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NAVFAC
Naval Facilities Engineering Command

Final

Interim Record of Decision
Site 21: Industrial Area

St. Juliens Creek Annex
Chesapeake, Virginia

EPA ID: VA5170000181

May 2010

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Final

Interim Record of Decision
Site 21: Industrial Area

St. Juliens Creek Annex, Chesapeake, Virginia

May 2010

1. Declaration

1.1 Site Name and Location

This Interim Record of Decision (ROD) presents the interim selected remedy for Site 21, Industrial Area, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. SJCA was placed on the United States Environmental Protection Agency (USEPA) National Priorities List (NPL) effective July 27, 2000 (EPA ID: VA5170000181).

1.2 Statement of Basis and Purpose

This remedy was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record[a] file for the site.

The response action selected in this Interim ROD is necessary to protect the public health, welfare and/or the environment from actual or threatened releases of hazardous substances. This ROD is "interim" because it does not fully address all potential site concerns. The response action selected in this Interim ROD addresses risk for future hypothetical residents from potable use of shallow groundwater and is being implemented as an interim action in order to reduce COC concentrations while other media are being investigated. A subsequent final ROD will be prepared to address the site as a whole, including the vapor intrusion pathway. This interim action will neither be inconsistent with, nor preclude, implementation of a final remedy.

The Department of the Navy (Navy) is the lead agency and provides funding for site cleanups at SJCA. The Navy and USEPA Region III issue this Interim ROD jointly. The Commonwealth of Virginia, Virginia Department of Environmental Quality (VDEQ) concurs with the decision.

Site 21 is one of several Environmental Restoration Program (ERP) sites at SJCA that are subject to the requirements of CERCLA. The status of all the ERP sites at SJCA can be found in the current version of the **Site Management Plan**[1] (SMP), which is located in the Administrative Record.

[a] **Bold blue text** identifies detailed site information available in the Administrative Record and listed in the References Table.

1.3 Assessment of the Site

Previous investigations have identified the presence of chemicals of concern (COCs), consisting of the chlorinated volatile organic compounds (CVOCs) trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), vinyl chloride (VC), and 1,1-DCE, in shallow groundwater (Columbia aquifer) at concentrations that pose a potential threat to human health under future residential land-use scenarios including potable use of groundwater. Currently vapor intrusion from groundwater into indoor air (volatilization) is under investigation. Based on the investigation results, the associated potential risk to indoor workers from the inhalation of indoor air will be evaluated.

1.4 Description of the Selected Remedy

The interim selected remedy for Site 21 is groundwater treatment through a two-phase approach:

- *In situ* chemical reduction (ISCR)
- Enhanced reductive dechlorination (ERD)

Performance monitoring will be included in both phases of treatment to ensure effective and optimal conditions are established for mitigation of the CVOCs and to ensure the treatment process is performing effectively. Land use controls (LUCs) will be implemented and maintained on groundwater and associated property use within the boundaries of Site 21 until the concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure.

1.5 Statutory Determinations

The interim selected remedy is protective of human health and the environment, complies with Federal and State regulations that are applicable or relevant and appropriate to the remedial action, is cost effective, utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, and satisfies the preference for treatment as a principal element of the remedy. Until the concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted every 5 years after initiation of remedial action to ensure that the remedy is protective of human health and the environment.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this Interim ROD. Additional information can be found in the Administrative Record file for SJCA, Site 21.

- COCs and their respective concentrations (Section 2.5)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater (Section 2.6)
- Baseline risk represented by the COCs (Section 2.7)
- How source materials constituting principal threats will be addressed (Section 2.10)
- Cleanup levels established for COCs and the basis for these levels (Section 2.8)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.9, Table 7)

- Key factor(s) that led to selecting the remedy (i.e., describe how the interim selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.11.1)
- Potential land and groundwater use that will be available at the site as a result of the interim selected remedy (Section 2.11.4)

If contamination posing an unacceptable risk to human health or the environment is discovered, including unacceptable concentrations of VOCs in indoor air associated with potential vapor intrusion, after execution of this Interim ROD, the Navy will undertake all necessary actions to ensure continued protection of human health and the environment.

1.7 Authorizing Signatures

W. C. Kiestler
Captain, U.S. Navy
Commander, Norfolk Naval Shipyard
Portsmouth, Virginia

2/19/10
Date

Kathryn A. Hodgkiss, Acting Director
Hazardous Site Cleanup Division
EPA (Region III)

5/12/10
Date

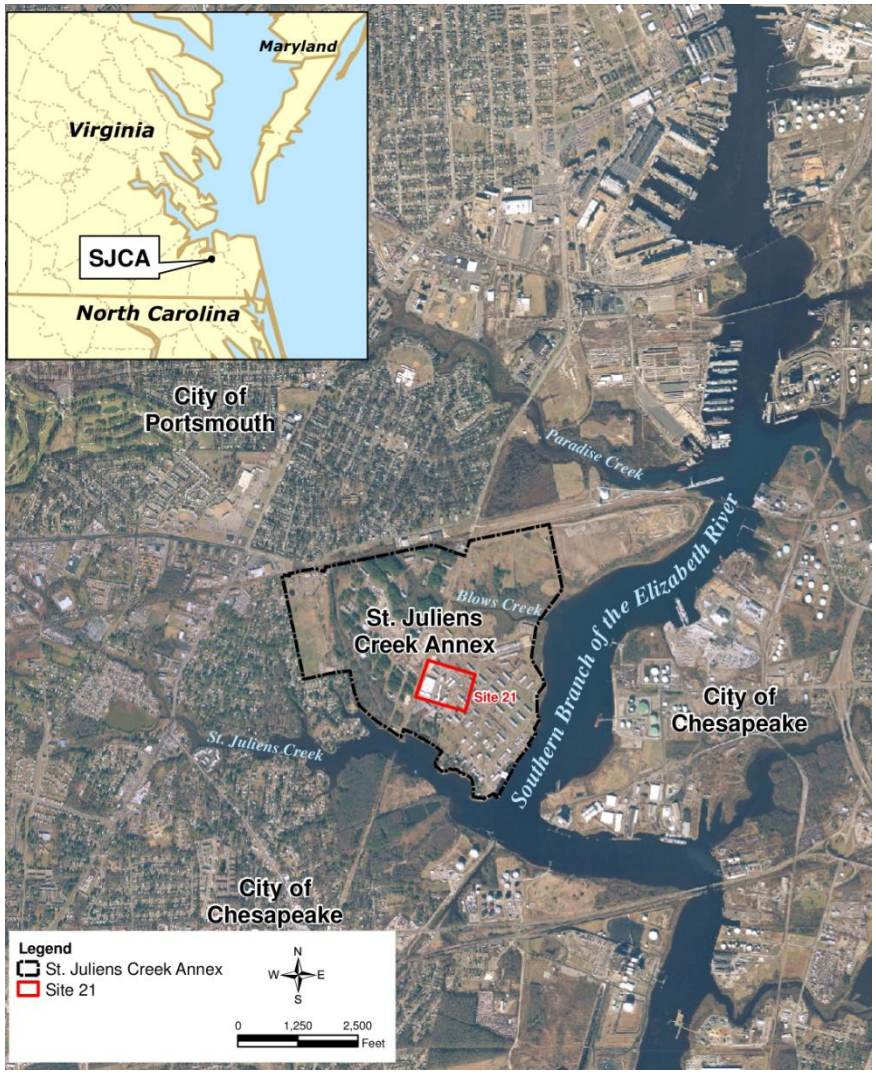
2 Decision Summary

2.1 Site Name, Location, and Description

Site 21 (Industrial Area)
St. Juliens Creek Annex
Chesapeake, Virginia
EPA ID: VA5170000181

SJCA covers approximately 490 acres and is located 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. Site 21 is an industrial area in the southcentral portion of the facility, currently used for storage and maintenance operations (Figure 1).

FIGURE 1
Site Location



2.2 Site History and Enforcement Activities

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.

Site 21 was initially identified as Building 187 (Figure 2), which was a locomotive maintenance facility where TCE was used; however, data from investigations indicated the need to expand the initial boundary to encompass a CVOC groundwater plume. The expanded site boundary included a number of nearby industrial buildings, which historically had been used as machine, vehicle, and locomotive maintenance shops, electrical shops, and munitions-loading facilities; and outdoor areas that were used for storing equipment and chemicals. A fuel service station, including two underground storage tanks, had existed just south of Building 187, but has been removed (Figure 2). Waste oils and degreasers (including TCE) were reportedly disposed of on the ground surface and around the railroad tracks in this industrial area. Many of the older buildings at the site have been demolished. Remaining buildings within the Site 21 area are used for storage and maintenance activities.

