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NSWC WHITE OAK
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# Record of Decision

## Former Naval Surface Warfare Center – White Oak
## Site 4 Soil and Groundwater

Naval Facilities Engineering Command,
Washington

United States Environmental Protection Agency
Region III

MDE

Maryland Department of the Environment

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# RECORD OF DECISION

## SITE NAME AND LOCATION

Former Naval Surface Warfare Center – White Oak
Site 4 Soil and Groundwater
Silver Spring, Maryland
EPA RCRA ID No. MD0170023444

## 1.0 DECLARATION

### 1.1 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the determination that *in-situ* enhanced reductive dechlorination with institutional controls and long-term monitoring to address groundwater contamination, and soil vapor extraction to address soil contamination, are necessary to protect human health and the environment at Navy Installation Restoration Site 4, Chemical Burial Area at the former Naval Surface Warfare Center - White Oak (NSWC - White Oak) in Silver Spring, Maryland. The selected remedy also includes the continued operation of the existing interim groundwater extraction and treatment system at Site 4 to maintain plume containment until specific exit criteria are met. This determination has been made in accordance with the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In 1997, ownership of the property occupied by Site 4, was transferred from the Department of the Navy (Navy) to the General Services Administration (GSA).

This decision is based on information contained in the Administrative Record file for the NSWC – White Oak. The Maryland Department of the Environment (MDE) concurs with the selected remedy. A letter from MDE indicating concurrence is provided in Appendix A.

The United States Environmental Protection Agency (EPA) and the Navy recognize that publication and successful implementation of this ROD shall constitute fulfillment of requirements related to soil and groundwater at Navy Installation Restoration Site 4 as required by the RCRA Section 7003 Administrative Order for NSWC – White Oak (First Amended Administrative Order to the Department of the Navy, the Former Naval Surface Warfare Center - White Oak, June 2, 1998).

### 1.2 DESCRIPTION OF THE SELECTED REMEDY

Site 4 consists of a series of former pits that were used for the disposal of various chemical wastes; specifically chlorinated solvents and petroleum, in addition to miscellaneous debris, beginning in the mid-1950s until the early 1970s.

The Site 4 groundwater is defined as the groundwater contaminant plume (consisting primarily of chlorinated volatile organic compounds (VOCs)) originating at the former chemical burial area (Site 4) and extending south and southeast toward Paint Branch and the stream flowing along the east side of Floral Drive. For the purposes of this ROD, Site 4 groundwater includes the groundwater beneath the area previously identified as Site 46, because the Navy has determined that Site 4 is the source of contaminated groundwater in the Site 46 area. Site 4 groundwater does not include the plume of explosives-contaminated groundwater originating at Site 7, except where this plume overlaps the Site 4 VOC plume.

The alternative selected to mitigate identified potential risks from exposure to site groundwater combines *in-situ* enhanced reductive dechlorination with institutional controls and long-term monitoring and the continued operation of the existing interim groundwater extraction and treatment system. The selected remedy to treat site soil to eliminate continuing releases from the soil to the groundwater is soil vapor extraction.

## 1.3 STATUTORY DETERMINATIONS

The selection of this remedy for groundwater is based upon the results of ongoing groundwater sampling and analysis and of the risk assessment performed as part of the Remedial Investigation (RI) for Operable Unit 1 (OU-1), of which Site 4 groundwater is a part. These analyses indicate that exposure to Site 4 groundwater as a drinking water source must be restricted for protection of human health. The results of the OU-1 RI and Feasibility Study (FS) also indicate that the soil at Site 4 contains VOCs at concentrations indicative of a continuing source of contamination to the groundwater. Five-year reviews will be necessary for the Site 4 groundwater since the remedy will result in hazardous substances, pollutants, or contaminants remaining on site for more than 5 years at concentrations above levels that allow for unlimited use and unrestricted exposure.

## 1.4 ROD DATA CERTIFICATION CHECKLIST

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

- Chemicals of concern (COCs) and their respective concentrations (pages 2-8 and 2-9).
- Baseline risk presented by the COCs (pages 2-15 and 2-17).
- Current and reasonably anticipated future land use assumptions (page 2-11).
- Potential land use that will be available at the site because of the selected remedy (page 2-11).
- Key factor(s) that led to selection of the remedy (i.e., how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (page 2-27).

Kevin R. Slates, CAPT, CEC, USN
Commanding Officer
NAVFAC Washington

30 Aug 05
Date

Abraham Ferdas, Director
Hazardous Site Cleanup Division
U.S. EPA - Region III

9/28/05
Date

# 2.0 DECISION SUMMARY

## 2.1 SITE NAME, LOCATION, AND DESCRIPTION

The former NSWC-White Oak was originally established in 1946 as the Naval Ordnance Laboratory, with a mission to carry out research on military mines and explosives. The former facility is located in Prince George's and Montgomery Counties, approximately 5 miles north of Washington, D.C., off New Hampshire Avenue in Silver Spring, Maryland (see Figure 2-1). Through the years, the mission was expanded to include research involving torpedoes and projectiles. In September 1974, the facility combined with the Naval Weapons Laboratory, Dahlgren, Virginia, to become the Naval Surface Weapons Center, which was renamed the Naval Surface Warfare Center, Dahlgren Division, in 1988. After that time, the facility functioned as the principal Navy research, development, test, and evaluation center for surface warfare weapon systems, ordnance technology, strategic systems, and underwater weapons systems.

In response to the Base Realignment and Closure (BRAC) Act, NSWC-White Oak was closed in 1997. Approximately 662 acres of the approximately 712-acre property were subsequently transferred to the GSA in the fall of 1997, and the remaining area in the southeastern portion of the facility was transferred to the U.S. Army in February 1998. The GSA has plans to reuse and develop the subject property for nonresidential purposes; one of the major tenants will be the U.S. Food and Drug Administration (FDA). The property transferred to the U.S. Army will be used in conjunction with ongoing activities at the adjacent Adelphi Research Laboratory

The EPA RCRA identification number for NSWC-White Oak is MD0170023444.

For purposes of CERCLA and the NCP, the Navy is the lead agency for the facility, pursuant to Executive Order 12580 and a Memorandum of Understanding signed by the Navy and the GSA in July 1997; MDE is the support agency. Additionally, EPA is exercising its authorities under Section 7003 of RCRA under which it issued an administrative order to the Navy. In accordance with these authorities, the Navy and EPA are jointly selecting the response actions at the former NSWC-White Oak.

## 2.2 SITE HISTORY, ENFORCEMENT ACTIVITIES, AND INVESTIGATIONS

### 2.2.1 Site History

Site 4 is located in the northeast portion of NSWC-White Oak, along the property line with Percontee Sand and Gravel. Chemicals and other wastes reportedly were buried beginning in the mid-1950s until the early 1970s. It was initially believed that wastes were disposed of in four discrete burial trenches within the 1.1 acre site. However, information from tests pits collected in 1999 in preparation for the 1999 removal action determined that disposal of material was not confined to discrete trenches, but rather to two larger burial areas (Burial Area 1 and Burial Area 2). Wastes disposed at Site 4 reportedly included chlorinated solvents, fuel tank sludges, kerosene, acids, explosives compounds and chemical powder (including white phosphorus). Unidentified laboratory chemicals in glass bottles also were disposed at the site.

The site is relatively flat and surrounded by a rising slope to the east, south and west. There are no surface water features near the site. Surface water runoff from on, and around the immediate vicinity of the site, flows toward the center of the site and infiltrates the soil overlying the former disposal pits and migrates into the subsurface soils. Site 4 supports old field vegetation but is bordered to the south, east, and west by oak-hickory forest.

Site 4 is located entirely within property currently owned by the GSA. See Figure 2-2.

The Site 4 groundwater is defined as the groundwater contaminant plume (consisting primarily of chlorinated VOCs) originating at the former chemical burial area (Site 4) and extending south and southeast toward Paint Branch and the stream flowing along the east side of Floral Drive.

For the purposes of this ROD, Site 4 groundwater includes the groundwater beneath the area previously identified as Site 46, because the Navy has determined that Site 4 is the source of contaminated groundwater in the Site 46 area. Site 4 groundwater does not include the plume of explosives-contaminated groundwater originating at Site 7, except where this plume overlaps the Site 4 VOC plume. The groundwater plume defined as Site 4 groundwater is shown in Figure 2-3. The Site 4 plume extends from the property currently owned by GSA onto the Army property, and the leading edge of the plume has migrated onto private residential property located between the federal government property and the aforementioned steams (Paint Branch and the stream along Floral Drive).

### 2.2.2 Enforcement Activities

On June 2, 1998, EPA issued an Administrative Order to the Navy, pursuant to Section 7003 of RCRA, 42 U.S.C.§ 6973, that required the Navy to

(1) undertake "'Interim Measures' (IM) at the facility to prevent or mitigate threats to human health and/or the environment;

(2) perform a [RCRA Facility Investigation (RFI) or RI] to determine fully the nature and any release of hazardous wastes, solid wastes and/or hazardous constituents at and/or from the Facility; and

(3) perform a [RCRA Corrective Measures Study (CMS) or FS] to identify and evaluate alternatives for corrective action necessary to prevent or mitigate migration or releases of hazardous wastes, solid wastes and/or hazardous constituents at and/or from the Facility."

EPA's RCRA 7003 Order provides the framework for completing the investigation and remediation of the former NSWC-White Oak facility under RCRA. The Order also recognizes that "EPA and the Navy intend to integrate the Navy's CERCLA response obligations and RCRA corrective action obligations" at the facility. As part of this CERCLA integration, the Navy and EPA understand that certain specific documents necessary to complete response actions at the sites will be prepared in accordance with the NCP and with applicable EPA guidance.

This ROD addresses the soil at Site 4 and the groundwater underlying Site 4, which is part of Operable Unit 1 (OU-1). OU-1 is defined as the groundwater underlying the eastern half of the former White Oak facility.

### 2.2.3 Site Investigations

Numerous investigations have been completed at NSWC-White Oak over the last 18 years. The work from previous studies and investigations related to Site 4 is outlined below.

Site 4 was identified as a Navy Installation Restoration Program (IRP) site in an Initial Assessment Study (IAS) conducted by the Navy's Naval Energy and Environmental Support Activity (NEESA) in 1984. The purpose of the IAS was to identify sites at NSWC-White Oak that would undergo potential environmental investigation. The IAS included a records search, on-site survey, and site ranking and identified 14 sites as needing further investigation.

Investigation activities have been conducted at Site 4 since 1987 to meet the requirements of both a CERCLA RI and a RCRA RFI. The term "RI" is used throughout this document to refer to the activities of these investigations. The investigative activities focused on characterizing subsurface soil, groundwater, surface water, and sediment at or adjacent to Site 4.

A Confirmation Study Verification Phase for NSWC-White Oak was conducted in 1985 (Malcolm-Pirnie, April 1987). This study was performed to confirm the findings of the IAS and to obtain additional information in characterizing site hazards.

The study involved the installation of groundwater monitoring wells, the drilling of soil borings in areas of suspected soil contamination, and the collection of soil, surface water, groundwater, and sediment samples to

characterize site contaminants. Site contamination was found in subsurface soil and groundwater. The study concluded that sufficient contamination existed to warrant additional study.

In accordance with the Code of Maryland Regulations (COMAR Title 26), hazardous waste generators that store hazardous waste for longer than 90 days are required to obtain a permit as a treatment, storage, and disposal facility (TSDF). Additionally, under the provisions of the Hazardous and Solid Waste Amendments (HSWA) to RCRA, Treatment, Storage or Disposal Facilities seeking final permits are required to initiate corrective actions for releases of hazardous wastes or constituents from Solid Waste Management Units (SWMUs). NSWC-White Oak operated under an interim status for on-site storage of hazardous waste. The Navy first submitted an application for a final (Part B) permit to Maryland in 1985, and made subsequent resubmissions and modifications. The last permit application was submitted in 1992.

Following the submission of the revised RCRA Part B permit application in 1988, a RCRA Facility Assessment (RFA) was conducted by an EPA contractor in 1990 (Kearney/Centaur Division, November 1990). The RFA identified 97 SWMUs and 19 areas of concern (AOCs) at NSWC-White Oak. All 14 of the IRP sites identified in the IAS were identified as SWMUs or AOCs in the RFA report. Forty SWMUs were recommended for further investigation in a RCRA Facility Investigation (RFI) to assess the presence and migration of contaminants of potential concern (COPCs). SWMU 4 is associated with Site 4.

In September 1992, Malcolm-Pirnie completed an RFA review for the Navy that evaluated the applicability of the general recommendations of the RFA to each individual SWMU. Generally, for those SWMUs that were being investigated under the IRP, it was concluded that the planned level of effort was sufficient to address potential impacts from each SWMU. It was also concluded that some level of sampling would probably be required for the SWMUs and AOCs that were recommended for an RFI or verification sampling.

An RI was conducted at NSWC – White Oak in two phases between January 1989 and March 1992 (Malcolm-Pirnie, October 1992). The RI was conducted to further characterize hazards associated with the identified sites and to aid in the development of remedial action plans for each. The RI involved the placement of additional groundwater monitoring wells at all sites; collection of surface and subsurface soil, sediment, surface water, and groundwater samples throughout the areas of investigation; collection of ecological data at all sites; and completion of slug tests and aquifer pumping tests at Site 4.

The results of the RI confirmed the presence of contamination at Site 4. The analytical data were used in the calculation of potential risk, based on exposure to groundwater. The calculated risks were determined to be high enough to support the development of an FS for the site. A draft FS completed by Malcolm-Pirnie in 1993 (Malcolm-Pirnie, March 1993) outlined the proposed remedial strategies for the site. The FS evaluated the previous site characterization data to determine the most effective means to reduce environmental hazards at NSWC-White Oak.

A Design Verification Study was conducted in 1995 to prepare remedial designs for Sites 2, 3, 4, 8, 9, and 11. Activities associated with the Design Verification Study included record reviews, terrain conductivity surveys, test pit excavation, and subsurface soil and sediment sampling. The results of the activities were then used to develop remedial design plans for the six IRP sites. Two reports were issued addressing the various findings of the study: a final report was issued for Sites 8, 9, and 11 and a draft report was issued for Sites 2, 3, 4, and 9 (HNUS, June 1995).

During 1995, in conjunction with the Design Verification Study, a wetlands delineation and forest stand inventory were conducted for Sites 2, 3, 4, 7, 8, 9, and 11. The delineation was performed in accordance with the delineation criteria in the 1987 U.S. Army Corps of Engineers (USACOE) Wetlands Delineation Manual. Wetland areas were identified within or adjacent to five of the seven IRP sites investigated, including Site 7, however none were identified at Site 4 (HNUS, August 1995).

The Base Realignment and Closure Act of 1990 (BRAC II) directed the Secretary of Defense to close or realign those installations recommended by the BRAC commission. The Community Environmental Response Facilitation Act (CERFA) of 1992 directed federal agencies with jurisdiction over certain real property to terminate federal government operations and to identify "uncontaminated" parcels of the real property. In

1995, NSWC-White Oak was selected for closure on the BRAC IV list. A Phase I Environmental Baseline Survey (EBS) was conducted by EA Engineering Science and Technology (EA) to assess the existing environmental information related to storage, release, treatment, or disposal of hazardous substances or petroleum products and to document the environmental condition of the property. The EBS also addressed actions required prior to property transfer to ensure compliance with requirements of CERCLA 120(h), applicable state and real estate laws, compliance programs, and the Department of Defense (DOD) policy *Environmental Requirements for Federal Agency-to-Agency Property Transfer at BRAC Installations.* The EBS was finalized and submitted in April 1996 (EA, April 1996).

An investigation to characterize background soil, sediment, groundwater, and surface water quality was performed in the fall of 1997. A final background report was published in 1998 (TTNUS, December 1998).

A facility-wide groundwater investigation was competed in the spring and summer of 1997. The investigation included the sampling of all existing groundwater monitoring wells and piezometers and the installation and sampling of new temporary and permanent groundwater monitoring wells in areas of the base proposed for reuse. The groundwater quality was similar to that found during previous studies (B&R Environmental, September 1997).

Also in 1997, a site investigation (SI) was conducted at Site 46 to investigate the nature and extent of chlorinated VOCs detected in this area which is situated immediately downgradient of Site 4. (see Figure 2-2). This investigation involved the installation of nine permanent and one temporary monitoring wells, the sampling of these and other existing wells, and the sampling of surface water and sediment in the streams surrounding the Site 46 area. A final Site 46 SI report was release in 1998 (TTNUS, November 1998).

An RFI was conducted for the immediate area around Site 4 (and five other sites) that further characterized the nature and extent of contamination in soil and groundwater at Site 4 (TTNUS, October 2000). The RFI concluded that elevated risks were present from exposure to Site 4 soil contaminated with chlorinated VOCs, most notably trichloroethene (TCE) Additional groundwater data were obtained in 1999 during four rounds (January/February, April, July/August, and October) of sampling and analysis of groundwater from numerous wells through White Oak, including 26 of the wells that existed at and around Site 4 at the time. Data from this investigation are presented in the report titled Addendum Rounds 1, 2, 3, & 4 Groundwater Data, RCRA Facility Investigation for Sites 2, 3, 4, 7, 8, & 9 (TTNUS, April 2000). Groundwater samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), explosives, and inorganic compounds. Results provided data for within-well comparisons over time.

Beginning in 1994 and continuing through the present day, the US Army has also been conducting groundwater sampling on the Army property located downgradient of both Sites 4 and 46 to evaluate the impacts from Site 4 as well as from a former petroleum product release from an Army facility. The Army has installed eleven monitoring wells on their property. Samples from groundwater wells and from sediment and surface water in several downgradient streams, have been collected at least annually to date since 1996, and results are documented in annual or semiannual reports.

EPA collected two rounds of soil, surface water and sediment samples in 1998 and 1999 from private and local park commission properties located downgradient of sites 4 and 46 to characterize any impacts from releases from the NSWC-White Oak and the Army property.

The results of the groundwater investigations up through 1999 indicated a potential connection between Site 4 and the contamination observed in the groundwater at Site 46, the Army property and private property downgradient of the Army.

