Staszak, Janna/VBO

From: Doran, Karen (DEQ) [Karen.Doran@deq.virginia.gov]
Sent: Friday, February 05, 2010 1:38 PM
To: Bell, Walt J CIV NAVFAC, OPNEEV; Jones, Adrienne/VBO; Stroud.Robert@epamail.epa.gov; Staszak, Janna/VBO
Subject: Site 2 PP - VDEQ comments
Attachments: PRAP_Site2_StJuliensCreek_DRAFT - VDEQ comments.pdf

Team -
I have reviewed the referenced report and submit VDEQ comments in the attached document.
Please note, I did not review the glossary.
Thank you for the opportunity to comment.
Karen

Draft Proposed Plan

Site 2: Waste Disposal Area B

St. Juliens Creek Annex
Chesapeake, Virginia

January 2010

1 Introduction

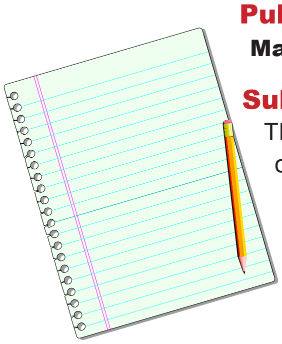
This **Proposed Plan** identifies the Preferred Alternative for addressing human health and ecological risks at **Environmental Restoration Program (ERP) Site** 2 at St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. This plan summarizes the remedial alternatives that were evaluated and provides the rationale for selection of combined soil cover, excavation, **enhanced reductive dechlorination (ERD)**, monitored **natural attenuation** (MNA), and **land use controls (LUCs)** as the Preferred Alternative for Site 2.

This Proposed Plan is issued jointly by the U.S. Navy (Navy), the lead agency for site activities; and the **U.S. Environmental Protection Agency (EPA)** Region III, the lead regulatory agency; in consultation with the **Virginia Department of Environmental Quality (VDEQ)**, the support agency. The Proposed Plan fulfills the public participation responsibilities required under Section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)** and Section 300.430(f)(2) of the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**.

Detailed information documenting environmental investigations at Site 2 can be found in the **Remedial Investigation/ Human Health Risk Assessment/Ecological Risk Assessment (RI/HHRA/ERA)** report (February 2004), Expanded RI report (November 2008), **Feasibility Study (FS)** report (October 2009), and other documents contained in the **Administrative Record** file and **Information Repository** for SJCA (see the "Mark your calendar" box below). Key information from the FS report, including all remedial options considered and detailed information for the Preferred Alternative, is summarized in this plan. A glossary of key terms, which are identified in bold print the first time they appear here, can be found at the end of this document.

The Navy and EPA, in consultation with the VDEQ, will make the final decision on the remedial approach for Site 2 after reviewing and considering all information submitted during the 45-day **public comment period**. The Preferred Alternative may be modified, or another **remedial action** may be selected based on new information or public comments received. Therefore, public comment on the alternatives and the rationale for selection of the Preferred Alternative is encouraged.

Mark Your Calendar for the Public Comment Period



Public Comment Period

March 20 - May 4, 2010

Submit Written Comments

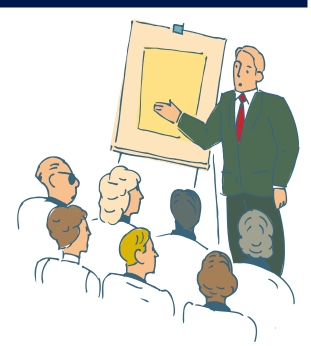
The Navy will accept written comments on the Proposed Plan during the public comment period. To submit comments or obtain further information, please refer to the back page.

Attend the Public Meeting

April 6, 2010 at 5:00 p.m.

Major Hillard Library

The Navy will hold a public meeting to explain the Proposed Plan. Verbal and written comments will be accepted at this meeting.



Location of Information Repository

Major Hillard Library
824 Old George Washington Highway N
Chesapeake, Virginia 23323
Phone: (757) 382-3600

2 Site Background

SJCA covers 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, Virginia (Figure 1). Most of the surrounding area is developed and includes residences, schools, recreational areas, and shipping facilities for several large industries.

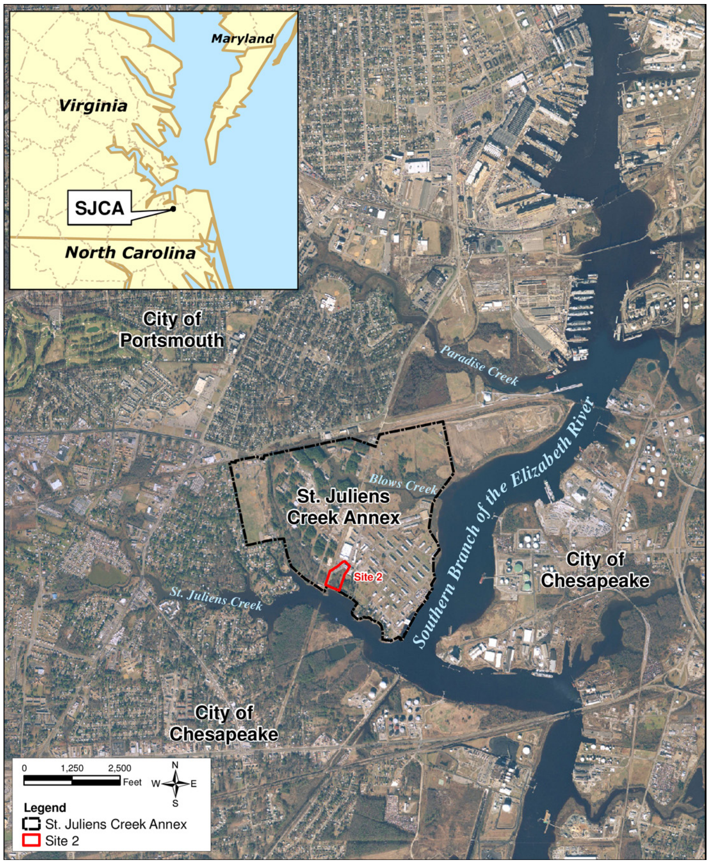


Figure 1 – Base and Site Location Map

SJCA began operations as a naval ammunitions facility in 1849. The facility was one of the largest ammunition depots in the United States and was involved in the wartime transfer of ammunitions to other naval facilities. After **ordnance** operations ceased at SJCA in 1977, decontamination was performed in, around, and under ordnance-handling facilities by flushing the areas with chemical solutions and water. SJCA has also been involved in non-ordnance services, including degreasing; operating various shops, such as paint, machine, vehicle and locomotive maintenance, pest control, battery, printing, and electrical; operating boiler plants, wash racks, and **potable**-water and saltwater fire-protection systems; providing firefighter training; and storing oil and chemicals.

2.1 Site Description and Background

Site 2 is a former waste disposal area covering approximately 5.7 acres at the corner of St. Juliens Road and Cradock Street, in the southern portion of SJCA (Figure 2). Mixed municipal wastes, abrasive blast material (ABM), waste ordnance, **organics** (including solvents), and **inorganics** were reportedly disposed of at Site 2. Operations began in 1921 and continued until some time after 1947. Initially, refuse was burned openly on the site 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. Construction debris (concrete, brick, and wood), as well as ABM, are currently visible on the ground surface. The total volume of waste accumulated is estimated to be 50,000 cubic yards.

Figure 2 – Site 2 Location Map

An underground stormwater sewer system originates approximately 1,000 feet northeast of the Site 2 area, within the ERP Site 21 boundary, and outlets to the north end of the Site 2 inlet (Figure 3). The site has historically received discharges from vehicle and equipment wash racks and ordnance degreasing operations located to the north. Four former aboveground storage tanks (removed between 1986 and 1990) and one underground storage tank were also located east of Site 2. These tanks were possibly used for storing fuel oil and diesel. Upgradient buildings were historically used as machine, vehicle, and locomotive maintenance shops; electrical shops; and munitions loading facilities.

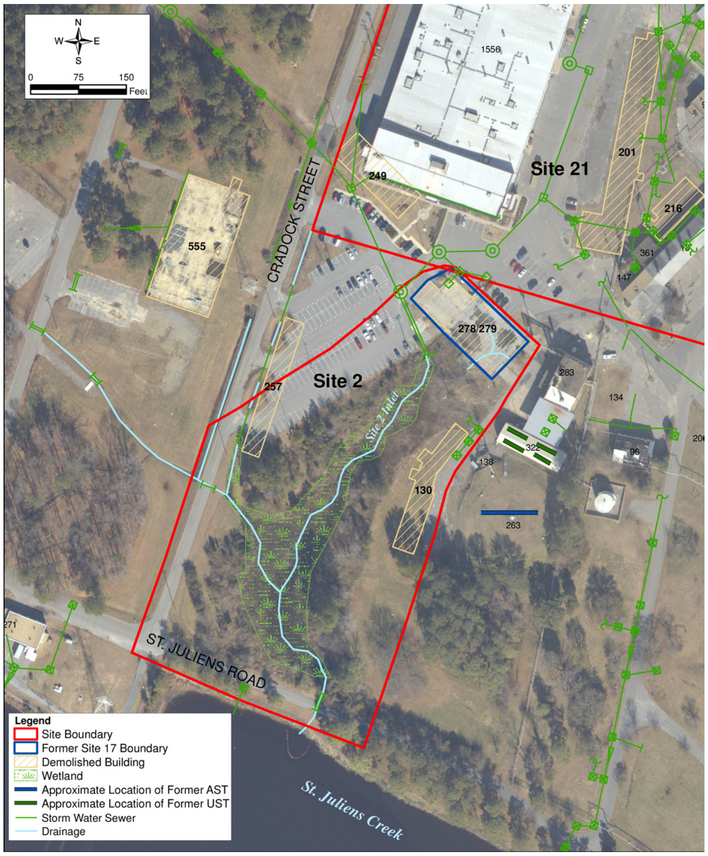


Figure 3 – Site 2 Vicinity Map

2.2 Summary of Previous Investigations

Site 2 was characterized as part of several investigations and studies since 1981. Detailed information from previous investigations conducted at Site 2 is available in the Administrative Record for SJCA. A complete list of the documents included in the Administrative Record files for SJCA can be obtained from the SJCA Installation Restoration Website, https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_env_pp/env_restoration_installations/lant/mid-lant/sjca, from the Information Repository (see page 1), or by contacting the **Naval Facilities Engineering Command (NAVFAC)** Public ~~a~~ffairs Office.

