls for areas where clean soil fill as cover material mitigates potential risks by preventing direct exposure of potential receptors to COPCs. Through the excavation of all waste materials and soils/sediments that pose a potential risk to receptors, Alternative 3 eliminates risk and would not require long-term monitoring or land use controls.

The Navy recommends Alternative 3, excavation (including UXO screening/removal), transport, and non-hazardous disposal in a local landfill, as the most feasible option. The scope of this removal action will be to remove visible burnt/stained soil and debris, as well as material posing a potential risk to human health and the environment. The removal will involve the excavation of approximately 9,204 cubic yards of material. Following complete removal of waste and contaminated media posing a potential risk, the land comprising Sites 3 and 6 will have unrestricted land-use. It is assumed that the material to be excavated will be classified as a non-hazardous waste. This alternative is expected to cost approximately $1,485,837. Should a portion of the material be classified as a hazardous waste, a significant cost increase (approximately six fold) can be expected in disposal fees, not including increased transportation costs.

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Acronyms and Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirement
BTAG	Biological Technical Assistance Group
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	Compounds of Potential Concern
DOD	Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
IC	Institutional Control
IR	Installation Restoration
MCL	maximum contaminant level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NTCRA	Non-Time-Critical Removal Action
O&M	Operation and Maintenance
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyl
RAB	Restoration Advisory Board
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SJCA	St. Juliens Creek Annex
SVOC	Semi-volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TCLP	toxicity characteristic leaching procedure
TPH	Total Petroleum Hydrocarbon
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
VDEQ	Virginia Department of Environmental Quality

XRF	X-Ray Fluorescence

1. Introduction

This report presents an Engineering Evaluation/Cost Analysis (EE/CA) for a non-time-critical removal action (NTCRA) for Installation Restoration (IR) Site 3 (Disposal Area) and IR Site 6 (Small Arms Pit) at St. Juliens Creek Annex (SJCA) Chesapeake, Virginia. The SJCA facility is situated at the confluence of St. Juliens Creek and the south branch of the Elizabeth River in the city of Chesapeake, located in southeastern Virginia (Figure 1-1). The facility covers approximately 490 acres and includes administrative buildings, wharf areas to the Elizabeth River, a central heating plant, numerous non-operational industrial facilities, and miscellaneous structures.

The facility is bordered to the north by the Norfolk and Western Railroad, the City of Portsmouth, and residential areas; to the west by residential areas; to the south by St. Juliens Creek; and to the east by the south branch of the Elizabeth River (Figure 1-2). Most of the surrounding areas are developed, and include residences, schools, recreational areas, and shipping facilities for several large industries. The Norfolk Naval Shipyard is located approximately 1.5 miles to the north.

1.1 Site 3 – Disposal Area

Site 3 covers approximately 2.1 acres in the northeastern corner of the Annex, the northwest extent of the site is approximately 125 feet south of a patrol road, which extends around the perimeter of the base (Figure 1-3). Drainage ditches are situated on the north, west and east side of the site. Previously, Site 3 was reported to be a landfill consisting of approximately 10 acres. An intrusive investigation conducted as part of the 2001 Remedial Investigation (RI) shows that the extent of waste at Site 3 is substantially smaller than previously reported (*Draft Remedial Investigation/Human Health Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, & 6*, CH2M HILL, December 2001) and the site was not an established landfill area. An interview with Mr. Archie Pinkleton, employed at SJCA from 1965 to 1977, and Mr. Alan Bryant, employed at SJCA from 1942 to 1977, was conducted with representatives from the Navy, EPA, and CH2M HILL on December 18, 2001. The interview confirmed the findings of the 2001 intrusive investigation that the size of Site 3 was considerably smaller than originally reported.

The following information is presented within the EE/CA for Site 3:

- Site description and analytical data
- Identification of the removal action objectives
- Identification of removal action alternatives and technologies
- Recommendation of a preferred removal alternative
- Schedule for the selected removal alternative

1.2 Site 6 – Small Arms Pit

Site 6 (Small Arms Pit), also called the Caged Pit, is approximately 0.6 acres in area and is located approximately 800 feet south of the patrol road. Access to the site can only be accomplished by traveling through an open field (Figure 1-3).

The following information is presented within the EE/CA for Site 6:

- Site description and analytical data
- Identification of the removal action objectives
- Identification of removal action alternatives and technologies
- Recommendation of a preferred removal alternative
- Schedule for the selected removal alternative

1.3 Regulatory Background

This document is issued by the U.S. Department of the Navy, lead agency responsible for remediation of IR Site 3 and IR Site 6, with the assistance of the United States Environmental Protection Agency (USEPA) Region III and the Virginia Department of Environmental Quality (VDEQ), under Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Section 104 of CERCLA and SARA allows an authorized agency to remove, or arrange for removal, and to provide for remedial action relating to hazardous substance, 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 the health or welfare and the environment.

The NCP, 40 Code of Federal Regulations (CFR) 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." The removal action being considered for Site 3 and Site 6 is necessary to prevent damage to public health and the environment and to minimize the threat of further release. This removal action is not time-critical. NTCRAs are defined in 40 CFR Section 300.415(b)(4) as actions pertaining to a less imminent threat to human health and the environment and that have planning periods of 6 months or more. For time-critical removal actions, actions shall begin as soon as possible to "abate, prevent, minimize, stabilize, mitigate, or eliminate the threat to public health or welfare of the United States or the environment" (40 CFR Section 300.415(b)(3)).

The 40 CFR Section 300.415 requires the lead agency to conduct an EE/CA when an NTCRA is planned for a site. The goals of an EE/CA are to identify the objectives of the removal action and to analyze the effectiveness, implementability, and cost of various alternatives

that may satisfy these objectives. An EE/CA documents the removal action alternatives and selection process. Where the extent of the contamination is well defined and limited in extent, NTCRAs also allow for the expedited cleanup of sites in comparison to the remedial action process under CERCLA.

Community involvement requirements for non-time-critical removals include preparing and approving an EE/CA and making it available for public review and comment (30 days). An announcement of the 30-day public comment period on the EE/CA is required in a local newspaper. Written responses to significant comments must be prepared and included in the Administrative Record.

1.4 Purpose and Objectives

Submittal of this document fulfills the requirements for non-time-critical actions defined by CERCLA, SARA, and the NCP. This EE/CA has been prepared in accordance with USEPA's guidance document *Superfund, Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, PB93-963402, January 1993.

The EE/CA compares three removal alternatives based on their technical feasibility, ability to protect human health and the environment, ability to prevent the potential release of hazardous constituents, and cost. Individual goals of this EE/CA are to: (1) satisfy environmental review and public information requirements for removal actions, (2) satisfy administrative record requirements for documenting the removal action selection, (3) compile analytical results, and (4) provide a framework for evaluating and selecting alternative technologies.

The objective of this removal action is to implement a permanent remedy that mitigates the potential risk posed by metals and polycyclic aromatic hydrocarbons (PAHs) present in contaminated soils and sediment at Sites 3 & 6. Additionally, it is the preference of the Navy to eliminate the need for Institutional Controls (ICs) that would limit the future use of land at these sites. At the conclusion of the removal action, confirmatory sampling of the remaining soil and sediment at Site 3 and Site 6 will be conducted to ensure the remedial action goals have been met.

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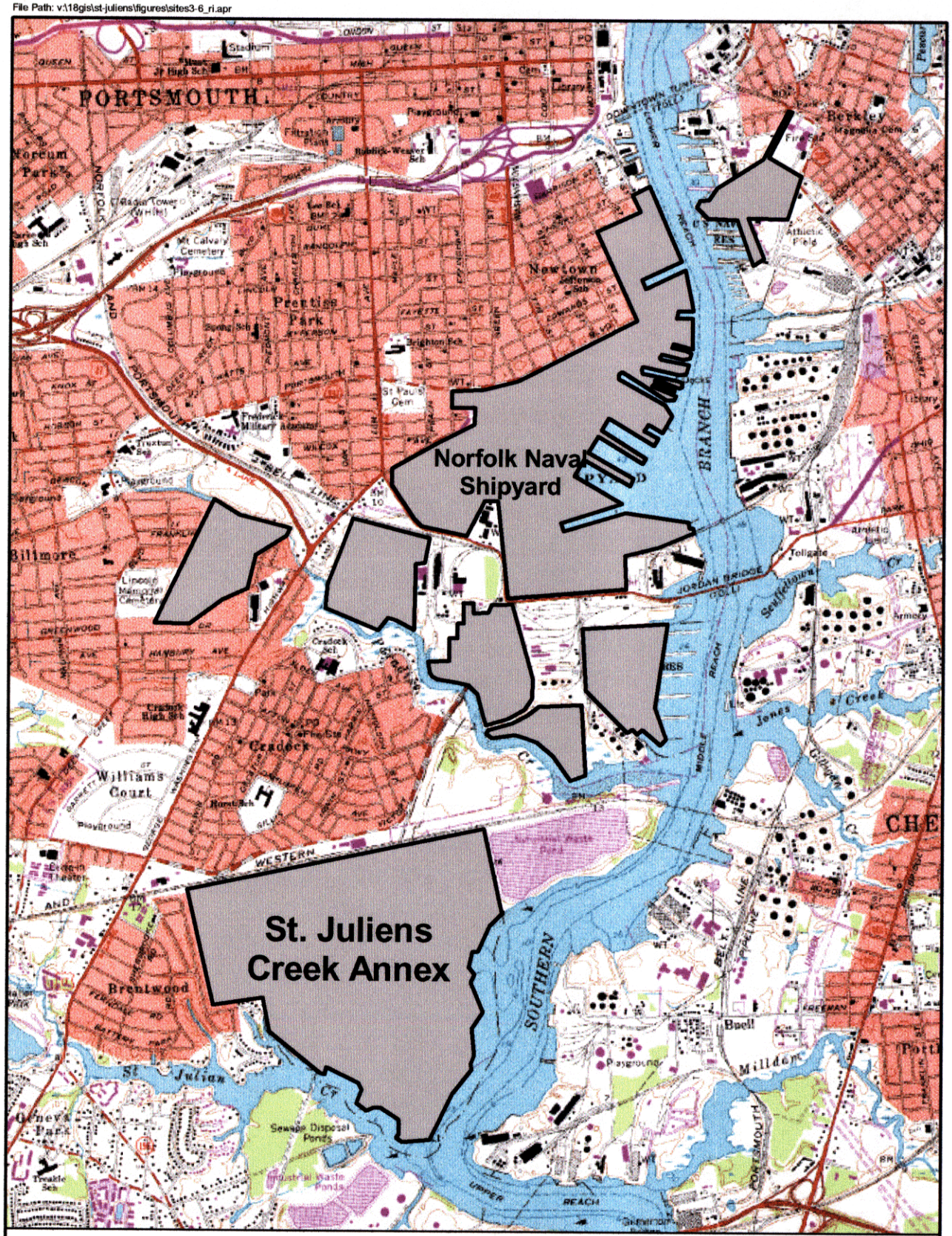

LEGEND

Navy Owned Property

N

1000 0 1000 2000 Feet

Figure 1-2
Location of St. Juliens Creek Annex
and Surrounding Area
St. Juliens Creek Annex
Chesapeake, Virginia

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LEGEND

- Site Locations
- Roads
- Railroads
- Activity Boundary
- Water Bodies

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0 800 1600 Feet

Figure 1-3
Location of Sites 3 and 6
within St. Juliens Creek Annex
St. Juliens Creek Annex
Chesapeake, Virginia

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2. Site Characterization

2.1 Site Description and Background

2.1.1 Site 3

The Site 3 Disposal Area was originally a mudflat where refuse was dumped and allowed to burn; the ash was then used to fill in the area. The Site 3 Disposal Area was not lined. Operation began in 1940 and continued until 1970. After 1970, the area was graded level and covered with grass (CDM, 1999). Review of historical aerial photographs, interpreted by USEPA's Photographic Interpretation Center, indicate that prior to use for disposal purposes, the site, and much of the adjacent area, had been used for placement of dredge spoil material (USEPA, 1995).

Refuse burned at Site 3 included solvents, acids, bases, and mixed municipal waste. The total volume of solvents, waste oil, and oil sludge disposed was estimated to be about 750,000 cubic feet (ft^3) (27,800 cubic yards) prior to burning. Salvageable materials were removed from the site each day, and once every two weeks the site was bulldozed for compaction and leveling (CH2M HILL, December 2001).

Two pits at Site 3 were reportedly used for disposal of oil and oily sludge, as well as for periodic burning. The locations of the waste disposal pit and waste disposal area were outlined based on historical aerial photographs taken in 1958, 1961, 1964, and 1970 interpreted by USEPA (USEPA, 1995). As identified in the photographs, the disposal pits were located along the north side of the access road that crosses the site diagonally. USEPA also interpreted ground scarring along the road to be possible waste disposal areas (CDM, 1999) (Figure 2-1). A Waste Delineation Investigation was conducted in June 2001 to determine the extent of waste at both Sites 3 and 6. An interview was conducted on December 18, 2001 with former SJCA employees Mr. Pinkleton and Mr. Bryant. The interviews and the intrusive investigations conducted as part of the 2001 Remedial Investigation (RI) show that the extent of waste at Site 3 is substantially smaller than previously reported (*Draft Remedial Investigation/Human Health Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, & 6*, CH2M HILL, December 2001) and the site was not an established landfill area.

2.1.2 Site 6 – Small Arms Pit

Site 6 was operated as part of the ordnance disposal operations at SJCA. It was located southwest of Site 3 and consisted of a pit with a cage over it. No date of operation of the pit was found in the background material. However, a review of historical aerial photographs during Phase II of the RI investigation indicated that activities associated with Site 6 began around 1974. According to the RCRA Facility Assessment (RFA) report (A.T. Kearney, 1989), small items, such as igniters and fuses, were burned in the pit. The 1989 RFA also reported that the Navy had filled in the pit "during recent years." Interviews with former employees indicate that small items were transported into a steal container via a conveyor belt for

destruction. The container was estimated to be 8-feet wide by 20-feet long by 12-feet high. Geophysical investigations indicate potential buried remains of this container. Trenching investigations conducted in 2001 did not confirm the geophysical findings. Currently, the area is covered with grass and there is no surface evidence of the Caged Pit at Site 6. Due to its proximity to another IR site, Site 5 (Burning Grounds), Site 6 was previously investigated as part of Site 5.

2.2 Previous Removal Actions at the Sites

The United States Navy, lead agency responsible for SJCA, has no documentation of any previous removal actions taking place at Site 3 or Site 6.

2.3 Identification of Removal Areas

The extent of soil and sediment identified for removal is based on the potential risk posed to human health and ecological receptors as well as the removal of waste to eliminate the need for land use controls at the Sites. Potential risks associated with waste/debris, soil and sediment recommended for removal are based on the analysis of soil and sediment samples collected and analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), TCL pesticides, TCL polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) metals. The removal of waste in place is based on the physical waste delineation investigation conducted in 2001. Data used to identify the removal areas are contained in the following documents: the *Final Background Investigation Report* (CH2M HILL, October 2001) and the *Draft Remedial Investigation/Human Health Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, & 6* (CH2M HILL, December 2001). Statistical evaluation of potential risk driver compounds and risk management decisions were utilized to identify the final areas of removal. The steps for identifying the areas of removal are detailed below.

Human health and ecological risk assessments (through Step 3a) identified compounds that pose a potential risk. To identify areas which may pose a potential risk, the identified risk drivers were compared to the 95% Upper Tolerance Limit (UTL) established for background dredge fill, and a population (site)-to-population (background) central tendency comparison was performed. The identified risk drivers that exceeded the UTL and that indicated a statistical difference between the site population and the background population were reviewed by the SJCA Tier I Partnering Team for discussion and risk management. This process is detailed below.

Upper Tolerance Limit Comparison

Those compounds identified in the ecological or human health risk assessments were compared to the background UTL specific to SJCA to determine if a release had occurred (CH2M HILL, October 2001). Those risk drivers that exceeded the background UTL at Site 3 are identified on Figure 2-2. The distribution of the potential risk driver compounds which exceeded the UTL are concentrated in samples collected within, or adjacent to the limits of waste and at surface soil sample location SJS03-SS15.