Site 21 was characterized under numerous investigations and studies between 1981 and 2009. Based on the investigation findings, a shallow groundwater CVOC plume was identified and the Site 21 boundary was expanded to encompass the plume. The expanded boundary includes **Sites 9, 10, 11, 12, 13, 14 and 18**[2], which were previously identified as separate sites (Figure 2). Table 1 provides a chronological list and brief summary of previous investigations conducted at Site 21 and the other sites encompassed by its expanded boundary. The respective investigations are a part of the Administrative Record and can be referenced for further details for specific sampling strategies, media investigations, and when and where the sampling was performed.

TABLE 1
Previous Investigations Summary

Previous Study / Investigation*	Date	Investigation Activities
Initial Assessment Study (IAS) (Naval Engineering Environmental Support Activity, 1981)	1981	The IAS indicated that degreasers were disposed of onto railroad tracks next to buildings, waste hydraulic oil was disposed of along fence lines to control weeds, and waste oils and solvents were applied to roads to control dust. The area around Building 187 is detailed in the report as being saturated with oil.
Resource Conservation and Recovery Act Facility Assessment (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). Seven of the SWMUs and one of the AOCs identified and recommended for further action were located within the current Site 21 boundary (SWMUs 13, 14, 15, 16, 20, 23, and 25, and AOC E).
Building 1556 Construction**	1992 - 1993	Preparation activities for construction of Building 1556 included demolition of buildings and removal and offsite disposal of select areas of soil, including soil within the boundaries of AOC E and Sites 9 (SWMUs 13, 23, and 25), 12 (SWMU 16) and 13 (SWMU 20). Therefore, AOC E and Sites 9, 12, and 13 were closed with no further action required and documented in the **Federal Facilities Agreement**[3] (FFA).
Relative Risk Ranking System (RRR) Data Collection Report (CH2M HILL, 1996)	1996	Groundwater and/or soil samples were collected at Sites 9 (SWMUs 13, 23, and 25), 10 (SWMU 14), 11 (SWMU 15), 18, and 21 to determine and prioritize sites requiring possible further investigation. The sample locations were focused in areas of potential historical releases/potential risk, representing worst-case scenarios.
Site Screening Assessment (SSA) (CH2M HILL, 2002)	2002	A quantitative human health risk screening was conducted using the groundwater and soil analytical results from the RRR and a qualitative ecological risk screening was conducted through an evaluation of ecological habitats. Based on the elevated VOC concentrations detected in groundwater and potential human health risks identified, the SSA recommended further evaluation of groundwater at Sites 11 and 21, combining them as Site 21 for future activities. No further action (NFA) was recommended for groundwater at Sites 9 and 10; and for surface soil at Sites 9, 10, 11, 18, and 21. The results of the ecological risk screening indicated that there was minimal habitat for ecological receptors, no pathways to transport contamination offsite, and no known groundwater discharge points. Therefore, **no further evaluation of potential ecological effects**[4] was recommended.

TABLE 1
Previous Investigations Summary

Previous Study / Investigation*	Date	Investigation Activities
Site Investigation (SI) (CH2M HILL, 2006)	2004	Groundwater samples were collected to further characterize contamination associated with Site 21. A human health risk screening was conducted using groundwater analytical results and identified potential risks from CVOCs and cyclotrimethylenetrinitramine (RDX) in shallow groundwater and from chloroform, arsenic, and vanadium in deep groundwater. Because the potential for chemicals in groundwater at Site 21 to be transported and discharged to St. Juliens Creek and/or its tributaries was identified, an ecological risk screening was performed to determine if groundwater concentrations were present at concentrations that could represent a potential risk to aquatic life. Because the results indicated only a minimal potential for adverse effects to aquatic life, **no further ecological evaluation**[5] was recommended. Further evaluation of CVOCs in shallow groundwater and sampling of existing wells to confirm or rule out the elevated concentrations of arsenic, chloroform, vanadium, and RDX in groundwater was recommended.
Remedial Investigation (RI) (CH2M HILL, 2008)	2008	Groundwater samples were collected to further define the nature and extent of contamination, further assess human health risk, and aid remedial alternative evaluation; subsurface soil samples were collected to aid in remedial alternative evaluation and determine the presence or absence of sorbed trichloroethene (TCE) and dense non-aqueous phase liquid (DNAPL); and surface water and stormwater samples were collected to determine if VOCs in groundwater are discharging to the storm sewer system and being transported to the Site 2 inlet. TCE, cis-1,2-DCE, VC, and 1,1-DCE were retained as COCs for potable use of the shallow groundwater. Potential risk associated with benzene and arsenic in shallow groundwater was identified; however, they were not retained as COCs based on the results of a **qualitative evaluation**[6] of the data. A Feasibility Study (FS) was recommended to evaluate potential remedial alternatives to mitigate unacceptable human health risks for potable use from the COCs in the shallow groundwater at Site 21. Additional investigation of the **vapor intrusion pathway**[7] from shallow groundwater was also recommended. No potential human health risks were identified from exposure to deep groundwater. No ecological risks were identified from exposure to stormwater or surface water discharging to Site 2 based on a comparison of analytical results to Biological Technical Assistance Group surface water screening criteria. Therefore, **no further evaluation of deep groundwater or ecological risk**[8] was recommended.
FS (CH2M HILL, 2009)	2009	Remedial action alternatives were developed and evaluated to prevent unacceptable risk exposure through potable use of shallow groundwater. Four remedial alternatives were selected for detailed comparative analysis: (1) no action, (2) monitored natural attenuation (MNA), (3) ISCR and ERD, and (4) *in situ* chemical oxidation (ISCO) and ERD.

Notes:

*The documents listed are available in the Administrative Record and provide detailed information used to support remedy selection at Site 21.

**The Building 1556 construction was not an investigation or study. However, it is included because activities associated with its construction were considered in the closeout of sites within the Site 21 boundary.

2.3 Community Participation

The Navy and USEPA provide information regarding the cleanup of SJCA to the public through the community relations program, which includes a Restoration Advisory Board (RAB) that was formed in 1999, public meetings, the Administrative Record file for Site 21, the information repository, and announcements published in the local newspapers. During the course of investigations at Site 21, the RAB has been apprised of all environmental activities related to the site.

In accordance with Sections 113 and 117(a) of CERCLA, the Navy provided a public comment period between August 1, 2009 and September 14, 2009, for the Site 21 Interim Proposed Plan. A public meeting to present the Interim Proposed Plan was held on August 11, 2009 at the Major

Hillard Public Library. Public notice of the meeting and availability of documents was placed in the *Virginian-Pilot* newspaper on July 18, 2009.

The Interim Proposed Plan was available during the public comment period at the Major Hillard Public Library. The final Interim Proposed Plan and previous investigation reports for Site 21 are available to the public in the Administrative Record. The Administrative Record is accessible to the public via:

Public Affairs Office, NNSY
NNSY, Building 1500-2
Portsmouth, Virginia 23709-5000
Phone: (757) 396-9550

Or the index is available online at:
http://public.lantops-ir.org/sites/public/nablc/Site%20Files/AdminRecords.aspx

2.4 Scope and Role of Response Action

Site 21 is one of several ERP sites at SJCA that are part of the comprehensive environmental investigation and cleanup currently being performed at SJCA under the CERCLA program. The status of all the ERP sites at SJCA can be found in the current version of the SMP, which is located in the Administrative Record. This Interim ROD documents the interim remedial action for Site 21 and does not include any other sites at the facility. This interim action will neither be inconsistent with, nor preclude, implementation of the final remedy.

2.5 Site Characteristics

Most of Site 21's ground surface, with the exception of a few small, unconnected grassy areas, is covered with asphalt. Although many of the older buildings at the site have been demolished, several remain, including Buildings 47 and 1556. The general topography of the area is flat, with elevations ranging from 7 to 9 feet above mean sea level. A storm sewer system runs through Site 21 and drains to a downstream inlet to St. Juliens Creek (Site 2). Shallow groundwater at Site 21 is encountered from 2 to 7 feet below ground surface (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 2). The majority of the storm sewer system is below the water table. The pipe bedding material and leaks in the storm sewer system appear to be acting as a preferential pathway and influencing the flow of groundwater.

