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FINAL FIVE YEAR REVIEW REPORT ST JULIENS CREEK ANNEX VA (PUBLIC DOCUMENT)

5/1/2015

CH2M HILL

Final

Five-Year Review Report

St. Juliens Creek Annex
Chesapeake, Virginia

Contract Task Order WE94

May 2015

Prepared for

Department of the Navy
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Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

CH2MHILL

Virginia Beach, Virginia

Final

Five-Year Review Report

St. Juliens Creek Annex
Chesapeake, Virginia

May 2015

This report documents the Five-Year Review for St. Juliens Creek Annex as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in accordance with CERCLA §121(c), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan, Part 300.430(f)(4)(ii) of the Code of Federal Regulations.

Approved by:

A. ILIAKIS, CAPT, SC, USN, NNSY CODE 800
By direction

19 MAY 2015
Date

Executive Summary

The United States Navy conducted this Five-Year Review for St. Juliens Creek Annex (SJCA) in Chesapeake, Virginia, as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in accordance with CERCLA Section 121(c), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan, Part 300.430(f)(4)(ii) of the Code of Federal Regulations. This report has been prepared in accordance with the *Navy/Marine Corps Policy for Conducting CERCLA Statutory Five-Year Reviews* (Department of the Navy, 2011) and United States Environmental Protection Agency (USEPA) *Comprehensive Five-Year Review Guidance* (USEPA, 2001), and provides a description of the site, site data and information necessary to evaluate the effectiveness of the site remedy, the results of the Five-Year Review, and recommendations.

This report addresses remedies that have been implemented at the sites for which there is a Record of Decision (ROD) in place. Three sites are included in this review:

- Site 2 [Operable Unit (OU) 2] – Waste Disposal Area B
- Site 4 (OU4) – Landfill D
- Site 21 (OU12) – Industrial Area

The objective of this Five-Year Review is to evaluate the performance of the implemented remedies at SJCA sites with remedies in place leaving hazardous substances, pollutants, or contaminants onsite above levels that would allow for unrestricted use and unlimited exposure (i.e., Sites 2, 4, and 21) and verify that the remedies remain protective of human health and the environment in accordance with the requirements stated in the Record of Decisions. This evaluation was accomplished through a review of various documents pertaining to site activities, analytical data, and findings; and through site inspections and interviews. The methods, findings, and conclusions of the evaluation are presented in this Five-Year Review report. The Five-Year Review report is intended to identify any issues that may prevent a remedy from functioning as designed or providing sufficient protection of human health and the environment. The overall evaluation of the effectiveness of the remedy is presented as a protectiveness statement in the Five-Year Review Summary Form provided below for the above three sites.

Five-Year Review Summary Form

Activity Identification

Site Name: St. Juliens Creek Annex
USEPA ID: VA5170000181
Region: 03 **State:** Virginia
City/County: City of Chesapeake

Activity Status

National Priorities List Status: Final
Construction Completion Date: Not applicable
Remediation Status: Ongoing Operation
Has the site(s) been put into reuse? No
Multiple Sites: Yes

Review Status

Lead Agency: United States Navy
Who conducted the review? (USEPA Region, State, Federal Agency): United States Navy
Author Name: CH2M HILL
Author Title: Comprehensive Long-term Environmental Action—Navy (CLEAN) Contractor
Author Affiliation: United States Navy Contractor
Review Period: From: 2010 **To:** 2015
Date(s) of Site Inspection: July 31, 2014
Type of Review: Statutory **Review Number:** 2
Triggering Action: Initiation of Site 4 Remedial Action (on-site mobilization for commencement of the remedial action-construction phase for Site 4)
Trigger Action Date: March 21, 2005
Due Date: May 18, 2015 (based on first Five-Year Review signature)

OU2 – Site 2

Issues/Recommendations

Affect Current Protectiveness:	Affect Future Protectiveness:	Implementing Party:	Oversight Party:	Milestone Date:
No	Yes	Navy	USEPA	May 2017

Issue Category: Monitoring

Issue: Based on site history, there is the potential for emerging contaminants perchlorate and 1,4-Dioxane to be present in site groundwater. However, the presence of perchlorate and 1,4-dioxane and any resulting unacceptable risk is unknown.

Recommendation: Determine whether perchlorate and 1,4-Dioxane are present and pose unacceptable risk in the shallow aquifer groundwater. If a data evaluation indicates these chemicals should be considered constituents of concern (COCs) for Site 2, revise the existing remedy, land use control (LUC) boundary, and/or treatment system if warranted.

Affect Current Protectiveness:	Affect Future Protectiveness:	Implementing Party:	Oversight Party:	Milestone Date:
No	Yes	Navy	USEPA	May 2016

Issue Category: Monitoring

Issue: Cleanup level for naphthalene in groundwater is not protective of potential future use.

Recommendation: Calculate a cleanup value for naphthalene in groundwater that is protective of potential future use. Document the revised cleanup goal in a Record of Decision Memorandum to File.

Affect Current Protectiveness:	Affect Future Protectiveness:	Implementing Party:	Oversight Party:	Milestone Date:
No	Yes	Navy	USEPA	May 2016

Issue Category: Monitoring

Issue: Remedial Action-operation phase groundwater data is not available to determine whether the groundwater component of the remedy is functioning as intended by the Record of Decision.

Recommendation: Collect groundwater data in accordance with the Remedial Action-operation monitoring plan and evaluate the data to determine whether the remedy is functioning as intended by the Record of Decision.

Affect Current Protectiveness:	Affect Future Protectiveness:	Implementing Party:	Oversight Party:	Milestone Date:
No	No	Navy	USEPA	May 2016

Issue Category: Monitoring

Issue: Successful restoration of the compensatory mitigation wetland has not been demonstrated.

Recommendation: Develop a Wetland Maintenance and Monitoring Plan, conduct the monitoring, report the monitoring, and conduct any necessary maintenance.

Protectiveness Statement(s)

Protectiveness Determination: Short-term Protective	***Addendum Due Date (if applicable):*** Not applicable (N/A)

Protectiveness Statement: The remedy at Site 2 currently protects human health and the environment because human and ecological exposures that could result in an unacceptable risk are being controlled through LUCs. However, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure continued protectiveness: complete a groundwater evaluation to determine if perchlorate and 1,4-dioxane should be considered COCs for the site and revise the site remedy, LUC boundary, and/or treatment system if warranted; calculate a cleanup goal for naphthalene in groundwater that is protective of potential future use of the site; and collect RA-Operation phase groundwater data and evaluate the data to determine if the groundwater component of the remedy is functioning as intended.

OU4 – Site 4

Issues/Recommendations

Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
N/A	N/A	N/A	N/A	N/A

Issue Category: No Issue

Issue: None

Recommendation: None

Protectiveness Statement(s)

Protectiveness Determination: Protective	***Addendum Due Date (if applicable):*** N/A

Protectiveness Statement: The remedy at Site 4 is protective for human health and the environment. Exposure pathways that could result in an unacceptable risk are being controlled through LUCs.

OU12 – Site 21

Issues/Recommendations

Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
No	Yes	Navy	USEPA	May 2017

Issue Category: Monitoring

Issue: Based on site history, there is the potential for emerging contaminants perchlorate and 1,4-dioxane to be present in site groundwater. However, the presence of perchlorate and 1,4-dioxane and any resulting unacceptable risk is unknown.

Recommendation: Determine whether perchlorate and 1,4-dioxane are present and pose unacceptable risk in the shallow aquifer groundwater. If a data evaluation indicates these compounds should be considered COCs for Site 21, revise the existing remedy, LUC boundary, and/or treatment system if warranted

Protectiveness Statement(s)

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU12 (Site 21)	Short-term Protective	N/A

Protectiveness Statement: The remedy at Site 21 currently protects human health and the environment because exposure pathways that could result in unacceptable risk are being controlled through LUCs. However, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure continued protectiveness: complete a groundwater evaluation to determine if perchlorate and 1,4-dioxane should be considered COCs for the site and revise the site remedy, LUC boundary, and/or treatment system if warranted.

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Acronyms and Abbreviations

AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
BERA	baseline ecological risk assessment
bgs	below ground surface
BTAG	Biological Assistance Technical Group
CCR	Construction Closeout Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIP	Community Involvement Plan
CLEAN	Comprehensive Long-term Environmental Action—Navy
COC	constituent of concern
DCE	dichloroethene
DoD	Department of Defense
EPIC	Environmental Photographic Interpretation Center
ERA	Ecological Risk Assessment
ERD	enhanced reductive dechlorination
ERP	Environmental Restoration Program
EVO	emulsified vegetable oil
FFA	Federal Facility Agreement
FS	Feasibility Study
GIS	geographic information system
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System
IAS	Initial Assessment Study
IDW	investigation-derived waste
iNFADS	Internet Navy Facility Assets Data Store
IR	Installation Restoration
IRP	Installation Restoration Program
ISCR	in situ chemical reduction
LUC	land use control
MCL	Maximum Contaminant Level
MNA	monitored natural attenuation
MRP	Munitions Response Program
msl	mean sea level
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
PA	Preliminary Assessment
PFC	perfluorinated chemical
PRB	permeable reactive barrier
PCB	polychlorinated biphenyl

RA	remedial action
RACR	Remedial Action Completion Report
RAO	Remedial Action Objective
RD	Remedial Design
RFA	Resource Conservation and Recovery Act Facility Assessment
RI	Remedial Investigation
ROD	Record of Decision
RRR	Relative Risk Ranking
SI	Site Inspection
SJCA	St. Juliens Creek Annex
SMP	Site Management Plan
SVOC	semivolatile
SWMU	solid waste management unit
TBC	to be considered
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
UU/UE	unrestricted use and unlimited exposure
VC	vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
VSI	Visual Site Inspection

SECTION 1

Introduction

This document presents the results of the Five-Year Review for St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This Five-Year Review Report was prepared by CH2M HILL under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-term Environmental Action—Navy (CLEAN) Program, Contract N62470-11-D-8012, Contract Task Order WE94, for submittal to NAVFAC Mid-Atlantic, United States Environmental Protection Agency (USEPA), and the Virginia Department of Environmental Quality (VDEQ).

SJCA is a federal facility at which Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities are funded and implemented by the Department of the Navy (Navy) under the Navy Environmental Restoration Program (ERP). The Navy implements CERCLA at SJCA in partnership with the USEPA and the VDEQ.

The purpose of a Five-Year Review is to evaluate the performance of remedies for sites with a Record of Decision (ROD) leaving hazardous substances, pollutants, or contaminants onsite above levels that would allow for unrestricted use and unlimited exposure (UU/UE) and to verify that the remedies remain protective of human health and the environment as stated in the RODs. This Five-Year Review was conducted by CH2M HILL, on behalf of the Navy, in accordance with the *Navy/Marine Corps Policy for Conducting CERCLA Statutory Five-Year Reviews* (DoD, 2011) and the *Comprehensive Five-Year Review Guidance* (USEPA, 2001) and pursuant to CERCLA Section 121(c) and the National Oil and Hazardous Substances Pollution Contingency Plan, or National Contingency Plan (NCP).

In accordance with Navy policy, the triggering action of the statutory review process is the on-site mobilization for commencement of the remedial action (RA)-Construction phase for Site 4 – Landfill D in March 2005. SJCA has elected to follow the Navy recommendation to conduct installation-wide Five-Year Reviews, which include all sites with remedies in place. A Five-Year Review is required 5 years from the initiation of the first RA where hazardous substances, pollutants, or contaminants remain onsite above levels that allow for UU/UE. If a site contains multiple remedies, all are subject to a Five-Year Review when at least one remedy is initiated. This Five-Year Review for SJCA consisted of a review of various reports and documents pertaining to pre- and post-remedy-implementation activities, analytical data, and findings; and through site inspections and interviews. Inspection at the sites were conducted on July 31, 2014, by representatives of the Navy, USEPA, VDEQ, and CH2M HILL.

Four sites; Site 2, Site 4, Site 5, and Site 21; are currently active in the Installation Restoration Program (IRP) at SJCA. Of these, three (Sites 2, 4, and 21) are being addressed by this Five-Year Review. Site 5 is not included in this Five-Year Review because it is currently in the remedial investigation (RI) phase of the CERCLA process.

SECTION 2

Facility Background

2.1 Facility Description

SJCA is approximately 490 acres and is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River in the City of Chesapeake, in southeastern Virginia (**Figure 2-1**). Most surrounding areas are developed and include residences, schools, recreational areas, and shipping facilities for several large industries.

SJCA is located in the Atlantic Coastal Plain, which is characterized by unconsolidated sediments several thousand feet in thickness (NEESA, 1981). The Southern Branch of the Elizabeth River defines the eastern boundary of SJCA. St. Juliens Creek, a tributary of the Southern Branch of the Elizabeth River, defines the southern boundary of SJCA. Blows Creek, also a tributary of the Southern Branch of the Elizabeth River, flows through the center of SJCA. The Southern Branch of the Elizabeth River and its tributaries are part of a tidal estuary system.

Land surface elevations at SJCA are generally low, ranging from sea level to approximately 20 feet above mean sea level (msl) in the northeastern portion of the facility. The majority of surface water on SJCA drains to Blows Creek, St. Juliens Creek, and the Southern Branch of the Elizabeth River. St. Juliens Creek and the Southern Branch of the Elizabeth River are used for commercial, industrial, and recreational purposes. All of these surface water bodies eventually discharge to the Chesapeake Bay, also used for commercial, industrial, and recreational purposes.

The aquifers most relevant to CERCLA investigations at SJCA are the shallow water-table aquifer (Columbia aquifer) and the underlying aquifer (Yorktown aquifer). These aquifers are separated by the Yorktown confining unit, which ranges in thickness from 15.3 to 38.7 feet within SJCA. Groundwater flow directions for the aquifers are controlled by topography and surface water bodies with the primary discharge direction being towards St. Juliens Creek, Blows Creek, and the Southern Branch of the Elizabeth River.

SJCA began operations as a naval facility in 1849. The annex was one of the largest ammunition depots in the United States involving wartime transfer of ammunitions to various other naval facilities. Specific ordnance operations and processes conducted at SJCA included stockpiling Explosive D (ammonium picrate, which was received in lined boxes from the manufacturer) for use in projectiles, manufacturing Mark VI mines, assembling small caliber guns and ammunition, storing torpedoes, filling shells, and testing ordnance. In 1975, all ordnance operations were transferred to the Yorktown Naval Weapons Station. As a result, decontamination was performed in, around, and under ordnance-handling facilities at SJCA in 1977.

SJCA has also been involved in non-ordnance operations, including degreasing operations; paint, machine, vehicle and locomotive maintenance, pest control, battery, print, and electrical shop operations; boiler plant operations; wash rack operations; potable water and salt water fire-protection systems; fire-fighter training operations; and storage of oil and chemicals.

While activity at SJCA has decreased overall in the past decade with the demolishment of many older structures, most recently it has increased. The current primary mission of SJCA is to provide a radar-testing range and administrative and warehousing facilities for nearby Norfolk Naval Shipyard and other local naval activities. SJCA also provides light industrial shops and storage facilities for several tenant commands, including Defense Logistics Agency, Space and Naval Warfare Systems Command, Fleet Logistics Center Norfolk, Naval Undersea Warfare Center Detachment; and a cryogenics school. Portions of the base remain undeveloped and include grassy, wooded, or wetland areas.

Groundwater is not used or planned for future use as a potable resource at SJCA. Public water is supplied to SJCA and the surrounding area by the City of Chesapeake Waterworks. Private deep wells exist locally (http://hrpdc-gis.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=227b28370ea94d678fa4f0a1913318b0); however, not in the immediate vicinity of SJCA. The closest well is approximately 1 mile upgradient of SJCA and is screened in the Potomac aquifer and used for industrial activities. No surrounding water bodies serve as a water supply to the surrounding areas.

The SJCA mission and current land and resource use at the facility are not expected to change in the foreseeable future.

2.2 Environmental Response History

In 1975, the Department of Defense (DoD) began the Navy Assessment and Control of Installation Pollutants Program to assess past hazardous and toxic materials storage and disposal activities at military installations. The goals of this program were to identify environmental contamination resulting from past hazardous materials management practices, to assess the impacts of the contamination on public health and the environment, and to provide corrective measures as required to mitigate adverse impacts.

Given the nature and extent of its operations, the Navy activities have involved toxic and hazardous materials for several decades. The DoD, as well as general industry, has realized that previously acceptable methods of disposal are no longer sufficient, and actions are being taken through these programs to clean up Navy sites that pose a threat to human health or the environment. Current Navy waste management operations are expected to comply with all federal, state, and Navy regulations to ensure safe operation and disposal of hazardous substances.

SJCA initiated its environmental investigation efforts by conducting an Initial Assessment Study (IAS) in 1981 (NEESA, 1981) followed by a Preliminary Assessment in 1983 (NUS Corporation, 1983) and Resource Conservation and Recovery Act Facility Assessment (RFA) in 1989 (A. T. Kearney, 1989). The RFA included a preliminary review of all available relevant documents and a Visual Site Inspection (VSI) that identified 34 Solid Waste Management Units (SWMUs) and 12 Areas of Concern (AOCs).

To assess whether SJCA should be proposed for the National Priorities List (NPL), the USEPA completed a Hazard Ranking System (HRS) evaluation in January 2000 (Tetra Tech, 2000). SJCA was assigned a score of 50 based on the potential for surface water migration. Those facilities with HRS scores exceeding 28.5 are proposed for the NPL. Therefore, on February 3, 2000, USEPA proposed that SJCA be added to the NPL. The proposed listing was followed by a minimum 60-day review and comment period prior to the inclusion of SJCA on the NPL on July 27, 2000.

The Federal Facility Agreement (FFA) (DoD, 2004), negotiated between the Navy, USEPA, and VDEQ, was signed in July 2004. In accordance with the FFA, all past and future work at IRP sites, SWMUs, and AOCs will be reviewed, and a course of action for future work requirements at each site will be developed. The FFA also includes specific requirements for the preparation and contents of the Site Management Plan (SMP).

Background soil and groundwater chemical concentrations were addressed for SJCA as part of the basewide *Final Background Investigation* (CH2M HILL, 2001) and *Final Background Investigation Report Addendum for Groundwater* (CH2M HILL, 2004b). The investigations' objective was to establish background concentrations of inorganics, pesticides, and polynuclear aromatic hydrocarbons in surface and subsurface soil and groundwater for use in comparison to IRP site data to better identify release-related constituents of concern (COCs). Background levels are due to naturally occurring (those chemicals expected at a site in the absence of human influence) or anthropogenic (chemicals present in the environment due to manmade, non-CERCLA-activity-related) sources.

The DoD established the Munitions Response Program (MRP) under the Defense ERP to address munitions and explosives of concern and munitions constituents at sites other than operational ranges. The DoD and the Navy are establishing policy and guidance for munitions and response actions under the MRP; however, the key program drivers developed to date conclude that munitions response actions will be conducted under the process outlined in the NCP, as authorized by CERCLA. Therefore, the SJCA ERP Partnering Team follows the CERCLA process to address MRP sites identified at SJCA.

Fifty-nine potentially contaminated IRP sites, MRP sites, SWMUs, and AOCs have been identified for evaluation at SJCA based on the assessments and investigations. Four sites (Site 2, Site 4, Site 5, and Site 21) are currently active in the IRP at SJCA; and no sites are currently active in the MRP at SJCA (**Figure 2-2**). Three of the currently active IRP sites have signed RODs and remedies in place that left hazardous substances, pollutants, or contaminants onsite above levels that would allow for UU/UE and are, therefore, included in this Five-Year Review (Site 2, Site 4, and Site 21). Fifty-five sites at SJCA have been determined to require no further action under the ERP by the SJCA

ER Partnering Team following desktop audits, site inspections, and/or removal actions (**Figure 2-3**). The status of all the ERP sites at SJCA at the time this report was drafted (October 2014) is presented in **Table 2-1**.

TABLE 2-1
Environmental Restoration Program Site Status Summary
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Site ID	Name/Description	EPA Operable Unit and Other IDs	Comments	Documentation of Closure or Response Complete
Installation Restoration Program Sites				
Site 2	Waste Disposal Area B	EPA: OU-2, Landfill B; Dump B; Dump B Incinerator; Dump B Blast Grit; RFA: SWMU 2, SWMU 3, SWMU 4; NIRIS: Site 00002 - Trash/Ash Fill Dump	Final Site 2 RI completed February 2004, Final Expanded RI completed November 2008, and Final Expanded RI revised January 2010. Final FS completed October 2009 and Final FS revised January 2010. PP completed July 2010 and ROD signed January 2011. Final RD completed in November 2011 and RD Addendum for St. Juliens Creek sediment finalized in January 2013. RA-construction initiated April 2012 and completed July 2014. RA-operation initiated July 2014, currently ongoing. First five-year review in progress.	
Site 4	Landfill D	EPA: OU-4; Dump D; Old Tanks at Dump D; RFA: SWMU 6, AOC L; NIRIS: Site 00004 - Sanitary Landfill Dump D	Final RI completed March 2003; Final FS completed March 2004; PP finalized June 2004; ROD signed September 2004, RD submitted November 2004; RA completed in October 2005; RA Completion Report signed October 2006. LUCs implemented, site inspections continuing annually. First five-year review completed FY 2010. Second five-year review in progress.	RA Completion Report (signed October 2006).
Site 5	Burning Grounds	EPA: OU-5; RFA: SWMU 8; NIRIS: Site 00005 - Waste Ord Burn Ground	Final RI completed March 2003; Final Expanded RI Report completed June 2006 recommending additional groundwater sampling. Final EE/CA for non-time-critical removal action of Waste/Burnt Soil Area completed February 2007. Final Expanded RI Addendum recommending NFA for groundwater completed December 2007. Removal action initiated December 2007 and completed July 2012. Final Confirmation Sampling Report and CCR completed in December 2012. Supplemental RI for shallow groundwater initiated 2013, currently ongoing.	
Site 21	Industrial Area	EPA: OU-12, Site 21 - Bldg 187; FFA: Site Staining at Building 187; NIRIS: Site 00021 - Heavy Soil Staining	Final SI completed June 2004; Draft Supplemental SI Report completed April 2006; RI finalized July 2008. Final FS completed February 2009. Interim PP completed July 2009 and Interim ROD signed May 2010. RD for groundwater completed May 2010. RI and FS Addendum for vapor intrusion completed October 2010. Interim RA-construction initiated November 2010 and completed May 2012. PP completed May 2011 and ROD signed October 2011. RA-operation initiated May 2012, currently ongoing. Final CCR completed September 2012. Final IRACR documenting RIP signed July 2013. RD Addendum completed March 2014. First five-year review in progress.	
Site 1	Waste Disposal Area A	Dump A; RFA: SWMU 1	Consensus for NFA by Navy, VDEQ, and EPA in November 2002 based on RRR data and September 2002 test pit information.	SSA Addendum (signed July 2004).
Site 3	Waste Disposal Area C	EPA: OU-3, Landfill C; Dump C; Dump C Waste Disposal Pits; RFA: SWMU 5, SWMU 30	Final RI completed March 2003; Final EECA/Action Memorandum completed August 2002; Phase I Removal conducted September 2002; Phase II Removal conducted 2004; Final Construction Closeout Report completed March 2003; PP finalized January 2005; NFA ROD signed February 2006.	Final NFA ROD (signed February 2006).
Site 4	Dumpster Storage at Landfill D	EPA: OU-4, Landfill D; Dumpster storage at Dump D; RFA: SWMU 7	RFA indicated that the dumpsters were no longer present.	Final ROD (signed September 2004).
Site 6	Small Arms Unit	EPA: OU-8, Caged Pit Disposal; Caged Pit; RFA: SWMU 24; FFA: Caged Pit at the Burning Grounds	Final RI completed March 2003; Final EE/CA and Action Memorandum completed August 2002; Removal Action completed September 2002; Final Close-Out Report in March 2003; PP finalized July 2003; NFA ROD signed September 2003.	NFA Final ROD (signed September 2003).
Site 7	Old Storage Yard	Old Storage Yard #1; RFA: SWMU 17	Consensus for NFA in July 2001 by Navy, VDEQ, and EPA pending debris removal. Debris removal was conducted FY 2002 and is documented in a construction removal document completed FY 2003.	FFA (signed July 2004).
Site 8	Cross and Mine	RFA: SWMU 9; FFA: PSA Site 8	Final SSA completed April 2002 recommending an SI to further investigate potential release to groundwater; Identified in the FFA as Preliminary Screening Area (FFA Appendix B) March 2004; Final SI completed June 2004 recommending NFA; Consensus for NFA by Navy, VDEQ, and EPA July 2004.	SI (signed July 2004).
Site 9	Pest. Control Bldg. 249	PA: SWMU 13	Removed/remediated during construction of the SIMA building (currently referred to as the Fleet and Industrial Supply Center [FISC], Norfolk Integrated Logistics Support building).	FFA (signed July 2004)
Site 9	Oil Water Separator at Bldg. 249	RFA: SWMU 23	Removed/remediated during construction of the SIMA building (currently referred to as the FISC, Norfolk Integrated Logistics Support building).	FFA (signed July 2004)
Site 9	Washrack Bldg. 249	RFA: SWMU 25	Removed/remediated during construction of the SIMA building (currently referred to as the FISC, Norfolk Integrated Logistics Support building).	FFA (signed July 2004)
Site 10	Waste Disposal at Railroad Tracks	Hazardous Waste Disposal Area at Bldg. 13 (Railroad Tracks); RFA: SWMU 14	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
Site 10	Swale beneath Bldg. 13	RFA: SWMU 31	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
Site 11	Waste Disposal at Building 53 (formerly referenced to Bldg. 266)	RFA: SWMU 15	Consensus by Navy, VDEQ, and EPA for NFA during a site visit in July 2001 for Site 11 and groundwater underlying site will be investigated as part of Site 21.	SSA (signed February 2002).
Site 12	Sand Blast Area Bldg. 323	RFA: SWMU 16	Removed/remediated during construction of the SIMA building (currently referred to as the FISC, Norfolk Integrated Logistics Support building).	FFA (signed July 2004)

TABLE 2-1
Environmental Restoration Program Site Status Summary
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Site ID	Name/Description	EPA Operable Unit and Other IDs	Comments	Documentation of Closure or Response Complete
Site 13	Waste Generation Area	RFA: SWMU 20	Removed/remediated during construction of the SIMA building (currently referred to as the FISC, Norfolk Integrated Logistics Support building).	FFA (signed July 2004)
Site 14	Washrack Bldg. 266	None	Removed/remediated during construction of the SIMA building (currently referred to as the FISC, Norfolk Integrated Logistics Support building).	FFA (signed July 2004)
Site 15	Fire Training Area	Fire Training Area at Bldg. 271; RFA - SWMU 27	Consensus by Navy, VDEQ, and EPA in July 2002 for NFA under CERCLA, as the site was to be investigated under the Navy's Underground Storage Tank (UST) Program. The site is currently managed under the Navy's Petroleum, Oil, and Lubricant Program.	FFA (signed July 2004).
Site 16	DRMO Storage/Salvage Yard	RFA: SWMU 28	While active, the DRMO does not fall under CERCLA and therefore, NFA under CERCLA consensus by Navy, VDEQ, and EPA in July 2002. Regional inspections are conducted for storm water management.	FFA (signed July 2004).
Site 17	Storage Pad at Building 279	Satellite storage at Bldg. 279; RFA: AOC A	The roof and walls of Building 278/279 were demolished in early 2003, the flooring and concrete pilings are still in place awaiting final removal. Final expanded SI submitted in September 2001. Based upon the proximity to Site 2, consensus in February 2003 by Navy, VDEQ, and EPA that further action related to Site 17 will be addressed as part of Site 2.	FFA (signed July 2004).
Site 18	Blasting Grit at Building 47	RFA: AOC C	During the July 2001 SJCA Partnering Team site visit, no blast grit was observed in several hand auger borings therefore, consensus for NFA was reached by Navy, VDEQ, and EPA.	SSA (signed February 2002).
Site 18	Air Compressor at Bldg. 47	RFA: AOC B	NFA consensus by Navy, VDEQ, and EPA in July 2002. Regional inspections are conducted for storm water management.	FFA (signed July 2004).
Site 19	Building 190	EPA: OU-7, Site 19 - Bldg 190 EE/CA; Residual Ordnance at Bldg. M-5 & 190; RFA: AOC H; FFA: Wharf Area Building 190	Final SI submitted in June 2004 recommending Supplemental SI to further investigate soil and groundwater; Final Supplemental SI submitted in September 2005 recommending EE/CA for a soil hotspot NTCRA; Final EE/CA for NTCRA submitted in November 2005; Final Action Memorandum signed in January 2006; NTCRA conducted in May 2006; Final Site Closeout Report signed December 2006.	Site Closeout Report (signed December 2006).
Site 20	Wharf Area Sediments	Residual Ordnance at wharf area; RFA: AOC I; Site 20	During the July 2001 site visit, the Navy, VDEQ and EPA reached consensus for NFA under CERCLA, as the site was to be managed under the MR Program. The site is currently managed under the MR Program as part of Area UXO 1.	SSA (signed February 2002).
SWMU 10	Hazardous Waste Container Storage Bldg. 154Y	None	Recommended for NFA in the RFA as SWMU 10 was assigned to RCRA Program as a >90 day storage bunker. Consensus by Navy, VDEQ, and EPA for NFA under CERCLA in July 2002, as SWMU 10 was managed under RCRA. SWMU 10 has been closed under RCRA.	FFA (signed July 2004).
SWMU 11	Hazardous Waste Container Storage Bldg. 163Y	None	Recommended for NFA in the RFA as SWMU 11 was assigned to RCRA Program as a >90 day storage bunker. Consensus by Navy, VDEQ, and EPA for NFA under CERCLA in July 2002, as SWMU 11 was managed under RCRA. SWMU 11 has been closed under RCRA.	FFA (signed July 2004).
SWMU 12	PCB Storage Bldg. 198	None	Recommended for NFA in the RFA. SWMU 12 was used as a storage facility and managed under Toxic Substances Control Act therefore, consensus by Navy, VDEQ, and EPA for NFA under CERCLA in July 2002. PCBs are no longer stored at SWMU 12 and SWMU 12 has been closed under TSCA.	FFA (signed July 2004).
SWMU 18	Old Storage Yard # 2	None	Recommended for NFA in the RFA. Currently in operation and Regional inspections are conducted for storm water management. Consensus by Navy, VDEQ, and EPA for NFA under CERCLA.	FFA (signed July 2004).
SWMU 19	Old Storage Yard # 3	None	RFA recommended action for better management practice. A site visit was performed in November 2002 by Navy, VDEQ, and EPA to confirm status and consensus for NFA under CERCLA was reached.	FFA (signed July 2004).
SWMU 21	Hazardous Waste Accumulation Area (SIMA # 2)	None	The RFA recommended NFA as the SWMU was managed under RCRA. A site visit was performed in November 2002 by Navy, VDEQ, and EPA to confirm status and consensus for NFA under CERCLA was reached, as the SWMU was remediated during a removal action conducted as part of the SIMA building (currently referred to as the FISC, Norfolk Integrated Logistics Support building) construction. The Navy submitted a closure notification letter to VDEQ for SWMU 21.	FFA (signed July 2004).
SWMU 22	Repair Shop Satellite Storage Area NE of Bldg. 40	None	The RFA recommended NFA as the SWMU was managed under a VDEQ program. A site visit was performed in November 2002 by Navy, VDEQ, and EPA to confirm status and consensus for NFA under CERCLA was reached. The Navy submitted a closure notification letter to VDEQ for SWMU 22.	FFA (signed July 2004).
SWMU 26	Scrap Metal Storage in Railroad Cars near Bldg. 176	None	Based on a site visit in November 2002, NFA consensus was reached by Navy, VDEQ, and EPA, as the SWMU was managed according to Virginia Solid Waste Management regulations. SWMU 26 is no longer present.	FFA (signed July 2004).
SWMU 29	Dumpsters (throughout the facility)	None	Based on a site visit in November 2002, NFA consensus was reached by Navy, VDEQ, and EPA, as the SWMU is managed according to Virginia Solid Waste Management regulations.	FFA (signed July 2004).
SWMU 32	Overland Drainage Ditches	None	Navy, VDEQ, and EPA reached consensus for NFA under CERCLA, as drainage ditches associated with individual sites, AOCs, or SWMUs will be investigated on a site-specific basis. Site-specific investigations will identify the exact boundaries of the drainage ditch and samples will be collected at all locations where there is either visible evidence of release or suspicion that past releases may have occurred.	FFA (signed July 2004).
SWMU 33	Sewer Drainage System	None	Navy, VDEQ, and EPA reached consensus for NFA under CERCLA, as the sewer drainage system associated with individual sites, AOCs, or SWMUs will be investigated on a site-specific basis. Site-specific investigations will include evaluating the integrity of the subsurface system and may include soil sampling to determine if hazardous constituents have been released.	FFA (signed July 2004).

TABLE 2-1
Environmental Restoration Program Site Status Summary
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Site ID	Name/Description	EPA Operable Unit and Other IDs	Comments	Documentation of Closure or Response Complete
SWMU 34	Operational Waste Accumulation Areas	None	Based on a site visit in November 2002, NFA consensus was reached by Navy, VDEQ, and EPA, as the SWMU is managed under RCRA.	FFA (signed July 2004).
AOC D	Storm Water Outfalls	None	Navy, VDEQ, and EPA reached consensus for NFA under CERCLA, as the storm water outfalls will be investigated under CERCLA on a site-specific basis. Site-specific investigations may include sampling various outfalls to determine whether there has been a release of hazardous constituents.	FFA (signed July 2004).
AOC E	Temporary Pump Storage	None	AOC E was remediated during a removal action conducted as part of the SIMA building (currently referred to as the FISC, Norfolk Integrated Logistics Support building) construction. Therefore, the SJCA Partnering Team reached consensus for NFA for AOC E based on the removal action.	FFA (signed July 2004).
AOC F	Underground Storage Tanks	None	Navy, VDEQ, and EPA reached consensus for NFA under CERCLA in July 2002, as AOC F was managed under the Navy's UST Program. The USTs have been closed under the Navy's UST Program.	FFA (signed July 2004).
AOC G	Former Process Buildings	None	Navy, VDEQ, and EPA reached consensus for NFA under CERCLA in July 2002 however, as new information becomes available on the locations and processes conducted at former process buildings, the SJCA Partnering Team will determine if new AOCs should be added. Any former process buildings identified for further evaluation will be evaluated on a site-specific basis.	FFA (signed July 2004).
AOC J	Former Ammunition Manufacturing Areas	None	Navy, VDEQ, and EPA reached consensus for NFA under CERCLA, however, as new information becomes available on the manufacturing areas, the SJCA Partnering Team will determine if new AOCs should be added. Any former ammunition manufacturing areas identified for further evaluation will be evaluated on a site-specific basis.	FFA (signed July 2004).
AOC K	Former Sewage Treatment Plant	FFA: SSA AOC K	Identified in the FFA as Site Screening Area (FFA Appendix A) March 2004; Final SSA completed June 2004 recommending NFA; Consensus for NFA by Navy, VDEQ, and EPA July 2004.	SSA Addendum (signed July 2004).
EPIC AOC 1	E Street and Marsh Road Ground Scarring	AOC 1; FFA: PSA AOC 1	Final SSA completed April 2002 recommending an SI to further investigate soil; Identified in the FFA as Preliminary Screening Area (FFA Appendix B) March 2004; Final SI completed June 2004 recommending NFA; Consensus for NFA by Navy, VDEQ, and EPA July 2004.	SI (signed July 2004).
EPIC AOC 2	Piers in front of Building 83	AOC 2	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 3	Ground Scarring at Building M5	AOC 3	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 4	Parking Area South of Building M-1	AOC 4	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 5	Possible Soil Staining Between Buildings 87 and 88	AOC 5	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 6	Ground Scarring East of Site 2	AOC 6	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 7	City of Portsmouth Outgrant Area	AOC 7	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 8	Possible Waste Disposal/Bulk Storage Area	AOC 8	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 9	Ground Scarring Southwest of Building 75	AOC 9	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 10	Ground Scarring in Wharf Area	AOC 10	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 11	Open Storage Area Northeast of Building 55	AOC 11	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
EPIC AOC 12	Sandy Flat	AOC 12	NFA consensus by Navy, VDEQ, and EPA during a site visit in July 2001.	SSA (signed February 2002).
AOC 13	Pentachlorophenol Dip Tank	AOC 13; FFA: SSA AOC 13	Identified in the FFA as Site Screening Area (FFA Appendix A) March 2004; Final SSA completed June 2004 recommending NFA; Consensus for NFA by Navy, VDEQ, and EPA July 2004.	SSA Addendum (signed July 2004).
AOC 14	Building 89	AOC 14; FFA: SSA AOC 14	Identified in the FFA as Site Screening Area (FFA Appendix A) March 2004; Final SSA completed June 2004 recommending NFA; Consensus for NFA by Navy, VDEQ, and EPA July 2004.	SSA Addendum (signed July 2004).
Munitions Response Program Sites				
Area UXO 1	Wharf Area Sediments	Residual Ordnance at wharf area; RFA: AOC I; Site 20	PA completed June 2009 and SI completed September 2010. Expanded SI, documenting NFA, signed in June 2013.	Final Expanded SI Report (signed June 2013).

TABLE 2-1

Environmental Restoration Program Site Status Summary

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Site ID	Name/Description	EPA Operable Unit and Other IDs	Comments	Documentation of Closure or Response Complete

Notes:

Site Status: RC - LUCs in place

Site Status: RI/FS

Site Status: RD/RA - LUCs in place

Site Status: RC - NFA

RFA - RCRA Facility Assessment

AOC - Area of Concern

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

DRMO - Defense Reutilization and Marketing Office

EE/CA - Engineering Evaluation and Cost Analysis

EPA - Environmental Protection Agency

EPIC - Environmental Photographic Interpretation Center

FFA - Federal Facility Agreement

FISC - Fleet and Industrial Supply Center

FS - Feasibility Study

FY - Fiscal Year

LUC - land use control

NFA - no further action

OU - Operable Unit

PA - Preliminary Assessment

PP - Proposed Plan

PSA - Preliminary Screening Area

RA - Remedial Action

RC - Response Complete

RCRA - Resource Conservation and Recovery Act

RD - Remedial Design

RI - Remedial Investigation

RIP - Remedy-in-Place

ROD - Record of Decision

SI - Site Inspection

SIMA - Shore Intermediate Maintenance Activity

SJCA - St. Juliens Creek Annex

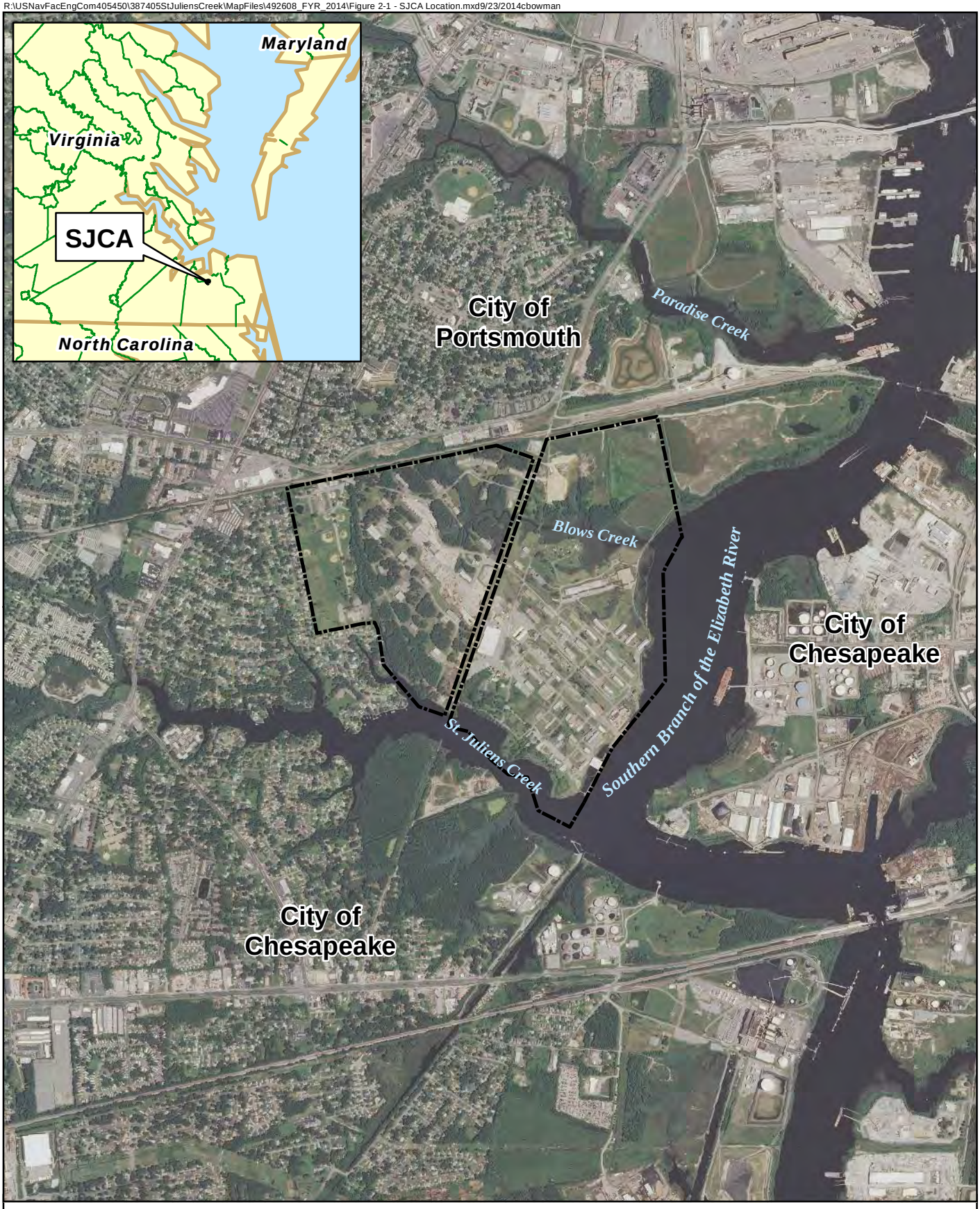
SSA - Site Screening Assessment

SWMU - Solid Waste Management Unit

UST - underground storage tank

VDEQ - Virginia Department of Environmental Quality

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 2-1 - SJCA Location.mxd9/23/2014cbowman



Legend

St. Juliens Creek Annex Boundary

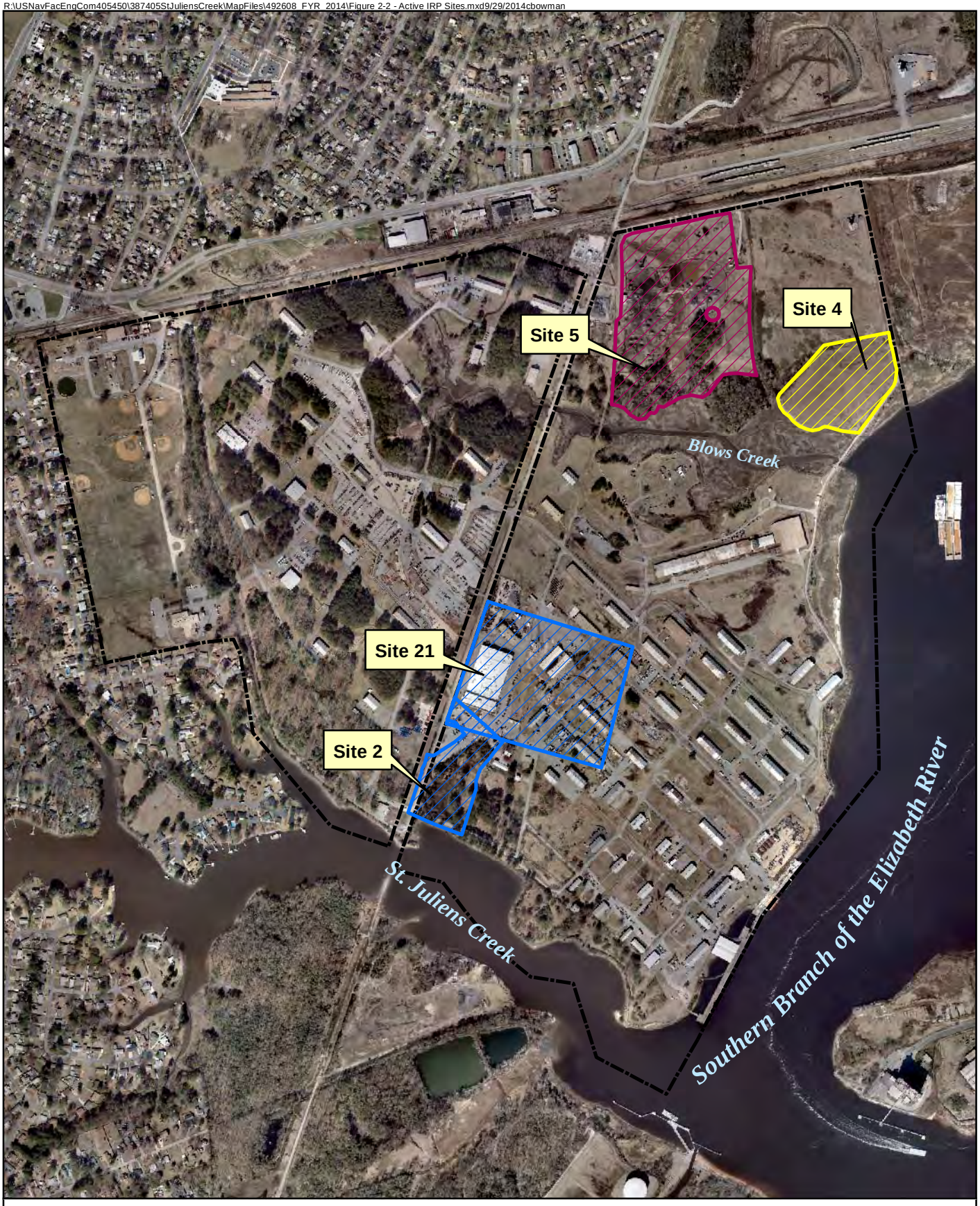
N
W E
S

0 1,000 2,000 Feet

Figure 2-1
Location of St. Juliens Creek Annex
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 2-2 - Active IRP Sites.mxd9/29/2014cbowman



Legend

- St. Juliens Creek Annex Boundary
- Response Complete Site with Land Use Controls
- Remedial Investigation/Feasibility Study Site
- Remedial Design/Remedial Action with Land Use Controls

N
W E
S

0 450 900
Feet

Figure 2-2
Location of Active Environmental Restoration Program Sites
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 2-3 - No Further Action Sites.mxd8/29/2014cbowman

Legend

- St. Juliens Creek Annex Boundary
- Response Complete - No Further Action Site

N
W E
S

0 450 900
Feet

Figure 2-3
Location of No Further Action Sites, Solid Waste Management Units, and Areas of Concern
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 3

Five-Year Review Process

The process used to complete this Five-Year Review is described in this section.

3.1 Administrative Component

The SJCA Five-Year Review team was led by Ms. Krista Parra (NAVFAC Mid-Atlantic) and comprises representatives from USEPA Region 3 (Mr. Robert Stroud) and VDEQ (Ms. Karen Doran). Assistance with the Five-Year Review process was provided by the Navy's CLEAN contractor, CH2M HILL.

The members of the team were notified of the initiation of this Five-Year Review in March 2014.

3.2 Community Involvement

The community was informed of the initiation of this Five-Year Review during the May 28, 2014, Restoration Advisory Board meeting and through a public notice placed in *The Virginian-Pilot* on July 13, 2014. Interviews were conducted with stakeholders and questionnaires were mailed to community members to obtain feedback on the remedies. The interviews and questionnaires are further discussed in Subsection 3.6. The community will be notified of the completion of this review and the signed report will be made available in the information repository.

3.3 Document Review

Documents concerning the response actions for the sites were reviewed to help assess remedy performance and continued protection of human health and the environment. In addition to site-specific documentation review, a review of current state and federal regulations was completed to ensure requirements have not changed following implementation of the RA and the five-year review is conducted using the most recent guidance and regulations. The documents reviewed for each site are provided in **Appendix A**.

3.4 Data Review

Data, including relevant trends and levels, were reviewed to help assess remedy performance and continued protection of human health and the environment.

3.5 Site Inspections

Site Inspections for the Five-Year Review were conducted on July 31, 2014; with representatives of the Navy, USEPA, VDEQ, and CH2M HILL. The inspections were conducted to assess current conditions relevant to the protectiveness of the remedies. The inspection checklist provided in the *Comprehensive Five-Year Review Guidance* was used to conduct the inspections.

3.6 Interviews

Concurrent with this Five-Year Review, an update to the Community Involvement Plan (CIP) for SJCA was initiated. Stakeholders were contacted in order to obtain their feedback about the ERP at SJCA. Seven written questionnaires were returned from those mailed to randomly-selected residents located within approximately 0.5 miles of SJCA. Nine interviews were conducted with a variety of stakeholders, consisting of a city representative, representatives of an environmental organization, a local civic league representative, a former businessman and elected city official who now works in community development, local residents (some of whom are also restoration advisory board members), and a base employee. Specific questions related to the Five-Year Review were included in the questionnaire and interview questions. The questionnaire and interview questions and their responses are presented in the CIP (CH2M HILL, 2014).

SECTION 4

Site 2—Waste Disposal Area B

This section presents background information and the Five-Year Review evaluation for Site 2.