Central Tendency

To determine if potential risk driver compounds that exceeded a background UTL showed a statistical difference from background, a population-to-population central tendency comparison of site data to background data was conducted. The comparison used either a one-sided t-test or a Wilcox Rank Sum Test. The results of the population-to-population central tendency comparison are summarized in Table 2-1. The comparison identified two compounds that showed a statistical difference between site and background data, anthracene and phenanthrene. Naphthalene did not exceed its UTL and was not considered a risk driver, but would be included in the risk management discussion with the SJCA Tier I Partnering Team as it did show a statistical difference from background. Figure 2-3 shows the distribution of these three compounds in site samples and in dredge fill background samples.

Risk Management

The Navy, EPA and VDEQ evaluated all compounds in soil and sediment at Site 3, focusing on metals and PAHs in soil which posed the greatest potential risk. Based on that discussion, a team consensus was reached that, though the population-to-population comparison indicated no statistical difference to background, certain metals that exceed the UTL (antimony, iron, zinc) located within the limits of waste, adjacent to the waste, and at sample location SJS03-SS15, would be addressed as part of this removal action. Further, though the population-to-population comparison indicated statistical difference to background, anthracene, naphthalene, and phenanthrene were not compounds of concern that required removal action except within the limits of waste.

2.3.1 Site 3

This section discusses the extent of waste, the nature and extent of analytical compounds in soil and sediment, and the potential risks identified for the removal action at Site 3.

2.3.1.1 Extent of Waste

The results of the June/July 2001 waste delineation investigation activities indicated visual signs of potentially contaminated soils, construction debris, and spent ordnance at Site 3. The extent of these materials is presented on Figure 2-4 and discussed below.

Two types of waste were visually identified; debris and burnt/stained soil. Waste which was considered debris consisted of construction related material including wires, tin cans, spent ordnance, metal strapping, pieces of concrete, and wood. The debris was generally located within the first 24 inches of the test pits. The aerial extent of the debris was confined along the access road, which transects Site 3, with the majority of debris located on the north side of the road.

Soils classified as burnt or stained generally consisted of black stained silty sand, occasionally exhibited petroleum odors, and contained wires, scrap metal, and wood. Test Pit 8 identified on Figure 2-4 exhibited burnt soils and fire fighting equipment (used fire extinguisher and a fire hose coupling) providing further indication that soils at the site were burned at one time or were transported to the site after being burned. The extent of the burnt or stained soil was limited to the north side of the gravel road at Site 3. The depth of the burnt or stained soil extended to a maximum depth of 30 inches below ground surface.

2.3.1.2 Nature, Extent, and Potential Risk of Compounds in Soils at Site 3

A total of eighteen surface soil samples (SJS03-SS01 through SJS03-SS18) were collected during the Remedial Investigation Phase I and Phase II sampling events. Seven samples were collected from a depth of 0 to 3 inches below ground surface (bgs) during the Phase I RI and eleven samples were collected from 0 to 6 inches bgs during the Phase II RI. The surface soil samples were analyzed for TAL metals, TCL VOCs, TCL SVOCs, and pesticides/PCBs. Twenty subsurface soil samples (SJS03-SB01 through SJS03-SB20) were collected and analyzed during the Phase I and Phase II sampling events and analyzed for TAL metals, TCL VOCs, TCL SVOCs, and pesticides/PCBs. Five additional subsurface soil samples (SJS03-SB21 through SJS03-SB24 and SJS03-SB26) were collected during an Extent of Waste Investigation and analyzed for dioxins and/or total petroleum hydrocarbons (TPH).

Metals

All twenty-three TAL metals were detected at least once in the eighteen surface soil samples collected at Site 3. Those metals which exceeded their UTLs were antimony, arsenic, barium, chromium, copper, iron, lead, vanadium, and zinc and are presented on Figure 2-2. Ecological and human health risk drivers identified are aluminum, antimony, arsenic, chromium, copper, iron, lead, mercury, vanadium, and zinc (Table 2-1). The population-to-population comparison of the risk drivers and metals that exceed their UTL did not identify any central tendency statistical difference between site and background sample populations. With the exception of sample location SJS03-SS15, the highest concentrations of metals at Site 3 correspond to samples collected within the limits of waste and debris (SJS03-SS04, SS09, SS17, SB17, SB18, SB19, SB20, SB22, SB23, and SB26) or immediately adjacent to the waste and debris (SJS03-SS12, SS07, SB04, SB07, and SB24).

The Navy, EPA and VDEQ evaluated the best approach for managing the potential risk to human health and the environment related to metals in surface soils at Site 3. A decision was made to remove the potential risk associated with the waste, debris, and adjacent soil. Additionally, the potential risk would also be reduced by considering a removal action for soils at sample location SJS03-SS15, due to the concentrations of antimony and zinc in surface soil at this location.

Only two compounds were detected in subsurface soil samples that indicated a potential human health risk; arsenic and iron. Neither of these compounds exhibited statistical difference between background and site data in the population-to-population comparison for Site 3. Based on their distribution, within the limits of waste, the potential risk posed by these compounds will be eliminated through the selection of any one of the three removal action alternatives.

Volatile Organic Compounds

No volatile organic compounds (VOCs) were identified as human health risk drivers in surface and subsurface soil samples at Site 3. Two VOCs were identified as risk drivers in the ecological (through Step 3a) risk assessment; acetone and chloromethane. There are no BTAG screening values for these compounds therefore, no removal action is required based upon VOC contamination.

Semi-Volatile Organic Compounds

Twenty-three SVOCs were detected in surface soil samples. Eighteen COPCs were identified as ecological risk drivers. Based on statistical differences between site and background samples, only two polycyclic aromatic hydrocarbons (PAHs) required further consideration to address potential risk; anthracene and phenanthrene. Although, based on population-to-population comparison, naphthalene was identified as having a statistical difference between site and background samples, concentrations did not exceed the background UTL and naphthalene was not identified as a potential risk. The distribution of the three PAHs is similar to that of the metals where concentrations posing a potential risk occur only within the limits of waste.

Four additional PAHs were identified as ecological risk drivers which had no established background UTL to perform a population-to-population comparison; 2-methylnaphthalene, carbazole, dibenzofuran, and bis(2-ethylhexyl)phthalate). There is no established BTAG screening values for these four compounds and no removal action is required for these SVOCs.

No SVOCs in subsurface soil samples were identified as risk drivers.

The Navy, EPA and VDEQ evaluated the best approach for managing the potential risk to human health and environment related to PAHs in soils at Site 3 and agreed that there is no unacceptable risk outside the peripheral limits of waste and debris.

Pesticides/PCBs

Several pesticides/PCBs were detected in both surface soil and subsurface soil samples. These included the pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endosulfan 1, alpha-chlordane, and PCBs aroclor-1254 and aroclor-1260. Of the detected compounds, only endosulfan 1 was identified as a risk driver. Based on the population-to-population comparison of site and background data, there was no statistical difference between site and background data for endosulfan 1. Therefore, pesticides and PCBs do not indicate a potential risk to human health or the environment. Additionally, the removal action alternatives to address metals and PAHs would include those sample locations with the highest pesticide/PCB concentrations.

Total Petroleum Hydrocarbons

Total petroleum hydrocarbons (TPH) were analyzed in eleven surface soil and fifteen subsurface soil samples. Two subsurface soil sample locations (SJS03-SB09 and SJS03-SB24) had concentrations of TPH that exceeded VDEQ underground storage tank program reporting requirement for TPH of 100 mg/Kg (*Storage Tank Program Technical Manual*, VDEQ, 1999). Though there is no potential risk associated with the TPH in soils, the location of the two subsurface soil samples (SB09 and SB24) is within the extent of waste and would be addressed by any of the removal action alternatives.

2.3.1.3 Nature Extent and Potential Risk of Compounds in Sediment at Site 3

A total of seven sediment samples (SJS03-SD01 through SJS03-SD04 and SJS03-SD05 through SJS03-SD08) were collected from drainage ditches at Site 3 during the Remedial Investigation Phase I and Phase II sampling events. Samples were collected from a depth of

0 to 6 inches bgs. The sediment samples were analyzed for TAL metals, TCL VOCs, TCL SVOCs, and TCL pesticides/PCBs.

Results from the human health and ecological risk assessments from the RI report indicate a potential risk from sediments at Site 3, but because viable aquatic habitats are not present at Site 3, ecological risk associated with sediment was only evaluated as a media of potential contaminant transport to Blows Creek. COPCs were identified based on a comparison of sediment data to BTAG screening values. The human health risk assessment identified several inorganics as risk drivers and are described below.

Based on the presence of certain COPCs in sediment in ditches at Site 3 and the nature of sediment transport in the drainage ditches, the Navy, EPA and VDEQ agreed that the best approach for managing the potential risk to ecological and human health receptors related to compounds in sediment at Site 3 would be to remove surface layer sediment along the full length of the drainage ditches at Site 3.

Metals

Metals were detected in all sediment samples at Site 3. The constituents that were identified as posing a potential human health risk were arsenic, antimony, and iron. The compounds which were identified as posing a potential ecological risk were; aluminum, antimony, arsenic, barium, beryllium, copper, cyanide, iron, lead, manganese, mercury, nickel, and zinc based on comparison screening with BTAG criteria. Lead detected in sediment at several locations exceeded the Hazard Quotient of 1.0. However, the conceptual site model identified a lack of viable aquatic habitat at Site 3. The human health risk assessment identified antimony, arsenic, and iron as risk drivers. Based on the distribution of metals in sediment, any one of the three removal actions would mitigate potential site risk.

Volatile Organic Compounds

No volatile organic compounds were identified in the human health risk assessment. The ecological risk assessment identified twenty-nine potential risk drivers, of which, twenty-six were identified only because there is no established BTAG screening values for those compounds. The remaining three, 1,1,1-trichloroethane, 1,1,2-thrichloroethane, and ethylbenzene, were not statistically evaluated through a population-to-population comparison of site and background samples since there is no established background UTL for these compounds. Based on the distribution of the three VOCs in sediment, any one of the three removal actions would mitigate any potential risk posed by these compounds.

Semi-Volatile Organic Compounds

No SVOCs were identified in the human health risk assessment as potential risk drivers in sediment. The ecological risk assessment identified fifty-two potential risk drivers, of which twenty-nine were identified only because there is no established BTAG screening values for these compounds. Based on the distribution of the remaining twenty-three SVOCs in sediment, any one of the three removal actions would mitigate SVOCs as a risk in sediment.

Pesticides/PCBs

No pesticides/PCBs were identified in the human health risk assessment. The ecological risk assessment identified twenty-seven potential risk drivers, of which eight were

identified only because there is no established BTAG screening values for those compounds. Based on the distribution of the remaining nineteen pesticides/PCBs in sediment, any one of the three removal actions would mitigate pesticides/PCBs as a risk in sediment.

2.3.2 Site 6 – Small Arms Pit

This section discusses the extent of waste and the potential risks identified at Site 6. Since the ecological and human health risk assessments combined data from Site 5 as well as Site 6, it is not possible to quantitatively identify the potential risk of Site 6 soils. However, the highest concentrations of all compounds detected were in soils at Site 5, therefore the identified risks would be biased high as applied to Site 6 soils. To achieve closure of Site 6, it was agreed to by the Navy, EPA and VDEQ that to eliminate potential risk to human and ecological receptors, the removal action for Site 6 is included in all three removal action alternatives.

2.3.2.1 Extent of Waste

A geophysical survey of the area conducted in 1997 indicated the potential for a buried metal object. The results of the June 2001 waste delineation investigation indicated no visual signs of waste or stained/burned soils at Site 6; however, debris which may have been associated with the Small Arms Pit was detected. Test pit 1 (Figure 2-4) was excavated to confirm the location of the small cage pit and collect a soil sample for dioxin analysis. The first 6" of the test pit contained pieces of concrete, which may be the remains of the small arms pit. The extent of Site 6 was not altered from its previous boundaries based on the trenching activities.

Test Pit 2 (Figure 2-3) was excavated to determine if a specific area of activity identified during an aerial review was related to the small items pit. With the exception of a small ordnance item, no debris, waste, or burned/stained soils were observed in the test pit.

Based on the nature and extent of material encountered in Test Pit 1, the estimated volume of material for removal is 35 cubic yards. This is only an approximation estimating Site 6 to be a 20-foot diameter area for excavation of soil to a depth of 3 feet. A two-foot soil cover of the 20-foot diameter area is estimated for costing Alternative 1.

Table 2-1
Site and Background Population to Population Comparison of Central Tendency
All Site Samples
Site 3 Soils
St. Juliens Creek Annex

Matrix	Parameter	Risk Driver	Is Background Exceeded	Assumed Distribution for Comparison	Probability that the Observed Differences Would Occur Purely by Chance
SS	ALUMINUM	ECO	no	Normal	0.999
SO	ANTIMONY	ECO	no	Nonparametric	0.885
SB	ARSENIC	HH	no	Nonparametric	0.721
SS	ARSENIC	HH	no	Nonparametric	0.916
SS	CHROMIUM	ECO	no	Nonparametric	0.969
SS	COPPER	ECO	no	Nonparametric	0.566
SB	IRON	HH	no	Nonparametric	0.644
SS	IRON	ECO/HH	no	Nonparametric	0.935
SS	LEAD	ECO	no	Nonparametric	0.566
SS	MERCURY	ECO	no	Normal	1
SS	VANADIUM	ECO	no	Normal	0.972
SS	ZINC	ECO	no	Nonparametric	0.453
SS	2-METHYLNAPHTHALENE	ECO	no	Nonparametric	0.949
SO	ANTHRACENE	ECO	Yes	Nonparametric	0.005
SO	BENZO(A)ANTHRACENE	ECO	no	Lognormal	0.916
SO	BENZO(A)PYRENE	ECO	no	Nonparametric	0.942
SS	BENZO(B)FLUORANTHENE	ECO	no	Nonparametric	0.96
SS	BENZO(G,H,I)PERYLENE	ECO	no	Nonparametric	0.994
SO	BENZO(K)FLUORANTHENE	ECO	no	Lognormal	0.992
SS	CARBAZOLE	ECO	no	Nonparametric	0.79
SO	CHRYSENE	ECO	no	Lognormal	0.974
SS	DIBENZOFURAN	ECO	no	Nonparametric	0.949
SS	DIETHYLPHTHALATE	ECO	no	Nonparametric	0.92
SO	FLUORANTHENE	ECO	no	Nonparametric	0.926
SS	INDENO(1,2,3-CD)PYRENE	ECO	no	Nonparametric	0.992
SO	NAPHTHALENE	ECO	Yes	Nonparametric	0
SO	PHENANTHRENE	ECO	Yes	Nonparametric	0.003
SO	PYRENE	ECO	no	Nonparametric	0.922
SS	ACETONE	ECO	no	Nonparametric	0.959
SS	CHLOROMETHANE	ECO	no	Nonparametric	0.932

SS - Surface Soil Sample
SB - Subsurface Soil Sample
SO - Combined Surface and Subsurface Soil Sample
ECO - Ecological Risk Driver
HH - Human Health Risk Driver
Identified Ecological and/or Human Health Risk Drivers
Risk Drivers which are statistically different from background.

