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FINAL ENGINEERING EVALUATION/COST ANALYSIS FOR SOLID WASTE MANAGEMENT UNIT 7B (SWMU7B) SMALL BOATS SANDBLAST YARD JEB LITTLE CREEK VA

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CH2MHILL

Final

Engineering Evaluation/Cost Analysis for Solid Waste Management Unit 7b – Small Boats Sandblast Yard

Joint Expeditionary Base Little Creek
Virginia Beach, Virginia

Contract Task Order WE32

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Executive Summary

This report presents an Engineering Evaluation/Cost Analysis (EE/CA) for a non-time-critical removal action (NTCRA) for sediment at Solid Waste Management Unit (SWMU) 7b, Small Boats Sandblast Yard at Joint Expeditionary Base (JEB) Little Creek in Virginia Beach, Virginia.

SWMU 7 is located in the north-central portion of the Base. The site was used to sandblast and paint ships until 1996, when sandblasting activities were moved to an indoor facility (CB-125). Approximately 4,000 cubic yards (yd^3) of spent abrasive blast material (ABM) was stored in open piles in areas surrounding Desert Cove. No release controls were identified at SWMU 7; therefore, spent ABM was historically released to soils and Desert Cove.

For investigation purposes, SWMU 7 was subdivided by media. The terrestrial portion of the site (SWMU 7a) is composed of soil and groundwater, while the aquatic portion of the site (SWMU 7b) is composed of sediment and surface water. Following an Interim Removal Action in September 2004 to address lead-contaminated soils, the Navy, in partnership with the U.S. Environmental Protection Agency (USEPA) and the Virginia Department of Environmental Quality (VDEQ), agreed that No Further Action (NFA) was required for SWMU 7a, and a Record of Decision was signed in June 2005 (Navy, 2005). Previous site investigations at SWMU 7b had identified potentially unacceptable risk to ecological receptors associated with exposure to metals in sediment.

The objective of this NTCRA is to reduce concentrations of copper, lead, mercury, and zinc in surface sediment within the SWMU 7b removal area such that remaining concentrations do not pose unacceptable risk to ecological receptors. The following four removal action alternatives were evaluated:

- Alternative 1: No action
- Alternative 2: Mechanical dredging, upland disposal, and replacement with clean fill
- Alternative 3: Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill
- Alternative 4: Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill

Alternative 1 does not meet the objectives of the NTCRA to eliminate the potential for exposure to metals in sediment that may pose potential ecological risk. However, this alternative is provided as a basis for comparison.

Alternative 2 is effective in eliminating the potential for exposure to metals in sediment within the SWMU 7b removal area that may pose potential ecological risk. Following completion of this alternative, NFA would be required for sediment at SWMU 7b. Implementation of this alternative is moderately difficult to implement using common construction practices. Costs associated with Alternative 2 are moderate, similar to Alternative 3 and less expensive than Alternative 4. Alternative 2 is the recommended alternative, as it is consistent with the scope of the currently scheduled military construction (MILCON) maintenance dredge and is not significantly more expensive than other alternatives evaluated.

Alternative 3 is effective in eliminating the potential for exposure to metals in sediment within the SWMU 7b removal area that may pose potential ecological risk. Following completion of this alternative, NFA would be required for sediment at SWMU 7b. Implementation of the alternative is moderately difficult using common construction practices. Unlike Alternative 2, Alternative 3 also requires some level of onsite solidification making it slightly more difficult to implement. Additionally, the transport of waste from the site has the potential to interfere with facility activities. Costs associated with Alternative 3 are moderate, similar to Alternative 2 and less expensive than Alternative 4. Although not more difficult to implement or more expensive than Alternative 2, Alternative 3 is not recommended as it is not consistent with the scope of the currently scheduled MILCON maintenance dredge and requires procurement of additional equipment for completion of onsite solidification.

Alternative 4 is effective in eliminating the potential for exposure to metals in sediment within the SWMU 7b removal area that may pose potential ecological risk. Following completion of this alternative, NFA would be required for sediment at SWMU 7b. Implementation of this alternative is moderately difficult using common

construction practices. Unlike Alternative 2, Alternative 4 also requires some level of onsite solidification making it slightly more difficult to implement. Additionally, the transport of waste from the site has the potential to interfere with facility activities. Costs associated with Alternative 4 are moderately high; Alternative 4 is the most expensive alternative. Alternative 4 is not recommended.

In accordance with the National Oil and Hazardous Substance Pollution Contingency Plan, this EE/CA will be placed in the Administrative Record and notice of its availability for public review, along with a brief summary, will be published in the local newspaper. The EE/CA will then be available for review during a 30-day public comment period, to be held from December 13, 2012 through January 13, 2013. A public information session may be held during or immediately following the public comment period, if requested. Following the public comment period, if comments are received, a Responsiveness Summary summarizing responses to significant comments will be prepared and included in the Action Memorandum describing the proposed removal action and will be placed in the Administrative Record.

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Acronyms and Abbreviations

ABM	abrasive blast material
AET	apparent effects threshold
ARAR	applicable or relevant and appropriate requirement
BERA	Baseline Ecological Risk Assessment
bss	below sediment surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	contaminant of concern
COPC	contaminant of potential concern
EE/CA	Engineering Evaluation/Cost Analysis
ERA	Ecological Risk Assessment
ER-L	effects range–low
ER-M	effects range–medium
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
JEB	Joint Expeditionary Base
µg/kg	micrograms per kilogram
mg/kg	milligram/kilogram
MILCON	military construction
mlw	mean low water
NAB	Naval Amphibious Base
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NFA	no further action
NOAA	National Oceanic and Atmospheric Administration
NTCRA	non-time-critical removal action
PAH	polycyclic aromatic hydrocarbon
PEL	probable effects level
PRG	preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RQ	remediation quotient
SARA	Superfund Amendments and Reauthorization Act
SERA	Screening Ecological Risk Assessment
SI	Site Investigation
SQUIRT	Screening Quick Reference Tables
SVOC	semi-volatile organic compound
SWMU	Solid Waste Management Unit
TBC	to-be-considered
TBT	tributyltin
TEL	threshold effects level
USEPA	U.S. Environmental Protection Agency

VDEQ	Virginia Department of Environmental Quality
VPDES	Virginia Pollution Discharge Elimination System
yd^3	cubic yards

SECTION 1
Introduction

This report presents an Engineering Evaluation/Cost Analysis (EE/CA) for a non-time-critical removal action (NTCRA) for Solid Waste Management Unit (SWMU) 7b, Small Boats Sandblast Yard, Joint Expeditionary Base (JEB) Little Creek, Virginia Beach, Virginia. The EE/CA is prepared under the Naval Facilities Engineering Command Mid-Atlantic Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62470-08-D-1000, Contract Task Order WE32.

For investigation purposes, SWMU 7 was subdivided by media. The terrestrial portion of the site (SWMU 7a) is composed of soil and groundwater, while the aquatic portion of the site (SWMU 7b) is composed of sediment and surface water. Following an Interim Removal Action in September 2004 to address lead-contaminated soils, the Navy, in partnership with the U.S. Environmental Protection Agency (USEPA) and the Virginia Department of Environmental Quality (VDEQ), agreed that no further action was required for SWMU 7a, and a Record of Decision was signed in June 2005 (Navy, 2005).

Investigation activities for SWMU 7b were conducted in response to recommendations for further evaluation made in the Site Investigation (SI) report (CH2M HILL, 2000). The SI report identified one semi-volatile organic compound (SVOC) (benzo[a]pyrene) and two metals (arsenic and iron) as human health contaminants of potential concern (COPCs) in sediment. A Screening and Baseline Ecological Risk Assessment (CH2M HILL, 2001) identified fourteen SVOCs (acenaphthene, acenaphthylene, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, chrysene, dibenzo[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, naphthalene, phenanthrene, and pyrene) and five metals (copper, lead, mercury, silver, and zinc) as ecological COPCs in sediment. The human health and ecological COPCs were further evaluated during the Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment (RI/HHRA/ERA) (CH2M HILL, 2004), which identified seven metals (arsenic, copper, lead, mercury, selenium, silver, tin, and zinc) and polyaromatic hydrocarbons (PAHs) as ecological contaminants of concern (COCs) in sediment. No human health risk was identified. Following completion of a military construction (MILCON) action in 2008, which included limited dredging within SWMU 7b, potential ecological and human health risks in sediment were further evaluated. The post-MILCON action evaluation identified five metals (copper, lead, mercury, tin, and zinc) as COCs posing potentially unacceptable risks to ecological receptors (CH2M HILL, 2012). No unacceptable risks to human health were identified.

The following information is presented within this EE/CA:

- Site description
- Identification of the removal action objective
- Description of response action elements
- Identification of the removal action alternatives and technologies
- Recommendation of a preferred removal alternative
- Schedule for the selected removal alternative

1.1 Regulatory Background

This document is issued by the Navy, the lead agency responsible for remediation of SWMU 7b, in partnership with USEPA Region 3 and VDEQ, under Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA) of 1986.

Section 104 of CERCLA and SARA allows an authorized agency to remove, or arrange for removal of, and to provide for remedial action relating to hazardous substances, pollutants, or contaminants at any time, or to take any other response measures consistent with the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), as deemed necessary to protect public health or welfare and the environment.

The NCP, 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 following:

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

A removal action is being considered for the work element; the removal action is non-time-critical. NTCRAs are defined in 40 CFR Section 300.415(b)(4) as "actions pertaining to an imminent threat to human health and the environment and that have planning periods of 6 months or more." Under 40 CFR Section 300.415, the lead agency is required 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 NTCRAs include preparing an EE/CA and making it available for public review and comment for a period of 30 days. An announcement of the 30-day public comment period for the EE/CA is required in a local newspaper. Written responses to significant comments will be summarized in an Action Memorandum and included in the Administrative Record.

1.2 Purpose and Objectives

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

The EE/CA compares four remedial alternatives based on their technical feasibility/implementability, effectiveness (i.e., ability to protect human health and the environment and 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, and (3) provide a framework for evaluating and selecting alternative technologies.

The objectives of this NTCRA are to reduce or eliminate compounds determined to pose potential unacceptable risk to ecological receptors in SWMU 7b sediment and to achieve long-term site remediation to be protective of human health and the environment. The following alternatives were evaluated:

1. No action
2. Mechanical dredging, upland disposal, and replacement with clean fill
3. Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill
4. Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill

SECTION 2
Site Characterization

2.1 JEB Little Creek Description and History

On October 1, 2009, Hampton Roads' first Department of Defense Joint Base was established. This new installation comprises the former Naval Amphibious Base (NAB) Little Creek and the former Army Post Fort Story; the new name for the combined installation is Joint Expeditionary Base (JEB) Little Creek-Fort Story. With the formation of this new command, the Navy assumes responsibility for management of both properties and will now merge public meetings regarding the ongoing environmental restoration programs. However, separate records will be maintained to ensure the integrity of ongoing efforts at both properties. When required for public notices and distributions, the former bases are identified jointly as JEB Little Creek-Fort Story. For Environmental Restoration Program documents, the bases are referred to separately as JEB Little Creek or JEB Fort Story.

JEB Little Creek covers approximately 2,215 acres in the northwest portion of Virginia Beach, Virginia, adjacent to the Chesapeake Bay (**Figure 2-1**). The former NAB Little Creek began operations as a permanent base in 1946. The Base's mission was the training of landing craft personnel for operational assignments. JEB Little Creek has expanded in both area and complexity of its mission over the past 65 years. Base personnel provide logistic facilities and support services for local commands, organizations, home-ported ships, and other U.S. and allied units to meet amphibious warfare–training requirements of the U.S. armed forces. Past and present operations at JEB Little Creek include vehicle and boat maintenance, boat painting and sandblasting, construction and repair of buildings and piers, mixing and application of pesticides, electroplating of musical instruments, laundry and dry cleaning, medical and dental treatment, and the generation of steam for heat. Land development surrounding the Base is residential, commercial, and industrial.

2.2 SWMU 7b Description and History

SWMU 7 is located at the intersection of Intercove Road and Signal Point Road in the north-central portion of the Base (**Figure 2-2**). The SWMU was used to sandblast and paint ships until 1996, when sandblasting activities were moved to an indoor facility (CB-125). Approximately 4,000 cubic yards (yd^3) of spent abrasive blast material (ABM) generated between 1960 and 1982 were stored in open piles in the construction footprint of CB-125 and in the area of CB-317 and CB-318. No release controls were identified at SWMU 7; therefore, spent ABM was historically released to soils and Desert Cove.

The ground surface at SWMU 7 is covered primarily with buildings, concrete, asphalt, and hard-packed gravel. Precipitation runs off to Desert Cove or is discharged through one of 22 outfalls (11 non-regulated stormwater, 8 regulated stormwater, and 3 regulated process water) surrounding the cove with very little infiltration to groundwater. Almost the entire shoreline of SWMU 7 is bulkheaded and currently used to moor small ships. Desert Cove is a tidal marine environment connected to the Chesapeake Bay via the Connector and Little Creek Channels. All drainage to the cove is from on-Base areas, consisting mainly of buildings and asphalt parking areas. Before a MILCON action at Desert Cove completed in 2008, the area was last dredged in 1953 to a depth of 10 feet below mean low water (mlw). As part of the recent MILCON action, a pre-dredge survey was conducted in January 2008. Results indicate the deposition rate for the cove is relatively low. SWMU 7 is actively used by the facility for heavy equipment storage, small ship mooring, ship maintenance (i.e., sandblasting in Building CB-125), and training. The current and reasonably anticipated future land use of the SWMU 7 area is not expected to change.

In 2008, a MILCON action was completed to demolish and replace Piers 44 through 51, construct a new quaywall along the eastern and southern edges of the cove, and dredge limited areas surrounding the former piers. The new quaywall was constructed approximately 32 feet outboard of the former knee wall. Sheet piling was installed to a depth of 24 feet below sediment surface (bss), and all material between the sheet pile and knee wall was left in place. The roadway adjacent to the shoreline was demolished, and debris was allowed to fall in place. A new concrete roadway was constructed along the edge of the new quaywall. Following demolition and before construction of the new piers, the area around the former piers was dredged to a depth of 10 feet below mlw (**Figure 2-2**). A closed clamshell dredge, maneuvered by a crane staged on a barge, was used to remove sediments. Before disposal, sediments were staged on a separate barge with open slots on the bottom to allow surface water to drain from the material. During use, the sediment barge was located close to the piers; however, it was moved out into the cove while awaiting dredged material disposal at Craney Island. A turbidity curtain was used periodically during dredging to encircle the area in which the clamshell was operating. On occasion, debris captured in the clamshell would prevent complete closure of the clamshell, allowing sediments to run out of the shell.

2.3 Previous Site Investigations

JEB Little Creek initiated environmental investigation efforts under the Navy Assessment and Control of Installation Pollutants Program in 1984. The former NAB Little Creek was placed on the National Priorities List in May 1999 (USEPA ID #VA5170022482) and investigations have since been conducted under CERCLA authority. The Federal Facility Agreement for JEB Little Creek was signed in November 2003 (Navy, 2003).

SWMU 7 has been characterized under several investigations and studies between 1989 and 2012. For investigation purposes, SWMU 7 was subdivided by media. The terrestrial portion of the site (SWMU 7a) is composed of soil and groundwater, while the aquatic portion of the site (SWMU 7b) is composed of sediment and surface water. Following an Interim Removal Action in September 2004 to address lead-contaminated soils, the Navy, in partnership with the USEPA and the VDEQ, agreed that No Further Action (NFA) was required for SWMU 7a, and a Record of Decision was signed in June 2005 (Navy, 2005). **Table 2-1** provides a chronological list and summary of previous investigations conducted at SWMU 7b. Sediment sample locations are depicted on **Figure 2-3.** The conceptual site model is shown on **Figure 2-4**. The respective investigations are a part of the Administrative Record file for JEB Little Creek and can be referenced for further details regarding specific sampling strategies, media investigations, and when and where the sampling was performed.

TABLE 2-1
Previous Studies and Investigations Summary

Previous Study / Investigation	Date	Investigation Activities
Site Investigation (CH2M HILL, 2001)	2000	Sediment samples were collected to verify the presence or absence of contamination and to conduct a human health risk screening. Metals and PAHs were detected in sediment above human health screening criteria and identified as COPCs. Additionally, ABM was observed in sediment. The SI recommended a Screening ERA (SERA) to identify potentially complete exposure pathways for ecological receptors and an RI to define the nature and extent of contamination.
SERA and Baseline Ecological Risk Assessment (BERA) (CH2M HILL, 2001)	2001	A SERA and BERA, constituting Steps 1 through 3 of the ERA process, were completed using data collected as part of the SI. Metals and PAHs in sediment exceeded ecological screening values. The BERA concluded that potentially unacceptable risks to lower-trophic level receptors were identified associated with exposure to select metals and PAHs in sediment; however, potential risks to upper-trophic-level aquatic receptors were negligible.

TABLE 2-1
Previous Studies and Investigations Summary

Previous Study / Investigation	Date	Investigation Activities
SWMU 7 RI/HHRA/ERA (CH2M HILL, 2004)	2002	During the RI/HHRA/ERA, SWMU 7b was divided into three areas – the Connector Channel, Cove, and Pier Area – to better evaluate potential risks where exposures could vary because of differences in the magnitude of contaminant levels. Sediment samples were collected in each area to define the nature and extent of contamination and to evaluate potential human health and ecological risks. Because of the tidal nature of the water body and numerous stormwater outfall drainage locations, surface water samples were not collected, as it could not be determined if any detected contaminants were from SWMU 7 or non-site-related sources. Some ABM was observed in sediment throughout the Connector Channel and Cove Areas, with greater ABM concentrations noted in the Pier Area adjacent to Pier 53. Metals and PAHs were detected above human health and ecological screening levels in all three areas; however, the quantitative HHRA identified no unacceptable human health risks from exposure to sediment. The ERA (through Step 3A) identified potentially unacceptable ecological risks to lower-trophic-level receptors exposed to metals and PAHs in sediment. In general, COPC concentrations were highest in the Pier Area and lowest in the Connector Channel. The RI recommended that further investigation of SWMU 7b sediment be conducted following completion of the scheduled MILCON action.
SWMU 7b Post-MILCON Evaluation (CH2M HILL, 2012)	2009 to 2010	In November 2009, surface sediment sampling was conducted to evaluate post-MILCON action conditions within the Cove, Connector Channel, and Pier Areas. In general, post-MILCON action COPC concentrations in the Connector Channel and Desert Cove Areas were similar to pre-action conditions. Concentrations of COPCs detected within the dredged portion of the Pier Area were generally similar to, or lower than, those previously detected, with the exception of the northeastern corner of the Pier Area. In August and September 2010, additional sediment sampling was conducted in the Cove, Connector Channel, and Pier Areas to evaluate the condition of the benthic invertebrate community at SWMU 7b and assess the correlation between the benthic community and metals and ABM content in sediment. The data suggest that some impacts to the benthic community are occurring in portions of the Pier Area; however, the portion of the Pier Area with the highest metals concentrations and ABM (northeast corner) did not consistently show the most impact to the benthic invertebrate community, suggesting other non-CERCLA-related factors (such as dissolved oxygen [DO]) may have more impact on the survival of the benthic invertebrate community. The evaluation concluded that ecological risks in the Connector Channel and Cove Area are not unacceptable, and no further action is warranted for these areas for the protection of the environment. Potentially unacceptable risks to ecological receptors were identified in the Pier Area, particularly the northeast corner. Although the current, non-CERCLA-related physical characteristics of the site may be having more of an impact on the condition of the benthic invertebrate community than the CERCLA-related metals detected in site sediment, the magnitude of these metals concentrations may result in unacceptable risks to ecological receptors should these physical characteristics change over time; therefore, site remediation at SWMU 7b is warranted. It was recommended the RAOs established for the site focus on the reduction of metals concentrations and not the establishment of a comparable (to an urban reference condition) benthic invertebrate community.