Basewide and site-specific investigations and studies are summarized in Table 1.

Previous Study / Investigation*	Date	Investigation Activities
Initial Assessment Study (IAS) (Naval Engineering Environmental Support Activity, 1981)	1981	The IAS included collection and evaluation of archival records and an inspection of the site. The IAS noted the presence of broken glass, cinder, ash, deteriorated metal, and other residues of garbage burning operations within and surrounding the Site 2 boundary. Additionally, a drum of Pen-Strip-G (a chemical cleaner, penetone), reportedly used for vehicle and equipment cleaning, was identified in the wash rack at Building 249, just north of Site 2 (Figure 3). The IAS stated that lead-acid battery maintenance operations were conducted at Building 279 (Former Site 17); ordnance wastewaters and rinse waters were discharged into the wetland near Buildings 257 and 130; and wastewater effluent from operations in the adjacent industrial area (Site 21) was released into storm drains that emptied into the wetland (Figure 3).
Preliminary Assessment (PA) (NUS Corporation, 1983)	1983	The PA was conducted to identify sites that required further investigation based on potential threat to human health or the environment. Ambient air at Site 2 (termed Dump B and the Dump B Incinerator) was monitored for **volatile organic compounds (VOCs)** and radiation. No readings above **background** were encountered and no significant signs of contamination were observed.
Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (A.T. Kearney, 1989)	1989	A preliminary review of all available relevant documents and a visual site inspection were conducted to identify solid waste management units (SWMUs) and areas of concern (AOCs). The RFA recommended further action for three SWMUs and one AOC identified within the current Site 2 boundary.
Relative Risk Ranking System (RRR) Data Collection Report (CH2M HILL, 1996)	1996	**Groundwater** and soil samples were collected to identify and prioritize sites requiring possible further investigation. **Semivolatile organic compounds (SVOCs)** including **polycyclic aromatic hydrocarbons (PAHs)**, pesticides, **polychlorinated biphenyls (PCBs)**, and inorganics were detected in soil; one VOC, explosives, and inorganics were detected in groundwater.
Site 17 Site Investigation (SI) (CH2M HILL, 2001)	2001	Soil samples were collected at Site 17 (Building 279) to verify the presence or absence of contamination and to evaluate potential human health or ecological risks. Results indicated concentrations of PAHs, pesticides, PCBs, and inorganics pose potential risks to human health and the environment.
Site 2 Remedial Investigation (RI) (CH2M HILL, 2004)	1997-2001	Soil, groundwater, sediment, and surface water samples were collected to define the nature and extent of contamination and to evaluate potential human health and ecological risks. Results indicated there are concentrations of pesticides, PAHs, and inorganics in soil and sediment that pose potential risks to human health and the environment. No risk from exposure to groundwater was identified. Although elevated concentrations of VOCs in surface water were detected, no associated risk was identified. The RI recommended additional investigation of all media to delineate the nature and extent of contamination.
Expanded Remedial Investigation (ERI) (CH2M HILL, ~~2001~~)	2003 - 2007	Waste delineation was conducted using direct-push methods and groundwater, soil, sediment, sediment pore water, and surface water samples were collected to define the extent of waste, identify and [illegible] the source of VOCs to surface water, determine if VOCs had contaminated deep groundwater, characterize the toxicity of inlet sediment, evaluate the magnitude of VOCs in sediment pore water, and evaluate the potential impacts from the Site 2 inlet to St. Juliens Creek. Potential risks to human health associated with exposure to waste, soil, shallow groundwater, and sediment as well as potential risks to the environment associated with exposure to soil, sediment (including sediment pore water), and surface water were identified. Contaminants of concern (COCs) were identified for these media (Table 2). 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. An FS was recommended to evaluate potential remedial alternatives to mitigate unacceptable human health and ecological risks from COCs identified in shallow groundwater, soil, sediment, and surface water. No potential human health risks were identified from exposure to deep groundwater and no further evaluation of deep groundwater was recommended.
Feasibility Study (CH2M HILL, 2009)	~~2002~~	Remedial action alternatives were developed and evaluated to prevent unacceptable risk from exposure to shallow groundwater, soil, sediment, and surface water. Eight remedial alternatives were selected for detailed comparative analysis.

*The documents listed are available in the Administrative Record and provide detailed information used to support remedy selection at Site 2.

Table 1 – Previous Studies and Investigations

COCs	Surface Soil	Combined Surface and Subsurface Soil	Shallow Groundwater	Surface Water	Sediment	Sediment Pore Water
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	
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/PCBs						
4,4'-DDD	X					
4,4'-DDE	X					
4,4'-DDT	X					
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 2 – Contaminants of Concern

3 Site Characteristics

A **conceptual site model (CSM)** depicts the site characteristics (Figure 4). ~~Most of~~ Site 2 consists of a water body (inlet) in the center of the site surrounded by wetland, brush, trees, and grass (Figure 5). This tidally influenced inlet is directly connected to St. Juliens Creek through a culvert that drains surface water from adjoining land into the creek during low tide and receives water from St. Juliens Creek during high tide. With the exception of the inlet, the topography of the site is relatively flat. Grassed drainage ditches originate northwest of Site 2 and discharge stormwater runoff to the inlet. An underground stormwater sewer system originates approximately 1,000 feet northeast of the Site 2 area, within Site 21, and outlets to the north end of the inlet. Most of the stormwater sewer system is below the water table within Site 21, where a chlorinated VOC plume is present in groundwater. Groundwater infiltrates into the stormwater sewer system through cracks and joints and is transported to Site 2.