1/3 BBJY

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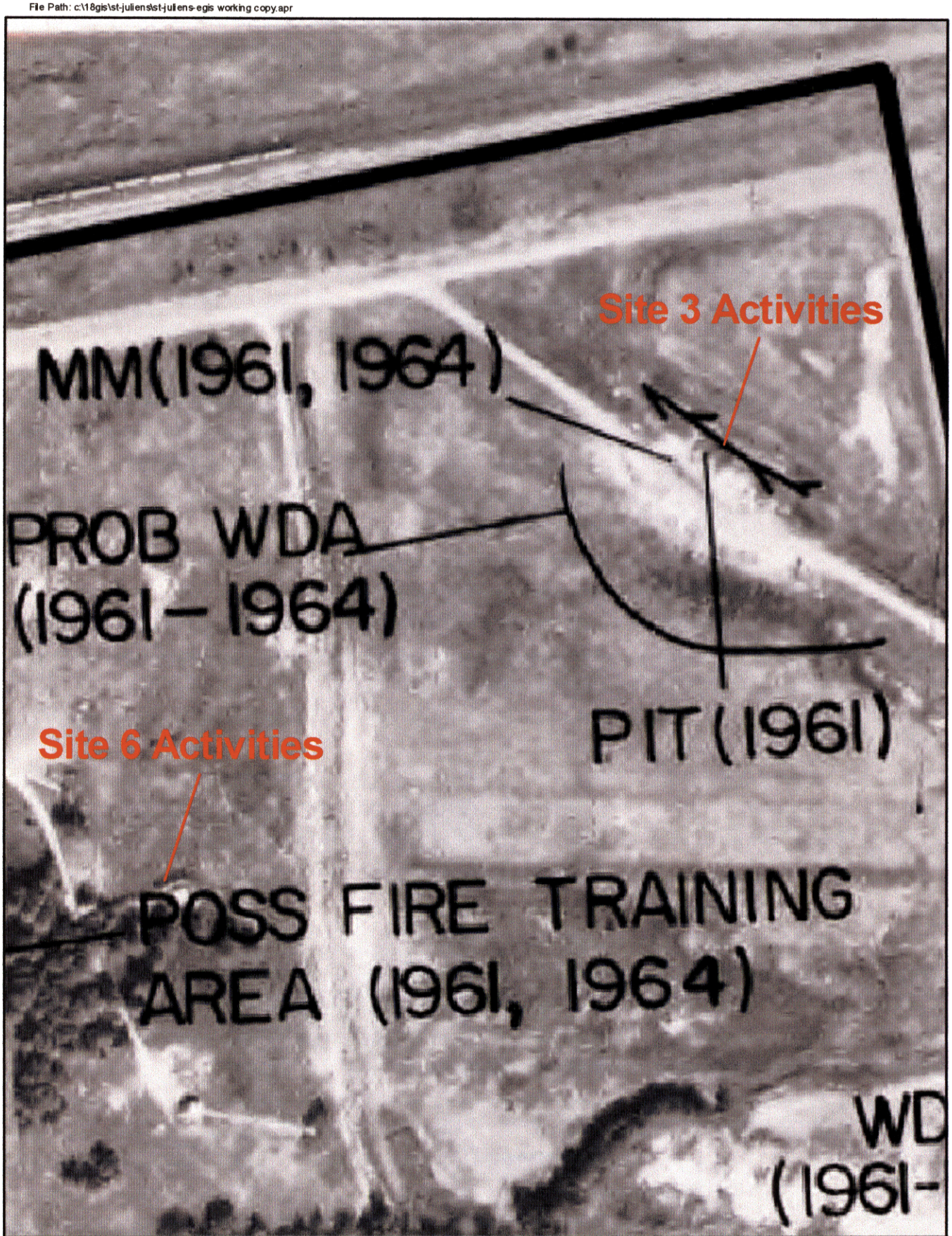

Source: EPA EPIC Study, 1995

N

0 100 200 Feet

Figure 2-1
Disposal Pit and Possible Waste Disposal Area
Site 3 and 6 EE/CA
St. Juliens Creek Annex
Chesapeake, Virginia

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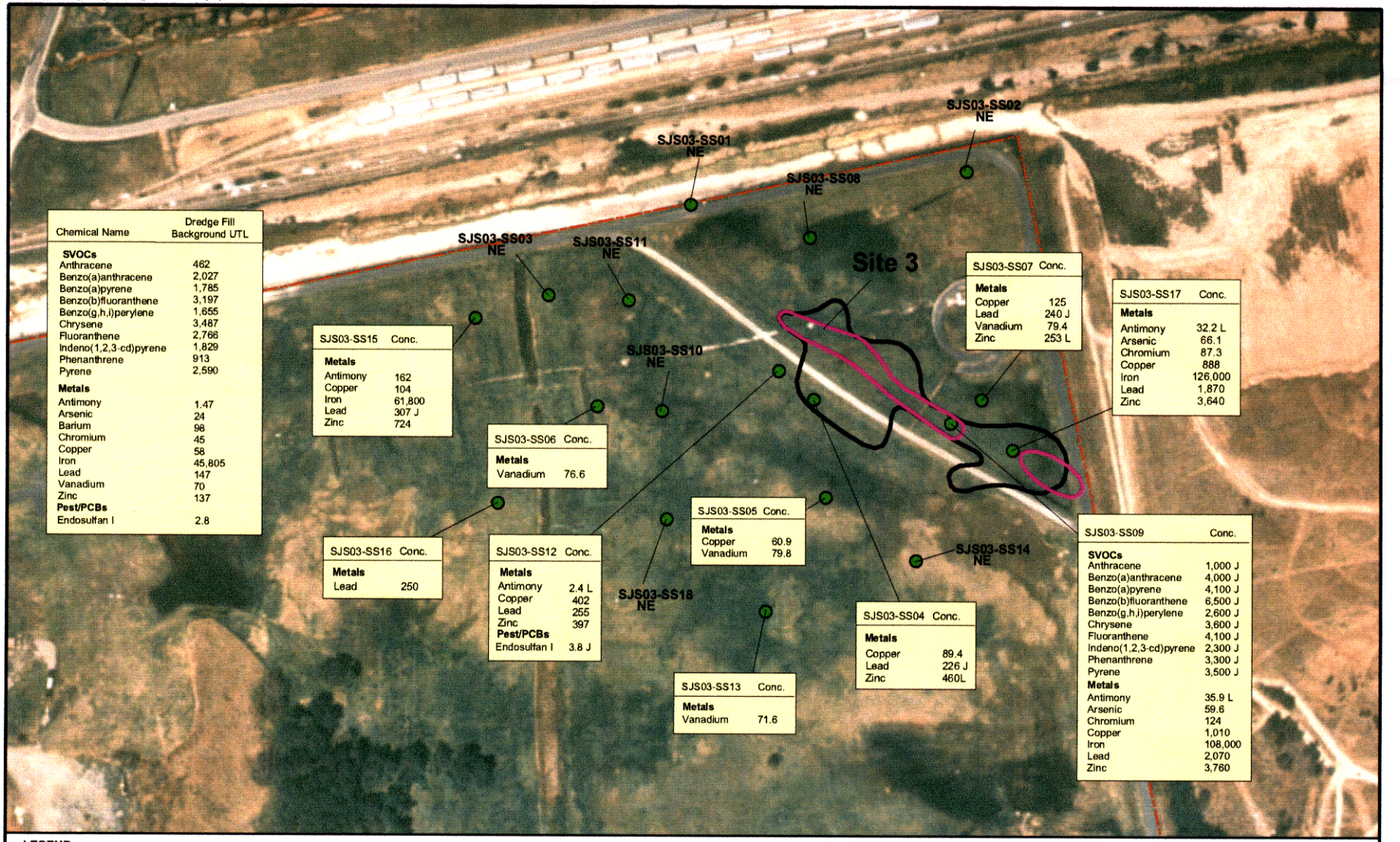

LEGEND

- Surface Soil Sample Locations
- IR Sites
- NE = No Exceedences of Background UTLs for PAH and Metal Risk Drivers
- Extent of Surface Debris
- Extent of Burnt Soil

Note: Metal concentrations are in mg/kg
SVOCs and Pest/PCB concentrations are in ug/kg

N

0 100 200 Feet

Figure 2-2
PAHs, Metals, and Pest./PCBs Risk Drivers Which Exceed the Background UTL in Surface Soils at Site 3
Site 3 and 6 EE/CA
St.Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

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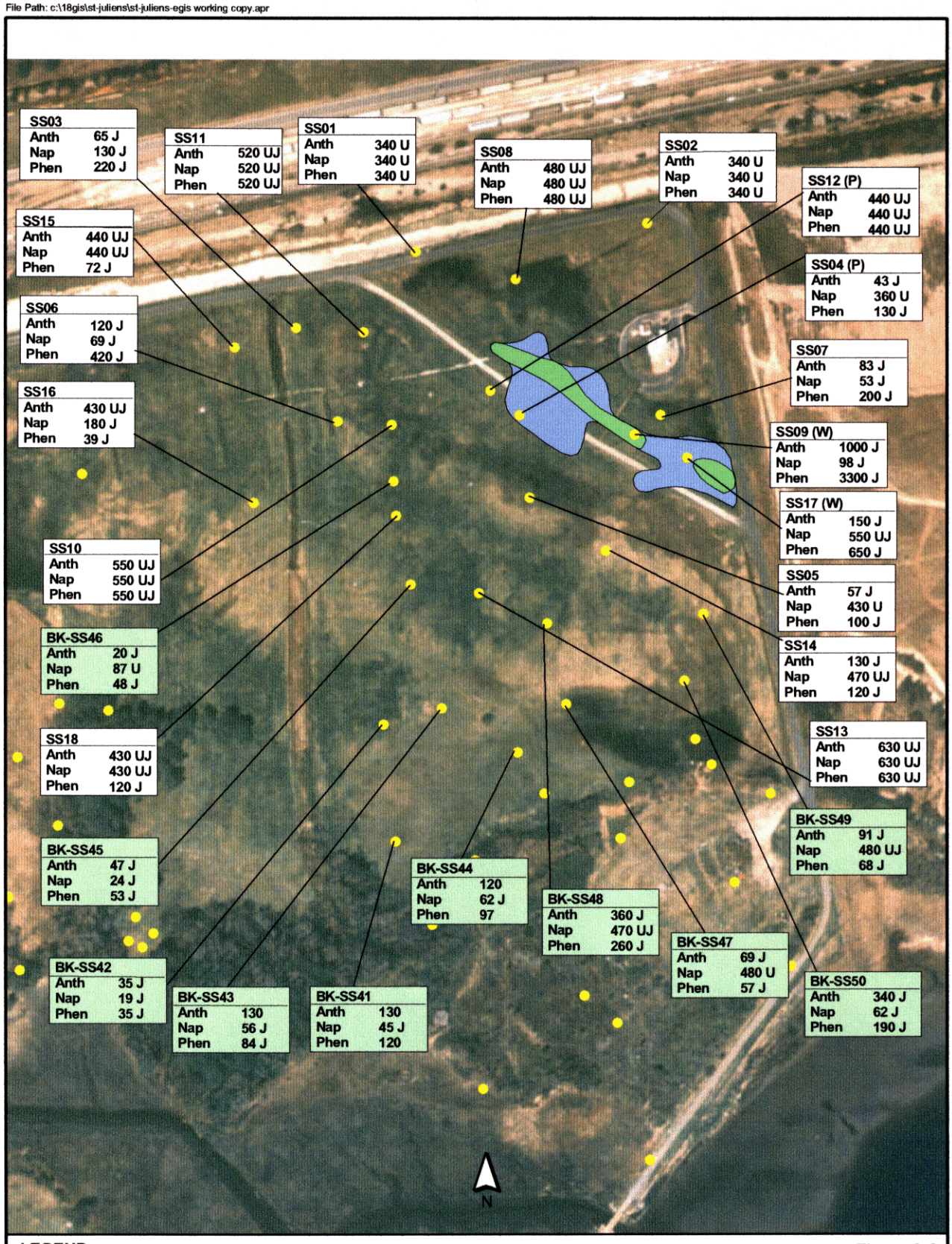

LEGEND

- Samples: Surface Soils
- Site 3 extent of burnt soils
- Site 3 extent of surface debris
- Background Sample Locations
- Site Sample Locations

Figure 2-3
Distribution of PAH Compounds in Surface Soil Which Show Statistical Difference
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

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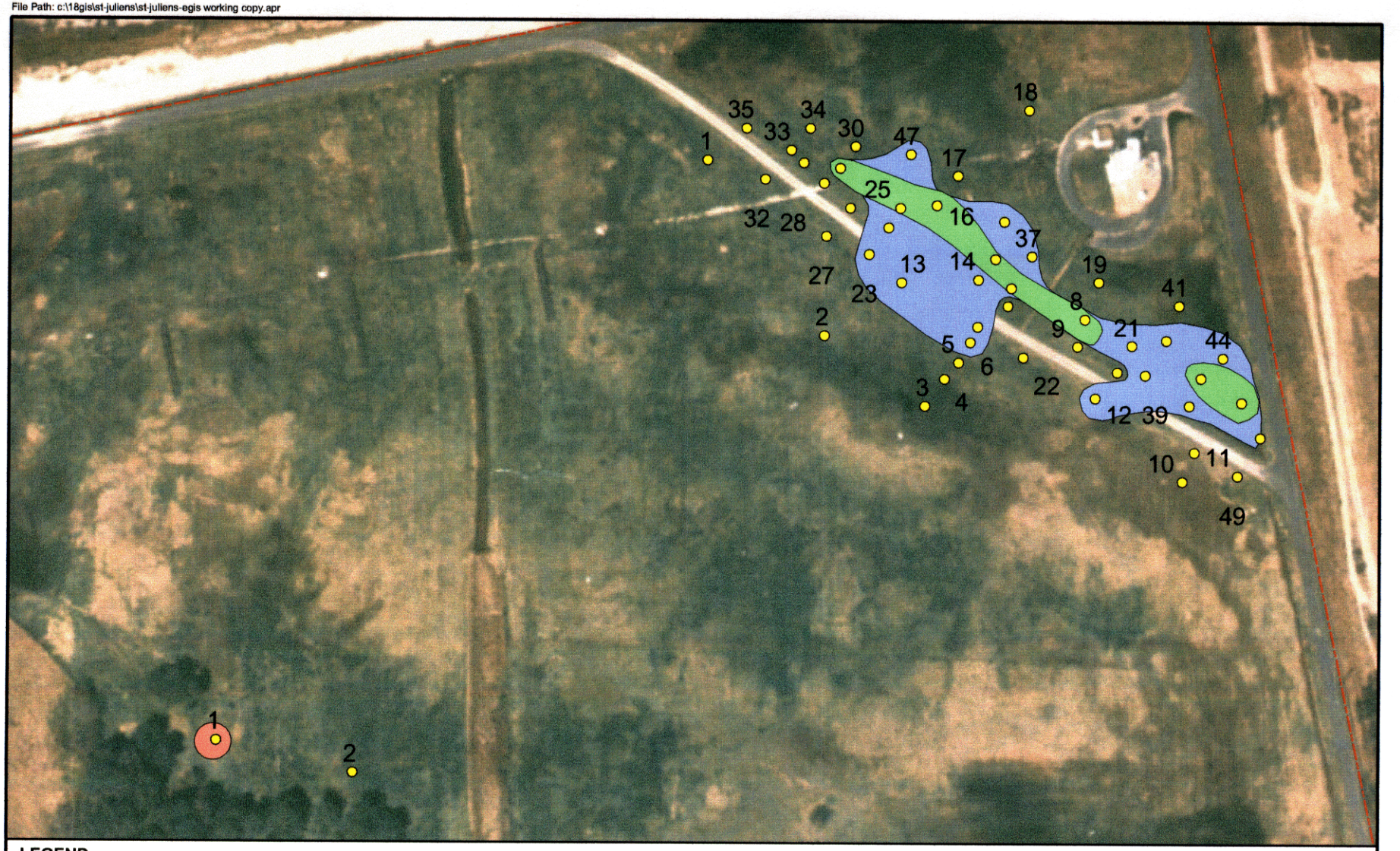


LEGEND

- Test Pits
- Site 6 extent of surface debris
- Site 3 extent of burnt soil
- Site 3 extent of surface debris

N

0 80 160 Feet

Figure 2-4
Extent of Waste - Sites 3 and 6
Site 3 and 6 EE/CA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

3. Identification of Remedial Action Objectives

3.1 Statutory Limits on Removal Action

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 CFR Part 300.415 dictates statutory limits of $2 million and 12 months of USEPA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the remedial action to be taken. This removal action will not be USEPA fund-financed. The Navy/Marine Corps Installation Restoration (IR) Manual does not limit the cost or duration of the removal action; however, cost-effectiveness is a recommended criterion for evaluation of removal action alternatives.