2.3.1 Risk Assessment Summary

No potentially unacceptable risks to human health from exposure to sediment were identified. Because of the tidal nature of the water body and 21 outfalls (19 stormwater and 3 process water) surrounding the cove, any contamination detected in the surface water of the cove may or may not be associated with SWMU 7; therefore, surface water was not evaluated in the HHRA and ERA. Potential ecological risks were identified associated with constituent transport via groundwater to Desert Cove, although the ERA concluded that groundwater is not a significant transport route from the site to the Desert Cove system. Potentially unacceptable risks to lower-trophic-level receptors from exposure to arsenic, copper, lead, nickel, selenium, silver, tin, zinc and PAHs in sediment were identified.

The Tier I Partnering Team agreed that potentially unacceptable ecological risks associated with PAHs in sediment are likely primarily attributable to the 19 stormwater outfalls that convey stormwater runoff from various locations within the facility, including numerous parking areas, and not attributable to historic sandblasting activities at SWMU 7b. Therefore, PAHs in Desert Cove do not require further investigation/action as part of the SWMU 7 CERCLA release. Additionally, although arsenic, selenium, and silver may have been components of ship hull paint historically sandblasted at SWMU 7b (Navy, 2006), the Tier I Partnering Team agreed potential risks associated with these COCs in sediment are not unacceptable based upon the following:

- Arsenic was identified as a COC in the Cove Area and Pier Area during the 2004 RI, where only the discrete RI sediment samples were used to derive the list of COCs. However, this constituent is present at levels representative of the urban nature of the water body rather than historic sandblasting activities. Additionally, other potential COCs from sandblasting (copper, lead, mercury, tin, and zinc) do not show similarly uniform distributions.
- Selenium was identified as a COC in the Channel, Cove, and Pier areas during the 2004 RI, where only the discrete SI (5 samples collected in 2000) and RI (36 samples collected in 2002) sediment samples were used to derive the list of COCs. When considering both the discrete and composite RI samples, the site-wide maximum hazard quotient (HQ) for selenium, based upon the apparent effects threshold (AET) [effects range low (ER-L), effects range medium (ER-M), threshold effects level (TEL), and probable effects level (PEL) screening values have not been developed for selenium], in surface sediment is 2.50 and the site-wide mean HQ, calculated using ½ the detection limit for non-detected sample locations, is less than 1. All detected concentrations of selenium [maximum of 2.5 milligram per kilogram (mg/kg)] exceed the AET (1 mg/kg); however, selenium was only detected in 10 of 41 (about 25 percent) of the surface sediment samples. Detected concentrations were noted in the Connector Channel, Cove, and Pier Areas with a low range in detected concentrations (minimum of 1.3 J mg/kg to maximum of 2.5 mg/kg), likely indicative of urban conditions and not a result of historic sandblasting activities.
- Silver was identified as a COC in the Pier Area during the 2004 RI, where only the discrete RI sediment samples were used to derive the list of COCs. When considering both the discrete and composite RI samples, the site-wide maximum HQ for silver, based upon the ER-L screening values), in surface sediment is 7.80 and the site-wide mean HQ is less than 1. Silver was detected in 7 of 41 (about 15 percent) of surface sediment samples and was not detected in subsurface sediment. The four sample locations that exceeded screening values [ER-L, ER-M, TEL, and/or PEL] are located within the area since removed by the MILCON action.

Additionally, per a May 21, 2012 Tier I Partnering Team consensus statement (**Appendix A**), potential ecological risk associated with tin was determined to be not unacceptable based upon the following:

- In the Pier Area, 7 of 33 (21 percent) samples analyzed for total tin between 2000 and 2010 (excluding samples collected within the dredged area) exceed maximum background for total tin.
- In the Pier Area, the mean background ratio for total tin (mean Pier Area concentration / mean background) is below 1 for all samples collected between 2000 and 2010 (excluding samples collected within the dredged area). Additionally, the mean background ratio for total tin is below 1 for each individual sampling event with the exception of the 2010 sampling event, where the mean ratio equaled 1.11.
- In the Pier Area, 11 of the 17 samples analyzed for total tin in 2009 were also analyzed for tributyltin (TBT). TBT samples were not collected as part of the 2000/2002 and 2010 sampling events. The maximum HQ (based upon the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRT) screening value of 3.4 mg/kg) for total tin detected between 2000 and 2010 is 8.79 and the mean HQ is 2.34. The maximum HQ (based upon the NOAA SQUIRT screening value of 3.4 mg/kg) for the detected TBT fraction of total tin in 2009 is 0.002 and the mean HQ for the detected TBT fraction of total tin is 0.001. Additionally, when compared to the TEL screening value (0.048 mg/kg), the maximum HQ for the detected TBT fraction of total tin in 2009 is 0.158 and the mean HQ for the detected TBT fraction of total tin is 0.098.

- TBT was detected in each of the 11 samples collected within the Pier Area. Detected concentrations range from 2.00 micrograms per kilogram (µg/kg) to 7.60 µg/kg. The arithmetic mean is 4.86 µg/kg with a standard deviation of 1.48. The ratio of TBT to total tin in the Pier Area ranged from 0.00011 to 0.00076. Because of low variability in the detected TBT values, similar TBT concentrations and ratios to total tin can be expected across the site. Where both total tin and TBT were detected in samples collected in 2009, the ratio of TBT to total tin (TBT/total tin) was calculated. The average of these ratios (0.00017) was used to extrapolate the TBT fraction of the remaining total tin samples (total tin x 0.00017) collected between 2000 and 2010 for comparison to NOAA SQUIRT and TEL screening criteria. The maximum HQ (based upon the NOAA SQUIRT screening value) within the Pier Area for the extrapolated TBT fractions of total tin is 0.001 and the mean HQ for the extrapolated TBT fractions of total tin is 0.0004. Additionally, when compared to the TEL screening value, the maximum HQ for the extrapolated TBT fraction of total tin is 0.070 and the mean HQ for the extrapolated TBT fraction of total tin is 0.028.

As a result of these risk management decisions, no action is warranted for arsenic, selenium, silver, tin, and PAHs in sediment.

2.3.2 Basis for Removal Action

A NTCRA is currently planned for SWMU 3, the Pier 10 Sandblast Yard, in conjunction with scheduled February 2013 dry dock maintenance and MILCON maintenance dredging. Because site clean-up strategies are similar for SWMU 7b and SWMU 3, the Navy, in partnership with USEPA and VDEQ, agree that completion of an NTCRA at SWMU 7b in conjunction with SWMU 3 is warranted to avoid duplication of equipment mobilization resulting in significant increases in overall site costs. It is expected that the removal action will be the final remedy for SWMU 7b.

2.4 Development of Cleanup Goals

During development of clean-up goals for SWMU 3, a former sandblasting area with similar sediment COCs, regression equations developed based upon the correlation between ABM content and COC concentrations were used to calculate associated sediment concentrations using 1 percent ABM (the lowest possible integer). The resulting values generally fell between the PEL and ER-M. No correlation between ABM and metals COC concentrations at SWMU 7b was established. However, based upon the similarity of SWMU 3 and SWMU 7b, and the urban nature of Desert Cove, preliminary remediation goals (PRGs) were established as the NOAA ER-M screening value (**Table 2-2**). Because ABM itself is not toxic and does not pose risk to the environment, the presence of ABM in sediment does not drive the need for action at either site.

TABLE 2-2
Sediment PRGs

Copper	Lead	Mercury	Zinc
270	218	0.71	410

Note: Values are in milligrams per kilogram (mg/kg)

2.4.1 Determination of Removal Area

In line with the methodology established for SWMU 3, to define the area requiring action under CERCLA, a remediation quotient (RQ), was calculated. The RQ is defined as the ratio of the sediment concentration to the PRG. The lateral remediation area boundary was determined by calculating the RQ for each of the four COCs using all available surface sediment data. The site was broken down into 100-by-100-foot grid cells. In line with SWMU 3 and as discussed during the July 2012 Tier I Partnering Team meeting and documented herein, a grid cell is defined as being impacted if the RQ for one or more individual COCs exceeds 1.5 and the average RQ for the five COCs exceeds one. The RQ calculations for those grid cells with exceedances of criteria and the area proposed for

CERCLA sediment remediation is depicted on **Figure 2-5**. Grid cell locations LW07-L5, LW07-SD03, and LW07-M3 are proposed for elimination from the CERCLA remediation boundary based upon the following:

- Grid cell LW07-L5: Grid cell fails RQ criteria as a result of mercury detection in the 2002 composite sample; however, no other samples (2002 discrete, 2009, and 2010) from this location fail the RQ criteria.
- Grid cell LW07-SD03: Grid cell fails RQ criteria for samples collected in 2000; however, the cell is located within the MILCON action dredge limits.
- Grid cell LW07-M3: Grid cell fails RQ criteria for samples collected in 2002; however, the cell is located within the MILCON action dredge limits.

Prior to completion of the NTCRA, additional sampling to confirm COC concentrations in those grid cells proposed for elimination will be conducted. If no exceedances of criteria are noted, action will not be required within the grid. If exceedances of criteria are noted, action will be required within the entire grid cell. In establishing the area to be addressed as part of this NTCRA, the following logistical and engineering challenges were identified:

- Per facility direction, sediment cannot be dredged within 5 feet of bulk-head shoreline and 10 feet of piers, without the potential for structural impacts to the surrounding area.
- The elevation of the cove floor cannot be raised above -10 JEB Little Creek Station Vertical Datum (-11.06 mlw).
- Following dredging, the cove floor elevation must be reestablished at no less than -10 JEB Little Creek Station Vertical Datum.

Based upon these considerations, the preliminary removal area to be addressed as part of this NTCRA is depicted on **Figure 2-6**. Additional removal area delineation sampling will be conducted before completion of the NTCRA and the removal area will be expanded as necessary to eliminate the exposure pathway and mitigate potentially unacceptable ecological risks at SWMU 7b.

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\LITTLECREEK\MAPFILES\408774_SWMU7B_EECA\FIGURE 2-1 - SITE LOCATION MAP.MXD CBOWMAN 8/31/2012 7:27:26 AM

Legend

SWMU 7b Study Area Boundary

Installation Boundary

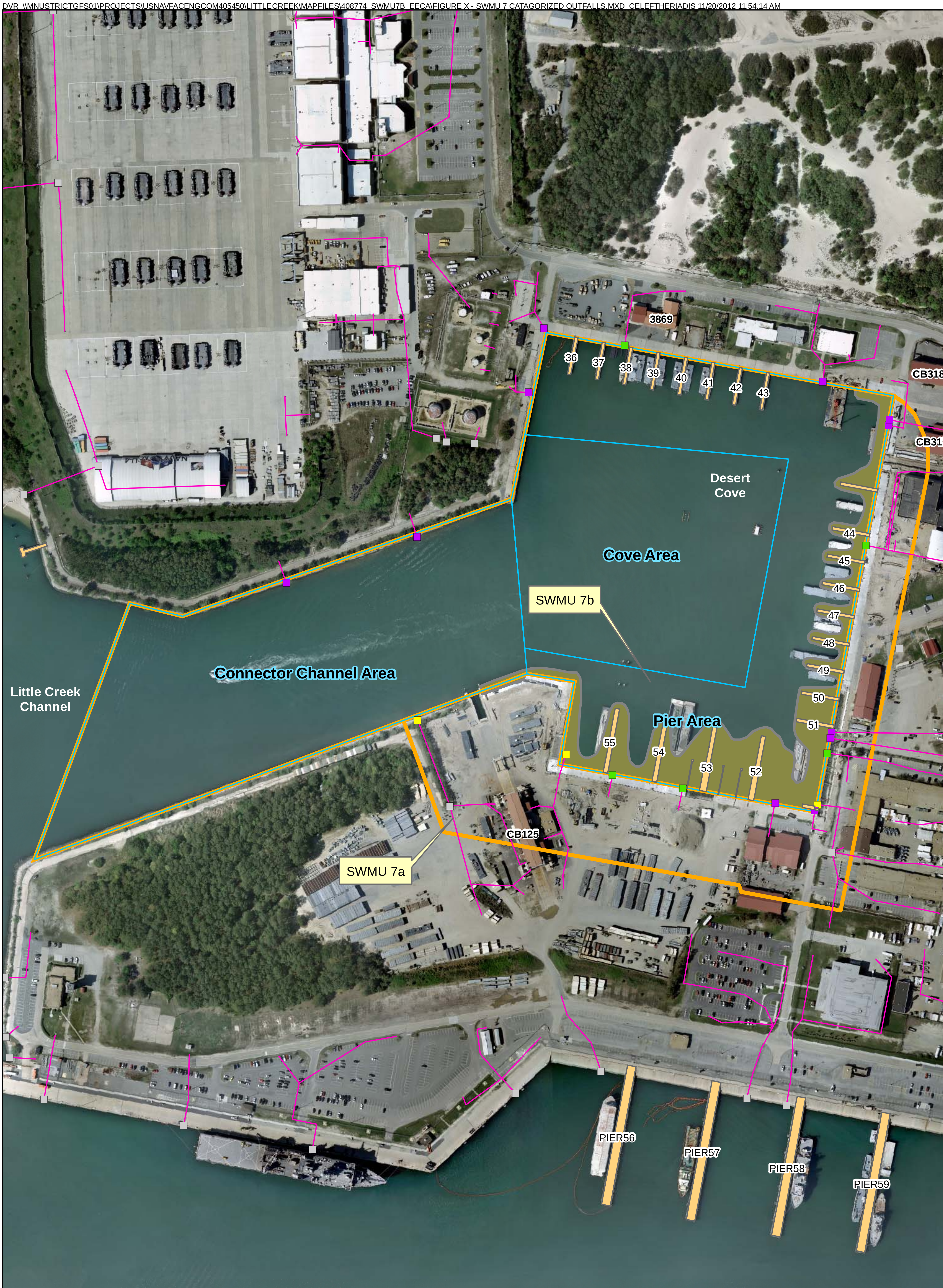
N W E S

0 1,000 2,000 4,000 Feet

Figure 2-1
SWMU 7b Location Map
SWMU 7b Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\LITTLECREEK\MAPFILES\408774_SWMU7B_EECA\FIGURE X - SWMU 7 CATAGORIZED OUTFALLS.MXD CELEFTHERIADIS 11/20/2012 11:54:14 AM



Legend

- Outfall
- Combined Regulated Storm/Process Water Outfall
- Non-Regulated Stormwater Outfall
- Regulated Stormwater Outfall
- Storm Sewer Line
- Installation Boundary
- SWMU 7 Study Area Boundary
- Area Boundary Line
- Limits of 2008 MILCON Dredge

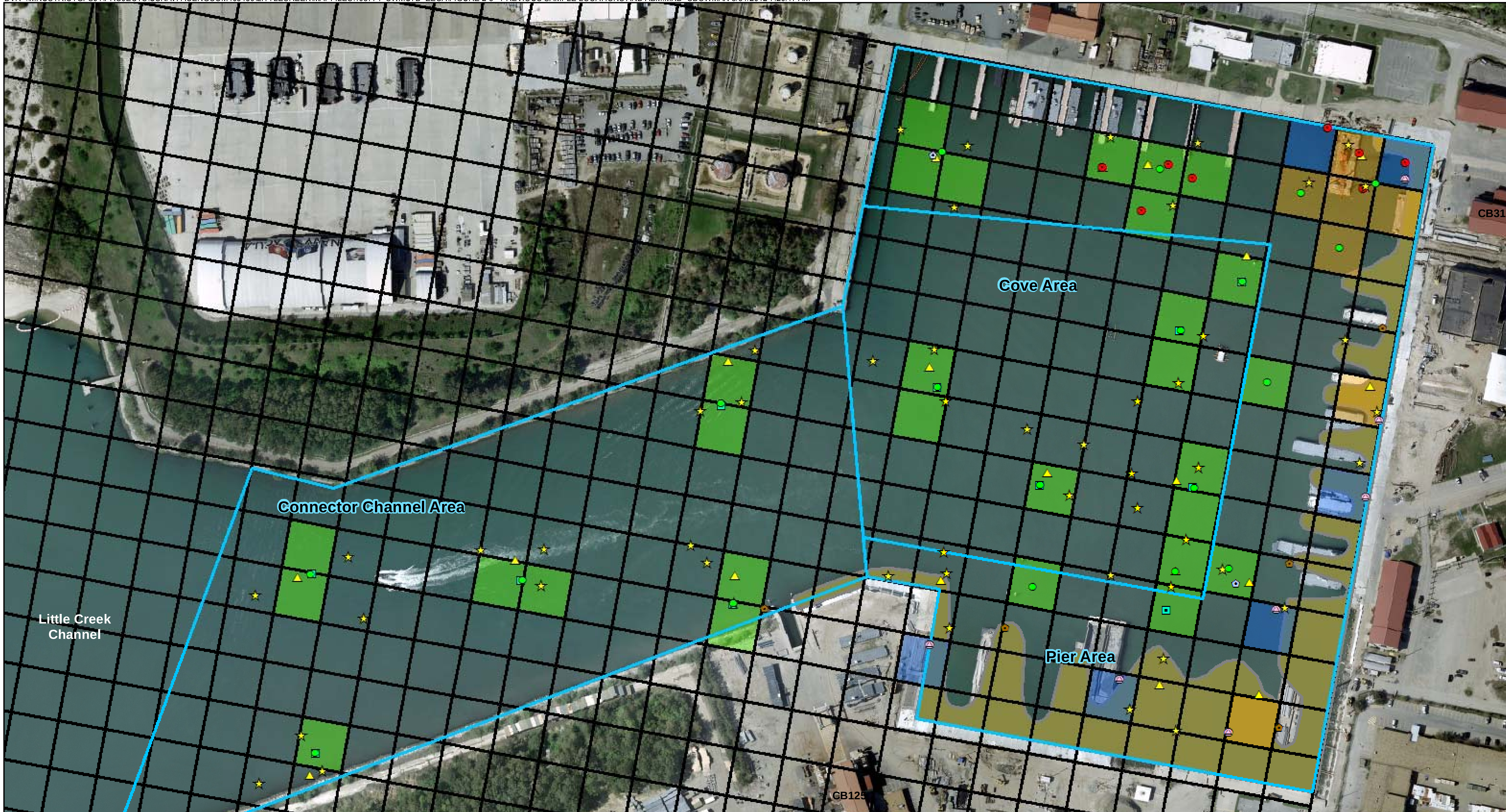
N W E S

0 150 300 Feet

Figure 2-2
SWMU 7 Boundary and Immediate Vicinity
SWMU 7b Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\LITTLECREEK\MAPFILES\408774_SWMU7B_EECA\FIGURE 2-3 - PREVIOUS SAMPLE LOCATIONS AND ABM.MXD CBOWMAN 8/31/2012 7:20:17 AM



Legend

- 2010 Sediment Sample Station Location (mid-point of grab samples)
- 2000 SI Sediment Sample Location
- 2002 RI Composite Sediment Sample Location
- 2009 Cove/Connector Channel Sediment Sample Location
- 2009 Dredged Area Sediment Sample Location
- 2009 Pier Area Sediment Sample Location - Low Concentrations
- 2009 Pier Area Sediment Sample Location - High Concentrations
- 2002 RI Discrete Sediment Sample Location
- Area Boundary Line

Surface Sediment ABM Content (per 2009 and 2010 Sampling)

- ≤ 1%
- 1-5%
- 5-10%
- Limits of 2008 MILCON Dredge

N
W E
S

0 100 200 400
Feet

Figure 2-3
Previous Sample Locations and ABM Delineation
SWMU 7b Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL.