Two residential wells had been in use on the private properties situated between the Army property and the bounding streams (Paint Branch and the Floral Drive stream). These two wells have been sampled regularly since 1998. Risk assessments were performed by EPA in 1998. On the basis of the results of the samples and the risk assessment it was determined that there are no unacceptable risks to the use of water from the two private wells. Both properties are now on public water supply and the wells are abandoned.

Data also indicated some intermingling of contaminants from Site 7 (explosives compounds) with those from Site 4. The groundwater impacted by Site 4 (and Site 7) was investigated further between 1999 and 2001 as part of the OU-1 RI (CH2M HILL, August 2002). OU-1 includes groundwater beneath IR sites in the eastern portion of White Oak, including the Site 46 area, the Army property, and the bounding streams located both on and off the U.S. government property (See Figure 2-2). OU-1 was designated by the BRAC Cleanup Team (BCT), consisting of the Navy, EPA and MDE, to allow for a more complete understanding of the nature and extent of groundwater contamination in this part of the facility. The OU-1 RI focused groundwater contamination characterization on two primary areas: (1) defining the boundaries of the groundwater contamination within OU-1 including developing and confirming a groundwater conceptual model that suggested that the surrounding streams act as barriers to groundwater migration, and (2) determining if a connection exists between the groundwater contamination at Site 4 and that observed further downgradient at Site 46. The investigation included the installation of 52 temporary and 42 permanent monitoring wells, and the collection of surface water samples from Paint Branch, West Farm Branch, the Floral Drive stream, the Building 500 Outfall stream, and the Site W swale stream. The OU-1 RI concluded that the streams do act as hydrologic boundaries and that the VOC-contaminated groundwater plume present within Site 46 and the Army property is emanating from Site 4. The OU-1 RI also included a baseline human health risk assessment for the groundwater and surface water.

An FS was conducted for OU-1 in 2003 (CH2M HILL, June 2003). The FS included an evaluation of remedial alternatives for Site 4 soil and Site 4 groundwater. As part of the FS process, four temporary and three permanent wells were installed in the immediate vicinity of the Site 4 disposal area to provide data for better evaluating remedial alternatives, and to determine if contamination has migrated into the bedrock beneath the site. The area of the Site 4 groundwater plume, and the existing monitoring well network, is shown in Figure 2-3.

### 2.2.4 Soil Removal Action

Based on the soil contamination found at Site 4 resulting from the disposal of wastes, the Navy decided to conduct a removal action at Site 4. Data collected during the Design Verification Study were used to plan the removal action. These included data from subsurface soil sampling, groundwater sampling, a soil gas survey, and a geophysical survey to define the extent of the removal action at the site. Following the completion of the Design Verification Report, an Action Memorandum was prepared that addressed the excavation of waste and soil at the site. The Action Memorandum was made available for public review and comment between February 17, 1999 and March 18, 1999.

A soil removal action was conducted at Site 4 in the summer of 1999. During the removal action, approximately 23,000 tons (18,000 cubic yards) of contaminated soil and solid waste were removed and transported to a municipal solid waste landfill for disposal. An additional 187 tons of soil contaminated with PCBs were excavated and disposed at a hazardous waste landfill in accordance with federal regulations. The goal of the removal action was to remove soil with contaminant concentrations in excess of industrial land-use risk-based standards. During the removal action, excavation proceeded until no trash was visible and no organic vapors were detected. Verification samples were collected throughout the duration of the removal action and at the completion. The cleanup goals, based on industrial use standards, were met. Following completion of excavation and verification sampling, Site 4 was back-filled with clean soil and returned to grades similar to that which existed prior to the removal action. Grass cover was established on the area.

Verification samples were collected and a post-removal action report was prepared to document post-removal conditions (TTNUS, October 1999). Data from these samples were also used to conduct a human health risk evaluation of the soil remaining after the removal action (TTNUS, January 2003).

The FS for OU-1 groundwater (CH2M HILL, June 2003) also included additional sampling of the deep subsurface soil remaining at Site 4 after the 1999 removal action, in order to determine if the soil still represented a source of contamination to groundwater via leaching. The FS concluded that the soil between approximately 17 and 30 feet below ground surface (bgs) across an area of 8,000 square feet, contained concentrations of TCE, and 1,1,2,2-tetrachloroethane (PCA) that represent potential continuing sources of

groundwater contamination. This amounts to a total of approximately 3,800 cubic yards of contaminated soil. The groundwater table is encountered at depth of approximately 30 to 32 feet.

### 2.2.5 Groundwater Interim Actions

As a result of the findings from the various groundwater investigations, three interim measures were implemented to address contamination in the Site 46 area and on the Army property downgradient of Site 4. A groundwater extraction trench and treatment system (air stripper) was constructed near the government property line in 1998 to intercept the VOC plume and prevent contaminated groundwater from migrating offsite and discharging to the Site W Swale stream (See Figure 2-3). The treated water is monitored and is discharged to the Site W Swale stream. In 1999 a system of three groundwater extraction wells was installed further upgradient in this VOC plume in order to reduce contaminant concentrations and contain contaminated groundwater closer to the source. This system was enlarged to six wells in 2000. The groundwater extracted by the wells is treated in the same air stripper as is the water from the extraction trench.

An air stripper was also added to the storm water outfall for the Army Building 500 area by the Navy in 1997. The storm water system in this area is constructed below the water table, and thus it inadvertently collects groundwater containing VOCs. Prior to treatment in the air stripper, the water is passed through an oil water separator that was installed by the Army to remove petroleum product from an unrelated release at Building 500. The treated effluent from the storm water system is discharged to the Building 500 Outfall.

## 2.3 COMMUNITY PARTICIPATION

In accordance with Sections 113 and 117 of CERCLA, 42 U.S.C. Sections 9613 and 9617, the Navy, in conjunction with EPA, issued a Proposed Plan on June 24, 2003 that presented the preferred remedy for Site 4 groundwater and soil. The Proposed Plan for Site 4, and the RI and FS for OU-1 (including Site 4), became available for review by the public at that time and are among the documents that comprise the Administrative Record file for NSWC-White Oak, which is maintained at Naval Facilities Engineering Command (NAVFAC) Washington, at the Washington Navy Yard, Washington D.C. In addition, the Proposed Plan for Site 4, and the RI and FS for OU-1 (including Site 4) and other documents relevant to the remedy selection for Site 4 groundwater and soil were made available to the public in June 2003 in an information repository for NSWC-White Oak that is maintained at the Montgomery County Public Library, White Oak Branch in Silver Spring, Maryland. The notice of the availability of these documents, the public comment period, and a public meeting was published in the *Washington Post* on June 19, 2003, and in the *Silver Spring Gazette, College Park Gazette,* and *Burtonsville Gazette* on June 18, 2003. The public comment period was held from June 24, 2003 to July 24, 2003, and a public meeting was held on July 8, 2003. Additional community involvement is detailed in Section 3.0.

## 2.4 SCOPE AND ROLE OF RESPONSE ACTION

Although the NSWC-White Oak facility is not on CERCLA's National Priorities List (NPL), in its response actions at the Site, the Navy has been guided by the NCP provisions pertaining to remedial actions. Section 300.430(a) (1)(ii)(A) of the NCP, 40 C.F.R. Section 300.340(a)(1)(ii)(A) provides that CERCLA NPL sites "should generally be remediated in operable units when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phase analysis or response is necessary or appropriate given the size or complexity of the site, or to expedite the completion of the total cleanup." This ROD for Site 4 groundwater and soil is the eighth prepared for sites at NSWC-White Oak.

*In-situ* enhanced reductive dechlorination combined with institutional controls, long-term monitoring and the continued operation of the existing interim groundwater extraction and treatment system, is selected for groundwater at Site 4 to protect human health and the environment. Soil vapor extraction is the selected remedy for soil at Site 4, to remove any potential continuing source of groundwater contamination.

## 2.5 SITE CHARACTERISTICS

### 2.5.1 Physical Setting

The former NSWC-White Oak is located approximately 5 miles northeast of Washington, D.C., near the boundary between the Piedmont and Coastal Plain physiographic provinces The facility lies in gently rolling terrain. The topographic expression of the area is typical of a deeply incised, dendritic stream channel pattern. Paint Branch and its tributaries dominate local drainage patterns.

The highest elevation of NSWC-White Oak is approximately 398 feet above mean sea level (msl). The lowest elevation is roughly 145 feet above msl. The terrain of the western portion of the facility slopes generally eastward toward Paint Branch with about 3.5 percent grade. Similar grades are encountered in the eastern portion of the facility, but slopes are more generally southward or are locally influenced by proximity to Paint Branch and its tributary drainages. Near stream channels, the ground slopes increase to as much as 65 percent. Site 4 is relatively flat and surrounded by a rising slope to the east, south and west. There are no surface water features near the former burial pits. Surface water runoff from on, and around the immediate vicinity of the site, flows toward the center of the site and infiltrates the soil overlying the area of the former burial pits and migrates into the subsurface soils.

The subsurface geology of Site 4 is illustrated in Figure 2-4. The three primary stratigraphic units underlying the former NSWC - White Oak in the Site 4 area are the Coastal Plain sediments, saprolite, and bedrock. The Coastal Plain deposits are silty sand, sand and gravel underlain by clayey sand with gravel on silt. Results of the surface geophysical survey and soil borings indicate Coastal Plain deposits vary between 50 and 100 ft thick throughout the majority of Site 4 and OU-1 but abruptly reduce in thickness near the streams, and are completely weathered away in the major stream valleys. Furthermore, the deposits are thickest in the northern portion of the site and thin in a southerly direction. Site data also show the Coastal Plain/saprolite contact to be an undulating surface.

The saprolite forms on the upper surface of a crystalline bedrock schist. It grades from a micaceous silt or silty sand with varying amounts of clay and schist fragments to a severely weathered schist with relief texture; it varies in thickness from 5 to 55 feet (and possibly greater). The competent bedrock is primarily a garnet schist; however, in the borings for the deep wells interbedded quartzites were observed.

### 2.5.2 Conceptual Site Model

Figure 2-5 provides the conceptual site model (CSM) for exposure of human receptors to soil and groundwater. The CSM illustrates contaminant sources, release mechanisms, exposure pathways, migration routes, and potential receptors and provides a basis for the risk assessments summarized later in this ROD and, as a result, the basis for necessary response actions.

Human receptors evaluated for exposure to groundwater include: present and/or future construction workers, and potential future child and adult residents.

Receptors evaluated for exposure to Site 4 soil include: present and/or future industrial workers, maintenance workers, construction workers, adult recreational user, adolescent trespasser, potential future day-care-center child and potential future child and adult residents.

Although use of the groundwater as a residential drinking water source is not reasonably anticipated, this potential use was still evaluated to determine whether land use controls (LUCs) would be needed. Current and potential future land and resource uses are discussed further in Section 2.6. Potential risks to human health are identified in Section 2.7.1.

Ecological receptors were evaluated for exposure to Site 4 soil as part of the base-wide ecological risk assessment. Ecological receptors on the property would not be directly exposed to groundwater at Site 4.

While TCE, 1,1,2,2-PCA, RDX and HMX were detected in the surface water in one or more of the following surface water bodies: the Floral Drive stream, the Site W Swale stream, and the Building 500 Storm water Outfall, they were not found to be present anywhere at the Site above the risk-based screening levels for human health or ecological risk, and therefore, risks to receptors were not evaluated for this media.

Neither the sediment nor surface water are considered media of concern for Site 4 and have not been addressed further in the risk assessment or FS for Site 4.

### 2.5.3 Nature and Extent of Contamination

The RI for OU-1 (CH2M HILL, August 2002) presents a complete set of data and graphics defining the nature and extent of soil and groundwater contamination throughout the OU. Data from sampling activities at Site 4, between 1999 and the present, were used to assess the extent of soil and groundwater contamination that exceed preliminary remediation goals (PRGs). The nature and extent of contamination at Site 4 can be summarized as follows:

- The source of TCE and 1,1,2,2-PCA contamination was waste and contaminated soil in the Site 4 chemical disposal area. The vast majority of this waste was excavated in 1999, but a layer of contaminated soil still remains from a minimum depth of 14 feet below the current ground surface extending to the water table at about 32 feet bgs. TCE and 1,1,2,2-PCA concentrations in this soil do not present an unacceptable risk to receptors from contact with the soil, but do represent a continuing source of groundwater contamination.
- The contaminated soil and waste has resulted in a plume of contaminated groundwater that extends from Site 4, approximately 3,300 feet to where the groundwater discharges into several surface water streams
- Other contaminants (benzene, toluene, explosives, perchlorate) have been detected in discrete areas of the TCE/1,1,2,2-PCA plume. These contaminants appear to have originated from other known sources (Site 7, and a former gasoline UST at the centrifuge in Site 46).
- While Site 4 related contaminants have been detected in the receiving surface water streams, the concentrations are below risk-based screening levels for all applicable exposure routes.
- No site related contaminants have been detected in sediments in the receiving surface water streams.

Soil and groundwater contamination are discussed in more detail in the following sections.

#### *2.5.3.1 Soil*

Contaminated source materials (soil and buried waste) were excavated at Site 4 as part of a non-time critical removal action conducted in June through August 1999. The excavation extended to a depth of 27 ft below the former ground surface in many locations. The area was then backfilled with up to approximately 20 ft of clean fill, lowering the ground surface by as much as 7 ft in many areas. The objectives of the removal action were to excavate soil and solid waste to eliminate human health risk to future land users based on an industrial land-use scenario. The removal action goals used for the excavation were based on risk from direct contact with soil and were not necessarily protective of groundwater. Therefore, there is concern that soil contamination (specifically with TCE and 1,1,2,2-PCA) still is present at concentrations that represent a potential source of groundwater contamination through leaching.

Confirmation samples collected from the bottoms and side walls of the excavation, indicated that PAHs, TPH, and VOCs, namely TCE, remained in the soil at depths of approximately 14 feet below the current ground surface. Of these contaminants only TCE was also present in the groundwater at concentrations that exceed the PRGs. PAH contaminated soils remain in-place primarily in the northern half of the excavation (Burial Area 1 - See Figure 2-6), although several spots in the central and southern part of the excavation (Burial Area 2) also contained detectable concentrations. The concentrations of TPH in soil samples ranged from 170 mg/kg on the bottom of the Burial Area 1 excavation to 5,900 mg/kg on the bottom of the Burial Area 2 excavation. TCE was only detected in soil samples from the bottom of the excavation in Burial Area 2.

Additional soil sampling was performed within Burial Area 2 in September 2001, May 2002, and January 2003, to better define the extent of VOCs in soil, that may represent a continuing source of groundwater contamination above PRGs. These data are presented in Tables 2-1, 2-2, and 2-3 respectively. Boring locations are shown in Figure 2-6 In general, detectable soil contamination was encountered beginning at depths of approximately 14 ft and extending to the water table. The maximum concentration of TCE detected was 59,000 µg/kg in boring 04SB403 at a depth of 32 to 34 ft. The maximum concentration of 1,1,2,2-PCA detected was 830 µg/kg in boring 04SB302 at a depth of 18 to 20 ft. Figure 2-6 presents the average concentrations of TCE and 1,1,2,2-PCA at each boring location The averages were calculated throughout the depth of the boring. Figure 2-6 also delineates the extent of soil contamination above the proposed PRGs. The procedures used to determine average concentrations and delineate the extent of contamination are discussed in the FS for OU-1.

Figures 2-7 and 2-8 are cross-sections depicting the vertical distribution of TCE and 1,1,2,2-PCA contamination in the subsurface soil. The cross-section transects are shown in Figure 2-6. The vertical extent of TCE and/or 1,1,2,2-PCA contamination extends from 14 ft bgs to the groundwater table approximately 30 to 34 ft bgs. However, the bulk of contamination seems to be located within a 12 to 15 ft thick layer of medium to course sand and gravel between 14 to 28 ft bgs

It should also be noted that relatively high levels of TPH, both diesel (DRO) and gasoline (GRO) range organics were detected in the subsurface soil. The maximum DRO concentration was 500 µg/kg and the maximum GRO concentration was 200,000 µg/kg.

#### *2.5.3.2 Groundwater*

Groundwater contamination originating from Site 4, and possibly some smaller sources within the Site 46 area have created a dissolved-phase plume that extends from Site 4 in the north to Paint Branch and the Floral Drive stream, the hydrogeologic discharge boundary, in the south. The southern limit of the contamination is where low levels of TCE and other chlorinated solvents and explosives were detected in seeps and monitoring wells near Paint Branch and the Floral Drive stream. Concentrations of VOCs, several explosives compounds, and iron are present in this plume at levels that require remediation in order to meet the preliminary remediation goals. This area is shown in Figure 2-3.

The dissolved-phase groundwater contamination south of Sites 4 and 7 occupies an area that varies between about 500 ft and 1,500 ft wide (averaging about 800 ft wide) from east to west and extends about 3,300 ft downgradient (south) from Site 4. Figure 2-3 shows the approximate extent of the groundwater plume in Coastal Plain groundwater based on a compilation of site data from 2000 to present. The plume of contamination is generally defined by groundwater containing TCE at concentrations greater than 5 µg/L, the maximum contaminant level (MCL) for TCE. The plume contains several other VOCs and several explosives compounds, but these compounds typically are only found in areas where TCE is also present above its MCL. The COCs in this area, and maximum concentrations found since the 1999 removal action at Site 4 consists of (in order of prevalence):

- TCE—4,300 µg/L
- 1,1,2,2-PCA—317 µg/L
- Vinyl chloride—73 µg/L
- Cis-1,2-DCE—402 µg/L
- 1,2-DCA—285 µg/L
- 2-amino-4,6-DNT—0.8 µg/L
- 4-amino-2,6-DNT—1.0 µg/L
- Iron—38,500 µg/L
- Benzene—1,710 µg/L (detected in one well)
- Toluene—2,490 µg/L (detected in one well)

Perchlorate has also been detected in wells within this area, with a maximum detected concentration of 76 µg/L. Concentrations of total VOCs in excess of 500 µg/L are found only in wells north (upgradient) of the

centrifuge extraction wells (see Figure 2-3).