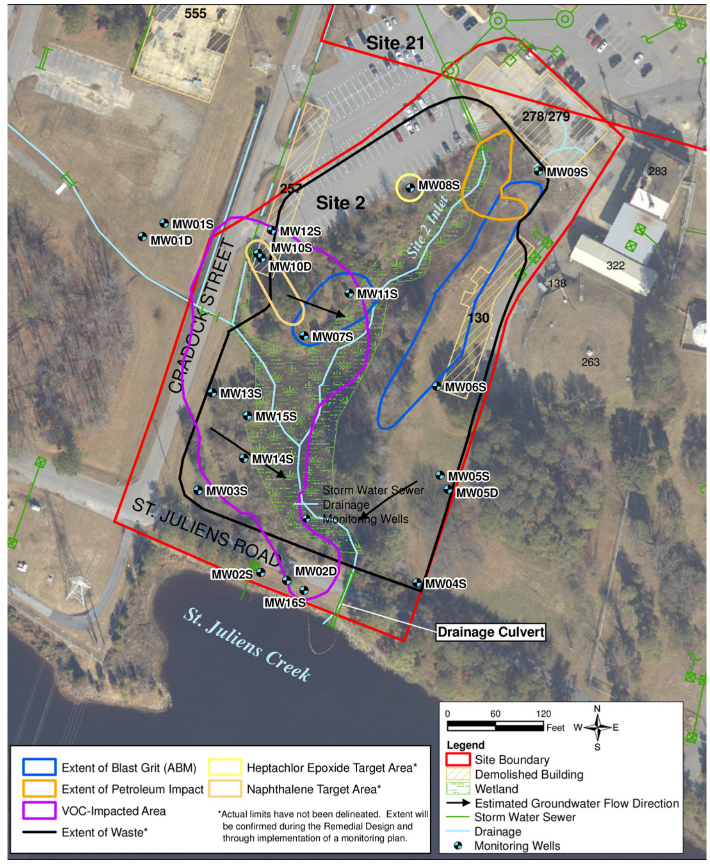


Figure 5 – Site 2 Vicinity Map

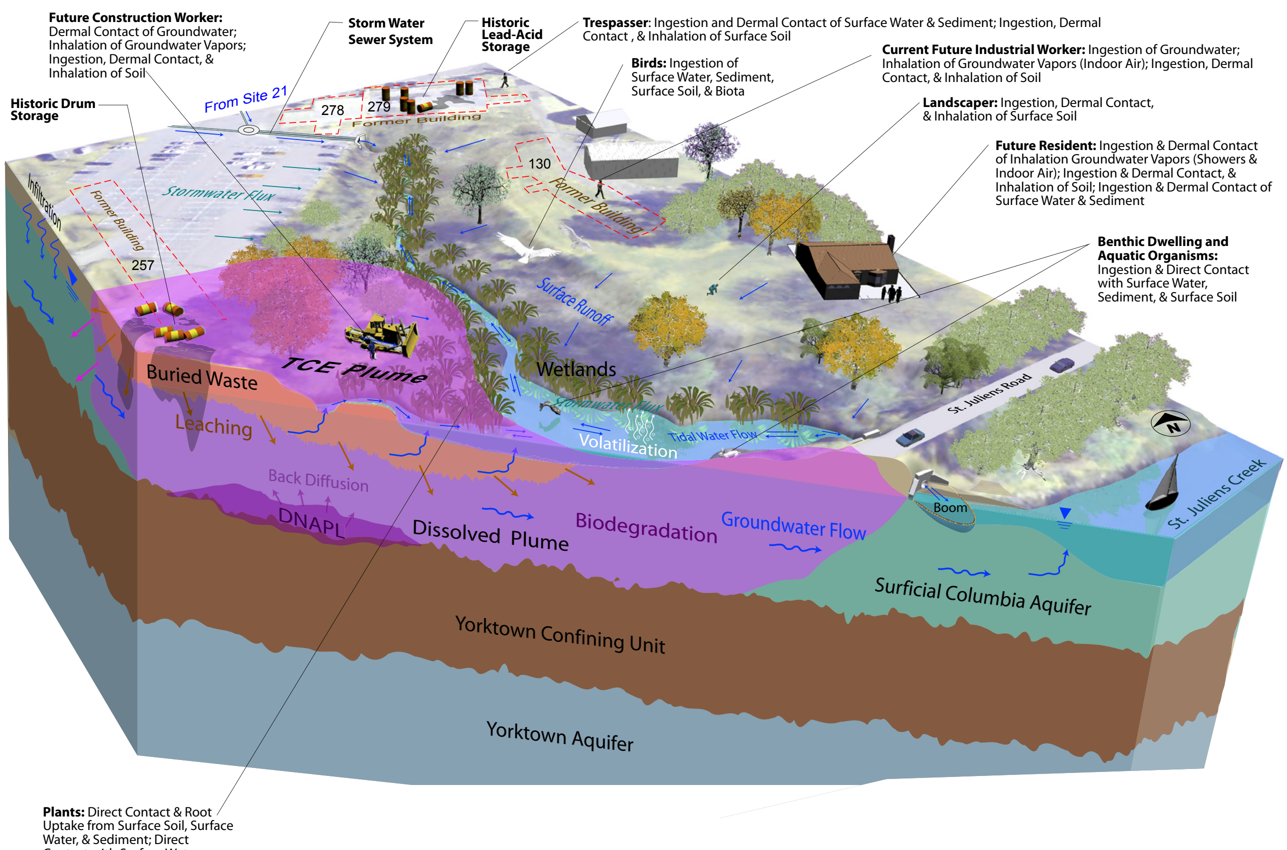


Figure 4 – Site 2 Conceptual Site Model

Shallow groundwater (Columbia **aquifer**) at the site is encountered from 3 to 7 feet below ground surface (bgs) and discharges into the inlet located in the middle of Site 2 and to St. Juliens Creek (Figure 5). The average shallow groundwater flow velocity at Site 2 is estimated to be 55 feet per year. The Columbia aquifer is not currently used, and is not expected to be used, as a potable or industrial water supply. Water for drinking and industrial use is supplied to SJCA by the City of Portsmouth. An approximately 30-foot-thick clay unit (Yorktown confining unit), at a depth of 15 to 25 feet bgs, separates the Columbia aquifer from the underlying Yorktown aquifer.

3.1 Nature and Extent of Contamination

Several sources of contamination have been identified at Site 2, including buried waste, waste incinerator residue, former chemical and fuel storage, lead-acid maintenance activities, degreasing activities, runoff from an upgradient industrial area, and discharge of upgradient Site 21 groundwater from the stormwater sewer system. COCs from these sources are identified in the following paragraphs and summarized in Table 2. The extent of waste at Site 2 was conservatively estimated to be approximately 3.9 acres and consists mainly of ABM, burnt/stained soil, concrete, asphalt, brick, metal, glass, wood, solvents, **munitions and explosives of concern (MEC)**-related scrap, and potential MEC (Figure 5). The thickness of waste varies from surficial to 11 feet bgs and waste is present within both the unsaturated zone and the saturated zone.

Constituents in surface and subsurface soil reflective of potential impacts from historic Site 2 activities are inorganics, PAHs, and pesticides. The highest concentrations of inorganics in surface and subsurface soil were generally limited to the ABM waste areas (Figure 5). In surface soil, pesticides and PAHs were found at elevated concentrations across the site; however, pesticides were detected with no definitive pattern, suggesting they may have been applied historically across the site. Concentrations of the PCB Aroclor 1260 in surface soil were significantly elevated in the northern portion of the site, within a drainage ditch passing under the foundation of former Buildings 278/279. In subsurface soil, the pesticide 4,4-dichlorodiphenyltrichloroethane (4,4-DDT) was significantly elevated at one location near the southwest corner of former Building 130.

In shallow groundwater (Columbia aquifer), VOCs, one SVOC (naphthalene), and one pesticide (heptachlor epoxide) have been detected at concentrations attributable to Site 2 activities (Figure 5). A **chlorinated VOC plume** in shallow groundwater, consisting primarily of **trichloroethene (TCE)** and its breakdown products, was identified in shallow groundwater and extends from the suspected release area near former Building 257 to near St. Juliens Creek, covering an area of approximately 1.6 acres. In addition, SVOCs and pesticides were detected at isolated locations in shallow groundwater within the limits of waste and chlorinated VOC plume. Inorganics were detected in shallow groundwater across the site.

In deep groundwater (Yorktown aquifer), with the exception of VOCs at one sample location, constituents were not detected at concentrations attributable to site activities. VOCs (TCE and its daughter products) were detected in deep groundwater collected from monitoring well SJS02-MW10D immediately following well installation. Additional activities, including subsequent rounds of groundwater sampling and aquifer pump testing, were conducted to further investigate the presence of VOCs in deep groundwater and the potential for transport of VOCs from the shallow aquifer to deep groundwater. During these subsequent sampling events, VOC concentrations significantly decreased to below the drinking water standards or were not detected. In addition, pump test results indicated the Yorktown confining unit is an effective barrier to vertical contaminant migration. It was therefore concluded the VOCs had been carried down during well installation and naturally degraded.

In surface water, VOCs and inorganics were detected and attributed to site activities. VOC concentrations were highest at the upstream drainage outfall locations, decreasing downstream. Although inorganics were detected in surface water across the inlet, the highest concentrations were detected in the most downstream locations.

VOCs were detected in sediment pore water; SVOCs, pesticides, and inorganics were detected in the sediment and attributed to site activities. The highest concentrations of VOCs in sediment pore water were detected in the western drainage ditch just south of the area where the highest concentrations of VOCs were detected in shallow groundwater. The highest SVOC concentrations were detected in sediment collected near the center of the tidal inlet. Pesticides in sediment were at the highest concentrations to the southwest of former Building 130 and within the western drainage ditch. Elevated inorganics were detected in sediment across the tidal inlet, with the highest concentrations occurring within the central portion of the Site 2 inlet. Only a few inorganics and SVOCs were detected in sediment samples collected within St. Juliens Creek near the outfall of the culvert that connects Site 2 to the creek. Although Site 2 is potentially contributing, or has historically contributed, inorganics and SVOCs to St. Juliens Creek via tidal influx through the low-flow culvert, significant site-related effects are only indicated in a localized area directly at the outfall location.

3.2 Fate and Transport of Contamination

As depicted in the CSM (Figure 4), the current primary **contaminant migration pathways** of COCs at Site 2 consist of:

- Back **diffusion** or **dissolution** of **dense non-aqueous phase liquid (DNAPL)** sorbed or trapped in the residual pore space at the top of the Yorktown confining unit into shallow groundwater
- Natural biodegradation of VOCs in groundwater
- Leaching of inorganics from buried wastes into groundwater
- Dissolved contaminant migration downgradient with groundwater flow **(advection)**, additionally resulting in migration to residual pore space
- Discharge of VOCs in groundwater to the stormwater sewer system that runs through Site 21 and south towards St. Juliens Creek
- Surface water runoff erosion of inorganics, SVOCs, pesticides, and PCBs in surface soil and deposition as sediment
- Leaching of inorganics from surface soil and sediment into surface water

3.3 Fate and Transport of Contamination

"Principal threat wastes" are **source materials** that are considered to be highly toxic or highly mobile and that generally cannot be reliably contained or would present a significant risk to human health or the environment should they be exposed. The waste at Site 2 consists of mixed municipal waste and is not considered a principal threat waste. Contaminated groundwater at Site 2 is also not considered to be a source material; however, **non-aqueous phase liquids (NAPLs)** in groundwater may be viewed as a source material. Therefore, DNAPL, if present at the top of the Yorktown confining unit, could represent a principal threat waste because it cannot be easily contained and, for the VOCs identified at Site 2, is highly toxic. Investigations have not confirmed that DNAPL exists at the site, though the chlorinated VOC concentrations indicate it is likely present, based on the rule-of-thumb that concentrations in excess of 1 percent of a compound's solubility suggest that DNAPL may be present. Therefore, as a conservative measure, the potential DNAPL will be considered as a principal threat waste.

4 Scope and the Role of the Action

SJCA was placed on EPA's **National Priorities List (NPL)** on July 27, 2000. Fifty-nine potentially contaminated ERP sites, Munitions Response Program (MRP) sites, SWMUs, and AOCs were identified. Fifty-two were closed following desktop audits or inspections and required no action. Three sites have a Final **Record of Decision (ROD)**:

- Site 3: No-action ROD
- Site 4: Action ROD for soil cover and LUCs
- Site 6: No-action ROD

Site 21 currently has an Interim ROD to address the potable use of groundwater through in situ chemical reduction and ERD. The Final ROD will be prepared for Site 21 after completion of the vapor intrusion pathway evaluation at the site. In addition to Sites 2 and 21, Site 5 is undergoing a Removal Action in accordance with an Engineering Evaluation/Cost Analysis (EE/CA). Area Unexploded Ordnance (UXO) 0001 is currently active in the MRP and is undergoing an SI. Details of these investigations and assessments are included in the **Site Management Plan** for SJCA, which is available in the Administrative Record and Information Repository.

The Preferred Alternative presented in this Proposed Plan is intended to address all potential risks to human health and the environment at Site 2, is intended to be the final remedy for the site, and does not directly include or affect any other ERP site or operable unit at SJCA.

5 Summary of Site Risks

Detailed results of the HHRA and ERA conducted at Site 2 are presented in the ERI report, which is available in the Administrative Record. Short descriptions of the risk calculation process are provided in the information boxes that accompany the following site-specific risk summaries.

5.1 Human Health Risk Summary

An HHRA was completed to evaluate potential human health risks from current and future human exposure to soil, groundwater, sediment, and surface water at Site 2. The only current exposure scenarios evaluated were the adult/adolescent trespasser and adult landscaper exposure to soil, sediment, and surface water. Hypothetical future exposure scenarios were evaluated for the construction worker and industrial worker exposure to soil and groundwater; and adult/adolescent trespasser and adult/child resident exposure to soil, groundwater, sediment, and surface water. The exposure pathways evaluated were dermal contact, inhalation, and ingestion of surface soil, subsurface soil, shallow groundwater, sediment, and surface water. Although VOCs were detected in deep groundwater during the ERI, the concentrations were found to be a result of monitoring well installation and not indicative of aquifer contamination; therefore, the RI conclusion that no unacceptable risks were posed by exposure to deep groundwater was considered appropriate and this medium was not evaluated further.