3.2 Removal Action Scope and Objective

3.2.1 Removal Action Objective

The removal action objective for Site 3 and Site 6 is to mitigate the potential risk to human health and the environment posed by the contaminated soils, sediment and waste/debris present at each site. This will be done by:

1. Characterization of the material to be excavated prior to excavation in order to ensure proper disposal facilities are selected,
2. Covering or excavating of soils and sediment posing an unacceptable risk to human health or the environment,
3. Continuing to restrict access to the site during the action,
4. Screening and removal of potential unexploded ordnance (UXO), during *all* excavation activities,
5. Transport and disposal of excavated materials at a permitted disposal facility,
6. Confirmation testing of soil/sediment remaining in place in areas where soils and sediment are excavated, followed by replacement with clean backfill soil,
7. Restoration of the site to include fine grading, seeding, and mulching.

3.2.2 Removal Action Scope

The objective of this proposed action will be to eliminate the potential risk to human health and ecological receptors posed by waste/debris and contaminated soils and sediment from the areas described in Section 2. These areas were identified as posing an unacceptable risk for one or more compounds including metals and PAHs. Due to past uses of Sites 3 and 6, a small potential for unexploded ordnance exists; therefore all activities related to excavation at the sites will require oversight by qualified UXO technicians. Explosives Safety Submissions (ESS) will be prepared, submitted and approved per Department of Defense

Explosives Safety Board (DDESB) requirements for NTCRAs involving explosives safety hazards related to potential UXO (*Interim Final - Handbook on the Management of Ordnance and Explosives at Close, Transferring, and Transferred Ranges and Other Sites,* USEPA, 2002)

Alternative 1 will prevent contact with potential risk media through a soil cover and, with the exception of sediment in drainage ditches, no upland excavation would be conducted. For Alternatives 2 and 3, the horizontal limits of waste have been determined through trenching activities performed at each site by CH2M HILL during the summer of 2001. The proposed limits of excavation at Site 3 for Alternative 2 will be based on the visual limits of waste as identified during the 2001 waste delineation investigation. The proposed limits of excavation for Alternatives 3 will be based on the limits of waste and identified locations of unacceptable risk. The actual excavation extent and depth may vary, depending upon the results of confirmation sampling (with in-field XRF and PAH test kit field analysis) for identified risk drivers that will be performed during the removal activities. In-field confirmation sampling will be followed by analytical laboratory confirmation analysis. Excavation will not exceed the depth of the groundwater table, measured to be no more than 5 feet below ground surface. The removal action will require the excavation of soil/debris (including UXO screening/removal), transport and disposal of excavated materials, and site restoration.

3.3 Determination of Removal Schedule

Once the EE/CA has been drafted, it is placed in the Administrative Record, and notice of its availability, along with a brief summary, are published for public review. The EE/CA is then subjected to a 30-day public comment period. Following the 30-day public comment period, responses will be published in the SJCA Administrative Record and incorporated into the final document. Further, the comments will be addressed at the next SJCA RAB meeting. The RAB meeting minutes also are incorporated into the Administrative Record.

Since this removal action has been designated non-time-critical, the start date will be determined by factors other than the urgency of the threat. Possible factors include weather conditions, the availability of resources, and site constraints.

A preliminary breakdown of the schedule is provided in Gantt Chart form in Figure 3-1. Alternative 1 would be conducted in fiscal year 2002 and is expected to last approximately 2 to 3 weeks. If either of the soil excavation alternatives are chosen (Alternative 2 and 3), limitations on government funding would require two phases to complete the entire removal action at Site 3. Phase one would be conducted in fiscal year 2002 and phase two would be scheduled for completion in fiscal year 2003. The Site 6 removal action is scheduled for completion in fiscal year 2002. The removal action for Site 6 is expected to last approximately 5 months from the end of the public comment period to completion of the closeout report. If Alternatives 2 or 3 are chosen, once funding is available, completion of the removal action for Site 3 would take an additional 4 months. Critical milestones are summarized below:

- EE/CA Public Comment Period–30 days
- Preparation of Work Plan–35 days
- Subcontracting and Mobilization–10 days

- Removal Action–14 to 21 days
  - Alternative 1 - 14 days
  - Alternative 2 - 21 days
  - Alternative 3 - 21 days
- Closeout Report Writing–38 days

The removal action time frame includes the time required for mobilization and setup of equipment, and performing the selected removal action. The time frames stated above to complete critical milestones are dependent upon the assumptions that all materials may be disposed of as non-hazardous, no significant UXO findings are encountered during excavation activities, and the limits of excavation required reflect the waste limits determined during the 2001 trenching activities and risks identified in the RI and subsequent risk management decisions agreed upon by the Navy, EPA, and VDEQ. Section 4 provides details regarding the amount of time necessary to complete the removal action.

For Site 3, if Alternative 2 or 3 are selected, excavation of the remaining soil, waste/debris, and sediment would occur in early 2003, followed by closeout reporting for Site 3.

3.4 Applicable or Relevant and Appropriate Requirements

The removal action will, to the extent practicable, attain Applicable or Relevant and Appropriate Requirements (ARARs) under federal and state environmental laws, as described in 40 CFR 300.415. Other federal and state advisories, criteria, or guidance will, as appropriate, be considered in formulating the removal action. Applicable requirements are those requirements specific to the conditions at Site 3 and Site 6 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 Site 3 and Site 6, but are meant to address similar situations, and therefore are suitable for use at Site 3 and Site 6. Federal ARARs are determined by the lead agency, which in this case is the Department of 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 what 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 media 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 chemicals of concern in the designated media, or set safe concentrations of discharge for remedial activity. Guidance relevant to the specific chemicals at Site 3 and Site 6 includes the RBCs put forth by USEPA Region III. If the soil is classified hazardous, then prohibitions on land disposal specified in 40 CFR, Part 268, may apply.

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 floodplains, near locations of known endangered species, or on protected waterways. There are no location-specific ARARs for the removal action at Site 3 and Site 6. The federal and state of Virginia location-specific regulations that have been reviewed are summarized in Appendix A.

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for hazardous substances. Federal and State of Virginia Action-specific ARARs that may affect the development and conceptual arrangement of remedial alternatives are summarized in Appendix A.

3.5 General Disposal Requirements

Characterizing the soil contamination by toxicity characteristic leaching potential (TCLP) is critical in determining the status of Resource Conservation and Recovery Act (RCRA) requirements. RCRA "operating" hazardous waste management regulations are not applicable unless waste material is excavated.

If contaminated soil excavation and disposal were part of the selected removal action, waste characterization would include sampling of in-situ soils in order to determine disposal requirements (at a minimum). A round of composite sampling would be conducted prior to developing the waste management plan, and these efforts would determine the disposal characteristics of the waste. Specific disposal characterization requirements may vary depending on the requirements of the disposal facility accepting the waste. The analytical methods, sample frequency, and concentration limits are given in Table 3-1.

Characterization sampling can either be conducted in-situ (prior to excavating the soils) or ex-situ (after excavating the soils), in order to determine soil staging and disposal requirements. If wastes are to be disposed of offsite, written permission based on in-situ waste characterization must be obtained from the receiving facility and from the state in which the disposal facility is located (if applicable).

Material that is characterized as hazardous or not acceptable for local Subtitle D landfill disposal would require stabilization prior to disposal. All stabilized material must meet the treatment requirements outlined in 40 CFR Part 268.40.

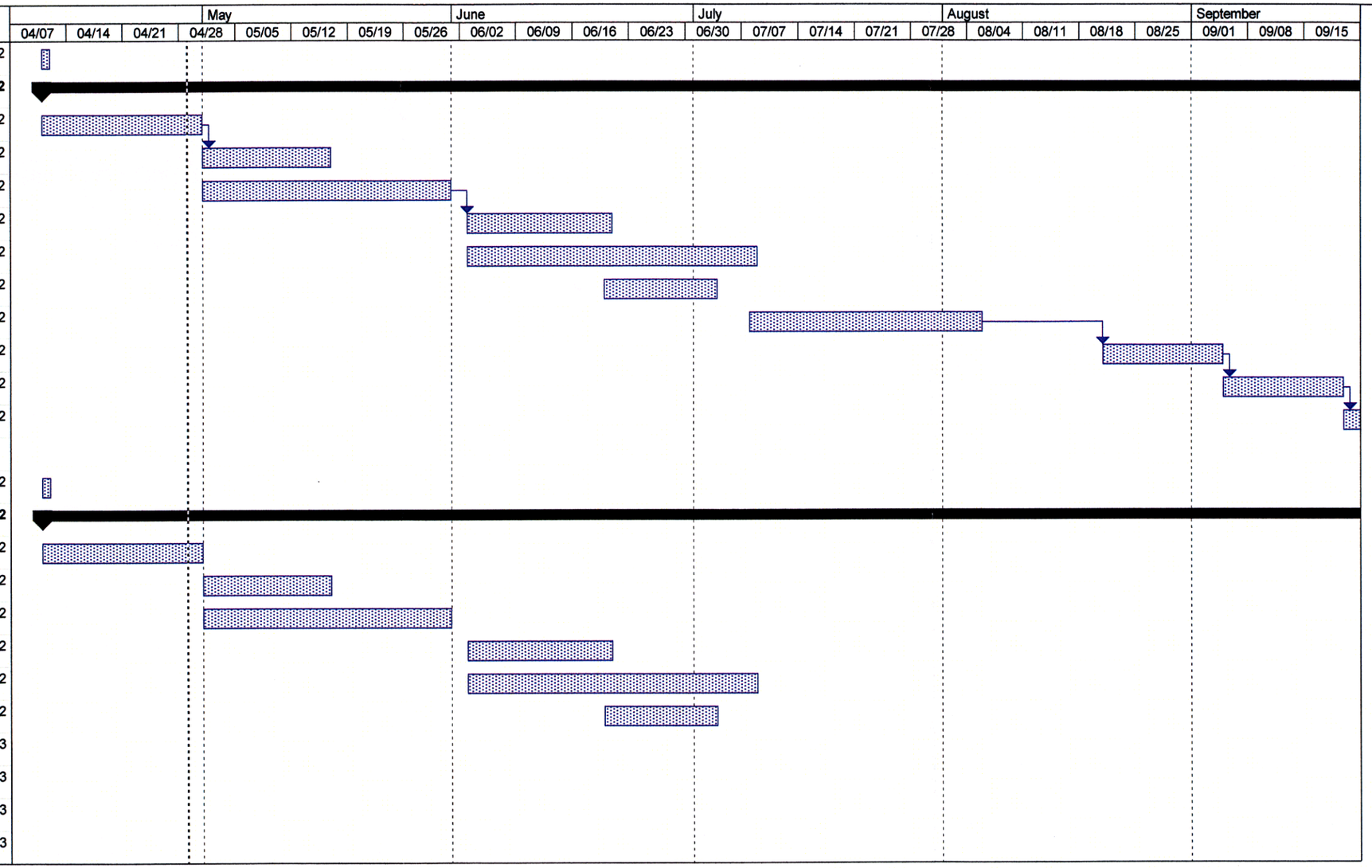
TABLE 3-1
Summary of Characterization Sampling for St. Juliens Creek Annex Sites 3 & 6 Material1

Analysis	Method	Frequency	Limit
TPH (GRO or DRO)	USEPA SW 846 – 8015B Modified	1 per 1000 cy	500 mg/kg
BTEX	USEPA SW 846 – 8260B	1 per 1000 cy	10 mg/kg
TOX	USEPA SW 846 – 9020B	1 per 1000 cy	100 mg/kg
TCL PCBs	USEPA SW 846 – 8082	1 per 1000 cy	50 mg/kg
Paint Filter Test	USEPA SW 846 – 9095A	1 per 1000 cy	Not liquid waste
TCLP Lead	USEPA SW 846 – 1311/6010B	1 per 1000 cy	< 5 mg/kg
TCLP – VOC	USEPA SW 846 – 1311/8260B	1 per 1000 cy	Below all toxicity characteristic levels for VOCs
TCLP – SVOCs	USEPA SW 846 – 1311/8270B	1 per 1000 cy	Below all toxicity characteristic levels for SVOCs
TCLP – Pesticides	USEPA SW 846 – 1311/8081A	1 per 1000 cy	Below all toxicity characteristic levels for pesticides
TCLP – Herbicides	USEPA SW 846 – 1311/8151A	1 per 1000 cy	Below all toxicity characteristic levels for herbicides
TCLP – Metals	USEPA SW 846 – 1311/6010B/7471A	1 per 1000 cy	Below all toxicity characteristic levels for metals
Ignitability	USEPA SW 846 – 1010/1020A	1 per 1000 cy	Not ignitable
Corrosivity	USEPA SW 846 – 9045C	1 per 1000 cy	Not corrosive
Reactivity – Cyanide	USEPA SW 846 Section 7.3	1 per 1000 cy	250 mg/kg
Reactivity – Sulfide	USEPA SW 846 Section 7.3	1 per 1000 cy	500 mg/kg

1. Specific disposal characterization requirements may vary depending on the requirements of the disposal facility accepting the waste.

Figure 3-1
EE/CA Project Shedule
Sites 3 & 6
St. Juliens Creek Annex
Chesapeake, Virginia

ID	Task Name	Duration	Start
1	**Alternative 1**	1 day	Thu 04/11/02
2	**EE/CA (Site 6)**	**122 days**	**Thu 04/11/02**
3	Submit Draft EE/CA	14 days	Thu 04/11/02
4	Regulatory Review	12 days	Wed 05/01/02
5	Public Comment Period	23 days	Wed 05/01/02
6	Submit Final EE/CA	14 days	Mon 06/03/02
7	Preparation of the Work Plan	26 days	Mon 06/03/02
8	Subcontracting and Mobilization	10 days	Thu 06/20/02
9	Removal Action (Site 6/Parial Site 3)	21 days	Mon 07/08/02
10	Draft Closeout Report	11 days	Wed 08/21/02
11	Regulatory Review	11 days	Thu 09/05/02
12	Final Closeout Report	6 days	Fri 09/20/02
13			
14	**Alternative 2 and 3**	1 day	Thu 04/11/02
15	**EE/CA (Site 3)**	**287 days**	**Thu 04/11/02**
16	Submit Draft EE/CA	14 days	Thu 04/11/02
17	Regulatory Review	12 days	Wed 05/01/02
18	Public Comment Period	23 days	Wed 05/01/02
19	Submit Final EE/CA	14 days	Mon 06/03/02
20	Preparation of the Work Plan	26 days	Mon 06/03/02
21	Subcontracting and Mobilization	10 days	Thu 06/20/02
22	Completion of Removal Action Site 3	14 days	Mon 02/03/03
23	Draft Closeout Report	25 days	Mon 02/24/03
24	Regulatory Review	21 days	Mon 03/31/03
25	Final Closeout Report	14 days	Tue 04/29/03



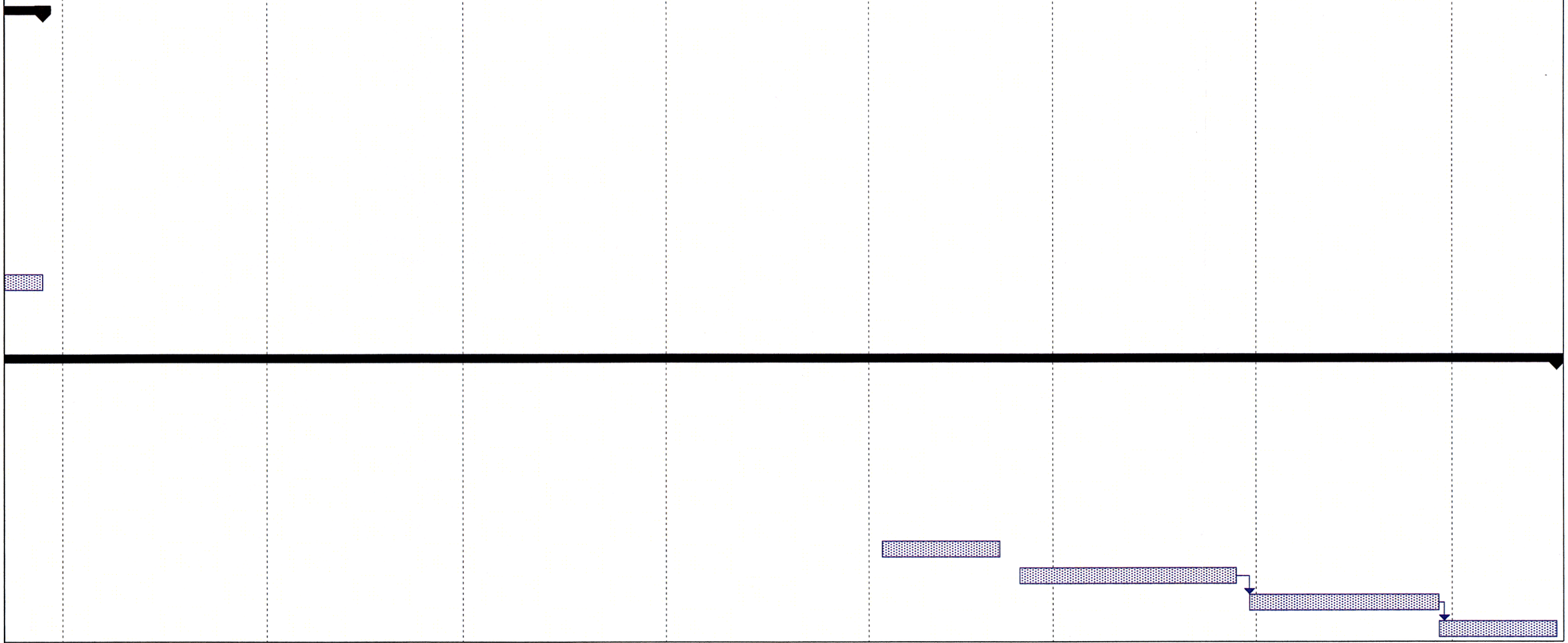
Project: EE_CA
Date: Mon 04/29/02

Task
Split
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Split
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary

163 BB3Y

Figure 3-1
EE/CA Project Shedule
Sites 3 & 6
St. Juliens Creek Annex
Chesapeake, Virginia

	October					November				December				January					February				March				April					May	
09/22	09/29	10/06	10/13	10/20	10/27	11/03	11/10	11/17	11/24	12/01	12/08	12/15	12/22	12/29	01/05	01/12	01/19	01/26	02/02	02/09	02/16	02/23	03/02	03/09	03/16	03/23	03/30	04/06	04/13	04/20	04/27	05/04	05/11



Project: EE_CA
Date: Mon 04/29/02

Task | Progress | Summary | Rolled Up Split | Rolled Up Progress | Project Summary
Split | Milestone | Rolled Up Task | Rolled Up Milestone | External Tasks

4. Description of Removal Action Alternatives

Three removal alternatives were developed using best professional judgment. One alternative (Alternative 1) involves covering the contaminated soils and waste that pose potential risks and excavating surface sediment in drainage ditches. Two alternatives, Alternatives 2 and 3, involve excavating the material that poses potential risk (contaminated soil, waste/debris, and sediment). Differences between Alternatives 2 and 3 consist of the approaches to the defined limits of excavation and the quantity of waste soil to be removed; including soil at sample location SJS03-SS15.

The potential risks at Sites 3 and 6 are defined as compounds that pose a potential risk using data from the *Final Background Investigation Report* (CH2M HILL, October 2001) and the *Draft Remedial Investigation/Human Health Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, & 6* (CH2M HILL, December 2001). Additionally, statistical comparison of site and background data and risk management decisions were used to better define the potential risk (as discussed in Section 2). Chemicals that pose potential risks are metals and PAHs. Also included within Sites 3 and 6 are miscellaneous pockets of burnt materials and spent ordnance shells (debris). Due to the uncertainties involved with potential ordnance at the site, UXO oversight is necessary during activities involving excavation. Since no single on-site treatment is a viable alternative to simultaneously treat the compounds that pose a potential risk (and due to the presence of construction debris), excavation and offsite disposal or a soil cover were the only viable alternatives to eliminate the potential risk from the sites. To avoid any land use restriction and/or long term monitoring requirements, removal of the contaminated material was the only viable alternative.

Once removal alternatives were developed, each one was evaluated individually according to its effectiveness, ease of implementation, and total present-value cost. A summary of the alternative evaluation is provided in Table 4-1 following the discussion of the alternatives.

4.1 Evaluation Criteria

Evaluation criteria for evaluating and comparing alternatives conform to the evaluation criteria used by EPA for all removal actions performed under CERCLA. They include effectiveness, implementability, and cost. The components of each are described below.

4.1.1 Effectiveness

The effectiveness criterion addresses the expected results of the removal alternatives. It includes two major subcategories: protectiveness and ability to achieve the removal objectives. The "effectiveness criteria," from the USEPA guidance document *Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA* (EPA/540-R-93-057), are identified below.

Protectiveness

To be protective, the removal alternative must be:

- Protective of public health and community;
- Protective of workers during implementation;
- Protective of the environment; and
- Compliant with Applicable or Relevant and Appropriate Requirement (ARARs).

Ability to Achieve Removal Objectives

To successfully achieve the removal objectives, the removal alternative must:

- Meet the expected level of treatment or containment;
- Have no residual effect concerns; and
- Will maintain control over the long-term.

4.1.2 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

Technical feasibility includes:

- Construction and operational consideration;
- Demonstrated performance and useful life;
- Adaptability to environmental conditions;
- Contribution to performance of long-term removal actions; and
- Implementation within the allotted time.

Availability of Resources

Availability of resources includes:

- Availability of equipment;
- Availability of personnel and services;
- Laboratory testing capacity;
- Off-site treatment and disposal capacity; and
- Post-removal site control.

Administrative Feasibility

Administrative feasibility includes:

- Required easement or rights-of-way;
- Impacts on adjoining property;
- Ability to impose institutional controls, and
- Likelihood of obtaining exemptions from statutory limits (if needed).

4.1.3 Cost

The cost criterion encompasses the life-cycle costs of a project, including the projected implementation costs and the long-term operational and maintenance costs of the remedial action. Alternatives 1 and 2 would require long-term operational and maintenance, including mowing, inspections, and routine groundwater monitoring. These costs have been calculated and are considered in the alternative selection.

Direct capital costs include actual costs of the removal action, such as:

- Construction costs;
- Equipment and material costs;
- Buildings and service costs;
- Transport and disposal costs;
- Analytical costs; and
- Contingency allowances.

Other commonly encountered direct capital costs, such as land and site acquisition costs, relocation expenses, and treatability costs are not applicable to this project.

Indirect capital costs typically include non-construction costs of the action, such as:

- Engineering and design expenses;
- Legal fees and license; and
- Startup and shakedown costs for processes and equipment.

The cost estimates for this section are provided to an accuracy of +50 percent to -30 percent. The alternative cost estimates are in 2000 dollars and are based on information published in R.S. Means Environmental Cost Data (ECHOS 2001). Where Means data was not available or not appropriate phone quotes or engineering estimates were used for unit pricing.

4.2 Alternative 1—Soil Capping with Clean Fill and Excavation of Sediment

The goal of this alternative is to import approximately 9,991 cubic yards of clean fill material to be placed over the former waste disposal areas at Site 3, debris at Site 6, and soil sampling location SJS03-SS15 to provide a two-foot soil cover capable of providing separation from the waste, debris, and chemical compounds which pose a potential risk at Sites 3 and 6 (Figure 4-1). Information supporting the development of this quantity and related quantities is provided in Appendix B. This action will provide a separation layer of clean soil material over the identified soil areas of potential risk at each site. This will mitigate potential risks to human health and the environment by preventing an exposure pathway. At Site 3, the surface sediment (0-1 foot) in upland ditches will be excavated to mitigate potential risk associated with exposure to sediment.

For this alternative, no excavation of soil is required. Since recent investigations at the site have shown the contaminated soil/debris to be above the water table at the site and since potential impacts to groundwater are being addressed separately, the two feet of fill will not include engineering specifications to prevent infiltration into the former disposal areas.

UXO oversight will be necessary during excavation of the sediments. However, since no soil excavation is required in this alternative, the area is regularly mowed, and no shock sensitive material has been previously identified, the need for UXO oversight during construction of the soil covers is eliminated.

A summary of the components, acreage, and volume are listed below:

- **Alternative 1:** Soil cover for Sites 3 and 6, sample location SJS03-SS15, removal of sediment
- **Area:**
  - Soil Cover: 3.01 acres
  - Sediment Removal: 0.80 acres
- **Volume:**
  - **Soil Cover:** 7,796 cubic yards
  - **Sediment Removal:** 1,287 cubic yards
- **Cost of Removal Action without Operation and Maintenance (O&M) costs:** $360,697
- **Present Worth Cost:** $1,256,827

The following steps will be involved in this alternative:

1. Import approximately 9,991 cubic yards of clean fill material to be placed to a 2-foot thickness over the entire limits of waste/debris at Site 3 and 6. This volume also includes backfill material for the removed sediments. The estimated extent of the cover for Site 6 is 20 foot in diameter. The estimated extent of the soil cover and the sediment to be removed are depicted on Figure 4-1.
2. Place a 2-foot thick and estimated 20 foot diameter soil cover over sample location SJS03-SS15.
3. Remove surface sediment with appropriate off-site non-hazardous disposal and replace with clean fill.
4. Site grading to include 2-foot thickness over former waste areas and SJS03-SS15 while keeping grades small enough to not interfere with on-going site maintenance (mowing).
5. Site restoration to include mulching and seeding to re-establish vegetative cover over soil cover areas; restoration of drainage ditches.
6. Annual operation and maintenance activities including annual inspection of the covers, mowing, and routine groundwater monitoring.

The long-term effectiveness of Alternative 1 is low. The alternative will mitigate the potential risks to human health and the environment by providing separation from identified potential risks (waste/debris and chemical compounds) at the sites. Land use restrictions would be required to ensure adequate protection is provided at the site for any potential future uses of the sites.

Alternative 1 would be easy to implement. Importing fill, site grading, and seeding/mulching could be carried out in a short time. Such activities are routine for a number of contractors. Alternative No. 1 has a total present-value cost of $1,256,827. The cost breakdown for Alternative 1 is provided in Appendix C.

4.3 Alternative 2—Excavation and Disposal of Burnt/Stained Waste Identified During 2001 Investigation for Sites 3 and 6

This alternative includes the removal of visibly contaminated soils/waste and debris identified during the 2001 waste delineation investigation at Sites 3 and 6, a two-foot soil cover over soils posing a potential risk along the periphery of the waste area and SJS03-SS15, and the removal of surface sediment in upland ditches at Site 3. The extent of the visible waste and debris determined by the 2001 waste delineation investigation is presented in Figure 4-2. The final removal depth will depend on in-field XRF analysis and PAH test kits followed by confirmatory laboratory samples, but will not exceed the depth to the groundwater table, determined to be no more than 5 feet bgs. However, the removal depth is estimated to be approximately 3 feet bgs.

A summary of the components, acreage, and volume are listed below:

- **Alternative 2:** Removal of visibly contaminated soil and waste/debris at Site 3 and 6, soil cover over the periphery of the waste area and SJS03-SS15, and the removal of surface sediment in upland ditches at Site 3
- **Area:**
  - Soil/waste Removal: 1.08 acres
  - Soil Cover: 0.97 acres
  - Sediment Removal: 0.80 acres
- **Volume:**
  - Soil/waste removal: 5,226 cubic yards
  - Soil Cover: 3,130 cubic yards
  - Sediment Removal: 1,287 cubic yards
- **Cost of Removal Action without O&M costs:** $1,128,310
- **Present Worth Cost:** $2,024,440

The following steps will be involved in this alternative:

1. Excavation of approximately 1.08 total acres of soil/waste and debris at Sites 3 and 6 to a maximum depth of 5 feet bgs (approximate depth to groundwater) as shown on Figure 4-2. The estimated extent of excavation at Site 6 is 20 foot diameter. However, removal depth is estimated to be approximately 3 feet bgs. Excavation will include in-field XRF and PAH readings and confirmation sampling (24-hour turnaround time) to ensure that the potential risk posed by the chemicals in soils, identified in Section 2, have been removed.

2. Placement of a two-foot soil cover over soils posing a potential risk along the periphery of the waste area and SJS03-SS15.
3. The removal of 0.80 acres of surface sediment in upland ditches at Site 3 with appropriate off-site non-hazardous disposal and replace with clean fill.
4. UXO construction oversight during excavation to include screening for and handling of potential unexploded ordnance that may be present at the site.
5. Disposal of excavated material (non-hazardous) in local Subtitle D landfill, including verification testing that the material is acceptable by the facility.
6. Importing clean fill materials to the excavation and re-establishing the site to its original ground surface.
7. Final grading, seeding, and mulching to restore the site to its original vegetated cover.

Costs for this alternative are based upon the assumption that burnt/stained waste are within the limits identified during the 2001 Extent of Waste Investigation and that all materials may be disposed of as non-hazardous. Should the volume of waste encountered be significantly greater than that identified during the trenching activities at either site, or should the material require disposal in a hazardous landfill facility, the estimated cost would increase. A hazardous disposal requirement (including stabilization) will increase disposal fees by approximately six fold.

The long-term effectiveness of Alternative 2 is moderate. The alternative will mitigate the potential risks to human health and the environment by removing the sources of contamination identified at Sites 3 and 6, removing sediment posing a potential risk and preventing an exposure pathway with the soil cover. Over the short term, there would be a slightly increased risk to workers involved in the excavation and disposal of the sediment and soil/waste/debris. However, adequate protection will be in place to ensure that workers are not exposed to contamination. Since surface soil at SJS03-SS15 and along the periphery of the limits of waste will remain in place, potential risk to health and environment posed by certain chemicals in the remaining media. This would require the use of long term maintenance of the soil cover and institutional controls (ICs) for the sites.

Alternative 2 would be straightforward to implement. Excavation could be carried out over a period of several weeks. However, based on the extent of the waste encountered in the field and the possible increase in costs due to classification of the waste, funds would not be sufficient to complete the removal during one mobilization. Due to the variables in cost, the removal action would require two mobilizations over a period of 12 months. Disposal of excavated materials (once UXO clearance has been given) is a routine activity. Identification of waste that potentially contains unexploded ordnance is not necessarily a routine activity and can be very costly. Additional safety precautions necessitated from construction oversight by qualified UXO personnel relating to potential unexploded ordnance would be strictly followed and could severely inhibit the project schedule. Alternative 2 has a total present-value cost of $2,024,440. The cost breakdown for Alternative 2 is provided in Appendix C.

4.4 Alternative 3—Excavation and Disposal of Full Extent of All Waste at Site 3 and 6, Sample Location SJS03-SS15, and All Sediment at Site 3

Alternative 3 includes excavation to depths corresponding to those identified at specific areas during the waste delineation investigation at Sites 3 and 6, the removal of soil at sample location SJS03-SS15, and the removal of approximately 1,500 linear feet of sediment (approximately 5 feet wide to a depth of 1 foot) from the drainage ditches on the north, east and west sides of Site 3. To eliminate all potential risk, soils adjacent to the visible waste and debris at Site 3 will also be removed. The extent of this additional area is defined by samples SJS03-SS07, SS12, SB04, SB07, and SB24 and shown on Figure 4-3. This alternative will require the excavation of approximately 11,045 cubic yards of soil, waste, debris, and sediment from Sites 3 and 6.

A summary of the components, acreage, and volume are listed below:

- **Alternative 3:** Removal of visibly contaminated soil and debris at Sites 3 and 6, removal of surface sediment in upland ditches at Site 3, removal of soils adjacent to the extent of waste/debris identified as posing a potential risk.
- **Area:** 2.4 acres
- **Volume:** 9,204 cubic yards
- **Cost of Removal Action:** $1,485,837

Due to the known presence of spent ordnance shells at Sites 3 and 6, UXO oversight is required during excavation activities conducted as part of this alternative.

The following steps will be involved in this alternative:

1. Excavation of approximately 2.4 total acres of soil/sediment/waste/debris at Sites 3 and 6 as depicted in Figure 4-3. The estimated diameter for excavation at Site 6 is 20 foot. Excavation will include in-field XRF and PAH readings and confirmation sampling (24-hour turnaround time) for compounds identified as posing a potential risk, as described in Section 2, to ensure that the potential risk has been removed.
2. UXO construction oversight during excavation to include screening for and handling of potential unexploded ordnance that may be present at the site.
3. Disposal of excavated material (non-hazardous) in local Subtitle D landfill, including verification testing that the material is acceptable by the facility.
4. Importing clean fill materials to the excavation and re-establishing the original grade within the sites and drainage ditches.
5. Final grading, seeding, and mulching to restore the site to its original vegetated cover.