Groundwater in the immediate footprint of the former burial area at Site 4 (i.e. the source area) has been sampled on numerous occasions both before and after the 1999 soil removal action. Pre-removal action results indicate that Site 4 is a source of groundwater contamination of chlorinated VOCs, primarily TCE and 1,1,2,2-PCA.

Prior to the removal action, maximum groundwater concentrations detected in a shallow well located in the center of Burial Area 2 (04GW102) contained TCE at the 11,000 µg/L, 1,1,2,2-PCA at 300 µg/L, cis-1,2-DCE at 8,000 µg/L, 1,2-DCA at 20 µg/L, and vinyl chloride at 70 µg/L. This well was screened across the water table. A paired well (04GW103), which was screened at the bottom of the Coastal Plain deposits, contained TCE at only 10 µg/L.

Groundwater sampling has taken place within the former Burial Area 2 footprint on three occasions since the removal action to evaluate the effects of the action and to determine if the groundwater and/or saturated soil at Site 4 represent a continuing source of contamination to the groundwater. Wells 04GW301 and 04GW203 were constructed to replace wells 04GW102 and 04GW103 respectively (which were damaged during the removal action). The concentration of TCE in the groundwater in lower portions of the Coastal Plain aquifer continue to be relatively low, ranging from 0.56 µg/L to 104 µg/L, while concentrations in the upper portion of the aquifer have increased from 21 µg/L in May 2002, to 1,200 µg/L in February 2003 and to 4,300 µg/L in May 2003.

Approximately 200 feet south (downgradient) of the source area, at wells 04GW50 and 04GW105, this vertical distribution flip-flops, (i.e. the higher TCE concentrations are detected in the lower portions of the Coastal Plain aquifer), presumably because clean water infiltration from rainfall pushes the contaminated groundwater down. In January 2003 a bedrock well (04GW302) was installed next to wells 04GW50 and 04GW105 to define the vertical extent of contamination. The results from this well indicated that there is no VOC contamination in the bedrock. Detected concentrations from September 2001, May 2002, February 2003, and May 2003 are presented in Tables 2-4, 2-5, 2-6 and 2-7 respectively.

From the source area, groundwater flows to the south-southeast with a hydraulic gradient estimated at 0.012 ft/ft between Site 4 and the vicinity of Building 500 and 0.073 ft/ft between the vicinity of Building 500 and Paint Branch. The geometric mean of hydraulic conductivity for the Coastal Plain deposits is 2.8 ft/day (CH2M HILL, August 2002). Groundwater flow velocity ranges between 50 and 300 ft per year, with the higher velocities present where the gradients are steeper.

Contamination is believed to be limited to the Coastal Plain hydrogeologic unit within the majority of the Sites' 4, 7 and 46 plume. This conclusion is based on the lower hydraulic conductivity of the saprolite compared to the Coastal Plain deposits (allowing it to at least impede flow and migration downward into the bedrock), the absence of contamination in bedrock wells in the vicinity of Site 4 (well 04GW302) and Building 500 (wells C-14, C-15, and well nest 46GW213S, M and D), and the absence of contamination in wells screened in the saprolite downgradient of Site 7 (well 07GW201). Therefore, for the purposes of evaluating remedial measures, only contamination in the Coastal Plain hydrogeologic unit was considered. However, in the vicinity of the southern limit of the Coastal Plain deposits (near the bounding streams) and under natural flow conditions, the contaminated groundwater flows through the saprolite and bedrock (and then flows through fractures into Paint Branch); discharges from seeps onto the ground surface and then into small local streams; or discharges into the Floral Drive stream.

As discussed in Section 2.2.5, there are three existing interim facilities for containing and remediating groundwater contamination within this plume. These collection facilities intercept contaminated groundwater that otherwise would have discharged to seeps, swales, the lower reaches of the Floral Drive stream or Paint Branch. The locations of these systems and their approximate groundwater capture zones are shown in Figure 2-3.

No significant trends in groundwater contaminant concentrations have been observed in the plume with the following exceptions, which are discussed further in Section 2.5.3.3:

- Wide fluctuations have been observed in the TCE concentrations in the vicinity of the former Site 4 disposal area.

- Significant decreases of TCE concentrations have been observed in the areas downgradient of the interim extraction systems.

A preliminary evaluation of natural attenuation processes in this plume was conducted as part of the RI for OU-1 (CH2M HILL, August 2002). The study looked for the two lines of evidence in EPA guidance that might suggest that natural attenuation is taking place.

The first line of evidence should show that contaminant plume has stabilized or is shrinking in size. TCE contaminant concentrations appear to be stable in the downgradient portion of the plume as is evidenced by the consistent concentrations of TCE observed in the centrifuge extraction wells, but there is no observable shrinkage of the plume. The second line of evidence relies on observable changes in groundwater chemistry that occur during biodegradation. Daughter products of TCE and 1,1,2,2-PCA, namely *cis*-1,2-DCE, *trans*-1,2-DCE, vinyl chloride, and ethene, have all been detected in groundwater in locations in the plume, which supports their provenance from TCE and 1,1,2,2-PCA. In addition, nitrate and sulfate reduction and chloride and methane production suggest that anaerobic degradation of chlorinated hydrocarbons is occurring in the groundwater system impacted by the plume.

This evaluation concluded that biodegradation of chlorinated hydrocarbons in groundwater through reductive dechlorination and cometabolism is likely to have occurred and, in some cases, is continuing to occur to some degree. However, the fact that TCE and 1,1,2,2-PCA are still the predominant contaminants at the downgradient edge of the plume indicate that the current rate of degradation is inadequate to sufficiently remediate the plume. Additionally, it appears that the biological activity is limited by an inadequate supply of carbon. The current primary mechanisms for attenuation are more likely dilution, adsorption, and dispersion, rather than biodegradation.

#### *2.5.3.3 Recent Findings*

The most recent data available during the preparation of the FS for OU-1 and Site 4, which were collected in May 2002, indicated that the highest groundwater concentrations emanating from Site 4 are no longer located immediately beneath the former burial area. This observation, together with the fact that groundwater contamination at Site 4 is limited to the upper portion of the Coastal Plain groundwater, lead to a conclusion that the vast majority of the source of contamination is no longer present at the former burial area and that there is very little if any residual contamination below the water table at Site 4 (i.e.: any continuing source is limited to the soil above the water table), and that the contamination in the groundwater at Site 4 is strictly in the dissolved phase.

More recent data from February and May 2003, have shown significant increases in the TCE and 1,1,2,2-PCA concentrations in the shallow groundwater directly beneath Site 4. While this increase is possibly due to a significant rise in the water table since May 2002 (e.g.: the water table has risen more than 14 feet into the layer of contaminated subsurface soil), it indicates that there now is likely to be significant residual contamination below the water table that warrants a revision to the preferred alternative identified in the Proposed Plan.

Groundwater data collected since the interim groundwater extraction systems were installed in approximately 2000 show significant decreases in TCE concentrations in the wells located downgradient of these systems. TCE concentrations in wells downgradient of the centrifuge extraction wells have declined between 75 and 100 percent. TCE concentrations in the wells downgradient of the Site W swale extraction trench have declined about 80 percent.

## 2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

Site 4 former burial area consists of an open bowl-shaped field approximately one acre in size. The area surrounding the field to the east, west and south is wooded property owned by GSA. The property bounding the site to the north is an industrial property formerly operated as a sand and gravel quarry. The land overlying the groundwater plume originating at Site 4, and extending south to Paint Branch, consists of federal land owned by GSA and the U.S. Army, and several private properties along Paint Branch and the Floral Drive stream (See Figure 2-3).

The GSA, which owns the property overlying the groundwater containing the highest concentrations of contaminants, has no immediate plans to use this area. The Army property is currently being used for industrial purposes.

The private properties overlying the far southern extent of the plume cover approximately 16 acres. There are no drinking water supply wells located on these properties and all of the properties are provided with water from a public source. Groundwater at Site 4, and throughout the former NSWC White Oak, is not used as a potable water source at this time and is unlikely to be used for such purposes in the future. Water for the current and future occupants of the former NSWC-White Oak and the surrounding properties is (and is expected to continue to be) supplied by a local municipal water authority. Local ordinances prevent the installation of new private potable supply wells without a permit.

Nonetheless, for the purposes of the site assessment, the site was evaluated assuming the possibility of residential use for the entire area including the use of the groundwater as a primary drinking water source.

## 2.7 SUMMARY OF SITE RISKS

The baseline risk assessments estimate the risks the site would pose if no action were taken beyond the source removal already completed. It can provide the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by a remedial action. It can also be used to support a determination that no additional remedial action is necessary to protect human health and the environment. Both ecological and human health baseline risk assessments were conducted to evaluate risks from Site 4 contaminants. The ecological risk assessment was conducted on a facility-wide basis, and results as they relate to Site 4 are discussed in Section 2.7.4. Baseline human health risk assessments (BHHRA) were conducted separately for Site 4 soil (in the *Addendum-Human Health Risk Evaluation for Post-Removal Soil, Site 4 – Chemical Burial Area, Tetra tech NUS, January 2003*) and the Site 4 groundwater (in the *Remedial Investigation for Operable Unit 1, CH2M HILL, August 2002*). As discussed in Section 2.5.2, surface water and sediment have been shown not to have been impacted by releases from Site 4 at concentrations above risk-based screening criteria. The basis for this conclusion is provided in the RI for OU-1.

This section of the ROD summarizes the results of these baseline risk assessments. The human health risk assessments contain evaluations of all chemicals (or contaminants) of potential concern (COPCs) [alternately referred to as potential chemicals of concern (PCOCs) in some site reports] and exposure pathways, including some that were later determined to not pose unacceptable risks to human health. COPCs are those chemicals that are identified as a potential threat to human health after an initial screening and are evaluated further in the baseline risk assessment. COPCs are identified by comparing soil, groundwater, surface water, and sediment contaminant concentrations to risk-based screening levels based on direct contact with the contaminated media. Soil concentrations are also compared to leaching to groundwater screening levels. Chemicals of concern (COCs) are a subset of the COPCs. COCs are identified as chemicals in an environmental medium (e.g., soil or groundwater) needing to be addressed by a response action because they exceed risk-based remediation goals or drinking water standards (i.e.: MCLs), or if concentrations in the soil exceed site-specific leaching-to-groundwater criteria developed by site-specific modeling.

No COCs were identified for Site 4 soil under post-removal action conditions based on direct exposure to soil. However, two compounds were identified as COCs in soil by the site-specific leaching model because they represent possible continuing sources of groundwater contamination. As a result, action is warranted for the soil to protect human health. Several COCs were identified in Site 4 groundwater; therefore, action is

warranted for the groundwater to protect human health. No unacceptable risks to the environment were identified for any media.

The following subsections summarize the various risk assessments conducted for Site 4 media. Because risks presented by contaminated soil and groundwater were evaluated in separate reports, they are presented separately here.

### 2.7.1 Baseline Human Health Risk Assessment Process

#### *2.7.1.1 COPCs*

The selection of COPCs is a qualitative screening process that identifies those site-related chemicals in the risk assessment that may add to overall potential risks.

The COPC selection process was conservative to ensure selection of the constituents comprising the great majority of the potential risk associated with the site. The maximum detected concentration of each constituent in each medium was compared to a screening value to select the COPCs for the media. If the maximum concentration of a constituent exceeds the screening value, the constituent was selected as a COPC and retained for the risk evaluation. The COPC screening levels were based on EPA Region III risk-based concentrations (RBCs) (EPA, 2002) for residential land use considering both cancer and non-cancer risks. The EPA Region III RBCs were developed using protective default exposure scenarios suggested by EPA (EPA, 1991) and the most current available reference doses (RfD) and cancer slope factors (CSF) (EPA, 2002). Chemicals eliminated from further evaluation at this step are assumed to present minimal risks to potential human receptors.

#### *2.7.1.2 Exposure Assessment*

The exposure assessment defines and evaluates the type and magnitude of human exposure to the chemicals present at, or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, identify potentially exposed populations, and estimate chemical intakes under the identified exposure scenarios. Actual or potential exposures are based on the most likely pathways of contaminant release and transport, as well as human activity patterns. A complete exposure pathway has three components: a source of chemicals that can be released into the environment, a route of contaminant transport through an environmental medium, and an exposure or contact point for a human receptor.

A human health exposure assessment defines and evaluates, quantitatively or qualitatively, the type or magnitude of human exposure to COPCs identified in environmental media at a site under investigation. The potential human receptors evaluated for exposure to soil and groundwater at Site 4 are identified in Section 2.5.2. Reasonable Maximum Exposure (RME) and Central Tendency Exposure (CTE) risk were evaluated for each receptor. The RME scenario represents the highest level of human exposure that could reasonably be expected to occur, and the central tendency exposure (CTE) scenario portrays the average human exposure.

Pathway-specific information for these receptors, such as the values of exposure parameters used to quantify exposure, are presented in the RI for OU-1 (groundwater) and the *Addendum-Human Health Risk Evaluation for Post-Removal Soil for Site 4* (soil).

The exposure point concentration (EPC), which is calculated for COPCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time and is used to calculate estimated exposure intakes. The 95 percent upper confidence limit (UCL), which is based on the distribution of a data set, is considered to be the best estimate of the exposure concentration for data sets with 10 or more samples. The methodology for calculating the 95 percent UCLs is presented in the RI for OU-1. The 95 percent UCL for each PCOC was used as the EPC for both soil and groundwater because the data set for each media consisted of more than ten samples.

### *2.7.1.3 Toxicity Assessment*

This section provides the methodologies for the characterization of the potential human health risks associated with the potential exposure to media at Site 4. The toxicity assessment identifies the potential adverse health effects in exposed populations. Toxicity values approved by EPA are used to characterize the potential risk.

The toxicity value used to evaluate carcinogenic effects is the CSF. The CSF is an upper-bound estimate of the probability that a person will develop cancer over a lifetime based on a given dose. It is based on dose-response data from human and/or animal studies. At this time, slope factors are not available for the dermal route of exposure. Thus, the dermal slope factors used in the assessment have been extrapolated from oral values. An adjustment factor is sometimes applied, and is dependent upon how well the chemical is absorbed via the oral route.

The toxicity value used to evaluate noncarcinogenic effects is the RfD. The RfD is an estimate of the daily exposure level for the human population that is likely to be without appreciable risk during an established period of time; ranging from several weeks to a lifetime, depending on the exposure scenario being evaluated. It is based on a review of available animal and/or human toxicity data, with adjustments for various uncertainties associated with the data. As with CSFs, RfDs are not available for the dermal route of exposure. As was the case with the carcinogenic compounds, dermal RfDs can be extrapolated from the oral reference doses by applying an appropriate adjustment factor. Adjustments are particularly important for chemicals with less than 50 percent absorption via the ingestion route.

### *2.7.1.4 Carcinogenic Risk Characterization*

Quantitative estimates of risk are calculated using exposure and toxicity values according to risk assessment methods outlined in current EPA guidance (EPA, 1989). Incremental lifetime cancer risks (ILCRs) are expressed in the form of dimensionless probabilities, which are derived using published CSFs. Noncarcinogenic risk estimates are presented in the form of hazard quotients (HQs) that are derived using published RfDs

ILCR estimates are generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$ILCR = (CDI) / (CSF)$$

where:

ILCR = a unitless probability (e.g. $2.0 \times 10^{-5}$) of an individual's developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
CSF = cancer slope factor, expressed as $(mg/kg\text{-}day)^{-1}$

An excess ILCR of $1.0 \times 10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess ILCR" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or overexposure to the sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three.

In order to interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates are compared to typical benchmarks. EPA has defined the range $1.0 \times 10^{-6}$ to $1.0 \times 10^{-4}$ as the ILCR "target range" for most sites addressed under CERCLA. A cumulative ILCR greater than $1.0 \times 10^{-4}$ generally will indicate that some degree of remediation is required and ILCRs below $1.0 \times 10^{-6}$ normally will not require remedial efforts. Whenever ILCRs fall between $1.0 \times 10^{-4}$ and $1.0 \times 10^{-6}$, decisions for remediation will be made on a case-specific basis. Individual chemicals contributing significantly to risks above the target range are considered to be COCs.

#### 2.7.1.5 *Noncarcinogenic Risk Characterization*

Noncarcinogenic risks are assessed using the concept of hazard quotients (HQs) and hazard indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

HQ = (Estimated Exposure Intake) / (RfD)

Summing the individual HQs for all the COPCs generates an HI. It should be noted that an HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk," it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

An HI exceeding unity (one) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity (one), target organ effects from individual COPCs contributing to the risk are considered next. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) are regarded as being truly additive. Thus, COPCs contributing to an HI greater than 1.0 on the basis of a single target organ/effect are considered to be COCs.

#### 2.7.1.6 *Uncertainty Analysis*

The risk measures used in site risk assessments are not fully probabilistic estimates of risk but are conditional estimates given that a set of assumptions about exposure and toxicity are used. Thus it is important to specify fully the assumptions and uncertainties inherent in the risk assessment to place the risk assessments in proper perspective. This process is referred to as an uncertainty analysis. The uncertainties associated with the risk evaluations for soil and groundwater are discussed in the following sections.

### 2.7.2 Baseline Human Health Risk Assessment Results - Soil

The BHHRA for soil was conducted specifically for the soil that was left at Site 4 after the 1999 removal action. The list of soil COPCs was developed using this data. A summary of the COPC selection process for exposure to Site 4 soil under a residential land use scenario is presented in Table 2-8. COPCs for soil were defined as those chemicals with maximum concentrations greater than the EPA Region 3 risk-based concentration for soil ingestion in a residential setting. The chemicals retained as COPCs are:

- Four polycyclic aromatic hydrocarbons (PAHs): benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(a,h)anthracene
- One PCB: Aroclor 1260
- Dioxins/furans

The EPCs for COPCs in Site 4 soil are presented in Table 2-9. Soil EPCs are based on the 95 percent UCL because the data set consists of greater than ten samples. The oral/dermal CSFs for the soil COPCs are presented in Table 2-10. HIs were not calculated for soil because none of the soil COPCs are known to present adverse noncarcinogenic effects (None of the COPCs have RfDs).