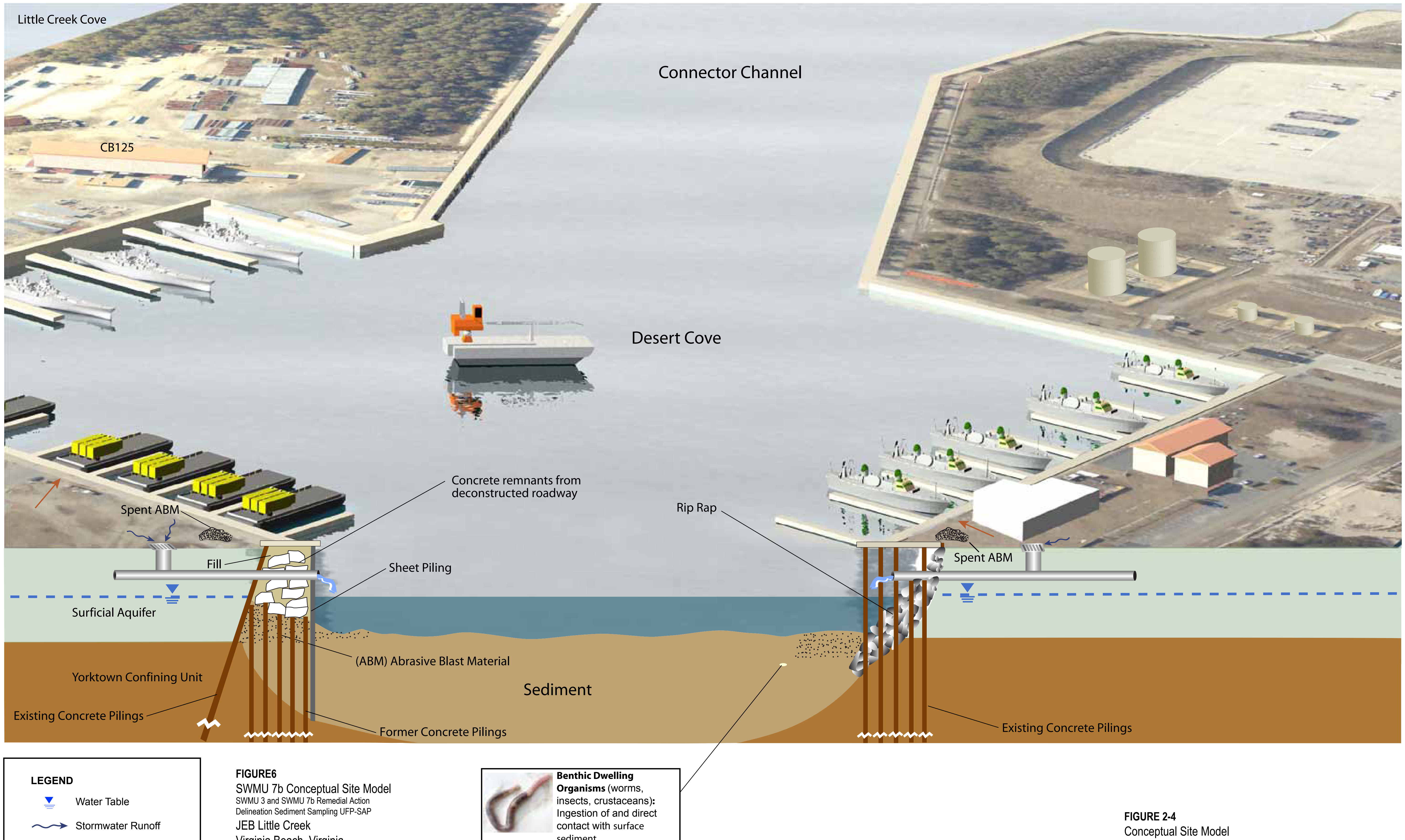
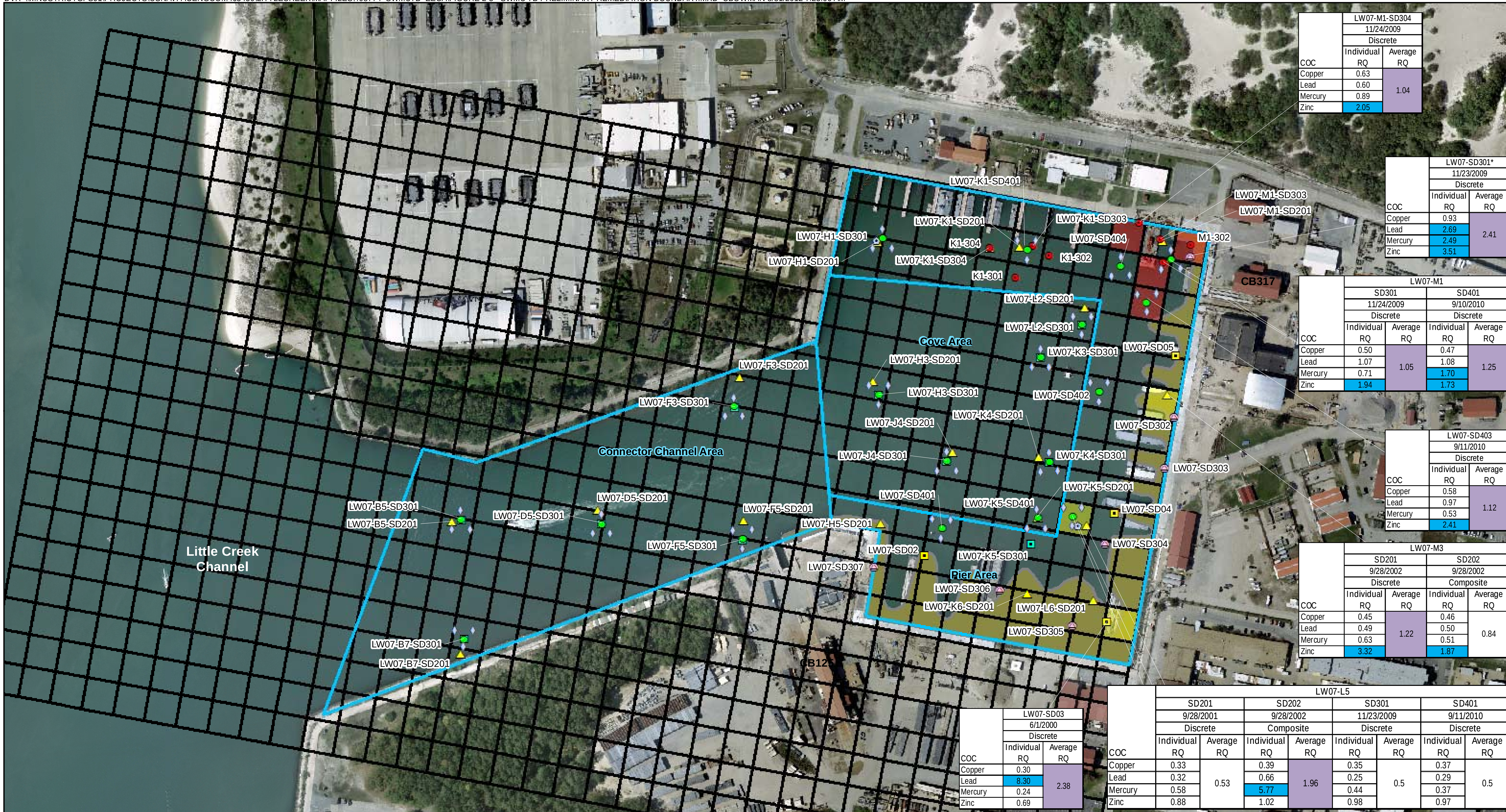


FIGURE 2-4
Conceptual Site Model
SWMU 7b Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\LITTLECREEK\MAPFILES\408774_SWMU7B_EECA\FIGURE 2-5 - SWMU 7B PRELIMINARY REMEDIATION BOUNDARY.MXD CBOWMAN 8/31/2012 7:23:06 AM



COC	LW07-M1-SD304	
	11/24/2009	
	Discrete	
	Individual RQ	Average RQ
Copper	0.63	1.04
Lead	0.60	
Mercury	0.89	
Zinc	2.05	

COC	LW07-SD301*	
	11/23/2009	
	Discrete	
	Individual RQ	Average RQ
Copper	0.93	2.41
Lead	2.69	
Mercury	2.49	
Zinc	3.51	

COC	LW07-M1			
	SD301		SD401	
	11/24/2009		9/10/2010	
	Discrete		Discrete	
	Individual RQ	Average RQ	Individual RQ	Average RQ
Copper	0.50	1.05	0.47	1.25
Lead	1.07		1.08	
Mercury	0.71		1.70	
Zinc	1.94		1.73	

COC	LW07-SD403	
	9/11/2010	
	Discrete	
	Individual RQ	Average RQ
Copper	0.58	1.12
Lead	0.97	
Mercury	0.53	
Zinc	2.41	

COC	LW07-M3			
	SD201		SD202	
	9/28/2002		9/28/2002	
	Discrete		Composite	
	Individual RQ	Average RQ	Individual RQ	Average RQ
Copper	0.45	1.22	0.46	0.84
Lead	0.49		0.50	
Mercury	0.63		0.51	
Zinc	3.32		1.87	

COC	LW07-SD03	
	6/1/2000	
	Discrete	
	Individual RQ	Average RQ
Copper	0.30	2.38
Lead	8.30	
Mercury	0.24	
Zinc	0.69	

COC	LW07-L5							
	SD201		SD202		SD301		SD401	
	9/28/2001		9/28/2002		11/23/2009		9/11/2010	
	Discrete		Composite		Discrete		Discrete	
	Individual RQ	Average RQ	Individual RQ	Average RQ	Individual RQ	Average RQ	Individual RQ	Average RQ
Copper	0.33	0.53	0.39	1.96	0.35	0.5	0.37	0.5
Lead	0.32		0.66		0.25		0.29	
Mercury	0.58		5.77		0.44		0.37	
Zinc	0.88		1.02		0.98		0.97	

Legend

- 2000 Sediment Sample Location
- 2002 RI Discrete Sediment Sample Location
- 2009 Pier Area Sediment Sample Location - Low Concentrations
- 2009 Pier Area Sediment Sample Location - High Concentrations
- 2009 Dredged Area Sediment Sample Location
- 2009 Cove/Connector Channel Sediment Sample Location
- 2010 Composite Surface Sediment Sample Locations
- 2010 Surface Water Quality Sample Locations
- Limits of 2008 MILCON Dredge
- Area Boundary Line
- Preliminary Remediation Area
- Grid Proposed for Risk Management

N W E S

0 150 300 Feet

Figure 2-5
Preliminary Remediation Area
SWMU 7b Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

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DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\LITTLECREEK\MAPFILES\408774_SWMU7B_EECA\FIGURE 2-6 - REMOVAL ACTION AREA.MXD CELEFTHERIADIS 9/6/2012 1:56:35 PM

Legend
Removal Action Area
Area Boundary Line

N
W E
S

0 50 100
Feet

Figure 2-6
Removal Action Area
SWMU 7b Engineering Evaluation/Cost Analysis
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

SECTION 3

Identification of Objective

3.1 Statutory Limits on Removal Action

The 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 manual does not limit the cost or duration of the removal action; however, cost-effectiveness is a recommended criterion for the evaluation of removal action alternatives.

3.2 Removal Action Objective and Scope

3.2.1 Removal Action Objective

The removal action objective in this EE/CA will address SWMU 7b sediment, as shown on **Figure 2-6** and expanded as necessary following additional sediment sampling. There are no potentially unacceptable human health risks associated with current or future exposure to SWMU 7b sediment; therefore, no action is required for this medium for the protection of human health. The removal action objective for the protection of the environment is as follows:

- Reduce concentrations of copper, lead, mercury, and zinc in sediment such that remaining concentrations do not pose unacceptable risk to ecological receptors.

3.2.2 Removal Action Scope

In the preparation of this EE/CA, removal action alternatives were scoped and developed to meet the objective listed above. The scope of the engineering measures for each removal alternative is defined in this section.

1. No action: The no action alternative means that no removal work will be done at this site.
2. Mechanical dredging, upland disposal, and replacement with clean fill: The sediment removal area would be dredged and backfilled with a clean sand layer. This option would mitigate potentially unacceptable risk and would incorporate actions for erosion and sediment control and upland disposal.
3. Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill: The sediment removal area would be dredged and backfilled with a clean sand layer. This option would mitigate potentially unacceptable risk and would incorporate actions for erosion and sediment control, onsite dredge spoil solidification, and upland disposal.
4. Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill: The sediment removal area would be dredged and backfilled with a clean sand layer. This option would mitigate potentially unacceptable risk and would incorporate actions for erosion and sediment control, onsite passive dewatering via geotube, and upland disposal.

3.3 Determination of Removal Schedule

The EE/CA will be placed in the Administrative Record, and notice of its availability for public review, along with a brief summary, will be published in the local newspaper. The EE/CA will be available for a 30-day public comment period. The public comment period is scheduled to be from December 13, 2012 through January 13, 2013. A public information session will be held during or immediately following the public comment period, if requested. If public comments are received during the public comment period, a Responsiveness Summary summarizing responses to significant comments will be prepared and included in the Administrative Record. Because this removal action has been designated non-time-critical, the main factor controlling the start date of the NTCRA is completion of the SWMU 3 NTCRA during the removal and maintenance of the dry dock and anchoring system, scheduled to begin in February 2013 and take approximately 90 days to complete.

The total project period is anticipated to last 9.5 months from the beginning of the public comment period to completion of the associated construction completion documentation. Mobilization for completion of the NTCRA will correspond with completion of the SWMU 3NTCRA. The following presents critical milestone periods related to the EE/CA:

- EE/CA public comment period—30 days
- Subcontracting, work plan, and mobilization—3 months
- Removal action—1 month
- CERCLA documentation—4 months

3.4 Applicable or Relevant and Appropriate Requirements

As required by Section 121 of CERCLA, remedial actions carried out under Section 104 or secured under Section 106 must attain the levels of standards of control for hazardous substances, pollutants, or contaminants specified by the applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws and state facility-siting laws, unless waivers are obtained. However, as required by USEPA policy 40 CFR Section 300.415(j), ARARs will be identified and attained for removal actions to the extent practicable. Two factors will be applied to determine whether the identification and attainment of ARARs is practicable in a particular removal situation: (1) the urgency of the situation; and (2) the scope of the removal action to be conducted.

ARARs are identified by USEPA as either being applicable to a situation or relevant and appropriate to it. These distinctions are critical to understanding the constraints imposed on response alternatives by environmental regulations other than CERCLA. The following definitions of ARARs are from the USEPA guidance (USEPA, 1998):

- “Applicable” requirements are standards and other environmental protection requirements of federal or state law dealing with a hazardous substance, pollutant, contaminant, action being taken, location, or other circumstance at a CERCLA site.

- “Relevant and appropriate” requirements are standards and environmental protection criteria of federal or state law that, although not “applicable” to a hazardous substance, pollutant, contaminant, action being taken, location, or other circumstance, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. The procedure to determine if a requirement is relevant and appropriate is a two-step process. A requirement is “relevant” if it addresses problems or situations sufficiently similar to the circumstances of the proposed response action. A requirement is “appropriate” if it would also be well suited to the conditions of the site.

A requirement may be “relevant” to a particular situation but not “appropriate,” given site-specific circumstances; such a requirement would not be an ARAR for the site. A requirement that is relevant and appropriate must be met as if it were applicable.

“To-be-considered” (TBC) criteria are non-promulgated advisories or guidance issued by federal or state government that are not legally binding, and do not have the status of potential ARARs. TBCs are evaluated along with ARARs and may be implemented when ARARs are not fully protective of human health and the environment.

Another factor in determining which response requirement must be met is whether the requirement is substantive or administrative. Onsite CERCLA response actions must meet substantive requirements but not administrative requirements. Substantive requirements are those dealing directly with actions or with conditions in the environment. Administrative requirements implement the substantive requirements by prescribing procedures such as fees, permitting, and inspection that make substantive requirements effective. This distinction applies to onsite actions only; offsite response actions are subject to all applicable standards and regulations, including administrative requirements such as permits.

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

Chemical-specific ARARs are health or risk management-based numbers or methodologies that result in the establishment of numerical values for a given medium that would meet the NCP threshold criterion of overall protection of human health and the environment. These requirements generally set protective cleanup concentrations for the COCs in the designated media, or set safe concentrations of discharge for response activity. Chemical-specific requirements are generally set for a single chemical or closely related group of chemicals and do not typically consider mixtures of chemicals. When chemical-specific requirements do not adequately protect human health or the environment, cleanup goals may be set by the TBC value. Federal and Commonwealth of Virginia chemical-specific regulations that have been reviewed are summarized in **Appendix B**.

Location-specific ARARs restrict response activities and media concentrations based on the characteristics of the surrounding environments. Location-specific ARARs may include restrictions on response actions within wetlands or floodplains, near locations of known endangered species, or on protected waterways. Federal and Commonwealth of Virginia location-specific regulations that have been reviewed are summarized in **Appendix B**.

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances. Federal and Commonwealth of Virginia action-specific ARARs that may affect the development and conceptual arrangement of response alternatives are summarized in **Appendix B**.

3.5 General Disposal Requirements

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

SECTION 4

Description and Analysis of Removal Action Alternatives

A sediment removal action is planned for SWMU 7b based upon the removal area identification presented in Section 2.6. The alternatives for this NTCRA were developed using professional judgment and information from previous investigations. Alternatives were evaluated based on effectiveness, implementability, and cost. The no action alternative was evaluated for comparative purposes.

4.1 Description of Removal Action Alternatives

4.1.1 Alternative 1—No Action

With the no action alternative, no removal work will be done, no controls will be implemented, and the site will remain in its current condition, leaving the impacted sediment in place. This alternative does not represent the final action for the site. The need for additional action will be evaluated as part of a forthcoming ROD. It is assumed that the current level of maintenance will be sustained.

4.1.2 Alternative 2—Mechanical dredging, upland disposal, and replacement with clean fill

Alternative 2 includes the removal and offsite disposal of impacted sediment followed by placement of a clean sand layer. This section discusses the elements of this removal.

Pre-Delineation Sampling

Before completion of the work planning phase, pre-delineation surface and subsurface sediment sampling will be conducted to determine the final removal area and required final dredging depths. As a result of the equipment being utilized (mechanical dredge), a minimum of 1 foot of sediment will be removed, plus an allowance for an additional 1 foot of overdredge (2 feet total). For the purposes of this EE/CA, it is assumed that removal of 2 feet of impacted sediment within the preliminary removal area is required, plus an allowance for an additional 1 foot of overdredge (3 feet total).

Mobilization

Before removal activities, utility locating will be performed to identify any underground and overhead utilities that may impact the removal action. A MILCON maintenance dredging is scheduled to take place at the facility during the timeframe of this NTCRA; therefore, it is assumed the same dredging subcontractor will be used and no mobilization costs will be associated with the dredge equipment or personnel. A pre-removal bathymetric survey will be completed to confirm the pre-excavation surface elevations and identify any large anomalies within the removal area. If any large debris is identified, a debris sweep will be performed before dredging.

Dredging

Removal of sediment will be performed using a mechanical dredge outfitted with a clamshell bucket specifically designed for environmental sediment removal projects. The dredge will be positioned on scows to allow for easier movement around Desert Cove and prevent disturbance to upland activities. Turbidity and sheens in the dredging area will be reduced through use of the environmental clamshell bucket and controlled with silt curtains and oil booms. Dredged sediment will be loaded onto water-tight scows and moved to an onsite staging area for dewatering. Intermediate bathymetric surveys will be performed during dredging activities. Following completion of dredging, a post-removal bathymetric survey will be completed to confirm contract dredging depths were achieved.

Dewatering

Dredged sediment will undergo passive dewatering within water-tight scows for a period of time by allowing solids to settle to the bottom of the scows. The overlying water will be pumped through a filter system located on the barge and discharged to Desert Cove. Before transporting the dredged sediment for offsite disposal, waste characterization sampling will be conducted. All materials will be disposed of in accordance with state regulations at a state-permitted disposal facility that is approved by the Navy and is permitted by USEPA to accept CERCLA waste.

Barge Decontamination

Following completion of all dredging and sediment solidification, each scow will be decontaminated onsite. Decontamination fluids will be containerized for waste characterization and transported to a CERCLA-approved facility (Soilex Facility in Suffolk, Virginia) for disposal.