Waste and Soil

The results of the HHRA indicated there are no unacceptable **reasonable maximum exposure (RME)** cancer risks associated with exposure to site soils for current and future receptors. In addition, there are no RME **non-cancer hazards** above EPA's acceptable levels for adult trespassers and landscapers. There are no unacceptable **central tendency exposure (CTE)** cancer risks and no CTE non-cancer hazards above EPA's acceptable levels for current and future receptors. The unacceptable risks and hazards are summarized in Table 3.

	Exposure Route		Reasonable Maximum Exposure				Central Tendency Exposure			
Receptor	**Cancer**	**Non-Cancer**	**Cancer Risk**	**COCs with Cancer Risks >10^{-4}**	**Hazard Index**	**COCs with Hazard Quotient >1**	**Cancer Risk**	**COCs with Cancer Risk >10^{-4}**	**Hazard Index**	**COCs with Hazard Quotient >1**
Soil										
Current/ Future Trespasser - Adolescent	Ingestion Dermal		2.2 x 10^{-6}	Individual Consitituents <10^{-4}	**1.5**	Vanadium	1.7 x 10^{-7}	Individual Consitituents <10^{-4}	0.012	Individual Consitituents <1
Future Adult Resident	NA	Ingestion Dermal Inhalation	NA	NA	**1.8**	Individual Consitituents <1	NA	NA	0.087	Individual Consitituents <1
Future Child Resident	NA	Ingestion Dermal Inhalation	NA	NA	**13**	Antimony, Iron, Vanadium	NA	NA	0.81	Individual Consitituents <1
Future Construction Worker	Ingestion, Dermal, Inhalation		8.4x10^{-7}	Individual Consitituents <10^{-4}	**1.1**	Individual Consitituents <1	2.7 x 10^{-7}	Individual Consitituents <10^{-4}	0.15	Individual Consitituents <1
Future Industrial Worker	Ingestion, Dermal, Inhalation		1.5x10^{-5}	Individual Constituents <1^{4}	**1.8**	Vanadium	7.8 x 10^{-7}	Individual Consitituents <10^{-4}	0.084	Individual Consitituents <1
Groundwater										
Future Resident Adult	NA	Ingestion Dermal Inhalation	NA	NA	**292**	1,1,2-TCA, Vinyl chloride, cis-1,2-DCE, trans-1,2-DCE, Naphthalene, Heptachlor epoxide, Iron, Manganese	NA	NA	**26**	Vinyl chloride, cis-1,2-DCE
Future Resident Child	NA	Ingestion Dermal	NA	NA	**585**	1,1,2-TCA, 1,1-DCE, Vinyl chloride, cis-1,2-DCE, trans-1,2-DCE, Naphthalene, Heptachlor epoxide, 2,6-dinitrotoluene, Arsenic, Iron, Manganese	NA	NA	**82**	1,1,2-TCA, Vinyl chloride, cis-1,2-DCE, trans-1,2-DCE, Iron, Manganese
Future Resident Lifetime	Ingestion Dermal Inhalation	NA	**2.2x10^{-1}**	1,1,2-TCA, PCE, TCE, Vinyl chloride, Naphthalene, Heptachlor epoxide, Arsenic	NA	NA	**1.7x10^{-2}**	PCE, TCE, Vinyl chloride	NA	NA
Future Construction Worker	Dermal Inhalation		**2.3x10^{-4}**	Vinyl chloride	**11**	Vinyl chloride, Naphthalene	3.1x10^{-5}	Individual Constituents <10^{-4}	0.78	Individual Constituents <1
Future Industrial Worker	Ingestion		**2.9x10^{-2}**	TCE, Vinyl chloride	**83**	Vinyl chloride, cis-1,2-DCE	**2.0x10^{-3}**	TCE, Vinyl chloride	**16**	Vinyl chloride, cis-1,2-DCE
Sediment										
Future Resident Adult	NA	Ingestion Dermal	NA	NA	**1.5**	Chromium	NA	NA	0.19	Individual Constituents <1
Future Resident Child	NA	Ingestion Dermal	NA	NA	**77**	Chromium	NA	NA	**3.1**	Chromium
Future Resident Lifetime	Ingestion Dermal	NA	**1.6x10^{-4}**	Individual Constituents <10^{-4}	NA	NA	8.0x10^{-6}	Individual Constituents <10^{-4}	NA	NA

Table 3 – Human Health Risk Summary

Bold indicates a risk or hazard that exceeds the EPA's target level

EPA regulates exposure to lead based on the concentration of lead in the blood. Blood lead concentrations were estimated through the use of a model, and the results indicated a potential risk associated with exposure to lead in soil. Therefore, in addition to waste remaining in place, the HHRA identified potential risks associated with exposure to antimony, iron, vanadium, and lead in soil.

Shallow Groundwater

Risk estimates were calculated for future residents and industrial workers based on potable use of groundwater and for future construction worker exposure to groundwater in an open excavation. These exposure scenarios would result in cancer risks and non-cancer hazards primarily associated with concentrations of chlorinated VOCs, naphthalene, and heptachlor epoxide above EPA's acceptable levels (see Table 3).

Arsenic, iron, manganese, and 2,6-dinitrotoluene concentrations in groundwater resulted in cancer risks or non-cancer hazards above EPA's acceptable levels based on RME calculations. However, the potential risks or hazards are considered acceptable based on the following:

- Arsenic
  - There is no risk based on CTE.
  - During the most recent round of sampling, arsenic was detected below the federal maximum contaminant level (MCL) and background in all but one monitoring well (SJS02-MW09S).
  - There is no discernable arsenic plume. Elevated arsenic in the area of SJS02-MW09S, adjacent to the petroleum-contaminated area, has likely resulted from reducing conditions generated during degradation of petroleum compounds, as supported by field observations and measurements collected in the vicinity of this monitoring point.
- Iron
  - Concentrations are statistically similar to background levels.
- Manganese
  - Concentrations are below background levels.
- 2,6-dinitrotoluene
  - There is no risk based on CTE.
  - The explosive was only detected in one well, which, based on its high mobility, indicates that it is most likely naturally degrading and not migrating across the site.

Although no unacceptable cancer risk or non-cancer hazard was identified resulting from exposure to chloroform or methylene chloride in shallow groundwater, the two contaminants were retained as COCs because they were detected at concentrations that exceeded their respective MCLs (see Table 2).

Sediment

Risk estimates were calculated for current/future trespassers and future resident exposure to sediment. The results of the HHRA indicated there are no unacceptable cancer risks and non-cancer hazards associated with current and future trespasser exposure based on RME calculations. There are no cancer risks to the future lifetime resident from exposure to sediment. Future adult and child resident exposure scenarios result in RME non-cancer hazards above EPA's target threshold of 1 because of chromium. There is no risk to the future adult resident based on CTE calculations (see Table 3).

Surface Water

RME cancer risks and non-cancer hazards were below or within EPA's acceptable risk levels; therefore, no unacceptable human health risks are associated with exposure to surface water at Site 2.

Indoor Air Vapor

Because of the uncertainties associated with quantifying the risks associated with the inhalation [indoor air vapor] future pathway—about future building size, air exchange systems, and foundations—risks associated with this pathway were not quantitatively evaluated in the HHRA. Based on the elevated VOC concentrations detected in the shallow groundwater, it is assumed that vapor intrusion from the shallow groundwater into indoor air would pose unacceptable risks to future residents and industrial workers under the right building conditions.

5.2 Ecological Risk Summary

An ERA was completed to evaluate potential ecological risks from current ecological receptor exposure to soil, sediment (including sediment pore water), and surface water. There is no complete pathway for ecological receptor exposure to groundwater. Terrestrial, aquatic, and wildlife receptors were evaluated.

Terrestrial Receptors

Terrestrial plants (e.g., maple tree) and soil invertebrates (e.g., earthworms) could be exposed to constituents in Site 2 soil. Potential risks to terrestrial plants and soil invertebrates were identified based on the presence of several PAHs, pesticides, inorganics, and one PCB (Aroclor 1260) in surface soil.

Aquatic Receptors

Several pathways were identified by which aquatic life could be exposed to contaminants in the Site 2 inlet. **Benthic**-dwelling organisms (e.g., fiddler crab) can be exposed to constituents directly associated with sediment particles, or to constituents in groundwater (primarily

What is Human Health Risk and How is it Calculated?

A human health risk assessment estimates the "baseline risk." This is an estimate of the likelihood of health problems occurring if no cleanup action were taken at a site. To estimate the baseline risk at a site, the Navy performs the following four-step process:

Step 1: Analyze contamination

Step 2: Estimate exposure

Step 3: Assess potential health dangers

Step 4: Characterize site risk

In Step 1, the Navy looks at the concentrations of contaminants found at a site as well as past scientific studies on the effects these contaminants have had on people (or animals, when human studies are unavailable). Comparisons between site-specific concentrations and concentrations reported in past studies help the Navy to identify the contaminants most likely to pose the greatest threat to human health.

In Step 2, the Navy considers the different ways that people might be exposed to the contaminants identified in Step 1, the concentrations that people might be exposed to, and the potential frequency (how often) and length of exposure. Using this information, the Navy calculates an RME scenario that portrays the highest level of human exposure that could reasonably be expected to occur and a CTE scenario based on more realistic exposure durations.

In Step 3, the Navy uses the information from Step 2, combined with information on the toxicity of each chemical, to assess potential health risks. The Navy considers two types of risk: (1) cancer and (2) non-cancer. The likelihood of any kind of cancer resulting from a contaminated site is generally expressed as an upper-bound probability, for example, a "1 in 10,000 chance." In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than normally would be expected to from all other causes. For non-cancer health effects, the Navy calculates a "hazard index." The hazard index represents the ratio between the "reference dose," the dosage at which no adverse health effects are expected to occur, and the RME (see Step 2), the estimated maximum exposure level for a given category of individuals coming into contact with contaminants at the site. The key concept is that a "threshold level" (measured usually as a hazard index of less than 1) exists, below which noncancer health effects are no longer predicted to occur.