4.1 Site Chronology and Background

The following is a chronology of the major events for Site 2.

Date	Event
1921 through 1947	Mixed municipal wastes, organics, inorganics, solvents, waste ordnance, and abrasive blast materials disposed of. Initially refuse burned openly onsite and used to fill in the adjacent swampy area (Site 2 inlet). An incinerator was installed in 1942 to replace the open burning.
August 1981	IAS completed
1983	Preliminary Assessment (PA) completed
March 1989	Phase II RFA completed
February 1995	Environmental Photographic Interpretation Center (EPIC) Study and Regulatory Review completed
April 1996	Relative Risk Ranking (RRR) System Data Collection Report completed
January 2000	Hazard Ranking System Documentation Record completed
July 2000	SJCA placed on NPL
September 2001	Site 17 Expanded Site Inspection (SI) completed
February 2004	RI completed
July 2004	Federal Facility Agreement (FFA) signed
November 2008	Expanded RI completed (revised January 2010)
October 2009	Feasibility Study (FS) completed (revised January 2010)
July 2010	Proposed Plan completed
January 2011	ROD signed
March 2011	Remedial Design (RD) for land use controls (LUCs) remedy component completed
November 2011	RD for soil cover, enhanced reductive dechlorination (ERD), and monitored natural attenuation (MNA) remedy components completed
April 2012	RA initiated
January 2013	RD Addendum for St. Juliens Creek sediment excavation remedy component completed
July 2014	RA-construction completed and RA-operation initiated

4.1.1 Physical Characteristics

Site 2 is located in the southern portion of SJCA (**Figure 4-1**). Currently the site consists of a landfill with a vegetated soil cover and an asphalt parking lot that contains several mowed grassy areas (**Figure 4-1**). Prior to implementation of the RA, an inlet was located in the center of the site (**Figure 4-1**). The inlet was surrounded by brush, trees, and grass, and directly connected to St. Juliens Creek through a culvert. The Site 2 inlet was filled in during implementation of the selected remedy.

The Columbia aquifer at Site 2 begins at 3 to 7 feet below ground surface (bgs) and extends to approximately 15 to 25 feet bgs and averages approximately 15 feet thick. The aquifer consists predominantly of silty, fine to coarse sands with some clay. The Yorktown aquifer is predominantly sandy and typically encountered at an average depth of 50 feet bgs. The Yorktown confining unit separating the aquifers is approximately 30-feet thick

and consists of a series of interbedded clay and fine sand layers overlying a clay layer. The Yorktown confining unit is continuous across the base and impedes the downward migration of Columbia aquifer groundwater to the Yorktown aquifer. Columbia aquifer groundwater historically followed the topography and flowed towards the Site 2 inlet and St. Juliens Creek. However, the flow direction has changed as a result of filling in the inlet and constructing an extended enhanced detention basin west of the site, and is now flowing predominately southwest (**Figure 4-1**).

4.1.2 Land and Resource Use

Currently, Site 2 is maintained as a controlled closed landfill with a vegetated soil cover. Although groundwater is not currently used as a potable water supply at or in the vicinity of SJCA (**Section 2.1**), the Navy acknowledges the Commonwealth of Virginia's and USEPA's expectation to return usable groundwaters to their beneficial uses wherever practicable. Groundwater use, building construction, and excavation activities within the LUC boundaries at the site are controlled through site signs and notation in the Internet Navy Facility Assets Data Store (iNFADS) maintained by Commander Naval Region Mid-Atlantic. Additionally, the annually-updated SMP for SJCA includes maps and geographic information system (GIS) layers that depict the LUCs at the site.

Anticipated future land use for the site is to remain as a controlled closed landfill.

4.1.3 History of Contamination

Site 2, initially referred to as Dump B, was used for the disposal of mixed municipal wastes, abrasive blast material, waste ordnance, organics (including solvents), and inorganics. Operations began in 1921 and continued until sometime after 1947. Initially, refuse was burned openly onsite and was used to fill in the swampy area of the site (Site 2 inlet). An incinerator was installed in 1943 to replace open burning practices. Additionally, historic reports indicate that prior to the 1930s ordnance may have been disposed of in Dump B. The total volume of waste accumulated is estimated to be 50,000 cubic yards (yd^3). Due to its proximity, former IRP Site 17 (**Figure 4-1**), initially identified as AOC A (Satellite Storage at Building 279) was incorporated into the Site 2 boundary in 2004. Site 17 was used for lead battery maintenance after 1954. Waste acid electrolyte was collected in containers and transported off base for disposal. Documentation of the site visit conducted for the RFA indicated a concrete storage pad was used to store two 55-gallon drums of PD-680, a commercial product used as a degreaser. Stains on the ground near the pad, as well as indications of poor management (overflowing catch bucket under drum spigot) were also noted.

4.1.4 Initial Response

No environmental cleanup activities occurred before the signature of the ROD in January 2011 (NAVFAC, 2011a).

4.1.5 Basis for Remedial Action

A Human Health Risk Assessment (HHRA) was conducted as part of the Expanded RI (CH2M HILL, 2008b) to evaluate risks from exposure to site media under current and potential future land use scenarios, as follows:

- Current/future adult/adolescent trespassers/visitor exposed to surface soil (ingestion, dermal contact, and inhalation of fugitive dust), sediment (ingestion and dermal contact), surface water (ingestion and dermal contact)
- Current adult landscaper exposed to surface soil (ingestion, dermal contact, and inhalation of fugitive dust)
- Future construction worker exposed to combined surface and subsurface soil (ingestion, dermal contact, and inhalation of fugitive dust) and shallow groundwater (dermal contact and inhalation of volatile emissions)
- Future industrial worker exposed to combined surface and subsurface soil (ingestion, dermal contact, and inhalation of fugitive dust) and shallow groundwater (inhalation of volatile emissions in indoor air)
- Future adult/child resident exposed to combined surface and subsurface soil (ingestion, dermal contact, and inhalation of fugitive dust), sediment (ingestion and dermal contact), surface water (ingestion and dermal contact), shallow and deep groundwater (ingestion, dermal contact, inhalation of volatile emissions while showering [adult only], and inhalation of volatile emissions in indoor air)

An Ecological Risk Assessment (ERA) (Steps 1 through 7 of the ERA process) was conducted as part of the Expanded RI (CH2M HILL, 2008b) to evaluate potential risks to ecological receptors through direct exposure to surface soil, sediment (including sediment pore water), and surface water; and exposure via the food web. Exposure to groundwater was not assessed because there is no complete pathway for ecological receptors.

Based on the evaluation of the HHRA and ERA and subsequent risk management decisions that were made, it was determined that exposure to waste and volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and/or inorganics in soil, shallow groundwater, sediment, and/or surface water at Site 2 posed an unacceptable risk to human health and/or the environment. The COCs requiring a response action for each media are summarized on **Table 4-1**. Based on the elevated VOC concentrations detected in the shallow groundwater, it was assumed that vapor intrusion from the shallow groundwater into indoor air would pose unacceptable risks to future residents and industrial workers. No unacceptable risks from exposure to deep groundwater were identified.

4.2 Remedial Actions

4.2.1 Remedy Selection

A ROD documenting the selected remedy for Site 2 was signed in January 2011 (NAVFAC, 2011a). The selected remedy consists of the following components:

- Cover installation over waste, soil, and inlet sediment
- Excavation of St. Juliens Creek sediment
- ERD within target areas of shallow aquifer groundwater
- MNA within target areas of shallow aquifer groundwater
- LUCs

Additionally, a permeable reactive barrier (PRB) was developed as a contingency measure for potential addition to the selected remedy to prevent offsite migration of shallow aquifer groundwater COCs.

The following RA objectives (RAOs) were established for the selected remedy:

- Waste, soil, and sediment (including sediment pore water):
  - Prevent direct media contact with human and ecological receptors at concentrations that pose unacceptable risks
  - Prevent migration of contaminants through surface water runoff and erosion pathways
  - Prevent or minimize transport of COCs from waste to site media, including groundwater
- Shallow aquifer groundwater:
  - Reduce contaminant source mass to the maximum extent practicable
  - Prevent activities that might cause migration of COCs in the shallow aquifer to the underlying Yorktown (deep) aquifer
  - Prevent migration of COCs from shallow aquifer groundwater to surface water and sediment
  - Reduce COC concentrations in shallow aquifer groundwater to the maximum extent practicable
  - Prevent human exposure to COCs present in shallow aquifer groundwater at concentrations that pose unacceptable risks
- Surface Water:
  - Minimize degradation of surface water through source control in shallow aquifer groundwater, waste, surface soil, and sediment

Cleanup levels were established for the COCs as the preliminary remediation goals (PRGs) developed in the FS. In instances where both a human health and ecological PRG were developed, the cleanup level was established as the more conservative value. To achieve the RAOs and comply with the Commonwealth of Virginia's and USEPA's expectations to return usable groundwaters to their beneficial uses wherever practicable, the groundwater cleanup levels were established as the Maximum Contaminant Levels (MCLs) after consideration of the total risks/hazards associated with their use for all COCs but naphthalene, which does not have a MCL. Cleanup levels and their basis are identified in **Table 4-2**.

Unacceptable risks, RAOs, remedy components, performance standards, and expected outcomes for evaluating the overall performance of the remedy as documented in the ROD are summarized in **Table 4-3.**

The following LUC objective for the waste, soil, and inlet sediment at Site 2 was identified in the ROD:

- Prohibit digging into or disturbing the soil cover, disposal area contents, and/or contaminated soil and inlet sediment

The following LUC objectives for the shallow aquifer groundwater at Site 2 were identified in the ROD:

- Prohibit activities that would result in contact with shallow groundwater except for environmental monitoring;
- Prohibit the withdrawal of shallow groundwater except for environmental monitoring;
- Prohibit construction of new buildings at the site without evaluation of potential vapor intrusion and/or ensuring vapor intrusion mitigation measures are included in building design;
- Prohibit intrusive activities that would compromise the integrity of the Yorktown confining unit; and
- Maintain the integrity of any current or future remedial or monitoring system.

Waste, soil, and inlet sediment LUCs will be implemented within the waste boundary as long as waste remains in place and/or soil and inlet sediment COC concentrations remain above cleanup levels. Shallow groundwater LUCs will be implemented within the shallow groundwater LUC boundary indefinitely, or until site conditions allow for UU/UE.

4.2.2 Remedy Implementation

The RDs for the soil cover, ERD, MNA, and LUC components of the Selected Remedy were completed in 2011 (CH2M HILL, 2011; NAVFAC, 2011b). The RD Addendum for the St. Juliens Creek sediment excavation component of the Selected Remedy was completed in 2013 (CH2M HILL, 2013).

The RA was initiated in April 2012 and construction was completed in July 2014. The RA components are shown in **Figure 4-2**. The RA-Construction consisted of the following activities:

- Demolition of existing building foundation and surface debris with consolidation of inert debris under the landfill cover and offsite disposal of all other debris.
- Compensatory wetland mitigation at former IRP Site 19 for permanent impacts to 0.934 acres of the wetland area within Site 2. The mitigation was conducted in accordance with the *Compensatory Mitigation Plan for St. Juliens Creek Annex Site 2, Chesapeake, Virginia* (CH2M HILL, 2011).
- Modification of the existing storm water and drainage system so that the drainage was rerouted around the site.
- Installation of a minimum 2-foot soil cover graded to a minimum of 2 percent slopes to promote drainage and reduce infiltration.
- Removal of sediment to the hard pan within the sediment remediation area in St. Juliens Creek. The horizontal extent of the excavation was determined by existing locations with COC concentrations below the cleanup levels developed in the ROD and by the physical location of the culvert. The vertical extent of the excavation was determined by pre-excavation confirmation samples which were collected and analyzed for

the COCs identified in the ROD and compared to the sediment cleanup levels established in the ROD (NAVFAC, 2011a).

- Implementation of ERD through injection of emulsified vegetable oil (EVO) into target areas of the shallow aquifer groundwater
- Installation of signs around the perimeter of the landfill indicating the presence of buried waste and land use restrictions.
- Documentation of the restrictions for groundwater use, building construction, and excavation activities within the LUC boundaries at the site in the iNFADS maintained by Commander Naval Region Mid-Atlantic and the annually-updated SMP for SJCA.

During the construction phase of the RA, the following minor modifications to the RD were implemented:

- Extension of the cover
- Revision of some of the LUC boundaries and LUC objectives, and the LUC remedy component

The minor modifications were documented in a ROD Memorandum to File (CH2M HILL, 2014c) and a LUC RD revision (underway at the time this report was being drafted, October 2014). As a result of the changes in the LUC boundaries, the LUC objectives provided in the ROD (NAVFAC, 2011a) and LUC RD (NAVFAC, 2011b) were revised to reflect the varying conditions within the expanded boundary and allow necessary base operations within Site 2 to be completed. The following LUC objectives for the waste, soil, and inlet sediment at Site 2 were identified in the ROD Memorandum to File:

- Historical Inlet Disposal Area: Prohibit digging into the cover, disposal area contents, and/or contaminated soil and sediment except as required for RA-Operation and maintenance with the application of controls to prevent uncontrolled exposure to waste and contaminants in soil and inlet sediment that pose an unacceptable risk.
- Historical Parking Lot Disposal Area: Prohibit digging into the cover, disposal area contents, and/or contaminated soil and sediment except as required for RA-Operation and maintenance and/or facility operation and maintenance with the application of controls to prevent uncontrolled exposure to waste and contaminants in soil and inlet sediment that pose an unacceptable risk.

4.2.3 Remedy Operation and Maintenance

The RA is currently in the RA-Operation phase (initiated in July 2014). The RA-Operation phase includes groundwater monitoring to evaluate remedy effectiveness, compensatory mitigation wetland monitoring to ensure the mitigation has been successful, maintenance of LUCs, and additional injections and installation of a PRB, if needed. The RA-Operation phase groundwater monitoring is currently being conducted semiannually; however, the frequency may be adjusted as the RA progresses. The first RA-Operation phase groundwater monitoring event was conducted in September 2014; the data were not available for review at the time this report was being drafted (October 2014). Monitoring of the compensatory mitigation wetland had not occurred at the time this report was being drafted. LUC inspections are being conducted annually to verify LUCs are maintained. The findings from the inspections will be documented in annual letter reports that will be submitted to the regulatory stakeholders. The first LUC inspection had not occurred at the time this report was being drafted (October 2014).

A comparison of the actual operation and maintenance costs to the estimated costs is not provided because the RA-Operation phase was initiated less than a year from the time this report was being drafted (October 2014).

4.3 Progress since Last Five-Year Review

The ROD was signed in January 2011 and this is the first Five-Year Review for Site 2.

4.4 Five-Year Review Process

4.4.1 Document Review

Appendix A includes a list of the documents associated with Site 2 that were reviewed. The RAOs, cleanup levels, and applicable or relevant and appropriate requirement (ARARs) are documented in the ROD for Site 2 (NAVFAC, 2011a).

4.4.2 Data Review

No data other than the data presented in the documents included in **Appendix A** were reviewed. The results of the first RA-Operation groundwater monitoring event were not available for review at the time this report was being drafted (October 2014).

4.4.3 Site Inspection

No significant issues were identified during the Five-Year Review site inspection. The signs were up to date and in good condition. The groundwater monitoring wells were in good condition, although the well casings were missing well identification labels. The missing well identification labels were added following the inspection. The soil cover was bare of vegetation in the southern extent; however, there were plans to seed that area after completion of the injections. The area was seeded following the inspections. No low-lying areas, or signs of erosion were observed. No signs of unauthorized intrusive activities, investigation-derived waste (IDW) storage, dumping, or building construction within the site were observed. The completed site inspection checklist is provided in **Appendix B**.

4.4.4 Interviews

No significant or specific problems or concerns regarding the site or the remedy were identified during the interviews or in the questionnaire responses. The responses indicated that the more awareness a respondent had of the RA, the more confident they were that it is protective of human health and the environment. The interviews and questionnaire results are further discussed in the CIP (CH2M HILL, 2014d).

4.5 Technical Assessment

Question A: Is the remedy functioning as intended by the decision document?

The components of the remedy to address waste, soil, and inlet sediment are functioning as intended in the ROD and the ROD Memorandum to File. The components of the remedy to address shallow aquifer groundwater have been installed as intended in the ROD. Data was not available at the time this report was being drafted (October 2014) to assess the functionality of the components of the remedy to address shallow aquifer groundwater.

Remedial Action Performance

The components of the remedy to address waste, soil, and inlet sediment are operating and functioning in accordance with the RD. The soil cover was installed in accordance with the RD, as documented by the as-built in the Construction Closeout Report (CCR) (CB&I, 2014). The injection wells were also installed in accordance with the RD. The layout of the injection wells in the as-built in the CCR varies from what was presented in the RD; however, the RD noted anticipated changes in the groundwater flow direction, specified water level monitoring to verify the groundwater flow direction after the cover was installed, and included a provision to adjust the number, locations, and depths of injection wells. The layout of the injection wells in the as-built in the CCR is appropriate for the current groundwater flow patterns and consistent with the RD. The LUCs for all impacted media have been implemented in accordance with the LUC RD and the ongoing revision to the LUC RD. Data was not available at the time this report was being drafted (October 2014) to assess whether the components of the remedy to address contamination shallow aquifer groundwater, other than the LUCs, are operating and functioning in accordance with the RD.

Operation and Maintenance Activities

Whether the monitoring well network is appropriate for monitoring the remedy effectiveness and identifying potential concerns cannot be evaluated at this time because data from the wells are not available. The need for

maintenance of the compensatory mitigation wetland is not known because monitoring has not been conducted and reported.

Variances in the actual operation and maintenance costs from the estimated costs are not known, as the RA-Operation phase was initiated in July 2014 and actual costs were not available at the time this report was being drafted (October 2014).

Opportunities for Optimization

Due to the limited amount of time that the operation and maintenance activities have been occurring, no opportunities for optimization have been identified.

Early Indicators of Potential Issues

No early indicators of potential issues have been identified.

Implementation of ICs and Other Measures

LUCs have been implemented in accordance with the LUC RD. The first annual LUC inspection had not been conducted at the time this report was being drafted (October 2014). However, the Five-Year Review inspection confirmed that the signs are in place and have the correct contact information. Additionally, the LUCs and associated boundaries have been added to the iNFADS maintained by Commander Naval Region Mid-Atlantic and the current SMP for SJCA (CH2M HILL, 2014a).

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection are still valid. However, the potential for the presence of particular emerging contaminants, which have not been investigated at the site, has been identified.

Changes in Standards and TBCs

No changes in standards or items to be considered (TBCs) that adversely affect the protectiveness of the remedy were identified during this Five-Year Review.

Changes in Exposure Pathways

There have not been any changes in the land use at the site. No new routes of exposure or receptors have been identified. There is no indication that physical site conditions (such as hydrologic or hydrogeologic conditions) have changed in a way that could affect the protectiveness of the remedy.

In order to assess whether any of the common emerging contaminants could be present at the site and warrant investigation if they were not previously investigated and not addressed by the Selected Remedy, the site history and data were evaluated to assess the potential for those contaminants. The evaluation process is provided as **Appendix C**. Based on this evaluation, perfluorinated chemicals (PFCs) were not analyzed for and are not expected to be present at the site and dioxins/furans were not detected at concentrations that pose a risk. Because 1,4-dioxane and perchlorate have not been sampled for and their presence cannot be ruled out based on site history, they are recommended for investigation.

Changes in Toxicity and Other Contaminant Characteristics

The human health toxicity values for one of the soil COCs, vanadium, and one of the sediment COCs, chromium, have changed since the ROD was signed. However, the cleanup goals for those COCs are based on SJCA background upper tolerance limits (UTLs); therefore, the changes in those toxicity values do not affect the cleanup goals or protectiveness of the remedy. The cleanup goals for all except one of the groundwater COCs, naphthalene, are the federal MCLs, which have not changed since the ROD was signed. There have been no changes in human health toxicity values for naphthalene since the ROD was signed. However, the cleanup goal for naphthalene in groundwater that was identified in the ROD is not protective of potential future use and should be corrected.

None of the ecological toxicity values for soils or sediments have changed significantly since the ROD was signed. There have been some changes to the values recommended by the USEPA Region III Biological Assistance Technical Group (BTAG) for the initial screening of several chemicals in sediment since the completion of the . creenin co oi ca Ris Assessment (USEPA, 2014). However, these changes would not affect the final BERA conclusions and would not affect the cleanup goals or protectiveness of the remedy selected in the ROD. The remedy addressed the potential for risk from exposure to inlet sediment through the installation of a soil cover, thus eliminating any potential exposure of ecological receptors to that sediment.

Although there have been some changes in toxicity values of some of the COCs, these changes would not affect the protectiveness of the selected remedy.

Changes in Risk Assessment Methodologies

There have been no significant changes in standardized HHRA methodologies that could affect the protectiveness of the remedy for the exposure scenarios since the ROD was signed in 2011. Although the standard exposure factors used to estimate human health risks were updated in 2014, the changes were not significant enough to result in changes to the protectiveness of the remedy.

There have been no significant changes in ERA methodologies that could affect the protectiveness of the remedy for ecological receptors at this site since the ROD was signed in 2011.

Expected Progress Towards Meeting RAOs

The remedy has achieved the RAOs established to address waste, soil, and sediment through installation of the cover and implementation of the LUCs. The progress towards meeting the RAOs for groundwater cannot be adequately assessed because the results of the data from the first RA-Operation groundwater monitoring were not available at the time this report was being drafted (October 2014). It is assumed that groundwater remediation is progressing towards meeting the RAOs since the groundwater remedy has been implemented.

Question C: Has any other information come to light that could question the protectiveness of the remedy?

No other information has come to light that could question the protectiveness of the remedy.

Impacts from Natural Disasters

Site 2 and the surrounding area are located within flood zone AE and, therefore, may flood during significant storm events. However, should flooding occur, the remedy is expected to remain protective. There have not been any impacts from natural disasters that could affect the protectiveness of the remedy.

Any Other Information That Could Affect Protectiveness of the Remedy

No other information that could affect the protectiveness of the remedy has been identified.

4.5.1 Technical Assessment Summary

Based on the results of the technical assessment, human and ecological exposures are currently under control and no unacceptable risks are occurring. However, additional data is needed to evaluate future protectiveness of the groundwater component of the remedy and ensure the compensatory mitigation wetland was successful. RA-operation phase groundwater data were not available to evaluate whether the groundwater component of the remedy is operating as intended by the ROD and will ultimately be protective in the long term. Additionally, there is the potential for future protectiveness to be impacted because of the potential for the emerging contaminants, 1,4-dioxane and perchlorate, to be present at the site. The successfulness of the compensatory mitigation wetland and whether any maintenance is needed is not known because monitoring has not been conducted and reported.

4.6 Issues Identified, Recommendations and Actions Needed, and Follow Up Actions

Table 4-4 outlines the issues identified for Site 2 during this Five-Year Review and presents recommendations and follow-up actions. Because this is the first Five-Year Review for Site 2, there are no carryover issues from the earlier Five-Year Review.

4.7 Protectiveness Summary

The remedy at Site 2 currently protects human health and the environment because human and ecological exposures that could result in an unacceptable risk are being controlled through LUCs. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure continued protectiveness: complete a groundwater evaluation to determine if 1,4-dioxane and perchlorate should be considered COCs for the site and revise the site remedy, LUC boundary, and/or treatment system if warranted; calculate a cleanup goal for naphthalene in groundwater that is protective of potential future use of the site; and collect RA-Operation phase groundwater data and evaluate the data to determine if the groundwater component of the remedy is functioning as intended.

TABLE 4-1
Site 2 Constituents of Concern Requiring a Response Action
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Constituents of Concern	Surface Soil	Combined Surface and Subsurface Soil	Shallow Groundwater	Surface Water	Sediment	Sediment Pore Water
Volatile Organic Compounds						
1,1,2-Trichloroethane			X			
1,1-Dichloroethene			X			X
Chloroform			X	X		
Methylene chloride			X			
Tetrachloroethene			X			
Trichloroethene			X	X		X
Vinyl chloride			X			X
cis-1,2-Dichloroethene			X			X
trans-1,2-Dichloroethene			X			
Semivolatile Organic Compounds						
2-Methylnaphthalene					X	
Acenaphthene	X				X	
Acenaphthylene	X					
Anthracene	X				X	
Benzo(a)anthracene	X				X	
Benzo(a)pyrene	X				X	
Benzo(b)fluoranthene	X					
Benzo(g,h,i)perylene	X				X	
Benzo(k)fluoranthene	X				X	
Chrysene	X				X	
Dibenz(a,h)anthracene	X				X	
Diethylphthalate					X	
Fluoranthene	X				X	
Fluorene	X				X	
Indeno(1,2,3-cd)pyrene	X				X	
Naphthalene	X		X		X	
Phenanthrene	X				X	
Pyrene	X				X	
Pesticides/Polychlorinated Biphenyls						
4,4'-DDD	X					
4,4'-DDE	X					
4,4'-DDT	X					

TABLE 4-1
Site 2 Constituents of Concern Requiring a Response Action
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Constituents of Concern	Surface Soil	Combined Surface and Subsurface Soil	Shallow Groundwater	Surface Water	Sediment	Sediment Pore Water
Aroclor-1254					X	
Aroclor-1260	X				X	
Alpha-Chlordane					X	
Gamma-Chlordane					X	
Dieldrin					X	
Heptachlor epoxide			X			
Inorganics						
Aluminum	X			X		
Antimony		X				
Barium				X	X	
Cadmium					X	
Chromium				X	X	
Copper	X			X	X	
Cyanide				X	X	
Iron	X	X		X		
Lead	X	X		X	X	
Manganese				X		
Nickel				X	X	
Vanadium	X	X				
Zinc	X			X	X	

Human health risk drivers
Ecological risk drivers
Human health and ecological risk drivers

TABLE 4-2

Site 2 Constituents of Concern Cleanup Levels

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Constituent of Concern	Ecological PRG	Ecological PRG Basis	Human Health PRG	Human Health PRG Basis	Cleanup Goal**
Shallow Aquifer Groundwater					
Volatile Organic Compounds (µg/L)* **					
1,1,2-Trichloroethane	NA	NA	5	MCL[1]	5
1,1-Dichloroethene			7		7
Tetrachloroethene			5		5
Trichloroethene			5		5
cis-1,2-Dichloroethene			70		70
Chloroform			80		80
Methylene chloride			5		5
trans-1,2-Dichloroethene			100		100
Vinyl chloride			2		2
Semivolatile Organic Compounds (µg/L)					
Naphthalene	NA	NA	170	Calculated Risk-Based Screening Value[2]	170
Pesticide (µg/L)* **					
Heptachlor epoxide	NA	NA	0.2	MCL[1]	0.2
Surface Soil					
Inorganics (mg/kg)					
Aluminum	7,669	95% Munden-Tetotem Background UTL[3]	NA	NA	7,669
Copper	70	Literature Risk-Based Screening Value[4]	NA	NA	70
Iron	3,669	95% Munden-Tetotem Background UTL[3]	NA	NA	3,669
Lead	120	Literature Risk-Based Screening Value[4]	400*	Literature Risk-Based Screening Value[4]	120
Vanadium	26.6	95% Munden-Tetotem Background UTL[3]	72	95% Background UTL	26.6
Zinc	38	95% Munden-Tetotem Background UTL[3]	NA	NA	38

TABLE 4-2

Site 2 Constituents of Concern Cleanup Levels

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Constituent of Concern	Ecological PRG	Ecological PRG Basis	Human Health PRG	Human Health PRG Basis	Cleanup Goal**
Pesticide/Polychlorinated Biphenyls (µg/kg)					
4,4-DDD	100	Literature Risk-Based Screening Value[4]	NA	NA	100
4,4-DDE	532	95% Munden-Tetotem Background UTL[3]			532
4,4-DDT	237	95% Munden-Tetotem Background UTL[3]			237
Aroclor-1260	100	Literature Risk-Based Screening Value[4]			100
Semivolatile Organic Compounds (µg/kg)					
Acenaphthene	29,000	Literature Risk-Based Screening Value[4]	NA	NA	29,000
Acenaphthylene	29,000				29,000
Anthracene	29,000				29,000
Benzo(a)anthracene	1,100				1,100
Benzo(a)pyrene	1,100				1,100
Benzo(b)fluoranthene	1,100				1,100
Benzo(g,h,i)perylene	1,100				1,100
Benzo(k)fluoranthene	1,100				1,100
Chrysene	1,100				1,100
Dibenz(a,h)anthracene	1,100				1,100
Fluoranthene	1,100				1,100
Flourene	29,000				29,000
Indeno(1,2,3-cd)pyrene	1,100				1,100
Naphthalene	29,000				29,000
Phenanthrene	29,000				29,000
Pyrene	1,100				1,100

TABLE 4-2

Site 2 Constituents of Concern Cleanup Levels

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Constituent of Concern	Ecological PRG	Ecological PRG Basis	Human Health PRG	Human Health PRG Basis	Cleanup Goal**
Surface Soil and Subsurface Soil					
Inorganics (mg/kg)					
Antimony	NA	NA	26.4	Calculated Risk-Based Screening Value[2]	26
Iron			53,529	Calculated Risk-Based Screening Value[2]	53,529
lead			400*	Literature Risk-Based Screening Value[4]	400*
Vanadium			72	95% Background UTL[5]	72
Inlet Sediment					
Inorganics (mg/kg)					
Barium	121	Maximum Bioassay Concentration[6]	NA	NA	121
Cadmium	10.9	Maximum Bioassay Concentration[6]	NA	NA	10.9
Chromium	260	Maximum Bioassay Concentration[6]	53	95% Background UTL[5]	53
Copper	421	Maximum Bioassay Concentration[6]	NA	NA	421
Cyanide	0.1	Literature Risk-Based Screening Value[4]	NA	NA	0.1
Lead	351	Maximum Bioassay Concentration[6]	NA	NA	351
Nickel	44	95% Bohicket Background UTL[3]	NA	NA	44
Zinc	758	Maximum Bioassay Concentration[6]	NA	NA	758

TABLE 4-2

Site 2 Constituents of Concern Cleanup Levels

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Constituent of Concern	Ecological PRG	Ecological PRG Basis	Human Health PRG	Human Health PRG Basis	Cleanup Goal**
Pesticides/Polychlorinated Biphenyls (µg/kg)					
Aroclor-1254	22.7	Literature Risk-Based Screening Value[4]	NA	NA	22.7
Aroclor-1260	22.7	Literature Risk-Based Screening Value[4]			22.7
Alpha-Chlordane	9.1	95% Bohicket Background UTL[3]			9.1
Gamma-Chlordane	9.7	95% Bohicket Background UTL[3]			9.7
Dieldrin	2.9	Maximum Bioassay Concentration[3]			2.9
Semivolatile Organic Compounds (µg/kg)					
2-Methylnaphthalene	70	Literature Risk-Based Screening Value[4]	NA	NA	70
Acenaphthene	292	95% Bohicket Background UTL[3]			292
Anthracene	332	95% Bohicket Background UTL[3]			332
Benzo(a)anthracene	749	95% Bohicket Background UTL[3]			749
Benzo(a)pyrene	732	95% Bohicket Background UTL[3]			732
Benzo(g,h,i)perylene	670	Literature Risk-Based Screening Value[4]			670
Benzo(k)fluoranthene	467	95% Bohicket Background UTL[3]			467
Chrysene	986	95% Bohicket Background UTL[3]			986
Dibenz(a,h)anthracene	292	95% Bohicket Background UTL[3]			292
Diethylphthalate	200	Literature Risk-Based Screening Value[4]			200
Fluoranthene	2,500	95% Bohicket Background UTL[3]			2,500
Flourene	292	95% Bohicket Background UTL[3]			292
Indeno(1,2,3-cd)pyrene	600	Literature Risk-Based Screening Value[4]			600
Naphthalene	292	95% Bohicket Background UTL[3]			292
Phenanthrene	376	95% Bohicket Background UTL[3]			376
Pyrene	1,905	95% Bohicket Background UTL[3]			1,905

TABLE 4-2
Site 2 Constituents of Concern Cleanup Levels
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Constituent of Concern	Ecological PRG	Ecological PRG Basis	Human Health PRG	Human Health PRG Basis	Cleanup Goal**
St. Juliens Creek Sediment					
Inorganics (mg/kg)					
Barium	121	Maximum Bioassay Concentration[6]	NA	NA	121
Cadmium	10.9	Maximum Bioassay Concentration[6]	NA	NA	10.9
Chromium	260	Maximum Bioassay Concentration[6]	53	95% Background UTL[5]	53
Copper	421	Maximum Bioassay Concentration[6]	NA	NA	421
Cyanide	0.67	95% Reference UTL[5]	NA	NA	0.67
Lead	351	Maximum Bioassay Concentration[6]	NA	NA	351
Nickel	44	95% Bohicket Background UTL[3]	NA	NA	44
Zinc	758	Maximum Bioassay Concentration[6]	NA	NA	758
Pesticides/Polychlorinated Biphenyls (µg/kg)					
Aroclor-1254	22.7	Literature Risk-Based Screening Value[4]	NA	NA	22.7
Aroclor-1260	22.7	Literature Risk-Based Screening Value[4]			22.7
Alpha-Chlordane	9.1	95% Bohicket Background UTL[3]			9.1
Gamma-Chlordane	9.7	95% Bohicket Background UTL[3]			9.7
Dieldrin	2.9	Maximum Bioassay Concentration[3]			2.9

TABLE 4-2

Site 2 Constituents of Concern Cleanup Levels

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Constituent of Concern	Ecological PRG	Ecological PRG Basis	Human Health PRG	Human Health PRG Basis	Cleanup Goal**
Semivolatile Organic Compounds (µg/kg)					
2-Methylnaphthalene	70	Literature Risk-Based Screening Value[4]	NA	NA	70
Acenaphthene	292	95% Bohicket Background UTL[3]			292
Anthracene	492	95% Reference UTL[7]			492
Benzo(a)anthracene	1,300	95% Reference UTL[7]			1,300
Benzo(a)pyrene	1,000	95% Reference UTL[7]			1,000
Benzo(g,h,i)perylene	672	95% Reference UTL[7]			672
Benzo(k)fluoranthene	1,400	95% Reference UTL[7]			1,400
Chrysene	1,500	95% Reference UTL[7]			1,500
Dibenz(a,h)anthracene	410	95% Reference UTL[7]			410
Diethylphthalate	608	95% Reference UTL[7]			608
Fluoranthene	2,600	95% Reference UTL[7]			2,600
Flourene	292	95% Bohicket Background UTL[3]			292
Indeno(1,2,3-cd)pyrene	624	95% Reference UTL[7]			624
Naphthalene	292	95% Bohicket Background UTL[3]			292
Phenanthrene	920	95% Reference UTL[7]			920
Pyrene	1,905	95% Bohicket Background UTL[3]			1,905

Notes:

[1]USEPA, 2009. *National Primary Drinking Water Regulations* . EPA 816-F-09-004. May.

[2]CH2M HILL. 2009, Revised 2010. *Final Feasibility Study Report for Site 2, St. Juliens Creek Annex, Chesapeake, Virginia* . October, January revision.

[3]CH2M HILL. 2001. *Final Background Investigation Report.* St. Juliens Creek Annex, Chesapeake, Virginia. October.

[4]USEPA Region III, 1995. *Revised Region III BTAG screening levels* . Memorandum from R.S. Davis to Users. 9 August.; Buchman, M.F., 1999. *NOAA screening quick reference tables* . NOAA HAZMAT Report 99-1, Seattle, WA. 12 pp.; Long, E.R. and L.G. Morgan, 1990. *The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program* . NOAA Technical Memorandum NOS OMA 52.; Ontario Ministry of Environment and Energy, 1993. *Guidelines for the protection and management of aquatic sediment quality in Ontario* . ISBN 0-7729-9248-7. 27 pp.; USEPA, 2007. *Ecological Soil Screening Levels for PAHs* . Interim Final. OSWER Directive 9285.7-78 for PAHs in soils.; USEPA, 2007. *Ecological Soil Screening Levels for Copper* . OSWER Directive 9285.7-68 for copper in soils.; USEPA, 2005. *Ecological Soil Screening Levels for Lead* . OSWER Directive 9285.7-70 for lead in soils.; USEPA, 1994. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive 9335.4-12.

[5]CH2M HILL. 2004. *Final Background Investigation Report Addendum for Groundwater, St. Juliens Creek Annex, Chesapeake, Virginia* . August.

TABLE 4-2

Site 2 Constituents of Concern Cleanup Levels

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Constituent of Concern	Ecological PRG	Ecological PRG Basis	Human Health PRG	Human Health PRG Basis	Cleanup Goal**

[6]CH2M HILL. 2004. *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report for Site 2, St. Juliens Creek Annex, Chesapeake, Virginia* . February.

[7]CH2M HILL, 2005. *Site 2 Outfall Sediment Investigation Results and Development of Reference Sediment Data in St. Juliens Creek, St. Juliens Creek Annex, Chesapeake, Virginia* . January.

*Site-wide average concentration

**Cleanup level was established as more conservative PRG calculated.

***Total risks/hazards associated with use of Federal MCLs as PRGs were calculated and verified to be acceptable (within the acceptable range of $1x10^{-4}$ to $1x10^{-6}$ and/or total hazard index to a target organ does not exceed 1.0) for the industrial use scenario.

MCL - Maximum Contaminant Level

µg/L - microgram per liter

µg/kg - microgram per kilogram

mg/L - milligram per liter

mg/kg - milligram per kilogram

NA - No associated risk, PRG not established

PRG - preliminary remediation goal

UTL - upper tolerance limit

TABLE 4-3
Site 2 Remedial Action Summary and Expected Outcomes
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Risk		Remedial Action Objective	Remedy Component	Metric	Expected Outcomes	
Human Health	Ecological					
Waste/Soil/Inlet Sediment						
Ingestion of and dermal contact with waste, soil, and inlet sediment	Terrestrial plant and soil invertebrate direct exposure to surface soil; avian vermivore food web exposure to surface soil; avian piscivore food web exposure to inlet sediment	Prevent direct media contact with human and ecological receptors at concentrations that pose unacceptable risks	Soil Cover and LUCs	Periodic inspection of the integrity of the cover and confirmation of LUC adherence	Allow for restricted industrial use	
Ingestion of and dermal contact with inlet sediment	Benthic invertebrate direct exposure to inlet sediment; water column-dwelling aquatic life direct exposure to surface water; avian piscivore food web exposure to sediment	Prevent migration of contaminants through surface water runoff and erosion pathways	Soil Cover and LUCs	Periodic inspection of the integrity of the cover and confirmation of LUC adherence	Allow for restricted industrial use	
Not applicable – RAO established to prevent future degradation of site media		Prevent or minimize transport of COCs from waste to site media	Soil Cover and LUCs	Periodic inspection of the integrity of the cover and confirmation of LUC adherence	Allow for restricted industrial use	
St. Juliens Creek Sediment						
Dermal contact with sediment	Benthic invertebrate direct exposure to sediment	Prevent direct media contact with human and ecological receptors at concentrations that pose unacceptable risks	Excavation and Offiste Disposal	Confirmation sampling to ensure the excavation of all sediment exceeding established cleanup levels	Achieve unlimited use and unrestricted exposure	
Shallow Groundwater						
Ingestion of, dermal contact with, and inhalation of chlorinated VOCs, naphthalene, and heptachlor epoxide in groundwater under future potable use scenario; dermal contact with vinyl chloride and inhalation of naphthalene in shallow groundwater in an open excavation	No exposure pathway	Reduce contaminant source mass to the maximum extent practicable	ERD	Monitor shallow groundwater COC concentrations to confirm reduction to below the calculated NAC of the aquifer	Elimination of high-concentration target area	
Ingestion of, dermal contact with, and inhalation of chlorinated VOCs, naphthalene, and heptachlor epoxide in groundwater under future potable use scenario; dermal contact with vinyl chloride and inhalation of naphthalene in shallow groundwater in an open excavation	Benthic invertebrate direct exposure to sediment pore water; water-column-dwelling aquatic life direct exposure to surface water	Reduce COC concentrations in shallow groundwater to the maximum extent practicable and maintain LUCs until concentrations allow for unlimited use and unrestricted exposure	ERD	Monitor shallow groundwater COC concentrations to confirm the natural degradation process until concentrations are below the cleanup levels	Removal of groundwater LUCs	
			MNA			
			LUCs	Periodic inspection of the site to confirm adherence to LUCs until shallow groundwater COCs are at or below their respective cleanup levels		
		Prevent COC migration from the shallow groundwater to surface water and sediment	Soil Cover and LUCs	Periodic inspection of the integrity of the cover and confirmation of LUC adherence	Elimination of the Site 2 inlet sediment, sediment pore water, and surface water exposure pathway	Removal of groundwater LUCs
			ERD	Monitor shallow groundwater COC concentrations to confirm reduction to below the calculated NAC of the aquifer	Elimination of high-concentration target area	
			MNA	Monitor shallow groundwater COC concentrations to confirm the natural degradation process until concentrations are below the cleanup levels	Identify the potential for chlorinated VOC concentrations above established cleanup levels to migrate to St. Juliens Creek. Trigger implementation of potential contingency remedy component	
			PRB*	Monitor downgradient shallow groundwater COC concentrations to confirm concentrations are below established cleanup prior to offsite migration	Reduction of chlorinated VOC concentrations to below established clean-up levels prior to migration to St. Juliens Creek	

TABLE 4-3
Site 2 Remedial Action Summary and Expected Outcomes
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Risk		Remedial Action Objective	Remedy Component	Metric	Expected Outcomes	
Human Health	Ecological					
Ingestion of, dermal contact with, and inhalation of chlorinated VOCs, naphthalene, and heptachlor epoxide in groundwater under future potable use scenario	No exposure pathway.	Prevent activities that might cause migration of COCs in the Columbia aquifer to the underlying Yorktown Aquifer	LUCs	Periodic inspection of the site to confirm adherence to LUCs until shallow groundwater COCs are at or below their respective cleanup levels	Removal of groundwater LUCs	
Surface Water						
No unacceptable risks or hazards identified	Water-column-dwelling aquatic life direct exposure to surface water	Minimize degradation of surface water through source control in shallow groundwater, waste, surface soil, and sediment	Soil Cover and LUCs	Periodic inspection of the integrity of the cover and confirmation of LUC adherence	Elimination of the Site 2 inlet sediment, sediment pore water, and surface water exposure pathway	Removal of groundwater LUCs
			ERD	Monitor shallow groundwater COC concentrations to confirm reduction to below the calculated NAC of the aquifer	Elimination of high-concentration target area	
			MNA	Monitor shallow groundwater COC concentrations to confirm the natural degradation process until concentrations are below the cleanup levels	Identify the potential for chlorinated VOC concentrations above established cleanup levels to migrate to St. Juliens Creek. Trigger implementation of potential contingency remedy component	
			PRB*	Monitor downgradient shallow groundwater COC concentrations to confirm concentrations are below established criteria prior to offsite migration	Reduction of chlorinated VOC concentrations to below established criteria prior to migration to St. Juliens Creek	

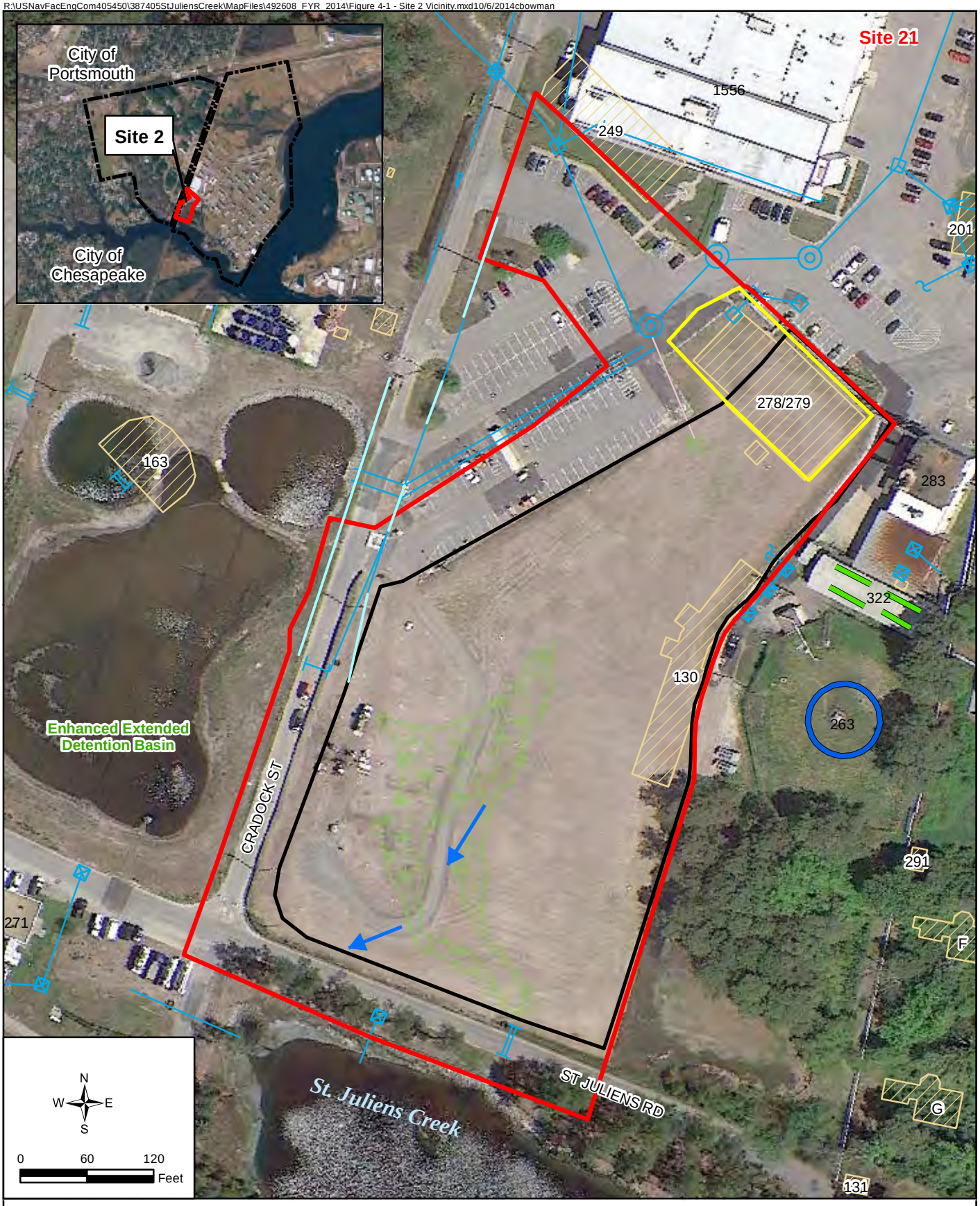
* The PRB is a contingency remedy component that will be implemented if site conditions and the results of modeling indicate chlorinated VOCs could migrate offsite at concentrations that may exceed surface water criteria.