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 contiguous at Site 21 and lies above the fine to coarse shelly sands of the Yorktown aquifer.

A conceptual site model (CSM) (Figure 3) has been developed to summarize the site conditions, contaminant distribution, potential receptors and exposure pathways, and land use data collected during the investigations. TCE and its degradation products are the most frequently detected contaminants in shallow groundwater at Site 21. Table 2 identifies the **COCs in groundwater**[9] and the maximum detected concentration of each COC.

FIGURE 2
Site Map

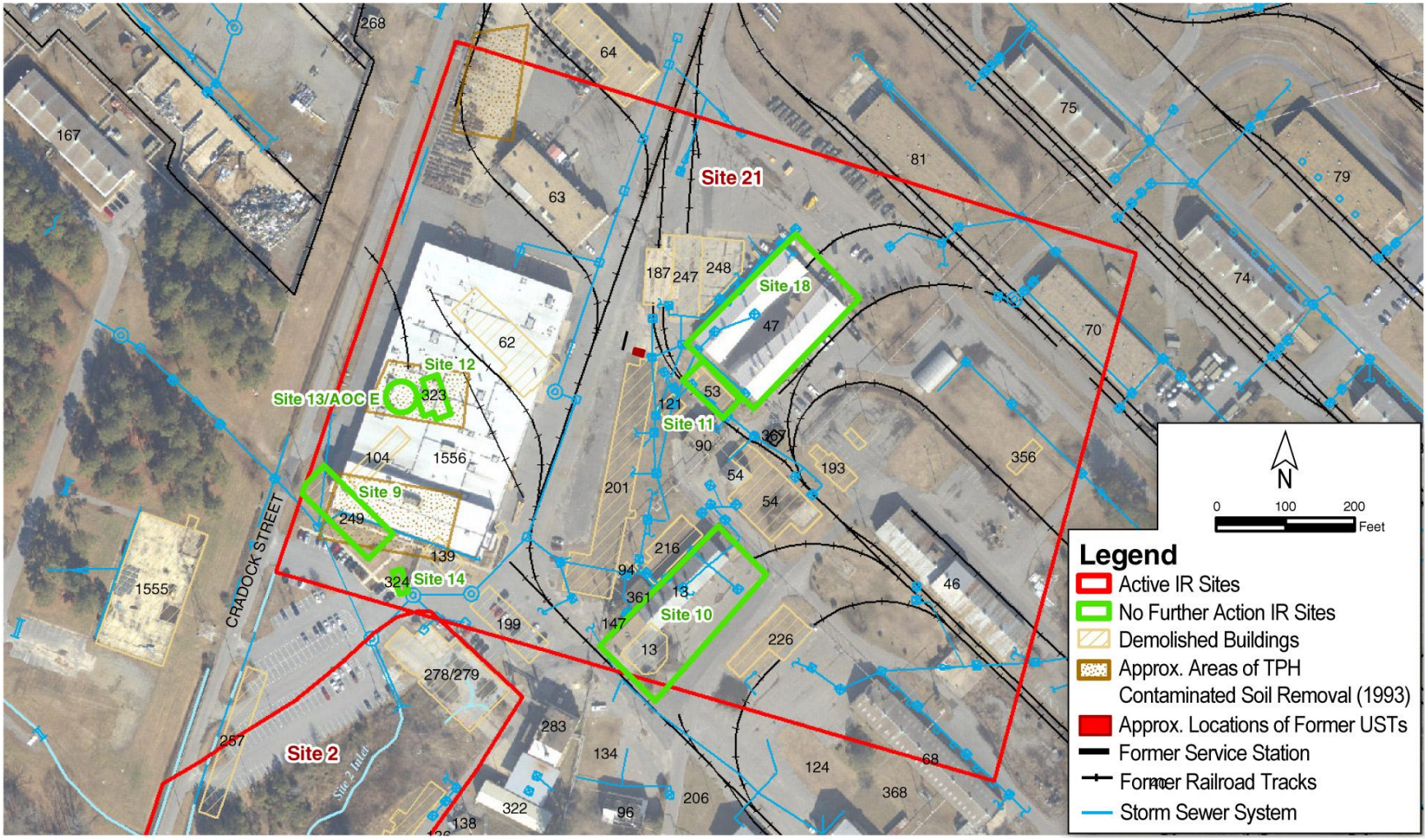


TABLE 2
COCs Requiring a Response Action

Groundwater COCs	Detection Frequency	Maximum Detected Value (µg/L)		MCL (µg/L)
TCE	60/90	16,000		5
cis-1,2-DCE	58/90	2,600	J	70
VC	33/90	390		2
1,1-DCE	22/90	11		7

Notes:
MCL - maximum contaminant level
µg/L - micrograms per liter
J - Reported value is estimated
Result details can be found in the RI (CH2M HILL,2009)

TCE concentrations appear to follow groundwater flow, moving from apparent source release points to the southeast and southwest toward the storm sewer system and the Site 2 inlet (Figure 4). A **video survey of the storm sewer**[10], which is below the water table, identified leaks in the system, supporting the fact that it is influencing the groundwater flow. Based on the analytical results and the corresponding potential source areas, the TCE plume at Site 21 has an areal extent of approximately 8 acres, and extends laterally within the Columbia aquifer from the parking lot south of Building 64 (north) to the south side of former Building 201 (south) and from the southwest side of Building 1556 (west) to Building 46 (east) (**Figure 4**). The orientation of the daughter product plumes (cis-1,2-DCE and vinyl chloride) closely resemble that of the TCE. The maximum detected concentration of TCE in shallow groundwater (16,000 µg/L) indicates that **DNAPL**[11] is likely present at the site.

The current primary migration pathways of CVOCs at Site 21 are through dissolved plume migration downgradient with groundwater flow (advection), groundwater discharge to the leaking storm sewer system and to the south toward St. Juliens Creek, and DNAPL desorbing from the top of the Yorktown confining unit into shallow groundwater. The mechanisms responsible for the fate of contaminants include sorption of contaminants to soil surfaces, which affects advection rates and the extent of lateral spreading, and natural degradation through different pathways (predominantly breakdown by biological processes), which will play a significant role in the length of time the contaminants will exist in the subsurface.

2.6 Current and Potential Future Land and Water Uses

Site 21 is currently an active industrial area of SJCA. Current land use is expected to continue at Site 21, and there is no other planned future land use. Groundwater is not currently used as a potable water supply at or in the vicinity of SJCA because of its general poor quality (iron and manganese above secondary drinking water standards), and low yield (generally less than 3 to 5 gallons per minute). Potable water is supplied to the base by the City of Chesapeake. LUCs will be implemented within the boundaries of the site to prohibit potable use of shallow groundwater until the remedial action reduces concentrations to levels that allow for unrestricted use.