Site Restoration

Following completion of the post-removal bathymetric survey, the site will be restored through placement of a clean sand layer across the entire grid cell. Prior to placement, sand will be sampled to determine its suitability for use as clean fill. Sampling requirements and clean fill criteria will be determined during the work-planning phase. A minimum of six inches of clean, medium-grained sand will be placed across the dredged area and remaining portions of the grid cell not dredged; however, enough sand will be placed to re-establish the cove floor elevation to -10.92 feet mean lower low water (-10 feet JEB Little Creek Station Vertical Datum). For the purposes of this EE/CA, it is assumed 2 feet of sand will be required over the dredged areas in each grid cell (full replacement of dredged sediment), with 6-inches of sand placed in those areas not dredged. Sand placement will be verified by collecting sediment cores for visual confirmation of thickness. Following completion of sand placement, a bathymetric survey of the area will be completed to confirm re-establishment of the cove floor to the specified elevation and determine final site conditions.

Short-Term Monitoring

Short-term monitoring will be required during the construction phase to protect human health and the environment. Monitoring requirements may include turbidity and water quality monitoring and noise monitoring; requirements will be defined during the work planning phase.

4.1.3 Alternative 3—Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill

Alternative 3 includes the removal of, onsite solidification of, and offsite disposal of impacted sediment followed by placement of a clean sand layer. This section discusses the elements of this removal.

Pre-Delineation Sampling

Before completion of the work planning phase, pre-delineation surface and subsurface sediment sampling will be conducted to determine the final removal area and required final dredging depths. As a result of the equipment being utilized (mechanical dredge), a minimum of 1 foot of sediment will be removed, plus an allowance for an additional 1 foot of overdredge (2 feet total). For the purposes of this EE/CA, it is assumed that removal of 2 feet of impacted sediment within the preliminary removal area is required, plus an allowance for an additional 1 foot of overdredge (3 feet total).

Mobilization

Before removal activities, utility locating will be performed to identify any underground and overhead utilities that may impact the removal action. A MILCON maintenance dredging is scheduled to take place at the facility during the timeframe of this NTCRA; therefore, it is assumed the same dredging subcontractor will be used and no mobilization costs will be associated with the dredge equipment or personnel. A pre-removal bathymetric survey will be completed to confirm the pre-excavation surface elevations and identify any large anomalies within the removal area. If any large debris is identified, a debris sweep will be performed before dredging.

Dredging

Removal of sediment will be performed using a mechanical dredge outfitted with an environmental clamshell bucket. The dredge will be positioned on scows to allow for easier movement around Desert Cove and to prevent disturbance to upland activities. Turbidity and sheens in the dredging area will be reduced through use of the environmental clamshell bucket and controlled with silt curtains and oil booms. Dredged sediment will be loaded onto water-tight scows and moved to an onsite staging area for dewatering and solidification. Intermediate bathymetric surveys will be performed during dredging activities. Following completion of dredging, a post-removal bathymetric survey will be completed to confirm contract dredging depths were achieved.

Dewatering and Solidification

Dredged sediment will undergo passive dewatering within water-tight scows for a period of time by allowing solids to settle to the bottom of the scows. The overlying water will be pumped through a filter system located on the barge and discharged to Desert Cove.

The dewatered sediment will then be stabilized onsite. For the purposes of this EE/CA, it is assumed that Portland cement will be used for solidification. Solidification will be performed to the degree needed for the dredged sediment to pass the paint filter test. Solidification within the scow will be accomplished by a rotary mixing head attached to an extended reach excavator or similar equipment. After solidification and waste characterization, the material will be off-loaded directly from the scow and trucked to a CERCLA-approved Resource Conservation and Recovery Act (RCRA) Subtitle D Landfill (Bethel Landfill in Hampton, Virginia) for disposal. All materials will be disposed of in accordance with state regulations at a state-permitted disposal facility that is approved by the Navy and is permitted by USEPA to accept CERCLA waste.

Barge Decontamination

Following completion of all dredging and sediment solidification, each scow will be decontaminated onsite. Decontamination fluids will be containerized for waste characterization and transported to a CERCLA-approved facility (Soilex Facility in Suffolk, Virginia) for disposal.

Site Restoration

Following completion of the post-removal bathymetric survey, the site will be restored through placement of a clean sand layer across the entire grid cell. Prior to placement, sand will be sampled to determine its suitability for use as clean fill. Sampling requirements and clean fill criteria will be determined during the work-planning phase. A minimum of six inches of clean, medium-grained sand will be placed across the dredged area and remaining portions of the grid cell not dredged; however, enough sand will be placed to reestablish the cove floor elevation to -10.92 feet mean lower low water (-10 feet JEB Little Creek Station Vertical Datum). For the purposes of this EE/CA, it is assumed 2 feet of sand will be required over the dredged areas in each grid cell (full replacement of dredged sediment), with 6-inches of sand placed in those areas not dredged. Sand placement will be verified by collecting sediment cores allowing for visual confirmation of thickness. Following completion of sand placement a bathymetric survey of the area will be completed to confirm re-establishment of the cove floor to the specified elevation and determine final site conditions.

Short-Term Monitoring

Short-term monitoring will be required during the construction phase to protect human health and the environment. Monitoring requirements may include turbidity and water quality monitoring, dust and air quality monitoring, and noise monitoring; requirements will be defined during the work planning phase.

4.1.4 Alternative 4—Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill

Alternative 4 includes the removal, onsite passive dewatering and solidification, and offsite disposal of impacted sediment followed by placement of a clean sand layer. This section discusses the elements of this removal.

Pre-Delineation Sampling

Before completion of the work planning phase, pre-delineation surface and subsurface sediment sampling will be conducted to determine the final removal area and required final dredging depths. As a result of the equipment being utilized (mechanical dredge), a minimum of 1 foot of sediment will be removed, plus an allowance for an additional 1 foot of overdredge (2 feet total). For the purposes of this EE/CA, it is assumed that removal of 2 feet of impacted sediment within the preliminary removal area is required, plus an allowance for an additional 1 foot of overdredge (3 feet total).

Mobilization

Before removal activities, utility locating will be performed to identify any underground and overhead utilities that may impact the removal action. A MILCON maintenance dredging is scheduled to take place at the facility during the timeframe of this NTCRA; therefore, it is assumed the same dredging subcontractor will be used and no mobilization costs will be associated with the dredge equipment or personnel. Additionally, it is assumed the material staging area for the onsite geotube dewatering operations constructed for completion of the SWMU 3 NTCRA will be used for completion of the SWMU 7b NTCRA; therefore, there are no associated costs. A pre-removal bathymetric survey will be completed to confirm the pre-excavation surface elevations and identify any large anomalies within the removal area. If any large debris is identified, a debris sweep will be performed before dredging.

Dredging

Removal of sediment will be performed using a mechanical dredge outfitted with an environmental clamshell bucket. The dredge will be positioned on scows to allow for easier movement around Desert Cove and to prevent disturbance to upland activities. Turbidity and sheens in the dredging area will be reduced through use of the environmental clamshell bucket and controlled with silt curtains and oil booms. Dredged sediment will be loaded onto water-tight scows and moved to an onsite staging area for dewatering. Intermediate bathymetric surveys will be performed during dredging activities. Following completion of dredging, a post-removal bathymetric survey will be completed to confirm contract dredging depths were achieved.

Dewatering and Solidification

Dredged sediment will undergo passive dewatering via geotube at an onsite staging area. Dredged materials will be pumped from the scow into geotubes staged upland. During pumping, it is assumed that a cationic polymer will need to be added to enhance dewatering of dredged sediment. Weep water from the geotubes will be collected in a secondary containment system and subsequently pumped through an onsite temporary water treatment system prior to point source discharge to Desert Cove.

The dewatered sediment will then be stabilized onsite. For the purposes of this EE/CA, it is assumed that Portland cement will be used for solidification. Solidification will be performed to the degree needed for the dewatered sediment to pass the paint filter test. Solidification within the material staging area will be accomplished using an extended reach excavator or similar equipment. After dewatering and waste characterization, the material will be off-loaded directly from the staging area and trucked to a CERCLA-approved RCRA Subtitle D Landfill (Bethel Landfill in Hampton, Virginia) for disposal. All materials will be disposed of in accordance with state regulations at a state-permitted disposal facility that is approved by the Navy and is permitted to accept CERCLA waste.

Barge Decontamination

Following completion of all dredging and sediment solidification, each scow will be decontaminated onsite. Decontamination fluids will be containerized for waste characterization and transported to a CERCLA-approved facility (Soilex Facility in Suffolk, Virginia) for disposal.

Site Restoration

Following completion of the post-removal bathymetric survey, the site will be restored through placement of a clean sand layer across the entire grid cell. Prior to placement, sand will be sampled to determine its suitability for use as clean fill. Sampling requirements and clean fill criteria will be determined during the work-planning phase.

A minimum of six inches of clean, medium-grained sand will be placed across the dredged area and remaining portions of the grid cell not dredged; however, enough sand will be placed to reestablish the cove floor elevation to -10.92 feet mean lower low water (-10 feet JEB Little Creek Station Vertical Datum). For the purposes of this EE/CA, it is assumed 2 feet of sand will be required over the dredged areas in each grid cell (full replacement of dredged sediment), with 6-inches of sand placed in those areas not dredged. Sand placement will be verified by collecting sediment cores allowing for visual confirmation of thickness. Following completion of sand placement a bathymetric survey of the area will be completed to confirm re-establishment of the cove floor to the specified elevation and determine final site conditions.

Short-Term Monitoring

Short-term monitoring will be required during the construction phase to protect human health and the environment. Monitoring requirements may include turbidity and water quality monitoring, dust and air quality monitoring, and noise monitoring; requirements will be defined during the work planning phase.

4.2 Evaluation Criteria

The evaluation criteria are based on *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, PB93-963402 (USEPA, 1993).

4.2.1 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.

- Protectiveness
  - Protective of public health and community
  - Protective of workers during implementation
  - Protective of the environment
  - Compliant with ARARs
- Ability to achieve removal objectives
  - Ability to meet the expected level of treatment or containment
  - Has no residual effect concerns
  - Maintain long-term control

In addition to the protectiveness and ability to achieve the removal objective subcategories, a sustainability assessment was conducted using SiteWise, a stand-alone tool that assesses the environmental footprint of a remedial alternative to compare the overall life-cycle environmental impacts of each remedy (Battelle, 2010). The sustainability assessment provides an additional comparison criterion that may allow options with a smaller environmental impact to be selected when all other criteria are met.

4.2.2 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
  - Construction and operational consideration
  - Demonstrated performance and useful life
  - Adaptability to environmental conditions
  - Contribution to performance of long-term removal actions
  - Implementation within the allotted time
- Availability of resources

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

- Administrative feasibility

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

4.2.3 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. For the detailed cost analysis, the expenditures required to complete each alternative were estimated in terms of capital costs to complete initial construction activities, including direct and indirect costs. Direct costs include the cost of construction, equipment, land and site development, treatment, transportation, and disposal. Indirect costs include engineering expenses and contingency allowances. No annual operations and maintenance costs are associated with any alternatives.

The estimated costs are provided to an expected accuracy of +50 percent and –30 percent. The alternative cost estimates are in 2012 dollars and the unit pricing is based on costs from similar projects, vendor quotes, or engineering estimates. The enclosed Engineer's Estimate (**Appendix C**) is only an estimate of possible construction costs for budgeting purposes.

4.3 Analysis of Removal Action Alternatives

Table 4-1 provides a summary of the alternative analysis with respect to effectiveness, ease of implementation, and cost. **Appendix C** provides cost estimate details pertaining to each alternative discussed in the following sections. The results using the sustainability analysis tool SiteWise for each alternative is included in **Appendix D**.

TABLE 4-1
Evaluation of Remedial Alternatives

Alternative	Description	Effectiveness	Ease of Implementation	Cost
Alternative 1—No Action	- No removal work performed; site left as is	*Protectiveness* Potentially unacceptable ecological risk will remain onsite. *Compliance with ARARs* This alternative does not comply with chemical-specific ARARs. Location- and Action-specific ARARs do not apply. *Ability to Achieve Removal Action Objective* This alternative does not meet the removal action objective. *Sustainability* No short-term sustainability impacts because no action is implemented.	*Technical Feasibility* No action to implement. *Availability of Resources* No resources required. *Administrative Feasibility* No action to implement.	$0.00
Alternative 2— Mechanical dredging, upland disposal, and replacement with clean fill	- Removal of impacted sediment - On scow dewatering of sediment for upland disposal in a RCRA Subtitle D Landfill via scow transport - Site restoration through placement of clean sand layer	*Protectiveness* Very effective in eliminating potentially unacceptable risk to ecological receptors. *Compliance with ARARs* This alternative achieves the chemical-, location-, and action-specific ARARs. *Ability to Achieve Removal Action Objective* This alternative meets the remedial action objective to reduce concentrations of site COCs in sediment such that remaining concentrations do not pose unacceptable risk to ecological receptors. Removal of contaminated sediment would permanently eliminate the potential threat to the environment through removal of the exposure pathway. An immediate reduction in the contaminant levels, toxicity, and volume in the sediment would be anticipated. Because the excavated materials will be disposed of at a landfill, the alternative would not meet the NCP preference of onsite treatment and site reuse over land disposal. *Sustainability* This alternative poses a potential environmental impact because of transportation of equipment, operation of equipment, and residual handling.	*Technical Feasibility* The implementation of this alternative would require common construction activities and the use of standard dredging, materials handling, and hauling equipment. This alternative would require a contractor experienced in environmental dredging who would be required to develop a Dredging Work Plan. *Availability of Resources* Site access and resources will be readily available during the proposed timeframe of the removal action for the type of equipment necessary to execute this work. *Administrative Feasibility* Alternative will require permits for the offsite solidification. This alternative would require manifests prepared by licensed waste haulers. No permanent deed restrictions would be required.	$1,273,600
Alternative 3— Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill	- Removal of impacted sediment - On scow dewatering and onsite solidification of sediment via on scow mixing, and sediment offload for upland disposal in a RCRA Subtitle D Landfill via trucking - Site restoration through placement of clean sand layer	*Protectiveness* Very effective in eliminating potentially unacceptable risk to ecological receptors. *Compliance with ARARs* This alternative achieves the chemical-, location-, and action-specific ARARs. *Ability to Achieve Removal Action Objective* This alternative meets the remedial action objective to reduce concentrations of site COCs in sediment such that remaining concentrations do not pose unacceptable risk to ecological receptors. Removal of contaminated sediment would permanently eliminate the potential threat to the environment through removal of the exposure pathway. An immediate reduction in the contaminant levels, toxicity, and volume in the sediment would be anticipated. Because the excavated materials will be disposed of at a landfill, the alternative would not meet the NCP preference of onsite treatment and site reuse over land disposal. *Sustainability* This alternative poses a potential environmental impact because of transportation of equipment, operation of equipment, and residual handling.	*Technical Feasibility* The implementation of this alternative would require common construction activities and the use of standard dredging, sediment solidification, materials handling, and hauling equipment. This alternative would require a contractor experienced in environmental dredging who would be required to develop a Dredging Work Plan. *Availability of Resources* Site access and resources will be readily available during the proposed timeframe of the removal action for the type of equipment necessary to execute this work. This alternative would require available property for construction of a materials staging area and use of facility roadways for waste hauling. *Administrative Feasibility* This alternative would require manifests prepared by licensed waste haulers. No permanent deed restrictions would be required.	$1,254,300

TABLE 4-1
Evaluation of Remedial Alternatives

Alternative	Description	Effectiveness	Ease of Implementation	Cost
Alternative 4— Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and replacement with clean fill	- Removal of impacted sediment - Onsite passive dewatering via geotube of sediment for upland disposal in a RCRA Subtitle D Landfill via trucking - Site restoration through placement of clean sand layer	*Protectiveness* Very effective in eliminating potentially unacceptable risk to ecological receptors. *Compliance with ARARs* This alternative achieves the chemical-, location-, and action-specific ARARs. *Ability to Achieve Removal Action Objective* This alternative meets the remedial action objective to reduce concentrations of site COCs in sediment such that remaining concentrations do not pose unacceptable risk to ecological receptors. Removal of contaminated sediment would permanently eliminate the potential threat to the environment through removal of the exposure pathway. An immediate reduction in the contaminant levels, toxicity, and volume in the sediment would be anticipated. Because the excavated materials will be disposed of at a landfill, the alternative would not meet the NCP preference of onsite treatment and site reuse over land disposal. *Sustainability* This alternative poses a potential environmental impact because of transportation of equipment, operation of equipment, and residual handling.	*Technical Feasibility* The implementation of this alternative would require common construction activities and the use of standard dredging, sediment dewatering, materials handling, and hauling equipment. This alternative would require a contractor experienced in environmental dredging who would be required to develop a Dredging Work Plan. *Availability of Resources* Site access and resources will be readily available during the proposed timeframe of the removal action for the type of equipment necessary to execute this work. This alternative would require available property for construction of a materials staging area and use of facility roadways for waste hauling. *Administrative Feasibility* This alternative would require manifests prepared by licensed waste haulers. No permanent deed restrictions would be required.	$1,738,600

SECTION 5

Comparative Analysis

Section 5 provides a comparative analysis of the removal alternatives to assist in the decision-making process by which an alternative will be selected. In the previous section, the removal alternatives were independently screened according to their effectiveness, ease of implementability, and cost. In this section, the alternatives are compared to each other for their relative metrics. From this analysis, it should become clear which alternative is preferable in each category and, consequently, which will be selected for implementation at SWMU 7b. **Table 5-1** summarizes the results of the alternative comparison.

TABLE 5-1
Remedial Alternatives Comparison

Alternative	Effectiveness	Implementation	Cost
Alternative 1—No Action	Not Effective	Easy	No cost
Alternative 2— Mechanical dredging, upland disposal, and replacement with clean fill	Effective	Moderate	Moderate
Alternative 3— Mechanical dredging, onsite solidification, upland disposal, and replacement with clean fill	Effective	Moderate	Moderate
Alternative 4— Mechanical dredging, onsite passive dewatering via geotube, upland disposal, an replacement with clean fill	Effective	Moderate	Moderately High

5.1 Effectiveness

Alternative 1 is not effective. It is not protective of human health and the environment, does not comply with ARARs, and does not achieve the removal action objective of this EE/CA. Because Alternative 1 is not protective of human health and the environment, ARARs were not even considered. Alternative 1 involves no action and therefore has no short-term sustainability impacts.

Alternatives 2, 3, and 4 are all effective in meeting the removal action objective and providing for long-term protection because each will result in removal of contaminated sediment within the removal area boundary, eliminating the pathway for ecological receptor exposure to COCs in sediment. Each alternative includes the removal and offsite disposal of contaminated sediment. Given the appropriate training and personal protective equipment, each alternative is protective to workers during construction. Because excavated sediment from each alternative would require transportation and offsite disposal, there is a small potential for exposing surrounding communities to the contaminants during transport and disposal. Each alternative poses an environmental impact because of transportation of equipment, operation of equipment, and residual handling. Alternative 2 poses a slightly greater environmental impact because the sediment will be transported up the James River to Port Weanack. None of the three removal alternatives meets the NCP's preference for onsite treatment and site reuse over land disposal. Each removal alternative achieves the chemical-, location-, and action-specific ARARs and the compliance with ARARs during implementation of the alternatives is summarized in **Appendix B.**

5.2 Implementability

Alternative 1 involves no action and therefore is easy to implement.

Alternatives 2, 3, and 4 are technically and administratively feasible, and resources for implementing the alternatives are readily available. Alternatives 2, 3, and 4 will follow all applicable federal and state regulations for offsite transportation and disposal activities. Alternatives 2, 3, and 4 can be accomplished utilizing standard construction methods and readily available resources. Alternatives 2, 3, and 4 each require some level of onsite dewatering. Alternatives 3 and 4 also require some level of onsite sediment solidification. Sediment solidification, dewatering, and construction of a material staging area are standard dredging processes and the equipment, materials, and labor force would be readily available. However, Alternatives 3 and 4 are slightly more difficult to implement than Alternative 2 as they require construction of onsite material staging areas and would require haul truck access to and from SWMU 3. The material staging areas and large volume of haul trucks required for Alternatives 3 and 4 have the potential to interfere with facility activities.