In Step 4, the Navy analyzes whether a site's risks are great enough to cause health problems for people at or near the site. The results of the three previous steps are combined, evaluated, and summarized. The Navy adds up the potential risks from the individual contaminants and exposure pathways and calculates a total site risk.

chlorinated VOCs) as groundwater discharges through sediment into the surface water body (sediment pore water). Potential risks to benthic-dwelling organisms in the Site 2 inlet were identified based on the presence of PAHs, pesticides, PCBs, and inorganics in inlet sediment. Limited potential for chlorinated VOCs to adversely affect benthic-dwelling organisms was identified. Chlorinated VOCs were detected in sediment pore water along the western branch of the inlet; however, the highest concentrations were detected in the portion of the branch serving as a drainage ditch that only periodically contains water, making it a poor habitat for benthic-dwelling organisms. Potential risks to benthic-dwelling organisms in St. Juliens Creek were identified at a localized area at the outfall of the culvert from Site 2 based on the presence of PAHs and inorganics.

Water-column-dwelling aquatic life (e.g., fish) could be exposed to constituents in surface water from surface runoff and following discharge of groundwater. Limited potential risks to water column-dwelling aquatic life ~~was~~ identified as attributable to inorganics and VOCs in Site 2 surface water.

Wildlife Receptors

Food web modeling was conducted to evaluate potential risk to wildlife. Potential risks to **avian vermivores** (e.g., American woodcock) and reptiles from lead, zinc, and 4,4′-DDE in soil as well as potential risks to **avian piscivores** (e.g., belted kingfisher) and reptiles from mercury in sediment were identified.

Carbon disulfide, arsenic, mercury, and vanadium were identified as posing potential ecological risk in sediment and/or surface water; however, the risks are considered minimal or not site-related based on the following:

- Carbon disulfide
  - 40 to 80 percent of carbon disulfide released to the enironment is a result of natural or biological activity. Production of carbon disulfide from soil and plants occurs naturally from the metabolism of soil bacteria and plants during the growing season. Soil, marshes, and coastal regions tend to be some of the most biologically active habitats. Carbon disulfide released is rapidly metabolized by organisms and therefore does not build up in organism tissues or get carried or increase through the food chain.
- Arsenic
  - The mean hazard quotient (HQ) for the site (1.19) was only slightly above the acceptable HQ value of 1
  - Concentrations are below background levels
- Mercury
  - Concentrations are below background levels and consistent with levels detected in urbanized soil and sediment
- Vanadium
  - The mean HQ (1.01) is at the target HQ of 1, and therefore does not pose a risk.

What is Ecological Risk and How is it Calculated?

An ERA is concep-tually similar to an HHRA except that it evaluates the potential risks and impacts to ecological receptors (plants, animals other than humans and domesticated species, habitats [such as wetlands], and communities [groups of interacting plant and animal species]). ERAs are conducted using a tiered, step-wise process (as outlined in Navy and EPA ERA policy and/or guidance) and are punctuated with Scientific Management Decision Points (SMDPs). SMDPs represent points in the ERA process where agreement among stakeholders on conclusions, actions, or methodologies is needed so that the ERA process can continue (or terminate) in a technically defensible manner. The results of the ERA at a particular SMDP are used to determine how the ERA process should proceed— for example, to the next step in the process or directly to a later step. The process continues until a final decision has been reached (i.e., remedial action if unacceptable risks are identified, or no further action if risks are acceptable). The process can also be iterative if data needs are identified at any step; the needed data are collected and the process starts again at the point appropriate to the type of data collected.

An ERA has three principal components:

1. Problem Formulation establishes the goals, scope, and focus of the ERA and includes:
   - Compiling and reviewing existing information on the habitats, plants, and animals that are present on or near the site.
   - Identifying and evaluating area(s) where site-related chemicals may be found (source areas) and at what concentrations.
   - Evaluating potential movement (transport) of chemicals in the environment.
   - Identifying possible exposure media (soil, air, water, sediment).
   - Evaluating if/how the plants and animals may be exposed (exposure pathways).
   - Evaluating routes of exposure (for example, ingestion).
   - Identifying specific receptors (plants and animals) that could be exposed.
   - Specifying how the risk will be measured (assessment and measurement endpoints) for all complete exposure pathways.
2. Risk Analysis:
   - Exposure Estimate - An estimate of potential exposures (concentrations of chemicals in applicable media, such as soil) to plants and animals (receptors). This includes direct exposures to lower trophic level receptors (organisms low on the food chain, such as plants and insects) and upper trophic level receptors (organisms higher on the food chain, such as birds and mammals), and indirect exposures (exposures via the food chain) for upper trophic level receptors.
   - Effects Assessment - The levels of concentrations of chemicals at which an adverse effect may occur are identified.
3. Risk Calculation or Characterization:
   - The information developed in the first two components is used to estimate the potential risk to plants and/or animals by comparing the exposure estimates with the effects thresholds.
   - Uncertainties (potential degree of error) associated with the predicted risk estimate and their effects on the conclusions that have been made are evaluated.

The three principal components of an ERA are implemented within the framework of an 8-step, 3-tiered process as follows:

1. Screening-Level ERA (Steps 1-2; Tier 1) – The SLERA is an assessment of ecological risk using the three components described above and very conservative assumptions (such as using maximum chemical concentrations).
2. Baseline ERA (Steps 3-7; Tier 2) – If potential risks are identified in the SLERA, a BERA is typically conducted. The BERA is a re-iteration of the three components described above but uses more site-specific and realistic exposure assumptions, as well as additional methods not included in the SLERA, such as consideration of background concentrations. The BERA may also include the collection of site-specific data (such as measuring the concentrations of chemicals in the tissues of organisms, such as fish) to address key risk issues identified in the SLERA.
3. Risk Management (Step 8; Tier 3) – Step 8 develops recommendations on ways to address any unacceptable ecological risks that are identified in the BERA and may also include other activities such as evaluating remedial alternatives.

6 Remedial Action Objectives

The Navy, EPA, and VDEQ concluded that remedial action is necessary to protect public health, welfare, and the environment from actual or threatened releases of hazardous substances in soil, shallow groundwater, sediment, and surface water at Site 2. Site-specific **Remedial Action Objectives (RAOs)** are as follows:

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

Shallow groundwater (including residual DNAPL):

- Reduce contaminant source mass to the maximum extent practicable
- Prevent activities that might cause migration of chlorinated VOCs in the Columbia aquifer to the underlying Yorktown aquifer
- Prevent chlorinated VOC migration from the shallow groundwater to surface water and sediment
- Reduce chlorinated VOC concentrations in shallow groundwater to the maximum extent practicable and maintain LUCs until concentrations allow for unlimited use and unrestricted exposure

Surface water:

- Minimize degradation of surface water through source control in shallow groundwater, waste, surface soil, and sediment

Human health preliminary remediation goals (PRGs), listed in Table 4, were developed for constituents with concentrations contributing to unacceptable risks and hazards in soil, sediment, and shallow groundwater at Site 2. Ecological PRGs were developed for constituents with concentrations contributing to unacceptable risks in soil and sediment at Site 2 and sediment within St. Juliens Creek. In instances where both a human health and ecological PRG were developed, the more-conservative value was used in determining the need for remediation. No PRGs were established for surface water and sediment pore water because remediation of the soil, sediment, and shallow groundwater is expected to address these media.

6.1 Human Health Preliminary Remediation Goals

Human health PRGs for Site 2 soil and sediment COCs were established for each medium as the greater of a calculated risk-based concentration and background value (soil or sediment) for each COC. Human health PRGs for Site 2 shallow groundwater were established as the MCLs for each groundwater COC for which an MCL exists. For the only shallow groundwater COC without an MCL (naphthalene), the human health PRG was established as the greater of a calculated risk-based concentration and background value for SJCA shallow groundwater. MCLs were used for the establishment of the PRGs because although the Columbia aquifer is not currently used, and is not expected to be used, as a potable or industrial water supply, the VDEQ groundwater antidegradation policy requires that all groundwater be restored to beneficial use (e.g., drinking water).

6.2 Ecological Preliminary Remediation Goals

Ecological PRGs for Site 2 soil were established as the greater of ecological literature-based toxicity screening values and SJCA background data for each soil COC. Ecological PRGs for Site 2 sediment were established as the highest of the literature-based toxicity screening value, site-specific sediment bioassay result, and SJCA sediment background value for each COC. Ecological PRGs for St. Juliens Creek sediment were established as the highest of the literature-based toxicity screening value, site-specific sediment bioassay result, and St. Juliens Creek sediment reference value for each Site 2 sediment COC. Ecological PRGs are provided in Table 5.