FIGURE 3
Site 21 Conceptual Site Model

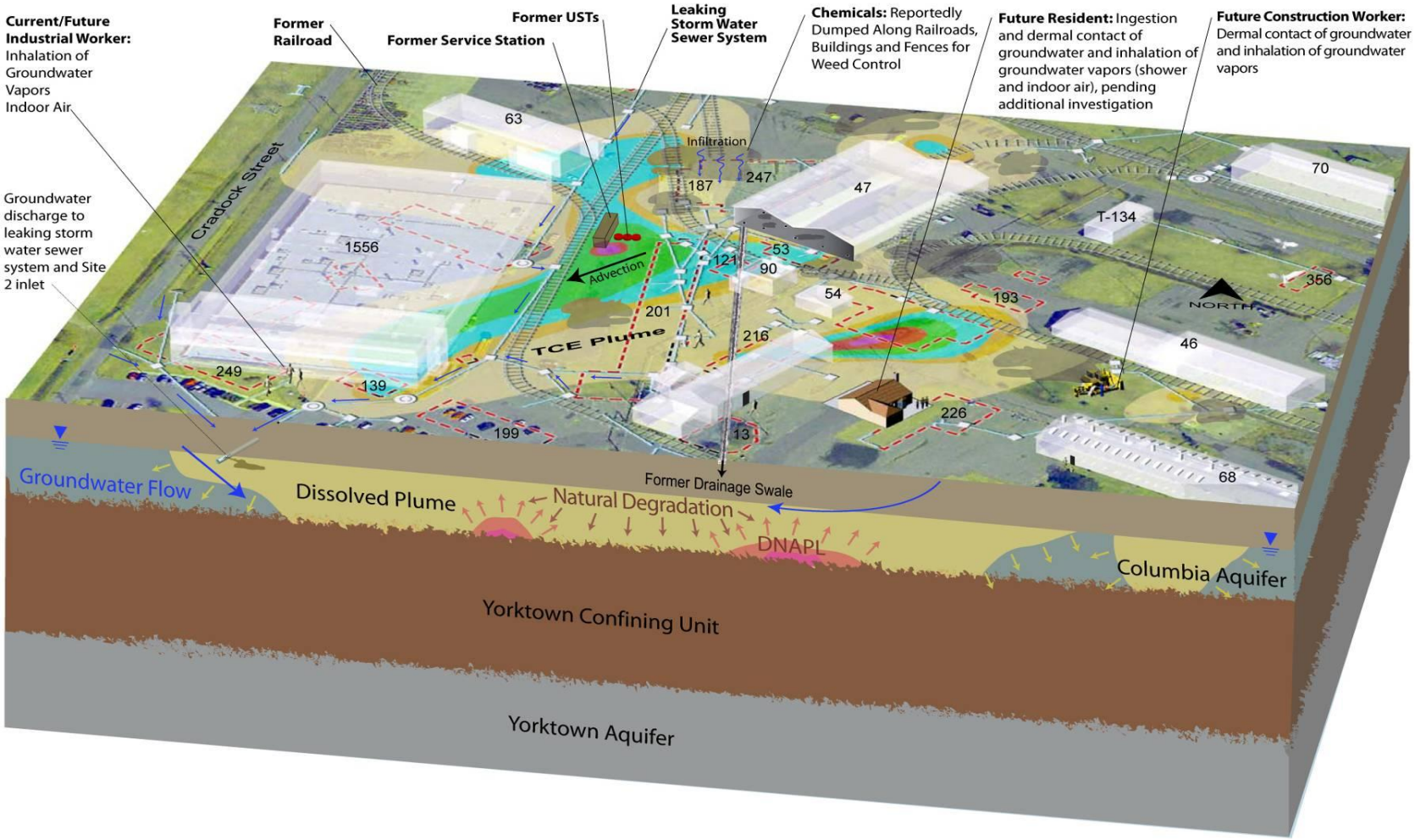
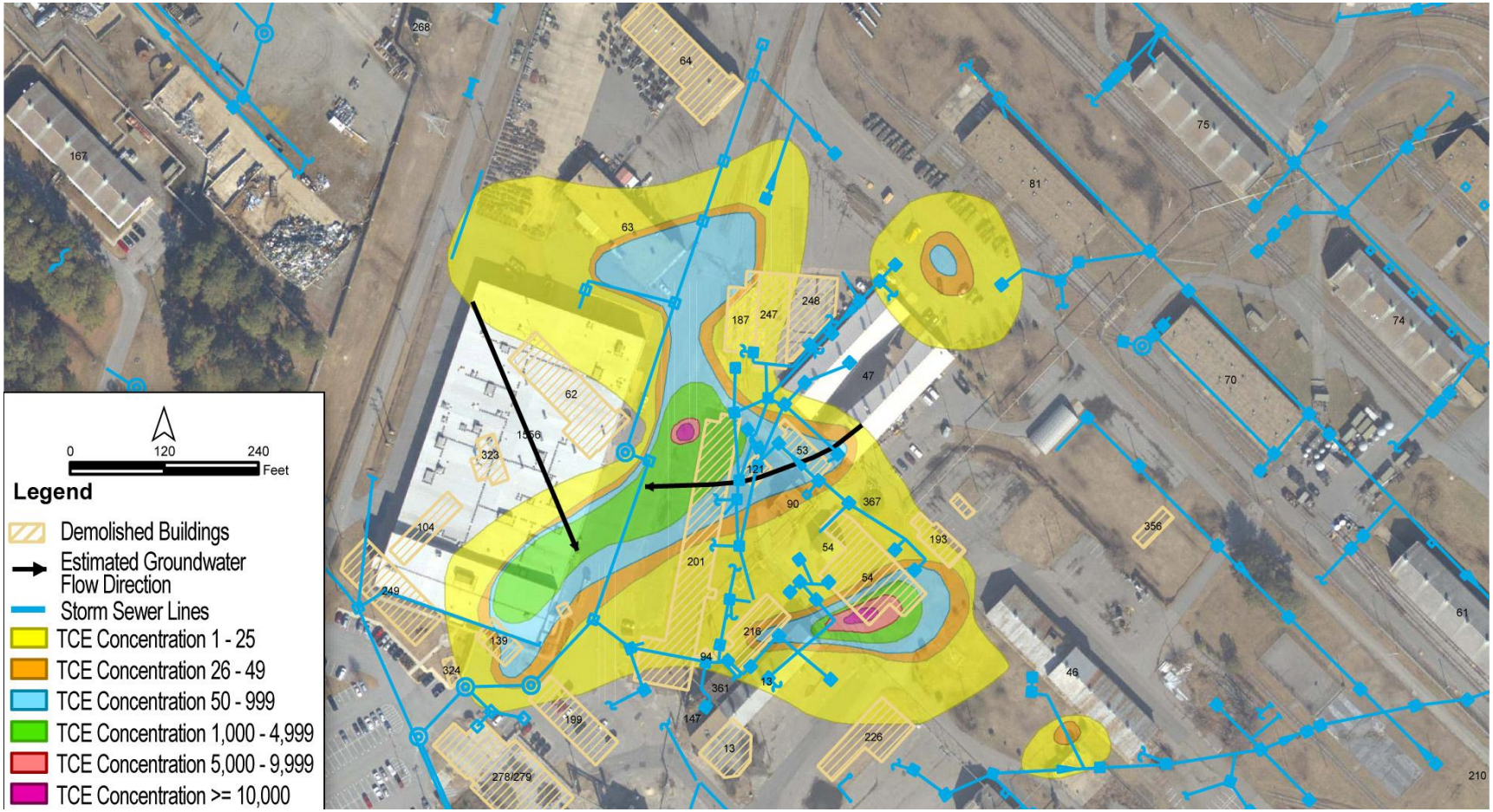


FIGURE 4
TCE Plume



2.7 Summary of Site Risks

Potential human health and ecological risks at Site 21 were evaluated and documented in the SSA, SI, and RI. Because the selected remedy in this ROD is interim and only addresses the risk associated with potable use of shallow groundwater, the following subsection focuses on the shallow groundwater risk. A summary of all risk assessments performed will be documented in the final ROD. The following subsections and Table 3 briefly summarize the findings of the risk assessments.

2.7.1 Human Health Risk Summary

A Human Health Risk Assessment (HHRA) was conducted to evaluate the potential human health risks associated with **current receptors**[12] (industrial workers) and **hypothetical future receptors**[13] (construction workers, adult residents, child residents, lifetime residents) and **exposure scenarios**[14] (ingestion, dermal contact, and inhalation through showering or breathing indoor air) if no remedial action were implemented for the shallow groundwater. This information was used to determine if any further actions needed to be taken at Site 21 to sufficiently protect human health. Health risks are based on a conservative estimate of the potential **cancer risk** or the potential to cause other health effects not related to cancer (**non-cancer hazard**, or **hazard index** [HI]). USEPA identifies an acceptable cancer risk range of 1 in 10,000 (10^{-4}) to 1 in 1 million (10^{-6}) and a non-cancer hazard as an HI of less than 1. Based on the HHRA, potential risks were calculated for current exposure to groundwater by maintenance workers and adult and/or child visitors/trespassers and future exposure to groundwater by adult and/or child visitors/trespassers, adult and child residents, lifetime residents, industrial workers, and construction workers.

Future potable use of shallow groundwater poses an unacceptable risk for future hypothetical residents (both adult and child) associated with ingestion of TCE, cis-1,2-DCE, VC, benzene, and arsenic; inhalation of TCE while showering; and dermal contact with TCE (Table 3). Although **potential risks**[15] were identified from exposure to benzene and arsenic, these compounds were identified only in the vicinity of a closed former underground storage tank, which is the likely source of the benzene. Because benzene is fuel-related, it is not treated under CERCLA based on the petroleum exclusion and was not carried through as a COC (See CERCLA Section 101(14)). Arsenic commonly occurs as natural mineral coatings of the sand and gravel in the aquifer and becomes more mobile under reducing conditions, which are present near the former underground storage tank, and, therefore, was also not carried through as a COC. However, the remedy evaluation performed in the FS took into consideration the potential for the mobilization of naturally occurring arsenic. Based upon this **evaluation**[16], if mobilization of naturally occurring arsenic occurs as a result of the selected alternative, monitoring will be performed to confirm that the concentrations return to a level that does not pose unacceptable risk to potential receptors. Although concentrations of 1,1-DCE in shallow groundwater did not pose unacceptable risks, it was detected above the MCL and is thus retained as a COC.