COC – constituent of concern
ERD – enhanced reductive dechlorination
LUC – land use control
MNA – monitored natural attenuation
NAC – natural attenuation capacity
PRB – permeable reactive barrier
RAO – remedial action objective
VOC – volatile organic compound

TABLE 4-4
Site 2 Issues, Recommendations, and Follow-Up Actions
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Issue	Recommendations and Follow-up Actions	Party Responsible	Milestone Date	Affects Protectiveness	
				Current	Future
Monitoring					
Based on site history, there is the potential for emerging contaminants perchlorate and 1,4-dioxane to be present in the site groundwater. However, the presence of perchlorate and 1,2-dioxane and any resulting unacceptable risk is unknown.	Conduct an investigation to determine whether perchlorate and 1,4-dioxane are present and pose unacceptable risk in the shallow aquifer groundwater and should be included as COCs for the site. Revise the site remedy, LUC boundary, and/or treatment system if warranted.	Navy	May 2017	No	Yes
Cleanup level for naphthalene in groundwater is not protective of potential future use.	Calculate a cleanup value for naphthalene in groundwater that is protective of potential future use. Document the revised cleanup goal in a ROD Memorandum to File.	Navy	May 2016	No	Yes
RA-operation phase groundwater data is not available to determine whether the groundwater component of the remedy is functioning as intended by the ROD.	Collect groundwater data in accordance with the RA-Operation monitoring plan and evaluate the data to determine whether the remedy is functioning as intended by the ROD.	Navy	May 2016	No	Yes
Successful restoration of the compensatory mitigation wetland has not been demonstrated.	Develop a Wetland Maintenance and Monitoring Plan, conduct the monitoring, report the monitoring, and conduct any necessary maintenance.	Navy	May 2016	No	No

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 4-1 - Site 2 Vicinity.mxd10/6/2014cbowman



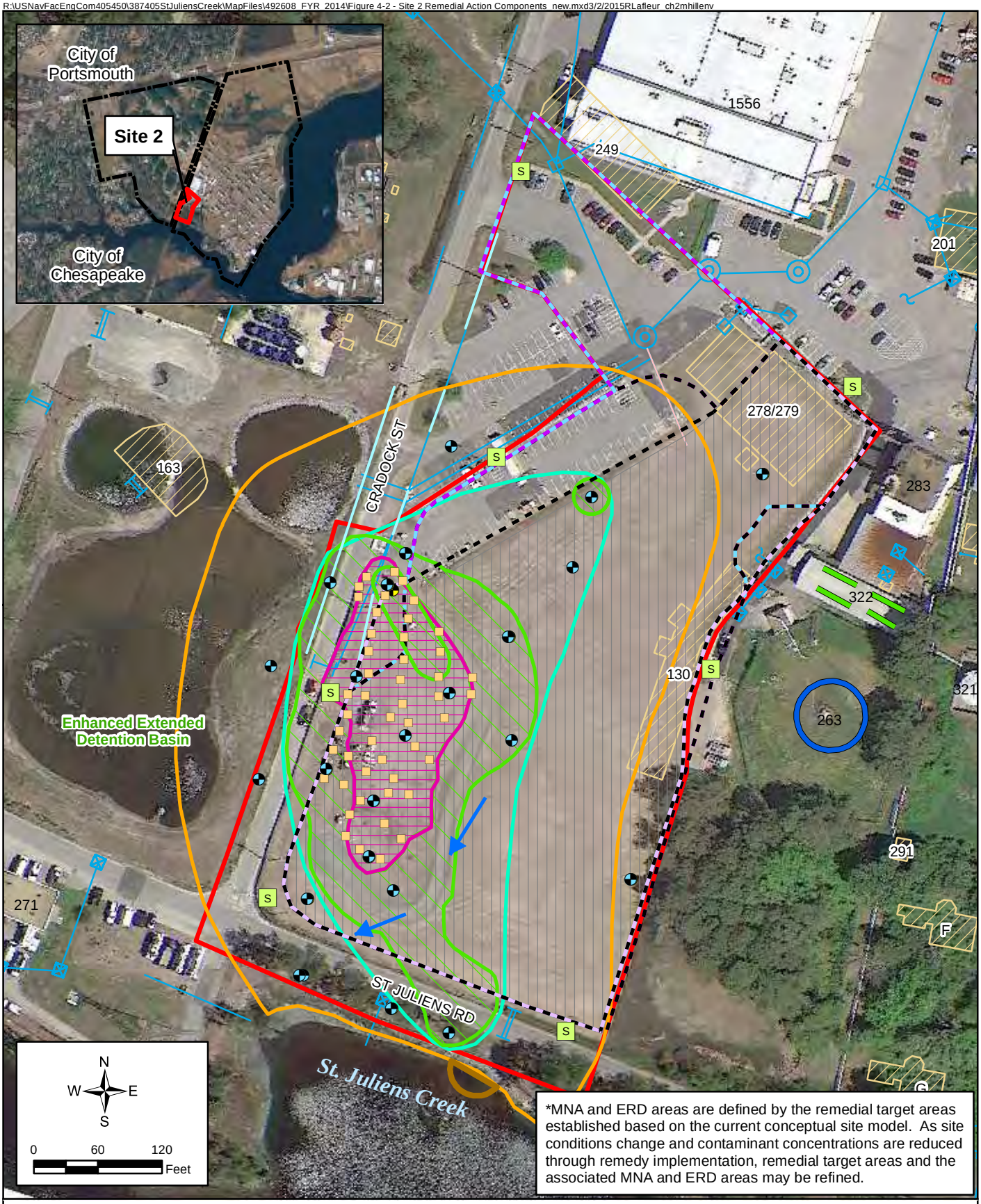
Legend

- Site 2 Boundary
- Former Site 17 Boundary
- Approximate Location of UST
- Approximate Location of AST
- Storm Sewer System
- Abandoned Storm Sewer System
- Drainage
- Groundwater Flow Direction (October 2013)
- Former Site 2 Inlet
- Demolished Building
- Soil Cover Boundary

Figure 4-1
Site 2 Location and Vicinity
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 4-2 - Site 2 Remedial Action Components_new.mxd3/2/2015RLafleur_ch2mhillenv



*MNA and ERD areas are defined by the remedial target areas established based on the current conceptual site model. As site conditions change and contaminant concentrations are reduced through remedy implementation, remedial target areas and the associated MNA and ERD areas may be refined.

Legend

- Groundwater Monitoring Well
- ERD Injection Well
- Site 2 Boundary
- Approximate Location of UST
- Approximate Location of AST
- Historical Inlet Disposal Area LUC Boundary
- Historical Parking Lot Disposal Area LUC Boundary
- Land Use Control Boundary - Waste and Soil
- Abandoned Storm Sewer System
- Drainage
- Storm Sewer System
- Groundwater Flow Direction (October 2013)
- Demolished Building
- Soil Cover
- Land Use Control Boundary - Groundwater (Potable use)
- Land Use Control Boundary - Groundwater (Inhalation)
- St. Juliens Creek Sediment Excavation Area
- S LUC Sign
- MNA Area*
- ERD Area*

Figure 4-2
Site 2 Remedial Action Components
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 5

Site 4—Landfill D

This section presents background information and the Five-Year Review evaluation for Site 4.

5.1 Site Chronology and Background

The following is a chronology of the major events for Site 4.

Date	Event
1961 through 1975	Primarily trash and wet garbage disposed of; sanitary landfill operations implemented in 1970
1976 through 1981	Inert construction material disposed of; solid waste hauled offsite
August 1981	IAS completed
1983	PA completed
March 1989	Phase II RFA completed
February 1995	EPIC Study and Regulatory Review completed
April 1996	RRR System Data Collection Report completed
January 2000	HRS Documentation Record completed
July 2000	SJCA placed on NPL
March 2003	RI completed
March 2004	FS completed
May 2004	Proposed Plan completed
July 2004	FFA signed
September 2004	ROD signed
November 2004	RD completed
March 2005	RA initiated
October 2005	RA completed
December 2005	LUC inspections initiated (ongoing)
February 2006	ROD Modification completed
June 2006	LUC RD completed
September 2006	RA Completion Report (RACR) completed
November 2006 through August 2008	Voluntary Groundwater Performance Monitoring conducted
August 2009	First Five-Year Review groundwater monitoring event conducted
May 2010	First Five-Year Review signed
February 2014	Second Five-Year Review groundwater monitoring event conducted

5.1.2 Physical Characteristics

Site 4 is an approximately 8.3–acre landfill located in the northeastern portion of SJCA at the confluence of Blows Creek and the Southern Branch of the Elizabeth River (**Figure 5-1**). The site is located on dredge fill material that reportedly originated from Blows Creek and the Southern Branch of the Elizabeth River. Grass-lined drainage ditches run along the eastern and western sides of Site 4 and transport surficial runoff from the area to an adjacent wetland area and Blows Creek. The adjacent wetland area and Blows Creek has been investigated and is included with Site 5.

The Columbia aquifer in the vicinity of Site 4 ranges in thickness from 25 feet, in the northern portion of the site, to approximately 32 feet, at the southern portion of the site. The aquifer consists predominantly of fine to coarse sands with some silt and clay. The Yorktown aquifer is predominantly sandy and typically encountered at an average depth of 50 feet bgs. The Yorktown confining unit separating the aquifers consists of a series of interbedded clay and fine sand layers overlying a clay layer. The Yorktown confining unit is present across the base and impedes the downward migration of Columbia aquifer groundwater to the Yorktown aquifer. Columbia aquifer groundwater at Site 4 is locally influenced by nearby surface water bodies (Southern Branch of Elizabeth River and Blows Creek) and generally flows in a south-southeasterly direction (**Figure 5-1)**.

5.1.3 Land and Resource Use

Currently, Site 4 is maintained as a controlled closed landfill with a vegetated soil cover. Although groundwater is not currently used as a potable water supply at or in the vicinity of SJCA (**Section 2.1**), the Navy acknowledges the Commonwealth of Virginia's and USEPA's expectation to return usable groundwaters to their beneficial uses wherever practicable. Construction and excavation activities at the site are prohibited and controlled through site signs, fencing, notation in the iNFADS maintained by Commander Naval Region Mid-Atlantic, and a survey plat filed with the City of Chesapeake. Additionally, the annually-updated SMP for SJCA includes maps and geographic information system layers that depict the LUCs at the site.

Anticipated future land use for the site is to remain as a controlled closed landfill.

5.1.4 History of Contamination

In earlier documents, Site 4 was referred to as Dump D or SWMU 6 and included SWMU 7 and AOC L. The first indication of activity at Site 4 is trenching identified on a historical aerial photograph from 1961. The trenches were filled with trash, wet garbage, and soil. The IAS (NEESA, 1981) indicated that around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek and continued until 1976, at which time trash and garbage were hauled to an offsite facility. Inert construction debris continued to be disposed of at the landfill until 1981. The wastes managed were primarily trash, wet garbage, construction material, and outdated civil defense stores. Although the RFA indicated that some solvents, acids, bases, and polychlorinated biphenyls were disposed of at Site 4, it is assumed that these materials were disposed of prior to 1976 because the IAS states that only inert material was disposed of after that date. Wastes disposed of at Site 4 were estimated at 56,000 cubic yards.

5.1.5 Initial Response

No environmental cleanup activities occurred before the signature of the ROD in September 2004.

5.1.6 Basis for Remedial Action

An HHRA was conducted as part of the RI (CH2M HILL, 2003) to evaluate potential risks to human health from exposure to site media, as follows:

- Current/Future adult/adolescent trespasser exposed to surface soil (ingestion, dermal contact, and inhalation of fugitive dust), sediment (ingestion and dermal contact), surface water (dermal contact)
- Future construction worker exposed to combined surface and subsurface soil (ingestion, dermal contact, and inhalation of fugitive dust) and shallow groundwater (dermal contact)
- Future other worker exposed to combined surface and subsurface soil (ingestion and dermal contact)

- Future adult/child resident exposed to combined surface and subsurface soil (ingestion, dermal contact, and inhalation of fugitive dust), sediment (ingestion and dermal contact), surface water (dermal contact), and deep groundwater (ingestion, dermal contact, and inhalation of volatile emissions while showering [adult only])

An ERA (Steps 1 and 2 of the ERA process and Step 3 of the BERA process) was conducted as part of the RI (CH2M HILL, 2003) to evaluate potential risks to ecological receptors through direct exposure to surface soil, sediment, and surface water; and exposure via the food web. Exposure to groundwater was assessed as discharge through sediment to surface water because there was no complete pathway for ecological receptor exposure to groundwater.

Based on the evaluation of the HHRA and ERA and subsequent risk management decisions that were made, it was determined that exposure to waste and SVOCs, a PCB, and inorganics in soil, and/or sediment at Site 4 posed an unacceptable risk to human health and/or the environment. No unacceptable risks from exposure to groundwater or surface water were identified. The COCs requiring a response action are summarized on **Table 5-1**.

5.2 Remedial Actions

5.2.1 Remedy Selection

A ROD for Site 4 was signed in September 2004. The selected remedy consisted of a soil cover, removal of eastern drainage ditch sediment, and implementation of LUCs to meet the following RAOs:

- Prevent or minimize direct contact of human and ecological receptors with landfill contents.
- Reduce infiltration and any resulting leaching of contaminants from the landfill into groundwater.
- Prevent overland flow entering the site (surface water run-on) and control surface water run-off and erosion.

Cleanup levels were not established for the soil COCs within the limits of the soil cover because the soil cover would eliminate the exposure pathway. A cleanup level was established for mercury in the eastern drainage ditch because this area is outside of the soil cover. The cleanup level was based on the site-specific background 95 percent UTL for dredge fill (1.1 mg/kg) (CH2M HILL, 2001) because the eastern drainage ditch on Site 4 falls within the dredge fill soil type.

The following LUC objectives for Site 4 were identified in the ROD:

- Prohibit digging into or disturbing the soil cover or landfill contents.
- Prohibit residential use and development of the site.

5.2.2 Remedy Implementation

The RD for the soil cover and sediment removal components of the Selected Remedy was completed in 2004 (AGVIQ-CH2M HILL, 2004). The RD for the implementation and maintenance of the LUCs component of the Selected Remedy was competed in 2006 (NAVFAC, 2006a). The RA-Construction was conducted from March through October of 2005 and included the following activities (AGVIQ-CH2M HILL, 2005b):

- Removal of surface debris from the ground surface and wetland area adjacent to Blows Creek with consolidation of inert debris under the landfill cover and offsite disposal of all other debris.
- Installation of a minimum 2-foot soil cover graded to a minimum of 2 percent slopes to promote drainage and reduce infiltration.
- Removal and offsite disposal of 1 foot of sediment from the floor and sidewalls of the eastern drainage ditch adjacent to the landfill and extending through the wetland to Blows Creek to prevent direct contact of human and ecological receptors with mercury in sediment. The one foot excavation depth and lateral extent was based on pre-confirmation samples collected from 1 to 2 feet bgs for mercury analysis and compared to the cleanup level (CH2M HILL, 2001).
- Reshaping of the eastern drainage ditch and construction of a new drainage ditch along the western boundary.

- Compensatory wetland mitigation for permanent impacts to 0.023 acres of the wetland area adjacent to Blows Creek by planting of wetland grasses at nearby Norfolk Navy Shipyard Site 9. The mitigation was conducted in accordance with the *Compensatory Mitigation Plan for the Site 4 Wetlands, St. Juliens Creek Annex, Chesapeake, Virginia* (AGVIQ-CH2M HILL, 2005a).
- Installation of a fence and signs around the perimeter of the landfill indicating the access restrictions and the presence of buried waste.
- Documentation of the restrictions for excavation and site use within the LUC boundary at the site in the iNFADS maintained by Commander Naval Region Mid-Atlantic and the annually-updated SMP for SJCA.

Minor modifications to the Selected Remedy in the ROD were documented in a Technical Memorandum in 2006 (CH2M HILL, 2006). The minor modifications consisted of extension of the soil cover to the west and compensatory mitigation for permanent wetland impacts.

A RACR for Site 4 was signed in September 2006, documenting that the remedy was in place, operating and functioning as intended, and protective of human health and the environment (NAVFAC, 2006c). A survey plat was registered with the City of Chesapeake in the Commonwealth of Virginia to provide public notice of the environmental conditions and limitations on the use of the property. A copy of the survey plat is included in the RACR.

LUCs will be maintained within the boundaries of the landfill indefinitely, or until all parties (Navy, USEPA, and Commonwealth of Virginia) agree that waste left in-place is at such levels to allow for unlimited use and unrestricted exposure.

5.2.3 Remedy Operation and Maintenance

The site has achieved Response Complete. Since waste remains onsite, operation and maintenance activities at the site consist of maintenance of LUCs.

In accordance with the ROD and LUC RD, LUC inspections were initiated in December 2005 to verify the continued integrity of the soil cover; ensure appropriate surface water runoff and erosion control measures are functioning; ensure adequate vegetation is maintained; and verify LUCs are in place. Inspections were conducted quarterly for the first year until an adequate vegetative cover was present over the landfill, and have been conducted annually since. The findings from the inspections are documented in annual letter reports submitted to the regulatory stakeholders. The annual inspection reports for the 5-year period covered by this five-year review are provided in **Appendix B**.

The only issues identified during the LUC inspections covered by the time period for this Five-Year Review occurred in 2010 and 2011 and consisted of outdated contact information on the site signs and damage to a protective bollard for one of the monitoring wells. Additionally it was determined that the controls on the site signs needed clarification because they indicated that no access was allowed although the LUCs do not prevent access to the site. The contact information on the signs was updated, the language explaining the controls was revised, and the bollard was repaired prior to the 2012 inspection. Therefore, the language on the signs does not match the language included in the LUC RD. The 2014 LUC inspection had not been conducted at the time this Five-Year Review was drafted (October 2014). Throughout the previous inspections, the fencing, riprap landfill toe, and drainage ditches remained in good condition. No signs of unauthorized intrusive activities, IDW storage, or dumping within the site were observed. Additionally, no signs of erosion were reported during the inspections. The results of the inspections indicate that the soil cover integrity has been maintained and exposure to landfill contents has been prevented.

The average operations and maintenance cost is approximately $2,000 per year. The estimated operations and maintenance costs for the selected remedy in the ROD were approximately $21,500 per year. The actual cost for the selected remedy is less than estimated because of the optimization measures implemented (no mowing of the soil cover required), no repairs have been needed in the last five years, and the need for groundwater monitoring was eliminated. One round of voluntary groundwater monitoring was conducted in the past five years. The cost of that monitoring event, including the associated planning and reporting, was approximately $21,000.

5.3 Progress since Last Five-Year Review

The previous Five-Year Review report included the following protectiveness statement for Site 4:

> *The remedy at Site 4 is protective of human health and the environment. All threats at the site have been addressed through installation of a soil cover over the contaminated soil and waste and removal of contaminated sediments, the installation of fencing and warning signs, and the implementation of institutional controls.*

No issues or follow up actions were identified for Site 4 in the previous Five-Year Review. However, because the voluntary groundwater monitoring indicated that the most recent (2006 to 2009) arsenic concentrations detected at one of the downgradient shallow aquifer monitoring wells were somewhat greater than the historical (1997 and 1999) concentrations, groundwater monitoring for arsenic in association with this Five-Year Review was recommended. The groundwater monitoring was conducted in February 2014 and the results are discussed in **Subsection 5.4.2**.

5.4 Five-Year Review Process

5.4.1 Document Review

Appendix A includes a list of the documents associated with Site 4 that were reviewed. The RAOs, cleanup levels, and ARARs are documented in the ROD for Site 4 (NAVFAC, 2004).

5.4.2 Data Review

In addition to the data included in the documents that were reviewed (**Appendix A**), Site 4 shallow aquifer groundwater data collected in association with this Five-Year Review were reviewed. The data was collected per the recommendation from the previous Five-Year Review. The monitoring activities and results are documented in a technical memorandum provided in **Appendix D**. A summary of the groundwater data for the site is provided below.

Although no unacceptable risk was identified in the shallow aquifer groundwater, the SJCA ER Partnering Team agreed to conduct voluntary post-ROD groundwater monitoring in order to evaluate the site's impact on groundwater quality and to confirm that no potential future releases will pose unacceptable risk. Four monitoring wells (three downgradient and one upgradient) were sampled quarterly from 2006 to 2008 for the surface soil human health COCs (arsenic and iron) and the groundwater MCL exceedances (arsenic, cadmium, lead, and thallium) identified in the RI (**Table 5-2**). Only dissolved and total arsenic concentrations were found to statistically exceed upgradient concentrations at two downgradient monitoring wells. A time trend analysis incorporating the RI data determined that there were no significant increases of concentrations in any monitoring wells. However, because dissolved and total arsenic concentrations were slightly higher than historical concentrations at one downgradient monitoring well, an additional round of monitoring for total and dissolved arsenic was conducted in 2009 in association with the 2010 Five-Year Review (**Table 5-2**). Evaluation of the data in the 2010 Five-year Review indicated that concentrations in groundwater at the site appeared to be steady over time and no site release or offsite migration of landfill contaminants had occurred or was occurring (CH2M HILL, 2010b). However, because the most recent (2006 to 2009) arsenic concentrations detected at one of the downgradient monitoring wells were somewhat greater than the historical (1997 and 1999) concentrations (**Table 5-2**), it was recommended that groundwater monitoring for arsenic be conducted prior to the 2015 Five-year Review and the site conditions, trends, and path forward be re-evaluated in accordance with the *Considerations for Developing Long-Term Monitoring Plans for Unpermitted Navy Landfills in Virginia* (Virginia-Navy Tier 2, April 2014).

Total and dissolved arsenic were not detected in the shallow aquifer during the monitoring event conducted in February 2014 in association with this Five-year Review (**Table 5-2**), and detections limits were below the SJCA background UTL and MCL. Therefore, in accordance with the project quality objectives established in the SAP, evaluation of trends in the groundwater is not necessary.

Although, as indicated in the RI, there is no complete pathway for direct ecological receptor exposure to groundwater, ecological exposure could occur from discharge through sediment to surface water. Blows Creek

(the presumed discharge point for site groundwater) in the vicinity of Site 4 has salinity in the brackish range. Comparison of the 2014 arsenic data to the lower of the freshwater (36 micrograms per liter) and marine (150 micrograms per liter) Ambient Water Quality Criteria values for the protection of aquatic life indicates the remedy is protective of ecological receptors from potential shallow groundwater discharge to Blows Creek because there are no exceedances of the freshwater screening value.

Based on the groundwater data collected to-date at the site, the landfill contents have not resulted in a release and/or mobilization of arsenic in the shallow aquifer groundwater and therefore, in accordance with the *Considerations for Developing Long-Term Monitoring Plans for Unpermitted Navy Landfills in Virginia* (Virginia-Navy Tier 2, 2014), discontinuation of groundwater monitoring at the site is planned based on the following:

- Current concentrations of arsenic in the shallow aquifer groundwater are below established "basewide" background concentrations and are not above upgradient concentrations
- Current concentrations of arsenic in the shallow aquifer groundwater are below the MCL
- More than 10 years of post-closure care with no release or expected release of hazardous substances to the environment or beyond the waste boundary point of compliance has occurred at the site.

5.4.3 Site Inspection

No significant issues were identified during the Five-Year Review site inspection. Vegetation was observed throughout the extent of the soil cover and within the drainage ditches. No low-lying areas or signs of erosion were observed. The signs, fencing, riprap landfill toe, and drainage ditches were observed to be in good condition, although the lock on the fence gate needed to be replaced. No signs of unauthorized intrusive activities, IDW storage, or dumping within the site were observed. The completed site inspection checklist is provided in **Appendix B**.

5.4.4 Interviews

No significant or specific problems or concerns regarding the site or the remedy were identified during the interviews or in the questionnaire responses. The responses indicated that the more awareness a respondent had of the RA, the more confident they were that it is protective of human health and the environment. The interviews and questionnaire results are further discussed in the CIP (CH2M HILL, 2014d).

5.5 Technical Assessment

Question A: Is the remedy functioning as intended by the decision document?

The remedy is functioning as intended by the ROD and ROD Memorandum to File.

Remedial Action Performance

The RA continues to operate and function as designed. The LUC inspections have confirmed that the soil cover is intact; preventing or minimizing direct contact of human health and ecological receptors with landfill contents. The as-built survey confirmed that the minimum 2 percent slope, which was designed to reduce infiltration and resulting leaching of contaminants from the landfill into groundwater, was achieved. Additionally, the inspections, which did not identify any sign of erosion or sediment buildup within the upland drainage ditches, and the as-built survey, have confirmed that overland flow entering the site is being prevented and surface water run-off and erosion are being controlled. Evaluation of the groundwater data indicates that no site release or offsite migration of landfill contaminants has occurred or is expected to occur.

Operation and Maintenance Activities

Continuation of the current operation and maintenance (O&M) activities as currently implemented is expected to continue to maintain the effectiveness of the response action. O&M costs are less than original estimates (**Section 5.2.3**).

Opportunities for Optimization

Maintenance costs were minimized through the team decision to not mow the vegetation of the landfill cover. For continued optimization, no mowing requirement is recommended. Discontinuation of groundwater monitoring and abandonment of the site monitoring wells to reduce future maintenance costs is recommended. The recommendation to discontinue groundwater monitoring is based on the results of the voluntary groundwater sampling, which indicates that the landfill contents have not resulted in a release and/or mobilization of contaminants in the shallow aquifer groundwater, and is in accordance with the *Considerations for Developing Long-Term Monitoring Plans for Unpermitted Navy Landfills in Virginia* (Virginia-Navy Tier 2, 2014). Based on the RAOs for the site, groundwater monitoring is not needed to assess the protectiveness of the remedy. The protectiveness of the remedy will be assessed in future Five-Year Reviews through inspections of the cover and ensuring that the LUCs are in place and adhered to.

Early Indicators of Potential Issues

No early indicators of potential issues have been identified. Only minor issues that could have potentially affected the protectiveness of the remedy have been identified during the site inspections.

Implementation of ICs and Other Measures

The LUCs identified in the LUC RD are in place and effective. Annual site inspections have verified that the soil cover integrity is being maintained, exposure to landfill contents is not occurring, and residential use and development of the site is not occurring. The site signs and fencing have remained intact and restrict access to the site. The survey plat filed with the City of Chesapeake is being maintained. A notation of the land use restrictions is included in the iNFADS maintained by Commander Naval Region Mid-Atlantic. The annually-updated SMP for SJCA includes maps and geographic information system layers depicting the LUCs for Site 4.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection are still valid.

Changes in Standards and TBCs

No changes in standards or TBCs that adversely affect the protectiveness of the remedy were identified during this Five-Year Review.

Changes in Exposure Pathways

There have not been any changes in the land use at the site. No new routes of exposure or receptors have been identified. No new contaminants or contaminant sources have been identified. There is no indication that physical site conditions (such as hydrologic or hydrogeologic conditions) have changed in a way that could affect the protectiveness of the remedy.

In order to assess whether any of the common emerging contaminants could be present at the site and warrant investigation if they were not previously investigated and not addressed by the Selected Remedy, the site history and data were evaluated to assess the potential for those contaminants. The evaluation process is provided as **Appendix C**. Based on this review, the emerging contaminants 1,4-dioxane, PFCs, dioxins/furans, and perchlorate were not analyzed for and are not expected to be present at the site.

Changes in Toxicity and Other Contaminant Characteristics

No clean up goals for the soil COCs were developed for the site, as the soil cover component of the remedy would address the unacceptable exposures to the landfill contents and contaminated soil, and LUCs to restrict unauthorized activities which could result in those exposures. Therefore, although there may have been some changes in toxicity values of some of the COCs, these changes would not affect the protectiveness of the selected remedy as they would not change the cleanup levels.

Changes in Risk Assessment Methodologies

There have been no significant changes in standardized HHRA and ERA methodologies that could affect the protectiveness of the remedy for the exposure scenarios since the last Five-Year Review. Although the standard exposure factors used to estimate human health risks were updated in 2014, the changes were not significant enough to result in changes to the protectiveness of the remedy.

Expected Progress Towards Meeting RAOs

The remedy has met the RAOs and is expected to continue to meet the RAOs.

Question C: Has any other information come to light that could question the protectiveness of the remedy?

No other information has come to light that could question the protectiveness of the remedy.

Impacts from Natural Disasters

During design of the Site 4 cover, potential for impacts from future natural disasters (e.g., flooding) were considered. The southern toe of the landfill, which is adjacent to the wetland on the northern bank of Blows Creek, was stabilized with a 2-foot layer of riprap up to the flood zone AE elevation of 8 feet to minimize the potential for erosion of the cover in the event of a flood. Post storm inspections are conducted following significant storm events and the results are documented in the annual LUC inspection reports (**Appendix B**). There have not been any impacts to the remedy effectiveness as the result of natural disasters.

Any Other Information That Could Affect Protectiveness of the Remedy

No other information that could affect the protectiveness of the remedy has been identified.

5.5.1 Technical Assessment Summary

Based on the results of the technical assessment, human and ecological exposures are currently under control and no unacceptable risks are occurring.

5.6 Issues and Associated Recommendations, and Follow Up Actions

No issues or follow up actions have been identified for Site 4 based on this Five-Year Review.

5.7 Protectiveness Statement

The remedy at Site 4 is protective of human health and the environment.

The soil cover is in good condition and prevents direct contact with landfill contents. LUCs are in place and prevent intrusive activities and unauthorized site use. Groundwater monitoring data indicate a release has not occurred from the landfill. There have been no changes in the physical conditions or use of the site that would affect the protectiveness of the remedy.

TABLE 5-1
Site 4 Constituents of Concern Requiring a Response Action
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Constituents of Concern	Surface Soil	Combined Surface and Subsurface Soil	Sediment
Semivolatile Organic Compounds			
Anthracene	X		
Benzo(a)anthracene	X		
Benzo(a)pyrene	X		
Fluoranthene	X		
Phenanthrene	X		
Pyrene	X		
Pesticides/Polychlorinated Biphenyls			
Aroclor-1260	X		
Inorganics			
Arsenic	X	X	
Chromium	X		
Copper	X		
Iron	X	X	X
Lead	X		
Mercury	X		X
Nickel	X		
Vanadium	X		
Zinc	X		

Human health risk drivers
Ecological risk drivers
Human health and ecological risk drivers

TABLE 5-2

Site 4 Shallow Aquifer Groundwater Arsenic

Detections and Exceedances of Screening Criteria

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Station ID	MCL-Groundwater	SJCA 95% UTL Groundwater	SJS04-MW01S							
Sample ID			SJS04-GW1S-001	SJS04-GW1S-002	SJS04-GW1S-003	SJS04-MW01S-06D	SJS04-MW01S-07A*	SJS04-MW01S-07B	SJS04-MW01S-07C	SJS04-MW01S-07D
Sample Date			07/21/97	11/03/97	05/18/99	11/28/06	02/28/07	05/29/07	08/28/07	11/20/07
Chemical Name										
Total Metals (UG/L)										
Arsenic	10	8	3 U	3.2 U	2 U	2 B	1 U	1.2	1 UJ	0.7 B
Dissolved Metals (UG/L)										
Arsenic	10	2.4	3 U	3.2 U	2 U	1.9 B	1 U	1.2	1 UJ	0.78 B

Notes:
* A duplicate sample was collected at this location; the most conservative result is shown.
Bold Blue font represents MCL exceedance
Shaded cells represent SJCA 95% UTL exceedance
B - Analyte not detected above the level reported in blanks
J - Reported value is estimated
U - Analyte not detected
UG/L - micrograms per liter
UTL - Upper Tolerance Limit
MCL - Maximum Contaminant Level

TABLE 5-2

Site 4 Shallow Aquifer Groundwater Arsenic

Detections and Exceedances of Screening Criteria

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Station ID	MCL-Groundwater	SJCA 95% UTL Groundwater	SJS04-MW01S					SJS04-MW03S		
Sample ID			SJS04-MW01S-08A	SJS04-MW01S-08B	SJS04-MW01S-08C	SJS04-MW01S-09C	SJS04-MW01S-14A	SJS04-GW3S-001	SJS04-GW3S-002	SJS04-GW3S-003
Sample Date			02/19/08	05/29/08	08/21/08	08/24/09	02/19/14	07/21/97	11/03/97	05/18/99
Chemical Name										
Total Metals (UG/L)										
Arsenic	10	8	1 U	0.3 B	0.61 J	1.5 B	5 U	3 U	3.2 U	2.30 J
Dissolved Metals (UG/L)										
Arsenic	10	2.4	0.3 J	1 U	0.67 J	1.8 B	5 U	3 U	3.2 U	3.5 J

Notes:
* A duplicate sample was collected at this location; the most conservative result is shown.
Bold Blue font represents MCL exceedance
Shaded cells represent SJCA 95% UTL exceedance
B - Analyte not detected above the level reported in blanks
J - Reported value is estimated
U - Analyte not detected
UG/L - micrograms per liter
UTL - Upper Tolerance Limit
MCL - Maximum Contaminant Level

TABLE 5-2

Site 4 Shallow Aquifer Groundwater Arsenic

Detections and Exceedances of Screening Criteria

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Station ID	MCL-Groundwater	SJCA 95% UTL Groundwater	SJS04-MW03S							
Sample ID			SJS04-MW03S-06D	SJS04-MW03S-07A	SJS04-MW03S-07B	SJS04-MW03S-07C*	SJS04-MW03S-07D	SJS04-MW03S-08A*	SJS04-MW03S-08B*	SJS04-MW03S-08C*
Sample Date			11/28/06	02/28/07	05/29/07	08/28/07	11/20/07	02/19/08	05/29/08	08/21/08
Chemical Name										
Total Metals (UG/L)										
Arsenic	10	8	1.9 B	0.63 J	1.3	1.7	2.8 B	0.96 J	0.65 J	1.2 J
Dissolved Metals (UG/L)										
Arsenic	10	2.4	1.8 B	0.51 J	1	1.9	1.8 B	0.78 J	0.5 J	1.5 J

Notes:
* A duplicate sample was collected at this location; the most conservative result is shown.
Bold Blue font represents MCL exceedance
Shaded cells represent SJCA 95% UTL exceedance
B - Analyte not detected above the level reported in blanks
J - Reported value is estimated
U - Analyte not detected
UG/L - micrograms per liter
UTL - Upper Tolerance Limit
MCL - Maximum Contaminant Level

TABLE 5-2

Site 4 Shallow Aquifer Groundwater Arsenic

Detections and Exceedances of Screening Criteria

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Station ID	MCL-Groundwater	SJCA 95% UTL Groundwater	SJS04-MW03S		SJS04-MW04S					
Sample ID			SJS04-MW03S-09C	SJS04-MW03S-14A*	SJS04-GW4S-001	SJS04-GW4S-002	SJS04-GW4S-003	SJS04-MW04S-06D*	SJS04-MW04S-07A	SJS04-MW04S-07B*
Sample Date			08/24/09	02/19/14	07/21/97	11/04/97	05/18/99	11/27/06	02/28/07	05/29/07
Chemical Name										
Total Metals (UG/L)										
Arsenic	10	8	1.7 B	5 U	9.2 J	**11**	9.5 J	**37.4**	**18.9**	**35**
Dissolved Metals (UG/L)										
Arsenic	10	2.4	1.6 B	5 U	7 J	5.5 J	7.90 B	**35.9**	**18.4**	**31.9**

Notes:
* A duplicate sample was collected at this location; the most conservative result is shown.
Bold Blue font represents MCL exceedance
Shaded cells represent SJCA 95% UTL exceedance
B - Analyte not detected above the level reported in blanks
J - Reported value is estimated
U - Analyte not detected
UG/L - micrograms per liter
UTL - Upper Tolerance Limit
MCL - Maximum Contaminant Level

TABLE 5-2

Site 4 Shallow Aquifer Groundwater Arsenic

Detections and Exceedances of Screening Criteria

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Station ID	MCL-Groundwater	SJCA 95% UTL Groundwater	SJS04-MW04S							SJS04-MW05S
Sample ID			SJS04-MW04S-07C	SJS04-MW04S-07D*	SJS04-MW04S-08A	SJS04-MW04S-08B	SJS04-MW04S-08C	SJS04-MW04S-09C*	SJS04-MW04S-14A	SJS04-MW05S-06D
Sample Date			08/28/07	11/20/07	02/19/08	05/29/08	08/21/08	08/24/09	02/19/14	11/27/06
Chemical Name										
Total Metals (UG/L)										
Arsenic	10	8	**38.8**	**32.9**	7.2	6.1	**22.1**	**21.8 J**	5 U	1.9 B
Dissolved Metals (UG/L)										
Arsenic	10	2.4	**49**	**29.7**	6.4	**12.3**	**24.4**	**21.7**	3.8 B	1.8 B

Notes:
* A duplicate sample was collected at this location; the most conservative result is shown.
Bold Blue font represents MCL exceedance
Shaded cells represent SJCA 95% UTL exceedance
B - Analyte not detected above the level reported in blanks
J - Reported value is estimated
U - Analyte not detected
UG/L - micrograms per liter
UTL - Upper Tolerance Limit
MCL - Maximum Contaminant Level

TABLE 5-2

Site 4 Shallow Aquifer Groundwater Arsenic

Detections and Exceedances of Screening Criteria

Five-Year Review Report

St. Juliens Creek Annex

Chesapeake, Virginia

Station ID	MCL-Groundwater	SJCA 95% UTL Groundwater	SJS04-MW05S								
Sample ID			SJS04-MW05S-07A	SJS04-MW05S-07B	SJS04-MW05S-07C	SJS04-MW05S-07D	SJS04-MW05S-08A	SJS04-MW05S-08B	SJS04-MW05S-08C	SJS04-MW05S-09C	SJS04-MW05S-14A
Sample Date			02/28/07	05/29/07	08/28/07	11/20/07	02/19/08	05/29/08	8/21/2008	8/24/2009	2/20/2014
Chemical Name											
Total Metals (UG/L)											
Arsenic	10	8	1.2	2.5	2.9	3.6 B	1.8	4.6 J	2.5	3 B	5 U
Dissolved Metals (UG/L)											
Arsenic	10	2.4	1.3	2.7	2.5	2.3 B	2.1	4.9 J	3.9	7.5 B	2.8 B

Notes:
* A duplicate sample was collected at this location; the most conservative result is shown.
Bold Blue font represents MCL exceedance
Shaded cells represent SJCA 95% UTL exceedance
B - Analyte not detected above the level reported in blanks
J - Reported value is estimated
U - Analyte not detected
UG/L - micrograms per liter
UTL - Upper Tolerance Limit
MCL - Maximum Contaminant Level

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 5-1 - Location of Site 4.mxd9/24/2014cbowman

Legend

- Shallow Aquifer Monitoring Well
- Fence
- Access Road
- SJCA Boundary
- Site 4 Boundary
- Estimated Groundwater Flow Direction (February 2014)
- S LUC Sign

N W E S

0 75 150 Feet

Figure 5-1
Site 4 Location and Vicinity
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

SECTION 6

Site 21 – Industrial Area

This section presents background information and the Five-Year Review evaluation for Site 21.

6.1 Site Chronology and Background

The following is a chronology of the major events for Site 21.

Date	Event
Unknown	Waste oils and degreasers (including trichloroethene [TCE]) reportedly disposed of on the ground surface and around railroad tracks
August 1981	IAS completed
1983	PA completed
March 1989	Phase II RFA completed
February 1995	EPIC Study and Regulatory Review completed
April 1996	RRR System Data Collection Report completed
January 2000	HRS Documentation Record completed
July 2000	SJCA placed on NPL
April 2002	Site Screening Assessment completed
July 2004	FFA signed
April 2006	Site Inspection completed
June 2008	RI completed
March 2009	FS completed
July 2009	Interim Proposed Plan completed
May 2010	Interim ROD signed and RD for in situ chemical reduction (ISCR) and ERD remedy components completed
October 2010	RI and FS Addendum completed
November 2010	Initiated RA
May 2011	Proposed Plan completed
October 2011	ROD signed and RD for LUC remedy component completed
May 2012	RA-C completed and RA-Operation initiated
September 2012	Initiated LUC Inspections
July 2013	Interim RA Completion Report (IRACR) signed
May 2014	Additional injections conducted

6.1.1 Physical Characteristics

Site 21 is located in the south-central portion of SJCA (**Figure 6-1**)**.** Most of Site 21's ground surface, with the exception of a few small, unconnected grassy areas, is covered with asphalt. The general topography of the area is flat, with elevations ranging from 7 to 9 feet above msl. A storm sewer system runs through the site and drains to a detention basin southwest of the site.

The subsurface geology at Site 21 consists of the fine to coarse silty and clayey sands of the Columbia aquifer underlain by the high-plasticity clay of the Yorktown confining unit. The Columbia aquifer extends to a depth of

between 13.5 and 20 feet bgs. Shallow groundwater flow velocity has been calculated to be approximately 72 feet per year. The Yorktown confining unit, consisting of relatively impermeable silt and clay layers, is approximately 17 feet thick and continuous at Site 21 and lies above the fine to coarse shelly sands of the Yorktown aquifer. Shallow groundwater at Site 21 is encountered from 2 to 7 feet bgs and flows southwest in the eastern portions of the site and southeast in the western portion of the site, toward the storm sewer system east of Building 1556 (**Figure 6-1**).

6.1.2 Land and Resource Use

Site 21 is currently an industrial area. The existing buildings and the Site 21 area are currently used for storage and maintenance activities. Although groundwater is not currently used as a potable water supply at or in the vicinity of SJCA (**Section 2.1**), the Navy acknowledges the Commonwealth of Virginia's and USEPA's expectation to return usable groundwaters to their beneficial uses wherever practicable. Groundwater use, building use, and building construction within the LUC boundaries at the site are controlled through site signs and notation in the iNFADS maintained by Commander Naval Region Mid-Atlantic. Additionally, the annually-updated SMP for SJCA includes maps and GIS layers that depict the LUCs at the site.

Anticipated future land use for the site is to remain as an industrial area.

6.1.3 History of Contamination

Site 21 was initially identified as Building 187 (**Figure 6-1**), a locomotive maintenance facility where TCE was used; however, data from investigations indicated the need to expand the initial boundary. The expanded boundary includes IRP Sites 9, 10, 11, 12, 13, 14 and 18, which were previously identified as separate sites (**Figure 6-1**). The current boundary encompasses a number of nearby industrial buildings, which historically were used as machine, vehicle, and locomotive maintenance shops, electrical shops, and munitions-loading facilities. The outdoor areas were used for storing equipment and chemicals. Railroad tracks were present throughout the industrial area. A fuel service station, including two underground storage tanks, had existed just south of Building 187. The underground tanks were closed in place in 1982. Waste oils and degreasers (including TCE) were reportedly disposed of on the ground surface and around the railroad tracks in this industrial area.

6.1.4 Initial Response

An interim RA was initiated in November 2010. The selected remedy, ISCR and ERD, to address risk to future hypothetical residents from potable use of shallow aquifer groundwater was documented in an Interim ROD (NAVFAC, 2010). The interim action was initiated to reduce COC concentrations in shallow groundwater while potential risk to current and future building occupants from inhalation of groundwater vapor in indoor air was further investigated. No unacceptable risks from the vapor intrusion pathway were identified; therefore, the interim action became the final action for the site, as documented in the final ROD for the site (NAVFAC, 2011c).

6.1.5 Basis for Remedial Action

An HHRA was conducted as part of the RI (CH2M HILL, 2008) to evaluate potential risks to human health from exposure to site media under current and potential future land use scenarios, as follows:

- Current industrial worker exposed to shallow groundwater (inhalation of volatile emissions in indoor air)
- Future construction worker exposed to shallow groundwater (dermal contact and inhalation of volatile emissions)
- Future adult/child resident exposed shallow and deep groundwater (ingestion, dermal contact, inhalation of volatile emissions while showering [adult only], and inhalation of volatile emissions in indoor air [shallow groundwater only])

A screening level human health risk evaluation conducted as part of the SI did not identify any unacceptable risks from exposure to soil; therefore, soil was not considered as a potential exposure point in the baseline HHRA conducted as part of the RI. Surface water and sediment were not considered as potential exposure points in the baseline HHRA because there are no surface water or sediment features located within the site boundary.

A screening level HHRA was conducted as part of the RI and FS Addendum (CH2M HILL, 2010c) to further evaluate potential risks to human health from exposure through the vapor intrusion pathway under current and future land use scenarios, as follows

- Current and Future industrial worker exposed to shallow groundwater (inhalation of volatile emissions in indoor air)
- Future adult/child resident exposed shallow groundwater (inhalation of volatile emissions in indoor air [shallow groundwater only])

A baseline ERA was not conducted for Site 21 based on the recommendations of the ecological risk screenings conducted during the SSA (CH2M HILL, 2002), SI (CH2M HILL, 2004a), and RI (CH2M HILL, 2008a). The ecological risk screening conducted during the SSA concluded that Site 21 provides little terrestrial habitat and no aquatic habitat for potential ecological receptors. During the SI and RI ecological risk screenings, no ecological risks were identified from exposure to storm water discharging to downgradient Site 2 surface water based on a comparison of analytical results to BTAG surface water screening criteria. It was determined that the water in the storm sewer system at Site 21 is primarily groundwater, except during precipitation events when it also contained storm water, and it would be addressed during the Site 21 groundwater RA. Therefore, no ecological risks were identified.

Based on the evaluation of the HHRA and ERA and subsequent risk management decisions that were made, it was determined that potable exposure to VOCs at Site 21 posed an unacceptable risk to human health. The COCs requiring a response action are 1,1-dichloroethene (DCE), TCE, vinyl chloride (VC), and cis-1,2-DCE. No unacceptable risks from exposure to soil or deep groundwater were identified.

Although no RA is required to address the vapor intrusion exposure scenario, continued vapor intrusion evaluation is warranted until shallow groundwater cleanup levels are achieved since the RA for groundwater is expected to temporarily increase concentrations of TCE daughter products (CH2M HILL, 2010c).

6.2 Remedial Actions

6.2.1 Remedy Selection

A final ROD for Site 21 was signed in October 2011. The selected remedy consisted of ISCR, ERD, and implementation of LUCs to meet the following RAOs:

- Reduce contaminant concentrations in shallow groundwater to the maximum extent practicable
- Prevent exposure to shallow groundwater until contaminant concentrations allow for unlimited use and unrestricted exposure

Cleanup levels were established for the COCs. To achieve the RAOs and comply with the Commonwealth of Virginia's and USEPA's expectations to return usable groundwaters to their beneficial uses wherever practicable, the cleanup levels were established as the MCLs after consideration of the total risks/hazards associated with their use. Cleanup levels are identified in **Table 6-1**.

Unacceptable risks, RAOs, remedy components, performance standards, and expected outcomes for evaluating the overall performance of the remedy as documented in the ROD are summarized in **Table 6-2.**

The following LUC objectives for Site 21 were identified in the ROD:

- Prohibit withdrawal of groundwater except for environmental monitoring
- Prohibit a change from current industrial building use to residential, child care, or elementary or secondary school use without further evaluation and/or implementation of mitigation measures
- Prevent occupation of unoccupied buildings, construction of new buildings, and activities that would compromise the integrity of the building envelopes without further evaluation and/or implementation of mitigation measures

The LUCs will be maintained until all parties (Navy, USEPA, and Commonwealth of Virginia) agree that site conditions allow for UU/UE.

6.2.2 Remedy Implementation

The RD for the ISCR and ERD components of the Selected Remedy at Site 21 was completed in May 2010 (CH2M HILL, 2010a). The RD for the LUC component of the Selected Remedy was completed in October 2011 (NAVFAC, 2006a).

The RA was initiated in November 2010 and construction was completed in May 2012. The RA components are shown in **Figure 6-2**. The RA-Construction consisted of the following activities:

- Implementation of ISCR through direct injection of zero valent iron into the accessible portions of the shallow aquifer high-concentration zone (individual COC concentrations greater than 1,000 micrograms per liter)
- Implementation of ERD through injection of EVO into the accessible portions of the shallow aquifer low-concentration zone (individual COC concentrations greater than cleanup levels and less than 1,000 micrograms per liter)
- Installation of signs around the perimeter of the site indicating the groundwater and building construction and use restrictions
- Documentation of the restrictions for groundwater use and building construction and use within the LUC boundaries at the site in the iNFADS maintained by Commander Naval Region Mid-Atlantic and the annually-updated SMP for SJCA.

In September 2012, an IRACR for Site 21 was signed to document the remedy was in place, operating and functioning as intended, and protective of human health and the environment (NAVFAC, 2012).

6.2.3 Remedy Operation and Maintenance

The RA is currently in the RA-Operation phase (initiated May 2012). The RA-Operation phase includes groundwater monitoring to evaluate remedy effectiveness, storm water monitoring to evaluate whether groundwater with contaminants at concentrations of concern are migrating offsite through the storm drain system, vapor intrusion monitoring to evaluate whether the RA or building deterioration have resulted in potential unacceptable inhalation risks or explosive hazards, additional EVO injections (if needed), and LUCs maintenance.

The RA-Operation phase groundwater, storm water, and vapor intrusion monitoring are currently being conducted semiannually; however, the frequency may be adjusted as the RA progresses. Five monitoring events had been conducted and reported at the time this report was being drafted (October 2014). Additional EVO injections were conducted in May 2014 (CB&I, 2014).

In accordance with the ROD and LUC RD, LUC inspections are being conducted annually to verify LUCs are in place (NAVFAC, 2011b). The inspections were initiated in 2012. The findings from the inspections are documented in annual letter reports submitted to the regulatory stakeholders. Two annual inspections had been conducted at the time this report was being drafted (October 2014). The annual inspection reports are provided in **Appendix B**. Throughout the inspections, no signs of unauthorized land use have been observed. Additionally, the monitoring wells and signs have remained in good condition and there have been no signs of unauthorized intrusive activities, IDW storage, or dumping within the site.

The average operations and maintenance costs is approximately $100,000[1] per year. The estimated operations and maintenance costs for the selected remedy in the ROD were approximately $125,000,000 per year; the actual cost for the selected remedy is less than the estimated costs.

[1] Total estimated based on costs associated with groundwater and vapor intrusion monitoring.

6.3 Progress since Last Five-Year Review

The Interim ROD was signed in May 2010, the Remedial Action was initiated in November 2010, and the ROD was signed in October 2011. This is the first Five-Year Review for Site 21.

6.4 Five-Year Review Process

6.4.1 Document Review

Appendix A includes a list of the documents associated with Site 21 that were reviewed.

6.4.2 Data Review

No data other than the data presented in the documents included in **Appendix A** were reviewed. Data results following the additional injections conducted in May 2014 had not been reported at the time this report was being drafted (October 2014). The RA-operation data that was available for review for this report are provided in **Appendix E**.

The most recent RA-Operation groundwater data indicate an overall reduction of TCE concentrations following the initial injections (Sovereign, 2014). The extent of the TCE plume has decreased and now consists of four smaller plumes with wells demonstrating no apparent trends or decreasing trends (**Figure 6-3**). The overall extent of COCs exceeding their cleanup levels has decreased by approximately 50 percent (**Figure 6-4**). The concentrations of daughter products (cis-1,2-DCE and VC) indicate continued COC degradation across most of the remaining plume. The cis-1,2-DCE analytical results indicate that the majority of the wells (all but one) demonstrated either a decreasing trend or no trend. The majority of the VC concentrations showed no apparent trends. The indicator parameter data shows that, with the exception of a few wells, overall site conditions remain favorable for reductive dechlorination. Arsenic levels were above the project indicator level at 12 locations; however, mobilization of arsenic is often observed with reducing conditions and the concentrations of arsenic are expected to return to pre-treatment conditions once COC degradation is complete.

The results from the two storm water system sampling events that had been reported at the time this documented was being drafted (October 2014) indicate that although COCs were present in the storm water system, groundwater with contaminants at concentrations of concern is not migrating offsite through the storm sewer system (Sovereign, 2014). This conclusion is based on comparison of the storm water data to the Virginia Surface Water Criteria, which are less than the associated BTAG surface water screening values and which there were no exceedances of.