Estimated ILCRs from exposure to soil at Site 4 under the RME and CTE conditions are summarized below.

**Incremental Lifetime Cancer Risks for Site 4 Soil (Cumulative Risk Summary)**

| | Full Time Worker | Maintenance /Utility Worker | Construction Worker | Adult Recreational User | Adolescent Trespasser | Day Care Center Child | Age-adjusted Resident |
|---|---|---|---|---|---|---|---|
| Total ILCR – RME | 1.5E-05 | 1.8E-06 | 1.7E-06 | 1.2E-06 | 2.2E-06 | 1.8E-05 | 5.8E-05 |
| Total ILCR – CTE | 1.9E-06 | 1.5E-07 | 8.4E-07 | 7.1E-08 | 4.3E-07 | 3.1E-06 | 4.2E-06 |

The cumulative ILCRs for all potential receptors under RME conditions are within the EPA acceptable target range of $1.0 \times 10^{-4}$ to $1.0 \times 10^{-6}$. Dioxins/furans account for 83 percent of the total cancer risk, while PAHs account for 14 percent. PCBs account for 3 percent. The cumulative ILCRs for all potential receptors under the CTE conditions are less than the lower bound of the EPA acceptable target range of $1.0 \times 10^{-4}$ to $1.0 \times 10^{-6}$.

Tables 2-11 through 2-18 summarize the contribution of cancer risks from each COPC under the RME scenario. Tables 2-19 through 2-26 summarize the contribution of risks from each COPC under the CTE scenario.

Some uncertainty associated with the identification of metals as COPCs still exists. A statistical analysis (Wilcoxon Rank-Sum Test) of site metal concentrations compared to site-specific background concentrations was conducted to determine if site concentrations are significantly greater than the background concentrations. If they are significantly greater than background, and the maximum detected concentrations are greater than the screening level, i.e., one-tenth the RBC for noncarcinogens and the RBC for carcinogens, they are identified as COPCs. If the site concentration was not significantly greater than the background concentration, the metal was not identified as a COPC, even if its maximum concentration was greater than the screening level. The statistical analysis accounts for the variability in concentrations.

The COPCs for soil based on the leaching-to-groundwater scenario, are those compounds that are found in soil and are also found in groundwater at the site at concentrations that exceed PRGs. Two COPCs were identified in the OU-1 FS: TCE and 1,1,2,2-PCA. While several chemicals, including benzene, benzo(a)pyrene, dieldrin, dioxins/furans, arsenic, and chromium, were detected in one or more soil samples from the Site 4 area at concentrations in excess of a conservative default leaching criteria, they were not included in the list of COPCs because they were not detected above PRGs in any groundwater samples from this area.

TCE and 1,1,2,2-PCA were subsequently identified as COCs because they are present in soil at concentrations that could cause exceedences of PRGs in the groundwater based on the site-specific leaching model used in the OU-1 FS.

Of the groundwater COCs identified in Section 2.8.3 for the Site 4 groundwater, only TCE and 1,1,2,2-PCA have been detected in any significant concentrations in Site 4 soil. The others are either:

1. Breakdown products of TCE and 1,1,2,2-PCA that were only detected in the groundwater and not detected in the soil (cis-1,2-DCE, 1,2-DCA, vinyl chloride), or

2. Were only detected above PRGs in the groundwater in the downgradient portions of the Site 4, 7 and 46 plume and are associated with other soil-based source areas that have been remediated by other actions (benzene, toluene, and the amino DNTs).

### 2.7.3 Baseline Human Health Risk Assessment Results - Groundwater

The BHHRA for groundwater presented in the OU-1 RI report was conducted to evaluate risks related to the entire OU-1, a groundwater OU of which Site 4 is just a part. This approach was taken because chemicals related to several of the individual sites mix together in the groundwater making it difficult and impractical to generate risks associated with individual source areas (sites). The OU-1 BHHRA generated a list of COPCs for the entire OU-1 and quantified worst-case risks to receptors. The OU-1 FS then identified the subset of groundwater COPCs related to distinct areas of OU-1 for the purpose of setting preliminary remediation goals (PRGs) and identifying COCs for each area. For the purpose of the ROD, site-specific risks have been conservatively estimated for Site 4 groundwater as discussed below.

### 2.7.3.1 *Risks from OU-1 Groundwater*

The list of groundwater COPCs for the entire OU-1 was developed using the samples identified in Table 2-27. Forty-one COPCs were identified in the groundwater in the Coastal Plain and saprolite aquifers. These consist of 20 VOCs, 4 explosives compounds, perchlorate, and 16 inorganics. Eighteen of these were also identified as COPCs in the bedrock groundwater (6 VOCs, 3 explosives compounds, perchlorate, and 8 inorganics). A list of the COPCs for all of OU-1 is presented in Table 2-28. A summary of the COPC selection process for exposure to OU-1 groundwater in the Coastal Plain/saprolite under a residential land use scenario is presented in Table 2-29. COPCs for OU-1 groundwater were defined as those chemicals with maximum concentrations greater than the EPA Region 3 risk-based concentration for tap water in a residential setting. Background concentrations were not used to screen out COPCs at this point in the risk assessment process.

The EPCs for COPCs in OU-1 groundwater under a residential use scenario are presented in Table 2-30. Groundwater EPCs are based on the 95 percent UCL because the data set consists of more than ten samples. The oral/dermal RfDs and CSFs for the OU-1 groundwater COPCs are presented in Tables 2-31 and 2-32, respectively.

Estimated HIs from exposure to OU-1 groundwater in the Coastal Plain/saprolite under the RME and CTE conditions are summarized below. The cumulative HIs (the sum of HQs for each COPC) for the construction worker under RME and CTE conditions do not exceed the EPA target of unity (one). The HIs for adult and child residents do exceed 1 for both the RME and CTE conditions.

**Hazard Index for all OU-1 Groundwater in the Coastal Plain/Saprolite**
**Cumulative Risk Summary**

| | Construction Worker | Adult Resident | Child Resident | Age-adjusted Resident |
|---|---|---|---|---|
| Total HI - RME | 1 | 37 | 66 | NA |
| Total HI - CTE | 0.04 | 6.8 | 13 | NA |

Estimated ILCRs from exposure to OU-1 groundwater in the Coastal Plain/saprolite under the RME and CTE conditions are summarized below. The cumulative ILCRs for the construction worker under RME and CTE conditions are within or less than the lower bound of the EPA acceptable target range of $1.0 \times 10^{-4}$ to $1.0 \times 10^{-6}$. The ILCRs for adult resident is greater than the upper bound of the EPA acceptable target range under the RME conditions and within the range under the CTE conditions. The ILCRs for the age-adjusted residents under both the RME and CTE conditions are greater than the upper bound of the EPA acceptable target range.

**Incremental Lifetime Cancer Risks for all OU-1 Groundwater in the Coastal Plain/Saprolite**
**Cumulative Risk Summary**

| | Construction Worker | Adult Resident | Child Resident | Age-adjusted Resident |
|---|---|---|---|---|
| Total ILCR – RME | 2.3E-06 | 6.6E-04 | NA | 5.6E-03 |
| Total ILCR – CTE | Not Calculated | 5.5E-05 | NA | 1.0E-03 |

Table 2-33 summarizes the contribution of risks (both cancer and non-cancer) from each COPC under the RME conditions. Table 2-34 summarizes the contribution of risks from each COPC under the CTE conditions.

### 2.7.3.2 *Site-Specific Risks from Site 4 Groundwater*

Site specific risks were estimated for the Site 4 groundwater using the results of the OU-1-wide risk assessment. Because the Site 4 area is a sub-area of OU-1 and several of the COPCs identified for OU-1 are not found at Site 4 groundwater, it is assumed the risks from Site 4 will be less than those from the entire OU-1. Also, it is assumed that the only exposure scenarios that might result in unacceptable risks from groundwater at Site 4 are those where unacceptable risks are present for OU-1as a whole, i.e. residential child, adult, and age-adjusted. The COPCs for the Site 4 groundwater were selected by identifying those OU-1 COPCs that are present at concentrations corresponding to a cancer risk of 5.0E-06 or above, or an HI of 0.1 or above, and were detected in monitoring wells within the Site 4 source area and plume. These levels were selected to ensure that the overall risk from COCs across OU-1 does not exceed a carcinogenic risk of 5x10-5 or noncancer hazard of 1.

Finally, inorganic compounds found in the groundwater at Site 4 in concentrations that do not exceed base-wide background levels were excluded as COPCs for Site 4 based on the background comparison evaluation conducted in the OU-1 RI. The maximum detected chemical concentrations in groundwater were compared to the 95 percent upper tolerance limits (UTLs) calculated for the background data. Additionally, a population to population (background groundwater to site groundwater) comparison was conducted using the nonparametric Mann-Whitney U test since the site data and background data are not normally distributed. The maximum detected concentration of thallium is slightly below the background UTL. Based on the Mann-Whitney U test; cobalt, manganese, and nickel are also present in the site groundwater at similar concentrations to the background groundwater. As a result of this comparison, thallium, cobalt, manganese and nickel were eliminated as COPCs.

The following chemicals were retained as COPCs in Site 4 groundwater:

- Eight VOCs: 1,1,2,2-PCA, TCE, cis-1,2-dichloroethene (DCE), 1,1-DCE, 1,2-dichloroethane (DCA), vinyl chloride, benzene, and toluene
- Three explosives compounds: 2,4,6-trinitrotoluene, 2-amino-4,6-DNT and 4-amino-2,6-DNT
- Three inorganics: arsenic, cadmium and iron
- Perchlorate

HIs and ILCRs were then calculated by assuming that the maximum incremental risk calculated for each of these COPCs during the OU-1 risk calculation applied to Site 4. Incremental risks related to other VOCs that were detected in a small number of samples below screening criteria were also included in the Site 4 groundwater risk summary. The incremental risks used to calculate the Site 4 risks are highlighted in Tables 2-33 for the RME conditions and in Table 2-34 for the CTE conditions.

Estimated HIs from exposure to Site 4 groundwater in the Coastal Plain/saprolite under the RME and CTE conditions are summarized below. The cumulative HIs for adult and child residents exceed 1 for both the RME and CTE conditions.

**Estimated Hazard Index for Site 4 Groundwater in the Coastal Plain/Saprolite**
**Cumulative Risk Summary**

| | Adult Resident | Child Resident | Age-adjusted Resident |
|---|---|---|---|
| Total HI – RME | 30 | 48 | NA |
| Total HI – CTE | 5.7 | 9.7 | NA |

Estimated ILCRs from exposure to Site 4 groundwater in the Coastal Plain/saprolite under the RME and CTE conditions are summarized below. The ILCR for the adult resident is greater than the EPA target risk range under the RME scenario, but within the range under the CTE scenario. The ILCR for and age-adjusted resident is greater than the EPA acceptable target range under both the RME and CTE conditions.

**Estimated ICLR for Site 4 Groundwater in the Coastal Plain/Saprolite**
**Cumulative Risk Summary**

| | Adult Resident | Child Resident | Age-adjusted Resident |
|---|---|---|---|
| Total ILCR - RME | 6.6E-04 | NA | 5.5E-03 |
| Total ILCR - CTE | 5.5E-05 | NA | 1.0E-03 |

### 2.7.4 Ecological Risk Assessment

The Navy conducted a facility-wide baseline ecological risk assessment (BERA) at NSWC-White Oak. The procedures followed in conducting the BERA are outlined in the April 2001 final report (TTNUS, April 2001). The BERA consisted of screening all soil, surface water, and sediment data collected at the facility against applicable ecological risk-based screening criteria. This data included soil data from Site 4 as well as sediment and surface water data from the surrounding streams that would receive groundwater impacted by Site 4. The BERA concluded that there was no unacceptable risk from Site 4 soil based on post-removal action conditions. The BERA also concluded that the sediment and surface water in the streams do not present unacceptable risks. As groundwater exposure is not associated with ecological receptors, Site 4 groundwater poses no unacceptable ecological risks.

### 2.7.5 Conclusions of Risk Assessments

Under current conditions, there is no significant human health risk associated with contaminants in groundwater because groundwater at Site 4 is not being used as a potable source.

Non carcinogenic HIs associated with exposure to Site 4 groundwater, both in the coastal plain/saprolite, and in the bedrock, under a hypothetical future residential scenario (adult or child) exceed the EPA's acceptable target of unity. The ILCRs associated with exposure to groundwater under a hypothetical future residential scenario exceed the EPA's acceptable range.

These unacceptable carcinogenic and non-carcinogenic risks warrant that an evaluation of remedial alternatives be conducted to determine the appropriate remedial action to reduce groundwater contaminant concentrations or mitigate exposure.

The BHHRA determined that the Site 4 soil remaining after the 2002 removal action does not present an unacceptable risk for exposure to soil [i.e., the HI was below unity (one) for all receptors and the ILCR was below the upper risk range of $1.0 \times 10^{-4}$]. The site soil also does not pose an unacceptable ecological risk.

However concentrations of TCE and 1,1,2,2-PCA in the soil do represent a continuing source of groundwater contamination. Site-specific modeling indicates that current soil concentrations of these two chemicals may result in groundwater contamination at levels that would exceed MCLs and result in an unacceptable risk to potential future residents that might use the groundwater for a primary drinking water source.

## 2.8 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) identify receptors, pathways, and action levels. The RAO for Site 4 soil is:

- Prevent leaching of contaminants from soil to groundwater at concentrations that would result in unacceptable risks to human receptors.

The RAOs for the contaminated groundwater at Site 4 are:

- Prevent unacceptable risks to human receptors from exposure to contaminants in the groundwater.
- Where practicable, to restore contaminated groundwater to a quality amenable to beneficial use (i.e., meet the PRGs identified).

### 2.8.1 Applicable or Relevant and Appropriate Requirements

Applicable or relevant and appropriate requirements (ARARs) and other to-be-considered (TBC) criteria were identified that pertain to the chemicals, actions, and location at Site 4 for each of the alternatives considered. These ARARs and TBCs are listed and evaluated for applicability in Tables B-1, B-2, and B-3 in Appendix B.

### 2.8.2 Soil COCs and PRGs

A mass-limited leaching model, as described in Appendix C of the OU-1 FS (CH2M HILL, June 2003), was used to calculate average, rather than maximum, allowable risk-based PRGs for TCE and 1,1,2,2-PCA for site soil. The calculated soil PRGs are concentrations that would not result in an exceedence of groundwater PRGs for these compounds (see groundwater PRGs below) through the process of partitioning (leaching) into rainfall as it infiltrates through the contaminated soil. The allowable concentrations for TCE and 1,1,2,2-PCA, averaged over the approximately 30-foot thick unsaturated zone at a given boring location, are 35 µg/kg and 21 µg/kg respectively. Concentrations of TCE and 1,1,2,2-PCA in discrete depth intervals in a given boring may significantly exceed these average PRGs as long as the concentration averaged over a 30-foot thick unsaturated zone does not exceed these PRGs.

For example if the vadose zone soil is 30-feet thick and the concentration of TCE in one two-foot interval is 500 µg/kg, while the TCE concentrations in all other two-foot intervals in that boring are less than the detection limit, then the average concentration is:

$$(500\ \mu g/kg \times 2\ feet)/30\ feet = 33\ \mu g/kg.$$

This is below the PRG of 35 µg/kg, so the soil in this location would be acceptable.

If at the time of site closure, it can be shown that other modeling methods are more appropriate, then they will be considered by Navy, MDE, and EPA.

Because the objective of the soil remediation is to protect groundwater, the ultimate success of the soil cleanup is more accurately tied to the resulting groundwater concentrations rather than a modeled soil concentration. If it can be shown through groundwater monitoring data that the soil no longer represents a source of groundwater contamination at unacceptable levels (i.e., above groundwater PRGs), the soil remediation will be considered to be complete. The methods used to provide representative groundwater data to show that the soil is no longer a continuing source are further discussed in the description of the selected remedy for soil in Section 2.12.2.7.

### 2.8.3 Groundwater COCs and PRGs

Two sets of PRGs were developed for the groundwater contamination associated with Site 4. One set of

PRGs applies to the upgradient portion of the plume (referred to as the Site 4 PRG attainment area) and the other set of PRGs applies to the downgradient portion of the plume (referred to as the Site 46 PRG attainment area). The plume was divided into two sections because the number and type of COPCs differs from one area to the other. The PRGs were developed based on combined risks from the COPCs in each attainment area only, and do not consider additional risks from chemicals found in the groundwater in other areas of OU-1. The rationale for this approach is presented in the OU-1 FS and is summarized in the following paragraph.

OU-1 consists of a large (210 acres) area with multiple source areas. Because the contaminants associated with each source area, and the resultant plume, vary from source to source, the risk drivers for groundwater are different in different areas of the OU. (Also because of this, the various groundwater areas of the OU requiring remedial action are being addressed by separate actions and RODs.) PRGs for groundwater in OU-1 were set with the goal of reducing the cumulative risk from all contaminants to an acceptable level in a specific area that one might be exposed to if a supply well was installed and used in that location. As a result, a contaminant such as 1,1,2,2-PCA would require a lower PRG in an area where it is present along with other contaminants that affect the same organ of a receptor's body than it would in an area where it is the sole contaminant. In order to ensure that risks are addressed appropriately, PRG attainment areas (contiguous areas with similar groupings of contaminants) were developed and a corresponding list of COPCs was identified for each. The PRG attainment areas for OU-1 are shown in Figure 2-9. As shown on this figure, the plume present in the Site 4 area has been divided into two separate attainment areas; one for the area immediately around Site 4, which contains relatively high concentrations of a few chemicals (primarily chlorinated VOCs), and one area downgradient of the Site 4 source area, referred to as the Site 46 attainment area, which contains relatively low concentrations of a wider variety of chemicals.