2.7.2 Ecological Risk Summary

Based on the recommendations of ecological risk screenings conducted during the SSA (CH2M HILL, 2002) and SI (CH2M HILL, 2006), an ecological risk assessment was not conducted for Site 21. 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 ecological risk screening, no unacceptable risks were identified from exposure to stormwater or surface water discharging from Site 21 based on a comparison to Biological Technical Assistance Group surface water screening criteria. Therefore, no further evaluation of ecological risk was recommended and an ecological risk assessment was not conducted.

2.7.3 Basis for Response Action

It is the current judgment of the Navy and USEPA, with the concurrence of VDEQ, that the interim selected remedy identified in this Interim ROD, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Based on the HHRA, exposure to shallow groundwater at Site 21 poses an unacceptable risk to human health due to the presence of TCE, cis-1,2-DCE, and VC. In addition, the Navy acknowledges the Commonwealth of Virginia's and EPA's expectation to return usable groundwaters to their **beneficial uses**[17] wherever practicable. Therefore, because 1,1-DCE was identified in groundwater at Site 21 at a concentration exceeding its MCL, it is also included as a COC (Table 2).

TABLE 3
Summary of Unacceptable Human Health Risks

Receptor	Media	Pathway	COC	Exposure Point Concentration (µg/L)	RME Cancer Risk	RME Non-Cancer Hazard Index	Cancer Toxicity Factor (CSF)	Non-Cancer Toxicity Factor (RfD)
Future Child Resident	Shallow Groundwater	Ingestion	TCE	3,100	NA	33	NA	6.0E-03
			VC	170	NA	3.6	NA	3.0E-03
			cis-1,2-DCE	1,600	NA	9.7	NA	1.0E-02
		Dermal	TCE	3,100	NA	5.5	NA	6.0E-03
Future Adult Resident	Shallow Groundwater	Ingestion	TCE	3,100	NA	14	NA	6.0E-03
			VC	170	NA	1.6	NA	3.0E-03
			Cis-1,2-DCE	1,600	NA	4.2	NA	1.0E-02
		Dermal	TCE	3,100	NA	2.4	NA	6.0E-03
		Inhalation (while showering)	TCE	3,100	1.6×10^{-4}	0.38	7.0E-03	1.7E-01
Future Lifetime Resident	Shallow Groundwater	Ingestion	TCE	3,100	6.0×10^{-4}	NA	1.3E-02	NA
			VC	170	3.6×10^{-3}		1.4E+00	NA

Notes:
µg/L – micrograms per liter
RME – reasonable maximum exposure
CSF – carcinogenic slope factor
RfD – reference dose
NA – not applicable

The maximum detected concentrations of COCs requiring a response action are summarized in Table 2. Figure 4 depicts the extent of the impact of the predominant COC (TCE) to shallow groundwater. The extent of the other COCs closely resemble that of TCE, as discussed in Section 2.5.

2.8 Remedial Action Objectives

The remedial action objectives (RAOs) for Site 21 are based upon the potential for future residential receptors to use groundwater as a potable water supply. The RAOs for Site 21 are as follows:

- 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 have been established for constituents with concentrations contributing to unacceptable risks and hazards from potable use of shallow groundwater within Site 21. The cleanup levels were developed from the **preliminary remediation goals**[18], which were established in the FS as the MCLs after consideration of the total risks/hazards associated with their use. Cleanup levels are identified in Table 4.

TABLE 4
Cleanup Levels

COC	Cleanup Level (µg/L)
TCE	5
cis-1,2-DCE	70
VC	2
1,1-DCE	7

2.9 Description and Comparative Analysis of Remedial Alternatives

2.9.1 Description of Remedial Alternatives

Remedial alternatives to address risk from potable use of shallow groundwater at Site 21 were developed and are detailed in the FS (CH2M HILL, 2009). Based on initial **screening of technologies**[19], four remedial alternatives were retained for detailed comparative analysis. A description is provided in Table 5.

The No Action alternative does not protect human health and the environment, but is presented as a baseline for comparison purposes. With the exception of the No Action alternative, the common elements of the remedial alternatives are groundwater monitoring and LUCs until COC concentrations in groundwater are reduced to the cleanup levels.

2.9.2 Comparative Analysis of Remedial Alternatives

A comparative analysis of the four alternatives with respect to the **nine evaluation criteria**[20] was completed and is summarized below. Table 6 depicts a relative ranking of the alternatives. Alternative 1 (No Action) does not achieve RAOs designed to protect human health and the environment; therefore, it fails the first threshold criterion and is not considered further in this Interim ROD.

Threshold Criteria

Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls. Alternatives 2, 3, and 4 are all protective of human health and the environment. Alternative 2 is considered to be less protective than Alternatives 3 and 4 because it relies on natural degradation, which adds a higher degree of uncertainty for the rate of contaminant reduction and length of time to achieve RAOs. Alternatives 3 and 4 are similar in protectiveness because they each employ an active treatment to reduce chemical concentrations. Monitoring will be conducted and LUCs will provide adequate protection of human health and the environmental by preventing the potable use of shallow groundwater until the RAOs are achieved.

TABLE 5
Descriptions of Remedial Alternatives

Alternative	Components	Details	Cost
1 - No Action	None	Allow the COCs to breakdown naturally over time.	Capital Cost $0 O&M Present Value $0 Total Present Value $0 Timeframe: Unlimited[2]
2 - MNA	Groundwater monitoring LUCs	Regular, long-term monitoring (LTM) performed to demonstrate that: • COC concentrations continue to decrease • Potentially toxic transformation products[1] are not created at levels that are a threat to human health • Impacted area is not expanding • There are no changes in hydrogeological, geochemical, or microbiological parameters that might reduce the effectiveness of the remedial action. LUCs prohibit potable use of shallow groundwater	Capital Cost $50K O&M Present Value $434K Total Present Value $484K Timeframe: 30 years[2]
3 - ISCR and ERD	Injection of reducing agent Injection of electron source Groundwater monitoring LUCs	Injection of reducing agents promotes abiotic *in situ* reduction of COCs to ethene and chloride. Electron donor source, which is generally the limiting factor in reductive dechlorination, is provided to enhance the naturally occurring reductive dechlorination process. Regular, long-term groundwater monitoring performed to demonstrate that: • COC concentrations continue to decrease • Potentially toxic transformation products[1] are not created at levels that are a threat to human health • Impacted area is not expanding • There are no changes in hydrogeological, geochemical, or microbiological parameters that might reduce the effectiveness of the remedial action. LUCs prohibit potable use of shallow groundwater	Capital Cost $3.1M O&M Present Value $0.8M Total Present Value $3.9M Timeframe: 30 years[2]
4 - ISCO & ERD	Injection of oxidizing agent Injection of electron source Groundwater monitoring LUCs	Injection of oxidizing agent to promote abiotic in-situ oxidation of COCs through reaction of oxidants with the COCs to produce innocuous substances such as carbon dioxide, water, and chloride. Electron donor source, which is generally the limiting factor in reductive dechlorination, is provided to enhance naturally occurring reductive dechlorination process. Regular, long-term groundwater monitoring performed to demonstrate that: • COC concentrations continue to decrease • Potentially toxic transformation products[1] are not created at levels that are a threat to human health • Impacted area is not expanding • There are no changes in hydrogeological, geochemical, or microbiological parameters that might reduce the effectiveness of the remedial action. LUCs prohibit potable use of shallow groundwater	Capital Cost $4.6M O&M Present Value $0.7M Total Present Value $5.3M Timeframe: 30 years[2]

[1] Toxic transformation products include daughter products generated during degradation and any toxic chemicals (e.g., naturally occurring arsenic) that may be mobilized during treatment).
[2] There is a high degree of uncertainty associated with the timeframes for remediation. Cost estimates were developed assuming a 30-year timeframe. The timeframes will be refined in the final ROD based on data collected following initial remedy implementation.