Costs for this alternative are the moderate, based upon the assumed volume and waste limits identified during the 2001 Extent of Waste Investigation and that all materials may be disposed of as non-hazardous. Should the volume of waste encountered be significantly greater than that identified during the trenching activities at either site, or should the

material require disposal in a hazardous landfill facility, the estimated cost would increase. A hazardous disposal requirement (including stabilization) will increase disposal fees by approximately six fold.

The long-term effectiveness of Alternative 3 is high. The alternative will eliminate the potential risks to human health and the environment by removing the sources of contamination and associated contaminated media identified in the Remedial Investigations at Sites 3 and 6. Over the short term, there would be a slightly increased risk to workers involved in the excavation and disposal of the soil. However, adequate protection will be in place to ensure that workers are not exposed to contamination.

Alternative 3 would be straightforward to implement. Excavation could be carried out in a period of several weeks, however, based on limitation of funding, this removal action would require two mobilizations over a period of 12 months. Disposal of excavated materials (once UXO clearance has been given) is a routine activity. Identification of waste that potentially contains unexploded ordnance is not necessarily a routine activity and can be very costly. Additional safety precautions necessitated from construction oversight by qualified UXO personnel relating to potential unexploded ordnance would be strictly followed and could inhibit the project schedule. Alternative No. 3 has a total present-value cost of $1,485,837. The cost breakdown for Alternative 3 is provided in Appendix C.

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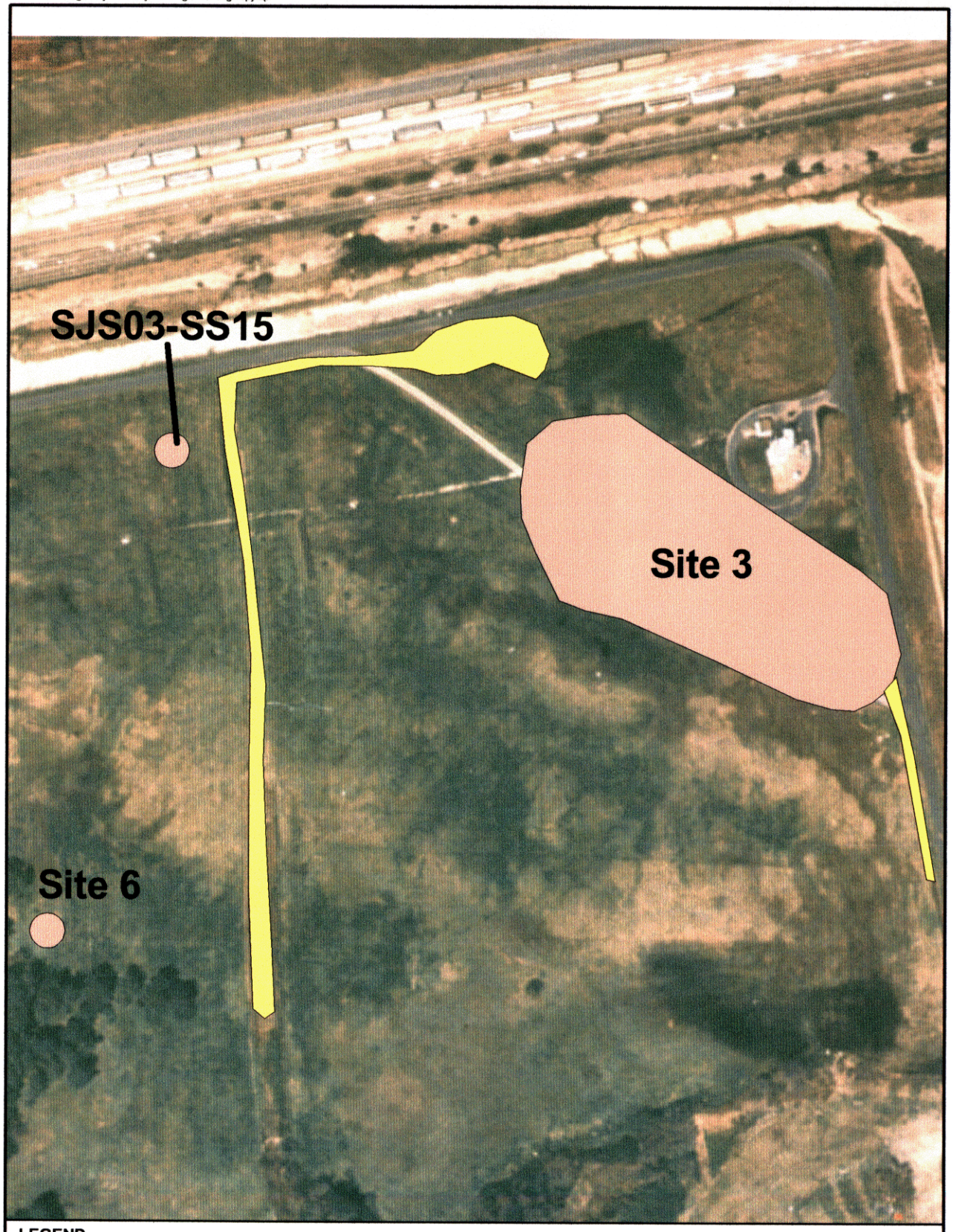

LEGEND

- Soil Cover
- Sediment Excavation

N

0 100 200 Feet

Figure 4-1
Alternative 1
Site 3 and 6 EE/CA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

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LEGEND

- Areas to be Covered
- Areas to be Excavated

N

0 100 200 Feet

Figure 4-2
Alternative 2
Site 3 & 6 EE/CA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

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LEGEND

Area of Removal

N

0 80 160 Feet

Figure 4-3
Alternative 3
Site 3 & 6 EE/CA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

5. Comparative Analysis

Section 5 provides a comparative analysis of the three alternatives to assist the decision-making process by which an action will be selected. Previously, the alternatives were evaluated according to their effectiveness, ease of implementation, and cost. In this section, the alternatives are directly compared for each of the three criteria. From this analysis, it should become clear which alternative is preferable in each category and, consequently, which alternative will be selected for implementation at Site 3 and Site 6. Table 5-1 is a summary of the comparative analysis.

TABLE 5-1
Comparative Analysis Summary
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Alternative	Effectiveness	Implementation	Cost
Alternative 1 – Soil Capping with Clean Fill of Sites 3 & 6, sediment removal in upland ditches at Site 3	Low	Easy	Lowest
Alternative 2 – Excavation and Disposal Burnt/Stained Waste and Debris at Site 3 and 6, soil cover of soils	Moderate	Moderate	Highest
Alternative 3 – Excavation of all Waste at Sites 3 & 6, SJS03-SS15 Removal, Removal of all Sediment at Site 3	High	Moderate	Moderate

5.1 Effectiveness

The overall effectiveness of Alternative 1 is low, moderate for Alternative 2, high for Alternative 3. These levels of effectiveness were assessed based on the number of "effectiveness criteria" that would be satisfied by each alternative.

Alternative 1 satisfies the removal action objective by eliminating the exposure pathway without excavating and removing soil/waste. Alternatives 2 and 3 also satisfy the removal action objective using varied degrees of soil cover in conjunction with excavation of soil/waste and sediment. Because the removal action objective is achieved, public health and the environment are protected. Since Alternatives 2 and 3 involve excavation of the waste source eliminating continued impacts to surrounding media, these alternatives better satisfy long term effectiveness. Further, Alternative 3 is the most protective of public health and the environment since it eliminates the potential risk associated with soil adjacent to waste, sediment in Site 3 drainage, and soil associated with sample location SJS03-SS15.

Workers would be equally protected during implementation of all three alternatives using standard respiratory and skin protection. Workers would be exposed to higher risk of encountering UXO during the implementation of Alternatives 2 and 3. Each of the three alternatives comply with the location-specific and action-specific ARARs, applicable to the

implementation of the alternatives. No environmentally sensitive locations are known to be present at Sites 3 or 6; the action will not endanger groundwater or surface water.

5.2 Implementability

The implementability evaluation of the alternatives varies from easy to moderate. These levels of implementability were assessed based on the number of "implementability criteria" satisfied by each alternative. The "implementability criteria," from the USEPA guidance document *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA/540-R-93-057), are as follows:

1. Construction and operational considerations
2. Demonstrated performance/useful life
3. Adaptable to environment conditions
4. Contributes to remedial performance
5. Can be implemented in 1 year
6. Availability of equipment, personnel and services, outside laboratory testing capacity, and offsite treatment and disposal capacity
7. Permits required
8. Easements or rights-of-way required
9. Impact on adjoining property
10. Ability to impose institutional controls

Evaluation of implementability essentially comes down to the evaluation of technical and administrative feasibility. The technical feasibility consists of items 1 through 6 above, and administrative feasibility involves items 7 through 10.

All three of the alternatives are technically feasible and may be implemented within one year. Alternative 1 may be implemented within Fiscal Year 2002 (FY02). Due to limitations in funding associated with the higher cost of excavation and disposal, only partial removal for Site 3 is possible for Alternatives 2 and 3 within the same fiscal year. All alternatives require implementation completion of the removal action for Site 6 in FY02. Funding would be available in 2003 to complete the remainder of the actions under Alternative 2 or 3.

5.3 Cost

Cost capital, annual operation and maintenance (O&M), long-term monitoring/inspections, and present-worth cost of each of the alternatives are summarized in Table 5-2. The removal action is scheduled to begin in fiscal year 2002. Since the cost data used to develop the construction costs were based upon expected 2002 data, no adjustments to present-worth costs were made. The cost breakdown for each alternative is provided in the Appendix C.

TABLE 5-2
Cost Summary
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Alternative	Capital Cost	Annual O&M Cost[1]	Present-Worth Cost
Alternative 1 – Soil Capping with Clean Fill at Sites 3 and 6, removal of surface sediment in upland ditches at Site 3	$360,697	$896,130	$1,256,827
Alternative 2 – Excavation and Disposal of Burnt/Stained Material and Debris at Sites 3 and 6, soil cover on soils posing potential risk, removal of surface sediment in upland ditches at Site 3	$1,128,310	$896,130	$2,024440
Alternative 3 – Excavation and Disposal of Waste for Sites 3 and 6, Removal of Soils Adjacent to the Waste, Removal of Site 3 Surface Sediment, Removal of Soil at Sample Location SJS03-SS15	$1,485,837	$0	$1,485,837

1. O&M Costs include routine inspections, mowing, and groundwater monitoring and reporting.

6. Recommended Alternative

The EE/CA was performed in accordance with current USEPA and Navy guidance documents for a NTCRA under CERCLA. The purpose of this EE/CA was to identify and analyze remedies or removal actions to mitigate potential risk at Sites 3 and 6. Three alternatives were identified, evaluated, and ranked.

The comparative analyses of the removal alternatives included evaluating the effectiveness, implementability, and cost of each alternative. The effectiveness evaluation included reviewing the protectiveness of the alternative and its ability to meet the removal action objectives. Implementability included assessing the technical feasibility, availability, and administrative feasibility of the alternatives. The evaluation of cost included a review of capital cost, operating cost, long-term maintenance costs, and present-worth cost.

Based on the comparative analyses of the removal alternatives completed in Section 5, the recommended removal action is Alternative 3. Alternative 3 involves excavation, characterization (including UXO construction oversight), and disposal of the excavated waste/debris from Site 3 and 6 (as well as the removal of soils and sediment which pose a potential risk at Site 3) at a local Subtitle D landfill. This will eliminate potential risk related to Sites 3 and 6 and be most protective of human health and the environment. The collection of the characterization samples would take place prior to excavation (in-situ) to verify disposal requirements. Due to the required UXO screening during the excavation, direct loading of transport vehicles will not be permitted. Once the materials are excavated, they will be screened for potential UXO prior to being stockpiled or loaded onto transport vehicles. Confirmatory samples also would be collected from the remaining soils and sediment at the sides and bottom of the excavated areas to establish that cleanup goals have been met. The soils would be disposed of in a permitted Subtitle D landfill off-site. Should the pre-construction disposal characterization indicate that the material is hazardous and not suitable for direct disposal in a Subtitle D landfill, the estimated volume and cost of disposal will be calculated and a reassessment will be conducted of the evaluation criteria for the removal action alternatives.

Alternative 3 is recommended because it will achieve the removal action objectives by eliminating potential risk to human health and ecological receptors posed by waste and debris at Sites 3 and 6 and will eliminate potential risk associated with chemical concentrations in sediment and soil. Alternative 3 is protective of human health and the environment without the need for ICs that would limit the future use of the property. Alternative 3 is significantly more effective than Alternative 1; more effective than Alternate 2 while only moderately more costly than Alternative 1 and less costly than Alternative 2. The cost for implementation of Alternative 3 is estimated to have a present worth of $1,485,837.

7. References

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Appendix A
ARAR Tables

Table A-1
Federal Location-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Executive Order 11988, Protection of Floodplain					
Within floodplain	Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values.	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas.	40 CFR Part 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Applicable.	Regrading activities may require compliance with this order. Measures required may include erosion control.
Executive Order 11990, Protection of Wetlands					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands.	Wetland as defined by Executive Order 11990 Section 7.	40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Not Applicable	Federal or state regulated wetlands are not present at either site.
Clean Water Act, Section 404					
Wetland	Action to prohibit discharge of dredged or fill material into wetland without permit.	Wetland as defined by Executive Order 11990 Section 7.	40 CFR 230.10; 40 CFR 231 (231.1, 231.2, 231.7, 231.8)	Not applicable.	No discharge of dredged or fill material to a wetland is planned as part of the removal action.
Endangered Species Act of 1973					
Endangered species	Action to ensure that any action is not likely to jeopardize the continued existence of endangered or threatened species or adversely affect its critical habitat.	Applies to actions that affect endangered or threatened species or their habitat.	16 USC 1531 50 CFR Part 402	Not Applicable.	Except for the occasional transient individuals, no federally listed or proposed endangered species are known to exist on either Site 3 or Site 6. Therefore, the requirements of the Endangered Species Act of 1973 (16 USC 1536(a)) will not be applicable to remediation activities occurring on Sites 3 and 6.

* Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that DON accepts the entire statues or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or relevant and appropriate requirements.
CFR - Code of Federal Regulations.
USC - United States Code.

Table A-2
Virginia Location-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Virginia State Water Control Laws and Virginia Wetlands Regulations					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands.	Wetland as defined by Virginia statutory provision.	Virginia Code Sections 62.1-44.15:5	Not Applicable	Federal and/or state regulated wetlands are not present at these sites.
Chesapeake Bay Preservation Act and Chesapeake Bay Preservation Area Designation and Management Regulations					
Chesapeake Bay areas	Under these requirements, certain locally designated tidal and non-tidal wetlands, as well as other sensitive land areas, may be subject to limitations regarding land-disturbing activities, removal of vegetation, use of impervious cover, erosion and sediment control, stormwater management, and other aspects of land use that may have effects on water quality.	Federally owned area designated as a Chesapeake Bay Preservation area.	Code of Virginia Section 10.1-2100 et seq. and 9 VAC 10-20-10	TBC	This requirement is not an ARAR since the area affected by the response action is not a federally owned Chesapeake Bay Preservation area. Also, City of Portsmouth does not have jurisdiction over the Naval Shipyard or Annex areas. Compliance is on a voluntary basis.
Coastal Zone Management Act; Coastal Management Plan, City of Portsmouth; NOAA Regulations of Federal Consistency with approved State Coastal Zone Management Programs					
Within coastal zone	Conduct activities within a coastal Management Zone in a manner consistent with local requirements.	Activities affecting the coastal zone including lands thereunder and adjacent shore land.	Section 307(c) of 16 USC 1456(c); also see 15 CFR 930 and 923.45	TBC	This requirement is not an ARAR since the City of Portsmouth does not have jurisdiction over the Naval Shipyard. Compliance is on a voluntary basis.
Virginia Endangered Species Act					
Critical habitat upon which endangered species or threatened species depend.	Action to conserve endangered species or threatened species, including consultation with the Virginia Board of Game and Inland Fisheries.	Determination of effect upon endangered or threatened species or its habitat.	Code of Virginia Sections 29.1-563 to 570 4 VAC 15-20-130	Not Applicable	Except for the occasional transient individuals, no federally listed or proposed endangered species are known to exist on Sites 3 and 6. Therefore, the requirements of the Endangered Species Act of 1973 (16 USC 1536(a)) will not be applicable to remediation activities occurring on Sites 3 and 6.