The results from the five vapor intrusion monitoring events that had been reported at the time this report was being drafted (October 2014) indicate that changes resulting from the RA or changes in building characteristics have not resulted in inhalation risks above the project action limits and/or target levels in the occupied buildings or explosive hazards beneath and/or within the occupied or unoccupied buildings (CH2M HILL, 2014b).

6.4.3 Site Inspection

No significant issues were identified during the Five-Year Review site inspection. The signs were up to date and in good condition. The groundwater monitoring wells were in good condition, although several of the well covers were missing well identification labels and bolts. No signs of unauthorized intrusive activities, IDW storage, dumping, or building occupancy within the site were observed. The completed site inspection checklist is provided in **Appendix B** and arrangements to add missing well identification labels and replace the missing bolts are being made.

6.4.4 Interviews

No significant or specific problems or concerns regarding the site or the remedy were identified during the interviews or in the questionnaire responses. The responses indicated that the more awareness a respondent had of the RA, the more confident they were that it is protective of human health and the environment. The interviews and questionnaire results are further discussed in the CIP (CH2M HILL, 2014d).

6.5 Technical Assessment

Question A: Is the remedy functioning as intended by the decision document?

The remedy is functioning as intended in the ROD.

Remedial Action Performance

The RA is performing as expected. Based on the results of the data provided in the most recent RA-Operation groundwater and storm water monitoring report (Sovereign, 2014), COCs in the groundwater are not being transferred offsite through the storm water system at concentrations of concern; and there has been significant reduction in the groundwater COCs and conditions are favorable for continued degradation. However, additional EVO injections were conducted in May 2014 as a polishing treatment to target areas of the site in which the COC degradation appeared to be slowing or stalled. Additional injections will be performed, as needed. The LUC inspections have confirmed that use of groundwater and unauthorized land and building use and construction has not occurred.

Operation and Maintenance Activities

Continuation of the current O&M activities as currently implemented is expected to continue to maintain the effectiveness of the response action. O&M costs are less than the original estimates.

Opportunities for Optimization

In 2013 the Team developed a decision logic for monitoring well optimization. The decision logic defines criteria to eliminate wells from the monitoring network and reduce analytes and monitoring frequency and will continue to be used to optimize the monitoring program. The RA-Operation vapor intrusion monitoring approach was being revisited at the time this report was drafted (October 2014) to determine whether there were opportunities to optimize that monitoring approach. No other opportunities for optimization have been identified.

Early Indicators of Potential Issues

As discussed previously, RA-Operation groundwater monitoring data indicate that overall conditions are favorable for continued COC degradation in the shallow aquifer groundwater. Because the data indicted the potential that the degradation might be slowing or stalled in areas of the site, additional EVO injections were conducted in May 2014. The RA-Operation groundwater monitoring data will continue to be evaluated to determine if additional injections should be considered.

Implementation of ICs and Other Measures

The LUCs identified in the LUC RD are in place and effective. Annual site inspections have verified that residential use and unauthorized building use and construction is not occurring. The site signs have remained intact. A notation of the land use restrictions is included in the iNFADS maintained by Commander Naval Region Mid-Atlantic. The annually-updated SMP for SJCA includes maps and geographic information system layers depicting the LUCs for Site 21.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection are still valid. However, the potential for the presence of emerging contaminants, which have not been investigated at the site, has been identified.

Changes in Standards and TBCs

No changes in standards or TBCs that adversely affect the protectiveness of the remedy were identified during this Five-Year Review.

Changes in Exposure Pathways

There have not been any changes in the land use at the site. No new routes of exposure or receptors have been identified. There is no indication that physical site conditions (such as hydrologic or hydrogeologic conditions) have changed in a way that could affect the protectiveness of the remedy.

In order to assess whether any of the common emerging contaminants could be present at the site and warrant investigation if they were not previously investigated and not addressed by the Selected Remedy, the site history and data were evaluated to assess the potential for those contaminants. The evaluation process is provided as **Appendix C**. Based on this review, PFCs and dioxins/furans were not analyzed for and are not expected to be present at the site. Because 1,4-dioxane and perchlorate have not been sampled for and their presence cannot be ruled out based on site history, they are recommended for investigation .

Changes in Toxicity and Other Contaminant Characteristics

Although the human health toxicity values for some of the COCs have changed since the ROD was signed, the cleanup goals for the COCs are the federal MCLs, which have not changed since the ROD was signed. There are no complete ecological exposure pathways at the site.

Therefore, changes in toxicity values would not affect the protectiveness of the selected remedy, as they would not change the cleanup levels.

Changes in Risk Assessment Methodologies

There have been no significant changes in standardized risk assessment methodologies that could affect the protectiveness of the remedy at Site 21 for the exposure scenarios since the final ROD was signed in 2011. Although the standard exposure factors used to estimate human health risks were updated in 2014, the changes were not significant enough to result in changes to the protectiveness of the Site 21 remedy.

Expected Progress Towards Meeting RAOs

The remedy has made significant progress in meeting the RAOs and achievement of the RAOs is expected.

Question C: Has any other information come to light that could question the protectiveness of the remedy?

No other information has come to light that could question the protectiveness of the remedy.

Impacts from Natural Disasters

The RA is not expected to be impacted by natural disasters. There have not been any impacts to the remedy effectiveness as the result of natural disasters.

Any Other Information That Could Affect Protectiveness of the Remedy

There is no other information that could affect the protectiveness of the remedy.

6.5.1 Technical Assessment Summary

Based on the results of the technical assessment, human and ecological exposures are currently under control and no unacceptable risks are occurring. However, there is the potential for future protectiveness to be impacted because of the potential for the emerging contaminant, perchlorate, to be present at the site.

6.6 Issues Identified, Recommendations and Actions Needed, and Follow Up Actions

Table 6-3 outlines the issues identified for Site 21 during this Five-Year Review and presents recommendations and follow-up actions. Because this is the first Five-Year Review for Site 21, there are no carryover issues from the earlier Five-Year Review.

6.7 Protectiveness Summary

The remedy at Site 21 currently protects human health and the environment because exposure pathways that could result in unacceptable risk are being controlled through LUCs. However, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure continued protectiveness: complete a groundwater evaluation to determine if 1,4-dioxane and perchlorate should be considered COCs for the site and revise the site remedy, LUC boundary, and/or treatment system if warranted.

TABLE 6-1
Site 21 Constituents of Concern Cleanup Levels
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Constituent of Concern	Cleanup Level (µg/L)	Cleanup Level Basis*
1,1-dichloroethene	7	MCL[1]
Trichloroethene	5	
Vinyl chloride	2	
cis-1,2-dichloroethene	70	

Notes:
[1]USEPA, 2009. *National Primary Drinking Water Regulations*. EPA 816-F-09-004. May.
*Total risks/hazards associated with use of Federal MCLs as PRGs were calculated and verified to be acceptable (within the acceptable range of $1x10^{-4}$ to $1x10^{-6}$ and/or total hazard index to a target organ does not exceed 1.0).
MCL – Maximum Contaminant Level
µg/L – microgram per liter

TABLE 6-2
Site 21 Remedial Action Summary and Expected Outcomes
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Risk		Remedial Action Objective	Remedy Component	Metric	Expected Outcomes	
Human Health	Ecological					
Shallow Groundwater						
Ingestion of, dermal contact with, and inhalation of chlorinated volatile organic compounds in shallow groundwater under future potable use scenario	No exposure pathway	Reduce contaminant concentrations in shallow groundwater to the maximum extent practicable	ISCR in high-concentration zone	Monitor shallow groundwater constituent of concern concentrations to confirm reduction of constituent of concern concentrations	Achieve unlimited use and unrestricted exposure or transition to ERD	Removal of LUCs
			Monitoring			
			ERD	Monitor shallow groundwater constituent of concern concentrations to confirm reduction of constituent of concern concentrations to at or below cleanup levels	Achieve unlimited use and unrestricted exposure	
			Monitoring			
			Monitoring	Monitor to evaluate the potential for vapor intrusion and discharge to the stormwater detention basin until cleanup levels are achieved	Removal of LUCs	
		Prevent exposure to shallow groundwater until contaminant concentrations allow for unlimited use and unrestricted exposure	LUCs	Periodic inspection of the site to confirm adherence to LUCs until shallow groundwater constituents of concern are at or below their respective cleanup levels	Removal of LUCs	

ERD – enhanced reductive dechlorination

ISCR – in situ chemical reduction

LUC – land use control

TABLE 6-3
Site 21 Issues, Recommendations, and Follow-Up Actions
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

Issue	Recommendations and Follow-up Actions	Party Responsible	Milestone Date	Affects Protectiveness	
				Current	Future
Monitoring					
Based on site history, there is the potential for emerging contaminants perchlorate and 1,4-dioxane to be present in the site groundwater. However, the presence of perchlorate and 1,4-dioxane and any resulting unacceptable risk is unknown.	Conduct an investigation to determine whether perchlorate and 1,4-dioxane are present and pose unacceptable risk in the shallow aquifer groundwater and should be included as COCs for the site. Revise the site remedy, LUC boundary, and/or treatment system if warranted.	Navy	May 2017	No	Yes

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 6-1 - Location of Site 21.mxd10/6/2014cbowman

Legend

- Site 21 Boundary
- Estimated Groundwater Flow Direction
- No Further Action IR Site
- Approx. Areas of TPH Contaminated Soil Removal (1993)
- VEPCO Corridor
- Storm Sewer System
- Abandoned Storm Sewer System
- Demolished Buildings
- Former Railroad Track
- Drainage
- Enhanced Extended Detention Basin
- Approximate Locations of Former USTs
- Former Pump Island

N W E S

0 100 200 Feet

Figure 6-1
Site 21 Location and Vicinity
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

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R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 6-2 - Site 21 Remedial Action Components.mxd10/6/2014cbowman

Legend

- Shallow Aquifer Monitoring Well
- Remedial Action-Operation Phase Permanent EVO Injection Well
- Remedial Action-Operation Phase Temporary EVO Injection Location
- Remedial Action-Construction Phase Temporary ZVI Injection Location
- Remedial Action-Construction Phase Temporary EVO Injection Location
- Small Sign
- VEPCO Corridor
- Site 21

N
W E
S

0 100 200 Feet

Figure 6-2
Site 21 Remedial Action Components
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

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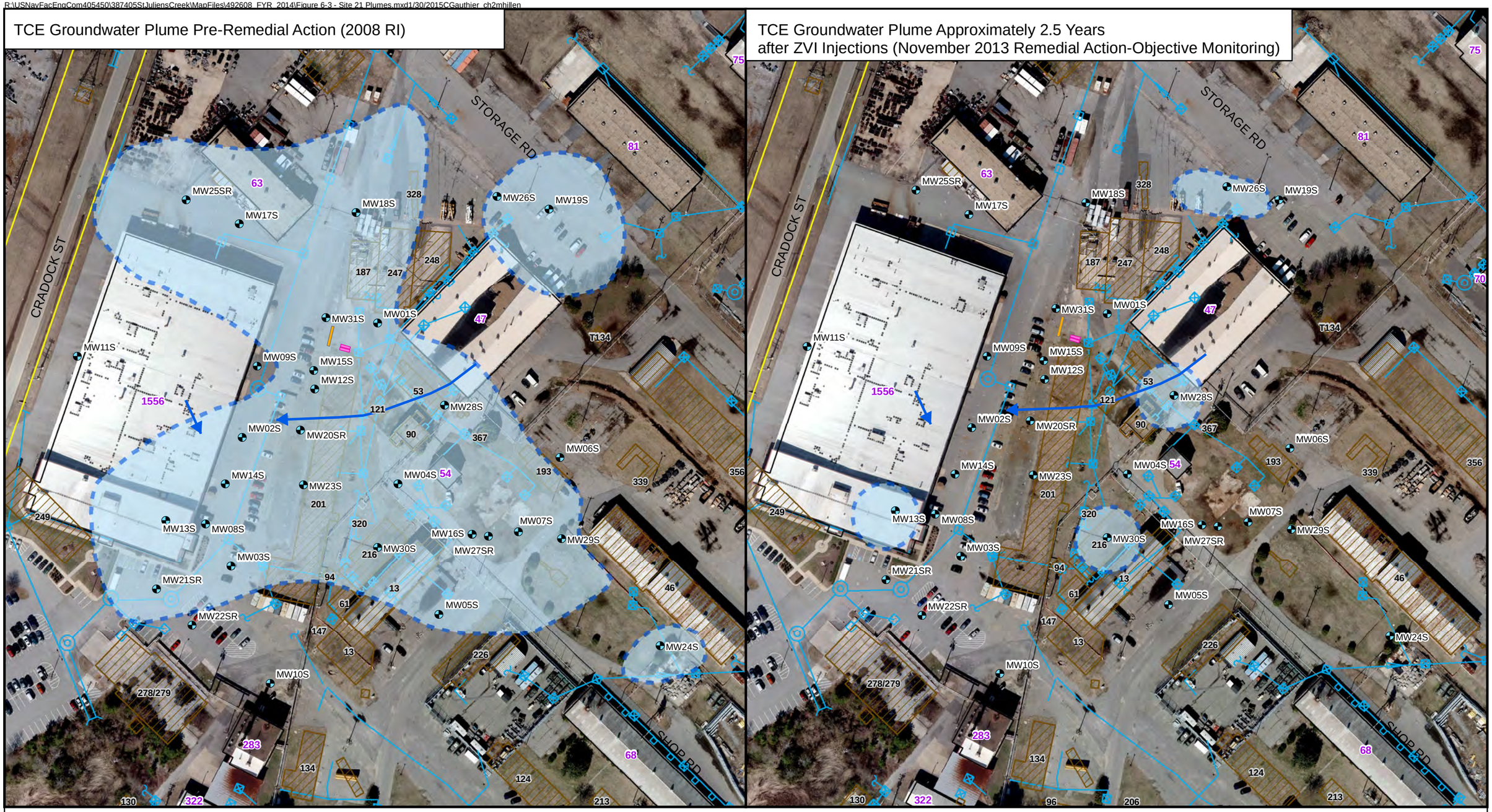
R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 6-3 - Site 21 Plumes.mxd1/30/2015CGauthier_ch2mhillen

TCE Groundwater Plume Pre-Remedial Action (2008 RI)

TCE Groundwater Plume Approximately 2.5 Years
after ZVI Injections (November 2013 Remedial Action-Objective Monitoring)



Legend

- Shallow Aquifer Groundwater Monitoring Well
- Estimated Groundwater Flow Direction
- VEPCO Corridor
- Demolished Building
- Existing Building
- Cumulative COC Groundwater Plume

Notes:
The plume boundaries are based on the cumulative extent of COCs greater than the MCLs (pre-remedial action) or Cleanup Goals (post injections).
Monitoring wells MW05S, MW06S, MW10S, MW12S, MW24S, and MW29S not sampled for groundwater COCs during the November 2013 monitoring event

N
W E
S

0 130 260
Feet

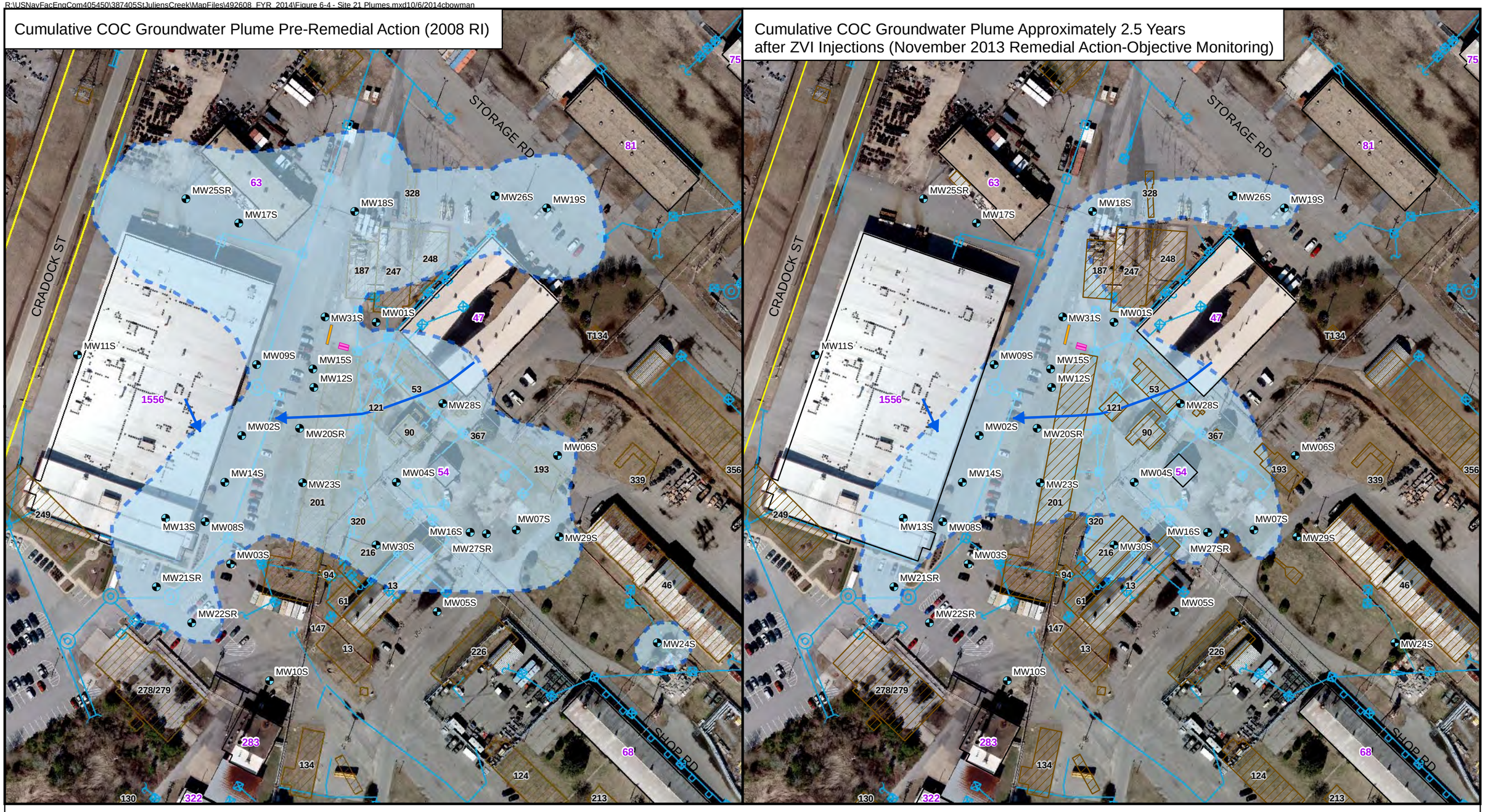
Figure 6-3
Site 21 Groundwater Remediation Progress - TCE Plume
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Figure 6-4 - Site 21 Plumes.mxd10/6/2014cbowman

Cumulative COC Groundwater Plume Pre-Remedial Action (2008 RI)

Cumulative COC Groundwater Plume Approximately 2.5 Years after ZVI Injections (November 2013 Remedial Action-Objective Monitoring)



Legend

- Shallow Aquifer Groundwater Monitoring Well
- Estimated Groundwater Flow Direction
- VEPCO Corridor
- Demolished Building
- Existing Building
- Cumulative COC Groundwater Plume

Notes:
The plume boundaries are based on the cumulative extent of COCs greater than the MCLs (pre-remedial action) or Cleanup Goals (post injections).
Monitoring wells MW05S, MW06S, MW10S, MW12S, MW24S, and MW29S not sampled for groundwater COCs during the November 2013 monitoring event

N
W E
S

0 130 260
Feet

Figure 6-4
Site 21 Groundwater Remediation Progress - Cumulative COC Plume
Five-Year Review Report
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 7

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Appendix B
Annual Inspection Reports and Five-Year Review Inspection Checklists

I. SITE INFORMATION

Site Name: Site 2 - Waste Disposal Area B | **Date of Inspection:** 7/31/2014

Location and Region: St. Juliens Creek Annex, Chesapeake, Virginia | **EPA ID:** VA5170000181

Agency, office, or company leading the five-year review: NAVFAC Mid-Atlantic with USEPA and VDEQ | **Weather/ temperature:** Clear and 80 °F

Remedy Includes: (Check all that apply):

- Landfill cover/containment ☑
- Access controls ☐
- Institutional controls ☑
- Groundwater pump and treatment ☐
- Surface water collection and treatment ☐
- Monitored natural attenuation ☑
- Groundwater containment ☐
- Vertical barrier walls ☐

Other : In situ groundwater treatment

Attachments: Site Map Attached ☑

II. INTERVIEWS

1. Local regulatory authorities and response agencies (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.)

Agency VDEQ

Contact Karen Doran/RPM (Name/Title) | 9/29/2014 (Date) | 804-698-4594 (Phone #)

Problems, suggestions: No issues or suggestions; indicated that the remedy is protective of human health and the environment.

☐ Report attached

III. ACCESS AND INSTITUTIONAL CONTROLS

A. Other Access Restrictions

1. Signs and other security measures N/A ☐

Locations shown on site map ☑

Remarks : Signs in place, clearly visible, and have current information

B. Institutional Controls (ICs)

1. Implementation and enforcement

Conditions imply ICs not properly implemented — Yes ☐ | No ☑ | N/A ☐

Conditions imply ICs not being fully enforced — Yes ☐ | No ☑ | N/A ☐

Type of monitoring (e.g., self-reporting, drive by) : LUC Tracker, site inspections, and Environmental Checklists

Frequency : Annual (LUCs) & as needed (Environmental Checklists for new projects)

Responsible party : NAVFAC

Contact : Krista Parra/RPM (Name/Title) | 757-341-0395 (Phone No.)

Reporting is up to date — Yes ☑ | No ☐ | N/A ☐

Reports are verified by the lead agency — Yes ☑ | No ☐ | N/A ☐

Specific requirements in deed or decision documents have been met — Yes ☑ | No ☐ | N/A ☐

Violations have been reported — Yes ☐ | No ☑ | N/A ☐

Other problems or suggestions: Report attached ☐

2 Adequacy N/A ☐

ICs are adequate ☑

ICs are inadequate ☐

Remarks :

C. General

1 Vandalism/trespassing

Location shown on site map ☐
No vandalism evident ☑

2 Land use changes on site N/A ☑

Remarks : No change in land use

3 Land use changes off site N/A ☑

Remarks : No change in land use

IV. GENERAL SITE CONDITIONS

A. Roads

1 Roads damaged N/A ☐

Location shown on site map ☐
Roads adequate ☑
Remarks :

B. Other Site Conditions

1 Remarks : None

V. LANDFILL COVERS

A. Landfill Surface

1 Settlement (low spots)

Location shown on site map ☐
Settlement not evident ☑
Areal extent : Depth :
Remarks:

2 Cracks

Location shown on site map ☐
Cracking not evident ☑
Length/width : Depth :
Remarks:

3 Erosion

Location shown on site map ☐
Erosion not evident ☑
Areal extent : Depth :
Remarks:

4 Holes

Location shown on site map ☐
Holes not evident ☑
Areal extent : Depth :
Remarks :

5 Vegetative Cover

Grass ☑
Cover properly established ☐
No signs of stress ☐
Trees/Shrubs (indicate size and locations on a diagram) ☐
Remarks : Bare areas present; however, plans in place to reseed those areas.

6 Alternative Cover (armored rock, concrete, etc.) N/A ☑

Remarks :

7 Bulges

Location shown on site map ☐
Bulges not evident ☑
Areal extent : Height :
Remarks :

8 Wet Areas/Water Damage

Wet areas/water damage not evident ☑

Wet areas ☐	Location shown on site map ☐	Areal extent :
Ponding ☐	Location shown on site map ☐	Areal extent :
Seeps ☐	Location shown on site map ☐	Areal extent :
Soft sub grade ☐	Location shown on site map ☐	Areal extent :

Remarks :

9 Slope Instability

No evidence of slope instability ☑

Slides ☐ Location shown on site map ☐

Areal extent :

Remarks :

B. Cover Penetrations

1 Monitoring Wells

Properly secured/locked ☑
Routinely sampled ☑
Good condition ☑
Evidence of leakage at penetration ☐
Needs maintenance ☐

Remarks :

C. Perimeter Ditches/Off-Site Discharge

1 Siltation

Location shown on map ☐
Siltation not evident ☑
Areal extent : Depth:

Remarks :

2 Vegetative Growth

Location shown on map ☐
Vegetation does not impede flow ☑
Areal extent : Type:

Remarks :

3 Erosion

Location shown on map ☐
Erosion not evident ☑
Areal extent : Depth:

Remarks :

4 Discharge Structure N/A ☑

Functioning ☐

Remarks :

VI.GROUNDWATER REMEDIES

A. Monitoring Data

1 Monitoring Data

Is routinely submitted on time ☐ Is of acceptable quality ☐

Remarks: RA-O groundwater data not available at the time of the inspection

2 Monitoring data suggests:

Groundwater plume is effectively contained ☐ Contaminant concentrations are declining ☐

Remarks: RA-O groundwater data not available at the time of the inspection

B. Monitored Natural Attenuation

1 Monitoring Wells

Properly secured/locked ☑
Functioning ☑
Routinely sampled ☑
Good condition ☑
All required wells located ☑
Needs Maintenance ☑

Remarks : Wells should be labeled on the outside casing

C. In Situ Groundwater Remediation

1 Injection Wells

Properly secured/locked ☑
Functioning ☑
Routinely sampled ☐
Good condition ☑
All required wells located ☑
Needs Maintenance ☐
Remarks : _____

VII. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy at Site 2 is intended to prevent unacceptable human health and ecological risks from exposure to waste, soil, sediment, and shallow aquifer groundwater; prevent migration of contaminants through surface water runoff and erosion pathways; prevent/minimize transport of COCs from waste to site media; reduce contaminant source mass and COC concentrations in shallow aquifer groundwater to the maximum extent practicable; prevent activities that might cause migration of COCs in the shallow aquifer to the deep aquifer; prevent migration of COCs from shallow aquifer groundwater to surface water and sediment; and minimize degradation of surface water through source control in shallow aquifer groundwater, waste, surface soil, and sediment. Inspection of the site verifies that the soil cover is in palce and in good condition, and access controls are in place, and that no unacceptable exposures are occuring. The remedy is effective and functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

No obervations or issues associated with O&M procedures were made. At the time of the inspection, the O&M phase had just begun and the planned O&M was expected to be sufficient.

C. Early indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost of scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be comprised in the future.

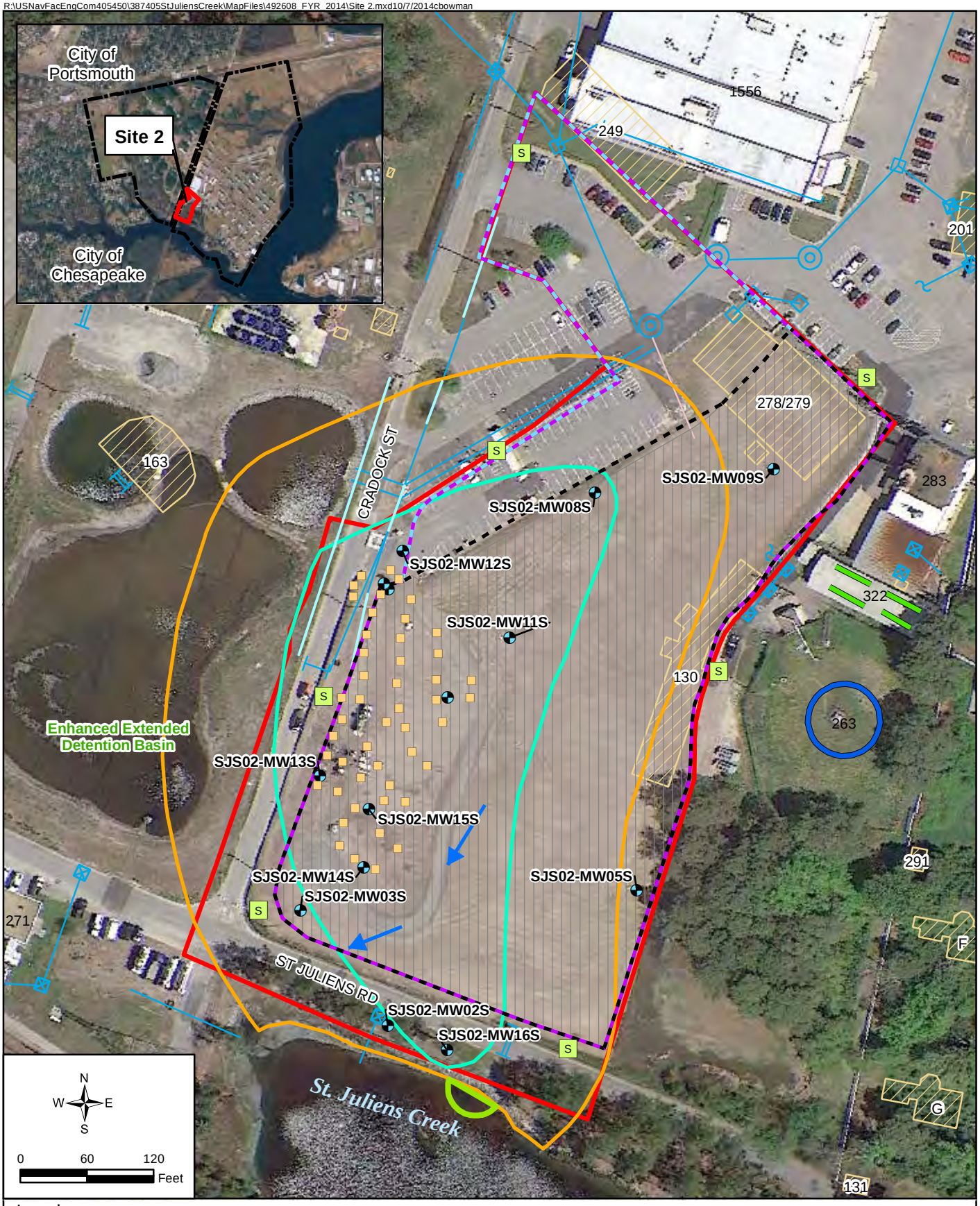
No early indicators of potential problems were observed.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

No oppurtunities for optimization were identified. At the time of the inspection, the O&M phase had just begun.

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Site 2.mxd10/7/2014cbowman



Legend

- Groundwater Monitoring Well
- ERD Injection Well
- Site 2 Boundary
- Approximate Location of UST
- Approximate Location of AST
- Historical Inlet Disposal Area LUC Boundary
- Historical Parking Lot Disposal Area LUC Boundary
- Land Use Control Boundary - Waste and Soil
- Abandoned Storm Sewer System
- Drainage
- Storm Sewer System
- Groundwater Flow Direction (October 2013)
- Demolished Building
- Soil Cover
- Land Use Control Boundary - Groundwater (Potable use)
- Land Use Control Boundary - Groundwater (Inhalation)
- St. Juliens Creek Sediment Excavation Area
- S LUC Sign

Site 2
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

I. SITE INFORMATION

Site Name: Site 4 - Landfill D

Date of Inspection: 7/31/2014

Location and Region: St. Juliens Creek Annex, Chesapeake, Virginia

EPA ID: VA5170000181

Agency, office, or company leading the five-year review: NAVFAC Mid-Atlantic with USEPA and VDEQ

Weather/ temperature: Clear and 80 °F

Remedy Includes: (Check all that apply):

- Landfill cover/containment ☑
- Access controls ☑
- Institutional controls ☑
- Groundwater pump and treatment ☐
- Surface water collection and treatment ☐
- Monitored natural attenuation ☐
- Groundwater containment ☐
- Vertical barrier walls ☐

Other : _____

Attachments: Site Map Attached ☑

II. INTERVIEWS

1. Local regulatory authorities and response agencies (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.)

Agency VDEQ

Contact Karen Doran/RPM (Name/Title) | 9/29/2014 (Date) | 804-698-4594 (Phone #)

Problems, suggestions: No issues or suggestions; indicated that the remedy is protective of human health and the environment.

☐ Report attached

III. ACCESS AND INSTITUTIONAL CONTROLS

A. Fencing

1. Fencing damaged N/A ☐

Location shown on site map ☑

Gates secured ☑

Remarks : Chain and lock are rusty and should be replaced

B. Other Access Restrictions

1. Signs and other security measures N/A ☐

Locations shown on site map ☑

Remarks : Due to safety concerns accessing the three signs on the western side of the site and the sign in the wetland, those signs were not inspected. The signs that could be inspected are in place, clearly visible, and have current information.

C. Institutional Controls (ICs)

1. Implementation and enforcement

Conditions imply ICs not properly implemented — Yes ☐ No ☑ N/A ☐

Conditions imply ICs not being fully enforced — Yes ☐ No ☑ N/A ☐

Type of monitoring (e.g., self-reporting, drive by) : LUC Tracker, site inspections, and Environmental Checklists

Frequency : Annual (LUCs) & As needed (Environmental Checklists for new projects)

Responsible party: NAVFAC

Contact : Krista Parra/ RPM (Name/Title) | 757-341-0395 (Phone No.)

Reporting is up to date — Yes ☑ No ☐ N/A ☐

Reports are verified by the lead agency — Yes ☑ No ☐ N/A ☐

Specific requirements in deed or decision documents have been met — Yes ☑ No ☐ N/A ☐

Violations have been reported — Yes ☐ No ☐ N/A ☑

Other problems or suggestions: Report attached ☑

2 **Adequacy**

ICs are adequate ☑

ICs are inadequate ☐

Remarks : _____

D. General

1 **Vandalism/trespassing**

Location shown on site map ☐

No vandalism evident ☑

2 **Land use changes on site** N/A ☑

Remarks : No change in land use

3 **Land use changes off site** N/A ☑

Remarks : No change in land use

IV. GENERAL SITE CONDITIONS

A. Roads

1 **Roads damaged** N/A ☐

Location shown on site map ☐

Roads adequate ☑

Remarks : Heavy vegetation growing on road

B. Other Site Conditions

1 Remarks : None

V. LANDFILL COVERS

A. Landfill Surface

1 **Settlement (low spots)**

Location shown on site map ☐

Settlement not evident ☑

Areal extent : _____ Depth : _____

Remarks: _____

2 **Cracks**

Location shown on site map ☐

Cracking not evident ☑

Length/width : _____ Depth : _____

Remarks: _____

3 **Erosion**

Location shown on site map ☐

Erosion not evident ☑

Areal extent : _____ Depth : _____

Remarks: _____

4 **Holes**

Location shown on site map ☐

Holes not evident ☑

Areal extent : _____ Depth : _____

Remarks : _____

5 **Vegetative Cover**

Grass ☑

Cover properly established ☑

No signs of stress ☑

Trees/Shrubs (indicate size and locations on a diagram) ☑

Remarks : Heavy vegetation is in complaince with design (back to nature landfill)

6 **Alternative Cover** (armored rock, concrete, etc.) N/A ☐

Remarks : _____

7 **Bulges**

Location shown on site map ☐

Bulges not evident ☑

Areal extent : _____ Height : _____

Remarks : _____

8 Wet Areas/Water Damage

Wet areas/water damage not evident ☑

Wet areas ☐	Location shown on site map ☐	Areal extent :
Ponding ☐	Location shown on site map ☐	Areal extent :
Seeps ☐	Location shown on site map ☐	Areal extent :
Soft sub grade ☐	Location shown on site map ☐	Areal extent :

Remarks :

9 Slope Instability

No evidence of slope instability ☑

Slides ☐ Location shown on site map ☐

Areal extent :

Remarks :

B. Cover Penetrations

1 Monitoring Wells

Properly secured/locked ☑

Routinely sampled ☐

Good condition ☐

Evidence of leakage at penetration ☐

Needs maintenance ☐

Remarks : Due to safety concerns accessing MW02S, that well was not inspected. The outer casing of MW02S is rusty; however, the integrety of the well has not been compromised. Wells are not routinely sampled because the remedy does not include groundwater monitoring.

C. Perimeter Ditches/Off-Site Discharge

1 Siltation

Location shown on map ☐

Siltation not evident ☑

Areal extent : Depth:

Remarks :

2 Vegetative Growth

Location shown on map ☐

Vegetation does not impede flow ☑

Areal extent : Type:

Remarks :

3 Erosion

Location shown on map ☐

Erosion not evident ☑

Areal extent : Depth:

Remarks :

4 Discharge Structure N/A ☑

Functioning ☐

Remarks :

VI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy at Site 4 is intended to prevent unacceptable human health and ecological risks to exposure to waste, soil, and sediment; reduce infiltration and any resulting leaching of contaminants from the landfill into groundwater; and Inspection of the site confirms that the cover is intact, erosion; and prevent overland flow entering the site (surface water run-on) and control surface water run-off and erosion. Inspection of the site verifies that the soil cover is in place and in good condition, and access controls are in place, and that no unacceptable exposures are occuring. The remedy is effective and functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

No issues or observations related to implementation and scope of the O&M.

C. Early indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost of scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be comprised in the future.

No early indicators were observed.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

No oppurtunties for optimization were identified.

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Site 4.mxd10/7/2014cbowman

Legend

- Shallow Monitoring Well
- Deep Monitoring Well
- SJCA Boundary
- Site 4 Boundary
- Access Road
- Drainage Ditch
- Fence
- Small Sign
- Large Sign

N
W E
S

0 75 150
Feet

Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Final Site 4 Annual Inspection Report – Fiscal Year 2010

PREPARED FOR: SJCA Tier I Partnering Team

INSPECTION CONDUCTED BY: Walter Bell/NAVFAC Mid-Atlantic
Robert Stroud/USEPA Region 3
Karen Doran/VDEQ
Janna Staszak/CH2M HILL
Adrienne Jones/CH2M HILL

PREPARED BY: CH2M HILL

DATE: October 14, 2010

This annual inspection report documents the results of fiscal year (FY) 2010 annual inspection at Site 4, Landfill D, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This technical memorandum was prepared under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-Term Environmental Action Navy 1000, Contract N62470-08-D-1000, Contract Task Order 0063, for submittal to NAVFAC Mid-Atlantic, U.S. Environmental Protection Agency Region III (USEPA), and Virginia Department of Environmental Quality (VDEQ).

Background

SJCA was placed on the National Priorities List on July 27, 2000 (EPA ID: VA5170000181). Investigation and remediation have been conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund"), as amended by Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan.

A Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report was completed for Site 4 in March 2003 (CH2M HILL, March 2003). A subsequent Feasibility Study was completed in March 2004 (CH2M HILL, March 2004). A Proposed Plan was completed in June 2004 (NAVFAC, June 2004) and a Record of Decision (ROD) was signed in September of 2004 (NAVFAC, September 2004). These reports identified the risks to human and ecological receptors, established Remedial Action Objectives (RAOs), and defined the Selected Remedy. The Selected Remedy for Site 4 included a soil cover, removal of eastern drainage ditch sediment, and land use controls (LUCs) to meet the following RAOs:

- Prevent or minimize direct contact of human and ecological receptors with landfill contents

- Reduce infiltration and any resulting leaching of contaminants from the landfill into groundwater
- Prevent overland flow entering the site (surface water run-on) and control surface water run-off and erosion

To further define and implement the RAOs, the ROD specified the following LUC objectives for Site 4:

- Prohibit digging into or disturbing the soil cover or landfill contents
- Prohibit residential use and development of the site

The Remedial Design (RD) for the Selected Remedy was completed in November 2004 (Agviq-CH2M HILL Joint Venture [JVI], November 2004]. The Remedial Action construction was conducted from March through October of 2005. LUC implementation and maintenance actions were documented in a RD for LUCs, which was finalized in June 2006 (CH2M HILL, June 2006). The Navy implements, maintains, monitors, and enforces the LUCs according to the RD. The LUCs shall be maintained within the boundaries of the landfill (Figure 1) indefinitely, or until all parties (Navy, EPA, and Commonwealth of Virginia) agree that waste left in-place is at such levels to allow for unlimited use and unrestricted exposure. A Remedial Action Completion Report, documenting that the remedy at Site 4 is operational and functional in accordance with CERCLA and memorializing the Response Complete, was signed in October 2006 (CH2M HILL, October 2006). A Five-Year Review was conducted to evaluate the performance of the implemented remedy at Site 4 and verify that the remedy remains protective of human health and the environment in accordance with the requirements stated in the ROD (CH2M HILL, 2010). The Five-Year Review, indicating that the remedy at Site 4 remains protective of human health and the environment, was signed in May 2010.

Inspection

In accordance with the ROD and RD for LUCs, the FY 2010 annual landfill inspection was conducted on September 15, 2010, to verify the continued integrity of the soil cover, confirm appropriate surface water drainage features and erosion controls are functioning, and ensure that adequate vegetation is maintained. The site-specific inspection checklist (Attachment 1) was used for the annual inspection and the findings are summarized below.

During the FY 2010 annual inspection, no signs of unauthorized intrusive activities, investigation derived waste storage, or dumping within the site was observed. The accessible signs and fencing were in good condition; however, the contact numbers on the signs need to be updated. All of the accessible monitoring wells were in good condition with the exception of SJS04-MW01S, which has a protective post that has fallen over. The integrity of the monitoring well does not appear to have been compromised; however, replacement of the fallen post should be considered during future site activities to maintain protection of the well. As noted in Attachment 1, three signs and two monitoring wells were not inspected because they could not be accessed at the time of the site inspection (overgrown with vegetation or located within Blows Creek).

Dense vegetation is growing throughout the site. No stressed vegetation or bare spots in the vegetation were observed within the limits of the soil cover during the inspection. However, an area of stressed vegetation was observed just north of the northern boundary of the site. Because the area is upgradient of Site 4, it is unlikely that the stressed vegetation in this area is the related to Site 4; however, it will continue to be monitored in future inspections. The site drainage ditches were in good condition, and no sediment buildup or debris was observed. Dense vegetation was observed in the drainage ditches, and is preventing erosion of the ditches while not adversely impacting the functionality of the ditches. The riprap landfill toe adjacent to the wetland also appears to be in good condition.

In addition to the annual inspection, one other inspection was performed in FY 2010 to document the site condition after a major storm event. This report was submitted separately to the partnering team and is included as Attachment 2 of this document.

References

CH2M HILL, March 2003. *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, and 6*. St. Juliens Creek Annex, Chesapeake, Virginia.

CH2M HILL, March 2004. *Final Feasibility Study for Site 4*. St. Juliens Creek Annex, Chesapeake, Virginia.

CH2M HILL, June 2006. *Remedial Design for Land Use Controls, Site 4, Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia.

CH2M HILL, September 2006. *Final Remedial Action Completion Report, Site 4 –Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia.

CH2M HILL, May 2010. *Final Five-Year Review Report, St. Juliens Creek Annex, Chesapeake, Virginia.*

JV I (AGVIQ-CH2M HILL Joint Venture I), November 2004. *Final Design Package, Site 4 – Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia.

NAVFAC, June 2004. *Final Proposed Remedial Action Plan for Site 4*. St. Juliens Creek Annex, Chesapeake, Virginia.

NAVFAC, September 2004. *Record of Decision, Site 4: Landfill D*. St. Juliens Creek Annex. Chesapeake, Virginia.

Attachment 1 – Site 4 Annual Inspection Checklist

Site 4 - Landfill D
St. Juliens Creek Annex, Chesapeake, Virginia

Description: Site 4 (Landfill D) covers an estimated 8.3 acres in the northeastern portion of the Annex just north of the confluence of Blows Creek and the Southern Branch of the Elizabeth River. The site is located on fill material that reportedly originated from the Southern Branch of the Elizabeth River. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two. The trenches were filled with trash, wet garbage, and soil. Around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was continued to be disposed of at Site 4 until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Some solvents, acids, bases, and polychlorinated biphenyls were reportedly disposed. Wastes disposed of at Site 4 were estimated at 1,500,000 cubic yards.

The Selected Remedy for Site 4; soil cover, surface and wetland debris removal, and eastern drainage ditch removal; was completed in 2005. Fencing is installed around the perimeter of the site with signs posted.

Legend
- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Signs
- Large Signs

N W E S

0 75 150 Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Comments: (Provide related question number for each comment)

Question 5: The signs circled on the figure were not inspected because they were not accessible. The contact phone number on the signs needs to be updated.

Question 6: A protective post for MW01S has fallen over. The circled monitoring wells on the figure were not inspected. All other monitoring wells were inspected.

Question 8: An area of stressed vegetation was observed north of the site and is shown on the figure.

		Yes	No
	General Questionnaire		
1	Is the area free of any indication of recent and/or current intrusive activities within the site boundary, as depicted on the figure, or in the immediate vicinity of the site? If no, mark location of intrusive activities on figure, note extent and purpose.	X	
2	Is the area free of storage of any investigative derived waste (IDW) on site? If no, mark location of IDW on figure, note its condition in the comment section below, and notify activity coordinator. Indicate if IDW is properly labeled, per example below: Investigative Derived Waste Purge water from Site 4 January 28, 2003 Do not handle, analysis pending Contact Walter Bell, NAVFAC MID LANT, (757) 341-0484	X	
3	Is the area free of identifiable concerns, such as, signs of dumping of chemicals or debris, with regards to this site? If no, annotate these concerns in the comments section above, mark location of concern on map, and notify activity coordinator.	X	
	Site Specific Questionnaire		
4	Are the drainage ditches, as depicted on the figure, in good condition (free of sediment buildup and debris)? If no, describe condition of the drainage ditch, mark deficient location(s) on map, and notify activity coordinator.	X	
5	Are the signs, depicted on the figure, in good condition (letters still visible, and standing upright)? If no, describe condition of the signs, mark location(s) on map, and notify activity coordinator.	X	
6	Are site monitoring wells, as depicted on the figure, in good condition and appear to be locked? (i.e. damaged protective posts and/or well head/casing) If no, describe condition of the deficient monitoring well(s), mark location of deficient monitoring well(s).		X
7	Is the soil cover free of notable defects that would require corrective action to ensure the effectiveness of the remedy?	X	
8	Is the site free of signs of stressed vegetation or bare spots that may lead to erosion of the soil cover?	X	
9	In the case of a severe weather event, is the integrity of the soil cover intact (no erosion by surface runoff)?	X	

Inspection performed by: (Print and sign)	Adrienne Jones Adrienne Jones
Date:	9/16/10

Attachment 2 – Site 4 Post-Storm Inspection Report

Site 4 Inspection Report – Post-Storm Inspection

PREPARED FOR: SJCA Tier I Partnering Team

INSPECTION CONDUCTED BY: Adam Forshey/CH2M HILL
Patrick Murphy/CH2M HILL

PREPARED BY: CH2M HILL

DATE: December 15, 2009

This inspection report documents the results of the post-storm inspection of Site 4, Landfill D, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This technical memorandum was prepared under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-Term Environmental Action Navy 1000, Contract N62470-08-D-1000, Contract Task Order 0063, for submittal to NAVFAC Mid-Atlantic, U.S. Environmental Protection Agency Region III (EPA), and Virginia Department of Environmental Quality (VDEQ).

The site inspection was conducted on November 17, 2009, following the "November Nor' Easter", which was a significant storm event that occurred November 11 through 13, 2009 and resulted in over 8-inches of rainfall in the Chesapeake area. The post-storm inspection was conducted to verify the continued integrity of the soil cover, confirm appropriate surface water drainage features and erosion controls are functioning, and ensure that adequate vegetation is maintained to prevent erosion after significant storm events. The annual site inspection checklist was used during the post-storm inspection and is included as an attachment, and the findings are summarized below.

During the inspection several small stressed vegetative areas were identified along the southern edge of the site, parallel to the riprap landfill toe. These stressed areas were located between 50 and 100 feet from the riprap landfill toe and ranged in size from 2'x2' up to approximately 10'x15'. These areas were not bare and showed no signs of erosion; however, the vegetation was thin and the soil was soft and saturated. These areas should continue to be monitored to ensure vegetative growth continues and additional seeding should be conducted, if necessary. All other areas were covered with dense vegetation. A potential erosion rill was identified along the southeast side of the site approximately 30-feet west of the fence line, adjacent to the drainage ditch. The rill was approximately 4- to 6-inches deep, 8-inches wide, and 30- to 50-feet long. The rill was fully vegetated and showed no signs of recent erosion. However, it may result in concentrated flows down-gradient and should be monitored during future inspections and repaired if necessary. No signs of sediment buildup or other evidence of erosion were identified during the inspection as a result of the recent storm.