TABLE 6
Relative Ranking of Alternatives

CERCLA Criteria	No Action (1)	MNA (2)	ISCR & ERD (3)	ISCO & ERD (4)
Threshold Criteria				
Protection of Human Health and the Environment	❍	⭘	●	●
Compliance with Applicable or Relevant and Appropriate Regulations (ARARs)	N/A	⭘	●	●
Primary Balancing Criteria				
Long-term effectiveness and permanence	❍	●	●	●
Reduction in toxicity, mobility, or volume through treatment	❍	❍	●	●
Short-term effectiveness	❍	⭘	●	⭘
Implementability	●	●	●	⭘
Cost**	$0	$0.5M	$3.9M	$5.3M

Ranking*: ● High ⭘ Moderate ❍ Low **N/A**=Not Applicable

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

** The cost represents a +50/-30% range of accuracy, based on estimates prepared in accordance with **USEPA cost estimating guidance**[21] in 2008 dollars.

Compliance with Applicable or Relevant and Appropriate Requirements

Compliance with ARARs addresses whether a remedy will meet all of the ARARs of Federal and State environmental statutes, or whether there is a basis for invoking a waiver. Alternatives 2, 3, and 4 are expected to comply with the Federal and State ARARs listed in Appendix A. Alternative 2 will have a longer timeframe associated with meeting the chemical-specific (Safe Drinking Water Act; MCL) ARAR because it relies on natural degradation, whereas Alternatives 3 and 4, which are similar, employ active treatment and will, therefore, meet the chemical-specific ARAR in a shorter timeframe than Alternative 2.

Primary Balancing Criteria

Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. Alternatives 2, 3, and 4 are each expected to effectively reduce concentrations of VOCs in shallow groundwater to allow for unlimited use and unrestricted exposure after RAOs are achieved. For each alternative, a monitoring plan will be developed and implemented to verify continued compliance with RAOs.

Reduction in Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Only Alternatives 3 and 4 have treatment components, which are expected to reduce toxicity, mobility, and volume of contaminants. (While MNA is not considered an active treatment, the natural reduction of contaminant concentrations through a variety of physical, chemical, or biological activities is expected over time with implementation of Alternative 2.)

Short-term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved. Alternatives 3 and 4 are similar with regard to how they would affect the community because both treatments rely on direct injection technology for implementation. The community impact associated with Alternatives 3 and 4 is slightly higher than Alternative 2 because of the vehicle traffic through the community associated with transportation of injection materials and investigation-derived waste (IDW). Alternative 2 has a lower impact on the community because it does not rely on an active treatment. Alternative 4 has a slightly higher risk to construction workers during implementation than Alternatives 2 and 3 do because it involves the handling of and potential exposure to oxidizing chemicals. Alternatives 3 and 4 have similar potential impacts to the environment because each may result in a temporary mobilization of naturally occurring metals, whereas Alternative 2 would not. Because Alternative 2 relies on natural degradation rather than active treatment, it results in the lowest rate of reduction in COCs and the longest timeframe for achieving the RAOs. Alternative 3 is the most effective in the short term.

Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Alternatives 2, 3, and 4 can each be implemented using standard and widely available technologies. The implementability of Alternatives 3 and 4 is lower than that of Alternative 2 due to the logistical challenges of working in an industrial area (e.g., the presence of buildings and utilities). Alternative 3 would be slightly easier to implement than Alternative 4 because Alternative 3 relies on naturally occurring conditions that promote groundwater treatment, whereas Alternative 4 would require the reversal of the naturally occurring reducing conditions for the initial phase of treatment (ISCO) then return to reducing for the second phase (ERD).

Cost

The **estimated capital cost**[22] for implementation of Alternative 2 ($50,000) is less than that of Alternative 3 ($3.1 million) or Alternative 4 ($4.6 million). The **estimated present value cost**[23], factoring in a 30-year O&M period for each alternative, is $500,000 for Alternative 2, which is less than for Alternatives 3 ($3.9 million) or 4 ($5.3 million). Alternative 3 has a lower capital cost and present-value cost than Alternative 4 due to the type and quantity of injection materials.

Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA and remedy selection process. The State concurs with the interim selected remedy.

Community Acceptance

The public meeting was held on August 11, 2009 to present the Interim Proposed Plan and answer community questions regarding the proposed remedial action at Site 21. The questions and concerns raised at the meeting were general inquiries for informational purposes only; no comments were received from the public.

2.10 Principal Threat Wastes

Principal threat wastes are source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should an exposure occur.

Contaminated groundwater generally is not considered to be a source material; however, non–aqueous phase liquids (NAPLs) in groundwater may be. Therefore, DNAPL could represent a principal threat waste if it is present at the top of the Yorktown confining unit. Investigations have not confirmed that DNAPL exists at the site, though the CVOC concentrations indicate it is likely present in select areas of the site based on the rule-of-thumb that concentrations in excess of 1 percent of a compound's solubility suggest that DNAPL may be present. Although no "threshold level" of risk has been established to identify principal threat waste, a general guideline is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios. Therefore, the contaminated groundwater as a whole will not be considered as a principal threat, but as a conservative measure, the potential DNAPL will be considered as a principal threat waste. The interim selected remedy includes treatment technology that will be used to permanently reduce the toxicity, mobility, and volume of the DNAPL to the maximum extent practicable.

2.11 Selected Remedy

Based on the comparative analysis, the interim selected remedy to address risk from potable use of shallow groundwater is Alternative 3, consisting of ISCR and ERD.

2.11.1 Rationale for the Selected Remedy

Although Alternatives 2, 3, and 4 will all achieve RAOs and meet the ARARs, Alternative 3 was selected as the interim remedy. Alternative 2 does not actively treat the source area and takes significantly longer to achieve the RAOs than Alternatives 3 and 4. Alternative 3 was chosen over Alternative 4 based on ease of implementation and lower associated cost. The naturally occurring conditions present at the site are favorable for the treatment included in Alternative 3.

2.11.2 Description of the Selected Remedy

The interim selected remedy for shallow groundwater at Site 21 includes ISCR in portions of the high-concentration zones (followed by ERD, if necessary) and ERD in the high-concentration zones where ISCR cannot be implemented (e.g., presence of utilities or buildings) and low-concentration zones. High-concentration zones are those areas where the COC concentrations are greater than 1,000 µg/L and low-concentration zones are those areas where the COC concentrations are greater than the cleanup level and less than 1,000 µg/L. Performance monitoring will be conducted to evaluate the effectiveness of ISCR and ERD and changes in the concentration and location of the plume; and to monitor changes in environmental conditions resulting from implementation of the interim selected remedy. LUCs for groundwater shall be maintained until cleanup levels have been achieved to prevent potable use of contaminated groundwater and to preserve the integrity of the remedy. The high- and low-concentration zones are shown on Figure 5; the actual extent may be adjusted as additional data is collected during implementation of the remedial action.

FIGURE 5
CVOC Plume

ISCR is a chemically driven process where compounds are reduced through an abiotic pathway. The use of ISCR for treatment of only portions of the high-concentration areas has been selected due to reasonableness of cost. It is assumed that the ISCR will be implemented through emplacement of a chemical reductant (e.g., zero valent iron) using high-pressure injection, which prevents its use near utilities and buildings. Once ISCR is no longer reducing contaminant concentrations, the area will transition to the low-concentration zone treatment approach with ERD, if determined to be necessary based on contaminant concentrations.

ERD is a microbially-mediated, anaerobic process in which chlorine atoms on a parent CVOC molecule are sequentially replaced with hydrogen. In the reductive dechlorination process, electrons are transferred from an electron donor source to the CVOC compound, which functions as an electron acceptor. Therefore, an external electron source is required for the reaction to occur. It is assumed that ERD will be implemented through direct injection of a suitable carbon substrate (e.g., emulsified vegetable oil) to the subsurface.

Following implementation of the remedy, groundwater monitoring will be conducted to evaluate the remedy effectiveness and confirm that favorable geochemical conditions are established and maintained for dechlorinating microorganisms to facilitate degradation of site CVOCs. If the evaluation of groundwater monitoring data determines that favorable geochemical conditions are no longer present for reductive dechlorination, a maximum of two subsequent rounds of ERD may be injected. The need for additional action to achieve the cleanup levels will be evaluated and documented within the final ROD for Site 21 or during the CERCLA Five-Year Review.