5.3 Cost

Alternative 1 has no cost and is therefore the least expensive. The cost estimates for Alternatives 2, 3, and 4 are provided in **Appendix C** and summarized in **Table 4-1**. Alternative 2 is estimated at $1,273,600 (-30% = 891,600; +50% = 1,910,400), Alternative 3 is estimated at $1,254,300 (-30% = 878,100; +50% = 1,881,500), and Alternative 4 is estimated at $1,738,600 (-30% = 1,217,100; +50% = 2,607,900). Alternative 4 is the most expensive alternative. Costs associated with Alternatives 2 and 3 are essentially the same.

SECTION 6

Recommended Alternative

Based on the comparative analysis of the removal alternatives completed in Section 5 and the scheduled MILCON maintenance dredge and SWMU 3 NTCRA, the recommended removal alternative is mechanical dredging, upland disposal, and replacement with clean fill, as described in Alternative 2. Alternative 2 is consistent with the current scope of the MILCON maintenance dredge, consisting of mechanical dredging with an environmental clamshell bucket and upland disposal via scow transport to Port Weanack; requires only the addition of sand placement to the existing MILCON scope of work; and is not significantly more expensive than the other alternatives evaluated.

Alternative 2 will require removal of contaminated sediment and site restoration through placement of a clean sand layer. The sediment will be disposed of offsite following waste characterization. Upon completion of the removal action, potential risk to ecological receptors will be mitigated and NFA will be required for sediment.

SECTION 7
References

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Appendix A
SWMU 7b Consensus Agreement

Consensus Agreement
Environmental Restoration SWMU 7b
Small Boats Sandblast Yard (Desert Cove)

JEB Little Creek
Virginia Beach, Virginia

The use of Abrasive Blast Material (ABM) during historic sandblasting operations at the Small Boats Sandblast Yard (SWMU 7) resulted in the deposition of ABM and metals on the surrounding land (SWMU 7a) and water (SWMU 7b - Desert Cove). Human health risks associated with SWMU 7a were addressed through a NTCRA under CERCLA. No unacceptable ecological risks associated with SWMU 7a were identified. SWMU 7a was closed with no further action under a ROD in 2005. No unacceptable human health risks associated with surface water and sediment in SWMU 7b (Desert Cove) were identified. Potentially unacceptable risks from exposure to metals in sediment at SWMU 7b were identified. The JEB Little Creek Tier I Partnering Team, consisting of representatives from NAVFAC Mid-Atlantic, USEPA Region III, and VDEQ, agree ecological risks associated with the concentrations of tin detected in sediment at SWMU 7b are not unacceptable per the following lines of evidence:

- In the Pier Area, 7 of 33 (21%) samples analyzed for total tin between 2000 and 2010 (excluding samples collected within the dredged area) exceed maximum background for total tin.
- In the Pier Area, the mean background ratio for total tin (mean Pier Area concentration / mean background) is below 1 for all samples collected between 2000 and 2010 (excluding samples collected within the dredged area). Additionally, the mean background ratio for total tin is below 1 for each individual sampling event with the exception of the 2010 sampling event where the mean ratio equaled 1.11.
- In the Pier Area, 11 of the 17 samples analyzed for total tin in 2009 were also analyzed for TBT. TBT samples were not collected as part of the 2000/2002 and 2010 sampling events. The maximum HQ (based upon the NOAA SQUIRT screening value of 3.4 mg/kg) for total tin detected between 2000 and 2010 is 8.79 and the mean HQ is 2.34. The maximum HQ (based upon the NOAA SQUIRT screening value of 3.4 mg/kg) for the detected TBT fraction of total tin in 2009 is 0.002 and the mean HQ for the detected TBT fraction of total tin is 0.001. Additionally, when compared to the TEL screening value (0.048 mg/kg), the maximum HQ for the detected TBT fraction of total tin in 2009 is 0.158 and the mean HQ for the detected TBT fraction of total tin is 0.098.

- TBT was detected in each of the 11 samples collected within the Pier Area. Detected concentrations range from 2.00 μg/kg to 7.60 μg/kg. The arithmetic mean is 4.86 μg/kg with a standard deviation of 1.48. The ratio of TBT to total tin in the Pier Area ranged from 0.00011 to 0.00076. Due to low variability in the detected TBT values, similar TBT concentrations and ratios to total tin can be expected across the site. Where both total tin and TBT were detected in samples collected in 2009, the ratio of TBT to total tin (TBT/total tin) was calculated. The average of these ratios (0.00017) was used to extrapolate the TBT fraction of the remaining total tin samples (total tin x 0.00017) collected between 2000 and 2010 for comparison to NOAA SQUIRT and TEL screening criteria. The maximum HQ (based upon the NOAA SQUIRT screening value) within the Pier Area for the extrapolated TBT fractions of total tin is 0.001 and the mean HQ for the extrapolated TBT fractions of total tin is 0.0004. Additionally, when compared to the TEL screening value, the maximum HQ for the extrapolated TBT fraction of total tin is 0.070 and the mean HQ for the extrapolated TBT fraction of total tin is 0.028

As a result of this risk management decision, no action is warranted for tin in sediment. The remaining COCs at SWMU 7b are copper, mercury, nickel, and zinc. Because of the urban nature of Desert Cove, the Tier I Team agrees to the use of the NOAA ER-M screening value as the preliminary remediation goal (PRG) for the remaining site COCs with the application of a remediation quotient (RQ) for determining the need for action within the grid system applied across the site. A RQ is calculated for each individual COC as the ratio of the COC concentration to the PRG (ER-M). A grid is deemed "impacted" (warranting action) if one or more individual COC RQs is above 1.5 and the average of the individual RQs for the grid is above 1. Because ABM is not toxic and does not pose risk to the environment, the Tier I Team agrees the presence of ABM in sediment does not drive the need for action.

In determining the area requiring remedial action, the JEB Little Creek Tier I Partnering Team agrees that the existing data set for SWMU 7b, consisting of samples collected in 2000, 2002, 2009, and 2010 is sufficient to define the area requiring action for development of alternatives in a FS and pre-delineation sampling is not required. Additionally, the members of the JEB Little Creek Tier I Partnering Team agree that the need for post-remedial action data will be dependent upon the alternatives evaluated in the FS.

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Appendix B
ARARs

Acronyms and Abbreviations

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

References

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

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

TABLE B-1

Federal Chemical-Specific ARARs

SWMU 7b EE/CA

JEB Little Creek

Virginia Beach, Virginia

Media	Requirement	Prerequisite	Citation	Alternative	ARAR/TBC Determination	Comment
Project Remediation Goals						
Sediment	Guidance document regarding how to conduct a technically defensible ecological risk assessment	Assessment of potential ecological risks.	Interim Final Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, June 1997). Copper (inorganic/metal) CAS #7440-50-8, Lead (inorganic/metal) CAS #7439-92-1, Mercury (inorganic/metal) CAS #7439-97-6, and Zinc (inorganic/metal) CAS #7440-66-6	2, 3, 4	TBC	The objective of the removal action at SWMU 7b is to reduce or eliminate risks to ecological receptors from copper, lead, mercury, and zinc in sediment. Project remediation goals (PRGs) for each contaminant of concern (COC) are below: Copper - 270 mg/kg Lead - 218 mg/kg Mercury - 0.71 mg/kg Zinc - 410 mg/kg

TABLE B-2
Virginia Chemical-Specific ARARs
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

Media	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Wastewater Treatment						
Surface Water	Contains minimum standards for surface water quality. No discharge to surface water may cause these criteria to be violated.	Applicable to any discharge of industrial wastewater to state waters.	9 VAC 25-260-140A, 9 VAC 25-260-140B only as it pertains to Copper (CAS #7440-50-8), Lead (CAS #7439-92-1), and Zinc (CAS #7440-66-6)	2,3	Applicable	Alternatives 2 and 3 will include discharge of decant water to Desert Cove. Based on this process, the sediment COCs with specific limits have criteria listed that will be controled as part of the discharge. There are no standards specified for mercury. Treatment of the decant water to concentrations that are below background is not required. However, once removed, contaminated sediment must be prevented from discharging back to Desert Cove while dewatering occurs. Effluent sampling will not be required during discharge activities. Monitoring for visual changes in turbidity and sheen will be conducted.
			9 VAC 25-260-140A, 9 VAC 25-260-140B only as it pertains to Copper (CAS #7440-50-8), Lead (CAS #7439-92-1), and Zinc (CAS #7440-66-6), pH, and Temperature	4	Applicable	Alternative 4 includes treatment of the dredge slurry by filtration and the addition of a cationic polymer. Based on that process, the COCs with specific limits, pH, temperature, and toxicity have criteria listed that will be controled as part of the discharge. There are no standards specified for mercury. The final set of standards that will need to be monitored will be set after the design of the treatment system is completed.

TABLE B-3
Federal Location-Specific ARARs
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Migratory Flyway						
Migratory bird area	Protects almost all species of native birds in the United States from unregulated taking.	Presence of migratory birds.	*Migratory Bird Treaty Act;* 16 USC 703	2, 3, 4	Applicable	SWMU 7b is located in the Atlantic Migratory Flyway. If migratory birds, or their nests or eggs, are identified at SWMU 7b, operations will not destroy the birds, nests or eggs.
Coastal Zone						
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with, to the maximum extent practicable, State coastal zone management programs.Federal agencies must comply with the consistency requirements of 15 CFR § 930.	Actions that may affect identified coastal zone resources or uses	15 CFR 930.33(a)(1), (a)(2), (b); .35(a), (b); .36(a)	2, 3, 4	Applicable	Activities at SWMU 7b that will affect Virginia's coastal zone will be consistent to the maximum extent practicable with Virginia's enforceable policies. Activites performed on-site and in compliance with CERCLA are not subject to adminsitrative review; however the substantive requirements of making a consistency determination will be met.

TABLE B-4
Virginia Location-Specific ARARs
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Wetlands						
Wetlands	Mitigate or minimize the loss of wetlands and the adverse ecological effects of all permitted activities. To preserve the wetlands as much as possible in their natural state and to consider appropriate requirements for compensation only after it has been proven that the loss of the natural resource is unavoidable and that the project will have the highest public and private benefit. Commitments to preserve other existing wetlands shall not ordinarily be an acceptable form of compensation.	If a wetlands zoning ordinance has been adopted by local government, in accordance with the *General Provisions Relating to Marine Resources Commission* , and the response action is not exempt from its provisions, the project must comply with the requirements of the ordinance. In the case of absence of an ordinance, or of an exemption to it, VMRC can exercise jurisdiction over tidal wetlands.	4 VAC 20-390-40, 50	2, 3, 4	Relevant and Appropriate	It is not anticipated that onsite activities will disturb the existing wetland areas. The dredging operation will not result in a net loss of wetland area.
Presence of Threatened and Endangered Species or Habitat						
Area where endangered species are present	Identified federal and state threatened and endangered species are protected from unlawful taking. This requirement includes prohibition of activities that adversely affect critical habitat. The list of federal threatened and endangered species is incorporated into state law along with additions.	Activity in an area where listed threatened or endangered species are present or in an area that is designated as their critical habitat.	4VAC 15-20-130 (c), 2 VAC 5-320-10 (as it references §3.2-1003)	2, 3, 4	TBC	Per Navy policy, state-listed species are protected through the implementation of an Integrated Natural Resource Management Plan (INRMP). Compliance with the INRMP will constitute compliance with all substantive requirements in the regulations for this action.

TABLE B-5
Federal Action-Specific ARARs
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Dredge and Fill						
Discharge of dredge-and-fill	No discharge of dredged or fill material will be allowed unless appropriate and practicable steps are taken that minimize potential adverse impacts of the discharge on the aquatic ecosystem.	Discharges of dredged or fill material to surface waters, including wetlands.	40 CFR 230.10(d); 33 CFR 320.4(a), (b), (d), (p), (r)	2, 3, 4	Applicable	Onsite actions may include removal of sediments as well as dewatering removed sediment. These actions will be taken in accordance with the substantive provisions of Nationwide Permit 38. Steps will be taken to minimize the impacts to the ecosystem.
Storage of Petroleum and Non-petroleum Oils						
Storage of fuels and oils (petroleum and non-petroleum) onsite	If storage capacity limits are exceeded a Spill, Prevention, Control, and Countermeasures Plan must be prepared and implemented with procedures, methods, equipment, and other requirements to prevent the discharge of into or upon the navigable waters of the United States.	Total onsite storage capacity exceeding 1,320 gallons in containers that are 55 gallons or larger in size.	40 CFR 112.3(a)(1); 112.5; 112.6(a)(1), (a)(3)*; 112.7(a)(3)(i), (a)(3)(iv), (a) (3)(vi),(a)(4), (a)(5), (c), (e), (f),(g),(k); 112.8(b)(1), (b)(2), (c)(1), (c)(3), (c)(6), (c)(10), and (d)(4) *the provisions incorporated by reference here are not ARARs unless they are also listed in this table.	2, 3, 4	Applicable	It is anticipated that fuels or other treatment chemicals will be stored onsite. If the storage capacity in containers that are 55 gallons or greater is equal to or exceeds 1,320 gallons a Spill Prevention, Control, and Countermeasure (SPCC) Plan must be prepared and implemented. Containers include oil and fuel reservoirs in equipment. Onsite CERCLA actions are not subject to administrative requirements such as administrative reviews and endorsements.

TABLE B-6
Virginia Action-Specific ARARs
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Dredge and Fill						
Dredging, filling, and/or discharging pollutants into, or adjacent to, surface waters (including wetlands)	Regulations for activities undertaken in State surface waters	Activities such as dredging, filling, or discharging any pollutant into or adjacent to surface waters, or otherwise altering the physical, chemical, or biological properties of surface waters; excavating in wetlands; or conducting the following activities in a wetland: 1. New activities to cause draining that significantly alters or degrades existing wetland acreage or functions.	9 VAC 25-210-90(F)(1), (2), (3); 115(C)(1)	2, 3, 4	Applicable	The removal area at SWMU 7b will be dredged to remove the impacted sediment and place a clean sand layer over the dredged areas. The clean sand layer will provide a layer of clean fill over the dredged area which will eliminate the need for post-dredging confirmation sampling.The substantive provisions of these regulations will be met, however onsite CERCLA actions are not subject to permitting. Measures that will be taken to protect water quality will be detailed in the remedial design or remedial action work plan.
Erosion and deposits of soil/sediment caused by land disturbing activities	Regulations for the effective control of soil erosion, sediment deposition and nonagricultural runoff which must be met in any control program to prevent the unreasonable degradation of properties, stream channels, waters and other natural resources.	Construction activities that will disturb more than 10,000 square feet of land.	Erosion and Sediment Control Regulations, 4 VAC 50-30-40-2; 12; 14; 15; 16(c); and 19(k)	2, 3, 4	Relevant and Appropriate	Since the response action occurs in a live watercourse and along its beds and banks, the only requirements in 4 VAC 50-30-40 that are relevant and appropriate to the response action itself are 12, 14, and 15. However, additional site work will be required to facilitate the response action including the construction of temporary access roads, material and equipment staging areas, and support facilities.
Waste Management						
Handling and storage of solid waste onsite in waste piles	Establishes standards and procedures pertaining to the management of solid wastes in stockpiles.	On-site management of wastes that meet the definition of solid waste in piles.	9 VAC 20-81-330(F)(1); 330(F)(2)(a)(1), (e),(f); 330(F)(4)	3	Applicable	Dredged sediment may be staged onsite in piles during the response action. In the event that staging piles are used they will be managed in accordance with these requirements.

TABLE B-6

Virginia Action-Specific ARARs

SWMU 7b EE/CA

JEB Little Creek

Virginia Beach, Virginia

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Accumulation and/or treatment of hazardous waste in staging piles onsite	A staging pile must me designed constructed and maintained to prevent the migration of hazardous constituents other media. The design must consider location, hydrogeology, and any other factors that may reasonably influence the migration of hazardous constituents. Closure requirements are also included.	Accumulation or treatment of hazardous wastes in staging piles onsite	9 VAC 20-60-264 only as it incorporates 40 CFR 264.554(d)(1)(ii), (d)(2)	3, 4	Relevant and Appropriate	These requirements are applicable to operating a staging pile for treatment or staging of hazardous wastes in piles during this action. Staging piles will be designed and operated in accordance with these standards; however, since this is a CERCLA action no permit will be required. These requriements are applicable only if hazardous waste is generated and treated or staged in piles.
Treatment of hazardous waste in containers	Containers used for treatment must be in good condition and compatible with the waste being treated. The containers must also be kept closed unless adding or removing waste, handled to minimize the possibility of failure, and inspected weekly. The containers must also be protected from contact with precipitation.	Treatment of hazardous wastes in containers onsite	9 VAC 20-60-264 only as it incorporates 40 CFR 264.171 through 174, and 175(c)	3	Applicable	Applicable if hazardous waste will be treated ex situ in containers.
Wastewater Treatment						
Discharge to state waters	The Virginia Pollutant Discharge Elimination System (VPDES) regulates point source discharges to state waters.	Treatment of wastewater prior to discharge	9 VAC 25-31-190(D), (E), (J)(1), J(3), J(4); 200(A)(2)(a) and (A)(2)(b).	4	Applicable	The water treatment system will be designed and operated to meet the substantive requirements of the VDPES system. Onsite CERCLA actions are not subject to administrative requirements such as administrative reviews or permitting.
Dust Control						
Generation of fugitive dust	Regulations regarding reasonable precautions to prevent particulate matter from becoming airborne.	Conducting any activity which may cause particulate matter to become airborne.	9 VAC 5-50-90	3, 4	Applicable	Dust control measures will be implemented during activities at the site.

Appendix C
Cost Estimate

Table C-1
Engineer's Cost Estimate for Alternative 2: Mechanical dredging, upland disposal, and sand layer placement
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

Description: Alternative 2 (Mechanical dredging, upland disposal, and sand layer placement) includes removal of contaminated sediment within the proposed removal area boundary. The total removal area is estimated to be 38,525 ft^2. Assumed dredge depth is 2 feet with an additional 1 foot of ovedredge. The total removal volume is estimated to be 4,281 yd^3.