Chemical	PRG
Soil (mg/kg)	
Antimony	26.4
Iron	53,529
Lead	400*
Vanadium	72
Sediment (mg/kg)	
Chromium	53
Groundwater (µg/L)	
1,1,2-Trichloroethane	5
1,1-Dichloroethene	7
Tetrachloroethene	5
Trichloroethene	5
cis-1,2-Dichloroethene	70
Chloroform	80
Methylene chloride	5
trans-1,2-Dichloroethene	100
Vinyl chloride	2
Naphthalene	170
Heptachlor Epoxide	0.2
*Average site-wide concentration mg/kg= milligrams per kilogram µg/L = micrograms per liter	

Table 4 – Human Health PRGs

Chemical	PRG	Chemical	PRG	Chemical	PRG
Surface Soil		**Site 2 Sediment**		**St. Juliens Creek Sediment**	
Inorganics (mg/kg)		**Inorganics (mg/kg)**		**Inorganics (mg/kg)**	
Aluminum	7,669	Barium	121	Barium	121
Copper	70	Cadmium	10.9	Cadmium	10.9
Iron	3,669	Chromium	260	Chromium	260
Lead	120	Copper	421	Copper	421
Vanadium	26.6	Cyanide	0.1	Cyanide	0.67
Zinc	38	Lead	351	Lead	351
Pesticides/PCB (µg/kg)		Nickel	44	Nickel	44
4,4-DDD	100	Zinc	758	Zinc	758
4,4-DDE	532	**Pesticides/PCBs (µg/kg)**		**Pesticides/PCBs (µg/kg)**	
4,4-DDT	237	Aroclor-1254	22.7	Aroclor-1254	22.7
Aroclor-1260	100	Aroclor-1260	22.7	Aroclor-1260	22.7
SVOCs (µg/kg)		Alpha-Chlordane	9.1	Alpha-Chlordane	9.1
Acenaphthene	29,000	Gamma-Chlordane	9.7	Gamma-Chlordane	9.7
Acenaphthylene	29,000	Dieldrin	2.9	Dieldrin	2.9
Anthracene	29,000	**SVOCs (µg/kg)**		**SVOCs (µg/kg)**	
Benzo(a)anthracene	1,000	2-Methylnaphthalene	70	2-Methylnaphthalene	70
Benzo(a)pryene	1,100	Acenaphthene	292	Acenaphthene	292
Benzo(b)fluoranthene	1,100	Anthracene	332	Anthracene	492
Benzo(g,h,i)perylene	1,100	Benzo(a)anthracene	749	Benzo(a)anthracene	1,300
Benzo(k)fluoranthene	1,100	Benzo(a)pryene	732	Benzo(a)pryene	1,000
Chrysene	1,100	Benzo(g,h,i)perylene	670	Benzo(g,h,i)perylene	672
Dibenz(a,h)anthracene	1,100	Benzo(k)fluoranthene	467	Benzo(k)fluoranthene	1,400
Fluoranthene	1,100	Chrysene	986	Chrysene	1,500
Flourene	29,100	Dibenz(a,h)anthracene	292	Dibenz(a,h)anthracene	410
Indeno(1,2,3-cd)pyrene	29,000	Diethylphehalate	200	Diethylphehalate	608
Naphthalene	1,100	Fluoranthene	2,500	Fluoranthene	2,600
Phenanthrene	29,000	Flourene	292	Flourene	292
Pyrene	1,100	Indeno(1,2,3-cd)pyrene	600	Indeno(1,2,3-cd)pyrene	624
		Naphthalene	292	Naphthalene	292
		Phenanthrene	376	Phenanthrene	920
		Pyrene	1,905	Pyrene	1,905
µg/kg = micrograms per kilogram					

Table 5 – Ecological PRGs

7 Summary of Remedial Alternatives

Remedial alternatives developed and evaluated to address waste, soil, shallow groundwater, sediment, and surface water at Site 2 are detailed in the FS. Remedial alternatives were developed by combining process options. To avoid evaluating an unmanageable number of alternatives, only the most logistically and technically sensible combinations for the given site conditions were carried forward. The screening of remedial technologies identified eight alternatives for detailed evaluation and comparative analysis. These alternatives are listed in Table 6.

Alternative	Site 2 Waste, Soil, and Sediment Area	St. Juliens Creek Sediment Area	High-Concentration Target Area*	Low-Concentration Target Area*	Naphthalene Target Area*	Heptachlor Epoxide Target Area*
1	No Action	No Action	No Action	No Action	No Action	No Action
2	Cover and LUCs	Excavation	MNA	MNA	MNA	MNA
3	Cover and LUCs	Excavation	Sheet Pile	MNA	MNA	MNA
4	Cover and LUCs	Excavation	ERD	MNA	MNA	MNA
5	Cover and LUCs	Excavation	ERD	ERD	MNA	MNA
6	Cover and LUCs	Excavation	Funnel and Gate	MNA	MNA	MNA
7	Cover and LUCs	Excavation	Excavation	MNA	MNA	MNA
8	Cover and LUCs	Excavation	Excavation	ERD	MNA	MNA

*Alternatives 2 through 8 include the implementation and maintenance of LUCs to prevent exposure to contaminants in groundwater until concentrations are reduced to a level that allows for unlimited use and unrestricted exposure to groundwater.

Table 6 – Remedial Alternatives

Details for each of the remedial alternative components are provided in Table 7.

Component	Details
Cover	Install a soil cover over the waste and contaminated soil and inlet sediment to prevent direct exposure to the contaminated media.
LUCs (waste, soil, and sediment)	Implement and maintain LUCs to maintain the cover and prevent exposure to waste and contaminants in soil and inlet sediment.
Excavation (St. Juliens Creek sediment)	Remove contaminated sediment from St. Juliens Creek to prevent direct exposure to contaminated sediment.
MNA (high-concentration target area)	Allow chlorinated VOCs in the high-concentration target area to break down naturally over time and implement a monitoring plan to confirm the continued breakdown.
Sheet Pile	Install impermeable sheet pile barrier around high-concentration target area to create a hydraulic barrier, preventing downgradient migration of chlorinated VOCs to low-concentration target area.
ERD (high-concentration target area)	Inject a substrate to create reducing conditions and produce electron donors to directly treat the high-concentration target area through ERD of chlorinated VOCs.
Funnel and Gate	Install impermeable sheet pile barriers sidegradient of the high-concentration target area to act as funnel and direct chlorinated VOC-contaminated groundwater through a treatment (ERD) zone.
Excavation (high-concentration target area)	Remove waste, contaminated soil and sediment, and all of the saturated soil (potentially containing DNAPL) from within the high-concentration area to prevent direct exposure to select areas of contaminated soil and inlet sediment and reduce contaminant source mass.
MNA (low-concentration target area)	Allow chlorinated VOCs in the low-concentration target area to break down naturally over time and implement a monitoring plan to confirm the continued breakdown.
ERD (low-concentration target area)	Inject a substrate to create reducing conditions and produce electron donors to directly treat the high- and low-concentration target area through ERD of chlorinated VOCs.
MNA (naphthalene and heptachlor epoxide)	Allow naphthalene and heptachlor epoxide to break down naturally over time and implement a monitoring plan to confirm the continued breakdown.
LUCs (groundwater)	Implement and maintain LUCs to prevent exposure to groundwater until conditions allow for unlimited use and unrestricted exposure.

Table 7 – Remedial Alternative Component Details

In addition to the remedial alternatives for each component, a passive reactive barrier contingency has been developed independently for addition to any of the alternatives. The remedial alternative areas are shown on Figure 6.

Figure 6 – Remedial Alternative Areas

8 Evaluation of Alternatives

The NCP identifies the nine evaluation criteria used in a comparative analysis of alternatives (Table 8). Each remedial alternative for Site 2 was evaluated against these criteria during the FS. The threshold criteria and primary balancing criteria associated with the eight alternatives evaluated for Site 2 are illustrated in Table 9. Alternative 1 is required by the NCP and serves as the baseline against which the other alternatives are compared. Alternative 1 does not achieve the threshold criteria and is therefore not discussed in detail in the following sections.

8.1 Threshold Criteria

Alternative 1 (no action) does not achieve RAOs and was not evaluated further. All other alternatives are protective of human health and the environment. Each alternative results in contamination remaining in place; however, performance monitoring will be conducted to confirm that the remedies are functioning and protective and LUCs (e.g., land use restrictions, signage) will be implemented and maintained to provide adequate protection of human health and the environment by controlling exposure to contaminated site media until the RAOs are met and while waste remains in place. All alternatives except Alternative 1 are also expected to comply with the ARARs.

CERCLA Criteria	Definition
Threshold Criteria	
Protection of human health and the environment	Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through mitigation, engineering controls, or institutional controls.
Compliance with **Applicable Relevant and Appropriate Requirements (ARARs)**	Addresses whether a remedy will meet all of the ARARs of other federal and state environmental laws and/or justifies a waiver of the requirements.
Primary Balancing Criteria	
Long-term effectiveness and permanence	Addresses the expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.
Reduction in toxicity, mobility, or volume through treatment	Discusses the anticipated performance of the treatment technologies a remedy may employ.
Short-term effectiveness	Considers the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.
Implementability	Evaluates the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement an option.
Present-worth cost	Compares the estimated initial, operations and maintenance, and present-worth costs.
Modifying Criteria	
State acceptance	Considers the state support agency comments on the Proposed Plan.
Community acceptance	Provides the public's general response to the alternatives described in the Proposed Plan, RI report, and FS report. The specific responses to the public comments are addressed in the "Responsiveness Summary" section of the ROD.

Table 8 – Evaluation Criteria for Comparatie Analysis of Alternatives

CERCLA Criteria	Alternatives 1	2	3	4	5	6	7	8
Threshold Criteria								
Protection of Human Health and the Environment	○	●	●	●	●	●	●	●
Compliance with ARARs	○	●	●	●	●	●	●	●
Primary Balancing Criteria								
Long-term Effectiveness and Permanence	○	●	◐	●	●	◐	●	●
Reduction in Toxicity, Mobility, or Volume Through Treatment	○	○	○	◐	●	◔	○	◔
Short-Term Effectiveness	◐	◐	◔	◐	◐	◔	◔	◔
Implementability	◔	●	◐	●	●	◐	◐	◐
Present-Worth Cost	●	●	●	◐	◔	◐	○	○

Relative Ranking: High ● ◐ ◔ ○ Low

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria.

Table 9 – Relative Ranking of Alternatives

8.2 Primary Balancing Criteria

Each of the alternatives, with the exception of Alternative 1, is expected to achieve long-term effectiveness and permanence once RAOs are met. Alternatives 2, 4, 5, 7, and 8 have similar levels of long-term effectiveness. Although the residual risks for all of the alternatives are anticipated at relatively the same magnitude, Alternatives 7 and 8 rated slightly higher because they may result in slightly lower residual risk because of the excavation and offsite disposal of the area with the highest contaminant concentrations. With proper engineering, planning, and implementation, controls can be put in place to monitor all the alternatives effectively and to verify continued compliance with RAOs. LUCs will need to be continually enforced until the RAOs are achieved and while waste remains in place. Alternatives 3 and 6 have a lower level of confidence because of their reliance on containment, the potential for failure over time, and the need for replacement or maintenance.

Alternatives 4, 5, 6, and 8 each reduce toxicity, mobility, and volume through treatment. Alternative 5 provides active treatment the largest areas of the site by implementing ERD throughout the high- and low-concentration target areas and therefore is rated the highest. Alternative 4 is rated slightly lower than Alternative 5 in this evaluation criteria because it employs active treatment in the smaller high-concentration target area only. Alternative 6 provides treatment in the gate but relies on the migration of the contamination to the treatment area. Alternative 8 only provides treatment in the comparatively small low-concentration area with ERD. Treatment is not a component of Alternatives 2, 3, or 7.