Although the effectiveness of mitigation of CVOCs in groundwater will be measured by comparison to cleanup levels, the remedial technology is not guaranteed to reduce CVOC concentrations to levels at or below cleanup levels across Site 21 in any particular timeframe due to the potential presence of DNAPL. Throughout implementation of the interim remedy, the Navy will implement LUCs to prevent unacceptable risks to human receptors from exposure to shallow groundwater COCs. LUCs will be implemented by the Navy within the LUC boundary, established as the Site 21 boundary (Figure 5), until the cleanup levels are achieved. The LUCs will meet the following objectives:

- Prohibit the withdrawal of groundwater except for environmental monitoring
- Prohibit the use of the site for residential facilities
- Maintain the integrity of any current or future remedial or monitoring system

The Navy will develop and submit to USEPA and VDEQ, in accordance with the FFA, a Remedial Design, and a LUC Remedial Design. The LUC Remedial Design will provide for implementation and maintenance actions, including periodic inspections and reporting. The Navy will implement, maintain, monitor, report on, and enforce the LUCs according to the LUC RD.

Although the Navy may transfer these responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall remain ultimately responsible for remedy integrity and shall: i) perform CERCLA Section 121(c) five-year reviews; ii) notify the appropriate regulators and/or local government representatives of any known LUC deficiencies or violations; iii) provide access to the property to conduct any necessary response; iv) retain the ability to change, modify, or terminate LUCs and any related deed or lease provisions; and, v) ensure that the LUC objective is met to maintain remedy protectiveness.

2.11.3 Summary of the Estimated Remedy Costs

Table 7 presents a cost estimate for implementation of the selected remedy; including a total estimated capital cost of $3.1 million, total operation and maintenance total present value of $0.8 million, and total present value of $3.9 million. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

2.11.4 Expected Outcomes of the Selected Remedy

Current land uses are expected to continue at Site 21 and there are no other planned land uses in the foreseeable future. Cleanup levels for the interim selected remedy are based on unlimited use and unrestricted exposure. Exposure will be controlled through LUCs until COCs in groundwater are reduced to the cleanup levels. Treatment at Site 21 will consist of ISCR and ERD. Treatment effectiveness will be evaluated through trend analysis of COC concentrations in the treatment area and aquifer geochemical conditions. If a decreasing trend in COC concentrations is not observed and geochemical conditions no longer appear favorable for degradation of contaminants, additional treatment with ERD only may be considered and will be documented within the final ROD for Site 21 or reported within the CERCLA Five-Year Review. When cleanup levels have been achieved and it has been confirmed that no rebound has occurred, if no additional action was required by the final ROD to address the vapor intrusion pathway, site closure will be initiated. If the final ROD requires further action for the vapor intrusion pathway, the revised site closure approach will be documented in that ROD. Vapor intrusion results from volatilization of contaminants in groundwater and migration of the volatilized contaminants through the vadose zone into indoor air when a pathway is present. Therefore, vapor intrusion should decrease with a reduction in groundwater contaminant concentrations. Once cleanup levels for this groundwater action have been achieved, the Site 21 area is expected to be suitable for unlimited use and unrestricted exposure for groundwater; however, the actual land use will be in accordance with the final ROD.

2.11.5 Statutory Determinations

In accordance with the NCP, the interim selected remedy meets the following statutory requirements in the short term and is intended to provide adequate protection until a final ROD is signed:

Protection of Human Health and the Environment—Although there is no known risk to current receptors, an interim remedy was selected to protect human health and the environment from known site risks to future receptors through treatment, groundwater performance monitoring, and LUCs to restrict the use of groundwater and reduce COC concentrations while other media are investigated. The assessment of human health risk is not yet complete, as the vapor intrusion pathway for shallow groundwater is currently under investigation. Following completion of the vapor intrusion investigation, the overall protection of human health and the environment will be discussed in the final ROD.

Compliance with ARARs—The interim selected remedy will attain the federal and state action- and location-specific ARARs presented herein. It is anticipated that the technologies employed in the interim selected remedy could eventually attain the chemical-specific ARAR presented herein; however, the final selected remedy for the site will ultimately ensure attainment of this ARAR. Federal and state ARARs, summarized by classification, for Site 21 are presented in **Appendix A.**

TABLE 7
Cost Estimates

Remedial Alternative	Capital Costs		Operation and Maintenance Costs		Total Cost (Present Value)	
1 - No Action		0		0		0
2 - Monitored Natural Attenuation	Engineering services	10,331	Semi-annual groundwater monitoring (Years 1 - 5)	155,425		
	Installation of 5 new monitoring wells	33,325	Annual groundwater monitoring (Years 6 - 30)	200,619		
			Land use controls	21,458		
	Subtotal Capital Cost	43,656	Subtotal O&M Cost Present Value	377,502	Estimated	484,332
	15% Contingency	6,548	15% Contingency	56,625	-30%	339,032
	Total Capital Cost	50,204	Total O&M Present Value	434,127	+50%	726,498
3 - In Situ Chemical Reduction and Enhanced Reductive Dechlorination	Engineering Services	393,650	Quarterly groundwater monitoring (Years 1 - 5)	425,030		
	Pre-construction planning	22,000	Annual groundwater monitoring (Years 6 - 30)	223,875		
	Installation of 5 new monitoring wells	33,325	Land use controls	21,458		
	ZVI injection in high-concentration zone	1,270,591				
	EVO injection in low-concentration zone	979,671				
	Site Completion and Restoration	10,000				
	Subtotal Capital Cost	2,709,237	Subtotal O&M Cost Present Value	670,363	Estimated	3,886,541
	15% Contingency	406,386	15% Contingency	100,554	-30%	2,720,578
	Total Capital Cost	3,115,623	Total O&M Present Value	770,918	+50%	5,829,811
4 - In Situ Chemical Oxidation and Enhanced Reductive Dechlorination	Engineering Services	585,940	Quarterly groundwater monitoring (Years 1 - 5)	359,908		
	Pre-construction planning	22,000	Annual groundwater monitoring (Years 6 - 30)	232,281		
	Installation of 5 new monitoring wells	33,325	Land use controls	21,458		
	$NaMnO_4$ injection in high-concentration zone	1,422,038				
	EVO injection in low-concentration zone (2 rounds)	1,959,342				
	Site Completion and Restoration	10,000				
	Subtotal Capital Cost	4,032,645	Subtotal O&M Cost Present Value	613,647	Estimated	5,343,236
	15% Contingency	604,897	15% Contingency	92,047	-30%	3,740,265
	Total Capital Cost	4,637,542	Total O&M Present Value	705,694	+50%	8,014,854

Cost-Effectiveness—The interim selected remedy is cost-effective and represents a reasonable value for the money to be spent. The costs are proportional to overall effectiveness in comparison to other alternatives (e.g., similar benefit at lower cost).

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable—Although this is an interim action and is not intended to address fully the statutory mandate for permanence and treatment to the extent practicable, this interim action does utilize treatment and thus supports the statutory mandate. The interim selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at Site 21.

Preference for Treatment as a Principal Element—The interim selected remedy uses treatment as a principal element, and, therefore, satisfies the statutory preference for treatment.

Five-Year Review Requirements—Until COC concentrations on site are below levels that allow for unlimited use and unrestricted exposure, the Navy will maintain LUCs and conduct a statutory remedy review every 5 years after initiating remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. Because this is an interim action ROD, review of this site and remedy will be ongoing as USEPA continues to develop final remedial alternatives for the site.

2.12 Documentation of Significant Changes

The Interim Proposed Plan for Site 21 was released for public comment on August 1, 2009. General inquiries were received during the public meeting on August 11, 2009, but no comments were received requiring amendment to the Interim Proposed Plan and no additional written comments, concerns, or questions were received from community members during the public comment period. It was determined that no significant changes to the remedy as originally identified in the Interim Proposed Plan were necessary or appropriate.

3 Responsiveness Summary

The participants in the public meeting held on August 11, 2009 included representatives of the Navy, USEPA, and VDEQ. One community member attended the meeting. Questions received during the public meeting were general inquires and are described in the public meeting minutes in the Administrative Record. There were no comments received at the public meeting requiring amendment to the Interim Proposed Plan and no additional written comments, concerns, or questions were received from community members during the public comment period.

Appendix A
ARARs

TABLE A-1
Federal Chemical-Specific ARARs
Site 21 Interim ROD
St. Juliens Creek Annex
Chesapeake, Virginia

Media	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Safe Drinking Water Act					
Groundwater	SDWA standards serve to protect public water systems. Primary drinking water standards consist of federally enforceable MCLs. MCLs are the highest level of a contaminant that is allowed in drinking water.	Groundwater contamination exceeds MCLs. CERCLA requires the return of usable waters to their beneficial use wherever practicable. Based on Virginia's and EPA's expectation for beneficial use of groundwater, cleanup to MCLs for the contaminants presenting Human Health Risk is required .	40 CFR 141.61 (a), (1), (5), (7), and (9)	Relevant and Appropriate	These remedial actions are being implemented with a target goal of achieving MCLs. However, the aquifer is not currently used, nor reasonably anticipated in the future to be used, as a potable water supply.