Cost Item	Unit	Quantity	Unit Cost	Cost	Cost Estimate Reference	Assumptions and Notes
Pre-Dredge Sampling						
In-situ Waste Characterization Sampling						
Sediment Sampling	LS	1	$ 18,980.00	$ 18,980.00	Recent similar projects	- Includes all sampling labor and expenses - Includes vibracore and IDW subcontractor costs
Sample Analysis	EA	6	$ 1,710.63	$ 10,263.78	Navy CLEAN Laboratory BOA Rates	- Includes analysis of full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), BTEX, PCBs, TPH, EOX, dioxins, reactivity, ingnitability, and corrosivity.
Site Preparation Activities						
Dredging						
Dredge Equipment Mobilization	LS	0	$ 150,000.00	$ -	Recent similar projects	- Assumes MILCON Contractor already onsite
Dredge Personnel Mobilization	LS	0	$ 29,180.00	$ -	Recent similar projects	- Assumes MILCON Contractor already onsite
Utility Locate	LS	1	$ 975.00	$ 975.00	Recent similar projects	- Includes mobilization, demobilization, and all labor, equipment, and materials.
Bathymetric Survey Mobilization/Demobilization	LS	1	$ 2,000.00	$ 2,000.00	Recent similar projects	- Assumes mobilization/demobilation of two-man survey crew and all associated supplies and equipment.
Pre-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Debris Sweep	Day	1	$ 12,000.00	$ 12,000.00	Recent similar projects	- Assumes equipment rented locally as needed when large debris is located
Turbidity Curtain	LF	0	$ 28.75	$ -	Recent similar projects	- Assumes turbidity curtain will already be onsite for SWMU 3 NTCRA
Turbidity Curtain Installation/Removal	LS	1	$ 3,910.00	$ 3,910.00	Recent similar projects	- Includes labor and boat for installation and removal of system
Dredging and Disposal						
Dredging						
Dredging	yd^3	4,281	$ 27.25	$ 116,657.25	Recent similar projects	- Assumes dredging 5 days per week M-F 12 hr/day. - Includes labor, mechanical dredge use, and fuel
Work-in-Progess Bathymetric Survey	Day	2	$ 4,025.00	$ 8,050.00	Recent similar projects	Bathymetric surveys will be completed following completion of each removal grid to identify need for additional dredging prior to dredge equipement downtime or demobilzation. Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Post-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Scow Free Water Removal						
Scow Free Water Removal	Day	12	$ 2,300.00	$ 27,600.00	Recent similar projects	- Includes 20 ton crane for pump manuevering, sump pump, and labor
Water Treatment Operations	Day	12	$ 1,000.00	$ 12,000.00	Recent similar projects	- Includes fuel, labor, and rental of frac tank, sand filter, and carbon
T&D of Water Treatment System Components	LS	0	$ 1,250.00	$ -	Recent similar projects	- Assumes cost covered under the SWMU 3 NTCRA
Water Quality Samples	EA	12	$ 1,000.00	$ 12,000.00	Recent similar projects	Includes labor, material, and equipment for 3 effluent, 6 inline and 3 surface water samples for turbidity.
Sediment Transportation and Disposal						
Waste Characterization Sampling	EA	5	$ 76.70	$ 383.50	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample per barge (approx. 1000 yds^3) for analysis of TPH and paint filter test. - Includes volume of sediment and portland cement.
Offsite Disposal Waste Management	Ton	7,064	$ 45.25	$ 319,630.16	Per quotes from Port Weanack and Waste Management Charles City Landfill	-Assumes 10% by weight stabilization agent mix ratio - Includes sediment stabilization, loading sediment from scow to truck, and transporting sediment to the landfill
Disposal @ Subtitle D Landfill	Ton	7,064	$ 25.00	$ 176,591.25	Per quote from Waste Management Charles City Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill (debris)	Ton	4	$ 50.00	$ 200.00	Per quote from Waste Management Charles City Landfill	- Tonnage based on recent similar projects
Decontamination Water Transportation and Disposal						
Scow travel for Decontamination	EA	0	$ 3,600.00	$ -	Recent similar projects	-Assumes cost covered under the SWMU 3 NTCRA
Barge Survey and Report	LS	0	$ 7,000.00	$ -	Recent similar projects	-Assumes cost covered under the SWMU 3 NTCRA
Waste Characterization Sampling	EA	0	$ 864.04	$ -	Navy CLEAN Laboratory BOA Rates	-Assumes cost covered under the SWMU 3 NTCRA
Transport to Disposal Facility	Load	0	$ 665.00	$ -	Per quote from Summit Environmental	-Assumes cost covered under the SWMU 3 NTCRA
Disposal @ Soilex Facility, Suffolk, VA	gal	0	$ 0.25	$ -	Per quote from Summit Environmental.	-Assumes cost covered under the SWMU 3 NTCRA
Solids Surcharge	gal	0	$ 0.70	$ -	Per quote from Summit Environmental	-Assumes cost covered under the SWMU 3 NTCRA
Site Restoration/Demoboilization						
Water Treatment System						
Demobilization	LS	0	$ 7,500.00	$ -	Recent similar projects	- Assumes cost covered under the SWMU 3 NTCRA
Sand Layer Placement						
Mobilization/Demobilization	LS	0	$ 20,000.00	$ -	Recent similar projects	-Assumes cost covered under the SWMU 3 NTCRA
Well Graded Sand (Washed Sand 100+)	Ton	4,654	$ 20.00	$ 93,081.85	Recent similar projects	- Includes cost for purchase/delivery and 15% loss
Placement of Well Graded Sand	yd^3	2,891	$ 12.00	$ 34,688.89	Recent similar projects	- Includes use of sand spreader (barge and long reach excavator), fuel, and labor.
Site Survey						
Final Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day - Conducted following completion of sand layer placement
Subtotal				***$861,087***		
Contingency (15%)				$129,163		
General Conditions (10%)				$86,109		
Subtotal				***$1,076,358***		
Performance Bond (2%)				$21,527		Industry Average
TOTAL				***$1,097,886***		
Design Costs (8%)				$87,831		Includes Closeout Reports
Construction Oversight (8%)				$87,831		
TOTAL CAPITAL COST				**$1,273,600**	**+50%** **$1,910,400**	
					-30% **$891,600**	

Notes

1. Base costs used are 2012 dollars.
2. For the bathymetric survey the dredge subcontractor will be responsible for coordinating with the surveyor to insure schedule efficiency. Navy will not be responsible for dredging delay due to surveyor. Survey will occur immediately after dredging is complete. Dredger will not leave dredging area until survey is confirmed.
3. Assumes that 90% of the free dredge water from the scows will be removed before turnover of the scows to the offloading contractor.
4. The enclosed Engineer's Cost Estimate based on seamless dredging operation from completion of SWMU 3 to start of SWMU 7b dredging.
5. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained.

Table C-2
Engineer's Cost Estimate for Alternative 3: Mechanical dredging, onsite solidification, upland disposal, and sand layer placement
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

Description: Alternative 3 (Mechanical dredging, onsite stabilization, upland disposal, and sand layer placement) includes removal of contaminated sediment within the proposed removal area boundary. The total removal area is estimated to be 38,525 ft^2. Assumed dredge depth is 2 feet with an additional 1 foot of ovedredge. The total removal volume is estimated to be 4,281 yd^3.

Cost Item	Unit	Quantity	Unit Cost	Cost	Cost Estimate Reference	Assumptions and Notes
Pre-Dredge Sampling						
In-situ Waste Characterization Sampling						
Sediment Sampling	LS	0	$ 18,980.00	$ 18,980.00	Recent similar projects	- Includes all sampling labor and expenses - Includes vibracore and IDW subcontractor costs
Sample Analysis	EA	6	$ 1,710.63	$ 10,263.78	Navy CLEAN Laboratory BOA Rates	- Includes analysis of full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), BTEX, PCBs, TPH, EOX, dioxins, reactivity, ingnitability, and corrosivity.
Site Preparation Activities						
Dredging						
Dredge Equipment Mobilization	LS	0	$ 150,000.00	$ -	Recent similar projects.	- Assumes MILCON Contractor already onsite
Dredge Personnel Mobilization	LS	0	$ 29,180.00	$ -	Recent similar projects.	- Assumes MILCON Contractor already onsite
Utility Locate	LS	1	$ 975.00	$ 975.00	Recent similar projects.	- Includes mobilization, demobilization, and all labor, equipment, and materials.
Bathymetric Survey Mobilization/Demobilization	LS	1	$ 2,000.00	$ 2,000.00	Recent similar projects.	- Assumes mobilization/demobilation of two-man survey crew and all associated supplies and equipment.
Pre-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Debris Sweep	Day	1	$ 12,000.00	$ 12,000.00	Recent similar projects.	- Assumes equipment rented locally as needed when large debris is located
Turbidity Curtain	LF	0	$ 28.75	$ -	Recent similar projects.	- Assumes turbidity curtain will already be onsite for SWMU 3 NTCRA
Turbidity Curtain Installation/Removal	LS	1	$ 3,910.00	$ 3,910.00	Recent similar projects.	- Includes labor and boat for installation and removal of system
Material Staging Area Civil Construction	LS	0	$ 130,000.00	$ -	Recent similar projects.	- Assumes cost covered under the SWMU 3 NTCRA
Dredging and Disposal						
Dredging						
Dredging	yd^3	4,281	$ 27.25	$ 116,657.25	Recent similar projects.	- Assumes dredging 5 days per week M-F 12 hr/day. - Includes labor, mechanical dredge use, and fuel
Work-in-Progess Bathymetric Survey	Day	2	$ 4,025.00	$ 8,050.00	Recent similar projects.	Bathymetric surveys will be completed following completion of each removal grid to identify need for additional dredging prior to dredge equipement downtime or demobilzation. Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Post-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Scow Free Water Removal						
Scow Free Water Removal	Day	12	$ 2,300.00	$ 27,600.00	Recent similar projects.	- Includes 20 ton crane for pump manuevering, sump pump, and labor
Water Treatment Operations	Day	12	$ 3,350.00	$ 40,200.00	Recent similar projects.	- Includes sump maintenance (submersible pumps, generator, mini excavator for sump cleaning), fuel, labor, and rental of frac tank, sand filter, and carbon
T&D of Water Treatment System Components	LS	0	$ 1,250.00	$ -	Recent similar projects.	- Assumes cost covered under the SWMU 3 NTCRA
Water Quality Samples	EA	12	$ 1,000.00	$ 12,000.00	Recent similar projects.	Includes labor, material, and equipment for 3 effluent, 6 inline and 3 surface water samples for turbidity.
Solidification						
Sediment Solidification	yd^3	4,281	$ 51.00	$ 218,331.00	Recent similar projects.	- Assumes 10% by weight portland cement. Includes purchase/delivery of portland cement, equipment mobilization/demobilization, labor, and equipment
Barge Survey and Report	LS	0	$ 7,000.00	$ -	Recent similar projects	-Assumes cost covered under the SWMU 3 NTCRA
Sediment Transportation and Disposal						
Loading	ton	7,064	$ 4.50	$ 31,786.43	Recent similar projects.	- Tonnage includes portland cement. Includes front end loader and excavator.
Waste Characterization Sampling	EA	5	$ 76.70	$ 383.50	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample per barge (approx. 1000 yds^3) for analysis of TPH and paint filter test. - Includes volume of sediment and portland cement.
Transport to Landfill	Ton	7,064	$ 9.00	$ 63,572.85	Per quote from Waste Management Bethel Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill	Ton	7,064	$ 20.00	$ 141,273.00	Per quote from Waste Management Bethel Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill (debris)	Ton	4	$ 50.00	$ 200.00	Per quote from Waste Management Bethel Landfill	- Tonnage based on recent similar projects
Decontamination Water Transportation and Disposal						
Dredge, Scows, & Equipment Decontamination	LS	0	$ 10,000.00	$ -	Recent similar projects.	-Assumes cost covered under the SWMU 3 NTCRA
Waste Characterization Sampling	EA	0	$ 864.04	$ -	Navy CLEAN Laboratory BOA Rates	-Assumes cost covered under the SWMU 3 NTCRA
Transport to Disposal Facility	Load	0	$ 665.00	$ -	Per quote from Summit Environmental.	-Assumes cost covered under the SWMU 3 NTCRA
Disposal @ Soilex Facility, Suffolk, VA	gal	0	$ 0.25	$ -	Per quote from Summit Environmental.	-Assumes cost covered under the SWMU 3 NTCRA
Solids Surcharge	gal	0	$ 0.70	$ -	Per quote from Summit Environmental	-Assumes cost covered under the SWMU 3 NTCRA
Site Restoration/Demoboilization						
Material Staging Area						
Demobilization	LS	0	$ 35,000.00	$ -	Recent similar projects.	- Assumes cost covered under the SWMU 3 NTCRA
Water Treatment System						
Demobilization	LS	0	$ 7,500.00	$ -	Recent similar projects.	- Assumes cost covered under the SWMU 3 NTCRA
Sand Layer Placement						
Mobilization/Demobilization	LS	0	$ 20,000.00	$ -	Recent similar projects.	- Assumes cost covered under the SWMU 3 NTCRA
Well Graded Sand (Washed Sand 100+)	Ton	4,654	$ 20.00	$ 93,081.85	Recent similar projects.	- Includes cost for purchase/delivery and 15% loss
Placement of Well Graded Sand	yd^3	2,891	$ 12.00	$ 34,688.89	Recent similar projects.	- Includes use of sand spreader (barge and long reach excavator), fuel, and labor
Site Survey						
Final Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day - Conducted following completion of sand layer placement
Subtotal				***$848,029***		
Contingency (15%)				$127,204		
General Conditions (10%)				$84,803		
Subtotal				***$1,060,036***		
Performance Bond (2%)				$21,201		Industry Average
TOTAL				***$1,081,236***		
Design Costs (8%)				$86,499		Includes Closeout Reports
Construction Oversight (8%)				$86,499		
TOTAL CAPITAL COST				**$1,254,300**	**+50% $1,881,500**	
					-30% $878,100	

Notes

1. Base costs used are 2012 dollars.
2. For the bathymetric survey the dredge subcontractor will be responsible for coordinating with the surveyor to insure schedule efficiency. Navy will not be responsible for dredging delay due to surveyor. Survey will occur immediately after dredging is complete. Dredger will not leave dredging area until survey is confirmed.
3. Assumes that 90% of the free dredge water from the scows will be removed before turnover of the scows to the offloading contractor.
4. The enclosed Engineer's Cost Estimate based on seamless dredging operation from completion of SWMU 3 to start of SWMU 7b dredging.
5. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained.

Table C-3
Engineer's Cost Estimate for Alternative 4: Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and sand layer placement
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

Description: Alternative 4 (Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and sand layer placement) includes removal of contaminated sediment within the proposed removal area boundary. The total removal area is estimated to be 38,525 ft^2. Assumed dredge depth is 2 feet with an additional 1 foot of ovedredge. The total removal volume is estimated to be 4,281 yd^3.

Cost Item	Unit	Quantity	Unit Cost	Cost	Cost Estimate Reference	Assumptions and Notes
Pre-Dredge Sampling						
In-situ Waste Characterization Sampling						
Sediment Sampling	LS	0	$ 18,980.00	$ 18,980.00	Recent similar projects	- Includes all sampling labor and expenses - Includes vibracore and IDW subcontractor costs
Sample Analysis	EA	6	$ 1,710.63	$ 10,263.78	Navy CLEAN Laboratory BOA Rates	- Includes analysis of full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), BTEX, PCBs, TPH, EOX, dioxins, reactivity, ignitability, and corrosivity.
Site Preparation Activities						
Dredging						
Dredge Equipment Mobilization	LS	0	$ 150,000.00	$ -	Recent similar projects.	- Assumes MILCON Contractor already onsite
Dredge Personnel Mobilization	LS	0	$ 29,180.00	$ -	Recent similar projects.	- Assumes MILCON Contractor already onsite
Utility Locate	LS	1	$ 975.00	$ 975.00	Recent similar projects.	- Includes mobilization, demobilization, and all labor, equipment, and materials.
Bathymetric Survey Mobilization/Demobilization	LS	1	$ 2,000.00	$ 2,000.00	Recent similar projects.	- Assumes mobilization/demobilation of two-man survey crew and all associated supplies and equipment.
Pre-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Debris Sweep	Day	1	$ 12,000.00	$ 12,000.00	Recent similar projects.	- Assumes equipment rented locally as needed when large debris is located
Turbidity Curtain	LF	0	$ 28.75	$ -	Recent similar projects.	- Assumes turbidity curtain will already be onsite for SWMU 3 NTCRA
Turbidity Curtain Installation/Removal	LS	1	$ 3,910.00	$ 3,910.00	Recent similar projects.	- Includes labor and boat for installation and removal of system
Material Staging Area Civil Construction	LS	0	$ 175,000.00	$ -	Recent similar projects.	- Assumes cost covered under the SWMU 3 NTCRA
Sediment Offload and Screening Installation	LS	0	$ 16,000.00	$ -	Recent similar projects.	-Assumes cost covered under the SWMU 3 NTCRA
Dredging and Disposal						
Dredging						
Dredging	yd^3	4,281	$ 27.25	$ 116,657.25	Recent similar projects.	- Assumes dredging 5 days per week M-F 12 hr/day. - Includes labor, mechanical dredge use, and fuel
Work-in-Progess Bathymetric Survey	Day	2	$ 4,025.00	$ 8,050.00	Recent similar projects.	Bathymetric surveys will be completed following completion of each removal grid to identify need for additional dredging prior to dredge equipement downtime or demobilzation. Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Post-Removal Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day
Dewatering						
Scow Slurry Pump Operation	Day	18	$ 12,000.00	$ 216,000.00	Recent similar projects.	- Includes long reach excavator w/root rake and all labor, equipment and materials.
Sediment Screening Operation	Day	18	$ 2,800.00	$ 50,400.00	Recent similar projects.	- Includes screening plant, slurry pump, electrical connections, open top mix tank and all labor and equipment to operate.
Polymer Injections and Geotube Operations	Day	18	$ 6,700.00	$ 120,600.00	Recent similar projects.	- Includes polymer injection equipment, electrical connections and labor
Geotubes	LF	310	$ 75.00	$ 23,250.00	Recent similar projects.	- Includes cost for purchase/delivery and 15% loss of 75 ft circumference geotubes
Polymer	LB	10,300	$ 2.00	$ 20,600.00	Recent similar projects.	- Includes cost for purchase/delivery and 15% loss of polymer at 3lb/dry ton
Solidification						
Sediment Solidification	yd^3	4,281	$ 48.00	$ 205,488.00	Recent similar projects.	- Assumes 5% by weight portland cement. Includes purchase/delivery of portland cement, equipment mobilization/demobilization, labor, and equipment
Barge Survey and Report	LS	0	$ 7,000.00	$ -	Recent similar projects	-Assumes cost covered under the SWMU 3 NTCRA
Sediment Transportation and Disposal						
Loading	ton	6,743	$ 4.50	$ 30,341.59	Recent similar projects.	- Tonnage includes portland cement. Includes front end loader and excavator.
Waste Characterization Sampling	EA	5	$ 76.70	$ 383.50	Navy CLEAN Laboratory BOA Rates	- Assumes 1 sample 1000 yds^3 for analysis of TPH and paint filter test. - Includes volume of sediment and portland cement.
Transport to Landfill	Ton	6,743	$ 9.00	$ 60,683.18	Per quote from Waste Management Bethel Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill	Ton	6,743	$ 20.00	$ 134,851.50	Per quote from Waste Management Bethel Landfill	- Tonnage includes portland cement
Disposal @ Subtitle D Landfill (debris)	Ton	4	$ 50.00	$ 200.00	Per quote from Waste Management Bethel Landfill	- Tonnage based on recent similar projects
Decontamination Water Transportation and Disposal						
Dredge, Scows, & Equipment Decontamination	LS	0	$ 10,000.00	$ -	Recent similar projects.	-Assumes cost covered under the SWMU 3 NTCRA
Waste Characterization Sampling	EA	0	$ 864.04	$ -	Navy CLEAN Laboratory BOA Rates	-Assumes cost covered under the SWMU 3 NTCRA
Transport to Disposal Facility	Load	0	$ 665.00	$ -	Per quote from Summit Environmental.	-Assumes cost covered under the SWMU 3 NTCRA
Disposal @ Soilex Facility, Suffolk, VA	gal	0	$ 0.25	$ -	Per quote from Summit Environmental.	-Assumes cost covered under the SWMU 3 NTCRA
Solids Surcharge	gal	0	$ 0.70	$ -	Per quote from Summit Environmental	-Assumes cost covered under the SWMU 3 NTCRA
Site Restoration/Demoboilization						
Geotube Dewatering System						
Demobilization	LS	0	$ 50,000.00	$ -	Recent similar projects.	- Assumes cost covered under the SWMU 3 NTCRA
Sand Layer Placement						
Mobilization/Demobilization	LS	0	$ 20,000.00	$ -	Recent similar projects.	- Assumes cost covered under the SWMU 3 NTCRA
Well Graded Sand (Washed Sand 100+)	Ton	4,654	$ 20.00	$ 93,081.85	Recent similar projects.	- Includes cost for purchase/delivery and 15% loss
Placement of Well Graded Sand	yd^3	2,891	$ 12.00	$ 34,688.89	Recent similar projects.	- Includes use of sand spreader (barge and long reach excavator), fuel, and labor
Site Survey						
Final Bathymetric Survey	Day	1	$ 4,025.00	$ 4,025.00	Recent similar projects.	Assumes: - Two-man survey crew 12 hr/day - Project management 2 hr/day - Conducted following completion of sand layer placement
Subtotal				***$1,175,480***		
Contingency (15%)				$176,322		
General Conditions (10%)				$117,548		
Subtotal				***$1,469,349***		
Performance Bond (2%)				$29,387		Industry Average
TOTAL				***$1,498,736***		
Design Costs (8%)				$119,899		Includes Closeout Reports
Construction Oversight (8%)				$119,899		
TOTAL CAPITAL COST				**$1,738,600**	**+50% $2,607,900**	
					-30% $1,217,100	

Notes

1. Base costs used are 2012 dollars.
2. For the bathymetric survey the dredge subcontractor will be responsible for coordinating with the surveyor to insure schedule efficiency. Navy will not be responsible for dredging delay due to surveyor. Survey will occur immediately after dredging is complete. Dredger will not leave dredging area until survey is confirmed.
3. Assumes that 90% of the free dredge water from the scows will be removed before turnover of the scows to the offloading contractor.
4. The enclosed Engineer's Cost Estimate based on seamless dredging operation from completion of SWMU 3 to start of SWMU 7b dredging.
5. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained.