Table A-2
Virginia Location-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Virginia Natural Areas Preserves Act					
Natural preserves area	Action to conserve natural preserve areas and restrict certain activities in these areas	Applicable to sites that meet natural preserve area criteria as determined by the Virginia Department of Conservation and Recreation	Code of Virginia Sections 10.1-209 through 217	Not Applicable	Except for the occasional transient individuals, no federally listed or proposed endangered species are known to exist on Sites 3 and 6. Therefore, the requirements of the Endangered Species Act of 1973 (16 USC 1536(a)) will not be applicable to remediation activities occurring on Sites 3 and 6.
Virginia Endangered Plant and Insect Species Act; Virginia Board of Game and Inland Fisheries					
Endangered plant and insect species	Action to conserve endangered or protected plant and insect species	Applies to actions that affect endangered or protected plant and insect species.	Va. Code Ann. §§ 3.1-1020 to 1030 2 VAC 5-320-10	Relevant and Appropriate	Virginia Department of Agriculture and Consumer Services will be notified of this project. The Navy requests determination if proposed activities will affect endangered plants or insects.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs- Applicable or relevant and appropriate requirements

Table A-3
Federal Chemical-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Groundwater					
Safe Drinking Water Act (SDWA), 42 USC 300					
	National primary drinking water standards are health-based standards for public water systems (maximum contaminant levels [MCLs]).	Public water system.	40 CFR Part 141 Subparts B & G	Not relevant and appropriate for the shallow water table aquifer, which is a Class III aquifer, and is not a potential drinking water source. Relevant and appropriate to the Yorktown Aquifer.	MCLs are relevant and appropriate for groundwater determined to be a current or potential source of drinking water in cases where MCLGs are not ARARs. MCLs are relevant and appropriate for Yorktown aquifer.
	Maximum contaminant level goals [MCLGs] pertain to known or anticipated adverse health effects (also known as recommended maximum contaminant levels).	Public water system.	40 CFR Part 141, Subpart F	Relevant and appropriate for Yorktown Aquifer only, which is a Class II aquifer. The water-table aquifer is a Class III aquifer.	MCLGs that have non-zero values are relevant and appropriate for groundwater determined to be a current or potential source of drinking water (40 CFR 300.430[e][2][i][B] through [D]). Relevant and appropriate at the unit boundary.
	National secondary drinking water regulations are standards for the aesthetic qualities of public water systems (secondary MCLs [SMCLs]).	Public water system.	40 CFR Part 143, excluding 143.5(b)	TBC for Yorktown Aquifer only.	SMCLs are non-enforceable federal contaminant levels intended as guidelines for the states. Because they are nonenforceable, federal SMCLs are not ARARs.

* Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that DON accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs-Applicable or relevant and appropriate requirements.

CFR- Code of Federal Regulations

USC- United States Code.

TBC- To Be Considered

Table A-4
Virginia Chemical-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
			Groundwater		
Virginia Drinking Water Standards					
	Primary drinking water standards are health-based standards for public water supplies (primary maximum contaminant levels [PMCLs]).	Public water system.	12 VAC 5-590-10	Relevant and appropriate for Yorktown Aquifer only. Not relevant and appropriate for shallow, non-potable water table aquifer, which is not a potential drinking water source.	Virginia PMCLs are similar to federal MCLs. PMCLs are relevant and appropriate for groundwater determined to be a current or potential source of drinking water. However, the shallow water table is not a potential drinking water source, and no contaminants detected in Yorktown Aquifer in excess of MCLs.
	Secondary drinking water regulations are chemical based standards for qualities of public water supplies (secondary MCLs [SMCLs]).	Public water system.	12 VAC 5-590-390	Relevant and appropriate for Yorktown Aquifer only.	Virginia SMCLs are similar to federal SMCLs. In Virginia, SMCLs are enforceable for potable water supplies.
Virginia Groundwater Standards					
	Establishes groundwater standards for State Antidegradation Policy.	Standards are used when no MCL is available.	9 VAC 25-260-190 to 220	Relevant and appropriate when MCLs not available, or when standards are more stringent than MCLs.	MCLs available for all contaminants of concern.
Virginia Air Pollution Control Regulations					
	Ambient Air Quality Standards: primary and secondary standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare.	9 VAC 5-30-20 and 9 VAC 5-30-60	Applicable.	Applicable to all activities at the site that may generate regulated pollutants.

*Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or relevant and appropriate requirements.
CFR - Code of Federal Regulations.
USC - United States Code.
TBC - To be considered criterion, not an ARAR

Table A-5
Federal Action-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Resource Conservation and Recovery Act (RCRA) Subtitle C					
Closure of Landfill	Closure and post-closure care requirements for hazardous waste landfills.	Landfill used to dispose hazardous waste.	40 CFR 264.310	Applicable.	Wastes were placed in the landfills after the promulgation of the regulation.
RCRA Subtitle D					
Closure of Landfill	Provides recommended procedures for cover material.	Landfill used to dispose solid wastes.	40 CFR Part 241	*Applicable.*	Landfills were in use before regulations were promulgated. The requirements of this section are delegated to the State of Virginia to implement.
Off-site Disposal	Provides criteria for determining if solid waste disposal facility poses an adverse effect on human health or environment.	Permitted solid waste landfill.	40 CFR Part 257	Applicable.	TBC for determining suitable off-site disposal facilities.
Off-site Disposal	Provides criteria for determining if municipal solid waste disposal facility poses an adverse effect on human health or environment.	Permitted municipal solid waste landfill.	40 CFR Part 258	Applicable.	TBC for determining suitable off-site disposal facilities.
Clean Air Act (CAA) 40 USC 7401 et seq					
Discharge to air	National Primary and Secondary Ambient Air Quality Standards (NAAQS) - standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare	40 CFR Sections 50.4 - 50.12	Not Applicable.	Not an ARAR; Federal NAAQS are nonenforceable standards. May be a TBC for site remediation activities.

* Statutes and policies, and their citations are provided as headings to identify general categories of ARARs. Specific potential ARARs are addressed in the table below each general heading.

** *A-Applicable, PR- Relevant and appropriate, TBC- To Be Considered*

CFR- Code of Federal Regulations

USC- United States Code

NAAQS- national Ambient Air Quality Standards (primary and secondary)

Table A-6
Virginia Action-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Virginia Hazardous Waste Regulations					
Closure of Landfill	Closure and post-closure care requirements for hazardous waste landfill.	Landfill used to dispose hazardous waste.	9 VAC 20-60-580	TBC	The landfills are not hazardous waste disposal facilities. The landfills ceased operation prior to the promulgation of these regulations.
Virginia Air Pollution Control Regulations					
Discharge to air	Virginia Ambient Air Quality Standards - standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare.	9 VAC 5-30-10	Applicable.	Applicable for all site remediation activities that may generate air discharges.
Discharge of visible emissions and fugitive dust	Fugitive dust/emissions may not be discharged to the atmosphere at amounts in excess of standards.	Any source of fugitive dust/ emissions.	VAC 5-50-60 to 120	Applicable.	Applicable for any site remediation activities that generate fugitive dust.
Discharge of toxic pollutants	Toxic pollutants may not be discharged to the atmosphere at amounts in excess of standards.	Any emission from the disturbance of soil, or treatment of soil or water, that do not qualify for the exemptions under Rule 4-3.	VAC 5-50-160 to 230	Applicable.	Applicable for any site remediation activities that generate toxic air pollutants.

Table A-6
Virginia Action-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Virginia Stormwater Management Regulations and Virginia Erosion and Sediment Control Regulations					
Stormwater Management	Regulates stormwater management and erosion/ sedimentation control practice.	Land disturbing activities.	Va. Code Ann. §§ 10.1-603.1 to 603.15; 4 VAC 50–30-10; 3-20-10 to 251; Va. Code Ann. §§ 10.1-560 to 571	Applicable.	Applicable for any site remediation activities involving surface water runoff and erosion.
Virginia Solid Waste Regulations					
Closure of Construction/ Demolition Debris Landfills and Industrial Waste Landfills	Closure and post-closure care requirements for construction/demolition debris landfills and for industrial waste landfills.	Landfill used to dispose construction/ demolition debris and/or industrial wastes.	9 VAC 20-80-260; 9 VAC 20-80-270	Applicable.	Industrial waste landfill requirements of 9 VAC 20-80-270 are applicable.
Virginia Pollutant Discharge Elimination System (VPDES) Permit Regulations					
Discharge of Treated Water to Surface Waters, and certain storm water discharges	Regulated point-source discharges through VPDES permitting program. Permit requirements include compliance with corresponding water quality standards, establishment of a discharge monitoring system, and completion of regular discharge monitoring records.	Applicable to discharge of treated water to surface water, and to storm water discharges from certain facilities, including landfills.	9 VAC 25-31-10 to 940	Applicable.	Substantive requirements of VPDES permit will be used to determine the need for discharge limits for the discharge of stormwater from the site.

Table A-6
Virginia Action-Specific ARARs
Soil Removal Action, Site 3 and Site 6, St. Juliens Creek Annex

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Solid Waste Management Regulations; Solid Waste Disposal Facility Standards (9 VAC 20-80); Virginia Waste Management Act					
Solid Waste Staging Transport, and Disposal	These regulations and laws define the requirements for the management of solid wastes. Any disposal facility must be properly permitted and in compliance with all operational and monitoring requirements of the permit and regulations.	Wastes must meet definition of solid waste.	9 VAC 20-80-10 to 790; 9 VAC 20-110-10-130	Relevant and Appropriate.	Applicable to management and staging, transportation, and off-site disposal of any soil, debris, sludge, or other material classified as a solid waste.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific ARARs are addressed in the table below each general heading.

**Applicable, RA- Relevant and appropriate, TBC- To Be Considered

ARAR- Applicable or relevant and appropriate requirement

CFR- Code of Federal Regulations USC- United States Code

Appendix B
Volume Estimates

Table B-1
Alternative 1
St. Juliens Creek Annex
Sites 3 and 6
Excavation/Fill Estimate

Site 3

Fill Requirements

Waste Area (ft^2)	104,622
Fill Depth (ft)	2
Fill Volume (ft^3)	209,244
Fill Volume (yd^3)	7,750

SJS03-SS15 Fill

Diameter to be filled (ft)	20
Radius	10
Depth to be filled (ft)	2
Area of SS15 Fill (ft^2)	314
Volume of Fill (ft^3)	628
Volume of Fill (yd^3)	23
Total SS15 Fill Volume (yd^3)	23
TOTAL FILL AREA (ft^2)	139,992
TOTAL FILL VOLUME (yd^3)	9,083
TOTAL FILL (TONS)	13,625
Assumed Soil Weight 1.5 tons/cy	

Site 3 Sediment

Complete Drainage Ditch Excavation (1' depth)

Removal Area (ft^2)	34,742
Removal Depth (ft)	1
Removal Volume (ft^3)	34,742
Removal Volume (yd^3)	1,287
Total Removal (Tons)	1,930

Site 6

Fill Requirements

Waste Area (ft^2)	314
Fill Depth (ft)	2
Fill Volume (ft^3)	628
Fill Volume (yd^3)	23
TOTAL FILL VOLUME (yd^3)	23
TOTAL FILL (TONS)	35

SEDIMENT REMOVAL FROM SITE 3: 1,930 tons
COMBINED SITE 3 AND SITE 6 FILL VOLUME: 9,991 yd^3
(INCLUDING 10% CONTINGENCY FOR SIDE SLOPES) 14,987 tons

Table B-2
Alternative 2
St. Juliens Creek Annex
Sites 3 and 6 EE/CA
Excavation/Fill Estimate

Site 3		Site 3 Sediment		SJS03-SS15 Cover		Site 6	
Landfill Excavation (3 foot depth)		Complete Drainage Ditch Excavation (1' depth)		SJS03-SS15 Cover (2 foot)		Landfill Excavation	
Waste Area (ft^2)	46,722	Sediment Area (ft^2)	34,742	Waste Area (ft^2)	314	Waste Area (ft^2)	314
Waste Depth (ft)	3	Sediment Depth (ft)	1	Fill Depth (ft)	2	Waste Depth (ft)	3
Waste Volume (ft^3)	140,166	Sediment Volume (ft^3)	34,742	Fill Volume (ft^3)	628	Waste Volume (ft^3)	942
Waste Volume (yd^3)	5,191	Sediment Volume (yd^3)	1,287	Fill Volume (yd^3)	23	Waste Volume (yd^3)	35
TOTAL EXCAVATION VOLUME (yd^3)	5,191	TOTAL EXCAVATION VOLUME (yd^3)	1,287	TOTAL FILL (yd^3)	23	TOTAL EXCAVATION VOLUME (yd^3)	35
Total Site 3 Removal (Tons)	7,787	Total Sediment Removal (Tons)	1,930	Total Fill Volume (Tons)	35	TOTAL EXCAVATION (TONS)	52

Site 3 Cover

Site 3 Fill Requirements	
Waste Area (ft^2)	41,951
Fill Depth (ft)	2
Fill Volume (ft^3)	83,902
Fill Volume (yd^3)	3,107
Total Fill Volume (Tons)	4,661
TOTAL EXCAVATION VOLUME (yd^3)	6,513
TOTAL EXCAVATION (TONS)	9,769
Assumed Soil Weight 1.5 tons/cy	

TOTAL EXCAVATION VOLUME (Site 3 Waste/Sediment and Site 6): (INCLUDING 20% CONTINGENCY)	**7,816 yd^3**	**11,723 tons**
FILL VOLUME FOR (Site 3 and SJS03-SS15) (INCLUDING 10% CONTINGENCY FOR SIDE SLOPES)	**3,444 yd^3**	**5,166 tons**
TOTAL FILL VOLUME (Includes Covers and Replacement Fill): (INCLUDING 10% CONTINGENCY FOR SIDE SLOPES)	**10,608 yd^3**	**15,912 tons**

Table B-3
Alternative 3
St. Juliens Creek Annex
Sites 3 and 6 EE/CA
Excavation/Fill Estimate

Site 3

Landfill Excavation of Burnt/Stained Soil and Debris plus additional material

Waste Area (ft^2)	70,862
Waste Depth (ft)	3
Waste Volume (ft^3)	212,586
Waste Volume (yd^3)	7,874

SJS03-SS15 Excavation

Diameter to be excavated (ft)	10	A=radius^2*pie
Radius to be excavated (ft)	5	V=pie*radius^2*height
Depth to be excavated (ft)	3	
Area of SS15 Removal (ft^2)	79	
Volume of SS15 Removal (ft^3)	236	
Volume at SS15 Removal (yd^3)	9	
Total SS15 Fill Volume (yd^3)	9	
TOTAL EXCAVATION AREA (ft^2)	**105,997**	2.23 acres
TOTAL EXCAVATION VOLUME (yd^3)	**9,204**	
TOTAL EXCAVATION (TONS)	13,806	
Assumed Soil Weight 1.5 tons/cy		

Site 3 Sediment

Complete Drainage Ditch Excavation (1' depth)

Removal Area (ft^2)	34,742
Removal Depth (ft)	1
Removal Volume (ft^3)	34,742
Removal Volume (yd^3)	1,287

Site 6

Landfill Excavation

Waste Area (ft^2)	314
Waste Depth (ft)	3
Waste Volume (ft^3)	942
Waste Volume (yd^3)	35
TOTAL EXCAVATION VOLUME (yd^3)	35
TOTAL EXCAVATION (TONS)	52

COMBINED SITE 3 and 6 LIMITS EXCAVATION VOLUME: 11,045 yd^3
(INCLUDING 20% CONTINGENCY) 16,567 tons

Appendix C
Detailed Cost Estimates

Table C-1
Alternative 1
St. Juliens Creek Annex
Sites 3 and 6 EE/CA
Cost Estimate

Worker Protection Level	D
Labor Efficiency	100%
Equipment Efficiency	100%
Material Efficiency	100%