Groundwater risk-based PRGs for this ROD were calculated separately for the COPCs identified in each of the two PRG attainment areas, using the future residential scenario. Risk-based groundwater PRGs were calculated for the child, adult, and lifetime resident since these receptors had risks (in the OU-1 BHHRA) which exceeded the criteria discussed above. The exposure scenarios considered were exposure to groundwater through ingestion, dermal contact, and inhalation of VOCs while showering (adult only). The contaminant concentrations related to carcinogenic risk levels of $10^{-6}$, $10^{-5}$, and $10^{-4}$ were calculated for each COPC in each of the two attainment area. The proposed PRG for each COPC in each of the two attainment area was then calculated so that the overall cancer risk would not exceed $5 \times 10^{-5}$, and the hazard to a target organ would not exceed 1. These calculations are presented in Tables 2-35 through 2-38 for the Site 4 PRG Attainment Area, and Tables 2-39 through 2-42 for the Site 46 PRG Attainment Area.

The PRGs for each COPC in these two groundwater attainment area are shown in Table 2-43. The PRG is the Safe Drinking Water Act MCL (for those compounds that have MCLs) and the calculated attainment-area-specific risk-based PRG for chemicals that do not have MCLs.

The PRGs were then compared to the maximum detected contaminant concentration in the groundwater in each attainment area in order to identify COCs. COCs are a subset of the COPCs; they are those chemicals that are identified as needing to be addressed by the response action. In general, if the maximum concentration of a chemical found in the groundwater in a specific attainment area exceeds the PRG then that chemical is considered a COC; COCs for each attainment area are identified in Table 2-43 and are listed below with their PRGs.

| COC | Groundwater PRGs for Site 4 Attainment Area (µg/L) | Groundwater PRGs for Site 46 Attainment Area (µg/L) | Basis |
|---|---|---|---|
| TCE | 5 | 5 | MCL |
| 1,1,2,2,-PCA | 3 | 5.9 | RB |
| Cis-1,2-DCE | 70 | 70 | MCL |
| 1,2-DCA | 5 | 5 | MCL |
| Vinyl Chloride | 2 | 2 | MCL |
| 1,1-DCE | -A | - | MCL |
| Benzene | - A | 5 B | MCL |
| Toluene | - | 1,000 B | MCL |
| 2-amino-4,6-DNT | - | 0.18 | RB |
| 4-amino-2,6-DNT | - | 0.18 | RB |
| 2,4,6-TNT | - | - | RB |
| RDX | - | - | RB |
| Iron (dissolved) | 4,600 | 9,300 | RB |

MCL – PRG is the maximum contaminant level drinking water standard.

RB - PRG is a site specific risk-based standard calculated using guidance developed by EPA Region III.

A – compound was detected throughout the attainment area at concentrations below MCL, but incremental risk from compound was included in the overall risk calculations to determine risk-based PRGs for other compounds.

B – compound was detected in only 1 well in the attainment area, but because it exceeded the MCL it was included as a PRG. The incremental risk from the compound was not included in the overall risk calculations to determine risk-based PRGs for other compounds.

Although perchlorate has been detected in several of the attainment areas, it is not considered a COC and no PRG has been established. At this time there is no established ARAR for perchlorate, and the human health risk-based screening level identified by EPA Region 3 is strictly associated with drinking water. Because of these considerations and given the fact that the OU-1 groundwater is not currently used as a source of drinking water, and its use is and will continue to be prohibited through existing local regulations and proposed institutional controls, perchlorate is not considered a COC. However, the monitoring of perchlorate concentrations in groundwater and in the influent and effluent of any ex-situ treatment system will be performed during the course of the remedial action and every five years the remedy will be reviewed to ensure it remains protective of human health and the environment. The maximum concentration of perchlorate found within the Site 4 groundwater area is 76 µg/L.

### 2.8.4 Estimated Volumes of Contaminated Soil

The lateral and vertical extent of the target remediation zone for Site 4 soil was delineated during extensive sampling conducted as part of the OU-1 FS investigation. The approach used to calculate PRGs for TCE and 1,1,2,2-PCA, and then average soil concentrations and develop a three dimensional target remediation zone is presented in the FS.

The proposed target remediation zone for soil covers an area 125 feet wide (perpendicular to groundwater flow) by 64 feet long (parallel to groundwater flow) or approximately 8,000 $ft^2$. The vertical extent of TCE and/or 1,1,2,2-PCA contamination is located within an average 12-foot thick layer of medium to course sand and gravel extending from roughly 14 to 28 feet bgs, however at a few locations TCE does extend deeper than 30 feet to approximately 34 feet bgs. The average concentration of TCE and 1,1,2,2-PCA within the target remediation zone for soil is 5,900 µg /kg and 55 µg/kg respectively.

### 2.8.5 Estimated Volumes of Contaminated Groundwater

The dissolved-phase plume originating at Site 4 encompasses an area of approximately 57 acres. Much of this plume is being adequately addressed (contained and /or remediated) by the existing interim groundwater extraction and treatment systems. A major focus of the remedial alternatives for the dissolved phase contamination in the Site 4 groundwater is the areas of greatest chlorinated VOC concentrations north of the centrifuge extraction wells. This area, referred to as the Site 4 groundwater target remediation zone, is characterized by TCE concentrations greater than 500 µg/L (Figure 2-10). The target remediation zone also includes the areas to the east and west (side-gradient) of this central plume, all of whose concentrations exceed the MCL. This zone is typically about 500 feet wide and about 950 feet long. This yields an area of about 470,000 square ft or 10.8 acres. The thickness of contamination is estimated to be the entire saturated zone within the Coastal Plain deposits, approximately 25 feet. Assuming an effective porosity of 0.25, an estimated 3 million cubic feet or about 22 million gallons of groundwater are within the groundwater target remediation zone.

The actual distribution of contamination is variable with depth. For the purposes of evaluating remedial alternatives, the assumption was made that TCE within the groundwater target remediation zone has a concentration that averages 500 µg/L. Under this assumption, the 22 million gallons or 84 million liters of contaminated groundwater contain approximately 42 kg or about 90 pounds of TCE in the dissolved phase. The amount of TCE adsorbed on the aquifer soil within the groundwater target remediation zone is estimated to be 50 kg or 108 pounds.

A similar set of calculations was made for 1,1,2,2-PCA. There is less than 1 pound of 1,1,2,2-PCA in the dissolved phase and a similar mass in the sorbed phase within the groundwater target remediation zone.

Calculations of contaminant mass were also made for the portions of the plume south (downgradient) of the groundwater target remediation zone. This portion of the plume, which encompasses 46 acres, contains lower concentrations of TCE ranging from 500 to 5 µg/L, and averaging about 200 µg/L. The thickness of contamination is estimated to be the entire saturated zone, approximately 15 feet averaged over the entire area. There are an estimated 7.6 million cubic feet or about 56 million gallons of groundwater within this area containing approximately 42 kg or about 94 pounds of TCE in the dissolved phase. There are an estimated 54 kg or 120 pounds of TCE in the sorbed phase.

## 2.9 DESCRIPTION OF ALTERNATIVES FOR SOIL

Four remedial alternatives were developed to address the contamination in the deep subsurface soil in the Site 4 area that may be a continuing source of groundwater contamination.

- Alternative 1—No Action
- Alternative 2—Soil Vapor Extraction
- Alternative 3—*In-situ* Chemical Oxidation
- Alternative 4—Excavation and Offsite Disposal

The following sections outline the components of each of these remedial alternatives.

### 2.9.1 Alternative 1—No Action

The no-action alternative is required by the NCP and serves as the baseline alternative for comparison

purposes. All other remedial action alternatives are judged against the no-action alternative. Under this alternative, no controls or remedial technologies would be implemented. No additional monitoring would be performed. No effort would be made to meet ARARs or PRGs and therefore the risk of TCE and 1,1,2,2-PCA leaching from soil to groundwater remain.

CERCLA (Section 121(c)), as amended by SARA (1986), would require that, even under the no-action alternative, the site be reviewed every 5 years since contamination in the soil would remain onsite.

### 2.9.2 Alternative 2—Soil Vapor Extraction

Soil vapor extraction (SVE) is an in-situ technology that involves extracting soil gas from the vadose zone to volatilize contaminants. Ambient air would be pulled through the vadose zone and flush the vadose zone. This would remove vapor-phase contaminants in the pore space and volatilize residual- and adsorbed-phase contaminants

The primary components of this alternative are:

- Installation of soil vapor extraction wells and blower system
- Baseline and verification soil and vapor sampling to monitor treatment efficiency
- Preparation of a remediation completion report
- Each of these components are discussed in detail below.

#### *2.9.2.1 Installation and Operation of Soil Vapor Extraction Wells and Blower System*

Approximately 5 SVE wells would be installed within the Site 4 soil target remediation zone. A radius of influence of approximately 30 ft is expected for each SVE well based on site geology. The SVE wells would be drilled using hollow stem auger (HSA) drilling techniques and would be constructed of 4-inch PVC, with a 20-ft screen throughout the zone of the contamination from approximately 15 to 35 ft bgs. The lower interval would coincide with the top of the water table. An SVE blower would be connected to the well network. A blower of 300 standard cubic ft per minute (scfm) and 90 inches of water vacuum capacity would be provided to extract approximately 60 scfm of air from each of the SVE wells. The SVE blower would be able to extract soil gas at a rate sufficient to achieve five to 10 pore volume exchanges per day.

The estimated design parameters and system layout for SVE are:

- Size of Target Remediation Zone - 125 ft by 64 ft or 0.2 acres
- Radius of Influence - 30 ft
- Number of SVE Wells and Spacing – 5 wells spaced at 60 ft
- Air Extraction Rate— 60 scfm per well
- Blower Demand - 300 scfm at 90 inches of water vacuum

Once the contaminants are stripped from the vadose zone, they would be discharged to the atmosphere where they would disperse. Emissions estimates show that the off-gas concentration of TCE would be more than an order of magnitude lower than the National Institute for Occupational Safety and Health (NIOSH) permissible exposure level (PEL). Therefore, it was assumed that no off-gas treatment would be required.

#### *2.9.2.2 Baseline and Post-treatment Monitoring*

Effectiveness of the treatment would be monitored by collecting and analyzing soil samples from selected locations prior to and following the treatment. Sampling and analysis of the off-gas and the collection of soil screening samples would be conducted to track disappearance of chlorinated VOCs (specifically TCE) and other chemicals in soil for which PRGs have been established, to provide an indication if an endpoint has been reached and confirmatory samples should be collected.

At the apparent completion of the treatment, a comprehensive soil sampling program would be conducted to determine if the established average PRGs have been met. Approximately 20 soil samples would be collected for laboratory analysis of chlorinated VOCs. The data would be evaluated to determine if additional aeration is necessary. For purposes of this analysis, remediation was assumed to be complete after 2 years.

#### *2.9.2.3 Institutional Controls*

This remedial action would not require institutional controls to limit land use during remediation. The soil concentrations are all below direct-contact risk-based levels. The potential risk from the site soils is related to leaching to groundwater and subsequent use of the groundwater as a drinking water source. Institutional controls to restrict groundwater use are included in the alternatives evaluated for the Site 4 groundwater in Section 2.13.

#### *2.9.2.4 Reporting*

A closeout report would be generated to document the results of the SVE treatment. Technical memoranda would also be generated to document the results of the out-year verification sampling rounds. It is assumed that a 5-year report would not be required if the SVE is successful within an estimated 2 years. If remediation requires more than 5 years, a 5-year report would be prepared.

### 2.9.3 Alternative 3—*In-situ* Chemical Oxidation

In this alternative, an oxidative reagent would be injected and distributed throughout the Site 4 soil target remediation zone to promote oxidization of the contaminants to innocuous compounds such as carbon dioxide and water. The primary components of this alternative are:

- Performance of a field-scale pilot test to determine the optimum oxidant and dose
- Installation of injection wells and injection of the oxidizing reagent
- Baseline and post-injection soil sampling to monitor treatment efficiency
- Preparation of a remediation completion report

*In situ* chemical oxidation (ISCO) is considered an emerging technology for the treatment of chlorinated VOCs. Typical oxidants include Fenton's Reagent (iron and hydrogen peroxide), hydrogen peroxide, potassium and sodium permanganate, sodium persulfate, and ozone. Because this is an emerging technology, the full spectrum of reaction intermediates and products is not fully understood for all contaminants. ISCO has been used to successfully treat TCE in subsurface soil. The major components of this alternative are discussed below.

#### *2.9.3.1 Performance of a Pilot Test*

Evaluation of the selected oxidant would be conducted during a field-scale pilot test in the source area. Contaminant degradation in the soil would be tracked with time to determine the effectiveness of the technology and feasibility and design parameters for full scale implementation.

It is assumed that Fenton's Reagent would be appropriate. Fenton's Reagent is an oxidant that is suitable for *in situ* application at this site because it is a strong oxidizer and, unlike potassium permanganate, can oxidize chlorinated ethanes as well as chlorinated ethenes. Its rapid reaction kinetics are favorable for expedited site remediation.

#### *2.9.3.2 Installation of Injection Wells and Oxidizing Reagent Injection*

Approximately 70 chemical injection points would be sufficient to treat the target zone of soil contamination. It was assumed that each injection point would have a radius of influence of 10 ft in the vadose zone. Additional points were added to cover the fringe areas of the target zone. Two layers of injection points would be installed within the target zone. The chemical injection points would be constructed similar to temporary monitoring wells and drilled using the hollow stem auger (HSA) rather than pushed using direct-push technology (DPT) due to the cobbles/boulders present in the site soil. The injection points would consist of 1¼-inch diameter

black steel pipe with a 5-ft section of stainless steel screen. The upper layer of injection points would be screened from approximately 17 to 22 ft bgs on average. The lower layer of injection points would be screened from approximately 26 to 31 ft bgs. It is estimated that approximately 105,000 lbs. of hydrogen peroxide (50-percent) would be required to destroy the approximately 28 lbs. of chlorinated VOCs in the soil and even larger amounts of petroleum hydrocarbon. This is based on a minimum requirement of 1,500 lbs of hydrogen peroxide per injection point, rather than stoichiometric requirements. Fenton's Reagent, a solution of iron catalyst and hydrogen peroxide, will be sequentially injected into the network of injection wells in the soil target zone. Through pressurized injection, the oxidant would be distributed throughout the contaminated zone to destroy the residual- and adsorbed-phase VOCs. It is estimated that approximately 15 working days will be required to perform chemical injection into all the points. The estimated design parameters and system layout are:

- Size of Target Remediation Area: 125 ft by 64 ft or 0.2 acres
- Radius of Influence: 10 ft
- Number of Injection Points and Spacing: 70 points, 35 points screened in upper half of the treatment zone and 35 points screened in lower half.
- Fenton's Reagent Dose Rate and Concentration: 300 gals of reagent/point at 25 percent $H_2O_2$
- Hydrogen Peroxide Requirement: 105,000 total pounds

An initial injection would be followed by a polishing injection. A polishing injection would typically be required where conditions of subsurface heterogeneity cause non-uniform distribution of oxidant. This is likely the case at Site 4. Since ISCO is a relatively rapid treatment process, it is assumed that the site can be treated to PRGs within one year using two injections to obtain the necessary treatment. The injection points would be left in the ground after the first treatment so as to be used for the second treatment (and any subsequent treatment until PRGs are met).

#### *2.9.3.3 Baseline and Post-injection Monitoring*

Effectiveness of the treatment would be monitored by collecting and analyzing soil samples from selected locations prior to and following the treatment. Sampling and analysis would be conducted to track disappearance of chlorinated VOCs and other chemicals in soil for which PRGs have been established, to determine if additional applications are necessary.

Follow-on sampling would be conducted 12 weeks after the initial injection. Field sampling efforts to support the injection effort would include testing soil moisture in approximately 19 lysimeters for the oxidant concentration using a field test kit. Approximately 20 soil samples will be collected for laboratory analysis of chlorinated VOCs, total organic carbon (TOC), COD, and pH. The data would be evaluated to determine if additional oxidant injection is necessary. The same soil sampling procedures would be implemented following the second injection to ensure remediation to the established average PRG. Remediation is assumed to be complete after one year.

#### *2.9.3.4 Institutional Controls*

This remedial action would not require institutional controls to limit land use during remediation. The soil concentrations are all below direct-contact risk-based levels. The potential risk from the site soils is related to leaching to groundwater and subsequent use of the groundwater as a drinking water source. Institutional controls to restrict groundwater use are included in the alternatives evaluated for the Site 4 groundwater in Section 2.13.

#### *2.9.3.5 Reporting*

A closeout report would be generated to document the results of the ISCO treatment. Technical memoranda would also be generated to document the results of the out-year verification sampling rounds. It is assumed that a 5-year report would not be required if the ISCO is successful within an estimated 1 year. If remediation requires more than 5 years, a 5-year report would be prepared.

### 2.9.4 Alternative 4—Excavation and Offsite Disposal

In this alternative, contaminated soil from within the soil target remediation zone would be excavated to a depth where clean soil is encountered and/or the top of the groundwater table. The primary components are:

- Excavation and stockpiling of clean soil
- Excavation and disposal of contaminated soil
- Verification sampling
- Backfilling with clean soil from onsite and offsite sources
- Preparation of remediation completion report

#### *2.9.4.1 Excavation*

Approximately 13,700 cy of soil would be excavated from Site 4 to meet the desired clean up goal for this site. This includes 9,100 cy of clean soil that would be excavated and stockpiled to access the contaminated soil and provide adequate slope stability, and 4,600 cy of soil contaminated with greater than 100 µg/kg of TCE and/or 1,1,2,2-PCA. This volume includes a 20 percent mixing factor.

All non-contaminated soil (i.e. soil with TCE and/or 1,1,2,2-PCA at a concentration <100 µg/kg) would be considered clean fill and stockpiled on site to be used as backfill. The clean excavated soil would be placed on plastic sheeting and covered at the end of each work day to prevent it from becoming saturated due to substantial rain and/or snow events. The contaminated soil would be placed directly into trucks or stockpiled in a lined staging area and covered nightly and during substantial rain events throughout the work day to prohibit the excavated soil from becoming saturated. The contaminated soil would be removed from the site and disposed into a non hazardous waste landfill by an approved hauler.

#### *2.9.4.2 Verification Sampling*

Prior to backfilling activities approximately 30 soil samples would be collected from the bottom and sides of the excavated area to confirm that the extent of excavation has met the PRGs. Confirmation samples would be analyzed for VOCs only.