Appendix D
SiteWise Evaluation

APPENDIX D

Sustainability Analysis for Solid Waste Management Unit 7b – Small Boats Sandblast Yard

Introduction

This appendix presents the approach taken and results obtained from a sustainability analysis that was completed for Solid Waste Management Unit (SWMU) 7b, Small Boats Sandblast Yard at Joint Expeditionary Base Little Creek in Virginia Beach, Virginia.

Alternatives are presented to address SWMU 7b contaminants of concern (COCs) in Desert Cove sediment. A detailed summary of the removal action alternatives is provided in Section 4 of the SWMU 7b Evaluation/Cost Analysis (EE/CA). A sustainability analysis was performed by CH2M HILL using SiteWise Version 2.0 (Battelle, 2011) for the following remedial alternatives:

- Alternative 1 - No action
- Alternative 2 – Mechanical dredging, upland disposal, and sand layer placement
- Alternative 3 – Mechanical dredging, onsite solidification, upland disposal, and sand layer placement
- Alternative 4 – Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and sand layer placement

Method and Assumptions

The SiteWise tool (Battelle, 2011) consists of a series of Excel-based spreadsheets used to conduct a baseline assessment of sustainability metrics. The assessment is carried out using a spreadsheet-based building block approach, where every removal action alternative is first broken down into modules that mirror the phases of remedial action work, specifically (1) remedial investigation (RI), (2) remedial action construction (RAC), (3) remedial action operation (RAO), and (4) long-term monitoring (LTM).

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

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

For the purpose of this discussion, the term footprint will be used to describe the quantified emissions or quantities for each metric. To estimate the sustainability footprint for each removal action alternative, only those elements of the RI, RAC, RAO, and LTM possessing important sustainability elements were included in the assessment. The No Action alternative (Alternative 1) is not analyzed because there are no impacts to environmental and social metrics. SiteWise uses a cradle-to-grave approach to quantify footprints. As a result, some activities, such as material production, incorporate environmental burdens that do not directly occur onsite, but contribute to the overall footprints of the remedial alternative. This is particularly true in the case of GHGs, which contribute on a global, long-term scale.

The major conclusions of this sustainability analysis are incorporated into the effectiveness criteria evaluation of the EE/CA report.

Detailed assumptions for removal action alternatives are provided in **Table D-1**. The following is a description of the major activities for Alternative 2. All activities for this alternative are covered under the RAC.

- RI: No actions for any alternatives.
- RAC:
  - Alternative 2 involves the dredging of 2 feet (with an additional 1-foot over-dredge) from a 0.9 acre area to 3 feet (4,281 cubic yard [yd^3]) and placement of a 2-foot-thick clean sand layer. Dredge sediment will be stabilized offsite using Portland cement for offsite disposal. This alternative includes the handling of backfill material and the transportation of personnel, materials, and equipment to site. Equipment use, labor hours onsite, water use, and offsite disposal of residual waste are also included.
  - Alternative 3 involves the dredging of 2 feet (with an additional 1-foot over-dredge) from a 0.9 acre area to 3 feet (4,281 yd^3) and placement of a 2-foot thick clean sand layer. Dredge sediment will be stabilized onsite using Portland cement for offsite disposal. This alternative includes the handling of backfill material and the transportation of personnel, materials, and equipment to site. Equipment use, labor hours onsite, water use, and offsite disposal of residual waste are also included.
  - Alternative 4 involves the dredging of 2 feet (with an additional 1-foot over-dredge) from a 0.9 acre area to 3 feet (4,281 yd^3) and placement of a 2-foot thick clean sand layer. Dredged sediment will be placed in geotextile tubes onsite for passive dewatering and stabilized offsite using Portland cement for offsite disposal. This alternative includes the handling of backfill material and the transportation of personnel, materials, and equipment to site. Equipment use, labor hours onsite, water use, and offsite disposal of residual waste are also included.
- RAO: No actions for any alternatives.
- LTM: No actions for any alternatives.

General Assumptions

The specific assumptions made for the individual remedies are presented in **Tables D-1** through **D-3**. The following overall assumptions are used for the SiteWise tool evaluation:

- The distances per trip for materials shipped onsite and remediation-derived waste (RDW) shipped offsite were included at full weight going one way and empty weight going one way.
- The complete environmental footprint for production of equipment used, or production of the vehicles used for transportation, is not considered in this analysis. This equipment is reusable and the burden of these removal actions in the duration of the equipments life is negligible.
- The transportation of the Portland cement, sand, and Geotube materials was captured using the Equipment Transportation section of the SiteWise tool.
- The following average distances traveled were used unless specific distances were known:
  - Oversight– 100 miles roundtrip (local workers)
  - Surveying – 100 miles roundtrip (local contractor)
  - Operators/Laborers –100 miles roundtrip (local workers)
  - Portland cement – 50 miles roundtrip
  - Sand - 50 miles roundtrip
  - Solid RDW – 12 miles (each way)
  - Aqueous RDW – 90 miles (each way)
  - Earthmoving Equipment – 50 miles roundtrip (by land)

- Sand weighs approximately 1.4 tons/yd^3
- Sediment weighs approximately 1.5 tons/yd^3

Results and Conclusions

It should be noted that while this analysis quantifies the overall footprint of the alternatives, the alternatives provide different end-uses. Therefore, a comparison of the results of the alternatives needs to be made in the context of the benefits (e.g., applicable or relevant and appropriate requirement [ARAR] compliance, contaminant reduction, and cost effectiveness) of each of the alternatives. The overall comparison of alternatives is shown on **Figure D-1** and in **Table D-4**. Alternatives 2 and 3 had similarly high GHG and total energy footprints, primarily from production of Portland cement used for solidification. Alternative 4 had slightly lower GHG and total energy footprints from less Portland cement use. The footprints for the remaining impact categories (NO_X, SO_X, water, PM_{10}, and accident risks) were similar between the three active alternatives. Alternative 2 had a slightly lower PM_{10} footprint and a slightly lower accident risk fatality footprint. Alternative 4 had the highest water and SO_X footprints from operating the compressor for the turbidity curtain longer than Alternatives 2 and 3. Alternative 4 also had the highest accident risk footprints primarily due to the higher number of onsite labor hours.

- Alternative 1— No Action

  This Alternative has no sustainability impacts because no action occurs; however, this alternative does not meet removal goals.

- Alternative 2 – Mechanical dredging, upland disposal, and sand layer placement

  The production of the Portland cement accounted for the majority of the GHG and total energy-use footprints. Handling of the sand at the distribution facility, transportation of materials and equipment and residual handling also contributed to these footprints. The water consumption footprint is from electricity used to power the compressor for the turbidity curtain (cooling water at the power plant) and the decontamination water. The NO_x and PM_{10} footprints are primarily (approximately 70 percent) from equipment use handling sediment, sand, and Portland cement. The electricity to power the compressor accounts for an additional 20 percent of the NO_x footprint. Residual handling and equipment transportation accounts for the remaining PM_{10} footprint. Approximately 60 percent of the SO_x footprint is from electricity to power the compressor. The equipment use to handle sediment, sand, and Portland cement accounts for almost the entire remaining footprint of SO_x. The accident risk fatality and injury footprints are primarily from the labor hours onsite, which accounted for over 70 percent of the total footprints. Personnel, equipment, and waste transportation made up the rest of the footprint. Results are provided in **Table D-5** and **Figure D-2**.

- Alternative 3 – Mechanical dredging, onsite solidification, upland disposal, and sand layer placement

  Like Alternative 2, the largest contributor to the GHG and total energy use footprints were from production of Portland cement. The water consumption footprint is primarily from the decontamination water although approximately 60 percent of the footprint is from electricity used to power the compressor for the turbidity curtain. The NO_x and PM_{10} footprints are primarily from equipment use handling sediment, sand, and Portland cement. The electricity to power the compressor accounts for an additional 20 percent of the NO_x footprint. Approximately 60 percent of the SO_x footprint is from electricity to power the compressor. The equipment use to handle sediment, sand, and Portland cement accounts for the remaining footprint of SO_x. The accident risk fatality and injury footprints are primarily from the labor hours onsite, which accounted for over two thirds of the total footprints. Personnel, equipment, and waste transportation made up the rest of the footprints. Results are provided in **Table D-6** and **Figure D-3**.

- Alternative 4 – Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and sand layer placement

  Because 50 percent less Portland cement is used in Alternative 4, the GHG and total energy footprints are lower even when accounting for the production of geotubes. Half of the water consumption footprint is from electricity used to power the compressor for the turbidity curtain (cooling water at the power plant) and half is from the decontamination water. The majority of the NO_x and PM_{10} footprints are from equipment use handling sediment, sand, and Portland cement. The electricity to power the compressor accounts for an additional 20 percent of the NO_x footprint. The SO_x footprint is approximately 75 percent from electricity to power the compressor. The equipment use to handle sediment, sand, and Portland cement accounts for the remaining footprint of SO_x The water, SO_X, NO_X and PM_{10} and accident risk footprints are highest for Alternative 4 primarily because of the longer duration of the field work (running the compressor longer and more hours worked). Transportation of waste and equipment, and onsite labor hours accounted for the accident risk footprints. Results are provided in **Table D-7** and **Figure D-4**.

Uncertainty Assessment

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

High density polyethylene (HDPE) liner was used as a proxy for the geotextile material used for the Geotubes.

Recommendations

Depending on local and state regulations as well as client preference, each of these impact categories may be given a different “weight” or importance and the alternative with the lowest overall sustainability footprint (i.e. minimizes the footprint of the “important” criteria) may be selected. It should also be noted that while this analysis compares the environmental footprints of each of the alternatives, the alternatives provide different end-uses. Therefore, a comparison of the results of the alternatives needs to be made in the context of the benefits (for example, ARAR compliance, contaminant reduction, and cost effectiveness) of each of the alternatives.

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

References

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

TABLE D-1

SiteWise Results Alternative 2 - Mechanical Dredging, Upland Disposal, and Sand Layer Placement

SWMU 7b EE/CA, JEB Little Creek, Virginia

<u>Assumptions:</u>

Sediment weighs 1.5 tons/cy

Sand weighs 1.4 tons/cy

Total volume of sediment removed is 4,281 cy

SITEWISE TAB	Assumptions
Remedial Investigation	No Actions
Remedial Action Construction	mechanical dredging, upland disposal, and sand layer placement
Material Production	Sand, 2,854 cy x 1.4 ton/cy = 3,996 tons (7,991,200 lbs)
	Portland cement (10 percent by weight for stabilization), 642 tons (1,284,300 lbs)
Personnel Transportation - Road	Oversight (PM, QA/QC, and H&S),100 miles r/t, 3 people
	4 operator/laborers,100 miles r/t
	Surveyors, 2 people, 1 truck,100 miles r/t
Equipment Transportation - Road	(2) Excavators, 50 miles r/t, 30 tons
	Transport 642 tons of portland cement, 25 miles empty, 25 miles full, 16 trips (400 miles full/empty), 40 tons full load
	Transport 3,996 tons of sand, local supplier, 25 miles empty, 25 miles full, 100 trips (2,500 miles full/empty) with 40 tons full
Equipment Transportation - Water	Transport 6,421 tons dredged/dewatered soil 80 miles
Equipment Use	Excavator moving sediment from scow to trucks for disposal, 4,281 cy
	Excavator mixing portland cement into dredged sediment, 4,281 cy
	Excavator moving sand from truck to water, 2,854 cy
Equipment use - Pump	Turbidity curtain: 275 hp compressor running 5 hrs/day for 12 days (60 hrs)
Residual Handling/Fill Material Transport	7,062 tons of stabilized sediment transported by truck, 12 miles full and 12 miles empty, (177 trips of 40 tons full)
	5,000 gallons of rinse water, transported by truck, 90 miles full and 90 miles empty, 1 trip of 21 tons full
Labor Hours Onsite	1,128 hrs (4 laborers/operators, 3 oversight crew, 12 hrs/day, 12 days=1,008 hours) (2 surveyors, 12 hrs/day, 5 days = 120 hours)
Water Consumption	5,000 gallons for decon
Remedial Action Operations	No Actions
Longterm Monitoring	No Actions

Notes:

cy = cubic yards

ft = feet

H&S = health and safety

hrs = hours

hp = horsepower

lbs = pounds

PM = project management

QA/QC = quality assurance/quality control

r/t = round trip

TABLE D-2

SiteWise Results Alternative 3 - Mechanical Dredging, Onsite Solidification, Upland Disposal, and Sand Layer Placement

SWMU 7b EE/CA, JEB Little Creek, Virginia

Assumptions:

Sediment weighs 1.5 tons/cy

Sand weighs 1.4 tons/cy

Total volume of sediment removed is 4,281 cy

SITEWISE TAB	Assumptions
Remedial Investigation	No Actions
Remedial Action Construction	mechanical dredging, onsite solidification, upland disposal, and sand layer placement
Material Production	Sand, 2,854 cy x 1.4 ton/cy = 3,996 tons (7,991,200 lbs)
	Portland cement (10 percent by weight for stabilization), 642 tons (1,284,300 lbs)
Personnel Transportation - Road	Oversight (PM, QA/QC, and H&S),100 miles r/t, 3 people
	4 operator/laborers,100 miles r/t
	Surveyors, 2 people, 1 truck,100 miles r/t
Equipment Transportation - Road	(2) Excavators, 50 miles r/t, 30 tons
	Transport 642 tons of portland cement, 25 miles empty, 25 miles full, 16 trips (400 miles full/empty), 40 tons full load
	Transport 3,996 tons of sand, local supplier, 25 miles empty, 25 miles full, 100 trips (2,500 miles full/empty) with 40 tons full
Equipment Use	Excavator moving sediment from scow to trucks for disposal, 4,281 cy
	Excavator mixing portland cement into dredged sediment, 4,281 cy
	Excavator moving sand from truck to water, 2,854 cy
Equipment use - Pump	Turbidity curtain: 275 hp compressor running 5 hrs/day for 12 days (60 hrs)
Residual Handling/Fill Material Transport	7,062 tons of stabilized sediment transported by truck, 30 miles full and 30 miles empty, (177 trips of 40 tons full)
	10,000 gallons of rinse water, transported by truck, 90 miles full and 90 miles empty, 2 trips of 21 tons full
Labor Hours Onsite	1,128 hrs (4 laborers/operators, 3 oversight crew, 12 hrs/day, 12 days=1,008 hrs) (2 surveyors, 12 hrs/day, 5 days = 120 hrs)
Resource Consumption - Water use	10,000 gallons for decon, disposed of offsite
Remedial Action Operations	No Actions
Longterm Monitoring	No Actions

Notes:

cy = cubic yards

ft = feet

H&S = health and safety

hrs = hours

hp = horsepower

lbs = pounds

PM = project management

QA/QC = quality assurance/quality control

r/t = round trip

TABLE D-3

SiteWise Results Alternative 4 - Mechanical Dredging, Onsite Passive Dewatering via Geotube, Upland Disposal, and Sand Layer Placement

SWMU 7b EE/CA, JEB Little Creek, Virginia

Assumptions:

Sand weighs 1.4 tons/cy

Total volume of sediment removed is 4,281 cy

Sediment weighs 1.5 tons/cy

SITEWISE TAB	Assumptions
Remedial Investigation	No Actions
Remedial Action Construction	mechanical dredging, onsite passive dewatering via geotube, upland disposal, and sand layer placement
Material Production	Sand, 2,854 cy x 1.4 ton/cy = 3,996 tons (7,991,200 lbs)
	Geotube material (proxy 10 mil HDPE liner for the geotextile material) area of material = 2,250 square yards (20,250 square ft) (270 ft of 75 ft circumference geotubes)
	Portland cement (5 percent by weight for stabilization), 321 tons (642,000 lbs)
Personnel Transportation - Road	Oversight (PM, QA/QC, and H&S),100 miles r/t, 3 people
	4 operator/laborers,100 miles r/t
	Surveyors, 2 people, 1 truck,100 miles r/t
Equipment Transportation - Road	(2) Excavators, 50 miles r/t, 30 tons
	Geotube materials = weight approximately 33 oz per square yard (manufacturer specifications) = 2,250 x 33 oz /16 oz/lb = 4,218 lb or 2.1 tons, transported 500 miles from Georgia, empty return
	Transport 3,996 tons of sand, local supplier, 25 miles empty, 25 miles full, 100 trips (2,500 miles full/empty) with 40 tons full
	Transport 321 tons of portland cement, 25 miles empty, 25 miles full, 8 trips (200 miles full/empty), 40 tons full load
Equipment Use	Excavator moving sediment from geotube to trucks for disposal, 4,281 cy
	Excavator mixing cement into sediment for stabilization, 4,281 cy
	Excavator moving sand to water, 2,854 cy
Equipment use - Pump	275 hp compressor running 5 hs/day for 18 days (90 hrs)
Residual Handling/Fill Material Transport	6,742 tons of stabilized sediment transported by truck, 30 miles full and 30 miles empty, (169 trips of 40 tons full)
	10,000 gallons of rinse water, transported by truck, 90 miles full and 90 miles empty, 2 trips of 21 tons full
Labor Hours Onsite	1,632 hrs (4 laborers/operators, 3 oversight crew, 12 hrs/day, 18 days=1,512 hours) (2 surveyors, 12 hrs/day, 5 days = 120 hours)
Resource Consumption - Water use	10,000 gallons for decon, disposed of offsite
Remedial Action Operations	No Actions
Longterm Monitoring	No Actions

Notes:

cy = cubic yards

ft = feet

H&S = health and safety

hp = horsepower

hrs = hours

lbs = pounds

PM = project management

oz = ounce

QA/QC = quality assurance/quality control

r/t = round trip

TABLE D-4

Relative Impact of Alternatives

SWMU 7b EE/CA, JEB Little Creek, Virginia

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Alternative 1- No Action	0	0	0	0	0	0	0	0
Alternative 2 - Mechanical dredging, upland disposal, and sand layer placement	5.63E+02	3.64E+03	1.13E+04	5.33E-02	4.29E-02	3.81E-03	1.98E-04	3.48E-02
Alternative 3 - Mechanical dredging, onsite solidification, upland disposal, and sand layer placement	5.53E+02	3.62E+03	1.63E+04	5.80E-02	4.30E-02	4.23E-03	2.49E-04	3.89E-02
Alternative 4 - Mechanical dredging, onsite passive dewatering via Geotube, upland disposal, and sand layer placement	3.16E+02	2.45E+03	1.94E+04	6.23E-02	5.94E-02	4.21E-03	2.96E-04	5.05E-02

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Alternative 1- No Action	Low	Low	Low	Low	Low	Low	Low	Low
Alternative 2 - Mechanical dredging, upland disposal, and sand layer placement	High	High	Medium	High	High	High	Medium	Medium
Alternative 3 - Mechanical dredging, onsite solidification, upland disposal, and sand layer placement	High	High	High	High	High	High	High	High
Alternative 4 - Mechanical dredging, onsite passive dewatering via Geotube, upland disposal, and sand layer placement	Medium	Medium	High	High	High	High	High	High

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

Notes:

GHG - Greenhouse Gases

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

PM10 - Particulate Matter

SOx - Sulfur Oxides

TABLE D-5

SiteWise Results Alternative 2 - Mechanical Dredging, Upland Disposal, and Sand Layer Placement