DESCRIPTION	ESTIMATED QUANTITY	UNIT	LABOR UNIT	EQUIP UNIT	MAT'L UNIT	ADJUSTED LABOR UNIT	ADJUSTED EQUIP UNIT	ADJUSTED MAT'L UNIT	LABOR TOTAL	EQUIP UNIT	MAT'L TOTAL	TOTAL	Source
EXCAVATION AND BACKFILL													
Unclassified Fill, 6" Lifts, Offsite (Incl. Compaction)	9,991	CY	$ 0.86	$ 1.98	$ 5.06	$ 0.86	$ 1.98	$ 5.06	$ 8,592.56	$ 19,782.88	$ 50,556.25	$ 78,931.69	ECHOS Item 17 03 0423
EXCAVATION AND BACKFILL													
4 cy Crawler Mounted Excavator (Direct Load)[1], [2]	30	HR	$ 29.90	$ 237.07	$ -	$ 29.90	$ 237.07	$ -	$ 889.56	$ 7,053.12	$ -	$ 7,942.69	ECHOS Item 17 03 0234
Unclassified Fill, 6" Lifts, Offsite (Incl. Compaction)	1,287	CY	$ 0.86	$ 1.98	$ 5.06	$ 0.86	$ 1.98	$ 5.06	$ 1,106.60	$ 2,547.75	$ 6,510.91	$ 10,165.25	ECHOS Item 17 03 0423
Decontamination (heavy equipment)	6	EA	$ 239.48	$ -	$ -	$ 239.48	$ -	$ -	$ 1,436.88	$ -	$ -	$ 1,436.88	ECHOS Item 33 17 0803
Construction Support													
UXO Technician II/III for UXO scanning	2.0	WEEK							$ 9,000.00			$ 18,000.00	Engineer's Estimate
XRF Field Screening	2.0	WEEK							$ 2,000.00			$ 4,000.00	Engineer's Estimate
Disposal Characterization													
TCLP Sampling	7	UNIT									$ 1,000.00	$ 7,286.74	Engineer's Estimate
Transportation (of Nonhazardous Waste)													
Transportation of Non-Hazardous Waste by Dump Truck (Local) [3]	114	HOUR	$ 23.00	$ 45.00	$ -	$ 23.00	$ 45.00	$ -	$ 2,611.33	$ 5,109.12	$ -	$ 7,720.44	Engineer's Estimate
Off-Site Disposal (as Nonhazardous Waste)													
Solid Waste Disposal at Subtitle D Landfill	1,930	TON	$ -	$ -	$ -	$ -	$ -	$ 38.00	$ -	$ -	$ 73,344.22	$ 73,344.22	Verbal Quote from SPSA
SITE RESTORATION													
Stone for Road Restoration	870	CY	$ 0.46	$ 0.90	$ 22.11	$ 0.46	$ 0.90	$ 22.11	$ 400.20	$ 783.00	$ 19,235.70	$ 20,418.90	ECHOS Item 17 03 0418
Seeding	2.5	ACRE	$ 64.10	$ 88.11	$ 325.70	$ 64.10	$ 88.11	$ 325.70	$ 160.25	$ 220.28	$ 814.25	$ 1,194.78	ECHOS 18 05 0401
Mulching	2.5	ACRE	$ 29.32	$ 22.53	$ 1,377.00	$ 29.32	$ 22.53	$ 1,377.00	$ 73.30	$ 56.33	$ 3,442.50	$ 3,572.13	Means Item 02830 2005
OVERSIGHT AND REPORTING (Distributive Costs)													
Superintendent	3.0	WEEK	$ 1,283.00	$ -	$ -	$ 1,283.00	$ -	$ -	$ 3,849.00	$ -	$ -	$ 3,849.00	ECHOS Item 99 01 0102
Project Engineer/QC Engineer (Double Hat)	3.0	WEEK	$ 839.66	$ -	$ -	$ 839.66	$ -	$ -	$ 2,518.98	$ -	$ -	$ 2,518.98	ECHOS Item 99 01 0104
Field Office (and related costs)	0.8	MONTH	$ -	$ -	$ 1,000.00	$ -	$ -	$ 1,000.00	$ -	$ -	$ 750.00	$ 750.00	Engineer's Estimate
Per Diem	15.0	DAY	$ -	$ -	$ 147.00	$ -	$ -	$ 147.00	$ -	$ -	$ 2,205.00	$ 2,205.00	Engineer's Estimate
Subtotal									**$ 32,638.66**	**$ 35,552.47**	**$ 157,858.83**	**$ 243,336.70**	
Location Multiplier												81%	ECHOS Localization Factors
Adjusted Cost												**$ 197,102.73**	
Mobilization/Demobilization											10%	$ 19,710.27	
Design											3%	$ 5,913.08	
Overhead											40%	$ 78,841.09	
Profit											10%	$ 19,710.27	
Contingency											20%	$ 39,420.55	
Total Cost												**$ 360,697.99**	
Routine Monitoring, Mowing, Inspection													
Groundwater Monitoring and Reporting (15 year period)	2.3	YEAR										$645,330.00	Engineer's Estimate
Quarterly Inspection and Annual Reporting (5 year period)	4.0	YEAR										$ 60,000.00	Engineer's Estimate
Mowing (5 year period)	12.0	YEAR										$ 190,800.00	Means Item 02900 1660
O&M Cost												$896,130.00	
Present Worth Cost												**$1,256,827.99**	

Table C-2
Alternative 2
St. Juliens Creek Annex
Sites 3 and 6 EE/CA
Cost Estimate

Worker Protection Level	D
Labor Efficiency	75%
Equipment Efficiency	75%
Material Efficiency	100%

DESCRIPTION	ESTIMATED QUANTITY	UNIT	LABOR UNIT	EQUIP UNIT	MAT'L UNIT	ADJUSTED LABOR UNIT	ADJUSTED EQUIP UNIT	ADJUSTED MAT'L UNIT	LABOR TOTAL	EQUIP UNIT	MAT'L TOTAL	TOTAL	Source
SITE PREPARATION													
Filter Barrier around Excavation Stockpile	1000	LF	$ 1.21	$ -	$ 0.60	$ 1.61	$ -	$ 0.60	$ 1,613.33	$ -	$ 600.00	$ 2,213.33	ECHOS Item 18 05 0206
EXCAVATION AND BACKFILL													
4 cy Crawler Mounted Excavator (Direct Load)[1], [2]	245	HR	$ 29.90	$ 237.07	$ -	$ 39.87	$ 316.09	$ -	$ 9,778.23	$ 77,529.28	$ -	$ 87,307.52	ECHOS Item 17 03 0234
Unclassified Fill, 6" Lifts, Offsite (incl. Compaction)	10,608	CY	$ 0.86	$ 1.98	$ 5.06	$ 1.15	$ 2.64	$ 5.06	$ 12,163.92	$ 28,005.32	$ 53,676.85	$ 93,846.10	ECHOS Item 17 03 0423
Decontamination (heavy equipment)	6	EA	$ 239.48	$ -	$ -	$ 319.31	$ -	$ -	$ 1,915.84	$ -	$ -	$ 1,915.84	ECHOS Item 33 17 0803
Construction Support													
UXO Technician II/III for UXO scanning	2.0	WEEK							$ 9,000.00			$ 18,000.00	Engineer's Estimate
XRF Field Screening	2.0	WEEK							$ 2,000.00			$ 4,000.00	Engineer's Estimate
Disposal Characterization													
TCLP Sampling	17	UNIT									$ 1,000.00	$ 16,608.07	Engineer's Estimate
Transportation (of Nonhazardous Waste)													
Transportation of Non-Hazardous Waste by Dump Truck (Local) [3]	586	HOUR	$ 23.00	$ 45.00	$ -	$ 30.67	$ 60.00	$ -	$ 17,975.78	$ 35,170.00	$ -	$ 53,145.78	Engineer's Estimate
Off-Site Disposal (as Nonhazardous Waste)													
Solid Waste Disposal at Subtitle D Landfill	11,723	TON	$ -	$ -	$ -	$ -	$ -	$ 38.00	$ -	$ -	$ 445,486.67	$ 445,486.67	Verbal Quote from SPSA
SITE RESTORATION													
Stone for Road Restoration	870	CY	$ 0.46	$ 0.90	$ 22.11	$ 0.61	$ 1.20	$ 22.11	$ 533.60	$ 1,044.00	$ 19,235.70	$ 20,813.30	ECHOS Item 17 03 0418
Seeding	2.5	ACRE	$ 64.10	$ 88.11	$ 325.70	$ 85.47	$ 117.48	$ 325.70	$ 213.67	$ 293.70	$ 814.25	$ 1,321.62	ECHOS 18 05 0401
Mulching	2.5	ACRE	$ 29.32	$ 22.53	$ 1,377.00	$ 39.09	$ 30.04	$ 1,377.00	$ 97.73	$ 75.10	$ 3,442.50	$ 3,615.33	Means Item 02830 2005
OVERSIGHT AND REPORTING (Distributive Costs)													
Superintendent	3.0	WEEK	$ 1,283.00	$ -	$ -	$ 1,710.67	$ -	$ -	$ 5,132.00	$ -	$ -	$ 5,132.00	ECHOS Item 99 01 0102
Project Engineer/QC Engineer (Double Hat)	3.0	WEEK	$ 839.66	$ -	$ -	$ 1,119.55	$ -	$ -	$ 3,358.64	$ -	$ -	$ 3,358.64	ECHOS Item 99 01 0104
Field Office (and related costs)	0.8	MONTH	$ -	$ -	$ 1,000.00	$ -	$ -	$ 1,000.00	$ -	$ -	$ 750.00	$ 750.00	Engineer's Estimate
Per Diem	25.0	DAY	$ -	$ -	$ 147.00	$ -	$ -	$ 147.00	$ -	$ -	$ 3,675.00	$ 3,675.00	Engineer's Estimate
Subtotal									**$ 63,782.75**	**$ 142,117.40**	**$ 528,680.97**	**$ 761,189.19**	
Location Multiplier												81%	ECHOS Localization Factors
Adjusted Cost												**$ 616,563.25**	
Mobilization/Demobilization											10%	$ 61,656.32	
Design											3%	$ 18,496.90	
Overhead											40%	$ 246,625.30	
Profit											10%	$ 61,656.32	
Contingency											20%	$ 123,312.65	
Total Cost												**$ 1,128,310.74**	
Routine Monitoring, Mowing, Inspection													
Groundwater Monitoring and Reporting (15 year period)	2.3	YEAR										$645,330.00	Engineer's Estimate
Quarterly Inspection and Annual Reporting (5 year period)	4.0	YEAR										$ 60,000.00	Engineer's Estimate
Mowing (5 year period)	12.0	YEAR										$ 190,800.00	Means Item 02900 1660
O&M Cost												**$896,130.00**	
Present Worth Cost												$ 2,024,440.74	

(1) Exacavation based upon productivity of 42 cy/hr
(2) Labor and equipment adjusted to 75% effeciency to account for UXO oversight
(3) Haul rate assumed to be 20 tons/hr

Table C-3
Alternative 3
St. Juliens Creek Annex
Sites 3 and 6 EE/CA
Cost Estimate

Worker Protection Level	D
Labor Efficiency	75%
Equipment Efficiency	75%
Material Efficiency	100%

DESCRIPTION	ESTIMATED QUANTITY	UNIT	LABOR UNIT	EQUIP UNIT	MAT'L UNIT	ADJUSTED LABOR UNIT	ADJUSTED EQUIP UNIT	ADJUSTED MAT'L UNIT	LABOR TOTAL	EQUIP TOTAL	MAT'L TOTAL	TOTAL	Source
SITE PREPARATION													
Filter Barrier around Excavation Stockpile	1000	LF	$ 1.21	$ -	$ 0.60	$ 1.61	$ -	$ 0.60	$ 1,613.33	$ -	$ 600.00	$ 2,213.33	ECHOS Item 18 05 0206
EXCAVATION AND BACKFILL													
4 cy Crawler Mounted Excavator (Direct Load)[1], [2]	255	HR	$ 29.90	$ 237.07	$ -	$ 39.87	$ 316.09	$ -	$ 10,160.70	$ 80,720.33	$ -	$ 90,901.03	ECHOS Item 17 03 0234
Unclassified Fill, 6" Lifts, Offsite (incl. Compaction)	11,045	CY	$ 0.86	$ 1.98	$ 5.06	$ 1.15	$ 2.64	$ 5.06	$ 12,664.58	$ 29,157.99	$ 55,886.15	$ 97,708.73	ECHOS Item 17 03 0423
Decontamination (heavy equipment)	6	EA	$ 239.48	$ -	$ -	$ 319.31	$ -	$ -	$ 1,915.84	$ -	$ -	$ 1,915.84	ECHOS Item 33 17 0803
Construction Support													
UXO Technician II/III for UXO scanning	4.0	WEEK							$ 9,000.00			$ 36,000.00	Engineer's Estimate
XRF Field Screening	4.0	WEEK							$ 2,000.00			$ 8,000.00	Engineer's Estimate
Disposal Characterization													
TCLP Sampling	17	UNIT									$ 1,000.00	$ 17,044.69	Engineer's Estimate
Transportation (of Nonhazardous Waste)													
Transportation of Non-Hazardous Waste by Dump Truck (Local) [3]	828	HOUR	$ 23.00	$ 45.00	$ -	$ 30.67	$ 60.00	$ -	$ 25,402.80	$ 49,701.12	$ -	$ 75,103.92	Engineer's Estimate
Off-Site Disposal (as Nonhazardous Waste)													
Solid Waste Disposal at Subtitle D Landfill	16,567	TON	$ -	$ -	$ -	$ -	$ -	$ 38.00	$ -	$ -	$ 629,547.57	$ 629,547.57	Verbal Quote from SPSA
SITE RESTORATION													
Stone for Road Restoration	870	CY	$ 0.46	$ 0.90	$ 22.11	$ 0.61	$ 1.20	$ 22.11	$ 533.60	$ 1,044.00	$ 19,235.70	$ 20,813.30	ECHOS Item 17 03 0418
Seeding	2.5	ACRE	$ 64.10	$ 88.11	$ 325.70	$ 85.47	$ 117.48	$ 325.70	$ 213.67	$ 293.70	$ 814.25	$ 1,321.62	ECHOS 18 05 0401
Mulching	2.5	ACRE	$ 29.32	$ 22.53	$ 1,377.00	$ 39.09	$ 30.04	$ 1,377.00	$ 97.73	$ 75.10	$ 3,442.50	$ 3,615.33	Means Item 02830 2005
OVERSIGHT AND REPORTING (Distributive Costs)													
Superintendent	4.0	WEEK	$ 1,283.00	$ -	$ -	$ 1,710.67	$ -	$ -	$ 6,842.67	$ -	$ -	$ 6,842.67	ECHOS Item 99 01 0102
Project Engineer/QC Engineer (Double Hat)	4.0	WEEK	$ 839.66	$ -	$ -	$ 1,119.55	$ -	$ -	$ 4,478.19	$ -	$ -	$ 4,478.19	ECHOS Item 99 01 0104
Field Office (and related costs)	1.0	MONTH	$ -	$ -	$ 1,000.00	$ -	$ -	$ 1,000.00	$ -	$ -	$ 1,000.00	$ 1,000.00	Engineer's Estimate
Per Diem	40.0	DAY	$ -	$ -	$ 147.00	$ -	$ -	$ 147.00	$ -	$ -	$ 5,880.00	$ 5,880.00	Engineer's Estimate
Subtotal									$ 74,943.10	$ 160,992.24	$ 717,406.17	$ 1,002,386.21	
Location Multiplier												81%	ECHOS Localization Factors
Adjusted Cost												$ 811,932.83	
Mobilization/Demobilization											10%	$ 81,193.28	
Design											3%	$ 24,357.98	
Overhead											40%	$ 324,773.13	
Profit											10%	$ 81,193.28	
Contingency											20%	$ 162,386.57	
Total Cost												$ 1,485,837.08	

(1) Excavation based upon productivity of 42 cy/hr
(2) Labor and equipment adjusted to 75% effeciency to account for UXO oversight
(3) Haul rate assumed to be 20 tons/hr