The site drainage ditches contained dense vegetation and showed signs of significant flow during the recent storm (vegetation bent in the direction of surface water flow). The drainage pipe beneath the construction access onto the cap was functional. Standing water

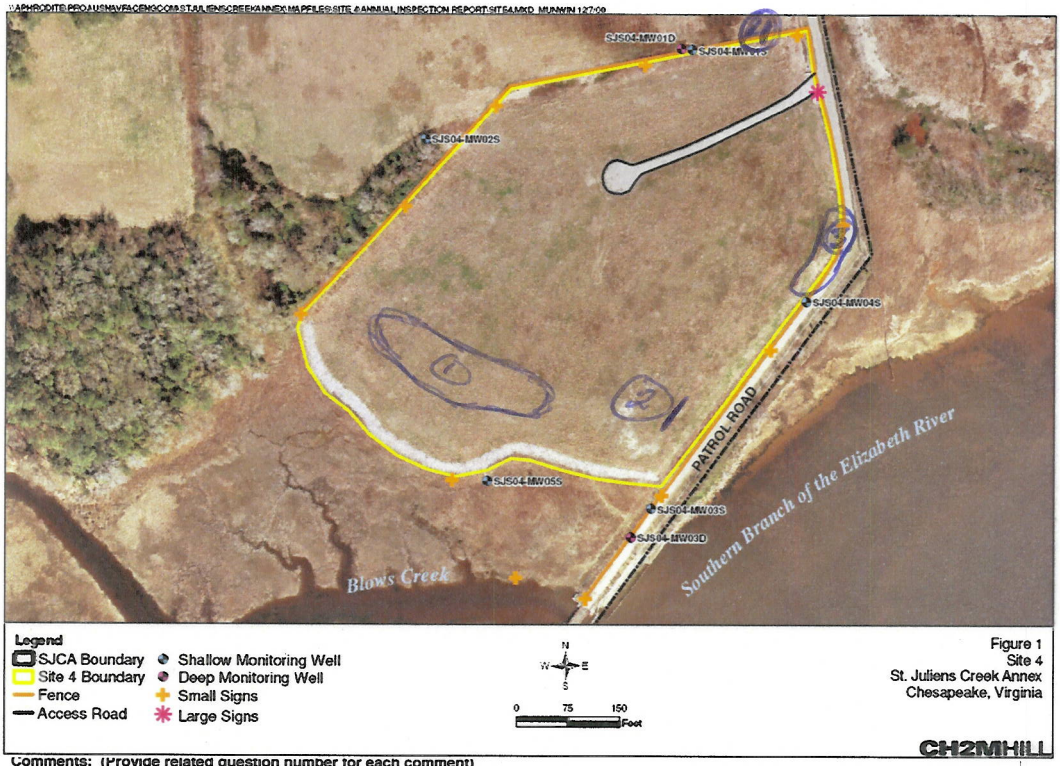
was present in the eastern drainage ditch in the central portion of the site. The riprap landfill toe adjacent to the wetland also appeared to be in good condition.

The low spot located along the northern edge of the site, which was previously identified during the May 2009 Post-Storm Inspection, was still present. The majority of the low spot is located outside the boundaries of the site but does extend beneath the fence and onto the site. The depth of water within the low spot ranges from approximately 1- to 4-inches deep. The ponded water does not appear to have negatively impacted the integrity of the landfill; no erosion or signs of landfill slope failure were observed.

Site 4 - Landfill D
St. Juliens Creek Annex, Chesapeake, Virginia

Description: Site 4 (Landfill D) covers an estimated 8.3 acres in the northeastern portion of the Annex just north of the confluence of Blows Creek and the Southern Branch of the Elizabeth River. The site is located on fill material that reportedly originated from the Southern Branch of the Elizabeth River. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. The original trench and others were filled with trash, wet garbage, and soil from subsequent trenches. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two. Around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was continued to be disposed of at Site 4 until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Some solvents, acids, bases, and polychlorinated biphenyls (PCBs) were reportedly dispose

The Selected Remedy for Site 4; soil cover, surface and wetland debris removal, and eastern drainage ditch removal; was completed in 2005. Fencing is installed around the perimeter of the site with signs posted.



Comments: (Provide related question number for each comment)

① MULTIPLE AREAS OF STRESSED VEGETATION (NOT BARE, BUT THIN) NO EROSION WAS OBSERVED BUT AREAS WERE SOFT AND SATURATED. STRESSED AREAS WERE BETWEEN SJS04-MW01D NORTH OF RIPRAP. MONITOR FOR GROWTH-QB

② 30-40' OF FENCE LANE (PARALLEL TO DITCH) A RILL WAS OBSERVED THE DIMENSIONS = 4-6" DEEP x 8" WIDE & 30-50' LONG. THE RILL WAS VEGETATED AND SHOWED NO SIGNS OF RECENT EROSION

③ STANDING WATER OBSERVED IN DRAINAGE DITCH-04

④ LARGE POOL OF STANDING WATER 1-4" DEEP ADJACENT TO & JUST UNDER SITE FENCE (SEE PREVIOUS POST STORM REPORT)

General Questionnaire

		Yes	No
1	Is the area free of any indication of recent and/or current intrusive activities within the site boundary, as depicted on the figure, or in the immediate vicinity of the site? If no, mark location of intrusive activities on figure, note extent and purpose.	X	
2	Is the area free of storage of any investigative derived waste (IDW) on site? If no, mark location of IDW on figure, note its condition in the comment section below, and notify activity coordinator. Indicate if IDW is properly labeled, per example below: Investigative Derived Waste Purge water from Site 4 January 28, 2003 Do not handle, analysis pending Contact Walter Bell, NAVFAC MID LANT, (757) 445-6638	X	
3	Is the area free of identifiable concerns, such as, signs of dumping of chemicals or debris, with regards to this site? If no, annotate these concerns in the comments section above, mark location of concern on map, and notify activity coordinator.	X	

Site Specific Questionnaire

4	Are the drainage ditches, as depicted on the figure, in good condition (free of sediment buildup and debris)? If no, describe condition of the drainage ditch, mark deficient location(s) on map, and notify activity coordinator.	X	
5	Are the signs, depicted on the figure, in good condition (letters still visible, and standing upright)? If no, describe condition of the signs, mark location(s) on map, and notify activity coordinator.	X	
6	Are site monitoring wells, as depicted on the figure, in good condition and appear to be locked? (i.e. damaged protective posts and/or well head/casing) If no, describe condition of the deficient monitoring well(s), mark location of deficient monitoring well(s).	X	
7	Is the soil cover free of notable defects that would require corrective action to ensure the effectiveness of the remedy?	X	
8	Is the site free of signs of stressed vegetation or bare spots that may lead to erosion of the soil cover?		X
9	In the case of a severe weather event, is the integrity of the soil cover intact (no erosion by surface runoff)?	X	

Inspection performed by: (Print and sign)	ADAM FORSHEY Adam Forshey
Date:	11/17/09

POST NOVEMBER "NOR-EASTER" 2009

Site 4 Annual Inspection Report – Fiscal Year 2011

PREPARED FOR:	SJCA Tier I Partnering Team
INSPECTION CONDUCTED BY:	Walter Bell/NAVFAC Mid-Atlantic Robert Stroud/USEPA Region 3 Adrienne Jones/CH2M HILL
PREPARED BY:	CH2M HILL
DATE:	September 23, 2011
REVISED:	October 20, 2011

This annual inspection report documents the results of fiscal year (FY) 2011 annual inspection at Site 4, Landfill D, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This technical memorandum was prepared under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-Term Environmental Action Navy 1000, Contract N62470-08-D-1000, Contract Task Order 0063, for submittal to NAVFAC Mid-Atlantic, U.S. Environmental Protection Agency Region III (USEPA), and Virginia Department of Environmental Quality (VDEQ).

Background

SJCA was placed on the National Priorities List on July 27, 2000 (EPA ID: VA5170000181). Investigation and remediation have been conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by Superfund Amendments and Reauthorization Act of 1986 (Superfund), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan.

The following documents identified the risks to human and ecological receptors, established Remedial Action Objectives (RAOs), and defined the Selected Remedy:

- Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report (CH2M HILL, 2003)
- Feasibility Study (CH2M HILL, 2004)
- Proposed Plan (NAVFAC, 2004a)
- Record of Decision (ROD) (NAVFAC, 2004b)

The Selected Remedy for Site 4 included a soil cover, removal of eastern drainage ditch sediment, and land use controls (LUCs) to meet the following RAOs:

- Prevent or minimize direct contact of human and ecological receptors with landfill contents

- Reduce infiltration and any resulting leaching of contaminants from the landfill into groundwater
- Prevent overland flow entering the site (surface water run-on) and control surface water run-off and erosion

To further define and implement the RAOs, the ROD specified the following LUC objectives for Site 4:

- Prohibit digging into or disturbing the soil cover or landfill contents
- Prohibit residential use and development of the site

The Remedial Design (RD) for the Selected Remedy was completed in November 2004 (Agviq-CH2M HILL Joint Venture [JVI], 2004]. The Remedial Action construction was conducted from March through October of 2005. LUC implementation and maintenance actions were documented in a RD for LUCs, which was finalized in June 2006 (CH2M HILL, 2006). The Navy implements, maintains, monitors, and enforces the LUCs according to the RD. The LUCs shall be maintained within the boundaries of the landfill (Figure 1) indefinitely, or until all parties (Navy, EPA, and Commonwealth of Virginia) agree that waste left in-place is at such levels to allow for unlimited use and unrestricted exposure. A Remedial Action Completion Report, documenting that the remedy at Site 4 is operational and functional in accordance with CERCLA and memorializing the Response Complete, was signed in October 2006 (NAVFAC, 2006). A Five-Year Review was conducted to evaluate the performance of the implemented remedy at Site 4 and verify that the remedy remains protective of human health and the environment in accordance with the requirements stated in the ROD (CH2M HILL, 2010). The Five-Year Review, indicating that the remedy at Site 4 remains protective of human health and the environment, was signed in May 2010.

Inspection

In accordance with the ROD and RD for LUCs, the FY 2011 annual landfill inspection was conducted on September 13, 2011, to certify that no digging has occurred and no residential use is allowed, verify the continued integrity of the soil cover, confirm appropriate surface water drainage features and erosion controls are functioning, and ensure that adequate vegetation is maintained. The site-specific inspection checklist (Attachment 1) was used for the annual inspection and the findings are summarized below. Additionally, a visit to the City of Chesapeake's planning office was conducted on September 16, 2011, to verify that the survey plat filed with the City of Chesapeake to prevent residential use of the site was accessible. An electronic copy of the original survey plat (Mapbook 149 pages 33 and 33a), which is maintained at the City of Chesapeake's Circuit Court, was available at the planning office. A copy of the recorded survey plat is included as Attachment 2.

During the FY 2011 annual inspection, no signs of unauthorized intrusive activities, investigation derived waste storage, or dumping within the site was observed. The accessible signs and fencing were in good condition; however, the contact numbers on several of the signs need to be updated (Attachment 1). All of the monitoring wells were in good condition with the exception of SJS04-MW01S (Attachment 1), which has a protective

post that has fallen over. The integrity of the monitoring well does not appear to have been compromised; however, replacement of the fallen post should be considered during future site activities to maintain protection of the well.

No stressed vegetation or bare spots in the vegetation were observed on the cover during the inspection. The stressed vegetation observed just north of the northern boundary of the site during the FY10 annual inspection no longer appeared to be stressed. The site drainage ditches were in good condition, and no sediment buildup or debris was observed. Dense vegetation was observed in the drainage ditches, and is preventing erosion of the ditches while not adversely impacting the functionality of the ditches. The riprap landfill toe adjacent to the wetland also appears to be in good condition.

In addition to the annual inspection, two other inspections were performed in FY 2011 to document the site condition after major storm events. These reports were submitted separately to the partnering team and are included as Attachment 3 of this document.

The results of the FY 2011 annual inspection indicate that the facility is compliant with the land use restrictions required in the LUC-RD to prohibit residential use of the site and digging into or disturbing the soil cover. The conditions of the landfill (integrity, drainage, erosion, and vegetation) are satisfactory. The site signs should be updated and the damaged monitoring well protective post should be repaired.

References

CH2M HILL, 2003. *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, and 6*. St. Juliens Creek Annex, Chesapeake, Virginia. March.

CH2M HILL, 2004. *Final Feasibility Study for Site 4*. St. Juliens Creek Annex, Chesapeake, Virginia. March

CH2M HILL, 2006. *Remedial Design for Land Use Controls, Site 4, Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. 2006

CH2M HILL, 2010. *Final Five-Year Review Report, St. Juliens Creek Annex, Chesapeake, Virginia*. May.

JV I (AGVIQ-CH2M HILL Joint Venture I), 2004. *Final Design Package, Site 4 – Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. November.

NAVFAC, 2004a. *Final Proposed Remedial Action Plan for Site 4*. St. Juliens Creek Annex, Chesapeake, Virginia. June.

NAVFAC, 2004b. *Record of Decision, Site 4: Landfill D*. St. Juliens Creek Annex. Chesapeake, Virginia. September.

NAVFAC, 2006. *Final Remedial Action Completion Report, Site 4 –Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. September.

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\STJULIENSCREEKANNEX\MAPFILES\SITE 4\ANNUAL INSPECTION REPORT\FIGURE 1 - SITE 4 .MXD CBOWMAN 9/22/2011 10:59:38 AM

Legend

- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Sign
- Large Sign

N
W E
S

0 75 150
Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Attachment 1 – Site 4 Annual Inspection Checklist

Site 4 - Landfill D

St. Juliens Creek Annex, Chesapeake, Virginia

Description: Site 4 (Landfill D) covers an estimated 8.3 acres in the northeastern portion of the Annex just north of the confluence of Blows Creek and the Southern Branch of the Elizabeth River. The site is located on fill material that reportedly originated from the Southern Branch of the Elizabeth River. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two. The trenches were filled with trash, wet garbage, and soil. Around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was continued to be disposed of at Site 4 until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Some solvents, acids, bases, and polychlorinated biphenyls were reportedly disposed. Wastes disposed of at Site 4 were estimated at 1,500,000 cubic yards.

The Selected Remedy for Site 4; soil cover, surface and wetland debris removal, and eastern drainage ditch removal; was completed in 2005. Fencing is installed around the perimeter of the site with signs posted.

Legend
- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Signs
- Large Signs

N W E S

0 75 150 Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Comments: (Provide related question number for each comment)

① The contact information on the sign is outdated – Question 5
② One of the protective posts for the monitoring well MW01S has fallen over – Question 6

		Yes	No
	General Questionnaire		
1	Is the area free of any indication of recent and/or current intrusive activities within the site boundary, as depicted on the figure, or in the immediate vicinity of the site? If no, mark location of intrusive activities on figure, note extent and purpose.	✓	
2	Is the area free of storage of any investigative derived waste (IDW) on site? If no, mark location of IDW on figure, note its condition in the comment section below, and notify activity coordinator. Indicate if IDW is properly labeled, per example below: Investigative Derived Waste Purge water from Site 4 January 28, 2003 Do not handle, analysis pending Contact Walter Bell, NAVFAC MID LANT, (757) 341-0484	✓	
3	Is the area free of identifiable concerns, such as, signs of dumping of chemicals or debris, with regards to this site? If no, annotate these concerns in the comments section above, mark location of concern on map, and notify activity coordinator.	✓	
	Site Specific Questionnaire		
4	Are the drainage ditches, as depicted on the figure, in good condition (free of sediment buildup and debris)? If no, describe condition of the drainage ditch, mark deficient location(s) on map, and notify activity coordinator.	✓	
5	Are the signs, depicted on the figure, in good condition (letters still visible, and standing upright)? If no, describe condition of the signs, mark location(s) on map, and notify activity coordinator.		✓
6	Are site monitoring wells, as depicted on the figure, in good condition and appear to be locked? (i.e. damaged protective posts and/or well head/casing) If no, describe condition of the deficient monitoring well(s), mark location of deficient monitoring well(s).		✓
7	Is the soil cover free of notable defects that would require corrective action to ensure the effectiveness of the remedy?	✓	
8	Is the site free of signs of stressed vegetation or bare spots that may lead to erosion of the soil cover?	✓	
9	In the case of a severe weather event, is the integrity of the soil cover intact (no erosion by surface runoff)?	✓	

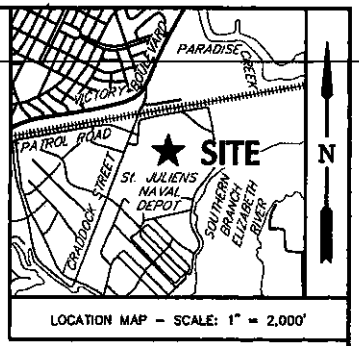
Inspection performed by: (Print and sign)	Adrienne Jones / Adrienne Jones
Date:	9/13/11

Attachment 2 – Site 4 Survey Plat

CIVIL LEGEND

EXISTING

- MANHOLE
- ASPHALT
- GRAVEL
- TEMPORARY BENCHMARK(TBM)
- ELEVATIONS
- RIPRAP
- FENCE
- CONTOUR
- LIMITS OF LANDFILL
- SURVEY TRAVERSE LINE



LOCATION MAP - SCALE: 1" = 2,000'

NOTES:

1. COORDINATE SYSTEM AS SHOWN HEREON IS BASED ON VIRGINIA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE, NAD 1983.
2. ELEVATIONS SHOWN HEREON ARE BASED ON PORTSMOUTH BENCHMARK III N.G.V.D. 1929 (1972 ADJUSTMENT). ELEVATION = 14.62
3. CONTOUR INTERVAL = 1.0'
4. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE REPORT AND MAY NOT SHOW ANY/ALL EASEMENTS OR RESTRICTIONS THAT MAY AFFECT SAID PROPERTY AS SHOWN.
5. THIS PLAT HAS NOT BEEN REVIEWED FOR FULL CITY CODE COMPLIANCE. THIS PLAT DOES NOT CONSTITUTE A SUBDIVISION OF LAND. THIS PLAT IS APPROVED FOR RECORDATION PURPOSES ONLY.

PROPERTY USE NOTATIONS AND EFFECT OF FILING:

1. WASTE AND CONTAMINATED SOIL ARE LOCATED ON REAL PROPERTY DELINEATED HEREIN AS SITE 4, LANDFILL D. PURSUANT TO THE RECORD OF DECISION (ROD) FOR THIS SITE, ISSUED BY THE UNITED STATES NAVY (NAVY) AND THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA) UNDER THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA), AND DATED DECEMBER 2004, USE OF SITE 4 MAY NOT DISTURB THE COVER PLACED THEREON. THE NAVY MUST ENSURE THE INTEGRITY OF THE COVER. IF THE NAVY WISHES TO TAKE ACTION INCONSISTENT WITH THIS LAND USE CONTROL, IT MUST FOLLOW CERCLA AND THE NATIONAL CONTINGENCY PLAN (NCP), 40 CODE OF FEDERAL REGULATIONS (CFR) PART 300. THESE NOTATIONS ARE FILED FOR INFORMATIONAL PURPOSES ONLY.
2. THE FILING OF THIS DOCUMENT SHALL IN NO WAY BE INTERPRETED AS A DISPOSITION OR ALIENATION OF ANY INTEREST IN REAL PROPERTY OF THE UNITED STATES.
3. THE FILING OF THIS DOCUMENT CREATES NO INDEPENDENT RIGHT OF ENFORCEMENT IN THE COMMONWEALTH OF VIRGINIA (VIRGINIA) OR ANY OTHER PARTY.
4. VIRGINIA AND THE NAVY HAVE AGREED THAT THE FILING OF THIS DOCUMENT NEITHER CREATES NOR CONVEYS ANY INTEREST IN REAL PROPERTY (E.G., RESTRICTIVE COVENANT) IN OR TO VIRGINIA OR ANY OTHER PARTY.
5. NOTHING IN THIS DOCUMENT SHALL BE CONSTRUED TO CREATE OR IMPOSE ANY OBLIGATION ON THE NAVY INCONSISTENT WITH OR ADDITIONAL TO THE ROD FOR SITE 4.
6. LAND USE CONTROLS ON REAL PROPERTY DELINEATED HEREIN ARE PART OF THE REMEDY FOR SITE 4 APPROVED IN THE ROD. THESE CONTROLS DO NOT CONSTITUTE COVENANTS RUNNING WITH THE LAND. LIMITATION OF LAND USE UPON TRANSFER OF THE PROPERTY BY THE UNITED STATES WILL BE ADDRESSED AT THAT TIME.

VIRGINIA:

IN THE CLERK'S OFFICE OF THE CIRCUIT COURT OF THE CITY OF CHESAPEAKE, VIRGINIA ON THE _____ DAY OF _____, 2006, THIS PLAT WAS RECEIVED AND ADMITTED TO RECORD IN MAP BOOK _____, AT PAGE _____.

TESTE: _____, CLERK.

BOUNDARY MONUMENTATION

PNT. NO.	NORTHING	EASTING	DESCRIPTION
500	3456735.4754	12125328.4457	DISK ENV-04
100	3455760.7604	12125542.5289	MAG. NAIL FOUND
101	3455431.4304	12125610.2014	DISK FOUND (MSA1)
N/A	3455157.4671	12125412.7885	MAG. NAIL FOUND
103	3454887.6233	12125218.348	MAG. NAIL FOUND
104	3454816.8227	12124866.2559	IRON PIN FOUND
105	3455291.9099	12124705.1380	H&T FOUND
106	3455622.2401	12124730.4685	DISK FOUND (MSA3)

I, HEREBY CERTIFY THAT THIS BOUNDARY SURVEY TO THE BEST OF MY KNOWLEDGE AND BELIEF IS CORRECT AND COMPLIES WITH THE MINIMUM PROCEDURES AND STANDARDS ESTABLISHED BY THE VIRGINIA STATE BOARD FOR ARCHITECTS, PROFESSIONAL ENGINEERS, LAND SURVEYORS, CERTIFIED INTERIOR DESIGNERS AND LANDSCAPE ARCHITECTS. FURTHER, THAT THE TOPOGRAPHIC INFORMATION SHOWN HEREON WAS OBTAINED BY AN ACTUAL FIELD SURVEY.

MSA, P.C.

SIGNED: _____

JEFFREY J. VIERRETHER, L.S.
LICENSE NO. 2306

COMMONWEALTH OF VIRGINIA
JEFFREY J. VIERRETHER
No. 2306
LAND SURVEYOR

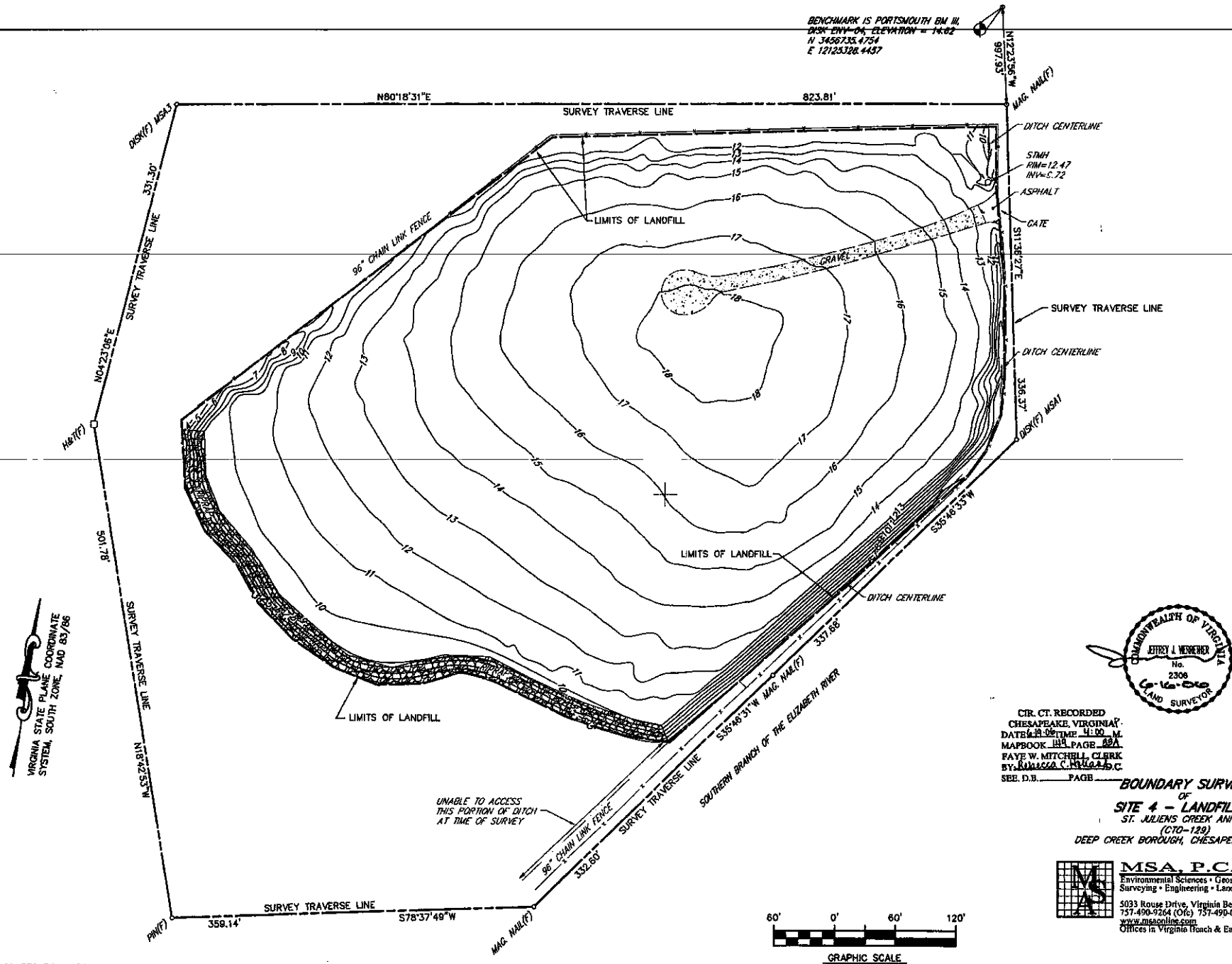
CIR. CT. RECORDED
CHESAPEAKE, VIRGINIA
DATE 6-19-06 TIME 4:00 M.
MAPBOOK 149 PAGE 33
PAYE W. MITCHELL, CLERK
BY Rebecca C. Hyatt D.C.
SEE. DB. _____ PAGE _____

BOUNDARY SURVEY
OF
SITE 4 - LANDFILL D
ST. JULIENS CREEK ANNEX
(CTO-129)
DEEP CREEK BOROUGH, CHESAPEAKE, VIRGINIA

MSA, P.C.
Environmental Sciences • Geosciences • Planning
Surveying • Engineering • Landscape Architecture
5033 Rouse Drive, Virginia Beach, VA 23462
757-490-9264 (Ofc) 757-490-0634 (Fax)
www.msaonline.com
Offices in Virginia Beach & Eastville, VA

FB: CS 372 PG 6, 20, 24, 28
DRWN. BY CJS
CHK'D. BY _____ DATE 06-07-06

JOB# 960531
SHEET 1 OF 2



COMMONWEALTH OF VIRGINIA
JEFFREY J. WERDEHOFF
No. 2306
6-16-06
LAND SURVEYOR

CIR. CT. RECORDED
CHESAPEAKE, VIRGINIA
DATE 6-19-06 TIME 4:00 M.
MAPBOOK 149 PAGE 33A
FAYE W. MITCHELL, CLERK
BY: Rebecca C. Hall D.C.
SEE. D.B. PAGE

BOUNDARY SURVEY
OF
SITE 4 – LANDFILL D
ST. JULIENS CREEK ANNEX
(CTO-129)
DEEP CREEK BOROUGH, CHESAPEAKE, VIRGINIA

MSA, P.C.
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Offices in Virginia Beach & Eastville, VA

FB: CS 372 PG 6, 20, 24, 28
DRWN. BY CJS
CHK'D. BY DATE 06-02-06

JOB# 96053ii
SHEET 2 OF 2

Attachment 3 – Site 4 Post-Storm Inspection Reports

Site 4 Inspection Report – Post-Storm Inspection

PREPARED FOR: SJCA Tier I Partnering Team

INSPECTION CONDUCTED BY: Walt Bell/NAVFAC
Adrienne Jones/CH2M HILL

PREPARED BY: CH2M HILL

DATE: October 13, 2010

This inspection report documents the results of the post-storm inspection of Site 4, Landfill D, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This technical memorandum was prepared under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-Term Environmental Action Navy 1000, Contract N62470-08-D-1000, Contract Task Order 0063, for submittal to NAVFAC Mid-Atlantic, U.S. Environmental Protection Agency Region III (EPA), and Virginia Department of Environmental Quality (VDEQ).

The site inspection was conducted on October 1, 2010, following a significant storm event (i.e., extratropical storm) that occurred September 29 and 30, 2010 and resulted in approximately 6 to 8 inches of rainfall in the Chesapeake area. The post-storm inspection was conducted to verify the continued integrity of the soil cover, confirm appropriate surface water drainage features and erosion controls are functioning, and ensure that adequate vegetation is maintained to prevent erosion after significant storm events. The annual site inspection checklist was used during the post-storm inspection and is included as an attachment, and the findings are summarized below.

Several small areas with a thin vegetative cover were identified along the southern edge of the site, parallel to the riprap landfill toe; the approximate locations of these areas are shown on the attached checklist. These areas were located between 50 and 100 feet from the riprap landfill toe and ranged in size from 5 feet x 5 feet up to approximately 10 feet x 15 feet. These areas showed no signs of erosion; however, the soil was soft and saturated. These areas should continue to be monitored to ensure vegetative growth continues and additional seeding should be conducted, if necessary. All other areas were covered with dense vegetation. No change in the condition of the stressed vegetation area located just north of the site was observed since it was identified during the Fiscal Year 2010 annual inspection. Standing water was present in the stressed vegetation area as well as in portions of the surrounding area. No standing water was observed on the soil cover. The riprap landfill toe adjacent to the wetland appeared to be in good condition.

The drainage ditches contained dense vegetation and showed signs of significant flow during the recent storm (vegetation bent in the direction of surface water flow) but appeared to be free of sediment buildup and debris. However, standing water was present in several portions of the drainage ditches, as shown on the attached checklist. The standing water did not appear to have negatively impacted the soil cover. A follow-up site visit was conducted on October 6 to monitor the condition of the drainage ditches. The time between

the original and follow-up inspections was due to additional rainfall on October 4. Only a small amount of the water that had previously been observed in the ditches was present and the drainage pipe beneath the construction access onto the cap appeared to be functional. These areas should continue to be monitored to ensure the drainage ditches function properly and to determine if corrective action becomes necessary.

Based on the results of the inspection summarized in this report, the integrity of the soil cover remains intact following the storm event.

Site 4 - Landfill D

St. Juliens Creek Annex, Chesapeake, Virginia

Description: Site 4 (Landfill D) covers an estimated 8.3 acres in the northeastern portion of the Annex just north of the confluence of Blows Creek and the Southern Branch of the Elizabeth River. The site is located on fill material that reportedly originated from the Southern Branch of the Elizabeth River. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two. The trenches were filled with trash, wet garbage, and soil. Around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was continued to be disposed of at Site 4 until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Some solvents, acids, bases, and polychlorinated biphenyls were reportedly disposed. Wastes disposed of at Site 4 were estimated at 1,500,000 cubic yards.

The Selected Remedy for Site 4; soil cover, surface and wetland debris removal, and eastern drainage ditch removal; was completed in 2005. Fencing is installed around the perimeter of the site with signs posted.

Legend
- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Signs
- Large Signs

N, W, E, S

0 75 150 Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Comments: (Provide related question number for each comment)

④ Several areas in the drainage ditches have standing water but do not appear to be negatively impacting the cover.

⑤ Not all Site Signs were inspected - those circled were present and inspected and in good condition

⑥ Monitoring wells were not inspected

⑧ Several areas approximately 50 - 100 ft north of the riprap were sparsely vegetated. They ranged in size between approximately 5x5 ft and 10x15 ft. No erosion in the areas were observed.

		Yes	No	
	General Questionnaire			
1	Is the area free of any indication of recent and/or current intrusive activities within the site boundary, as depicted on the figure, or in the immediate vicinity of the site? If no, mark location of intrusive activities on figure, note extent and purpose.	X		
2	Is the area free of storage of any investigative derived waste (IDW) on site? If no, mark location of IDW on figure, note its condition in the comment section below, and notify activity coordinator. Indicate if IDW is properly labeled, per example below: Investigative Derived Waste Purge water from Site 4 January 28, 2003 Do not handle, analysis pending Contact Walter Bell, NAVFAC MID LANT, (757) 341-0484	X		
3	Is the area free of identifiable concerns, such as, signs of dumping of chemicals or debris, with regards to this site? If no, annotate these concerns in the comments section above, mark location of concern on map, and notify activity coordinator.	X		
	Site Specific Questionnaire			
4	Are the drainage ditches, as depicted on the figure, in good condition (free of sediment buildup and debris)? If no, describe condition of the drainage ditch, mark deficient location(s) on map, and notify activity coordinator.	X		See Comments
5	Are the signs, depicted on the figure, in good condition (letters still visible, and standing upright)? If no, describe condition of the signs, mark location(s) on map, and notify activity coordinator.			See Comments
6	Are site monitoring wells, as depicted on the figure, in good condition and appear to be locked? (i.e. damaged protective posts and/or well head/casing) If no, describe condition of the deficient monitoring well(s), mark location of deficient monitoring well(s).			See Comments
7	Is the soil cover free of notable defects that would require corrective action to ensure the effectiveness of the remedy?	X		
8	Is the site free of signs of stressed vegetation or bare spots that may lead to erosion of the soil cover?		X	See Comments
9	In the case of a severe weather event, is the integrity of the soil cover intact (no erosion by surface runoff)?	X		

Inspection performed by: (Print and sign) Adrienne Jones

Date: 10/1/10

Site 4 Inspection Report - Post-Storm Inspection

PREPARED FOR: St. Juliens Creek Annex Tier I Partnering Team

INSPECTION CONDUCTED BY: Nate Price/CH2M HILL

PREPARED BY: CH2M HILL

DATE: September 19, 2011

This inspection report documents the results of the post-storm inspection of Site 4, Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia. This technical memorandum was prepared under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-Term Environmental Action Navy 1000, Contract N62470-08-D-1000, Contract Task Order 0063, for submittal to NAVFAC Mid-Atlantic, U.S. Environmental Protection Agency Region III, and Virginia Department of Environmental Quality.

The site inspection was conducted on August 30, 2011, following a significant storm event (i.e., Hurricane Irene) that occurred August 27 and 28, 2011 and resulted in approximately 8 inches of rainfall in the Chesapeake/Portsmouth area (National Weather Service: National Weather Center. 29 August 2011. Web. 31 August 31 2011. http://www.nhc.noaa.gov/text/refresh/MIAHPCAT4+shtml/291523.shtml). The inspection was conducted to verify the continued integrity of the soil cover, confirm appropriate surface water drainage features and erosion controls are functioning, and ensure that adequate vegetation is maintained to prevent erosion after significant storm events. The checklist used during the post-storm inspection is included as Attachment 1, and the findings are summarized below.

No stressed vegetation, bare spots in the vegetation, standing water, or signs of erosion were observed on the soil cover during the inspection. The vegetation in the area of stressed vegetation located just north of the northern boundary of the site, which was observed during the Fiscal Year 2010 annual inspection, did not appear to be stressed and did not contain standing water. The site drainage ditches were in good condition, and no sediment buildup or debris was observed. Dense vegetation was observed in the drainage ditches, and is preventing erosion of the ditches while not adversely impacting the functionality of the ditches. The riprap landfill toe adjacent to the wetland also appears to be in good condition.

Based on the results of the inspection summarized in this report, the integrity of the soil cover remains intact, the surface water drainage features and erosion controls are functioning, and adequate vegetation is present to prevent erosion after storm events.

Attachment 1 – Site 4 Post-Storm Inspection Checklist

Site 4 - Landfill D
St. Juliens Creek Annex, Chesapeake, Virginia

Description: Site 4 (Landfill D) covers an estimated 8.3 acres in the northeastern portion of the Annex just north of the confluence of Blows Creek and the Southern Branch of the Elizabeth River. The site is located on fill material that reportedly originated from the Southern Branch of the Elizabeth River. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two. The trenches were filled with trash, wet garbage, and soil. Around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was continued to be disposed of at Site 4 until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Some solvents, acids, bases, and polychlorinated biphenyls were reportedly disposed. Wastes disposed of at Site 4 were estimated at 1,500,000 cubic yards.

The Selected Remedy for Site 4; soil cover, surface and wetland debris removal, and eastern drainage ditch removal; was completed in 2005. Fencing is installed around the perimeter of the site with signs posted.

Legend
- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Signs
- Large Signs

N W E S

0 75 150 Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Comments: (Provide related question number for each comment)

(1) THE VEGETATION IN THE AREA OF STRESSED VEGETATION OBSERVED JUST NORTH OF THE NORTHERN BOUNDARY OF THE SITE, FIRST OBSERVED DURING THE FISCAL YEAR 2010 ANNUAL INSPECTION, DID NOT APPEAR TO BE STRESSED AND DID NOT CONTAIN STANDING WATER.

Post-Storm Site Specific Questionnaire

		Yes	No
1	Are the drainage ditches, as depicted on the figure, in good condition (free of sediment buildup and debris)? If no, describe condition of the drainage ditch, mark deficient location(s) on map, and notify activity coordinator.	✓	
2	Is the soil cover free of notable defects that would require corrective action to ensure the effectiveness of the remedy?	✓	
3	Is the site free of signs of stressed vegetation or bare spots that may lead to erosion of the soil cover?	✓	
4	Is the integrity of the soil cover intact (no erosion by surface runoff)?	✓	

Note: The site monitoring wells and signs are not inspected during the post-storm inspection

Inspection performed by: (Print and sign) NATE PRICE /s/ N P

Date: 8/30/11

Site 4 Annual Inspection Report – Fiscal Year 2012

PREPARED FOR: SJCA Tier I Partnering Team

INSPECTION CONDUCTED BY: Nate Price/CH2M HILL

PREPARED BY: CH2M HILL

DATE: October 24, 2012

This annual inspection report documents the results of fiscal year (FY) 2012 annual inspection at Site 4, Landfill D, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This technical memorandum was prepared under Comprehensive Long-Term Environmental Action, Navy, Contract N62470-11-D-8012, Contract Task Order WE05, for submittal to Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, U.S. Environmental Protection Agency Region 3 (USEPA), and Virginia Department of Environmental Quality (VDEQ).

Background

SJCA was placed on the National Priorities List on July 27, 2000 (USEPA ID: VA5170000181). Investigation and remediation have been conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan.

The following documents identified the risks to human and ecological receptors, established Remedial Action Objectives (RAOs), and defined the Selected Remedy:

- Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report (CH2M HILL, 2003)
- Feasibility Study (CH2M HILL, 2004)
- Proposed Plan (NAVFAC, 2004a)
- Record of Decision (ROD) (NAVFAC, 2004b)

The Selected Remedy for Site 4 included a soil cover, removal of eastern drainage ditch sediment, and land use controls (LUCs) to meet the following RAOs:

- Prevent or minimize direct contact of human and ecological receptors with landfill contents
- Reduce infiltration and any resulting leaching of contaminants from the landfill into groundwater

- Prevent overland flow entering the site (surface water run-on) and control surface water run-off and erosion

To further define and implement the RAOs, the ROD specified the following LUC objectives for Site 4:

- Prohibit digging into or disturbing the soil cover or landfill contents
- Prohibit residential use and development of the site

The Remedial Design (RD) for the Selected Remedy was completed in November 2004 (AGVIQ-CH2M HILL Joint Venture, 2004). The Remedial Action construction was conducted from March through October of 2005. LUC implementation and maintenance actions were documented in a LUC RD, which was finalized in June 2006 (CH2M HILL, 2006). The Navy implements, maintains, monitors, and enforces the LUCs according to the LUC RD. The LUCs shall be maintained within the boundaries of the landfill (Figure 1) indefinitely, or until all parties (NAVFAC, USEPA, and VDEQ) agree that waste left in-place is at such levels to allow for unlimited use and unrestricted exposure. A Remedial Action Completion Report, documenting that the remedy at Site 4 is operational and functional in accordance with CERCLA and memorializing the Response Complete, was signed in October 2006 (NAVFAC, 2006). A Five-Year Review, signed May 2010, was conducted to evaluate the performance of the implemented remedy at Site 4 and verify that the remedy remains protective of human health and the environment in accordance with the requirements stated in the ROD (CH2M HILL, 2010).

Inspection

In accordance with the ROD and LUC RD, the FY 2012 annual landfill inspection was conducted on September 5, 2012, to certify that no digging has occurred and no residential use is allowed, verify the continued integrity of the soil cover, confirm appropriate surface water drainage features and erosion controls are functioning, and ensure that adequate vegetation is maintained. The site-specific inspection checklist (Attachment 1) was used for the annual inspection and the findings are summarized below.

During the FY 2012 annual inspection, no signs of unauthorized intrusive activities, investigation derived waste storage, or dumping within the site was observed. The signs and fencing were in good condition. The contact information on the signs was correct. All of the monitoring wells were in good condition, including SJS04-MW01S, where a protective post had been replaced after it was observed during the 2011 inspection to have been knocked down.

No stressed vegetation or bare spots in the vegetation were observed on the cover or in the adjacent areas during the inspection. The site drainage ditches were in good condition, and no sediment buildup or debris was observed. Dense vegetation was observed in the drainage ditches, and was preventing erosion of the ditches while not adversely impacting their functionality. The riprap landfill toe adjacent to the wetland also appeared to be in good condition.

The results of the FY 2012 annual inspection indicate that the facility is compliant with the land use restrictions required in the LUC RD to prohibit residential use of the site and digging into or disturbing the soil cover. The conditions of the landfill (integrity, drainage, erosion, and vegetation) are satisfactory.

References

AGVIQ-CH2M HILL Joint Venture I, 2004. *Final Design Package, Site 4 – Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. November.

CH2M HILL, 2003. *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, and 6*. St. Juliens Creek Annex, Chesapeake, Virginia. March.

CH2M HILL, 2004. *Final Feasibility Study for Site 4*. St. Juliens Creek Annex, Chesapeake, Virginia. March

CH2M HILL, 2006. *Remedial Design for Land Use Controls, Site 4, Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. 2006

CH2M HILL, 2010. *Final Five-Year Review Report, St. Juliens Creek Annex, Chesapeake, Virginia*. May.

NAVFAC, 2004a. *Final Proposed Remedial Action Plan for Site 4*. St. Juliens Creek Annex, Chesapeake, Virginia. June.

NAVFAC, 2004b. *Record of Decision, Site 4: Landfill D*. St. Juliens Creek Annex. Chesapeake, Virginia. September.

NAVFAC, 2006. *Final Remedial Action Completion Report, Site 4 –Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. September.

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\STJULIENSCREEKANNEX\MAPFILES\SITE 4\ANNUAL INSPECTION REPORT\FIGURE 1 - SITE 4 .MXD CBOWMAN 9/22/2011 10:59:38 AM

Legend

- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Sign
- Large Sign

N
W E
S

0 75 150
Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Attachment 1 – Site 4 Annual Inspection Checklist

Site 4 - Landfill D

St. Juliens Creek Annex, Chesapeake, Virginia

Description: Site 4 (Landfill D) covers an estimated 8.3 acres in the northeastern portion of the Annex just north of the confluence of Blows Creek and the Southern Branch of the Elizabeth River. The site is located on fill material that reportedly originated from the Southern Branch of the Elizabeth River. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two. The trenches were filled with trash, wet garbage, and soil. Around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was continued to be disposed of at Site 4 until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Some solvents, acids, bases, and polychlorinated biphenyls were reportedly disposed. Wastes disposed of at Site 4 were estimated at 1,500,000 cubic yards.

The Selected Remedy for Site 4; soil cover, surface and wetland debris removal, and eastern drainage ditch removal; was completed in 2005. Fencing is installed around the perimeter of the site with signs posted.

Legend
- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Signs
- Large Signs

N, W, E, S

0 75 150 Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Comments: (Provide related question number for each comment)

- THE CONTACT INFORMATION ON ALL OF THE SITE SIGNS HAS BEEN UPDATED.
- THE PROTECTIVE POST FOR MONITORING WELL MW01S HAS BEEN REPAIRED.

	General Questionnaire	Yes	No
1	Is the area free of any indication of recent and/or current intrusive activities within the site boundary, as depicted on the figure, or in the immediate vicinity of the site? If no, mark location of intrusive activities on figure, note extent and purpose.	✓	
2	Is the area free of storage of any investigative derived waste (IDW) on site? If no, mark location of IDW on figure, note its condition in the comment section below, and notify activity coordinator. Indicate if IDW is properly labeled, per example below: Investigative Derived Waste Purge water from Site 4 January 28, 2003 Do not handle, analysis pending Contact Walter Bell, NAVFAC MID LANT, (757) 341-0484	✓	
3	Is the area free of identifiable concerns, such as, signs of dumping of chemicals or debris, with regards to this site? If no, annotate these concerns in the comments section above, mark location of concern on map, and notify activity coordinator.	✓	
	Site Specific Questionnaire		
4	Are the drainage ditches, as depicted on the figure, in good condition (free of sediment buildup and debris)? If no, describe condition of the drainage ditch, mark deficient location(s) on map, and notify activity coordinator.	✓	
5	Are the signs, depicted on the figure, in good condition (letters still visible, and standing upright)? If no, describe condition of the signs, mark location(s) on map, and notify activity coordinator.	✓	
6	Are site monitoring wells, as depicted on the figure, in good condition and appear to be locked? (i.e. damaged protective posts and/or well head/casing) If no, describe condition of the deficient monitoring well(s), mark location of deficient monitoring well(s).	✓	
7	Is the soil cover free of notable defects that would require corrective action to ensure the effectiveness of the remedy?	✓	
8	Is the site free of signs of stressed vegetation or bare spots that may lead to erosion of the soil cover?	✓	
9	In the case of a severe weather event, is the integrity of the soil cover intact (no erosion by surface runoff)?	✓	

Inspection performed by: (Print and sign) NATE PRICE / Nat O R

Date: 9/5/12

TECHNICAL MEMORANDUM

Site 4 Annual Inspection Report – 2013

PREPARED FOR: SJCA Tier I Partnering Team

INSPECTION CONDUCTED BY: Krista Parra/NAVFAC Midlant

DATE: November 14, 2013

This annual inspection report documents the results of the 2013 annual inspection at Site 4, Landfill D, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This technical memorandum was prepared for submittal to U.S. Environmental Protection Agency Region 3 (USEPA), and Virginia Department of Environmental Quality (VDEQ).

Background

SJCA was placed on the National Priorities List on July 27, 2000 (USEPA ID: VA5170000181). Investigation and remediation have been conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan.

The following documents identified the risks to human and ecological receptors, established Remedial Action Objectives (RAOs), and defined the Selected Remedy:

- Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report (CH2M HILL, 2003)
- Feasibility Study (CH2M HILL, 2004)
- Proposed Plan (NAVFAC, 2004a)
- Record of Decision (ROD) (NAVFAC, 2004b)

The Selected Remedy for Site 4 included a soil cover, removal of eastern drainage ditch sediment, and land use controls (LUCs) to meet the following RAOs:

- Prevent or minimize direct contact of human and ecological receptors with landfill contents
- Reduce infiltration and any resulting leaching of contaminants from the landfill into groundwater
- Prevent overland flow entering the site (surface water run-on) and control surface water run-off and erosion

To further define and implement the RAOs, the ROD specified the following LUC objectives for Site 4:

- Prohibit digging into or disturbing the soil cover or landfill contents
- Prohibit residential use and development of the site

The Remedial Design (RD) for the Selected Remedy was completed in November 2004 (AGVIQ-CH2M HILL Joint Venture, 2004). The Remedial Action construction was conducted from March through October of 2005. LUC implementation and maintenance actions were documented in a LUC RD, which was finalized in June 2006 (CH2M HILL, 2006). The Navy implements, maintains, monitors, and enforces the LUCs according to the LUC RD. The LUCs shall be maintained within the boundaries of the landfill (Figure 1) indefinitely, or until all parties (NAVFAC, USEPA, and VDEQ) agree that waste left in-place is at such levels to allow for unlimited use and unrestricted exposure. A Remedial Action Completion Report, documenting that the remedy at Site 4 is operational and functional in accordance with CERCLA and memorializing the Response Complete, was signed in October 2006 (NAVFAC, 2006). A Five-Year Review, signed May 2010, was conducted to evaluate the performance of the implemented remedy at Site 4 and verify that the remedy remains protective of human health and the environment in accordance with the requirements stated in the ROD (CH2M HILL, 2010).

Inspection

In accordance with the ROD and LUC RD, the 2013 annual landfill inspection was conducted on November 14, 2013, to certify that no digging has occurred and no residential use is allowed, verify the continued integrity of the soil cover, confirm appropriate surface water drainage features and erosion controls are functioning, and ensure that adequate vegetation is maintained. The site-specific inspection checklist (Attachment 1) and land use control inspection checklist (Attachment 2) was used for the annual inspection and the findings are summarized below.

During the 2013 annual inspection, no signs of unauthorized intrusive activities, investigation derived waste storage, or dumping within the site was observed. Due to safety concerns posed by high and dense vegetation multiple wells, signs and fence line were unable to be inspected; further inspection will be completed and reported via email once safety concerns have been resolved. The signs and fencing that were able to be accessed were in good condition. The contact information on the signs was correct. Monitoring wells SJ04-MW03S, SJ04-MW03D and SJ04-MW04S were in good condition, SJ04-MW01S, SJ04-MW01D, SJ04-MW02S and SJ04-MW05S were unable to be accessed.

No stressed vegetation or bare spots in the vegetation were observed on the cover or in the adjacent areas during the inspection. The site drainage ditches were in good condition, and no sediment buildup or debris was observed. Dense vegetation was observed in the drainage ditches, and was preventing erosion of the ditches while not adversely impacting their functionality; see Site 4 Post-Storm Inspection Report (Attachment 3). The riprap landfill toe adjacent to the wetland also appeared to be in good condition.

The results of the 2013 annual inspection indicate that the facility is compliant with the land use restrictions required in the LUC RD to prohibit residential use of the site and digging into or disturbing the soil cover. The conditions of the landfill (integrity, drainage, erosion, and vegetation) are satisfactory.

References

AGVIQ-CH2M HILL Joint Venture I, 2004. *Final Design Package, Site 4 – Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. November.

CH2M HILL, 2003. *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, and 6*. St. Juliens Creek Annex, Chesapeake, Virginia. March.

CH2M HILL, 2004. *Final Feasibility Study for Site 4*. St. Juliens Creek Annex, Chesapeake, Virginia. March

CH2M HILL, 2006. *Remedial Design for Land Use Controls, Site 4, Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. 2006

CH2M HILL, 2010. *Final Five-Year Review Report, St. Juliens Creek Annex, Chesapeake, Virginia*. May.