Alternatives 1, 2, 4, and 5 have the highest level of short-term effectiveness. Alternative 1 receives a high rating because it does not include an action that could adversely affect the community, workers, or environment through implementation. Alternatives 2, 4, and 5 have similar levels of short-term effectiveness. Alternative 2 poses the lowest risk during implementation whereas Alternatives 4 and 5 pose slightly higher risks to workers due to the addition of handling groundwater treatment materials. Alternatives 4 and 5 have higher short-term effectiveness than Alternative 2 as a result of the shortest timeframe for achieving RAOs through active shallow groundwater treatment, with Alternative 5 having the shortest timeframe through treatment of the largest area. Alternatives 3 and 6 have similar impacts on the community and risks to workers during implementation as Alternatives 4 and 5; however, rated slightly lower because they will require a longer timeframe to achieve the RAOs because of their reliance on natural degradation or groundwater flow to carry the contamination to a treatment area. Under each of these alternatives (2, 3, 4, 5, and 6), protection of the community and workers is possible through proper engineering and implementation. When implementation of the cover would result in a permanent loss of the existing wetland, the loss would be offset through a compensatory wetland mitigation. Alternatives 7 and 8 have the lowest level of short-term effectiveness because of the significant intrusiveness involved with their implementation in order to excavate the waste, sediment, and saturated soil within the high-concentration target area and associated potential risk of exposure to site contaminants.

The levels of implementability of Alternatives 4 and 5 are the highest because their technologies are readily available, reliable, able to be monitored for effectiveness, and can be followed by other remedial actions, if necessary. Of the two alternatives, the implementability of Alternative 5 is higher because it involves using a common, dependable technology (ERD) over the largest area, making it a more reliable alternative. Alternative 4 has a slightly lower implementability because its treatment area is smaller. Alternative 2 has a lower level of implementabilty than Alternatives 4 and 5 because it uses a less reliable technology. Alternatives 3, 6, 7, and 8 have similarly lower levels of implementability. Alternatives 3 and 6 have lower implementability because they use technology in a newer, less frequently used application that lacks proven effectiveness. The implementability of Alternatives 7 and 8 is low because they require significant deep excavation, most of which will be conducted below the water table, and will require significant engineering controls.

The costs associated with each of the alternatives is presented in Table 10, including the capital cost, operation and maintenance (O&M) present value, and total present value. The least expensive alternative is Alternative 2, with an estimated total present value of $2.4 million. The total present value increases sequentially with Alternative 3, 6, 4, 5, 7, and 8, with a highest present value of $28.8 million. Alternative 2 also has the lowest total capital cost, estimated at $1.3 million. The capital cost increases sequentially with Alternatives 4, 3, 6, 5, 7, and 8, with the highest total capital cost of $24.4 million. The cost varies significantly with the intrusiveness of the remedy. The alternatives relying on natural attenuation have the lowest associated costs, while the alternatives that require significant excavation and offsite disposal have significantly higher costs.

	Alternatives							
	1	2	3	4	5	6	7	8
Capital Cost	$0	$1.3M	$3.0M	$2.2M	$3.7M	$3.3M	$22.9M	$24.4M
O&M Present Value Cost	$0	$1.1M	$1.0M	$3.6M	$7.5M	$1.8M	$1.0M	$5.0M
Total Present Value	$0	$2.4M	$4.0M	$5.7M	$11.2M	$5.1M	$23.9M	$28.8M

Table 10 – Cost Summary

8.3 Modifying Criteria

State involvement has been solicited throughout the CERCLA process and proposed remedy selection. Final concurrence on the selected remedy will be solicited from the Commonwealth of Virginia following the review of all comments received during the public comment period. Community acceptance will be evaluated after the public comment period for the Proposed Plan.

9 Preferred Alternative

Based on the comparative analysis, the Preferred Alternative is Alternative 4 (Figure 8), consisting of cover (waste and soil), excavation (St. Juliens Creek sediment), ERD (high-concentration target areas), and MNA (low-concentration, naphthalene, and heptachlor epoxide target areas). This alternative is recommended because it significantly reduces the toxicity, mobility, and volume of COCs through active treatment in the high-concentration target area, it can be effectively implemented using readily available engineering and construction practices, and it achieves both short-term and long-term effectiveness at a moderate cost.

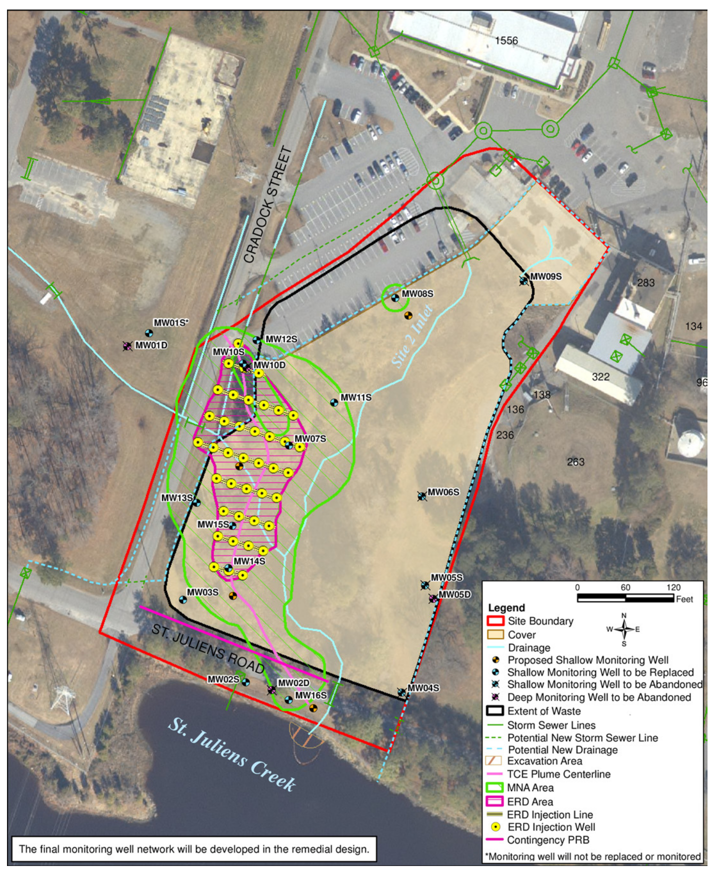


Figure 7 – Conceptual Overview of Alternative 4

As a comparison, all alternatives except for Alternative 1 comply with ARARs and provide overall protection to the environment. However, Alternatives 2, 3, and 7 do not significantly reduce the toxicity, mobility, and volume of COCs through active treatment, but rather depend upon natural attenuation of COCs. Alternatives 4 and 5 both achieve short-term and long-term effectiveness, reduce toxicity, mobility, and volume through active treatment, and are highly implementable. Alternative 5 rates slightly higher than Alternative 4 because it employs active treatment over a larger area and will result in a shorter timeframe to achieve the RAOs. However, the benefit is marginal and Alternative 5 is significantly more expensive than Alternative 4. Alternative 6 is less effective than Alternatives 4 and 5 at reducing the toxicity, mobility, and volume of COCs and is more difficult to implement because of additional technological requirements for constructing the funnel and gate system. Alternatives 7 and 8 are ranked low because they are less effective than Alternatives 4 and 5 at reducing toxicity, mobility, and volume of COCs, pose a higher risk to construction workers during implementation from the handling of and potential exposure to site COCs and MEC hazards, and have significantly higher costs than the other alternatives.

Shallow groundwater will be monitored to assess the effectiveness of the selected alternative and changes in the concentration, and location of the groundwater plume. LUCs, including institutional controls and cover inspections, will be implemented and maintained to prevent human exposure to waste and COCs in soil and sediment. Additionally, LUCs will be implemented to prohibit the withdrawal of groundwater except for environmental monitoring within the boundaries of Site 2 until the concentrations of COCs in the groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure. The need for groundwater LUCs to prevent exposure and ensure protection will be periodically reassessed as COC concentrations are reduced over time. As required by CERCLA, 5-year reviews will be conducted to assess the effectiveness of the remedy.

Based on information currently available, the Navy believes the Preferred Alternative (Alternative 4) meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The Navy expects the Preferred Alternative to satisfy the statutory requirements of CERCLA Section 121 (b): (1) protection of human health and the environment, (2) compliance with ARARs, (3) cost-effectiveness, (4) use of permanent solutions and alternative treatment technologies to the maximum extent practicable, and (5) the preference for treatment as a principal element. The Preferred Alternative will be reevaluated as appropriate in response to public comment or new information.

During the comment period, interested parties may submit written comments to the following individuals:

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NAVFAC MIDLANT OPHE3
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Building N-26, Room 3300
Norfolk, Virginia 23511-3095
Phone: (757) 445-6638
Fax: (757) 444-3000
Email – walt.j.bell@navy.mil

For further information, please contact:

Mr. Robert Stroud
US EPA (Region III)
1650 Arch Street
Philadelphia, PA 19103
Phone: (410)305-2748
Fax: (410)305-3096
Email – stroud.robert@.epa.gov

Ms. Karen Doran
Virginia Dept. of Environmental Quality
629 East Main Street
Richmond, VA 23219
Phone: (804) 698-4594
~~Fax : (804) 698-4234~~
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10 Community Participation

The Navy and EPA provide information regarding environmental cleanups at SJCA to the public through the Restoration Advisory Board, public meetings, the Administrative Record for the site, the information repository, and announcements published in The Virginian-Pilot newspaper. The public is encouraged to gain a more comprehensive understanding of Site 2 and the ERP. The public comment period for this Proposed Plan is from March 20, 2010~~,~~ through May 4, 2010; a public meeting will be held on April 6, ~~2020~~, at 5:00 p.m. (see page 1 of this report for details). Minutes of the public meeting will be included in the Administrative Record file. The Navy will summarize and respond to comments in a responsiveness summary, which will become part of the official ROD and the Administrative Record file.