#### *2.9.4.3 Backfill Excavation*

Clean soil stored on site would be used to backfill the open pit. The soil would be laid in 2-ft lifts and compacted to prevent settling. It is estimated that approximately 4,200 cy of clean fill would be brought onsite to restore the excavated area to its current elevation.

#### *2.9.4.4 Reporting*

A closeout report would be generated to document the results of the excavation activities. It is assumed that a 5-year report would not be required if the excavation of contaminated soil is successful.

### 2.9.5 Common Elements and Distinguishing Features of Each Soil Alternative

The one significant element which is common to the three "action" alternatives is that hazardous substances would be removed from the site (through treatment or excavation) in a relatively short time (within 2 years). Therefore, none of these alternatives would require 5-year site reviews if successful.

The distinguishing feature of Alternatives 3 is that contamination would be destroyed, whereas under Alternative 2 it would be transferred to the air and under Alternative 4 it would be transferred to a landfill (and, to a certain extent, the air during excavation and transportation).

### 2.9.6 Expected Outcomes of Each Soil Alternative

Under Alternative 1, contamination would continue to be released to the groundwater for 30 plus years.

Alternatives 2, 3, and 4 would remove the source within between 6 months and 2 years. Because of the required infrastructure associated with Alternative 2 (SVE), the site would not be available for other uses for a projected 2 years. Alternatives 3 and 4 would also place short-term limitations on site use, but for only 6 months to a year.

## 2.10 SUMMARY OF COMPARATIVE ANALYSIS OF SOIL ALTERNATIVES

The NCP outlines the approach for comparing remedial alternatives. Evaluation of the alternatives uses "threshold," "primary balancing," and "modifying" criteria. To be considered for remedy selection, an alternative must meet the two following threshold criteria:

1. Overall protection of human health and the environment
2. Compliance with ARARs and TBC criteria

The primary balancing criteria are then considered to determine which alternative provides the best combination of attributes. The primary balancing criteria are:

1. Long-term effectiveness and permanence
2. Reduction in toxicity, mobility, or volume through treatment
3. Implementability
4. Short-term effectiveness
5. Cost

A comparative evaluation for these 7 criteria was conducted in the OU-1 FS for the four remedial alternatives developed to address Site 4 soil. A summary of the evaluation is provided in Table 2-44 The cost information is repeated below for ease of comparison. The four alternatives were then ranked relative to each other and given a relative score. This ranking is provided in Table 2-45.

| | Capital Cost | O&M Cost | Net Present Worth |
|---|---|---|---|
| Alternative 1 | $0 | $0-$6,000 | $20,000 |
| Alternative 2 | $111,000 | $75,000 (1 year) | $313,000 |
| Alternative 3 | $308,000 | $374,000 (1 year) | $736,000 |
| Alternative 4 | $1,010,000 | $0 | $1,010,000 |

Based on the criteria evaluation and ranking, Alternative 2 was identified as the preferred remedy and was presented to the State of Maryland and the public as such in the Proposed Plan. Comments on the Proposed Plan are used as the basis for evaluating the selected remedy further against two modifying criteria:

1. Acceptance by the State
2. Acceptance by the community

### State Acceptance

The State of Maryland has gone on record in the Proposed Plan as supporting the selection of Alternative 2 as the selected remedy for soil.

### Community Acceptance

Based on comments expressed at the public meeting and received during the public comment period, the community generally agrees with the selected remedy for Site 4 soil, Alternative 2. Specific responses to public comments are in the Responsiveness Summary section of this ROD.

## 2.11 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable [40 CFR 300.430(a)(1)(iii)(A)]. Principal threat wastes include non-aqueous phase liquids in the environment, drums of liquids containing the COCs for the site, and drummed non-liquid waste or soil containing significant concentrations of highly toxic materials. Based on available information and on results of remedial investigations, Site 4 contains no principal threat wastes as defined by the NCP.

## 2.12 SELECTED REMEDY FOR SOIL

This section expands upon the details of the selected remedy for Site 4 soil.

### 2.12.1 Summary of the Rationale for the Selected Remedy

The selected remedy for Site 4 soil is Alternative 2, soil vapor extraction. Table 2-44 provides a summary of the results of the detailed analysis and it provides a numeric ranking of each criterion. A numeric value from 0 to 5 was assigned to each qualitative assessment of the criteria Where significant uncertainty existed in the value of the ranking, a numeric range was provided to include the bracket of uncertainty. The values were added to arrive at a final total score for each alternative. Each criterion was assigned equal weight in the final score. The highest-ranking alternatives were Alternative 2 (Soil Vapor Extraction) and Alternative 3 (*In-situ* Chemical Oxidation).

Alternative 2 was ranked slightly higher than Alternative 3 due to its relatively low to moderate cost and high ease of implementability rating. Both are estimated to have equal likelihood of success to treat soil to PRGs and both have significant uncertainties due to the ability do distribute air or chemical oxidant adequately throughout the subsurface. Alternative 3 scored slightly higher than Alternative 2 for reduction of toxicity, mobility, and volume of contamination and remediation timeframe. Remediation via ISCO (Alternative 3) destroys contaminants to harmless by-products while SVE (Alternative 2) was scored lower because it will transfer the contaminants from one media (subsurface soil) to another (atmosphere). However, the mass of contamination is very low and not expected to adversely impact the environment. The present worth cost for ISCO is estimated to be more than twice the cost for SVE primarily due to the additional chemical injection wells that are necessary to distribute the oxidant throughout the target treatment zone and the additional chemicals needed to satisfy natural organic demand, over an above the contaminant concentrations. Alternative 4 (excavation) ranks higher than ISCO and SVE for a number of criteria, the relatively poor scores for reduction in mobility toxicity and volume and especially the high cost make excavation a lower ranking alternative overall.

### 2.12.2 Description of the Selected Remedy

The selected remedy is Alternative 2 – Soil Vapor Extraction (SVE). SVE is an in-situ technology that involves extracting soil gas from the vadose zone to volatilize contaminants in the soil. Ambient air will be pulled through the vadose zone and used to flush the vadose zone.

This will remove vapor-phase contaminants in the pore space and volatilize residual- and adsorbed-phase contaminants. The primary components of this alternative are:

- Installation of soil borings to define treatment area and refine the design
- Installation of soil vapor extraction wells and blower system
- Baseline and verification soil and vapor sampling to monitor treatment efficiency
- Preparation of a remediation completion report
- Each of these components are discussed in detail below.

#### *2.12.2.1 Installation of Additional Soil Borings*

One to two additional soil borings will be drilled to bound the TRZ on the southeast side. Soil samples will be

collected continuously (at 2-foot intervals) from the surface to the water table and screened in the field using a photoionization detector. Approximately five samples will be selected from each boring for laboratory analysis for chlorinated VOCs. This data will also serve to define the baseline soil conditions upon which verification sampling data will be compared. The exact number and location of delineation borings and samples will be determined during the design phase and approved by EPA and MDE.

#### *2.12.2.2 Installation and Operation of Soil Vapor Extraction Wells and Blower System*

Approximately 5 SVE wells will be installed within the Site 4 soil TRZ. A radius of influence of approximately 30 ft is expected for each SVE well based on site geology. The SVE wells will be drilled using HSA drilling techniques and would be constructed of 4-inch PVC, with a 20-ft screen throughout the zone of the contamination from approximately 15 to 35 ft bgs. The lower interval will coincide with the top of the water table. An SVE blower will be connected to the well network. A blower of 300 scfm and 90 inches of water vacuum capacity will be provided to extract approximately 60 scfm of air from each of the SVE wells. The SVE blower will be able to extract soil gas at a rate sufficient to achieve five to 10 pore volume exchanges per day.

The estimated design parameters and system layout for SVE are summarized below. The exact number and location of vapor extraction wells and other system parameters would be determined during the design phase.

- Size of Target Remediation Zone - 125 ft by 64 ft or 0.2 acres
- Radius of Influence - 30 ft
- Number of SVE Wells and Spacing – 5 wells spaced at 60 ft
- Air Extraction Rate— 60 scfm per well
- Blower Demand - 300 scfm at 90 inches of water vacuum

Once the contaminants are stripped from the vadose zone, they will be discharged to the atmosphere where they would disperse. Emissions estimates show that the off-gas concentration of TCE would be more than an order of magnitude lower than the NIOSH PEL. Therefore, it was assumed that no off-gas treatment will be required. This will be confirmed during the design phase and monitored during operation.

#### *2.12.2.3 Baseline and Post-treatment Monitoring*

Effectiveness of the treatment will be monitored by collecting and analyzing soil samples from selected locations prior to and following the treatment. Sampling and analysis of the off-gas and the collection of soil screening samples will be conducted to track removal of chlorinated VOCs (specifically TCE) and other chemicals in soil for which PRGs have been established, to provide an indication if an endpoint has been reached and confirmatory samples should be collected. A system monitoring plan will be developed during the design phase and approved by EPA and MDE.

At the apparent completion of the treatment, a comprehensive soil sampling program will be conducted to determine if the established average PRGs have been met. Approximately 20 soil samples will be collected for laboratory analysis of chlorinated VOCs.

The data will be evaluated to determine if additional aeration is necessary. Remediation was assumed to be complete after 2 years. A verification sampling and analysis plan will be developed during the design phase and approved by EPA and MDE.

#### *2.12.2.4 Institutional Controls*

This remedial action would not require institutional controls to limit land use during remediation. The soil concentrations are all below direct-contact risk-based levels. The potential risk from the site soils is related to leaching to groundwater and subsequent use of the groundwater as a drinking water source. Institutional controls to restrict groundwater use are included in the selected remedy for the Site 4 groundwater in Section 2.16.

#### 2.12.2.5 Reporting

A closeout report will be generated to document the results of the SVE treatment. Technical memoranda will also be generated to document the results of the out-year verification sampling rounds. It is assumed that a 5-year report will not be required if the SVE is successful within an estimated 2 years. If remediation requires more than 5 years, a 5-year report will be prepared.

#### 2.12.2.6 Exit Strategy for Soil Vapor Extraction

The selected remedy for soil at Site 4 includes an exit strategy that identifies performance criteria for helping to determine when it is appropriate to turn off the SVE system and, if necessary, transition to another remedial technology. This exit strategy is outlined in this section.

The overall remedial action objective for soil at Site 4 is to eliminate the leaching of TCE and 1,1,2,2-PCA from the soil to the groundwater. This would ideally be measured by a lack of these chemicals in the groundwater above the MCL in wells screened in the aquifer below the soil Target Remediation Zone (TRZ), such as well 04GW301. An alternative method is to determine if the concentrations in the TRZ soil have been reduced to model-generated soil PRGs that will be protective of groundwater. As discussed in Section 2.8.2, these PRGs have been set as average soil concentrations of 35 µg/kg and 21 µg/kg respectively for TCE and 1,1,2,2-PCA, averaged across the 30-foot thickness of the unsaturated zone.

Extensive soil sampling conducted as part of the RI and FS for OU-1 have resulted in an estimated TCE mass of 27 kg and a 1,1,2,2-PCA mass of 0.24 kg within the 8,000 square-foot by 30-foot-deep layer of soil above the February 2003 water table. If the cleanup goals (PRGs) are met throughout the soil TRZ it would equate to a remaining contaminant mass in the soil of 0.4 kg of TCE and 0.06 kg of 1,1,2,2-PCA. This would be a removal rate of 98.5 percent for TCE and 75 percent for 1,1,2,2-PCA. Basing system shut-down on the removal of 98.5 percent (26.6 kg ) of the TCE is not realistic, however, due to the following factors:

- The water table at the site varies significantly (by as much as 14 feet) and the February 2001 level was a historic low. Therefore some of the contaminated soil will not be accessible to the SVE and will be treated through the groundwater remedy (biologically).

- Leaching of contamination via rainfall infiltration, and degradation has, and will, continue to remove mass from the soil that will not be measured in the SVE off-gas.

- It is neither technically feasible nor cost effective to remove mass sorbed to the soil in some areas using SVE.

Basing system shut-down on achieving groundwater PRGs in the aquifer below the area is also not realistic because there may be other sources of groundwater contamination below the water table, which would be addressed by the in-situ groundwater remedy (see Section 2.16.2).

Because of these factors, SVE system shutdown (i.e.: exit strategy) will be based on performance objectives related to the technical limitations of the remedy, rather than solely achieving RAOs and groundwater or soil PRGs. The exit strategy considers system optimization and contingencies for rebound in determining when system shutdown is warranted. The need for further active or passive treatment to meet RAOs and PRGs will then be evaluated based on the remaining soil or groundwater conditions.

***SVE System Performance Objectives-***

It has been well documented that VOC removal by SVE systems decreases exponentially with time. So even though removal rates of 0.06 to 0.26 kg/day were observed during a pilot test (which would result in a cleanup time of less than 1 year) these rates would not hold throughout the operation of the system. The performance objectives for the Site 4 SVE system are:

- Reduction in overall contaminant concentrations compared to baseline levels.

- Asymptotic mass removal achieved after temporary shutdown periods (to evaluate rebound) and appropriate system optimization.

- Operation only as long as cost effective. The system will no longer be cost effective when operating costs per unit mass removed indicate that continued operation is not justified based on comparison to associated risk or alternative cleanup technologies.

***SVE System Optimization-***

Steps to improve optimization of the system will be taken at various intervals of operation based on an evaluation of mass removal rates and operating costs. Optimization will also be evaluated prior to the decision to shut the system down once performance objectives have been met. Optimization steps may include:

- Shutting down individual SVE wells
- Increasing extraction rates
- Cycling the operation of the SVE wells
- Evaluating water levels and groundwater data to determine if leaching is occurring.

***SVE System Rebound Contingency-***

Once the preliminary performance objectives have been met (i.e.: asymptotic mass removal even after system optimization). A rebound evaluation will be conducted. The rebound evaluation will consist of putting the system on standby for a period of approximately 5 months and allowing the soil gas/soil to equilibrate. The system will then be restarted and off-gas concentrations will be measured. A rebound will be calculated using the following formula:

Rebound = [log(Cr/Cf)]/[log(Co/Cf)

Where:

Co = the initial concentration of TCE (at system startup)

Cf = the final asymptotic concentration of TCE

Cr = the concentration of a TCE after restart 5 months from system shut-down.

A rebound of 0.2 or less reflects a permanent reduction and confirmation that performance objectives have been met. Rebound will be calculated on a well-by-well basis.

***SVE System Shut-down Conditions-***

The SVE system shall be shut down if any one of the following conditions are met:

1) The performance objectives are met and rebound is acceptable.

2) Confirmation soil sampling indicates that the average soil concentrations in a given borehole are below the PRGs.

3) Groundwater concentrations of TCE and 1,1,2,2-PCA beneath the soil TRZ are reduced to groundwater PRGs with acceptable rebound (see groundwater exit strategy.).

The specific sampling protocol used to collect the data to be evaluated when making these decisions will be outlined in the SVE system monitoring plan to be prepared as part of the remedial design process. The monitoring plan will be subject to review and approval by EPA and MDE.

#### *2.12.2.7 Soil Remedy Closeout Process*

The shut-down of the SVE system may not necessarily coincide with the achievement of site RAOs. (i.e., the SVE system may reach its performance objectives and still leave a continuing source of groundwater contamination in the soil.) In this case it may be necessary to implement additional active or passive (e.g., MNA) technologies until RAOs are met. The achievement of RAOs and the final closeout of the soil portion of the site will be based on meeting one of the following two conditions:

1. After the completion of the SVE system operation a representative number of soil samples will be collected to characterize the average concentration of TCE and 1,1,2,2-PCA remaining in the soil. These data will be evaluated to determine if they are protective of groundwater using the methodology referenced in section 2.8.2. If the average concentrations are protective of groundwater the soil remedy will be considered complete.

2. If the average soil concentrations are not protective of groundwater but the groundwater PRGs are met in the area beneath the soil TRZ, an evaluation of the available groundwater data will be conducted. If a preponderance of evidence indicates that it is unlikely that the groundwater can be recontaminated in the future by the remaining soil contamination, then the soil remedy will be considered complete. Data to be considered when making this decision will include: long-term chemical sampling data, historic and current water levels, rainfall data, continuing impacts of the in-situ biological groundwater remedy.

The specific protocol used to collect and analyze the soil and groundwater data when making these decisions will be outlined in the long-term soil and groundwater monitoring plan to be prepared as part of the remedial design process. The monitoring plan will be subject to review and approval by EPA and MDE.

## 2.13 DESCRIPTION OF ALTERNATIVES FOR GROUNDWATER

Seven remedial alternatives were developed for the groundwater plume originating at Site 4.

- Alternative 1: No Action
- Alternative 2: Institutional Controls (ICs) and Long-term Monitoring (LTM) with Continued Operation of the Existing Groundwater Extraction Systems
- Alternative 3: Monitored Natural Attenuation with ICs and LTM and Continued Operation of Portions of the Existing Groundwater Extraction System
- Alternative 4. *In-Situ* Enhanced Reductive Dechlorination with ICs and LTM and Continued Operation of the Existing Groundwater Extraction Systems
- Alternative 5: Air Sparging with ICs and LTM and Continued Operation of the Existing Groundwater Extraction Systems
- Alternative 6: Additional Groundwater Extraction and *Ex Situ* Treatment with ICs and LTM and Continued Operation of the Existing Groundwater Extraction Systems
- Alternative 7: Mid-Plume Extraction System

Alternative 7, which comprises groundwater extraction and piping to a new or existing ex-situ treatment system, is not a stand-alone alternative, but rather can be included along with any other alternative (except Alternative 1) selected for the Site 4 groundwater plume.

The following sections outline the components of each of the remedial alternatives to address the Site 4 groundwater.

### 2.13.1 Alternative 1: No Action

The no-action alternative is required by the NCP and serves as the baseline alternative for comparison purposes. All other remedial action alternatives are judged against the no-action alternative. Under this alternative, no controls or remedial technologies would be implemented. No additional work or monitoring would be performed. There would be no reduction in toxicity, mobility, or volume of the contaminants other than what would result from natural dispersion, dilution, biodegradation, and other attenuating factors. Existing extraction and treatment systems would be shut down and mothballed and existing monitoring programs and would be discontinued. The site would be available for unrestricted use.