NAVFAC, 2004a. *Final Proposed Remedial Action Plan for Site 4*. St. Juliens Creek Annex, Chesapeake, Virginia. June.

NAVFAC, 2004b. *Record of Decision, Site 4: Landfill D*. St. Juliens Creek Annex. Chesapeake, Virginia. September.

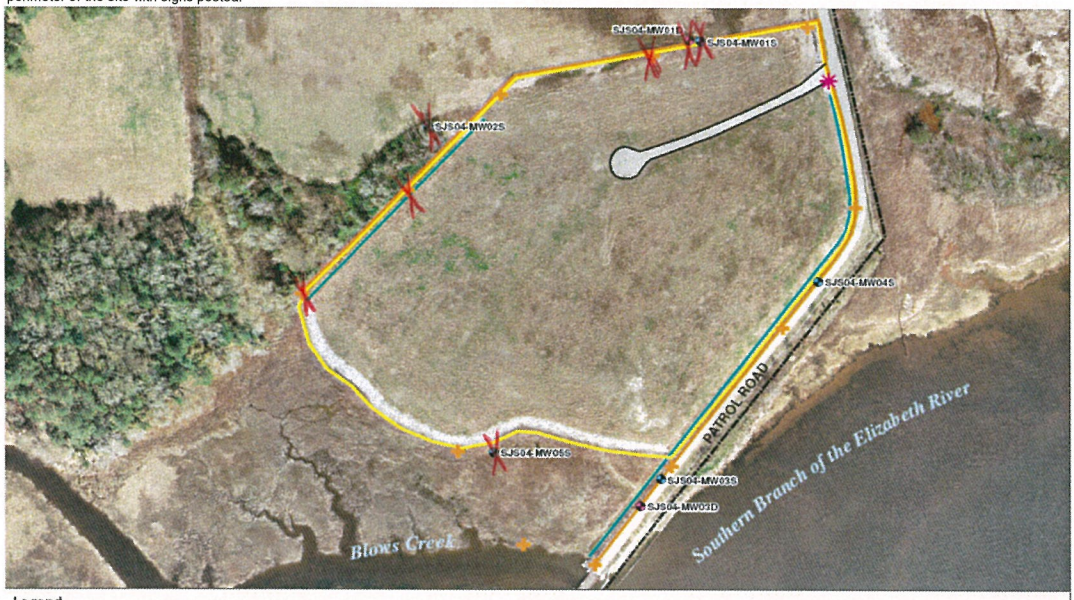
NAVFAC, 2006. *Final Remedial Action Completion Report, Site 4 –Landfill D*. St. Juliens Creek Annex, Chesapeake, Virginia. September.

Attachment 1 – Site 4 Annual Inspection Checklist

Site 4 - Landfill D
St. Juliens Creek Annex, Chesapeake, Virginia

Description: Site 4 (Landfill D) covers an estimated 8.3 acres in the northeastern portion of the Annex just north of the confluence of Blows Creek and the Southern Branch of the Elizabeth River. The site is located on fill material that reportedly originated from the Southern Branch of the Elizabeth River. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two. The trenches were filled with trash, wet garbage, and soil. Around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was continued to be disposed of at Site 4 until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Some solvents, acids, bases, and polychlorinated biphenyls were reportedly disposed. Wastes disposed of at Site 4 were estimated at 1,500,000 cubic yards.

The Selected Remedy for Site 4; soil cover, surface and wetland debris removal, and eastern drainage ditch removal; was completed in 2005. Fencing is installed around the perimeter of the site with signs posted.



Legend
- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Signs
- Large Signs

N W E S

0 75 150 Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Comments: (Provide related question number for each comment)

All signs and wells weren't able to be inspected due to dense vegetation. Due to safety concerns, the wells and signs unable to be inspected will be inspected at a later date and reported to the team via email. Wells and signs that could be seen were in good condition and locked.

represents wells and signs that were not inspected.

General Questionnaire

		Yes	No
1	Is the area free of any indication of recent and/or current intrusive activities within the site boundary, as depicted on the figure, or in the immediate vicinity of the site? If no, mark location of intrusive activities on figure, note extent and purpose.	X	
2	Is the area free of storage of any investigative derived waste (IDW) on site? If no, mark location of IDW on figure, note its condition in the comment section below, and notify activity coordinator. Indicate if IDW is properly labeled, per example below: Investigative Derived Waste Purge water from Site 4 January 28, 2003 Do not handle, analysis pending Contact Krista Parra, NAVFAC MID LANT, (757) 341-0395	X	
3	Is the area free of identifiable concerns, such as, signs of dumping of chemicals or debris, with regards to this site? If no, annotate these concerns in the comments section above, mark location of concern on map, and notify activity coordinator.	X	

Site Specific Questionnaire

4	Are the drainage ditches, as depicted on the figure, in good condition (free of sediment buildup and debris)? If no, describe condition of the drainage ditch, mark deficient location(s) on map, and notify activity coordinator.	X	
5	Are the signs, depicted on the figure, in good condition (letters still visible, and standing upright)? If no, describe condition of the signs, mark location(s) on map, and notify activity coordinator.		
6	Are site monitoring wells, as depicted on the figure, in good condition and appear to be locked? (i.e. damaged protective posts and/or well head/casing) If no, describe condition of the deficient monitoring well(s), mark location of deficient monitoring well(s).		
7	Is the soil cover free of notable defects that would require corrective action to ensure the effectiveness of the remedy?	X	
8	Is the site free of signs of stressed vegetation or bare spots that may lead to erosion of the soil cover?	X	
9	In the case of a severe weather event, is the integrity of the soil cover intact (no erosion by surface runoff)?	X	

Inspection performed by: (Print and sign) Krista Parra

14-Nov-13

Attachment 2 – Site 4 Land Use Control Inspection Checklist

LUC TRACKER REPORT
LAND USE CONTROL INSPECTION SHEET
COMMAND: MID_ATLANTIC
Remedial Project Manager: Parra, Krista

Event: IR SITE 4 - LANDFILL D Sep 2013
Site Information

Base:	ST_JULIENS_CREEK
NORM Site ID:	SITE 00004
Installation / Activity:	SITE 00004
Type of Site:	ERN
Ownership:	U.S. Navy
Inspection Date:	Nov 14, 2013 9:39:03 AM
Inspector:	

Remedial Action Objective	LUC	Implementation
Restrictions applied to digging.; Prohibit residential use in certain areas, unless prior written approval of the Navy and lead regulatory agency is obtained.	DIGGING; RESIDENT_PERM	ANNUAL CERTIFICA

Previous Inspection		Comments
Were any problems or deficiencies noted during the previous Inspections?	NO	

Property Use		Comments
What is the current property use within controlled area?		Covered landfill.
Does the property use comply with the applicable LUCs?	YES	
Has the property use changed since last inspection?	NO	
Have any changes to ownership or occupancy changes since the last inspection?	NO	
If property has transferred to a new owner, does the new deed include the LUCs?		

Institutional Controls		Comments
Do the institutional controls contain appropriate language?	YES	
Does the installation have an adequate construction review process that identifies if the site has LUCs?	YES	
Have there been any known instances of LUC breaches?	NO	

Current Inspection		Comments
Have any problems or deficiencies related to the restrictions and/or controls listed in Section A been identified since the last inspection and/or during this inspection? This includes the obtaining of proper permits and approvals for well installation, digging, etc., and the proper disposal of contaminated soil, groundwater or other media?	NO	
Has emergency digging (or other emergency waiving of LUCs) been required in restricted areas since the last inspection? If so, were the required follow-up notifications made?	NO	
Are there any signs of general site deterioration that may lead to a potential deficiency in the future?	NO	
Is adjacent property development activity occurring that could impact the LUC?	NO	

Conclusion		Comments
Have all problems or deficiencies identified during this inspection been corrected?		

Attachment 3 – Site 4 Inspection Report - Post-Storm Inspection

Site 4 Inspection Report - Post-Storm Inspection

PREPARED FOR: St. Juliens Creek Annex Tier I Partnering Team

INSPECTION CONDUCTED BY: Nate Price/CH2M HILL

PREPARED BY: CH2M HILL

DATE: October 14, 2013

This inspection report documents the results of the post-storm inspection of Site 4, Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia. This technical memorandum was prepared under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Contract N62470-11-D-8012, Contract Task Order WE05, for submittal to NAVFAC Mid-Atlantic, U.S. Environmental Protection Agency Region 3, and Virginia Department of Environmental Quality.

The site inspection was conducted on October 11, 2013, following a significant storm event that occurred October 9 through 10, 2013 and resulted in approximately 3.8 inches of rainfall in the Chesapeake/Portsmouth area (National Weather Service: National Weather Center, http://w1.weather.gov/data/obhistory/KNGU.html). The inspection was conducted to verify the continued integrity of the soil cover, confirm appropriate surface water drainage features and erosion controls are functioning, and ensure that adequate vegetation is maintained to prevent erosion after significant storm events. The checklist used during the post-storm inspection is included as Attachment 1, and the findings are summarized below.

No stressed vegetation, bare spots in the vegetation, standing water, or signs of erosion were observed on the soil cover during the inspection. The site drainage ditches were in good condition, and no sediment buildup or debris was observed. Dense vegetation was observed in the drainage ditches, and is preventing erosion of the ditches while not adversely impacting the functionality of the ditches. The riprap landfill toe adjacent to the wetland also appears to be in good condition.

Based on the results of the inspection summarized in this report, the integrity of the soil cover remains intact, the surface water drainage features and erosion controls are functioning, and adequate vegetation is present to prevent erosion after storm events.

Attachment 1 – Site 4 Post-Storm Inspection Checklist

Site 4 - Landfill D
St. Juliens Creek Annex, Chesapeake, Virginia

Description: Site 4 (Landfill D) covers an estimated 8.3 acres in the northeastern portion of the Annex just north of the confluence of Blows Creek and the Southern Branch of the Elizabeth River. The site is located on fill material that reportedly originated from the Southern Branch of the Elizabeth River. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two. The trenches were filled with trash, wet garbage, and soil. Around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was continued to be disposed of at Site 4 until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Some solvents, acids, bases, and polychlorinated biphenyls were reportedly disposed. Wastes disposed of at Site 4 were estimated at 1,500,000 cubic yards.

The Selected Remedy for Site 4; soil cover, surface and wetland debris removal, and eastern drainage ditch removal; was completed in 2005. Fencing is installed around the perimeter of the site with signs posted.

Legend
- SJCA Boundary
- Site 4 Boundary
- Fence
- Drainage Ditch
- Access Road
- Shallow Monitoring Well
- Deep Monitoring Well
- Small Signs
- Large Signs

N W E S

0 75 150 Feet

Figure 1
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Comments: (Provide related question number for each comment)

Post-Storm Site Specific Questionnaire

		Yes	No
1	Are the drainage ditches, as depicted on the figure, in good condition (free of sediment buildup and debris)? If no, describe condition of the drainage ditch, mark deficient location(s) on map, and notify activity coordinator.	X	
2	Is the soil cover free of notable defects that would require corrective action to ensure the effectiveness of the remedy?	X	
3	Is the site free of signs of stressed vegetation or bare spots that may lead to erosion of the soil cover?	X	
4	Is the integrity of the soil cover intact (no erosion by surface runoff)?	X	

Note: The site monitoring wells and signs are not inspected during the post-storm inspection

Inspection performed by: (Print and sign)
Date: 10/11/2013

I. SITE INFORMATION

Site Name: Site 21 - Industrial Area | **Date of Inspection:** 7/31/2014

Location and Region: St. Juliens Creek Annex, Chesapeake, Virginia | **EPA ID:** VA5170000181

Agency, office, or company leading the five-year review: NAVFAC Mid-Atlantic with USEPA and VDEQ | **Weather/ temperature:** Clear and 80 °F

Remedy Includes: (Check all that apply):

- Landfill cover/containment ☐
- Access controls ☐
- Institutional controls ☑
- Groundwater pump and treatment ☐
- Surface water collection and treatment ☐
- Monitored natural attenuation ☐
- Groundwater containment ☐
- Vertical barrier walls ☐

Other : In situ groundwater treatment

Attachments: Site Map Attached ☑

II. INTERVIEWS

1. Local regulatory authorities and response agencies (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.)

Agency VDEQ

Contact Karen Doran/RPM (Name/Title) | 9/29/2014 (Date) | 804-698-4594 (Phone #)

Problems, suggestions: Indicated that during injection of EVO furing the RA, a small amount of EVO discharged into a nearby waterway (offsite). The incident was reported to all appropriate officials, including VDEQ's Tidewater Regional Office. The Navy and contractors took corrective action measures and steps to ensure future releases did not occur. Indicated that the remedy is protective of human health.

☐ Report attached

III. ACCESS AND INSTITUTIONAL CONTROLS

A. Other Access Restrictions

1. Signs and other security measures

Locations shown on site map ☑

Remarks : Signs in place, clearly visible, and have current information

B. Institutional Controls (ICs)

1. Implementation and enforcement

Conditions imply ICs not properly implemented — Yes ☐ No ☑ N/A ☐

Conditions imply ICs not being fully enforced — Yes ☐ No ☑ N/A ☐

Type of monitoring (e.g., self-reporting, drive by) : LUC Tracker, site inspections, and Environmental Checklists

Frequency : Annual (LUCs) & As needed (Environmental Checklists for new projects)

Responsible party: NAVFAC

Contact : Krista Parra/RPM (Name/Title) | 7575-341-0395 (Phone No.)

Reporting is up to date — Yes ☑ No ☐ N/A ☐

Reports are verified by the lead agency — Yes ☑ No ☐ N/A ☐

Specific requirements in deed or decision documents have been met — Yes ☑ No ☐ N/A ☐

Violations have been reported — Yes ☐ No ☐ N/A ☑

Other problems or suggestions: Report attached ☑

2 Adequacy N/A ☐

ICs are adequate ☑

ICs are inadequate ☐

Remarks :

C. General

1 Vandalism/trespassing

Location shown on site map ☐
No vandalism evident ☑

2 Land use changes on site N/A ☐

Remarks : No change in land use

3 Land use changes off site N/A ☑

Remarks : No change in land use

IV. GENERAL SITE CONDITIONS

A. Roads Applicable ☐ N/A ☐

1 Roads damaged N/A ☐

Location shown on site map ☐
Roads adequate ☑

Remarks :

B. Other Site Conditions

1 Remarks : None

V.GROUNDWATER REMEDIES

A. Monitoring Data

1 Monitoring Data

Is routinely submitted on time ☑ Is of acceptable quality ☑

2 Monitoring data suggests:

Groundwater plume is effectively contained ☑ Contaminant concentrations are declining ☑

B. In Situ Groundwater Remediation

1 Monitoring Wells N/A ☐

Properly secured/locked ☐
Functioning ☑
Routinely sampled ☑
Good condition ☑
All required wells located ☑
Needs Maintenance ☑

Remarks : The labels for several wells were no longer visible and bolts were missing from the well lids for several of the wells. The wells should be re-labeled and the bolts replaced.

VI. OTHER REMEDIES

A. Vapor Intrusion Monitoring

1 Subslab Vapor Probes N/A ☑

Properly secured/locked ☐
Functioning ☐
Routinely sampled ☐
Good condition ☐
All required probes located ☐
Needs Maintenance ☐

Remarks : The probes were not inspected during the five-year review inspection but are during the RA-O vapor intrsion monitoring events and annual inspection reports.

VII. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy at Site 21 is intended to reduce contaminant concentrations in shallow groundwater to the maximum extent practicable and prevent exposure to shallow groundwater until contaminant concentrations allow for unlimited use and unrestricted exposure.

Inspection of the site verifies that access controls are in place, and that no unacceptable exposures are occuring.

The remedy is effective and functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

No issues or observations related to implementation and scope of the O&M.

C. Early indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost of scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be comprised in the future.

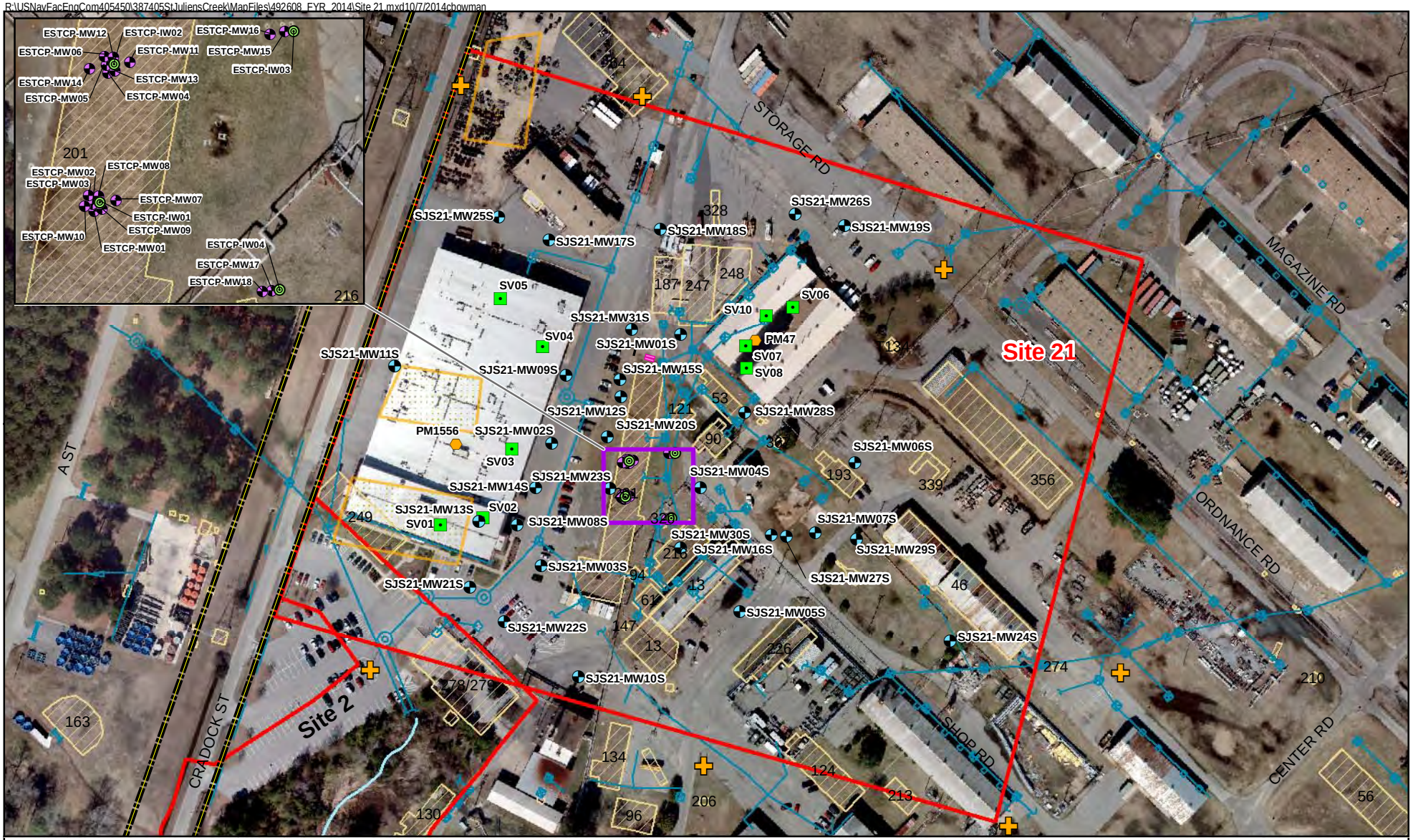
No early indicators were observed.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

No oppurtunties for optimization were identified.

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\492608_FYR_2014\Site 21.mxd10/7/2014cbowman



Legend

- Shallow Monitoring Well
- Subslab Vapor Location
- Pressure Monitoring Location
- Small Sign

ESTCP Wells

- Injection Wells
- Monitoring Wells

- Site Boundary
- Demolished Building
- Approx. Areas of TPH Contaminated Soil Removal (1993)
- Approx. Locations of Former UST
- Former Service Station
- SJCA Boundary

- VEPCO Corridor
- Storm Sewer Line

N W E S

0 100 200 Feet

Site 21
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Appendix C
Emerging Contaminants Review

Table C-1
Site 2 Emerging Contaminant Evaluation

1,4-Dioxane Checklist	Response	Comments
Is there a site history indicating the use of 1,1,1,-TCA (1,4-dioxane was used primarily as a stabilizer in chlorinated solvents, particularly 1,1,1-TCA)?	No	Site history of solvent disposal upgradient (at IR Site 21) but no specific records of 1,1,1-TCA use or disposal (only TCE specifically mentioned)
Have there been detections of 1,1,1-TCA in site media?	No	No detections found in historical reports where Target Compound List VOCs analyzed (IAS, RRR, SIs, RI, etc)
Is 1,1,-DCE (most common byproduct of 1,1,1-TCA degradation) detected in site media?	Yes	Identified as a COC in groundwater for the site. Also detected in sediment, surface water, and sediment porewater.
Have top 10 TICs been requested from the lab indicating 1,4-dioxane is present?	No	No Top 10 TIC data.
Has 1,4-dioxane been analyzed for at the site?	No	Current monitoring at the site is for groundwater COCs only (1,1,2-TCA, chloroform, methylene chloride, PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, VC, naphthalene, and heptachlor epoxide)
Recommend site for analysis of 1,4-dioxane?	Yes	Although 1,1,1-TCA was not detected in the groundwater, 1,1-DCE was and 1,4-dioxane cannot be ruled out as the source of 1,1-DCE based on history of solvent disposal upgradient of the site.
PFC Checklist	**Response**	**Comments**
Is there a site history indicating the use of AFFF for firefighting training activities (or fire fighting activities), PFC use at metal plating facilities, or use/storage of JP-7 at the site?	No	No records of firefighting training nor storage/use of JP-7. Reports of burning waste included in site history reported prior to 1970, which was before widespread use of AFFF. Also, AFFF would not have likely been used in fire control in a burn area at a landfill.
Is a firefighting training area present in the vicinity of the Site?	Yes	Firefighting training operations occurred adjacent to but downgradient of Site 2, near Building 271. A review of available historical documents was conducted. According to the RFA (Kearney and Brown, 1989), the training occurred at two adjacent celled areas. One of the celled areas consisted of a burning site where wooden pallets were soaked with diesel, ignited, and extinguished with water. The other area was a buried stainless steel pit (4' x 4' x 3' deep) filled with diesel fuel which is ignited and extinguished using carbon dioxide. Use of AFFFs as part of these training operations was not identified in the historical documents that were reviewed. Additionally, the Southside Regional Fire Academy (SRFA) is located at SJCA but is approximately a half mile from the site. AFFF firefighting concepts are included in courses taught at the SRFA. However, practical evolutions with AFFF are not taught at the academy; typically, water with food coloring is used to simulate when foam is being used for a practical evolution.

Table C-1

Site 2 Emerging Contaminant Evaluation

Have PFCs been analyzed in site media?	No	No analysis of PFCs in site media per review of IAS, RRR, SIs, and RI/ERI.
Recommend site for analysis of PFCs?	No	Based on site history, analysis of PFCs is not warranted. There are no records of the use of AFFF, metal plating activities or storage of JP-7 at or in the vicinity of the site.
Dioxin/Furan Checklist	**Response**	**Comments**
Is there a site history of burning chlorinated solvents at the site?	Yes	Reports of burning refuse included in site history.
Have dioxins/furans been analyzed in site media?	Yes	Evaluated in soil and sediment during RI phase for site.
Recommend site for analysis of dioxins/furans?	No	No unacceptable risk from dioxins/furans identified for Site 2.
Perchlorate Checklist	**Response**	**Comments**
Is there a site history indicating one of the following at the site? a. The manufacture/maintenance of solid-fuel missile/rocket motors, and/or munitions containing perchlorates; b. The use of perchlorate-containing munitions for training or testing purposes; c. The demilitarization of perchlorate-containing munitions using techniques, such as “hog-out” of rockets and missiles containing solid propellant; and d. Open burning/open detonation operations.	Yes	Open burning, including of waste ordnance, occurred at the site. Munitions manufactured at the installation but not at Site 2. Building 46, located upgradient of Site 2, was historically used to load smokeless powder into cartridges; related chemicals included explosives.
Have explosives been detected in site media?	Yes	RDX, HMX, and 2,6-dinitrotoluene detected in shallow groundwater. 1,3-dinitrobenzene detected in deep groundwater. 3-NT detected in surface water. No unacceptable potential risk identified to site receptors.
Has perchlorate been analyzed in site media?	No	No analysis of perchlorate in site media per review of IAS, RRR, SIs, and RI/ERI.
Recommend site for analysis of perchlorate?	Yes	Although the presence of perchlorate is not likely, based on site history and presence of explosives in site groundwater, the possibility of it's presence cannot be completely eliminated, due to the historical handling of ordnance.

Table C-2
Site 4 Emerging Contaminant Evaluation

1,4-Dioxane Checklist	Response	Comments
Is there a site history indicating the use of 1,1,1,-TCA (1,4-dioxane was used primarily as a stabilizer in chlorinated solvents, particularly 1,1,1-TCA)?	No	Not specifically but the RFA indicated that some solvents were disposed of at Site 4, it is assumed that these materials were disposed of prior to 1976 as the IAS states that only inert material was disposed of after that date. 1,1,1-TCA was a less common solvent in DOD applications prior to 1970.
Have there been detections of 1,1,1-TCA in site media?	No	No detections found in historical reports where Target Compound List VOCs analyzed (IAS, RRR, SIs, RI, etc)
Is 1,1,-DCE (most common byproduct of 1,1,1-TCA degradation) detected in site media?	No	No detections found in historical reports where TCL VOCs analyzed (IAS, RRR, SIs, RI, etc)
Have top 10 TICs been requested from the lab indicating 1,4-dioxane is present?	No	No Top 10 TICs data found.
Has 1,4-dioxane been analyzed for at the site?	No	Only voluntary groundwater monitoring for inorganics conducted since ROD signature.
Recommend site for analysis of 1,4-dioxane?	No	Early and minimal solvents history and absence of 1,1,1-TCA and degradation products suggests 1,4-dioxane presence in site media is unlikely.
PFC Checklist	**Response**	**Comments**
Is there a site history indicating the use of AFFF for fire fighting training activities (or fire fighting activities), disposal of AFFF materials, PFC use at metal plating facilities, or use/storage of JP-7 at the site?	No	No records of fire fighting training, storage/use of JP-7, or reports of fires at the site. No metal plating facilities were located at SJCA.
Is a fire fighting training area present in the vicinity of the Site?	No	Firefighting training operations occurred at two locations at the facility, neither or which are adjacent to Site 4. Historical records regarding firefighter training activities were reviewed and provided details about the activities; no records of use of AFFFs were found.
Have PFCs been analyzed in site media?	No	No analysis of PFCs in site media per review of IAS, RRR, SIs, and RI.
Recommend site for analysis of PFCs?	No	Based on site history, analysis of PFCs is not warranted. There are no records of the use of AFFF, metal plating activities or storage of JP-7 at or in the vicinity of the site.

Table C-2
Site 4 Emerging Contaminant Evaluation

Dioxin/Furan Checklist	**Response**	**Comments**
Is there a site history of burning chlorinated solvents at the site?	No	No records of burning activities were identified associated with Site 4.
Have dioxins/furans been analyzed in site media?	No	Site history did not warrant evaluation
Recommend site for analysis of dioxins/furans?	No	Lack of any identified usage associated with dioxins/furans suggests their presence in site media is unlikely.
Perchlorate Checklist	**Response**	**Comments**
Is there a site history indicating one of the following at the site? a. The manufacture/maintenance of solid-fuel missile/rocket motors, and/or munitions containing perchlorates; b. The use of perchlorate-containing munitions for training or testing purposes; c. The demilitarization of perchlorate-containing munitions using techniques, such as “hog-out” of rockets and missiles containing solid propellant; and d. Open burning/open detonation operations.	No	A review of the historical use of the site does not indicate ordnance-related activities at the site, although MPPEH were found during the Remedial Action south of the site. No history of burning at the site.
Have explosives been detected in site media?	No	Explosives have not been analyzed for at the site
Has perchlorate been analyzed in site media?	No	No analysis of perchlorate in site media per review of IAS, RRR, SIs, and RI.
Recommend site for analysis of perchlorate?	No	Site history indicates presence of perchlorate in site media is not anticipated. MPPEH was found South of the site which is not related to site activities (South of the site is Blows Creek, upgradient portions of Blows Creek are immediately adjacent to Site 5, munitions burning grounds).

Table C-3
Site 21 Emerging Contaminant Evaluation

1,4-Dioxane Checklist	Response	Comments
Is there a site history indicating the use of 1,1,1,-TCA (1,4-dioxane was used primarily as a stabilizer in chlorinated solvents, particularly 1,1,1-TCA)?	No	Site history of solvent disposal but no specific records of 1,1,1-TCA use or disposal (only TCE specifically mentioned).
Have there been detections of 1,1,1-TCA in site media?	No	No detections found in historical reports where Target Compound List VOCs analyzed (IAS, RRR, SIs, RI, etc).
Is 1,1,-DCE (most common byproduct of 1,1,1-TCA degradation) detected in site media?	Yes	Identified as a COC in groundwater for the site. Detected in indoor air (vapor intrusion).
Have top 10 TICs been requested from the lab indicating 1,4-dioxane is present?	No	No Top 10 TIC data.
Has 1,4-dioxane been analyzed for at the site?	No	Current monitoring at the site is for groundwater COCs only (TCE, cis-1,2-DCE, 1,1-DCE, and VC)
Recommend site for analysis of 1,4-dioxane?	Yes	Although 1,1,1-TCA was not detected in the groundwater, 1,1-DCE was and 1,4-dioxane cannot be ruled out as the source of 1,1-DCE based on history of solvent disposal.
PFC Checklist	**Response**	**Comments**
Is there a site history indicating the use of AFFF for fire fighting training activities (or fire fighting activities), PFC use at metal plating facilities, or use/storage of JP-7 at the site?.	No	No records of fire fighting training, storage/use of JP-7, nor reports of fires at the site. No metal plating facilities were located at SJCA.
Is a fire fighting training area present in the vicinity of the Site?	No	Firefighting training operations occurred at two locations at the facility, neither or which are adjacent to Site 21. Historical records regarding firefighter training activities were reviewed and provided details about the activities; no records of use of AFFFs were found.
Have PFCs been analyzed in site media?	No	No analysis of PFCs in site media per review of IAS, RRR, SIs, and RI.
Recommend site for analysis of PFCs?	No	Based on site history, analysis of PFCs is not warranted. There are no records of the use of AFFF, metal plating activities or storage of JP-7 at or in the vicinity of the site.
Dioxin/Furan Checklist	**Response**	**Comments**
Is there a site history of burning chlorinated solvents at the site?	No	No records of burning activities were identified associated with Site 21.
Have dioxins/furans been analyzed in site media?	No	Site history did not warrant evaluation
Recommend site for analysis of dioxins/furans?	No	Site history does not warrant evaluation

Table C-3

Site 21 Emerging Contaminant Evaluation

Perchlorate Checklist	Response	Comments
Is there a site history indicating one of the following at the site? a. The manufacture/maintenance of solid-fuel missile/rocket motors, and/or munitions containing perchlorates; b. The use of perchlorate-containing munitions for training or testing purposes; c. The demilitarization of perchlorate-containing munitions using techniques, such as “hog-out” of rockets and missiles containing solid propellant; and d. Open burning/open detonation operations.	Yes	Building 46 was historically used to load smokeless powder into cartridges; related chemicals included explosives. No discarded munitions have been identified at Site 21.
Have explosives been detected in site media?	Yes	RDX was detected in 1 shallow monitoring well at the site; however, the results were not able to be reproduced. 1,3-dinitrobenzene was detected in deep groundwater. No unacceptable potential risk identified to site receptors.
Has perchlorate been analyzed in site media?	No	No analysis of perchlorate in site media per review of IAS, RRR, SIs, and RI.
Recommend site for analysis of perchlorate?	Yes	Based on site history and limited presence of explosives in site groundwater, the presence of perchlorate is not likely but the possibility of it's presence cannot be completely eliminated, due to the historical handling of ordnance.

Table C-4
Site 2 Subsurface Soil Raw Analytical Dioxins Results

Station ID	SJS02-SB12	SJS02-SB15	SJS02-SB17	SJS02-SB19	SJS02-SB20
Sample ID	SJS02-SB12-001	SJS02-SB15-001	SJS02-SB17-001	SJS02-SB19-001	SJS02-SB20-001
Sample Date	06/28/01	06/30/01	07/02/01	07/03/01	07/06/01
Chemical Name					
Dioxin/Furans (µg/kg)					
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00795 J	0.118 J	0.0359 J	0.0250 J	0.03 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran	1.02E-04 UJ	0.0435 J	0.00806 J	0.00251 J	3.00E-04 NJ
1,2,3,4,7,8,9-Heptachlorodibenzofuran	1.50E-04 UJ	0.00322 J	2.00E-04 UJ	3.45E-04 UJ	6.40E-05 UJ
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.46E-04 UJ	0.00202 J	6.06E-04 J	2.35E-04 UJ	4.00E-04 NJ
1,2,3,4,7,8-Hexachlorodibenzofuran	1.19E-04 UJ	0.0087 J	0.00127 J	0.00112 J	5.30E-05 UJ
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.27E-04 UJ	0.00449 J	0.00299 J	7.11E-04 J	5.60E-04 J
1,2,3,6,7,8-Hexachlorodibenzofuran	1.15E-04 UJ	0.00388 NJ	0.00161 I	2.91E-04 UJ	5.10E-05 UJ
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	6.23E-04 J	0.00534 J	0.00274 J	0.00148 J	1.00E-03 J
1,2,3,7,8,9-Hexachlorodibenzofuran	1.60E-04 UJ	0.00221 UJ	2.39E-04 UJ	4.07E-04 UJ	7.10E-05 UJ
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.04E-04 UJ	0.00146 J	1.02E-04 UJ	1.92E-04 UJ	9.40E-05 UJ
1,2,3,7,8-Pentachlorodibenzofuran	1.29E-04 UJ	0.00440 J	1.56E-04 UJ	2.68E-04 UJ	7.10E-05 UJ
2,3,4,6,7,8-Hexachlorodibenzofuran	1.28E-04 U	0.00370 J	5.06E-04 J	3.25E-04 UJ	5.70E-05 UJ
2,3,4,7,8-Pentachlorodibenzofuran	1.24E-04 UJ	0.00435 J	4.77E-04 J	5.37E-04 NJ	6.80E-05 UJ
2,3,7,8-TCDD (dioxin)	8.80E-05 UJ	3.28E-04 NJ	8.70E-05 UJ	1.58E-04 UJ	8.00E-05 UJ
2,3,7,8-Tetrachlorodibenzofuran	1.06E-04 UJ	0.00636 J	8.48E-04 NJ	7.75E-04 NJ	8.60E-05 UJ
Octachlorodibenzo-p-dioxin	0.219 J	1.40 J	0.261 J	1.5 J	0.98 J
Octachlorodibenzofuran	8.16E-04 B	0.0794 J	0.00505 J	0.00313 J	6.80E-04 J
Total heptachlorodibenzo-p-dioxin	0.0211 J	0.281 J	0.0772 J	0.0752 J	0.065 J
Total heptachlorodibenzofuran	1.02E-04 UJ	0.0467 J	0.00806 J	0.00460 J	4.30E-04
Total hexachlorodibenzo-p-dioxin	0.00476 J	0.0392 J	0.0221 J	0.0244 J	0.011 J
Total hexachlorodibenzofuran	1.15E-04 UJ	0.0745 J	0.00938 J	0.00279 J	5.10E-05 UJ
Total pentachlorodibenzo-p-dioxin	1.04E-04 UJ	0.00315 J	5.36E-04 J	1.92E-04 UJ	9.40E-05 UJ
Total pentachlorodibenzofuran	1.24E-04 UJ	0.0290 J	0.00271 J	0.00408 J	6.80E-05 UJ
Total tetrachlorodibenzo-p-dioxin	8.80E-05 UJ	0.00328 J	2.99E-04 J	1.58E-04 UJ	8.00E-05 UJ
Total tetrachlorodibenzofuran	1.06E-04 UJ	0.0306 J	0.00383 J	0.00194 J	8.60E-05 UJ

Notes:

Represents detections

NA - Not analyzed

U - Analyte not detected

J - Reported value is estimated

B - Anlayte not detected above the associated blank

Table C-5
Site 2 Sediment Raw Analytical Dioxins Results

Station ID	SJS02-SD09	SJS02-SD10	SJS02-SD11	SJS02-SD12	SJS02-SD13	SJS02-SD14
Sample ID	SJS02-SD09	SJS02-SD10	SJS02-SD11	SJS02-SD12	SJS02-SD13	SJS02-SD14
Sample Date	07/18/01	07/18/01	07/18/01	07/18/01	07/18/01	07/18/01
Chemical Name						
Dioxin/Furans (µg/kg)						
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.42 J	0.13 J	0.34 J	0.016 J	0.19 J	0.094 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.23 J	0.056 J	0.087 J	0.0025 J	0.048 J	0.014 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.021 J	0.0044 J	0.0063 J	1.30E-04 UJ	0.0036 J	7.70E-04 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.0085 J	0.0023 J	0.0051 J	3.00E-04 J	0.0029 J	0.0024 J
1,2,3,4,7,8-Hexachlorodibenzofuran	0.025 J	0.0099 J	0.019 J	7.40E-04 J	0.0082 J	0.0049 I
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.018 J	0.0058 J	0.015 J	6.00E-04 J	0.008 J	0.004 J
1,2,3,6,7,8-Hexachlorodibenzofuran	0.06 J	0.0064 I	0.0094 J	5.00E-04 J	0.0044 J	7.60E-04 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.016 J	0.0047 J	0.013 J	0.0011 J	0.008 J	0.0047 J
1,2,3,7,8,9-Hexachlorodibenzofuran	0.002 J	1.00E-03 J	0.0023 J	1.50E-04 UJ	2.50E-04 UJ	4.00E-04 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.0036 J	0.0012 J	0.0028 J	1.70E-04 UJ	0.0012 J	0.0012 J
1,2,3,7,8-Pentachlorodibenzofuran	0.0043 J	0.0011 J	0.0027 J	2.40E-04 UJ	0.0014 J	0.0011 J
2,3,4,6,7,8-Hexachlorodibenzofuran	0.0093 J	0.0033 J	0.0068 J	3.60E-04 J	0.0024 J	1.00E-03 J
2,3,4,7,8-Pentachlorodibenzofuran	0.007 J	0.003 J	0.0061 J	4.30E-04 J	0.002 J	0.0016 J
2,3,7,8-TCDD (dioxin)	5.80E-04 J	3.40E-04 J	9.60E-04 J	1.30E-04 UJ	4.30E-04 J	3.20E-04 J
2,3,7,8-Tetrachlorodibenzofuran	0.0082 NJ	0.0034 J	0.0097 J	7.10E-04 NJ	0.0032 J	0.0037 J
Octachlorodibenzo-p-dioxin	3.2 J	1.6 J	4.4 J	0.66 J	1.9 J	1.1 J
Octachlorodibenzofuran	0.58 J	0.074 J	0.12 J	0.003 B	0.058 J	0.021 J
Total heptachlorodibenzo-p-dioxin	0.75 J	0.26 J	0.9 J	0.051 J	0.52 J	0.28 J
Total heptachlorodibenzofuran	0.25 J	0.15 J	0.26 J	0.0046 J	0.13 J	0.014 J
Total hexachlorodibenzo-p-dioxin	0.14 J	0.046 J	0.17 J	0.015 J	0.11 J	0.07 J
Total hexachlorodibenzofuran	0.3 J	0.091 J	0.19 J	0.0047 J	0.078 J	0.035 J
Total pentachlorodibenzo-p-dioxin	0.011 J	0.0048 J	0.02 J	1.70E-04 UJ	0.0091 J	0.0097 J
Total pentachlorodibenzofuran	0.08 J	0.031 J	0.091 J	0.002 J	0.023 J	0.02 J
Total tetrachlorodibenzo-p-dioxin	0.0067 J	0.0032 J	0.0066 J	3.70E-04 J	0.005 J	0.0029 J
Total tetrachlorodibenzofuran	0.036 J	0.0056 J	0.024 J	0.0021 J	0.016 J	0.013 J

Notes:
Represents Detections
NA - Not analayzed
B - Anlayte not detected above the associated blank
J - Reported value is estimated
U - Not detected

Appendix D
Site 4 Groundwater Monitoring Technical Memorandum

Site 4 Groundwater Monitoring for 2015 Five-Year Review, St. Juliens Creek Annex, Chesapeake, Virginia

PREPARED FOR: SJCA Tier I Partnering Team

PREPARED BY: CH2M HILL

DATE: May 2015

1 Introduction

This memorandum summarizes the field activities, analytical results, and data evaluation of the groundwater monitoring conducted in February 2014 at Site 4 – Landfill D, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This memorandum was prepared under the United States Navy, Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-term Environmental Action Navy (CLEAN) 8012, Contract N62470-11-D-8012, Contract Task Order WE94.

2 Background and Purpose

Site 4 is an approximately 8.3-acre landfill in the northeastern portion of SJCA located at the confluence of Blows Creek and the Southern Branch of the Elizabeth River (**Figure 1**). The site is currently maintained as a controlled, closed landfill with a vegetated soil cover. Construction and excavation activities at the site are prohibited and controlled through site signs, fencing, notation in the Internet Navy Facility Assets Data Store maintained by Commander Naval Region Mid-Atlantic, and a survey plat filed with the City of Chesapeake. Groundwater at the site is not used as a potable resource; potable water is supplied to SJCA and the surrounding area by the City of Chesapeake Waterworks. Anticipated future land use for the site is to remain as a controlled, closed landfill.

Unacceptable risks to human health and the environment from exposure to soil, sediment, and waste were identified during a Remedial Investigation (RI) conducted for the site. The selected remedy to address the unacceptable risks, removal of surface debris from the adjacent wetland, removal and offsite disposal of the eastern drainage ditch sediment, placement of vegetated soil cover, and implementation of land use controls (LUCs), was completed in 2005. Although no unacceptable risk was identified in the shallow aquifer groundwater, the SJCA IR Partnering Team agreed to conduct voluntary post-Record of Decision groundwater monitoring in order to evaluate the site's impact on groundwater quality and to confirm no potential future releases will pose unacceptable risk. The voluntary groundwater monitoring consisted of sampling upgradient and downgradient monitoring wells for the surface soil human health constituents of concern (COCs) (arsenic and iron) and the groundwater maximum contaminant level (MCL) exceedances (arsenic, cadmium, lead, and thallium) identified in the RI. The monitoring occurred quarterly between 2006 and 2008, and once in 2009 in association with the 2010 Five-year Review. Evaluation of the groundwater data in the 2010 Five-year Review indicated that concentrations in groundwater at the site appeared to be steady over time and that no site release or offsite migration of landfill contaminants had occurred or was occurring (CH2M HILL, 2010). However, because the most recent (2006 to 2009) arsenic concentrations detected at one of the downgradient monitoring wells were somewhat greater than the historical (1997 and 1999) concentrations, groundwater monitoring for arsenic was recommended to be conducted for the 2015 Five-Year Review.

The following table summarizes the objective of, the environmental question to be answered by, the investigation approach for, and the project quality objectives for the groundwater monitoring conducted for the 2015 Five-Year Review.

TABLE 1
Site 4 Groundwater Monitoring for the 2015 Five-Year Review Objective, Environmental Question, Investigation Approach, and Project Quality Objectives

Objective	Environmental Question	General Investigation Approach	Project Quality Objectives
Confirm the Site 4 remedy is protective of human health and the environment	Have the landfill contents resulted in a release and/or mobilization of arsenic in shallow aquifer groundwater?	• Collect one round of groundwater samples in February 2014 from one upgradient shallow aquifer monitoring well (MW01S) and three downgradient shallow aquifer monitoring wells (MW03S, MW04S, and MW05S) • Collect samples in accordance with the CH2M HILL standard operating procedures • Analyze samples at an offsite laboratory for total and dissolved arsenic – Samples collected for dissolved arsenic will be field-filtered	• If downgradient arsenic concentrations are below the project action limit (PAL), then the landfill has not resulted in a release to groundwater, no additional evaluation is needed, and monitoring can be discontinued. • If downgradient arsenic concentrations are above the PAL but less than upgradient concentrations and/or trends are stable or decreasing, then monitoring can be discontinued. • If downgradient arsenic concentrations are above the PAL and greater than upgradient concentrations and/or trends[1] are increasing, then it is possible that the landfill is the cause of the arsenic and it will be monitored in association with 2020 Five-year Review.

The PALs for total and dissolved arsenic were established as the MCL for consistency with past sampling events. However, because MCLs are not Applicable or Relevant and Appropriate Requirements for Site 4 and there are no groundwater remediation goals established in the Record of Decision, an exceedance of the PAL does not trigger a physical action.

3 Field Investigation Activities

The field activities described below were conducted in accordance with the Final Site 4 Groundwater Monitoring for the 2015 Five-Year Review, St. Juliens Creek Annex, Chesapeake, Virginia (CH2M HILL, 2014).

3.1 Groundwater Sampling

Groundwater samples were collected from four existing shallow (Columbia aquifer) monitoring wells: SJS04-MW01S, -MW03S, -MW04S, and -MW05S (**Figure 1**). Prior to sample collection, depth to groundwater was measured and recorded at each monitoring well.

Groundwater samples were collected using a peristaltic pump following a low-flow sampling protocol (USEPA, 1996). All samples were collected by placing the sample tubing intake in the middle of the screened interval. Water quality parameters (dissolved oxygen [DO], oxidation reduction potential, pH, temperature, conductivity, turbidity, and salinity) were field-measured with a YSI and flow-through cell to confirm aquifer stability prior to sample collection and recorded in the field notebook. The field notes are provided in **Attachment A**. Additionally, CHEMetrics DO field test kits were used to obtain more accurate DO measurements than those collected from a YSI at all monitoring wells. The aquifer was considered stable after at least one well volume was purged and water quality readings collected 5 minutes apart were stabilized to within 10 percent of one another, with the exception of turbidity, which was reduced to the extent practical. If all water quality parameters did not stabilize, at least one well volume was purged prior to sample collection in order to ensure a sample representative of the aquifer was collected. The water quality parameters at the time of sample collection are noted in **Table 1**.

The groundwater samples were collected into laboratory-prepared sample containers. The samples collected for dissolved arsenic analysis were field-filtered. A field duplicate, matrix spike/matrix spike duplicate, and equipment blank were collected for analysis of total and dissolved arsenic. The samples were packed on ice and shipped overnight with a chain of custody to an offsite laboratory.

[1] Evaluation of tends to include an analysis of variance comparison using the nonparametric Kruskal-Wallis test to determine whether downgradient concentrations exceed upgradient concentrations; and a time trend analysis using the nonparametric Mann-Kendall test using all site data collected from these wells to determine whether concentrations have increased or decreased since the RI was conducted.

3.2 Investigative-Derived Waste Management

Investigation-derived waste (IDW) generated during the groundwater sampling consisted of purge water. IDW was containerized in an approved 55-gallon drum, stored on secondary containment at the approved IDW staging location located at IR Site 2, and properly labeled. The IDW was disposed of as nonhazardous aqueous waste based on waste characterization results.

4 Data Management

The CH2M HILL project chemist tracked the samples from collection through analysis and data validation. Chain-of-custody entries were checked against the site-specific project instructions and SAP to verify that all designated field samples were collected and submitted for the appropriate analysis. Upon receipt of the samples by the laboratories, a comparison to the field information to verify that each sample was analyzed for the correct parameters and appropriate quality assurance/quality control (QA/QC) samples was performed. The analytical data was validated internally by CH2M HILL. The procedures in the Region III Modifications to Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis (USEPA, 1993) were used for validation. The validated data were uploaded to the Navy Installation Restoration Information Solution database. A data usability assessment of the validated data is provided in **Attachment B**.

5 Investigation Results and Data Evaluation

The depths to groundwater at each monitoring well are provided in **Table 2**.Groundwater at Site 4 generally flows southeast towards the Southern Branch of the Elizabeth River as shown on **Figure 2**.

The raw analytical results for the QA/QC samples are presented in **Attachment C**. Total and dissolved arsenic were not detected in the shallow aquifer at Site 4 (**Table 3** and **Figure 3**) (detections limits were below the PALs which factored in SJCA background concentrations and MCLs). Therefore, in accordance with the project quality objectives established in the SAP, evaluation of trends in the groundwater is not necessary.

6 Conclusions and Recommendations

The Site 4 landfill contents have not resulted in a release and/or mobilization of arsenic in the shallow aquifer groundwater and therefore, in accordance with the Considerations for Developing Long-Term Monitoring Plans for Unpermitted Navy Landfills in Virginia (Virginia-Navy Tier 11 April 2014), discontinuation of groundwater monitoring at the site is recommended based on the following:

- Current concentrations of arsenic in the shallow aquifer groundwater are below established “basewide” background concentrations and are not above upgradient concentrations
- Current concentrations of arsenic in the shallow aquifer groundwater are below the MCL
- More than 10 years of post closure care with no release or expected release of hazardous substances to the environment or beyond the waste boundary point of compliance has occurred at the site.

7 References

CH2M HILL. 2010. *Final Five-Year Review Report, St. Juliens Creek Annex, Chesapeake, Virginia*. May.