Glossary of Terms

This glossary defines in non-technical language the more commonly used environmental terms appearing in this Proposed Plan. The definitions do not constitute the Navy's, EPA's, or VDEQ's official use of terms and phrases for regulatory purposes, and nothing in this glossary should be construed to alter or supplant any other federal or Commonwealth document. Official terminology may be found in the laws and related regulations as published in such sources as the Congressional Record, Federal Register, and elsewhere.

Administrative Record: A compilation of site-related information for public review.

Advection: Transportation of contaminants via horizontal movement.

Applicable or Relevant and Appropriate Requirements (ARARs): These are federal or state environmental rules and regulations.

Aquifer: Underground bed of soil or rock from which groundwater can be usefully extracted.

Avian piscivore: Fish-eating bird.

Avian vermivore: Insect- or worm-eating bird.

Background: Constituents or locations that are not influenced by the releases from a site, and usually described as naturally occurring or anthropogenic. Naturally occurring are substances present in the environment that have not been influenced by human activity. Anthropogenic are natural- and human-made substances present in the environment as a result of human activities (not specifically related to the CERCLA release in question).

Benthic: Organisms living on the floor of a water body.

Cancer risk: Cancer risks are expressed as a number reflecting the increased chance that a person will develop cancer if exposed to chemicals or substances. For example, EPA's acceptable risk range for Superfund sites is 1 × 10-4 to 1 × 10-6, meaning there is 1 additional chance in 10,000 (1 × 10-4) to 1 additional chance in 1 million (1 × 10-6) that a person will develop cancer if exposed to a site that is not remediated.

Central tendency exposure (CTE): The mean concentration of site data, used as an exposure concentration in the risk assessment.

Chlorinated volatile organic compound: Manufactured chemical that evaporates easily and is typically used in manufacturing as industrial chlorinated solvents, such as degreasers. See also "volatile organic compound."

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA): A federal law, commonly referred to as the "Superfund" Program, that provides for cleanup and emergency response in connection with numerous existing inactive hazardous waste disposal sites that endanger public health and safety or the environment.

Conceptual site model: A description of a site and its environment that is based on existing knowledge and that assists in planning, interpreting data, and communicating. It describes sources of contamination (e.g., spills) and receptors (e.g., humans) and the interactions that link the two.

Contaminants of concern (COCs): A contaminant that is deemed to pose unacceptable risks or hazards to receptors at the site.

Contaminant migration pathway: The route that site contaminants may take to get from the source of contamination to a human being, animal, or plant.

Dense non–aqueous phase liquid. See "Non–aqueous phase liquid."

Diffusion: Movement of contaminants from a region of higher concentration to lower.

Dissolution: The act of separating components by parts, or dissolving.

Ecological Risk Assessment (ERA): An evaluation of the risk posed to the environment if remedial activities are not performed at the site.

Enhanced reductive dechloronation (ERD): An anaerobic (i.e., without oxygen) process in which an electron donor source is injected into the subsurface to allow chlorine atoms on a parent chlorinated VOC molecule to be sequentially replaced with hydrogen and break down COCs.

Environmental Restoration Program (ERP): The Navy, as lead agency, acts in partnership with EPA and VDEQ to address environmental investigations at naval facilities in Virginia through the ERP. The current ERP is consistent with CERCLA and applicable state environmental laws.

Feasibility Study (FS): Analysis of the practicability of a remedial proposal, supported by data and risk assessment, to allow decision makers to select the most appropriate site remedy.

Groundwater: Subsurface water that occurs in soils and in geologic formations that are fully saturated.

Hazard index (HI): A number indicative of non-cancer health effects that is the ratio of the existing level of exposure to an acceptable level of exposure. A value equal to or less than 1 indicates that the human population is not likely to experience adverse effects.

Hazard Quotient (HQ): Hazard quotients are used to evaluate non-carcinogenic health effects and ecological risks. The HQ is the ratio of the existing level of exposure for a single chemical to an acceptable level of exposure for that chemical. A value equal to or less than 1 indicates that the human or ecological population is not likely to experience adverse effects from exposure to that chemical.

Human Health Risk Assessment (HHRA): An evaluation of the risk posed to human health if remedial activities are not implemented.

Information Repository: A file containing information, technical reports, and reference documents regarding an NPL (defined below) site. This file is usually maintained at a location with easy public access, such as a public library.

Inorganics: Compounds that do not consist of hydrocarbons or their derivatives.

Land use controls (LUCs): Physical, legal, or administrative methods that restrict the use of or limits access to property to reduce risks to human health and the environment.

Maximum contaminant level (MCL): The maximum permissible level of a contaminant in water delivered to any user of a public system. MCLs are enforceable standards under the Safe Drinking Water Act.

Media (singular, medium): Soil, groundwater, surface water, or sediments at the site.

Munitions and explosives of concern (MEC): A military munitions or explosive that poses an explosive hazard. MEC may include discarded military munitions, unexploded ordnance, and/or munitions constituents.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): Provides the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

National Priorities List (NPL): A list, developed by EPA, of uncontrolled hazardous substance release sites in the United States that are considered priorities for long-term remedial evaluation and response.

Natural attenuation: Reduction in mass or concentration of a constituent over time or distance from the source due to naturally occurring physical, chemical, and biological processes.

Naval Facilities Engineering Command (NAVFAC): Global organization that provides planning, design, and construction of shore facilities for U.S. Navy activities around the world.

Non–aqueous phase liquid (NAPL): A liquid that does not dissolve or mix easily in water. A dense non–aqueous phase liquid (DNAPL) is a NAPL that is denser than water.

Non-cancer hazard: Non-cancer hazards are expressed as a quotient that compares the existing level of exposure to the acceptable level of exposure. There is a level of exposure (the reference dose) below which it is unlikely for even a sensitive population to experience adverse health effects. EPA's threshold level for non-cancer hazard at Superfund sites is 1, meaning that if the exposure exceeds the threshold, there may be a concern for potential non-cancer effects.

Ordnance: Military supplies including weapons, ammunition, combat vehicles, and maintenance tools and equipment.

Organics: Constituents consisting of or relating to a carbon compound.

Plume: A space in air, water, or soil containing pollutants released from a point source.

Polycyclic aromatic hydrocarbon (PAH): Any of a class of carcinogenic organic molecules that consists of three or more benzene rings that are commonly produced by fossil fuel combustion.

Polychlorinated biphenyl (PCB): A type of industrial compound, such as lubricants, heat-transfer fluids, and plasticizers, that accumulates in animal tissue and results in adverse health conditions. PCBs are especially deadly to fish and invertebrates, and stay in the food chain for many years. The manufacture and use of PCBs has been restricted since the 1970s because they are very harmful to the environment.

Potable: Safe for drinking.

Proposed Plan: A document that presents and requests public input regarding the proposed cleanup alternative.

Public comment period: The time allowed for the members of an affected community to express views and concerns regarding an action proposed to be taken by the Navy and EPA, such as a rulemaking, permit, or Superfund-remedy selection.

Receptor: Humans, animals, or plants that may be exposed to risks from contaminants related to a given site.

Record of Decision (ROD): A legal document that describes the cleanup action or remedy selected for a site, the basis for choosing that remedy, and public comment on alternative remedies.

Remedial Action Objectives (RAOs): Objectives that are developed based on contaminated media, COCs, potential receptors and exposure scenarios, human health and ecological risk assessment, and attainment of regulatory cleanup levels, if any exist.

Remedial action: A cleanup method proposed or selected to address contaminants at a site.

Remedial Investigation (RI): A study of a facility that supports the selection of a remedy where hazardous substances have been disposed or released. The RI identifies the nature and extent of contamination at the facility.

Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment (RI/HHRA/ERA): See "Remedial Investigation", "Human Health Risk Assessment", and "Ecological Risk Assessment".

Reasonable maximum exposure (RME): The highest level of site chemical concentrations a human can reasonably be exposed to under different exposure scenarios.

Sediment pore water: Water filling the spaces between grains of sediment.

Semivolatile organic compound (SVOC): Manufactured chemical that does not evaporate as easily as a VOC and is typically used in manufacturing materials such as adhesives and preservatives.

Site: The area of the facility where a hazardous substance, hazardous waste, hazardous constituent, pollutant, or contaminant from the facility has been deposited, stored, disposed of, or placed; has migrated; or otherwise come to be located.

Site Management Plan: Annual document generated in accordance with a Federal Facility Agreement that provides a 5-year plan for CERCLA ERP activities.

Source material: Material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, to surface water, to air, or acts as a source for direct exposure.

Trichloroethene (TCE): VOC typically used as a solvent in industrial applications.

U.S. Environmental Protection Agency (EPA): The federal agency responsible for administration and enforcement of CERCLA (and other environmental statutes and regulations), and with final approval authority for the selected remedy.

Virginia Department of Environmental Quality (VDEQ): The Commonwealth agency responsible for administration and enforcement of environmental regulations.

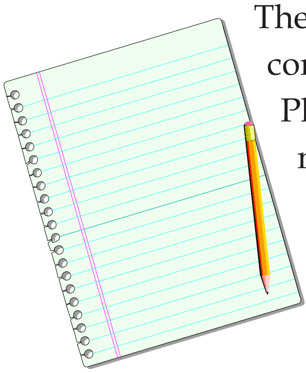
Volatile organic compound (VOC): A compound that easily vaporizes and has low water solubility. Many VOCs are manufactured chemicals that are associated with paint, solvents, and petroleum. VOCs are common groundwater contaminants.

Please print or type your comments for Site 2 here

Mark Your Calendar for the Public Comment Period

Public Comment Period
March 20 - May 4, 2010

Submit Written Comments



The Navy will accept written comments on the Proposed Plan during the public comment period. To submit comments or obtain further information, please refer to the back page.

Attend the Public Meeting
April 6, 2010 at 5:00pm

The Navy will hold a public meeting to explain the Proposed Plan. Verbal and written comments will be accepted at this meeting.

Major Hillard Library
824 Old George Washington Highway N
Chesapeake, Virginia 23323
Phone: (757) 382-3600

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Place stamp here

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