SWMU 7b EE/CA, JEB Little Creek, Virginia

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	5.02E+02	2.88E+03	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	2.29E-01	2.88E+00	NA	8.46E-05	2.98E-06	1.72E-05	7.02E-06	5.65E-04
	Transportation-Equipment	3.84E+01	3.90E+02	NA	4.23E-03	7.48E-05	3.76E-04	4.60E-05	3.70E-03
	Equipment Use and Misc	1.32E+01	2.30E+02	1.13E+04	4.59E-02	4.28E-02	3.14E-03	1.10E-04	2.77E-02
	Residual Handling	9.98E+00	1.30E+02	NA	3.14E-03	5.55E-05	2.79E-04	3.45E-05	2.78E-03
	Sub-Total	5.63E+02	3.64E+03	1.13E+04	5.33E-02	4.29E-02	3.81E-03	1.98E-04	3.48E-02
Total		**5.63E+02**	**3.64E+03**	**1.13E+04**	**5.33E-02**	**4.29E-02**	**3.81E-03**	**1.98E-04**	**3.48E-02**

Notes:

GHG - Greenhouse Gases

MMBTU - million British Thermal Unit

NA - Not Applicable

NOx - Nitrogen Oxides

PM10 - Particulate Matter

SOx - Sulfur Oxides

TABLE D-6

SiteWise Results Alternative 3 - Mechanical Dredging, Onsite Solidification, Upland Disposal, and Sand Layer Placement

SWMU 7b EE/CA, JEB Little Creek, Virginia

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	5.02E+02	2.88E+03	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	2.29E-01	2.88E+00	NA	8.46E-05	2.98E-06	1.72E-05	7.02E-06	5.65E-04
	Transportation-Equipment	1.35E+01	1.76E+02	NA	4.23E-03	7.48E-05	3.76E-04	4.60E-05	3.70E-03
	Equipment Use and Misc	1.32E+01	2.30E+02	1.63E+04	4.59E-02	4.28E-02	3.14E-03	1.10E-04	2.77E-02
	Residual Handling	2.48E+01	3.24E+02	NA	7.80E-03	1.38E-04	6.93E-04	8.56E-05	6.89E-03
	Sub-Total	5.53E+02	3.62E+03	1.63E+04	5.80E-02	4.30E-02	4.23E-03	2.49E-04	3.89E-02
Total		**5.53E+02**	**3.62E+03**	**1.63E+04**	**5.80E-02**	**4.30E-02**	**4.23E-03**	**2.49E-04**	**3.89E-02**

Notes:

GHG - Greenhouse Gases

MMBTU - million British Thermal Unit

NA - Not Applicable

NOx - Nitrogen Oxides

PM10 - Particulate Matter

SOx - Sulfur Oxides

TABLE D-7

SiteWise Results Alternative 4 - Mechanical Dredging, Onsite Passive Dewatering via Geotube, Upland Disposal, and Sand Layer Placement

SWMU 7b EE/CA, JEB Little Creek, Virginia

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	2.61E+02	1.66E+03	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	2.29E-01	2.88E+00	NA	8.46E-05	2.98E-06	1.72E-05	7.02E-06	5.65E-04
	Transportation-Equipment	1.40E+01	1.82E+02	NA	4.39E-03	7.77E-05	3.90E-04	5.07E-05	4.08E-03
	Equipment Use and Misc	1.66E+01	2.94E+02	1.94E+04	5.03E-02	5.92E-02	3.14E-03	1.56E-04	3.93E-02
	Residual Handling	2.37E+01	3.09E+02	NA	7.45E-03	1.32E-04	6.63E-04	8.19E-05	6.59E-03
	Sub-Total	3.16E+02	2.45E+03	1.94E+04	6.23E-02	5.94E-02	4.21E-03	2.96E-04	5.05E-02
Total		**3.16E+02**	**2.45E+03**	**1.94E+04**	**6.23E-02**	**5.94E-02**	**4.21E-03**	**2.96E-04**	**5.05E-02**

Notes:

GHG - Greenhouse Gases

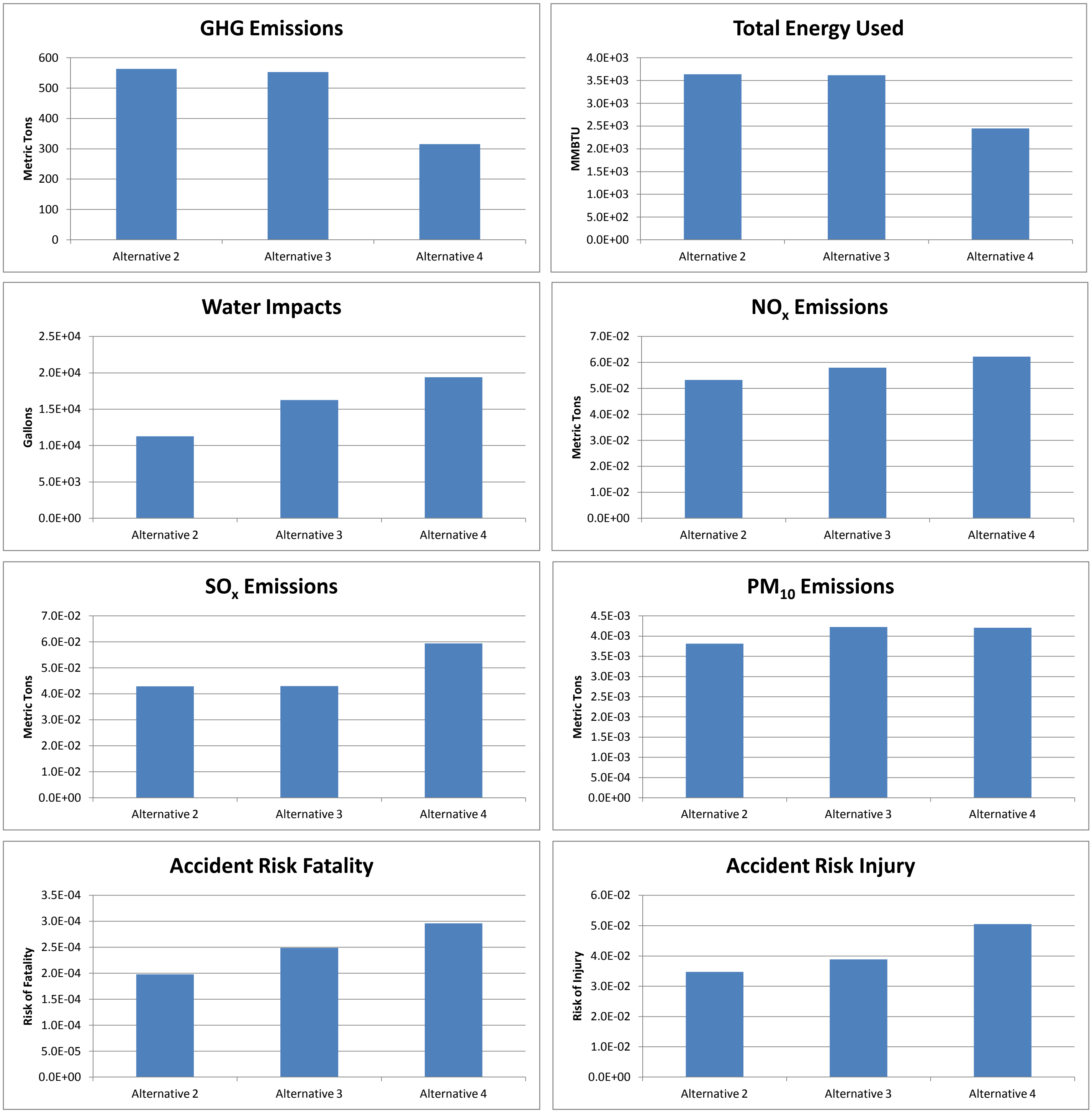
MMBTU - million British Thermal Unit

NA - Not Applicable

NOx - Nitrogen Oxides

PM10 - Particulate Matter

SOx - Sulfur Oxides



Notes:
Alternative 2 - Mechanical dredging, upland disposal, and sand layer placement
Alternative 3 - Mechanical dredging, onsite solidification, upland disposal, and sand layer placment
Alternative 4 - Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and sand layer placement

Figure D-1
Overall Summary
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

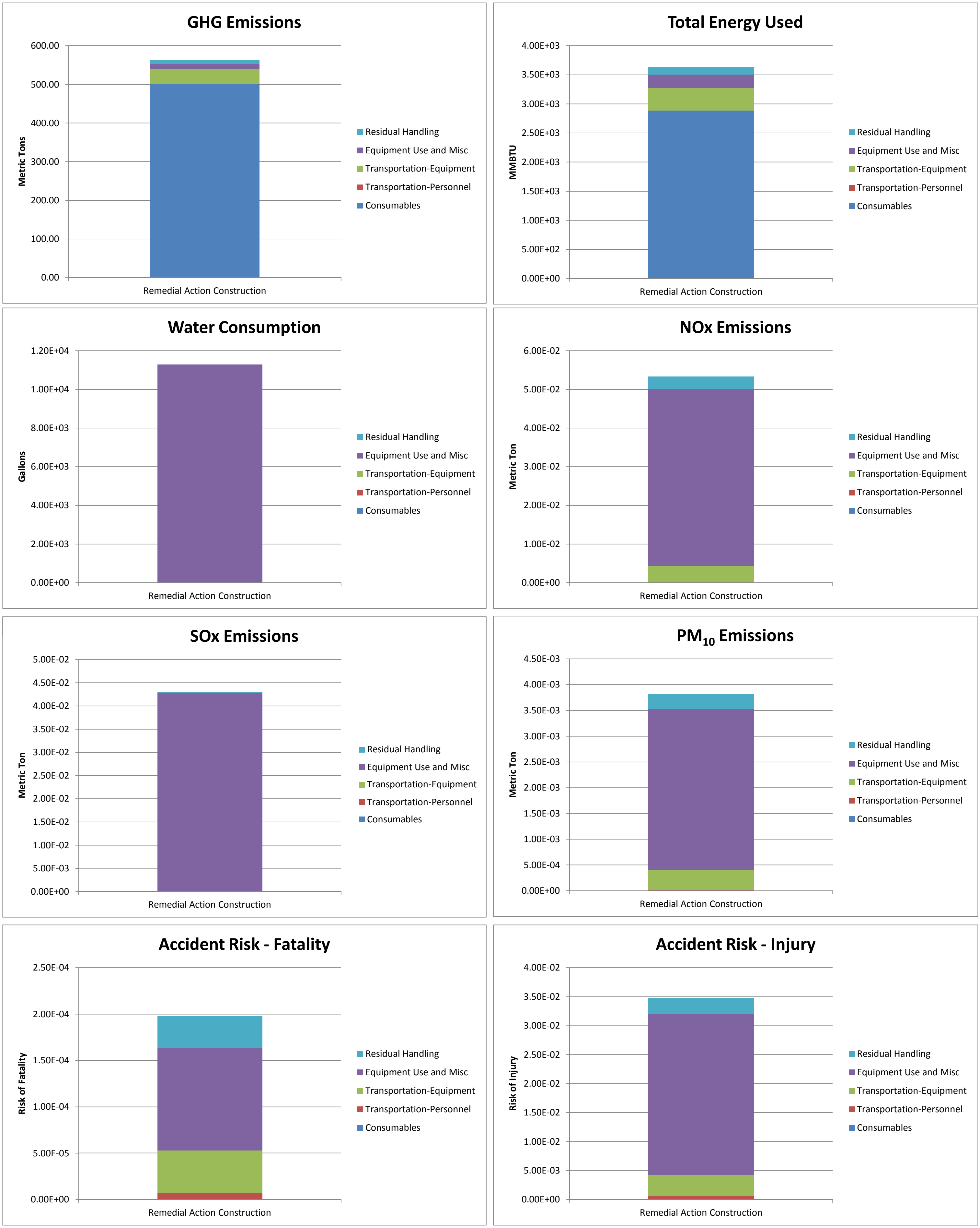


Figure D-2
Alternative 2 - Mechanical dredging, upland disposal, and sand layer placement
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia

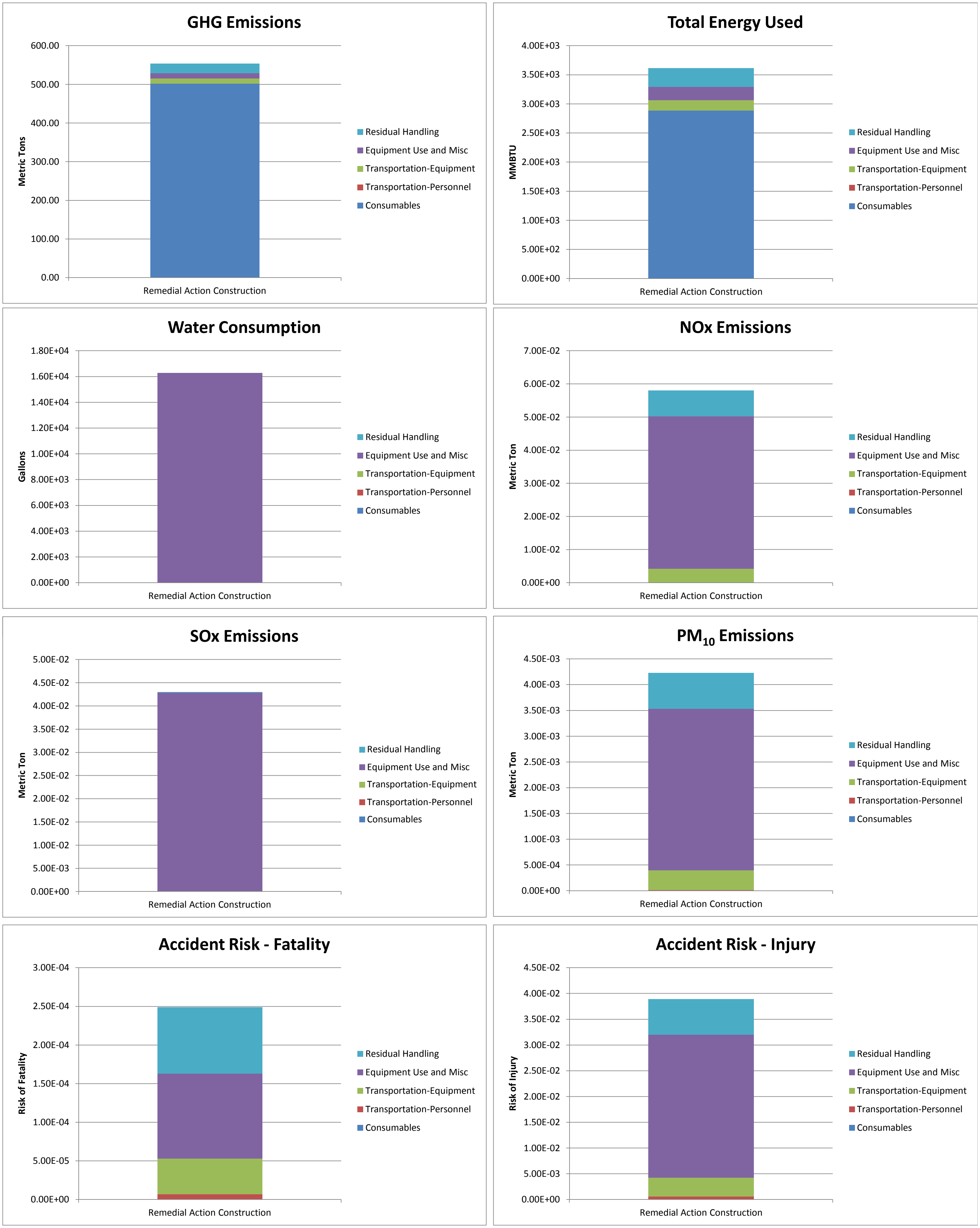


Figure D-3

Alternative 3 - Mechanical dredging, onsite solidification, upland disposal, and sand layer placement

SWMU 7b EE/CA

JEB Little Creek

Virginia Beach, Virginia

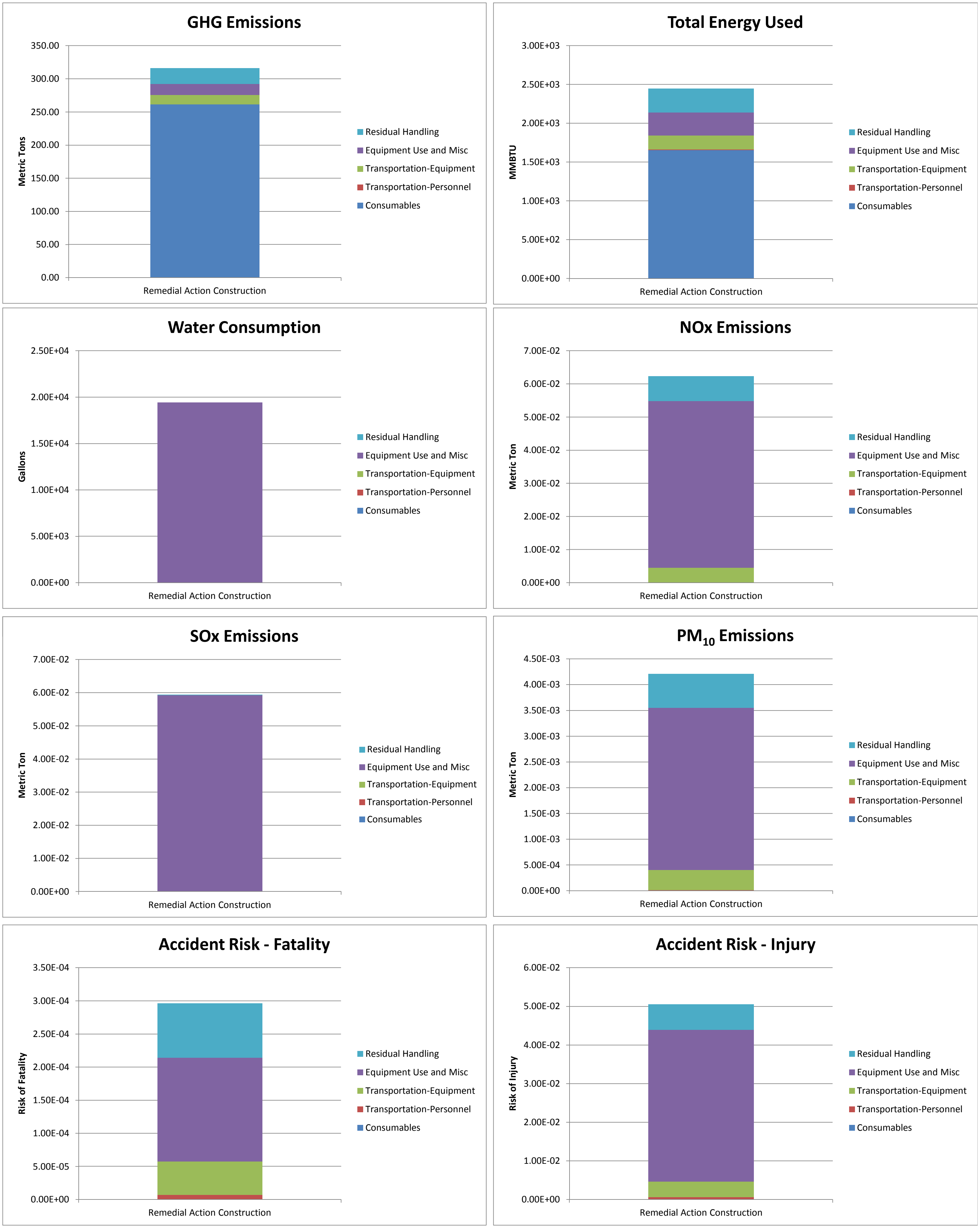


Figure D-4
Alternative 4 - Mechanical dredging, onsite passive dewatering via geotube, upland disposal, and sand layer placement
SWMU 7b EE/CA
JEB Little Creek
Virginia Beach, Virginia