CH2M HILL. 2014. Final Site 4 Groundwater Monitoring for 2015 Five-Year Review Uniform Federal Policy-Sampling and Analysis Plan. St. Juliens Creek Annex. Chesapeake, Virginia. February.

United States Environmental Protection Agency (USEPA). 1993. Region III Modifications to Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses. April.

USEPA. 1996. Low Flow (Minimal Drawdown) Groundwater Sampling Procedures. April.

Virginia-Navy Tier II. 2014. Considerations for Developing Long-Term Monitoring Plans for Unpermitted Navy Landfills in Virginia. April.

Tables

Table 1
Groundwater Quality Parameters
Technical Memorandum: Site 4 Groundwater Monitoring for 2015 Five-Year Review
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	**SJS04-MW01S**	**SJS04-MW03S**	**SJS04-MW04S**	**SJS04-MW05S**
Sample Date	02/19/14	02/19/14	02/19/14	02/20/14
Parameters				
Dissolved Oxygen (ppm)*	0.2	0.3	0.6	1
Oxidation Reduction Potential (mV)	269.1	-140.8	-139.7	-89.2
pH	4.07	7.03	6.9	6.86
Temperature (°C)	10.35	13.6	13.11	10.49
Conductivity (ms/cm)	0.711	1.991	1.366	4.409
Turbidity (NTU)	1.9	0.3	0.9	7.8
Salinity (%)	0.49	1.32	0.9	3.32

Notes:
*Dissolved Oxygen measured using
CHEMetrics Test Kits

Table 2
Groundwater Elevations
Technical Memorandum: Site 4 Groundwater Monitoring for Five-Year Review
St. Juliens Creek Annex
Chesapeake, Virginia

Monitoring Well	Top of PVC Elevation (ft amsl)	Feb-14	
		Depth to Water (ft)	Water Elevation (ft amsl)
SJS04-MW01S	13.02	2.69	10.33
SJS04-MW03S	6.67	4.14	2.53
SJS04-MW04S	8.60	3.14	5.46
SJS04-MW05S	6.21	2.69	3.52

Notes:
amsl - above mean sea level
ft - feet

Table 3
Groundwater Analytical Results
Technical Memorandum: Site 4 Groundwater Monitoring for 2015 Five-Year Review
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	MCL-Groundwater	SJCA 95% UTL Groundwater	SJS04-MW01S	SJS04-MW03S*	SJS04-MW04S	SJS04-MW05S
Sample ID			SJS04-MW01S-14A	SJS04-MW03S-14A	SJS04-MW04S-14A	SJS04-MW05S-14A
Sample Date			02/19/14	02/19/14	02/19/14	02/20/14
Chemical Name						
Total Metals (UG/L)						
Arsenic	10	8	5 U	5 U	5 U	5 U
Dissolved Metals (UG/L)			5 U	5 U	3.8 B	2.1 B
Arsenic	10	2.4				

Notes:

* A duplicate sample was collected at this location; the most conservative result is shown.

B - Analyte not detected above the level reported in blanks

U - Analyte not detected

UG/L - micrograms per liter

UTL - Upper Tolerance Limit

MCL - Maximum Contaminant Level

Figures

Legend

- Shallow Monitoring Well
- Fence
- Access Road
- SJCA Boundary
- Site 4 Boundary

N
W E
S

0 75 150
Feet

Figure 1
St. Juliens Creek Annex and Site 4 Location and Vicinity
Technical Memorandum:
Site 4 Groundwater Monitoring for 2015 Five-Year Review
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\423809_Site4_GW_FYR_2015\2014\Figure 2 - Columbia Aquifer Groundwater Surface Elevats.mxd9/22/2014cbowman

Legend

- Shallow Monitoring Well
- Fence
- Access Road
- SJCA Boundary
- Site 4 Boundary
- Estimated Groundwater Flow Direction
- Potentiometric Surface Contours (February 2014)
- 3.0 Groundwater Elevation (feet above mean sea level)

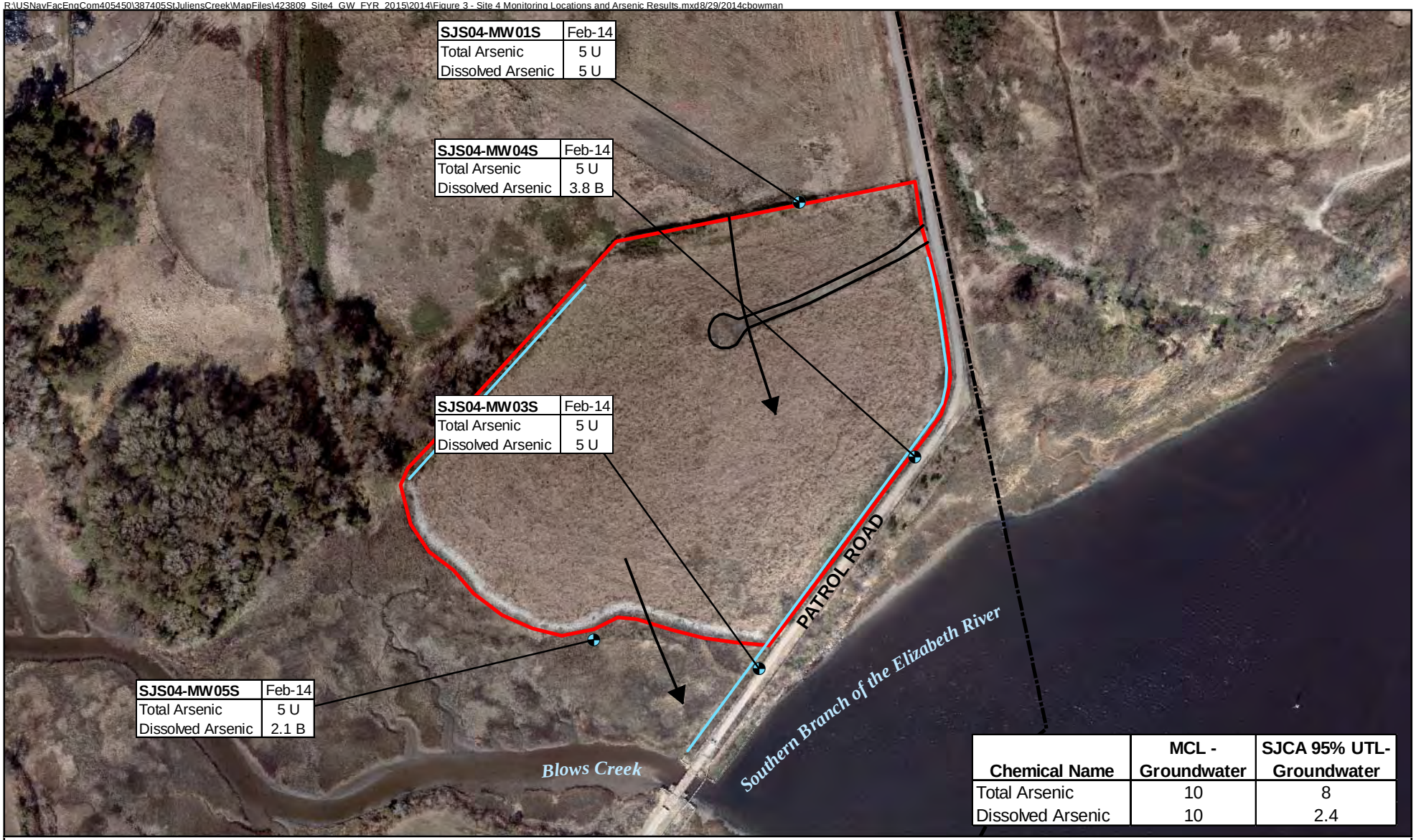
N W E S

0 75 150 Feet

Figure 2
Columbia Aquifer Groundwater Surface Elevations
Technical Memorandum:
Site 4 Groundwater Monitoring for 2015 Five-Year Review
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

R:\USNavFacEngCom405450\387405StJuliensCreek\MapFiles\423809_Site4_GW_FYR_2015\2014\Figure 3 - Site 4 Monitoring Locations and Arsenic Results.mxd 8/29/2014 cbowman



Chemical Name	MCL - Groundwater	SJCA 95% UTL-Groundwater
Total Arsenic	10	8
Dissolved Arsenic	10	2.4

Legend

- Shallow Monitoring Well
- SJCA Boundary
- Site 4 Boundary
- Access Road
- Drainage Ditch
- Estimated Groundwater Flow Direction

Notes:

MCL - Maximum Contaminant Level
UTL - Upper Tolerance Limit
UG/L - micrograms per Liter
B - Analyte not detected above the level reported in blanks
U - Analyte not detected
Concentrations reported in micrograms per liter (µg/L)

N
W E
S

0 100 200
Feet

Figure 3
Site 4 Groundwater Monitoring Results
Technical Memorandum: Site 4 Groundwater Monitoring for 2015 Five-Year Review
St. Juliens Creek Annex
Chesapeake, Virginia

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Attachment A
Field Notes

Location SJCA SITE 4 Date 2/18/14

Project / Client SITE 4 GW MONITORING

0700 Team MoB to NNSY Pass and ID

Personnel Joseph McCloud

Gwendolyn Buckley

Weather: Currently 37°F (HIGH 61°, LOW 40°)

Overcast w/rain on and off all day, 3 mph winds from WSW, gusts @ 13 mph

Objective: Clear site of brush and locate wells.

Complete water level survey, time permitting

0740 Meet Max of ECLS @ Pass/ID.

0815 MoB to SJCA to show him SITE 4 while his coworkers continue process of obtaining contractor badges

ECLS Personnel

0945 ECLS begins veg clearing

TIDAL SCHEDULE

0510	LOW	-0.1 ft
1122	HIGH	2.8 ft
1725	LOW	-0.1 ft
2345	HIGH	2.9 ft

1400 Collect WL measurements

MW01S: 2.63, 16.52

MW01D: 11.80, 54.78

1600 Off-site for day. To complete MW01S and 2S overflow

Location SJCA SITE 4 Date 2/19/14

Project / Client GW Monitoring

0630 Team MoB to SJCA Site 4

Personnel: Joseph McCloud

Gwendolyn Buckley

Weather: Currently 49°F, HIGH 67°, LOW 41°

Objective: Complete veg clearance. Begin GW monitoring

0800 calibrate YSI

PARAM	PRE	POST	LOT#	EXP
Cond mS/cm	0.769	1.000	3AK044	11/14
pH 7	7.15	7.0	343840	10/15
pH 4	3.85	4.0	3AK001	11/15
pH 10	9.92	9.99	34I800	9/15
Turb 0	5.5	0	A3213	7/15
Turb 100	116.5	100	A3259	9/15
ORP 246.6	277.6	246.6	13F100181	7/15
DO %	101.4	99.6	NA	NA

0835 ECLS arrives, preps

0845 ECLS continues veg clearance

0900 CH2M MoBs to set up on MW01S

Screen: 3.9' to 13.9 bgs DTW = 2.65 TOC DTB = 16.52 TOC

WV = 2.3g Tubing = 9' bgs Casing = 2.5'

0915 Pump on @ MW01S

Location SJCA Site 4 Date 2/19/14

Project / Client GW Monitoring

MW01S Purge log:

TIME	DTW (TOC)	GAL	TEMP (°C)	COND (mS/cm)	SAL	DO (mg/L)	PH	ORP	TURB (NTU)
0920	2.73	0.25	11.27	0.725	0.49	2.40	4.30	261.6	16.0
0925	2.73	0.5	11.01	0.720	0.49	1.44	4.19	272.3	14.5
0930	2.73	0.75	10.90	0.723	0.49	1.37	4.15	277.9	10.8
0935	2.73	1.0	10.71	0.726	0.50	1.15	4.12	279.5	8.1
0940	2.75	1.3	10.72	0.728	0.50	1.06	4.10	276.5	6.7
0945	2.75	1.6	10.53	0.725	0.50	1.00	4.09	274.4	3.9
0950	2.75	1.9	10.48	0.720	0.50	0.99	4.08	270.9	2.5
0955	2.75	2.2	10.35	0.712	0.49	0.96	4.07	268.9	2.9
1000	2.75	2.4	10.35	0.711	0.49	0.95	4.07	269.1	1.9

1005 collect SJSC4-MW01S-14A

FOR: Total and Field Filtered Arsenic

DO kit: 0.2

1030 Set up on MW04S

Screen = 3.5-13.5 bgs DTW = 3.18' TOC DTB = 16.09 TOC

WV = 2.1g Tubing = 8.5' bgs Casing = 2.05"

1040 Pump on @ MW04S

TIME	DTW	GAL	TEMP	COND	SAL	DO	PH	ORP	TURB
1045	3.41	0.25	14.20	1.339	0.86	1.98	6.85	-64.5	4.6
1050	3.99	0.4	13.35	1.321	0.87	1.38	6.90	-85.2	2.5
1055	4.12	0.6	13.50	1.329	0.87	1.24	6.92	-93.5	1.5
1100	4.12	0.8	13.64	1.339	0.87	1.26	6.94	-68.6	3.0
1105	4.12	1.0	13.58	1.345	0.88	1.22	6.93	-79.4	3.3

Location SJCA Site 4 Date 2/19/14

Project / Client GW Monitoring

TIME	DTW	GAL	TEMP	COND	SAL	DO	PH	ORP	TURB
1110	4.12	1.2	13.56	1.349	0.88	1.22	6.92	-94.9	2.1
1115	4.12	1.4	13.48	1.356	0.89	1.22	6.92	-95.1	2.1
1120	4.12	1.6	13.49	1.358	0.89	1.20	6.92	-97.0	1.9
1125	4.12	1.8	13.27	1.364	0.90	1.21	6.90	-125.9	1.4
1130	4.12	2.0	13.14	1.365	0.90	1.18	6.90	-133.1	1.3
1135	4.12	2.2	13.11	1.366	0.90	1.17	6.90	-139.7	0.9

1140 Collect
- SJSC4-MW04S-14A
- SJSC4-MW04S-14A-MS
- SJSC4-MW04S-14A-SD

DO kit: 0.6

1210 offsite for lunch

1240 Drop drum @ Site 2 IDW Staging area

1245 Return to Site 4. Wait for ECLS.

1315 Set up on MW03S

Screen: 3.4-13.4' bgs DTW: 4.04 TOC DTB: 15.15' TOC

WV = 1.9g Tubing: 8.5' bgs Casing: 2.16'

1330 Pump on @ MW03S

TIME	DTW	GAL	TEMP	COND	SAL	DO	PH	ORP	TURB
1335	4.79	0.2	14.01	2.522	1.68	1.64	7.12	-134.4	3.6
1340	4.88	0.4	13.37	2.454	1.66	0.91	7.09	-155.1	1.7
1345	5.02	0.6	13.30	2.420	1.64	0.91	7.09	-159.9	1.7
1350	5.07	0.8	13.29	2.405	1.63	0.87	7.10	-162.6	1.6
1355	5.07	1.0	13.16	2.386	1.62	0.85	7.10	-164.1	1.0
1400	5.01	1.25	13.32	2.317	1.56	0.88	7.10	-162.5	1.4

Location SJCA Site 4 Date 2/19/14

Project / Client GW Monitoring

MW03S Continued:

TIME	DTW	GAL	TEMP	COND	SAL	DO	PH	ORP	TURB
1405	4.99	1.5	13.32	2.255	1.52	0.92	7.09	-159.7	0.7
1410	4.98	1.75	13.36	2.162	1.45	0.89	7.07	-155.5	0.3
1415	4.99	2.0	13.71	2.007	1.34	0.90	7.05	-146.9	0.2
1420	4.99	2.25	13.63	1.998	1.32	0.91	7.02	-140.8	0.2
1425	4.99	2.5	13.60	1.991	1.32	0.91	7.03	-140.8	0.3

1430 Collect SJSC4-MW03S-14A DO kit = 0.3

1435 Collect SJSC4-MW03SP-14A

*1430 ECLS off site

1445 MOB to drop purge water

1500 off site for end of day activities

2/19/14

Location SJCA Site 4 Date 2/20/14

Project / Client GW Monitoring

0830 MOB to site

Personnel: Joseph McCloud
Gwendolyn Buckley

Weather: 53, sunny/clear skies

Objective: Sample MW05S and complete water level survey

0920 Calibrate YSI

PARAM	PRE		POST	
Conductivity	0.981		1.000	
pH 7	7.05		7.00	
pH 4	4.00		4.00	
pH 10	10.00		10.00	
Turb 0	0.5		0.0	
Turb 100	97.3		100.0	
ORP 246	244.6		246.0	
DO %	102.4	11.02 mg/L	100.8	10.85 mg/L

0940 MOB to set up on MW05S

Screen: 5.15 bgs DTW = 2.45 TOC DTB = 17.65 TOC

WV = 2.5 g Tubing = 10 bgs Casing = 2.3'

1005 Pump on @ MW05S

Purge log begins on next page →

Location SJCA Site 4 Date 2/20/14

Project / Client GW Monitoring

MW05S:

TIME	DTW	GAL	TEMP	COND	SAL	DO	PH	ORP	TURB
1010	2.85	0.2	12.66	15.98	13.01	2.31	6.76	-47.5	7.4
1015	2.92	0.4	12.41	15.56	12.26	3.50	6.81	-74.4	13.2
1020	2.94	0.6	12.04	12.06	9.35	3.55	6.83	-75.7	30.2
1025	3.05	0.8	11.60	9.268	7.11	3.62	6.84	-70.8	42.3
1030	3.14	1.0	11.11	6.376	4.83	3.43	6.85	-73.3	35.9
1035	3.09	1.2	11.02	5.197	3.90	3.42	6.85	-79.4	27.1
1040	3.09	1.4	10.74	4.954	3.75	3.35	6.84	-81.1	19.5
1045	3.08	1.6	10.64	4.703	3.52	3.32	6.86	-87.3	17.3
1050	3.07	1.8	10.73	4.575	3.45	3.25	6.85	-90.7	11.7
1055	3.08	2.0	10.56	4.504	3.41	3.18	6.86	-91.0	9.5
1100	3.08	2.2	10.48	4.420	3.35	3.19	6.86	-89.4	7.9
1105	3.08	2.4	10.54	4.410	3.33	3.15	6.86	-88.6	5.8
1110	3.08	2.6	10.49	4.409	3.32	3.12	6.86	-89.2	7.6

1115 Collect SJSC4-MW05S-14A

DO kit = 1.0

WATER LEVEL SURVEY:

Well	Time	DTW TOC	DTB TOC	
MW05S	1120	2.47	17.65	RUSTED SHUT REPLACED LOCK
MW03D	1121	3.62	58.92	BROKEN COVER LOCK REPLACED
MW03S	1125	4.14	15.75	LOCK REPLACED
MW04S	1127	3.41	16.09	BROKEN COVER
MW01S	1139	2.69	16.52	

Location SJCA Site 4 Date 2/20/14

Project / Client GW Monitoring

ID	TIME	DTW TOC	DTB TOC
MW01D	1138	11.75	54.75
MW02S	1157	3.06	16.39

1210 MOB to dump purge water

Total drums = 1 @ ~10 gallons

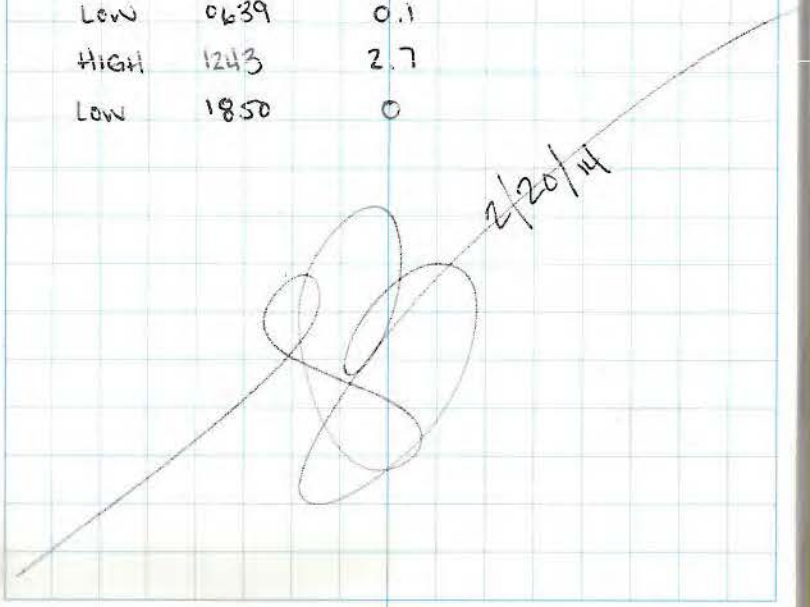
1220 Collect SJSC4-1DW022014

1240 Collect SJSC4-EB022014 via peri pump to be associated with all samples collected

1300 off site to pack and ship

TIDAL SCHEDULE

HIGH	1226 am	2.9 ft
LOW	0639	0.1
HIGH	1243	2.7
LOW	1850	0



Attachment B
Data Usability Assessment

APPENDIX B

1 Data Usability Assessment

CH2M HILL staff collected groundwater samples on February 19 and 20, 2014 for St. Juliens Creek Annex (SJCA) Site 4 in association with the SJCA 2015 Five- year Review. The samples were submitted to an independent off-site laboratory for analysis (Katahdin Laboratory in Scarborough, Maine).

In accordance with the UFP-SAP (CH2M HILL, 2014), a data usability assessment was performed for the data collected during the groundwater sampling event. As described in the UFP-SAP worksheets 34 through 36, this data has gone through several levels of data verification and validation. This includes internal laboratory quality control (QC) checks, CH2M HILL verification procedures, internal CH2M HILL Level III validation on definitive analytical results, and internal CH2M HILL Level IV validation (re-calculation of results) on 10 percent of the analytical results.

This data usability assessment evaluates the overall measurement performance results and their potential effects on data availability for decision-making. “Availability” in this context refers to whether results can be used by the project team based on their analytical soundness. If a result is analytically sound, it is available to use for evaluating the potential releases, nature and extent of contamination, and estimating potentially associated human health and ecological risks.

1.1 Quality Assurance/Quality Control Samples

Field quality assurance (QA)/ QC samples, including one field duplicate, one matrix spike/ matrix spike duplicate (MS/MSD), and one equipment blank, were collected and sent to the laboratory for analysis of total and dissolved arsenic. The field duplicate was collected to assess precision between the parent sample and it’s duplicate. The MS/MSD was collected to assess accuracy and bias in the field samples when injected with a known amount of target analytes. Additionally, precision is measured between the MS and MSD. The equipment blank was collected to assess the potential bias and contamination that may affect field samples due to the sampling and analytical process.

Laboratory QA/QC samples were prepared and analyzed to measure the precision and accuracy of their analytical results and aid in the usability assessment process. The laboratory QA/QC samples consisted of method blanks, laboratory control samples, internal standards, and laboratory duplicates.

1.2 Data Validation Process

During the data validation process, QA/QC criteria established in the UFP-SAP or in the analytical method were used to evaluate the data quality in a process similar to that outlined in *Contract Laboratory Program Region III Modifications to National Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1993).

The data validation included a recalculation of 10 percent of the analytical results and consisted of review of the following:

- Holding times
- Completeness
- Method and equipment blank contamination
- Initial and continuing calibration accuracy and precision
- Post-spike sample recovery
- Laboratory control sample accuracy and precision
- Internal standard response and retention time accuracy
- Field and laboratory duplicate precision

In cases where acceptance criteria for these aspects of data quality were not met, the validator applied a data qualifier to the data. The qualifiers that may be used are defined in Section 1.2.1.

1.2.1 Primary Validation Qualifiers

Validation qualifiers were assigned to the data subsequent to the laboratory analysis; the list of qualifiers used by the validator are defined in Table 1.

TABLE 1
Primary Validation Qualifiers

Qualifier	Description
U	Analyte not detected at a concentration greater than the detection limit.
B	Analyte is present; concentration is not significantly greater than that found in an associated field or laboratory blank and the result is usable as a non-detect.

1.3 Data Usability Assessment Findings

1.3.1 Validated Analytical Results

The CH2M HILL validator completed a review of the select total and dissolved metal (arsenic) data according to the guidelines in the UFP-SAP. Excluding lab QA/QC, 10 data results were validated. Table 2 shows the distribution of qualified results. All data were considered usable.

TABLE 2
Validation Qualifiers Applied to Site 4 Groundwater Data

Validator Qualifier	Secondary Qualifier	Result Count	Percent
U	[none]	6	60
B	[none]	4	40
TOTAL:		**10**	**100**

100 percent not R-flagged and available for use

Data that have a U- qualifier are usable as reported by the laboratory. The 6 U-qualified results represent analytes that were not detected by the laboratory and were reported at the laboratory limit of detection. The 4 B-qualification indicates that the results may be attributable to field or laboratory blank contamination, and that the analyte was detected in an associated blank as well as in the sample. If the B- qualifier is applied to definitive data, the results are usable as nondetects as long as they are considered “not detected at significantly greater concentration than that in an associated blank.” If the B- qualifier is applied to screening data, the results are usable as detects as qualified.

1.3.2 Conclusions

The quality of the data reported for the SJCA 4 is of excellent quality. The entire dataset is available for use as reported/ qualified.

1.4 References

CH2M HILL. 2014. Site 4 Groundwater Monitoring for the 2015 Five- Year Review Sampling and Analysis Plan, *St. Juliens Creek Annex, Chesapeake, Virginia.* January.

USEPA. 1993. *USEPA Contract Laboratory Program Region III Modification to National Functional Guidelines for Evaluating Inorganic Analyses.* April.

Attachment C
Raw Analytical Results

Table C-1
Site 4 Quality Assurance/Quality Control Groundwater Data
Site 4 Groundwater Monitoring for 2015 Five-Year Review
St. Juliens Creek Annex
Chesapeake, Virgina

Station ID	SJS04-QC
Sample ID	SJS04-EB022014
Sample Date	02/20/14
Chemical Name	
Total Metals (UG/L)	
Arsenic	5 U
Dissolved Metals (UG/L)	
Arsenic, Dissolved	5 U

Notes:

Shading indicates detections

U - Constituent analyzed for, but not detected

UG/L - Micrograms per liter

Appendix E
Site 21 Remedial Action-Operation Phase Groundwater Monitoring Data

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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		Sample ID	SJS21-MW01S-05D		SJS21-MW01S-1110		SJS21-MW01S-1211		SJS21-MW01S-0512		SJS21-MW01S-1112		SJS21-MW01S-0513		SJS21-MW01S-1113		SJS21-MW02S-05D		SJS21-MW02S-1110		SJS21-MW02S-0311		SJS21-MW02S-0511		SJS21-MW02S-1211		SJS21-MW02S-0512	
		Sample Date	11/7/2005		11/19/2010		12/15/2011		5/17/2012		11/14/2012		5/7/2013		11/11/2013		11/4/2005		11/16/2010		3/8/2011		5/3/2011		12/14/2011		5/14/2012	
		Sample Event	PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1-MONTH POST ZVI		3-MONTH POST ZVI		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	1.3		3.8		2.0		2.8		1.8		2.4		3.9		**1500**		**15.4**	J	**12.9**	J	**14.5**	J	5.2	U	**5.7**	
cis-1,2-Dichloroethylene	70.0	µg/L	1.4		2.2		1.2		4.3		0.97	J	1.8		2.9		**530**		**2020**		**1530**		**1090**		**1070**		**439**	
1,1-Dichloroethylene	7.0	µg/L	0.5	U	0.23	U	0.23	U	0.23	U	0.2	U	1	U	1	U	5	J	5.8	U	4.6	U	4.6	U	4.6	U	1.0	
Vinyl chloride	2.0	µg/L	**2.4**		1.7		**2.2**		**2.8**		0.44	U	**2.7**		**2.2**		**9**	J	**42.4**		**32.7**		**29.3**		**109**		**112**	
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	NA		225		128		200		200		397		646		NA		297		220		191		462		413	
Ethane	>500	µg/L	NA		0.32	U	0.32	U	0.52	J	0.32	U	2	U	2	U	NA		1.2		11.4		13.2		58.3		49.3	
Ethene	>500	µg/L	NA		0.43	U	0.43	U	0.43	U	0.43	U	2	U	2	U	NA		1.2		3.3		3.71		9.65		13.9	
Dissolved Iron	>1000	µg/L	NA		1730		1040		2240		1210		1010		2170		NA		1640		1400		375		55.8	J	35	U
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	NA		2.0	U	2.0	U	2.0	U	2.5	U	2	U	3.5	U	NA		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U
Sulfate	<20	mg/L	NA		9.8		5.8		5.5		7.8		5.5		7		NA		39.0		41.6		40.3		26.2		24.6	
Sulfide	>1.0	mg/L	NA		0.60	U	0.30	U	0.30	U	0.2	U	1.4	U	1.5	U	NA		0.60	U	0.60	U	0.60	U	0.80	J	0.33	J
Total Organic Carbon	>20	mg/L	NA		2.1		2.1		1.8		1.6		2.1		2.1		NA		2.4		NA		2.3		2.2		2.6	
Alkalinity, Total as CaCO3	>50	mg/L	NA		47.0		57.7		61.9		38.8		47.1		53.9		NA		70.7		NA		62.7		66.5		60	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	NA		2.2		1.2	J	4.3		0.97	J	1.8		2.9		NA		2020		1540		1090		956		439	

Notes:
[1] PAL = Project Action Limit from Revised Final Sampling and Analysis Plan Site 21 (CH2MHill, November 2010)
[2] PIL = Project Indicator Level from Revised Final Sampling and Analysis Plan Site 21 (CH2MHill, November 2010)
[3] Duplicate Sample collected from this location: the most conservative result is shown
[4] PRIOR results are most recent sample data as reported in Final Remedial Investigation Report for Site 21, CH2MHill, June 2008.
For newly installed wells, prior temporary wells at immediately adjacent location are reporeted when available
[5] Wells MW20S, MW21S, MW22S, MW25S, and MW27S were abandoned and replaced during the March 2011 sampling event.
[6] Per the decision criteria, sampling has been discontinued at wells MW10S, MW12S, and MW29S - these wells were not sampled during the 4th Semi-Annual Sampling.
[7] Per the decision criteria, wells MW05S, MW06S, and MW24S are annually sampled for disolved arsenic only and were not sampled during the 4th Semi-Annual Sampling.
[8] Per the decision criteria, well MW03S is annually sampled for COCs and disolved arsenic and was not sampled during the 4th Semi-Annual Sampling.
[9] Per the decision criteria, well MW22S is annually sampled for COCs and was not sampled during the 4th Semi-Annual Sampling.
BOLD shaded value indicates COC concentration exceeds PAL
U Analyte non-detected above the method detection limit
J Numerical value is an estimate between laboratory reporting limit and laboratory method detection limit
L Numerical value may be biased low
K Reported value may be biased high
B Not detected substantially above the level reported in laboratory or field blanks. Interferences present which may cause the results to be biased high.
NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
Page 2 of 17

	Sample ID	SJS21-MW02S-1112[3]		SJS21-MW02S-0513		SJS21-MW02S-1113		SJS21-MW03S-05D		SJS21-MW03S-1110[3]		SJS21-MW03S-1211		SJS21-MW03S-0512		SJS21-MW03S-1112		SJS21-MW03S-1113		SJS21-MW04S-05D		SJS21-MW04S-1110		SJS21-MW04S-1211		SJS21-MW04S-0512	
	Sample Date	11/13/2012		5/6/2013		11/11/2013		11/3/2005		11/16/2010		12/14/2011		5/16/2012		11/12/2012		11/15/2013		11/9/2005		11/19/2010		12/13/2011		5/17/2012	
	Sample Event	3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL[8]		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	2.5		1.9		1.7		2.6		3.9		0.26	U	1.1		0.81	J	1	U	**6**	J	2.6	U	1.3	U	**9.8**	J
cis-1,2-Dichloroethylene	70.0	µg/L	**349**		**185**		**385**		2	J	2.6		0.78	J	1.1		1.0		1	U	**540**		**512**		**1170**		**1190**	
1,1-Dichloroethylene	7.0	µg/L	0.65	J	1	U	1.5		0.5	U	0.23	U	0.23	U	0.2	U	0.20	U	1	U	50	U	2.3	U	3.1	J	4.6	U
Vinyl chloride	2.0	µg/L	**121**		**113**	L	**151**	L	0.5	U	0.22	U	0.22	U	0.22	U	0.44	U	1	U	50	U	**10.3**		**8.3**		**7.4**	J
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	2260		1340		4120		NA		82.2		64.5		66.3		166		NA		NA		68.4		109		164	
Ethane	>500	µg/L	158		68.4		166		NA		0.32	U	0.32	U	0.32	U	0.32	U	NA		NA		0.32	U	0.32	U	0.32	U
Ethene	>500	µg/L	34.2		21.5		10.2	K	NA		0.43	U	0.43	U	0.43	U	0.43	U	NA		NA		0.43	U	0.43	U	0.43	J
Dissolved Iron	>1000	µg/L	416		252		2900	K	NA		1180		67.8	J	2140		813		NA		NA		2200		1720		6770	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	2.5	U	2	U	3.5	U	NA		2.0	U	2.0	U	2.0	U	2.5	U	3.5	U	NA		2.0	U	2.0	U	2.0	U
Sulfate	<20	mg/L	15.8		17.1		28.2		NA		1.0	U	1.7	J	2.2		4.0		NA		NA		30.6		17.8		21.8	
Sulfide	>1.0	mg/L	0.29	J	1.4	U	1.5	U	NA		0.60	U	0.30	U	0.30	U	0.84		NA		NA		0.60	U	0.30	U	0.30	U
Total Organic Carbon	>20	mg/L	2.3		2.9		6		NA		1.7		1.7		2.2		1.9		NA		NA		3.0		1.5		1.5	
Alkalinity, Total as CaCO3	>50	mg/L	55.7		65.7		224		NA		152		157		195		184		NA		NA		50.8		41.3		55	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	349		192		388		NA		2.2		0.78	J	1.1	J	1.0	J	1	U	NA		517		1180		1200	

Notes:

[1] PAL = Project Action Limit from Revised Final Sampling and Analysis Plan Site 21 (CH2MHill, November 2010)

[2] PIL = Project Indicator Level from Revised Final Sampling and Analysis Plan Site 21 (CH2MHill, November 2010)

[3] Duplicate Sample collected from this location: the most conservative result is shown

[4] PRIOR results are most recent sample data as reported in Final Remedial Investigation Report for Site 21, CH2MHill, June 2008.
For newly installed wells, prior temporary wells at immediately adjacent location are reporeted when available

[5] Wells MW20S, MW21S, MW22S, MW25S, and MW27S were abandoned and replaced during the March 2011 sampling event.

[6] Per the decision criteria, sampling has been discontinued at wells MW10S, MW12S, and MW29S - these wells were not sampled during the 4th Semi-Annual Sampling.

[7] Per the decision criteria, wells MW05S, MW06S, and MW24S are annually sampled for disolved arsenic only and were not sampled during the 4th Semi-Annual Sampling.

[8] Per the decision criteria, well MW03S is annually sampled for COCs and disolved arsenic and was not sampled during the 4th Semi-Annual Sampling.

[9] Per the decision criteria, well MW22S is annually sampled for COCs and was not sampled during the 4th Semi-Annual Sampling.

BOLD shaded value indicates COC concentration exceeds PAL

U Analyte non-detected above the method detection limit

J Numerical value is an estimate between laboratory reporting limit and laboratory method detection limit

L Numerical value may be biased low

K Reported value may be biased high

B Not detected substantially above the level reported in laboratory or field blanks. Interferences present which may cause the results to be biased high.

NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA

	Sample ID	SJS21-MW04S-1112[3]		SJS21-MW04S-0513		SJS21-MW04S-1113		SJS21-MW05S-05D		SJS21-MW05S-1110		SJS21-MW05S-1211		SJS21-MW05S-0512		SJS21-MW05S-1112		SJS21-MW05S-1113		SJS21-MW06S-05D		SJS21-MW06S-1110		SJS21-MW06S-1211		SJS21-MW06S-0512	
	Sample Date	11/14/2012		5/7/2013		11/12/2013		11/7/2005		11/19/2010		12/13/2011		5/17/2012		11/14/2012		11/12/2013		11/4/2005		11/22/2010		12/13/2011		5/29/2012	
	Sample Event	3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL[7]		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	3.1	U	**9.8**		1.7		**8.1**		**23.8**		1.1		0.36	J	0.37	J	NA		0.5	U	**27.2**		0.26	U	0.26	U
cis-1,2-Dichloroethylene	70.0	µg/L	**732**		**1250**		**2260**		0.69		1.4		1.6		0.28	J	1.0		NA		0.5	U	0.35	J	0.47	J	0.26	U
1,1-Dichloroethylene	7.0	µg/L	2.0	U	4.1		5.7		0.5	U	0.23	U	0.23	U	0.23	U	0.20	U	NA		0.5	U	0.23	U	0.23	U	0.23	U
Vinyl chloride	2.0	µg/L	**13.8**		**8.2**		**24.5**		0.5	U	0.22	U	0.22	U	0.22	J	0.44	U	NA		0.5	U	0.22	U	0.92	J	0.22	U
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	105		2040		1030		NA		28.9		513		6300		12400		NA		NA		18.4		24.5		3270	
Ethane	>500	µg/L	0.32	U	2	U	2	U	NA		0.32	U	0.32	U	0.32	U	0.32	U	NA		NA		0.32	U	0.73	J	0.32	U
Ethene	>500	µg/L	0.43	U	2	U	2	U	NA		0.43	U	0.43	U	0.43	U	0.43	U	NA		NA		0.43	U	0.43	U	0.43	U
Dissolved Iron	>1000	µg/L	657		7700		7840		NA		1340		7590		121	J	110	J	NA		NA		2930		758		12700	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	2.5	U	2	U	3.5	U	NA		2.0	U	3.3	J	8.9	J	42.6		69.7		NA		2.0	U	2.0	U	7.7	J
Sulfate	<20	mg/L	13.6		21.3		14.2		NA		76.2		53.8		2.4		6.0	U	NA		NA		89.8		58.8		37.4	
Sulfide	>1.0	mg/L	0.42	J	1.4	U	1.5	U	NA		0.60	U	0.30	U	1.30		2.0		NA		NA		0.60	U	0.30	U	2.8	
Total Organic Carbon	>20	mg/L	1.4		1.5		1.9	B	NA		1.4		71.1		77		186		NA		NA		2.4		2.3		75.4	
Alkalinity, Total as CaCO3	>50	mg/L	26.2		58		80.3		NA		11.4		585		500		1780		NA		NA		28.6		38.5		435	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	741		1250		2260		NA		1.4	J	1.6	J	0.61	U	1.0	J	NA		NA		0.61	U	0.61	U	0.61	U

Notes:
[1] PAL = Project Action Limit from Revised Final Sampling and Analysis Plan Site 21 (CH2MHill, November 2010)
[2] PIL = Project Indicator Level from Revised Final Sampling and Analysis Plan Site 21 (CH2MHill, November 2010)
[3] Duplicate Sample collected from this location: the most conservative result is shown
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[7] Per the decision criteria, wells MW05S, MW06S, and MW24S are annually sampled for disolved arsenic only and were not sampled during the 4th Semi-Annual Sampling.
[8] Per the decision criteria, well MW03S is annually sampled for COCs and disolved arsenic and was not sampled during the 4th Semi-Annual Sampling.
[9] Per the decision criteria, well MW22S is annually sampled for COCs and was not sampled during the 4th Semi-Annual Sampling.
BOLD shaded value indicates COC concentration exceeds PAL
U Analyte non-detected above the method detection limit
J Numerical value is an estimate between laboratory reporting limit and laboratory method detection limit
L Numerical value may be biased low
K Reported value may be biased high
B Not detected substantially above the level reported in laboratory or field blanks. Interferences present which may cause the results to be biased high.
NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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	Sample ID		SJS21-MW06S-1112		SJS21-MW06S-1113		SJS21-MW07S-05D		SJS21-MW07S-1110		SJS21-MW07S-0311		SJS21-MW07S-0511		SJS21-MW07S-1211		SJS21-MW07S-0512[3]		SJS21-MW07S-1112		SJS21-MW07S-0513		SJS21-MW07S-1113		SJS21-MW08S-05D		SJS21-MW08S-1110	
	Sample Date		11/15/2012		11/13/2013		11/7/2005		11/18/2010		3/9/2011		5/2/2011		12/13/2011		5/31/2012		11/16/2012		5/8/2013		11/12/2013		11/4/2005		11/16/2010	
	Sample Event		3RD SEMI-ANNUAL[7]		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1-MONTH POST ZVI		3-MONTH POST ZVI		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	0.31	U	NA		**3600**		**873**		**269**		**282**		5.7	J	2.6	U	2.8		1	U	1.4		**830**		**166**			
cis-1,2-Dichloroethylene	70.0	µg/L	0.24	U	NA		500	U	**926**		**1730**		**1950**		**3600**		**677**		**176**		**274**		**158**		**560**		**1530**		
1,1-Dichloroethylene	7.0	µg/L	0.20	U	NA		500	U	4.6	U	4.6	U	5.8	U	**11.1**	J	2.30	U	0.40	U	1.4		1	U	4	J	5.8	U		
Vinyl chloride	2.0	µg/L	0.44	U	NA		500	U	4.4	U	4.4	U	5.5	U	**187**		**540**		**116**		**282**		**172**		**33**		**10.8**	J		
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	4230		NA		NA		42.2		51.5		91.3		321		1100		1860		1820		3860		NA		240			
Ethane	>500	µg/L	0.32	U	NA		NA		0.32	U	25.5		50.7		733		472		303		239		415		NA		1.3			
Ethene	>500	µg/L	0.43	U	NA		NA		0.51	J	7.16		14.4		338		176		126		161		196	K	NA		0.43	U		
Dissolved Iron	>1000	µg/L	6550		NA		NA		1240		1650		3160		4280		2920		2940		3120		2570		NA		1560			
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	10.4		10.2		NA		3.6	J	2.0	U	2.0	U	2.3	J	2.0	U	2.5	U	2	U	3.5	U	NA		203			
Sulfate	<20	mg/L	35.9		NA		NA		14.6		12.9		12.7		6.3		4.5		9.3		9.4		7.2		NA		52.5			
Sulfide	>1.0	mg/L	0.22	J	NA		NA		0.60	U	0.60	U	0.77	J	2.1		2.0		0.37	J	1.4	U	1.5	U	NA		0.60	U		
Total Organic Carbon	>20	mg/L	3.4		NA		NA		0.94		NA		0.82		4.7		2.5		0.81	J	0.8	J	0.92	J	NA		1.8			
Alkalinity, Total as CaCO3	>50	mg/L	229		NA		NA		49.3		NA		41.3		23.2		37.5		30.4		38.3		37.4		NA		55.5			
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	0.46	U	NA		NA		926		1730		1950		3600		677		176		278		158		NA		1530			

Notes:

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[8] Per the decision criteria, well MW03S is annually sampled for COCs and disolved arsenic and was not sampled during the 4th Semi-Annual Sampling.

[9] Per the decision criteria, well MW22S is annually sampled for COCs and was not sampled during the 4th Semi-Annual Sampling.