TABLE A-2
Virginia Chemical-Specific ARARs
Site 21 Interim ROD
St. Juliens Creek Annex
Chesapeake, Virginia

Media	Requirement	Prerequisite	Citation	ARAR Determination	Comment
There are no Virginia Chemical-Specific ARARs for the Selected Remedy					

TABLE A-3
Federal Location-Specific ARARs
Site 21 Interim ROD
St. Juliens Creek Annex
Chesapeake, Virginia

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Coastal Zone Management Act					
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with State coastal zone management programs. Federal agencies must supply the State with a consistency determination.	Wetland, flood plain, estuary, beach, dune, barrier island, coral reef, and fish and wildlife and their habitat, within the coastal zone.	*Coastal Zone Management Act*, 16 USC 1456(c), 15 CFR 930.30 to .34, .36(a), .39(b-d)	Relevant and Appropriate	If activities at Site 21 affect the Virginia's coastal zone, the activities will be consistent to the maximum extent practicable with the Virginia's enforceable policies.

TABLE A-4
Virginia Location-Specific ARARs
Site 21 Interim ROD
St. Juliens Creek Annex
Chesapeake, Virginia

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
There are no Virginia Location-Specific ARARs for the Selected Remedy					

TABLE A-5
Federal Action-Specific ARARs
Site 21 Interim ROD
St. Juliens Creek Annex
Chesapeake, Virginia

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Safe Drinking Water Act					
Underground injection	Regulates the subsurface emplacement of liquids through the Underground Injection Control program, which governs the design and operation of five classes of injection wells in order to prevent contamination of underground sources of drinking water. The Underground Injection Control program regulates well construction, well operation, and monitoring.	Any dug hole or well that is deeper than its largest surface dimension, where the principal function of the hole is in subsurface emplacement of fluids.	40 CFR 144.1(g), 144.6, 144.12(a) and (c), 144.24(a), 144.82, 144.83, 146.8, 146.10(c)	Applicable	These remedial actions will include substrate injections. Permits are not applicable to on-site CERCLA injection wells; however, these remedial actions will comply with the substantive requirements of the regulation.

TABLE A-6
Virginia Action-Specific ARARs
Site 21 Interim ROD
St. Juliens Creek Annex
Chesapeake, Virginia

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Virginia Waste Management Act					
Handling, storage, treatment, disposal, and/or transportation of hazardous waste IDW	Wastes to be managed must be samples for TCLP analyses to determine the appropriate waste characterization. TCLP regulatory levels and definition of RCRA hazardous waste.	Management of wastes that meet the definition of hazardous waste.	*Hazardous Waste Regulations*, 9 VAC 20-60-261 (hazardous waste identification incorporating all of 40CFR261); 9 VAC 20-60-262 (incorporating 40CFR Sections 262.11 and 262.34 [generator requirements]); Solid Waste Management Regulations, 9 VAC 20-80-140, -150, and -240 (c).	Applicable	These remedial actions will generate water and soil IDW which will be characterized for off site disposal. Based on site history, some IDW may be characterized as hazardous waste. If characterization results indicate this material is hazardous, it will be disposed of accordingly.

TABLE A-7
Acronyms and Abbreviations
Site 21 Interim ROD
St. Juliens Creek Annex
Chesapeake, Virginia

ARAR	Applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
IDW	investigation-derived waste
MCL	Maximum Contaminant Level
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act
TCLP	Toxicity Characteristic Leaching Procedure
USC	United States Code
VAC	Virginia Administrative Code

Notes:

Listing the statutes, policies, and citations for the ARARs does not indicate that the Navy accepts the entire statutes or policies as potential ARARs; only substantive requirements of the specific citations are considered potential ARARs.

References

Commonwealth of Virginia, 2004. Preliminary Identification, Applicable or Relevant and Appropriate Requirements.

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

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

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

Appendix B
Acronyms and Abbreviations

Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate regulation
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
CSM	conceptual site model
DCA	dichloroethane
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
ERD	enhanced reductive dechlorination
ERP	Environmental Restoration Program
FFA	Federal Facilities Agreement
FS	Feasibility Study
HHRA	Human Health Risk Assessment
HI	hazard index
IAS	Initial Assessment Study
IDW	investigation-derived waste
ISCO	*in situ* chemical oxidation
ISCR	*in situ* chemical reduction
LTM	long-term monitoring
LUC	land use control
MNA	monitored natural attenuation
NAPL	non-aqueous phase liquid
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NPL	National Priorities List
O&M	operation and maintenance
RAB	Restoration Advisory Board
RAO	remedial action objective
RDX	cyclotrimethylenetrinitramine
RI	Remedial Investigation
ROD	Record of Decision
RRR	Relative Risk Ranking
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SJCA	St. Juliens Creek Annex
SMP	Site Management Plan
SWMU	solid waste management unit

TCE	trichloroethene
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

References

Item	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
1	**Site Management Plan**	Section 1.2	CH2M HILL. 2009. *Site Management Plan Fiscal Years 2010 through 2014. St. Juliens Creek Annex, Chesapeake, Virginia.*
2	**Sites 9, 10, 11, and 18**	Section 2.2	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 2.3.4.
3	**Federal Facilities Agreement**	Section 2.2	Department of Defense (DoD). 2004. *Final Federal Facilities Agreement, St. Juliens Creek Annex, Chesapeake, Virginia.* Appendix C
4	**no further evaluation of potential ecological effects**	Section 2.2	CH2M HILL. 2002. *Final Site Screening Assessment Report. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 10.3.3.
5	**no further ecological evaluation**	Section 2.2	CH2M HILL. 2004. *Final Site Investigation Report for Sites 8, 19, 21, and AOC 1. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 6.8.
6	**qualitative evaluation**	Section 2.2	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 7.5.1.
7	**vapor intrusion pathway**	Section 2.2	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Sections 7.5.5 and 9.6.1.
8	**no further evaluation of deep groundwater or ecological risk**	Section 2.2	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Sections 9.6.2 and 9.5.
9	**COCs in groundwater**	Section 2.5	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 9.6.1.
10	**video survey of the storm sewer**	Section 2.5	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia*. Appendix E.
11	**DNAPL**	Section 2.5	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 6.2, page 47.
12	**current receptors**	Section 2.7.1	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Table 7.3.

Item	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
13	**hypothetical future receptors**	Section 2.7.1	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Table 7.3.
14	**exposure scenarios**	Section 2.7.1	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Table 7.3.
15	**potential risks**	Section 2.7.1	CH2M HILL. 2008. *Final Remedial Investigation Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Appendix I, Table 9s.
16	**evaluation**	Section 2.7.1	CH2M HILL. 2009. *Final Feasibility Study Report for Site 21. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 2.3.
17	**beneficial uses**	Section 2.7.3	USEPA. 1994. *National Oil and Hazardous Substances Pollution Contingency Plan.* 40 CFR 300.430 (a) (1)(iii)(f). VA. Code § 62.1-44.2.
18	**preliminary remediation goals**	Section 2.8	CH2M HILL. 2009. *Site 21 Final Feasibility Study Report. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 3.2.1 and Appendix A.
19	**screening of technologies**	Section 2.9.1	CH2M HILL. 2009. *Site 21 Final Feasibility Study Report. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 4.2 and Table 4-2.
20	**nine evaluation criteria**	Section 2.9.2	CH2M HILL. 2009. *Site 21 Final Feasibility Study Report. St. Juliens Creek Annex, Chesapeake, Virginia.* Section 5.2.
21	**USEPA cost estimating guidance**	Section 2.9.2	USEPA, 2000. *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study.*
22	**estimated capitol cost**	Section 2.9.2	CH2M HILL. 2009. *Site 21 Final Feasibility Study Report. St. Juliens Creek Annex, Chesapeake, Virginia.* Appendix C.
23	**estimated present value cost**	Section 2.9.2	CH2M HILL. 2009. *Site 21 Final Feasibility Study Report. St. Juliens Creek Annex, Chesapeake, Virginia.* Appendix C.

Detailed site information referenced in this ROD in bold blue text is contained in the Administrative Record.

For access to information contained in the Administrative Record for SJCA please contact:

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