CERCLA (Section 121(c)), as amended by SARA (1986), requires that, even under the no-action alternative, the site be reviewed every 5 years since contamination in the groundwater would remain onsite. Reporting costs are minimal because it is assumed that this will be a small part of a larger 5-year report that addresses the entire OU-1 as well as other sites at White Oak.

### 2.13.2 Alternative 2: Institutional Controls (ICs) and Long-term Monitoring (LTM) with Continued Operation of the Existing Groundwater Extraction Systems

The primary components of this alternative are:

- Institutional controls on groundwater access and use
- Continued operation of the existing groundwater extraction and trealment systems
- Long-term monitoring of the groundwater
- Preparing annual and 5-year reports

#### *2.13.2.1 Institutional Controls*

Institutional controls would be implemented to meet the following LUC Objectives:

- Ensure no withdrawal of groundwater for any purpose (including as drinking water) from within the restricted area shown on Figure 2-6 until the PRGs are met and risks from groundwater use are shown to be reduced to acceptable levels.

- Ensure adequate protection to minimize potentially adverse health and environmental effects of work or development in the restricted area.

- Ensure adequate protection to minimize physical disruption of any remedial equipment, such as monitoring wells, or remedial operations in the restricted area.

- Ensure adequate notification of pertinent use restrictions to current and future owners.

Institutional controls would be maintained until the concentrations of hazardous substances in the groundwater are at such levels as to allow for unrestricted use and exposure.

The Navy is responsible for implementing, inspecting, reporting, and enforcing the LUC Objectives in accordance with a LUC Remedial Design. The LUC Remedial Design would be developed during the design phase, submitted to EPA and MDE within 180 days of signature of this ROD, and would be subject to review and approval by the EPA and MDE.

Although the Navy retains ultimate responsibility for meeting the LUC Objectives, the Navy may arrange, by contract or otherwise, for another party to carry out the LUC Remedial Design implementing actions. In addition, since the particular sites subject to this ROD are presently under the jurisdiction of GSA, the Navy would work with GSA to ensure that the LUC Objectives are met in accordance with the LUC Remedial Design.

Should any LUC Remedial Design implementing action fail, or any LUC objective not be met, the Navy would ensure that appropriate actions are taken to reestablish the action and ensure compliance with the LUC Objectives. The Navy may initiate legal action against a third party to compel action and/or to recover the costs for remedying any LUC violation.

#### *2.13.2.2 Continued Operation of the Existing Groundwater Extraction and Treatment Systems*

The existing extraction systems (the centrifuge extraction wells and the Site W Swale extraction trench) would continue to be operated to extract and treat groundwater until exit criteria are met in those specific areas of the plume. The air stripper treating the discharge from the Army ALC Building 500 storm sewer system and under-drain would continue to be operated until it is determined that it is no longer needed to meet the surface water discharge requirements. The treatment-system monitoring requirements would be revisited during the design phase and documented in the O&M plan for the overall remediation system.

#### *2.13.2.3 Long-term Groundwater Monitoring*

Under this alternative, groundwater monitoring would be performed at approximately 22 wells every 9 months to track contaminant concentrations within the Site 4 groundwater plume. Groundwater monitoring on a 9-month schedule allows collection of data in each of the four seasons. These data would be used during the 5-year reviews to determine the effectiveness of the controls. It was assumed that 22 wells would be sampled for VOCs, and a smaller number of these wells would also be sampled for explosives and perchlorate.

#### *2.13.2.4 Reporting*

Reports would be prepared after each 9-month sampling event that would document the results of the sampling round. Since contamination will remain on site for a period longer than 5 years, 5-year reviews would be required.

### 2.13.3 Alternative 3: Monitored Natural Attenuation with ICs and LTM and Continued Operation of Portions of the Existing Groundwater Extraction System

The primary components of this alternative are:

- Long-term monitoring of groundwater contamination and natural attenuation parameters
- Preparation of annual technical memoranda and 5-year MNA analysis reports
- Provisions for the selection of a contingency remedy in the event that MNA is shown to be ineffective
- Continued operation of the existing groundwater extraction and treatment systems with the exception that the extraction wells near the centrifuge would be shut down
- Implementation of institutional controls until PRGs are met

MNA, as defined in this alternative, would be selected in tandem with the remediation approaches discussed under alternatives 4, 5, and 6 of this section for the Site 4 groundwater, because the active remediation identified in those alternatives would address only the defined Site 4 groundwater target remediation zone. (i.e.: the highest levels of contamination detected downgradient of Site 4). This would be discussed further under each of those alternatives. The primary components of Alternative 3 are discussed in detail below.

#### *2.13.3.1 Long-term Groundwater Monitoring*

Under this alternative, groundwater samples would be collected annually from a monitoring well network of approximately 22 wells. The monitoring wells in the MNA network would be sampled for all VOCs and a smaller number of wells would also be sampled for explosives and perchlorate. The groundwater also would be sampled for primary MNA indicating parameters: ferrous iron, sulfate, chloride, nitrate, alkalinity, methane, ethane, ethene, carbon dioxide, and total organic carbon. The following field parameters: dissolved oxygen, temperature, pH, conductivity, and redox potential also would be collected.

#### *2.13.3.2 Reporting*

Annual reports would be prepared for each year of monitoring. These reports would focus on data reporting and trend analysis rather than detailed MNA evaluation. A detailed MNA study would be performed after 4 years to be included as part of the 5-year review report, to confirm contaminant biodegradation rates, reevaluate the data collected, and document lines of evidence for MNA. The 5-year review report would indicate whether NA is occurring at a rate sufficient to maintain control of the contaminant plume and degrade it to PRGs within a reasonable time frame or whether a contingency remedy should be implemented. Detailed reports would continue to be prepared every 5 years

#### *2.13.3.3 Contingency Remedy*

A contingency remedy would be selected and implemented in the event that MNA is shown not to be an effective remedy at the end of 5 years. Selection would be based on the most recent data available. The contingency remedy would be one of the other alternatives evaluated in this FS. A contingency remedy could be implemented before the end of the 5 years of monitoring if interim results indicate that MNA is not going to be effective.

#### *2.13.3.4 Institutional Controls*

Institutional controls to prevent groundwater exposure from the site would be the same as those included in Alternative 2, including preparation of a LUC remedial design document. These would remain in effect until groundwater PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

#### *2.13.3.5 Continued Operation of Some of the Existing Groundwater Extraction and Treatment Systems*

In order to maintain containment of the plume, and continue mass removal, the Site W Swale extraction trench and the groundwater-treatment systems associated with the extraction trench would be maintained until exit criteria are met in that area. The air stripper treating the discharge from the Army ALC Building 500 storm sewer system and under-drain would continue to be operated until it is determined that it is no longer needed to meet the surface water discharge requirements. The treatment-system monitoring requirements would be revisited during the design phase and documented in the O&M plan for the overall remediation system.

However, the extraction wells near the centrifuge would be shut down so that MNA would be the predominant remedial alternative for the majority of the dissolved-phase plume south of Site 4.

### 2.13.4 Alternative 4: In-Situ Enhanced Reductive Dechlorination with ICs and LTM and Continued Operation of the Existing Groundwater Extraction Systems

The primary components of this alternative are:

- Installation of additional wells to define treatment area and establish an optimum groundwater monitoring network
- Installation of injection wells and injection of electron donor
- Groundwater monitoring of baseline and post-injection conditions
- Preparation of annual technical memoranda and 5-year report
- Continued operation of the existing groundwater extraction and treatment systems
- Long-term monitoring of the downgradient portions of the plume
- Implementation of institutional controls until PRGs are met

The enhanced reductive dechlorination (ERD) portion of this alternative would only be applied to the high levels of groundwater contamination (i.e., those greater than 500 µg/L VOCs) identified as the Site 4 groundwater target remediation zone (TRZ) (see Figure 2-10).

The assumption is that the current remedial measures in place (i.e., the centrifuge extraction wells, the extraction trench, and the Building 500 underdrain) provide effective remediation for most contamination further downgradient from this area and need not be replaced with ERD

ICs and LTM such as described in Alternative 2 would be selected for the lower levels of contamination bypassing the centrifuge extraction wells to the east toward the Floral Drive stream and the groundwater downgradient of the extraction trench and Building 500 underdrain.

In this alternative, the naturally occurring process of chemical decomposition under reducing conditions would be enhanced through injection and distribution of an electron donor or co-substrates (food source) in the groundwater target remediation zone just downgradient of the Site 4 source area, to increase the biodegradation rates of the contaminants by naturally occurring microorganisms. Injection of an electron donor material should result in creation of an anaerobic aquifer and the production of hydrogen. Reductive dechlorination by microbes present in the aquifer occurs, resulting in the removal of chlorine atoms from the chlorinated hydrocarbon contaminants. The major components of this alternative are discussed below.

#### *2.13.4.1 Installation of Additional Wells*

A design phase investigation involving the installation of an estimated six temporary wells and five permanent monitoring wells would be conducted. The temporary wells would be used to more precisely define the leading edge of contamination greater than 500 µg/L; contamination within the dissolved-phase plume south of Site 4 greater than this concentration would be considered the groundwater target remediation zone and would be addressed by this technology. The additional wells would provide information that could be used to avoid injecting electron donor in areas not needing treatment. The permanent wells would be installed in lower part of the saturated interval in the Coastal Plain deposits to provide adequate monitoring locations for evaluating the effectiveness of ERD.

#### *2.13.4.2 Performance of a Pilot Test*

During the design phase a field-scale pilot test would be conducted. The electron donor would be injected into one or two wells and contaminant degradation and byproduct production will be tracked over time at surrounding monitoring points to determine the optimum donor and dose for full-scale application.

#### *2.13.4.3 Installation of Injection Wells and Injection of an Electron Donor*

The electron donor substrate is metabolized by naturally occurring microorganisms, resulting in the creation of anaerobic aquifer conditions and the production of hydrogen. The electron donor is typically a food-grade liquid that can be injected under pressure into the saturated zone for plume remediation.

The electron donor would be injected using injection wells in three curtain arrangements, arrayed perpendicular to the direction of groundwater flow and contaminant migration. With this configuration, contaminated groundwater would flow through the curtains and contact the injected material as the groundwater flows by. The treatment curtains would be installed just upgradient of the leading edge of the contamination (defined here as contamination greater than 500 µg/L contour) and along two traverses between this curtain and Site 4.

Injection wells would be drilled using a hollow stem auger rather than using direct-push technology due to the cobbles/boulders present in the site soil. The re-usable injection wells would consist of 4-inch diameter Schedule 80 PVC pipe and would be screened across all 25 ft of the target zone. The lactate solution has an estimated radius of influence of 6 ft to 10 ft under site conditions. Therefore, the final design of injection point locations would need to be closely spaced (i.e., on a 16-ft spacing). This alternative would require a large number of injection wells because the estimated width of the plume perpendicular to groundwater flow is about 430 ft. Therefore, an estimated 81 injection points (27 points in each of the three traverses) would be required to allow for sufficient overlap of the injected material.

The actual electron donor and dosage would be calculated in the remedial design process. Preliminary estimates are summarized here:

| | |
|---|---|
| • Radius of influence: | 6 ft to 10 ft |
| • Length of each of the three injection curtains: | 430 ft |
| • Injection well spacing and configuration: | 27 wells spaced at 16 ft at each of three curtains |
| • Length of injection interval: | 25 ft |
| • Electron donor dose rate in pounds/well (assumes sodium lactate): | 1600 pounds per well |
| • Material requirement: | 130,000 pounds per injection event |

A remediation time of 8 years was calculated for the high levels of contamination in the groundwater target remediation zone. The time to remediation estimate for the remaining plume downgradient of the groundwater target remediation zone is 45 years. However, a greater amount of contamination would be removed earlier on in the remediation process than with Alternatives 1, 2 or 3. The centrifuge extraction wells could be shut down in 45 years.

#### *2.13.4.4 Baseline and Post-injection Monitoring*

Bioremediation effectiveness would be monitored by collecting and analyzing groundwater samples from approximately 10 selected wells before and throughout the duration of the treatment. Sampling and analysis would be conducted to track the disappearance of contaminants and byproduct generation, and the dispersion of the sodium lactate, to determine effectiveness and if additional applications are necessary.

The scope of each sampling event would include sampling the five new monitoring wells plus five other existing wells: two within the zone of treatment and three downgradient, per event, with modifications as needed to better understand the effectiveness of the electron donor injection. Laboratory analysis of the initial sampling rounds would involve analysis of hydrogen and metabolic organic acids in addition to the parameters identified under Alternative 3.

Baseline sampling would be conducted before the injection of the electron donor, then quarterly for the remainder of the first year, and then semiannually until PRGs are achieved. The sampling intervals have been chosen to represent durations after which the remediated groundwater would pass through the new monitoring wells immediately downgradient of the treatment curtain, based on the estimated groundwater linear velocity in this area.

#### *2.13.4.5 Reporting*

Semiannual result reporting would be performed for the first year and annual reporting would occur thereafter. These reports would focus on data reporting and trend analysis rather than detailed ERD evaluation. A detailed ERD study would be performed after 4 years of data and included as part of the 5-year review report, to determine contaminant biodegradation rates, reevaluate the data collected, and evaluate the effectiveness of the remedy.

#### *2.13.4.6 Continued Operation of the Existing Groundwater Extraction and Treatment Systems*

The existing extraction systems (the centrifuge extraction wells and the Site W Swale extraction trench) would continue to be operated to extract and treat groundwater until exit criteria are met in those specific areas of the plume. The air stripper treating the discharge from the Army ALC Building 500 storm sewer system and under-drain would continue to be operated until it is determined that it is no longer needed to meet the surface water discharge requirements. The treatment-system monitoring requirements would be revisited during the design phase and documented in the O&M plan for the overall remediation system.

#### *2.13.4.7 Long-term Groundwater Monitoring*

Groundwater monitoring would be performed at approximately 22 wells every 9 months to track contaminant concentrations within the Site 4 groundwater plume downgradient of the groundwater target remediation zone. Groundwater monitoring on a 9-month schedule allows collection of data in each of the four seasons. These data would be used during the 5-year reviews to determine the effectiveness of the controls. It was assumed that 22 wells would be sampled for VOCs, and a smaller number of these wells would also be sampled for explosives and perchlorate.

#### *2.13.4.8 Institutional Controls*

Institutional controls to prevent groundwater exposure from the site would be the same as those included in Alternative 2, including preparation of a LUC remedial design document. These would remain in effect until groundwater PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

### 2.13.5 Alternative 5: Air Sparging with ICs and LTM and Continued Operation of the Existing Groundwater Extraction Systems

Air sparging is an in-situ technology that involves injecting ambient air into the groundwater target remediation zone to volatilize dissolved, adsorbed, and residual contaminants. The primary components of this alternative are:

- Installation of additional wells to define the treatment area and establish an optimum groundwater monitoring network
- Installation of air sparging wells
- Groundwater monitoring of baseline and post-sparging conditions
- Preparation of annual technical memoranda and 5-year report
- Continued operation of the existing groundwater extraction and treatment systems
- Long-term monitoring of the downgradient portions of the plume
- Implementation of institutional controls until PRGs are met

The air stripping portion of this alternative would only be applied to the high levels of groundwater contamination (i.e., those greater than 500 µg/L VOCs) identified as the Site 4 groundwater TRZ (see Figure 2-10). The assumption is that the current remedial measures in place (i.e., the centrifuge extraction wells, the extraction trench, and the Building 500 underdrain) provide effective remediation for most contamination further downgradient from this area and need not be replaced with air sparging.

ICs and LTM such as described in Alternative 2 would be selected for the lower levels of contamination bypassing the centrifuge extraction wells to the east toward the Floral Drive stream and the groundwater downgradient of the extraction trench and Building 500 underdrain. Each of these components is discussed in detail below.

#### *2.13.5.1 Installation of Additional Wells*

A design phase investigation involving the installation of an estimated six temporary wells and five permanent monitoring wells would be conducted. The temporary wells would be used to more precisely define the leading edge of contamination greater than 500 µg/L; contamination within the dissolved-phase plume south of Site 4 greater than this concentration would be considered the target remediation zone and would be addressed by this technology. The additional wells would provide information that could be used to avoid conducting air sparging in areas not needing treatment. The permanent wells would be installed in lower part of the saturated interval in the Coastal Plain deposits to provide adequate monitoring locations for evaluating the effectiveness of air sparging.

#### *2.13.5.2 Installation of Air Sparging Wells*

Approximately 51 air sparging wells would be installed in three curtain arrangements (with 17 wells in each

curtain) oriented perpendicular to the groundwater flow and contaminant migration. With this configuration, contaminated groundwater would flow through the curtains and contact the injected air. The treatment curtains would be installed just upgradient of the leading edge of contamination (defined here as contamination greater than 500 µg/L) and along two traverses between this curtain and Site 4.

A radius of influence of approximately 15 ft was assumed for each sparge well, based on site geology. The air sparging wells would be drilled using HSA and be constructed of 2-inch PVC, with a 2-ft screen in each well set at the base of the contamination from approximately 63 ft to 65 ft bgs. An air-sparging blower would be connected to each well network. Blowers of 500 scfm and 16 psig capacity would be provided to inject approximately 30 scfm of air into each of the sparge wells. The estimated design parameters and system layout are specified below:

- Radius of influence: 15 ft
- Length of injection curtain: 430 ft
- Injection well spacing and configuration: 17 wells spaced at 25 ft in each of three curtains
- Air injection rate: 30 scfm per well
- Blower demands: 500 scfm and 16 psig

Once the contaminants are stripped from the saturated zone, they will enter the vadose zone. However, given the small amount of mass (90 pounds in the groundwater and 108 pounds adsorbed on the soil below the water table), the fact that lateral dispersion will occur, and that the remediation will be occurring over several years, there is no need for an SVE system installed above the air sparging system.

A remediation time of 8 years was calculated for the high levels of contamination in the groundwater target remediation zone. The time to remediation estimate for the remaining plume downgradient of the target remediation zone is 45 years. However, a greater amount of contamination would be removed earlier on in the remediation process than with Alternatives 1, 2 or 3. It is estimated that the centrifuge extraction wells could be shut down in 45 years.