BOLD shaded value indicates COC concentration exceeds PAL

U Analyte non-detected above the method detection limit

J Numerical value is an estimate between laboratory reporting limit and laboratory method detection limit

L Numerical value may be biased low

K Reported value may be biased high

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NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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	Sample ID	SJS21-MW08S-1211		SJS21-MW08S-0512[3]		SJS21-MW08S-1112		SJS21-MW08S-0513		SJS21-MW08S-1113		SJS21-MW09S-05D		SJS21-MW09S-1110		SJS21-MW09S-1211		SJS21-MW09S-0512		SJS21-MW09S-1112		SJS21-MW09S-0513		SJS21-MW09S-1113		SJS21-MW10S-05D	
	Sample Date	12/14/2011		5/16/2012		11/13/2012		5/6/2013		11/15/2013		11/4/2005		11/22/2010		12/14/2011		5/17/2012		11/13/2012		5/6/2013		11/14/2013		11/3/2005	
	Sample Event	1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	**27.4**		**26.5**		**7.6**		1	U	1	U	10	U	**11.2**		0.54	J	0.42	J	0.31	U	1	U	1	U	0.39	J		
cis-1,2-Dichloroethylene	70.0	µg/L	**822**		**448**		**97.8**		46.1		14		17		24.0		28.7		24.3		3.8		13.8		8		0.19	J		
1,1-Dichloroethylene	7.0	µg/L	4.6	U	1.20	U	0.20	U	1	U	1	U	10	U	0.96	J	1.1		1.2		0.20	U	1	U	1	U	0.5	U		
Vinyl chloride	2.0	µg/L	4.4	U	**91**		**42.8**		**22.8**		**10.8**		**6**	J	0.59	J	1.5		1.3		**7.0**		**2.7**		**2.6**		0.5	U		
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	214		3260		7670		5770		4510		NA		167		238		180		8170		266		247		NA			
Ethane	>500	µg/L	2.62		3.92		11.1		7.6	J	14.1		NA		0.32	U	0.32	U	0.32	U	6.51		2	U	2	U	NA			
Ethene	>500	µg/L	0.43	U	120		14.5		15		8.68	J	NA		0.43	U	0.43	U	0.43	U	4.22		2	U	2	U	NA			
Dissolved Iron	>1000	µg/L	772		5100		18800		12300		21500		NA		6790		2910		10000		2920		7080		4950		NA		U	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	2.0	U	2.8	J	12.2		17.1		67.6		NA		18.0		5.6	J	10.7		2.9	J	6.6		8.8		NA			
Sulfate	<20	mg/L	35.9		16.8		13.9		5.4		6		NA		13.3		11.5		12.2		17.9		11		12.5		NA			
Sulfide	>1.0	mg/L	0.30	U	0.30	U	0.21	U	1.4	U	1.5	U	NA		0.60	U	0.30	U	0.90	J	0.91		1.4	U	1.5	U	NA			
Total Organic Carbon	>20	mg/L	1.7		2.6		4.6		19.8		6.6		NA		1.3		1.6		1.5		15.9		0.87	J	0.91	B	NA			
Alkalinity, Total as CaCO3	>50	mg/L	71.2		172		243		598		439		NA		57.4		64.1		90.7		429		53.7		46.2		NA			
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	822		451		98.5		47.2		14.5		NA		24.8		29.5		25		3.8		14.7		8.8		NA			

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B Not detected substantially above the level reported in laboratory or field blanks. Interferences present which may cause the results to be biased high.
NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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	Sample ID		SJS21-MW10S-1110		SJS21-MW10S-1211		SJS21-MW10S-0512		SJS21-MW10S-1112		SJS21-MW12S-05D		SJS21-MW12S-1110[3]		SJS21-MW12S-0311		SJS21-MW12S-0511		SJS21-MW12S-1211		SJS21-MW12S-0512		SJS21-MW12S-1112		SJS21-MW13S-05D		SJS21-MW13S-1110	
	Sample Date		11/17/2010		12/13/2011		5/16/2012		11/14/2012		11/9/2005		11/19/2010		3/9/2011		5/3/2011		12/14/2011		5/17/2012		11/12/2012		11/9/2005		11/15/2010	
	Sample Event		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL[6]		PRIOR[4]		BASELINE		1-MONTH POST ZVI		3-MONTH POST ZVI		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL[6]		PRIOR[4]		BASELINE	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	0.99	J	0.26	U	0.26	U	0.31	U	**1400**		**1610**		**7.5**		0.66	J	2.6	U	1.3	U	1.6	U	**4800**		**1070**	
cis-1,2-Dichloroethylene	70.0	µg/L	0.88	J	0.93	J	1.0		2.1		**370**		**550**		**196**		**241**		**472**		**370**		**237**		**1800**		**3670**	
1,1-Dichloroethylene	7.0	µg/L	0.23	U	0.23	U	0.2	U	0.20	U	2	J	4.6	U	0.46	U	0.32	J	2.3	U	1.2	U	1.0	U	**11**		12	U
Vinyl chloride	2.0	µg/L	0.22	U	0.22	U	0.22	U	0.44	U	**9**	J	**9.1**	J	**8.2**		**8.9**		**234**		**188**		**78.2**		**86**		**63.6**	
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	424		481		529		302		NA		145		137		209		1130		1230		2460		NA		329	
Ethane	>500	µg/L	0.32	U	0.32	U	0.32	J	0.32	U	NA		1.5		27.3		51.8		168		132		154		NA		2.57	
Ethene	>500	µg/L	0.43	U	0.43	U	0.43	U	0.43	U	NA		0.99	J	5.34		10.1		64.4		68.8		73.8		NA		2.2	
Dissolved Iron	>1000	µg/L	3830		661		3980		4040		NA		4200		20100		13400		13000		15200		16300		NA		1140	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	5.8	J	2.0	U	3.2	J	2.5	J	NA		2.0	U	2.0	U	2.0	U	2.0	U	6.6	J	5.8	J	NA		2.0	U
Sulfate	<20	mg/L	40.6		26.3		35.3		33.3		55.5		99.1		135		142		68.3		108		76.7		51		47.2	
Sulfide	>1.0	mg/L	0.60	U	0.30	U	0.30	U	0.19	U	NA		0.60	U	0.60	U	0.91	J	0.30	U	0.54	J	0.21	J	NA		0.60	U
Total Organic Carbon	>20	mg/L	2.6		2.9		3.6		3.2		4.68	J	4.5		NA		6.6		5.5		6.0		6.0		4.65	J	1.6	
Alkalinity, Total as CaCO3	>50	mg/L	131		131		174		131		52.9		125		NA		184		139		153		230		58.4		65.0	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	0.88	J	0.93	J	1.0	J	2.1		NA		495		196		162		472		372		237		NA		3670	

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Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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	Sample ID		SJS21-MW13S-1211		SJS21-MW13S-0512		SJS21-MW13S-1112		SJS21-MW13S-0513		SJS21-MW13S-1113		SJS21-MW14S-06D		SJS21-MW14S-1110		SJS21-MW14S-0311		SJS21-MW14S-0511		SJS21-MW14S-1211		SJS21-MW14S-0512		SJS21-MW14S-1112		SJS21-MW14S-0513	
	Sample Date		12/12/2011		5/16/2012		11/13/2012		5/7/2013		11/15/2013		10/30/2006		11/16/2010		3/8/2011		5/3/2011		12/14/2011		5/17/2012		11/13/2012		5/6/2013	
	Sample Event		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1-MONTH POST ZVI		3-MONTH POST ZVI		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	**306**		**445**		**557**		**250**		**150**		**650**		**27.6**		**18.7**	J	**18.7**	J	**9.4**	J	**10**		**5.2**	J	3.4	
cis-1,2-Dichloroethylene	70.0	µg/L	**3330**		**3910**		**2760**		**2600**		**2300**		**880**		**1300**		**914**		**821**		**687**		**706**		**653**		**890**	
1,1-Dichloroethylene	7.0	µg/L	6.8	J	**12**	U	10	U	**7.1**		10	U	130	U	4.6	U	4.6	U	4.6	U	2.3	U	2.3	U	2	U	2.2	
Vinyl chloride	2.0	µg/L	**77.5**		**58.9**		**86.3**		**47.8**		**48.1**		130	U	**12.8**	J	**12.8**	J	**18.1**	J	**129**		**69.2**		**81.1**		**141**	
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	464		491		417		428		429		NA		246		441		469		2300		1320		3650		3520	
Ethane	>500	µg/L	3.98		5.92		4.02		4.31	J	5.7	J	NA		0.86	J	64.8		61.3		87.4		30.3		64.2		55.9	
Ethene	>500	µg/L	2.6		2.2		2.0		2	U	2.8	J	NA		0.54	J	9.88		6.31		29		7.84		19.4		17.2	
Dissolved Iron	>1000	µg/L	2200		3340		832		3320		3400		NA		2190		7300		8150		3200		9090		1430		14200	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	2.0	U	2.0	U	2.5	U	2	U	3.5	U	NA		2.0	U	2.0	U	2.0	U	6.8	J	11.1		4.8	J	18.1	
Sulfate	<20	mg/L	43.2		48.1		49.7		47.1		48.7		NA		51.6		38.7		46.9		27.2		41.6		38.2		39.8	
Sulfide	>1.0	mg/L	0.30	U	0.30	U	0.19	U	1.4	U	1.5	U	NA		0.60	U	0.80	J	0.63	J	0.60	J	0.30	U	0.20	U	1.4	U
Total Organic Carbon	>20	mg/L	2.7		1.4		2.2		1.5		2.1		NA		1.6		NA		1.8		2.4		1.3		1.7		1.7	
Alkalinity, Total as CaCO3	>50	mg/L	86.6		79		61.8		73.4		88		NA		36.6		NA		50.0		63.0		60.3		61.6		76.7	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	3330		3910		2760		2600		2310		NA		1300		914		821		691		711		653		919	

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Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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	Sample ID		SJS21-MW14S-1113		SJS21-MW15S-06D		SJS21-MW15S-1110		SJS21-MW15S-0311		SJS21-MW15S-0511		SJS21-MW15S-1211		SJS21-MW15S-0512[3]		SJS21-MW15S-1112[3]		SJS21-MW15S-0513		SJS21-MW15S-1113		SJS21-MW16S-06D		SJS21-MW16S-1110		SJS21-MW16S-0311	
	Sample Date		11/14/2013		10/30/2006		11/22/2010		3/8/2011		5/3/2011		12/14/2011		5/17/2012		11/12/2012		5/8/2013		11/14/2013		10/30/2006		11/18/2010		3/9/2011	
	Sample Event		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1-MONTH POST ZVI		3-MONTH POST ZVI		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1-MONTH POST ZVI	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	2	U	**16000**		**12500**		**174**		**33.2**	J	**8.0**	J	26	U	16	U	1	U	2	U	**13000**		**3770**		**1070**	
cis-1,2-Dichloroethylene	70.0	µg/L	**363**		**2600**	J	**1010**		**4710**		**2440**		**2000**		**4210**		**2950**		**348**		**449**		**460**	J	**598**		**504**	
1,1-Dichloroethylene	7.0	µg/L	2	U	2000	U	58	U	23.0	U	12	U	4.6	U	23	U	10	U	1	U	2	U	670	U	**29.6**	J	4.6	U
Vinyl chloride	2.0	µg/L	**74.4**		2000	U	55	U	22	U	11	U	**584**		**1440**		**896**		**375**		**219**		670	U	**33.8**	J	**17.6**	J
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	8570		NA		133		159		157		1010		1050		3090		4150		3530		NA		48.9		99	
Ethane	>500	µg/L	133		NA		0.79	J	215		213		389		643		609		517		336		NA		0.32	U	245	
Ethene	>500	µg/L	44	K	NA		2.2		90.5		88.6		198		484		518		395		188	K	NA		0.83	J	133	
Dissolved Iron	>1000	µg/L	16600		NA		2410		4400		9720		7830		13300		14500		17400		13900		NA		756		7640	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	25.5		NA		2.5	J	2.0	U	5.0	J	2.0	U	9.2	J	8.4	J	13.1		17		NA		2.0	U	2.0	U
Sulfate	<20	mg/L	34.2		NA		45.8		44.8		67.5		36.7		41.4		37.1		39.7		46		NA		24.9		18.6	
Sulfide	>1.0	mg/L	1.5	U	NA		0.60	U	0.60	U	0.64	J	0.30	U	2.50		0.70		1.4	U	1.5	U	NA		0.60	U	0.71	J
Total Organic Carbon	>20	mg/L	2.3		NA		2.6		NA		7.1		8.3		9.8		7.5		5.1		5.3		NA		2.3		NA	
Alkalinity, Total as CaCO3	>50	mg/L	88.7		NA		53.4		NA		90.5		104		107		117		126		143		NA		30.8		NA	
1,2-Dichloroethene (total)	incneasing or decreasing	µg/L	366		NA		1010		4710		2440		2010		4210		2950		357		452		NA		635		504	

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Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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	Sample ID		SJS21-MW16S-0511		SJS21-MW16S-1211		SJS21-MW16S-0512		SJS21-MW16S-1112		SJS21-MW16S-0513		SJS21-MW16S-1113		SJS21-MW17S-07A		SJS21-MW17S-1110		SJS21-MW17S-1211		SJS21-MW17S-0512		SJS21-MW17S-1112		SJS21-MW17S-0513		SJS21-MW17S-1113	
	Sample Date		5/2/2011		12/13/2011		5/29/2012		11/16/2012		5/8/2013		11/12/2013		2/26/2007		11/18/2010		12/15/2011		5/15/2012		11/15/2012		5/8/2013		11/13/2013	
	Sample Event		3-MONTH POST ZVI		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	**7320**		2.3	J	1.2		0.73	J	1	U	1	U	**29**		**15.5**		**9.2**		2.7		**5.1**		4.1		2.4	
cis-1,2-Dichloroethylene	70.0	µg/L	**1700**		**238**		26.5		5.6		27.9		28.4		22		21.9		15.4		4.5		13.7		6.5		8.3	
1,1-Dichloroethylene	7.0	µg/L	23	U	1.2	U	0.23	U	0.20	U	1	U	1	U	5	U	0.23	U	0.23	U	0.23	U	0.20	U	1	U	1	U
Vinyl chloride	2.0	µg/L	**26.3**	J	**761**		**1440**		**144**		**60.8**		**673**		1	U	0.35	J	0.22	U	0.22	U	0.44	U	1	U	1	UL
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	102		1230		2480		2020		2160		1300		NA		68.4		28.2		22		41.4		53		35.4	
Ethane	>500	µg/L	694		506		758		201		195		163		NA		0.32	U	0.32	U	0.32	U	0.32	U	2	U	2	U
Ethene	>500	µg/L	284		273		303		121		28.2		178	K	NA		0.43	U	0.43	U	0.43	U	0.43	U	2	U	2	U
Dissolved Iron	>1000	µg/L	6670		736		2420		940		3030		2590		NA		2010		1020		467		775		1380		523	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	2.0	U	2.0	U	4.9	J	2.5	U	5.9		4.4		NA		2.0	U	2.0	U	2.0	U	2.5	U	2	U	3.5	U
Sulfate	<20	mg/L	9.6		8.5	J	9.7		13.6		8.2		11.3		NA		28.9		25.2		23.4		24.8		28.3		24.8	
Sulfide	>1.0	mg/L	1.9		0.30	U	1.10		0.60	J	1.4	U	1.5	U	NA		0.60	U	0.30	U	0.60	J	0.29	J	1.4	U	1.5	U
Total Organic Carbon	>20	mg/L	5.7		8.5		9.8		8.6		6.1		14.2		NA		0.72		0.88		0.71	J	1.1		0.64	U	0.9	B
Alkalinity, Total as CaCO3	>50	mg/L	34.4		52.4		128		92.4		96.4		105		NA		23.7		15.1		11.1		20.4		13.1		8.8	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	1700		238		26.5		5.6		28.8		28.4		NA		22.7		15.9		4.5		14.3		6.5		8.3	

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St. Juliens Creek Annex
Chesapeake, VA

	Sample ID	SJS21-MW18S-07A[3]		SJS21-MW18S-1110		SJS21-MW18S-1211		SJS21-MW18S-0512		SJS21-MW18S-1112		SJS21-MW18S-0513		SJS21-MW18S-1113		SJS21-MW19S-07A		SJS21-MW19S-1110		SJS21-MW19S-1211		SJS21-MW19S-0512		SJS21-MW19S-1112		SJS21-MW19S-0513	
	Sample Date	2/26/2007		11/22/2010		12/15/2011		5/15/2012		11/14/2012		5/8/2013		11/14/2013		2/26/2007		11/15/2010		12/15/2011		5/15/2012		11/15/2012		5/8/2013	
	Sample Event	PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	**180**		**35.8**		3.6		2.4		0.73	J	1	U	1	U	**150**		**92.1**		2.2		**10**		3.7		**7.5**	
cis-1,2-Dichloroethylene	70.0	µg/L	49		**99.7**		**83**		62.3		**88.2**		62		**76.3**		**140**		**99.9**		29.5		20.5		7.2		17.9	
1,1-Dichloroethylene	7.0	µg/L	5	U	0.53	J	0.50	J	0.35	J	0.55	J	1	U	1	U	1.6	J	1.7		0.41	J	0.54	J	0.20	U	1	U
Vinyl chloride	2.0	µg/L	**16**		**5.3**		**6.5**		**3.7**		**4.9**		**8**		**5.3**		**25**		**19.5**		**15.5**		**13.6**		**6.4**		**12.1**	
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	NA		171		94		129		2960		5360		3740		NA		405		5410		9700		8230		11400	
Ethane	>500	µg/L	NA		0.32	U	0.32	U	0.32	U	0.32	U	2	U	2	U	NA		0.32	U	0.32	U	0.39	J	0.32	U	2	U
Ethene	>500	µg/L	NA		1.3		0.72	J	0.91	J	1.1		2	U	2	U	NA		0.59	J	0.43	U	5.08		0.98	J	2	J
Dissolved Iron	>1000	µg/L	NA		2470		768		2260		1920		1950		1890		NA		11900		65000		49600		11600		51500	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	NA		2.0	U	2.0	U	2.0	U	2.5	U	2	U	3.5	U	NA		3.4	J	32.5		31.7		65.2		263	
Sulfate	<20	mg/L	NA		39.0		31.5		11.0		8.1		13.1		12.7		NA		25.3		5.0	U	5.0	U	1.4	J	5.7	
Sulfide	>1.0	mg/L	NA		0.60	U	0.30	U	0.84	J	0.42	J	1.4	U	1.5	U	NA		0.60	U	2.7		0.32	J	0.70	J	1.4	U
Total Organic Carbon	>20	mg/L	NA		1.4		1.4		6.0		1.6		1.6		2		NA		4.1		223		49.2		71.3		52.9	
Alkalinity, Total as CaCO3	>50	mg/L	NA		61.1		51.5		81.3		98.7		93.1		96.8		NA		49.7		795		491		745		667	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	NA		101		84		62.8		89.2		64.4		77.4		NA		101		29.9		20.8		7.2		18.6	

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Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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	Sample ID		SJS21-MW19S-1113		SJS21-TW109-05D		SJS21-MW20S-1110		SJS21-MW20SR-0311[3]		SJS21-MW20SR-0511		SJS21-MW20SR-1211		SJS21-MW20SR-0512		SJS21-MW20SR-1112		SJS21-MW20S-0513		SJS21-MW20SP-0513		SJS21-MW20S-1113		SJS21-MW20SP-1113		SJS21-TW106-05D	
	Sample Date		11/13/2013		11/1/2005		11/22/2010		3/9/2011		5/3/2011		12/14/2011		5/17/2012		11/12/2012		5/7/2013		5/7/2013		11/14/2013		11/14/2013		11/2/2005	
	Sample Event		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1-MONTH POST ZVI		3-MONTH POST ZVI		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	4.5		**1600**		**152**		**29.9**		2.6	U	0.80	J	2.4		0.31	U	1	U	1	U	1	U	1	U	**500**			
cis-1,2-Dichloroethylene	70.0	µg/L	10		**450**		**906**		**786**		**405**		36.4		**81.9**		30.7		18.6	J	13.4	J	11.5		10.7		**730**			
1,1-Dichloroethylene	7.0	µg/L	1	U	2	J	3.4	J	2.3	U	2.3	U	0.23	U	0.29	J	0.20	U	1	U	1	U	1	U	1	U	1	J		
Vinyl chloride	2.0	µg/L	**5.4**	L	**6**	J	**33.4**		**15.5**		**12.9**		**57.7**		**133**		**94.8**		**25.1**	J	**14.5**	J	**21**		**19.9**		**4**	J		
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	10500		NA		582		280		276		7360		4360		7330		6750		NA		8460		NA		NA			
Ethane	>500	µg/L	2	U	NA		2.43		232		199		216		74.9		126		57.9		NA		166		NA		NA			
Ethene	>500	µg/L	2	U	NA		4.02		40.5		30.1		179		29		39.5		14.2		NA		19	K	NA		NA			
Dissolved Iron	>1000	µg/L	42400		NA		578		1730		141	J	2120		4950		4830		14200		17100		10700		11700		NA			
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	415		NA		2.6	J	2.0	U	2.0	U	2.3	J	6.0	J	6.2	J	10.4		16.1		11.2		12		NA			
Sulfate	<20	mg/L	5.2		NA		7.2		25.8		36.7		3.8		10.7		7.4		13.6		NA		6.1		NA		NA			
Sulfide	>1.0	mg/L	1.5	U	NA		0.60	U	0.60	U	0.64	J	0.45	J	1.3		0.19	U	1.4	U	NA		1.5	U	NA		NA			
Total Organic Carbon	>20	mg/L	97		NA		3.8		10.8		8.3		22.7		6.1		4.6		5.1		NA		5.1		NA		NA			
Alkalinity, Total as CaCO3	>50	mg/L	1150		NA		127		107		142		308		293		264		265		NA		265		NA		NA			
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	10		NA		913		786		405		36.9		82.8		30.7		18.6	J	13.4	J	11.5		10.7		NA			

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NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
Page 12 of 17

	Sample ID		SJS21-MW21S-1110		SJS21-MW21SR-0311		SJS21-MW21SR-1211		SJS21-MW21SR-0512		SJS21-MW21SR-1112		SJS21-MW21S-0513		SJS21-MW21S-1113		SJS21-TW203-06D		SJS21-MW22S-1110		SJS21-MW22SR-0311		SJS21-MW22SR-1211		SJS21-MW22SR-0512		SJS21-MW22SR-1112	
	Sample Date		11/16/2010		3/11/2011		12/13/2011		5/16/2012		11/13/2012		5/6/2013		11/15/2013		10/26/2006		11/17/2010		3/11/2011		12/13/2011		5/16/2012		11/12/2012	
	Sample Event		BASELINE		EPLACEMENT BASELIN		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		EPLACEMENT BASELIN		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL[5]	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	**1370**		**745**		0.69	J	0.62	J	0.45	J	1	U	1	U	0.17	J	1.6		0.36	J	0.26	U	1.9		0.31	U		
cis-1,2-Dichloroethylene	70.0	µg/L	**2500**		**1110**		10.1		6.5		16.7		**81**		1	U	2.2		1.6		0.57	J	0.49	J	5.1		1.6			
1,1-Dichloroethylene	7.0	µg/L	12	U	4.6	U	0.23	U	0.23	U	0.20	U	1	U	1	U	0.5	U	0.23	U	0.23	U	0.23	U	0.23	U	0.20	U		
Vinyl chloride	2.0	µg/L	11	U	**9.6**	J	**10.1**		**13**		1.5		**171**		**7.3**		0.19	J	**11.1**		**3.0**		0.22	U	0.22	U	0.44	U		
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	431		204		5800		6570		206		5370		6930		NA		5220		3260		6670		6960		9710			
Ethane	>500	µg/L	0.64	J	0.34	J	0.32	U	1.8		0.32	U	2.58	J	11		NA		0.32	U	0.32	U	0.32	U	0.32	U	0.32	U		
Ethene	>500	µg/L	0.53	J	0.43	U	0.43	U	5.17		0.43	U	67.3		19.2		NA		0.43	U	0.43	U	0.43	U	0.43	U	0.43	U		
Dissolved Iron	>1000	µg/L	2900		763		72400		57500		3530		46000		73800		NA		16500		941		17900		15400		17100			
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	2.0	U	2.0	U	18		23.6		6.3	J	85.1		57.6		NA		5.5	J	2.0	U	2.0	U	5.0	J	2.5	U		
Sulfate	<20	mg/L	38.3		53.8		5.0	U	5.0	U	12.1		5.8		20.5		NA		1.0	U	4.8		5.0	U	2.4	J	3.6			
Sulfide	>1.0	mg/L	0.60	U	0.60	U	2.3		0.9	J	0.21	J	1.4	U	1.5	U	NA		0.60	U	0.60	U	1.3		0.66	J	0.75			
Total Organic Carbon	>20	mg/L	1.6		2.5		35.5		14.5		0.79	J	27		16.5		NA		2.8		26.1		29.0		14.5		24.3			
Alkalinity, Total as CaCO3	>50	mg/L	49.7		72.7		763		663		37.1		630		437		NA		156		327		459		244		410			
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	2500		1120		10.1		6.5		17.4		84.7		1	U	NA		2.7		0.84	J	0.61	U	5.1		1.6	J		

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NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA

		Sample ID	SJS21-MW22S-1113		SJS21-TW108-05D		SJS21-MW23S-1110		SJS21-MW23S-1211		SJS21-MW23S-0512		SJS21-MW23S-1112		SJS21-MW23S-0513		SJS21-MW23S-1113		SJS21-TW122-05D		SJS21-MW24S-1110		SJS21-MW24S-1211		SJS21-MW24S-0512		SJS21-MW24S-1112	
		Sample Date	11/15/2013		11/2/2005		11/22/2010		12/14/2011		5/16/2012		11/12/2012		5/7/2013		11/14/2013		10/31/2005		11/17/2010		12/12/2011		5/29/2012		11/15/2012	
		Sample Event	5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL[7]	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	1	U	**3000**		**18.8**	J	0.26	U	0.37	J	0.63	U	1	U	1	U	**27**		**6.8**		1.5		0.26	U	1.3	
cis-1,2-Dichloroethylene	70.0	µg/L	1	U	**1300**		**1320**		14.9		10.8		**173**		**214**		62.3		2	J	1.2		2.1		0.72	J	2.5	
1,1-Dichloroethylene	7.0	µg/L	1	U	500	U	4.6	U	0.23	U	0.23	U	0.40	U	1	U	1	U	10	U	0.23	U	0.23	U	0.23	U	0.20	U
Vinyl chloride	2.0	µg/L	1	U	500	U	4.4	U	**379**		**77.4**		**257**		**243**		**141**		10	U	0.22	U	0.22	U	0.22	U	0.44	U
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	NA		NA		311		790		5840		4340		5650		7690		NA		44.6		3670		8880		10800		
Ethane	>500	µg/L	NA		NA		0.93	J	3.14		1.0		2.81		2	U	3.25	J	NA		0.32	U	0.32	U	0.32	U	0.32	U	
Ethene	>500	µg/L	NA		NA		1.4		71.9		174		142		127		247	K	NA		0.43	U	0.43	U	0.43	U	0.43	U	
Dissolved Iron	>1000	µg/L	NA		NA		2150		19500		17700		16200		24500		15600		NA		9090		38000		49100		86800		
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	3.5	U	NA		2.0	U	8.7	J	14.4		12		16.2		15.1		NA		4.4	J	28.1		123		60.6		
Sulfate	<20	mg/L	NA		NA		41.8		5.0	U	2.0	U	14.5		22.9		16.3		NA		56.6		5.0	U	5.0	U	0.70	J	
Sulfide	>1.0	mg/L	NA		NA		0.60	U	0.45	J	0.51	J	0.63	J	1.4	U	1.5	U	NA		0.60	U	0.84	J	2.4		0.45	J	
Total Organic Carbon	>20	mg/L	NA		NA		2.3		168		30		3.3		2.8		3.5		NA		2.3		815		192		98.3		
Alkalinity, Total as CaCO3	>50	mg/L	NA		NA		90.8		770		449		268		231		228		NA		42.1		898		427		364		
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	1	U	NA		1320		15.6		10.8		175		215		63		NA		1.2	J	2.1		0.72	J	2.5		

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Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA
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	Sample ID		SJS21-MW24S-1113		SJS21-TW205-07A		SJS21-MW25S-1110		SJS21-MW25SR-0311		SJS21-MW25SR-1211		SJS21-MW25SR-0512		SJS21-MW25SR-1112		SJS21-MW25S-0513		SJS21-MW25S-1113		SJS21-TW201-06D[3]		SJS21-MW26S-1110		SJS21-MW26S-1211		SJS21-MW26S-0512	
	Sample Date		11/12/2013		2/20/2007		11/18/2010		3/11/2011		12/15/2011		5/15/2012		11/15/2012		5/8/2013		11/13/2013		10/25/2006		11/15/2010		12/15/2011		5/15/2012	
	Sample Event		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		EPLACEMENT BASELIN		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	NA		**8**		**17.1**		**7.5**		**5.5**		1.7		0.54	J	1	U	NA		1		**158**		**92.5**		**85.5**	
cis-1,2-Dichloroethylene	70.0	µg/L	NA		5	J	16.0		6.2		3.8		0.99	J	0.28	J	1	U	NA		18		**187**		**82.4**		**97.6**	
1,1-Dichloroethylene	7.0	µg/L	NA		5	U	0.23	U	0.23	U	0.23	U	0.23	U	0.20	U	1	U	NA		10	U	2.4		1.7		2.2	
Vinyl chloride	2.0	µg/L	NA		2	U	0.82	J	0.23	J	0.22	U	0.22	U	0.44	U	1	U	NA		**10**		**43.5**		**39.1**		**45.9**	
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	NA		NA		151		83.6		1110		2040		5120		5060		NA		NA		376		301		540	
Ethane	>500	µg/L	NA		NA		0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	2	U	NA		NA		0.32	U	0.32	U	0.32	U
Ethene	>500	µg/L	NA		NA		0.43	U	0.43	U	0.43	U	0.43	U	0.43	U	2	U	NA		NA		2.0		1.0		1.8	
Dissolved Iron	>1000	µg/L	NA		NA		9230		2110		56200		47500		116000		105000		NA		NA		4760		1390		8660	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	146		NA		2.0	U	2.0	U	4.7	J	8.1	J	15.6		26.6		22.3		NA		2.0	U	2.0	U	2.0	U
Sulfate	<20	mg/L	NA		NA		40.6		55.5		21		17		14.7		20.2		NA		NA		28.2		20		20.5	
Sulfide	>1.0	mg/L	NA		NA		0.60	U	0.60	U	0.30	U	0.87	J	0.22	J	1.4	U	NA		NA		0.60	U	0.30	U	0.30	U
Total Organic Carbon	>20	mg/L	NA		NA		1.4		8.2		4.4		3.9		7.6		6.4		NA		NA		5.1		5.1		5.4	
Alkalinity, Total as CaCO3	>50	mg/L	NA		NA		61.1		104		118		103		182		164		NA		NA		50.1		37.4		55.8	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	NA		NA		16.7		6.4		3.8		0.99	J	0.46	U	1	U	NA		NA		187		83.3		98.2	

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Chesapeake, VA

		Sample ID	SJS21-MW26S-1112		SJS21-MW26S-0513		SJS21-MW26SP-0513		SJS21-MW26S-1113		SJS21-MW26SP-1113		(none)		SJS21-MW27S-1110		SJS21-MW27SR-0311		SJS21-MW27SR-0511		SJS21-MW27SR-1211		SJS21-MW27SR-0512		SJS21-MW27SR-1112		SJS21-MW27S-0513	
		Sample Date	11/15/2012		5/8/2013		5/8/2013		11/13/2013		11/13/2013				11/18/2010		3/11/2011		5/2/2011		12/12/2011		5/31/2012		11/15/2012		5/8/2013	
		Sample Event	3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1-MONTH POST ZVI		3-MONTH POST ZVI		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	**96.3**		**117**		**120**		**113**		**107**		--		**5440**		**209**		**70.5**		1.5		0.42	J	0.31	U	1	U
cis-1,2-Dichloroethylene	70.0	µg/L	**87**		**108**		**108**		**93**		**89.8**		--		**1560**		**767**		**3830**		59.2		6.5		1.1		1	U
1,1-Dichloroethylene	7.0	µg/L	2.9		3.3		2.9		2.2		1.9		--		23	U	2.3	U	12	U	0.23	U	0.23	U	0.20	U	1	U
Vinyl chloride	2.0	µg/L	**54.6**		**55.1**		**54.5**		**34.1**	L	**34.2**	L	--		22	U	2.2	U	11	U	**146**		**11.4**		1.5		1.5	
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	421		637		NA		320		NA		--		30.9		61		92.2		5930		9210		9510		12800	
Ethane	>500	µg/L	0.32	U	2	U	NA		2	U	NA		--		0.32	U	189		361		270		319		167		205	
Ethene	>500	µg/L	1.4		2.1	J	NA		2	U	NA		--		1.9		48.1		111		204		177		54.9		25.2	
Dissolved Iron	>1000	µg/L	4620		9870		9530		5210		5700		--		2290		3090		6430		5870		5220		8280		7810	
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	2.5	U	2.1	J	2.1	J	3.5	U	3.5	U	--		2.0	U	2.0	U	2.0	U	2.0	U	2.8	J	7.2	J	9.5	
Sulfate	<20	mg/L	25.2		25.6		NA		5.4		NA		--		22.7		27.9		2.7		5.9		4.7		4.3		4.5	U
Sulfide	>1.0	mg/L	0.20	U	1.4	U	NA		1.5	U	NA		--		0.60	U	0.60	U	2.0		0.54	J	1.4		0.19	U	1.4	U
Total Organic Carbon	>20	mg/L	5.6		5.1		NA		6.1		NA		--		1.0		3.4		11.1		45.8		19.9		6.0		4.5	
Alkalinity, Total as CaCO3	>50	mg/L	40.3		49.3		NA		52.8		NA		--		12.5		37.4		42.6		180		127		82		65.7	
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	87.7		111		111		93.8		90.6		--		1560		767		3830		59.7		6.5		1.1	J	1	U

Notes:
[1] PAL = Project Action Limit from Revised Final Sampling and Analysis Plan Site 21 (CH2MHill, November 2010)
[2] PIL = Project Indicator Level from Revised Final Sampling and Analysis Plan Site 21 (CH2MHill, November 2010)
[3] Duplicate Sample collected from this location: the most conservative result is shown
[4] PRIOR results are most recent sample data as reported in Final Remedial Investigation Report for Site 21, CH2MHill, June 2008.
For newly installed wells, prior temporary wells at immediately adjacent location are reporeted when available
[5] Wells MW20S, MW21S, MW22S, MW25S, and MW27S were abandoned and replaced during the March 2011 sampling event.
[6] Per the decision criteria, sampling has been discontinued at wells MW10S, MW12S, and MW29S - these wells were not sampled during the 4th Semi-Annual Sampling.
[7] Per the decision criteria, wells MW05S, MW06S, and MW24S are annually sampled for disolved arsenic only and were not sampled during the 4th Semi-Annual Sampling.
[8] Per the decision criteria, well MW03S is annually sampled for COCs and disolved arsenic and was not sampled during the 4th Semi-Annual Sampling.
[9] Per the decision criteria, well MW22S is annually sampled for COCs and was not sampled during the 4th Semi-Annual Sampling.
BOLD shaded value indicates COC concentration exceeds PAL
U Analyte non-detected above the method detection limit
J Numerical value is an estimate between laboratory reporting limit and laboratory method detection limit
L Numerical value may be biased low
K Reported value may be biased high
B Not detected substantially above the level reported in laboratory or field blanks. Interferences present which may cause the results to be biased high.
NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA

	Sample ID		SJS21-MW27S-1113		SJS21-TW115-05D		SJS21-MW28S-1110		SJS21-MW28S-1211		SJS21-MW28S-0512		SJS21-MW28S-1112		SJS21-MW28S-0513		SJS21-MW28S-1113		SJS21-TW214-07A		SJS21-MW29S-1110		SJS21-MW29S-1211		SJS21-MW29S-0512		SJS21-MW29S-1112	
	Sample Date		11/12/2013		11/1/2005		11/19/2010		12/15/2011		5/17/2012		11/14/2012		5/8/2013		11/12/2013		2/21/2007		11/17/2010		12/13/2011		5/29/2012		11/15/2012	
	Sample Event		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL[6]	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	1	U	**190**		**111**		**30**		**75**		**58.5**		**43.2**		**28.9**		5	U	0.26	U	0.26	U	0.26	U	0.31	U		
cis-1,2-Dichloroethylene	70.0	µg/L	1	U	**140**		**103**		**148**		**96.7**		**105**		**71.1**		**89.2**		10	U	0.26	U	7.5		0.26	U	0.24	U		
1,1-Dichloroethylene	7.0	µg/L	1	U	10	U	0.23	U	2.3	U	0.46	U	0.46	J	1	U	1	U	5	U	0.23	U	0.23	U	0.23	U	0.20	U		
Vinyl chloride	2.0	µg/L	1		**390**		**167**		**577**		**244**		**305**		**173**		**274**		2	U	0.22	U	0.29	J	0.22	U	0.44	U		
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	10800		NA		214		150		181		173		289		201		NA		24.8		26.9		95.1		36.3			
Ethane	>500	µg/L	106		NA		2.43		10.8		4.68		8.3		8.59	J	17.6		NA		0.32	U	0.69	J	0.32	U	0.32	U		
Ethene	>500	µg/L	5.3	K	NA		3.41		8.92		3.63		6.12		3.64	J	9.75	K	NA		0.43	U	0.43	U	0.43	U	0.43	U		
Dissolved Iron	>1000	µg/L	18700		NA		860		415		3830		1780		4730		2690		NA		12000		1040		8130		6890			
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	16.5		NA		2.0	U	2.0	U	2.1	J	2.5	U	2.8	J	3.5	U	NA		2.0	U	2.0	U	2.9	J	6.1	J		
Sulfate	<20	mg/L	4.5	U	NA		15.5		6.6		9.9		10.6		10.9		8.8		NA		99.1		79.2		70.5		64.9			
Sulfide	>1.0	mg/L	1.5	U	NA		0.60	U	0.30	U	0.30	U	0.21	U	1.4	U	1.5	U	NA		0.80	J	0.52	J	0.44	J	0.19	U		
Total Organic Carbon	>20	mg/L	18.4		NA		1.5		2.0		1.4		1.9		1.3		2		NA		5.7		7.0		9.9		11.4			
Alkalinity, Total as CaCO3	>50	mg/L	196		NA		51.8		90.3		63.3		68		76.7		96.8		NA		40.3		74.2		162		173			
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	1	U	NA		105		148		98.4		105		73.6		91.3		NA		0.61	U	7.5		0.61	U	0.46	U		

Notes:
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[3] Duplicate Sample collected from this location: the most conservative result is shown
[4] PRIOR results are most recent sample data as reported in Final Remedial Investigation Report for Site 21, CH2MHill, June 2008.
For newly installed wells, prior temporary wells at immediately adjacent location are reporeted when available
[5] Wells MW20S, MW21S, MW22S, MW25S, and MW27S were abandoned and replaced during the March 2011 sampling event.
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[8] Per the decision criteria, well MW03S is annually sampled for COCs and disolved arsenic and was not sampled during the 4th Semi-Annual Sampling.
[9] Per the decision criteria, well MW22S is annually sampled for COCs and was not sampled during the 4th Semi-Annual Sampling.
BOLD shaded value indicates COC concentration exceeds PAL
U Analyte non-detected above the method detection limit
J Numerical value is an estimate between laboratory reporting limit and laboratory method detection limit
L Numerical value may be biased low
K Reported value may be biased high
B Not detected substantially above the level reported in laboratory or field blanks. Interferences present which may cause the results to be biased high.
NA Not analyzed

Table 5
Site 21 Cumulative Groundwater Data
St. Juliens Creek Annex
Chesapeake, VA

	Sample ID		SJS21-MW30S-1110		SJS21-MW30S-1211		SJS21-MW30S-0512		SJS21-MW30S-1112		SJS21-MW30S-0513		SJS21-MW30S-1113		SJS21-TW209-07A		SJS21-MW31S-1110[3]		SJS21-MW31S-1211		SJS21-MW31S-0512		SJS21-MW31S-1112		SJS21-MW31S-0513		SJS21-MW31S-1113	
	Sample Date		11/18/2010		12/13/2011		5/17/2012		11/14/2012		5/7/2013		11/14/2013		2/22/2007		11/19/2010		12/14/2011		5/15/2012		11/14/2012		5/7/2013		11/14/2013	
	Sample Event		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL		PRIOR[4]		BASELINE		1ST SEMI-ANNUAL		2ND SEMI-ANNUAL		3RD SEMI-ANNUAL		4TH SEMI-ANNUAL		5TH SEMI-ANNUAL	
COCs	**PAL[1]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Trichloroethylene	5.0	µg/L	**126**		**86.2**		**80.8**		**81**		**52.2**		**35.8**		**11**		**9.8**		0.59	J	1.6		1.2		1	U	1	U	
cis-1,2-Dichloroethylene	70.0	µg/L	8.1		7.4		6.20		6.8		6.6		8.9		2	U	9.6		5.1		4.8		9.3		8.1		8.5		
1,1-Dichloroethylene	7.0	µg/L	0.46	U	0.23	U	0.23	U	0.20	U	1	U	1	U	5	U	0.57	J	0.23	U	0.25	J	0.40	J	1	U	1	U	
Vinyl chloride	2.0	µg/L	0.44	U	0.22	U	0.22	U	0.44	U	1	U	1	U	2	U	0.22	U	**11.1**		**7.2**		**7.9**		**5.1**		**3.3**		
Indicator Parameters	**PIL[2]**	**units**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Methane	>500	µg/L	287		263		254		159		166		111		NA		138		6230		4680		4890		2090		3200		
Ethane	>500	µg/L	0.32	U	0.32	U	0.32	U	0.32	U	2	U	2	U	NA		0.32	U	3.19		1.5		1.3		2	U	2	U	
Ethene	>500	µg/L	0.43	U	0.43	U	0.43	U	0.43	U	2	U	2	U	NA		0.43	U	0.43	U	0.64	J	0.63	J	2	U	2	U	
Dissolved Iron	>1000	µg/L	5520		2770		5940		5090		5880		3960		NA		337		758		4800		3730		6950		4570		
Dissolved Arsenic	≤ Baseline or MCL (10 µg/L), whichever is higher	µg/L	2.8	J	2.0	U	2.1	J	2.5	U	4.3		4		NA		2.0	U	2.0	U	2.3	J	5.7	J	9.4		10.1		
Sulfate	<20	mg/L	38.6		30.7		32.6		37		36.1		36.8		NA		15.8		2.3		5.5		12.7		13.7		14.6		
Sulfide	>1.0	mg/L	0.60	U	0.30	U	0.49	J	0.35	J	1.4	U	1.5	U	NA		0.60	U	0.67	J	0.76	J	0.21	U	1.4	U	1.5	U	
Total Organic Carbon	>20	mg/L	0.85		1.0		1.2		1.1		1		1.2	B	NA		1.7		2.2		2.0		1.4		1.3		1.6		
Alkalinity, Total as CaCO3	>50	mg/L	35.2		44.9		60.6		40		53.7		39.6		NA		68.0		135		121		73.9		74.5		62.7		
1,2-Dichloroethene (total)	increasing or decreasing	µg/L	8.1		7.4		6.2		6.8		6.6		8.9		NA		9.6		5.1		4.8		9.3		8.1		8.5		

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[7] Per the decision criteria, wells MW05S, MW06S, and MW24S are annually sampled for disolved arsenic only and were not sampled during the 4th Semi-Annual Sampling.
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J Numerical value is an estimate between laboratory reporting limit and laboratory method detection limit
L Numerical value may be biased low
K Reported value may be biased high
B Not detected substantially above the level reported in laboratory or field blanks. Interferences present which may cause the results to be biased high.
NA Not analyzed

TABLE 3-1

Site 21 Remedial Action-Operation Phase Vapor Intrusion

Monitoring Events 1 through 4 Indoor Air Analytical Results

Technical Memorandum: Site 21 Remedial Action-Operation

Phase Vapor Intrusion Monitoring Event 5

St. Juliens Creek Annex

Chesapeake, Virginia

Station Name	**Indoor Air-Inhalation Risk PAL**	SJS21-IA01				SJS21-IA02					SJS21-IA03				
Sample Name		SJS21-IA01-12A	SJS21-IA01-12C	SJS21-IA01-13A	SJS21-IA01-13C	SJS21-IA02-12A	SJS21-IA02P-12A[1]	SJS21-IA02-12C	SJS21-IA02-13A	SJS21-IA02-13C	SJS21-IA03-12A	SJS21-IA03-12C	SJS21-IA03P-12C[1]	SJS21-IA03-13A	SJS21-IA03-13C
Sample Date		2/13/2012	8/13/2012	1/28/2013	7/30/2013	2/13/2012	2/13/2012	8/13/2012	1/28/2013	7/30/2013	2/13/2012	8/13/2012	8/13/2012	1/28/2013	7/30/2013
Chemical Name															
Volatile Organic Compounds (µg/m3)															
1,1-Dichloroethene	220	10 U	10 U	12 U	0.25 U	10 U	10 U	10 U	10 U	0.25 U	10 U	10 U	10 U	10 U	0.25 U
1,2-Dichloroethane	4.7	10 U	10 U	12 U	**0.13 J**	10 U	10 U	10 U	10 U	0.25 U	10 U	10 U	10 U	10 U	0.25 U
cis-1,2-Dichloroethene[2]	--	10 U	10 U	12 U	**0.091 J**	10 U	10 U	10 U	**1 J**	**0.2 J**	10 U	10 U	10 U	**1 J**	**0.14 J**
trans-1,2-Dichloroethene	65	10 U	10 U	12 U	0.25 U	10 U	10 U	10 U	10 U	**0.15 J**	10 U	10 U	10 U	10 U	0.25 U
Trichloroethene[3]	2.2	13 U	13 U	17 U	**0.31 J**	13 U	13 U	13 U	**2 J**	**0.43 J**	13 U	13 U	13 U	**2 J**	**0.32 J**
Vinyl Chloride	28	6 U	6 U	8 U	0.16 U	6 U	6 U	6 U	6 U	**0.043 J**	6 U	6 U	6 U	6 U	**0.033 J**
Hydrogen Sulfide	2.2	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	**2.6 J**	7 U	7 U	7 U	7 U	**6 J**

Notes:

[1]Duplicate sample

[2]A PAL has not been established for cis-1,2-DCE because an inhalation toxicity value, and consequently an RSL, does not exist for cis-1,2-DCE. Note that concentrations of cis-1,2-DCE would likely need to be significantly higher than the other CVOCs (such as trans-1,2-DCE) for this to result in a significant uncertainty.

[3]The detection in the sample collected at location IA09 during the February 2012 monitoring event is not considered an exceedance because the PAL at the time of that sampling event was 61 µg/m3

Bold indicates detection

Shading indicates PAL exceedance

J - Analyte present between the laboratory reporting limit and the laboratory detection limit

U - Analyte not detected above the detection limit

µg/m3 - microgram per cubic meter

TABLE 3-1

Site 21 Remedial Action-Operation Phase Vapor Intrusion

Monitoring Events 1 through 4 Indoor Air Analytical Results

Technical Memorandum: Site 21 Remedial Action-Operation

Phase Vapor Intrusion Monitoring Event 5

St. Juliens Creek Annex

Chesapeake, Virginia

Station Name	**Indoor Air-Inhalation Risk PAL**	SJS21-IA04				SJS21-IA05				SJS21-IA06				SJS21-IA07			
Sample Name		SJS21-IA04-12A	SJS21-IA04-12C	SJS21-IA04-13A	SJS21-IA04-13C	SJS21-IA05-12A	SJS21-IA05-12C	SJS21-IA05-13A	SJS21-IA05-13C	SJS21-IA06-12A	SJS21-IA06-12C	SJS21-IA06-13A	SJS21-IA06-13C	SJS21-IA07-12A	SJS21-IA07-12C	SJS21-IA07-13A	SJS21-IA07-13C
Sample Date		2/13/2012	8/13/2012	1/28/2013	7/30/2013	2/13/2012	8/13/2012	1/28/2013	7/30/2013	2/13/2012	8/13/2012	1/28/2013	7/31/2013	2/13/2012	8/13/2012	1/28/2013	7/31/2013
Chemical Name																	
Volatile Organic Compounds (µg/m3)																	
1,1-Dichloroethene	220	10 U	10 U	10 U	0.25 U	10 U	10 UJ	10 U	0.25 U	10 U	10 U	10 U	0.25 U	10 U	10 U	10 U	0.25 U
1,2-Dichloroethane	4.7	10 U	10 U	10 U	0.25 U	10 U	10 UJ	10 U	0.25 U	10 U	10 U	10 U	0.25 U	**2 J**	10 U	10 U	0.25 U
cis-1,2-Dichloroethene[2]	--	10 U	10 U	10 U	**0.19 J**	10 U	10 UJ	10 U	**0.22 J**	10 U	10 U	**3 J**	**0.48 J**	**3 J**	10 U	**6 J**	**0.63**
trans-1,2-Dichloroethene	65	10 U	10 U	10 U	0.25 U	10 U	10 UJ	10 U	0.25 U	10 U	10 U	10 U	0.25 U	10 U	10 U	10 U	0.25 U
Trichloroethene[3]	2.2	13 U	13 U	13 U	**0.42 J**	13 U	13 UJ	13 U	**0.46 J**	13 U	13 U	13 U	**0.8**	13 U	13 U	13 U	**0.75**
Vinyl Chloride	28	6 U	6 U	6 U	**0.046 J**	6 U	6 UJ	6 U	**0.046 J**	6 U	6 U	6 U	**0.066 J**	6 U	6 U	6 U	**0.072 J**
Hydrogen Sulfide	2.2	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U

Notes:

[1]Duplicate sample

[2]A PAL has not been established for cis-1,2-DCE because an inhalation toxicity value, and consequently an RSL, does not exist for cis-1,2-DCE. Note that concentrations of cis-1,2-DCE would likely need to be significantly higher than the other CVOCs (such as trans-1,2-DCE) for this to result in a significant uncertainty.

[3]The detection in the sample collected at location IA09 during the February 2012 monitoring event is not considered an exceedance because the PAL at the time of that sampling event was 61 µg/m3

Bold indicates detection

Shading indicates PAL exceedance

J - Analyte present between the laboratory reporting limit and the laboratory detection limit

U - Analyte not detected above the detection limit

µg/m3 - microgram per cubic meter

TABLE 3-1

Site 21 Remedial Action-Operation Phase Vapor Intrusion

Monitoring Events 1 through 4 Indoor Air Analytical Results

Technical Memorandum: Site 21 Remedial Action-Operation

Phase Vapor Intrusion Monitoring Event 5

St. Juliens Creek Annex

Chesapeake, Virginia

Station Name	**Indoor Air-Inhalation Risk PAL**	SJS21-IA08				SJS21-IA09				SJS21-IA09		SJS21-IA10			
Sample Name		SJS21-IA08-12A	SJS21-IA08-12C	SJS21-IA08-13A	SJS21-IA08-13C	SJS21-IA09-12A	SJS21-IA09-12C	SJS21-IA09-13A	SJS21-IA09P-13A[1]	SJS21-IA09-13C	SJS21-IA09P-13C[1]	SJS21-IA10-12A	SJS21-IA10-12C	SJS21-IA10-13A	SJS21-IA10-13C
Sample Date		2/13/2012	8/13/2012	1/28/2013	7/31/2013	2/13/2012	8/13/2012	1/28/2013	1/28/2013	7/30/2013	7/30/2013	2/13/2012	8/13/2012	1/28/2013	7/31/2013
Chemical Name															
Volatile Organic Compounds (µg/m3)															
1,1-Dichloroethene	220	10 U	40 U	10 U	0.25 U	10 U	10 U	18 U	20 U	0.25 U	0.25 U	10 U	40 U	10 U	0.25 U
1,2-Dichloroethane	4.7	**2 J**	40 U	10 U	0.25 U	10 U	10 U	18 U	21 U	**0.089 J**	0.25 U	10 U	40 U	10 U	0.25 U
cis-1,2-Dichloroethene[2]	--	10 U	40 U	**2 J**	**0.16 J**	10 U	10 U	**2 J**	20 U	**0.22 J**	**0.17 J**	10 U	40 U	**3 J**	**0.67**
trans-1,2-Dichloroethene	65	10 U	40 U	10 U	**0.079 J**	10 U	10 U	18 U	20 U	0.25 U	**0.27 J**	10 U	40 U	10 U	0.25 U
Trichloroethene[3]	2.2	13 U	54 U	13 U	**0.34 J**	**4 J**	13 U	**4 J**	**4 J**	**0.47 J**	**0.36 J**	13 U	54 U	**2 J**	**0.86**
Vinyl Chloride	28	6 U	26 U	6 U	0.16 U	6 U	6 U	11 U	13 U	**0.054 J**	**0.038 J**	6 U	26 U	6 U	**0.069 J**
Hydrogen Sulfide	2.2	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	**3.3 J**	7 UJ	7 U	7 U	7 U	7 U

Notes:

[1]Duplicate sample

[2]A PAL has not been established for cis-1,2-DCE because an inhalation toxicity value, and consequently an RSL, does not exist for cis-1,2-DCE. Note that concentrations of cis-1,2-DCE would likely need to be significantly higher than the other CVOCs (such as trans-1,2-DCE) for this to result in a significant uncertainty.

[3]The detection in the sample collected at location IA09 during the February 2012 monitoring event is not considered an exceedance because the PAL at the time of that sampling event was 61 µg/m3

Bold indicates detection

Shading indicates PAL exceedance

J - Analyte present between the laboratory reporting limit and the laboratory detection limit

U - Analyte not detected above the detection limit

µg/m3 - microgram per cubic meter

TABLE 5-1

Site 21 Remedial Action-Operation Phase Vapor Intrusion Monitoring Event 5 Indoor Air Analytical Results

Technical Memorandum: Site 21 Remedial Action-Operation Phase Vapor Intrusion Monitoring Event 5

St. Juliens Creek Annex

Chesapeake, Virginia

Station Name	**Indoor Air-Inhalation Risk PAL**	SJS21-IA01	SJS21-IA02	SJS21-IA03	SJS21-IA04	SJS21-IA05	SJS21-IA09
Sample Name		SJS21-IA01-14A	SJS21-IA02-14A	SJS21-IA03-14A	SJS21-IA04-14A	SJS21-IA05-14A	SJS21-IA09-14A
Sample Date		2/3/2014	2/3/2014	2/3/2014	2/3/2014	2/3/2014	2/3/2014
Chemical Name							
Volatile Organic Compounds (µg/m3)							
1,1-Dichloroethene	220	0.4 U	**0.83 J**	**0.87 J**	0.4 U	**0.87 J**	**0.4 J**
1,2-Dichloroethane	4.7	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
cis-1,2-Dichloroethene[1]	--	0.4 U	0.4 U	**0.4 J**	0.4 U	0.4 U	0.4 U
trans-1,2-Dichloroethene	65	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Trichloroethene	2.2	**0.11 J**	**0.86 J**	**0.81 J**	0.16 U	**0.48 J**	**0.75 J**
Vinyl Chloride	28	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Hydrogen Sulfide	2.2	7 U	7 U	7 U	7 U	7 U	7 U

Notes:

[1]A PAL has not been established for cis-1,2-DCE because an inhalation toxicity value, and consequently an RSL, does not exist for cis-1,2-DCE. Note that concentrations of cis-1,2-DCE would likely need to be significantly higher than the other CVOCs (such as trans-1,2-DCE) for this to result in a significant uncertainty.

Bold indicates detection

Shading indicates PAL exceedance

J - Analyte present between the laboratory reporting limit and the laboratory detection limit

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µg/m3 - microgram per cubic meter