#### *2.13.5.3 Baseline and Post-injection Monitoring*

Groundwater sampling and analysis would be conducted to track the removal of chlorinated VOCs and other chemicals for which PRGs had been established. The scope of each sampling event would include sampling the five new monitoring wells plus five other existing wells: two within the target remediation zone and three downgradient per event, with modifications as needed to better understand the effectiveness of air sparging.

Baseline sampling would be conducted before the start of the air sparge system, quarterly for the remainder of the first year, and then semiannually until PRGs are achieved. The sampling intervals have been chosen to represent durations after which the remediated groundwater would pass through the monitoring wells based on the estimated groundwater linear velocity in this area.

#### *2.13.5.4 Reporting*

Semiannual result reporting would be performed for the first year and annual reporting would occur thereafter. These reports would focus on data reporting and trend analysis A detailed evaluation would be performed after 4 years of data are collected and included as part of the 5-year review report, to evaluate the effectiveness of the remedy.

#### *2.13.5.5 Continued Operation of the Existing Groundwater Extraction and Treatment Systems*

The existing extraction systems (the centrifuge extraction wells and the Site W Swale extraction trench) would continue to be operated to extract and treat groundwater until exit criteria are met in those specific areas of the plume. The air stripper treating the discharge from the Army ALC Building 500 storm sewer system and under-drain would continue to be operated until it is determined that it is no longer needed to meet the surface water

discharge requirements. The treatment-system monitoring requirements would be revisited during the design phase and documented in the O&M plan for the overall remediation system.

#### *2.13.5.6 Long-term Groundwater Monitoring*

Groundwater monitoring would be performed at approximately 22 wells every 9 months to track contaminant concentrations within the Site 4 groundwater plume downgradient of the target remediation zone. Groundwater monitoring on a 9-month schedule allows collection of data in each of the four seasons. These data would be used during the 5-year reviews to determine the effectiveness of the controls. It was assumed that 22 wells would be sampled for VOCs, and a smaller number of these wells would also be sampled for explosives and perchlorate.

#### *2.13.5.7 Institutional Controls*

Institutional controls to prevent groundwater exposure from the site would be the same as those included in Alternative 2, including preparation of a LUC remedial design document. These would remain in effect until groundwater PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

### 2.13.6 Alternative 6: Additional Groundwater Extraction and *Ex-Situ* Treatment with ICs and LTM and Continued Operation of the Existing Groundwater Extraction Systems

Alternative 6 involves installation of a groundwater extraction system south of Site 4 to achieve hydraulic control of the plume and mass removal within the Site 4 groundwater target remediation zone. The primary components of this alternative are:

- Installation, testing, and startup of groundwater extraction wells
- Construction of a groundwater conveyance and treatment system to treat the extracted water
- Instrumentation to monitor and record flow rates and notify maintenance personnel of malfunction
- Discharge of the treated water to a surface water body
- Annual operation and maintenance (O&M) to monitor performance and assure proper operation
- Groundwater monitoring for contaminant concentrations and hydraulic capture (including addition of a new monitoring well)
- Preparation of annual technical memoranda and 5-year report
- Continued operation of the existing groundwater extraction and treatment systems
- Long-term monitoring of the downgradient portions of the plume
- Implementation of institutional controls until PRGs are met

The new extraction and treatment portion of this alternative would only be applied to the high levels of groundwater contamination (i.e., those greater than 500 µg/L VOCs) identified as the Site 4 groundwater TRZ (see Figure 2-10). The assumption is that the current remedial measures in place (i.e., the centrifuge extraction wells, the extraction trench, and the Building 500 underdrain) provide effective remediation for most contamination further downgradient from this area and need not be replaced or enhanced.

ICs and LTM as described in Alternative 2 would be selected for the lower levels of contamination bypassing the centrifuge extraction wells to the east toward the Floral Drive stream and the groundwater downgradient of the extraction trench and Building 500 underdrain. Each of these components is discussed in detail below.

#### *2.13.6.1 Installation of Groundwater Extraction Wells*

Groundwater extraction serves two purposes: 1) it allows for contaminant mass removal and 2) it can provide

hydraulic containment by altering the natural hydraulic gradient to prevent contaminated groundwater flow either horizontally or vertically.

A network of between three and six groundwater wells, pumping a combined 9 gallons per minute (gpm), would be installed to control the groundwater in the Site 4 groundwater target remediation zone. In addition, between four and six piezometers would also be installed to monitor water levels around the extraction wells and determine if the necessary capture zones were being established. It is assumed that these piezometers would be constructed identical to 2-inch monitoring wells.

#### *2.13.6.2 Groundwater Treatment System*

A total of approximately 9 gpm would be extracted and directed to a treatment system consisting of a filter, equalization tank, low-profile tray air stripper, and a discharge pump Calculations show that the potential for calcium carbonate scaling is very low. Therefore, no additional pre-treatment besides equalization and filtration are anticipated to be required. Preliminary calculations also show that no emissions control is necessary. The treatment system would be equipped with instrumentation to record flow rates and total flow, and to shut down the system and notify maintenance personnel in the event of malfunction.

#### *2.13.6.3 Discharge of Treated Water*

The treated water would be pumped to an appropriate nearby surface water stream, assumed to be the stream that flows along the east side of Isherwood Road, under a National Pollutant Discharge Elimination System (NPDES) permit. Discharge concentrations would have to meet the State of Maryland surface water discharge requirements.

#### *2.13.6.4 Annual O&M and Target Remediation Zone Groundwater Monitoring*

The pumping time estimated to achieve PRGs in the Site 4 groundwater target remediation zone is 6 years. This assumes that any continuing source in the vadose zone soil at Site 4 (the Site 4 soil target remediation zone discussed in section 2.9) has been removed, the adsorbed phase contaminant concentrations are minimal, and there are no NAPLs in the subsurface. During this period, annual O&M and monitoring would be performed.

In addition to mechanical system maintenance and checks, annual O&M would include sampling the discharge from each well and stripper influent and effluent monthly, and collecting water levels in the surrounding wells and piezometers monthly.

Groundwater monitoring would include collecting groundwater samples for VOC and perchlorate analysis from a network of 6 wells on a quarterly basis for 1 year and then semiannually for the duration of the remediation: estimated at 6 years for the groundwater target remediation zone.

#### *2.13.6.5 Reporting*

A 5-year report would be prepared that documents the effectiveness of the treatment system and meets the requirements of CERCLA. Technical memoranda would be prepared on a quarterly basis to report treatment performance.

#### *2.13.6.6 Continued Operation of the Existing Groundwater Extraction and Treatment Systems*

The existing extraction systems (the centrifuge extraction wells and the Site W Swale extraction trench) would continue to be operated to extract and treat groundwater until exit criteria are met in those specific areas of the plume. The air stripper treating the discharge from the Army ALC Building 500 storm sewer system and under-drain would continue to be operated until it is determined that it is no longer needed to meet the surface water discharge requirements. The treatment-system monitoring requirements would be revisited during the design phase and documented in the O&M plan for the overall remediation system.

#### *2.13.6.7 Long-term Groundwater Monitoring*

Groundwater monitoring would be performed at approximately 22 wells every 9 months to track contaminant concentrations within the Site 4 groundwater plume downgradient of the target remediation zone. Groundwater monitoring on a 9-month schedule allows collection of data in each of the four seasons. These data would be used during the 5-year reviews to determine the effectiveness of the controls. It was assumed that 22 wells would be sampled for VOCs, and a smaller number of these wells would also be sampled for explosives and perchlorate.

#### *2.13.6.8 Institutional Controls*

Institutional controls to prevent groundwater exposure from the site would be the same as those included in Alternative 2, including preparation of a LUC remedial design document. These would remain in effect until groundwater PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

### 2.13.7 Alternative 7: Mid-Plume Extraction System

Alternative 7 involves installation of a groundwater extraction system between the current centrifuge extraction system and the southern edge of the groundwater target remediation zone to achieve hydraulic control and mass removal of the plume across its entire width at this distance from the source. This alternative is not considered a stand-alone alternative, but rather an alternative that would be combined with one of the previous six. The primary components of this alternative are:

- Installation, testing, and startup of groundwater extraction wells
- Construction of a groundwater conveyance to treat the extracted water in the existing air stripper that serves the centrifuge extraction well system and the Site W swale extraction trench
- Instrumentation to monitor and record flow rates and notify maintenance personnel of malfunction
- Annual O&M to monitor performance and assure proper operation of the wells
- Groundwater monitoring for contaminant concentrations and hydraulic capture

Each primary component is discussed below.

#### *2.13.7.1 Installation of Groundwater Extraction Wells*

A network of six to eight groundwater wells, pumping at a total combined rate of 10 to 11 gpm would be installed to control the contaminated groundwater north of the centrifuge extraction system. This would reduce the clean up time for groundwater relative to the other six alternatives and contain contaminated groundwater that is moving toward the middle reaches of the Floral Drive stream and bypassing the existing centrifuge extraction well system. Specifically, the time to remediate the area between the southern edge of the TRZ and the centrifuge extraction wells would be reduced from 45 years to 20 years. The conceptual locations of the wells are shown in Figure 2-10.

In addition, four to six piezometers would also be installed to monitor water levels around the extraction wells and determine if the necessary capture zones were being established. It is assumed that these piezometers would be constructed identical to 2-inch monitoring wells.

#### *2.13.7.2 Groundwater Conveyance System*

The extracted water would be piped to an air stripper to remove volatile organic compounds. Based on historic groundwater data at the locations of the proposed extraction wells, all non-VOC contaminants in the groundwater extracted by these wells would be at concentrations below surface water discharge limits and would not require treatment to reduce concentrations. The treated water would be discharged to the surface water in the stream that runs along the east side of Isherwood Road.

#### *2.13.7.3 Annual O&M and Groundwater Monitoring*

During the estimated 20-year operation period, annual O&M and monitoring would be performed. In addition to mechanical system maintenance and checks, annual O&M would include sampling stripper influent and effluent and the discharge from each well and collecting water levels in the surrounding wells and piezometers on a monthly basis.

Groundwater monitoring would include collecting groundwater samples for VOC analysis from a network of 3 wells on a quarterly basis for 1 year and then semiannually for the duration of the remediation (estimated at 20 years).

#### *2.13.7.4 Reporting*

Preparation of technical memoranda and 5-year reports for the mid-plume extraction system would be included in those prepared for the existing extraction systems.

### 2.13.8 Common Elements and Distinguishing Features of Each Alternative

The one significant element which is common to all six alternatives is that hazardous substances would remain on site for some time at concentrations above those protective of unrestricted use. Therefore, all alternatives would require institutional controls. A distinguishing feature of Alternatives 4, 5 and 6 is the use of active remediation to accelerate the removal of COCs from groundwater within the most contaminated part of the plume (the TRZ) and the achievement of PRGs within 10 years. Further distinguishing features of Alternatives 4 and 5 is that the active remediation would occur *in-situ*.

### 2.13.9 Expected Outcomes of Each Alternative

Under Alternative 1, potential unacceptable risks to human health and the environment would continue indefinitely.

Alternatives 2, 3, 4, 5, and 6 would be immediately protective of human health and the environment through the use of institutional controls to prevent groundwater use, and monitoring to ensure institutional controls are addressing all contamination. Alternatives 4, 5, and 6 would also allow unrestricted groundwater use in portions of the plume within 10 years and for all of the plume in 45 years. Adding Alternative 7 to any of these three active remedies would allow unrestricted groundwater use for the entire plume in an estimated 20 years. The duration until unrestricted groundwater use would apply under Alternatives 2 and 3 is substantially longer.

Since May 2002 there has been a substantial increase in dissolved TCE concentrations immediately below the Site 4 source area. This increase has coincided with, and may be due to near-record rainfall over the past 24 months. This rainfall has resulted in increased infiltration through the contaminated soil in the source area and a substantial rise (over 14 feet) in the groundwater levels at the site. The infiltration and water level rise have both likely flushed TCE out of the subsurface soil and have submerged contaminated soil that was proposed to have been treated through SVE as discussed in section 2.12.

## 2.14 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP outlines the approach for comparing remedial alternatives. Evaluation of the alternatives uses "threshold," "primary balancing," and "modifying" criteria. To be considered for remedy selection, an alternative must meet the two following threshold criteria:

1. Overall protection of human health and the environment
2. Compliance with ARARs and TBC criteria

The primary balancing criteria are then considered to determine which alternative provides the best combination of attributes. The primary balancing criteria are:

3. Long-term effectiveness and permanence
4. Reduction in toxicity, mobility, or volume through treatment
5. Implementability
6. Short-term effectiveness
7. Cost

A comparative evaluation for these 7 criteria was conducted in the OU-1 FS for the seven remedial alternatives developed to address Site 4 groundwater. A summary of the evaluation is provided in Table 2-46. The cost information is repeated below for ease of comparison. The seven alternatives were then ranked relative to each other and given a relative score. This ranking is provided in Table 2-47.

| | Capital Cost | O&M Cost | Net Present Worth |
|---|---|---|---|
| Alternative 1 | $14,000 | $6,000 | $34,000 |
| Alternative 2 | $25,000 | $85,000 | $1,570,000 |
| Alternative 3 | $25,000 | $84,000 | $1,550,000 |
| Alternative 4 | $540,000 | $80,000-$280,000 | $2,800,000 |
| Alternative 5 | $630,000 | $80,000-$200,000 | $2,800,000 |
| Alternative 6 | $578,000 | $80,000-$220,000 | $2,400,000 |
| Alternative 7 | $200,000 | $30,000-$60,000 | $400,000 |

Based on the criteria evaluation and ranking, the combination of Alternatives 6 and 7 was identified as the preferred remedy and was presented to the State of Maryland and the public as such in the Proposed Plan. Comments on the Proposed Plan are used as the basis for evaluating the selected remedy further against two modifying criteria:

1. Acceptance by the State
2. Acceptance by the community

**State Acceptance**

The State of Maryland has gone on record in the Proposed Plan as supporting the combination of Alternatives 6 and 7 as the preferred remedy for Site 4 groundwater.

**Community Acceptance**

Based on comments expressed at the public meeting and received during the public comment period, the community generally agreed with the preferred remedy for groundwater with one exception.

This exception, together with new groundwater data collected since March 2003 (see section 2.5.3.3) and recent Navy guidance strongly discouraging the use of groundwater extraction and treatment, has resulted in a difference between the preferred remedy as described in the Proposed Plan and the selected remedy as described below. The selected remedy relies on *in-situ* bioremediation similar to that described in Alternative 4 of the FS, but expanded to include biological treatment of the groundwater at the source area. Specific responses to public comments are in the Responsiveness Summary section of this ROD.

## 2.15 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable [40 CFR 300.430(a)(1)(iii)(A)]. Principal threat wastes include non-aqueous phase liquids in the environment, drums of liquids containing the COCs for the site, and drummed non-liquid waste or

soil containing significant concentrations of highly toxic materials. Based on available information and on results of remedial investigations, Site 4 contains no principal threat wastes as defined by the NCP.

## 2.16 SELECTED REMEDY

This section expands upon the details of the selected remedy for Site 4 groundwater.

### 2.16.1 Summary of the Rationale for the Selected Remedy

The selected remedy for Site 4 groundwater is *in-situ* enhanced reductive dechlorination, institutional controls and long-term monitoring combined with the continued operation of the existing groundwater extraction and treatment system. The selected remedy consists of an approach similar to that outlined in Alternative 4 from the FS expanded to biologically treat the groundwater within the source area and the groundwater in the vicinity of the mid-plume extraction system defined in Alternative 7 (as necessary).

Table 2-47 provides a summary of the results of the detailed analysis and a numeric ranking of each alternative. A numeric value from 0 to 5 was assigned to each qualitative assessment of the criteria. Where significant uncertainty existed in the value of the ranking, a numeric range was provided to include the bracket of uncertainty. The values were added to arrive at a final total score for each alternative. Each criterion was assigned equal weight in determining the final score. Note that Alternative 7 was not ranked because it is not a stand-alone alternative and can be included with the selected alternative for non-source groundwater. The highest-ranking alternatives were:

- Alternative 6 with Alternative 7- Groundwater Extraction and *Ex Situ* Treatment with ICs and LTM and the Mid-plume Extraction System
- Alternative 4 with Alternative 7 –Enhanced Reductive Dechlorination with ICs and LTM and the Mid-plume Extraction System

Alternatives 4 and 6 scored the same for protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction in toxicity, mobility, or volume; short-term effectiveness; and implementability. The two alternatives differed only in cost, with groundwater extraction and treatment being the less expensive of the two. Clean-up time using Alternative 6 is expected to be on the order of 6 years for the target remediation zone, whereas the clean-up time for the target remediation zone under Alternative 4 is expected to be on the order of 10 years. The cleanup of the overall plume under both alternatives is expected to take 20 years.

Alternative 5 (air sparging) had a similar cost to Alternative 4 but did not score as well for compliance with ARARs because of its likely inability to effectively meet clean up goals for 1,1,2,2–PCA. Alternative 3 (MNA) had a wide range in overall score because of the uncertainty with its effectiveness.

The FS concludes that Alternative 7, when combined with either Alternative 4, 5, or 6, would reduce the time of remediation for the portion of the plume that bypasses the existing extraction systems from 41 years to 16 years. It would also reduce the overall time to cleanup the area between the southern end of the target remediation zone and the centrifuge extraction system from 45 years to about 20 years.

Since the time that this ranking was conducted in the FS, several events have occurred that have increased the overall benefits of Alternative 4 and decreased the attractiveness of Alternative 6 and 7.

- In April 2004 the Navy finalized groundwater remediation guidance that strongly discouraged the use of groundwater extraction and treatment as a final remedy. The guidance was based on site experience that shows that this technology very rarely achieves clean-up goals and almost always results in significant increases in treatment duration and cost accompanied by serious treatment inefficiencies.
- A more detailed look at remediation costs in 2004 indicated that costs for ex-situ groundwater treatment (Alternatives 6 and 7) would likely be greater than that indicated in the FS because of the need to treat for

iron in the water. At the same time it was determined that in-situ bioremediation costs would likely be less than that indicated in the FS because market pressures have reduced the price of the various substrates typically used for in-situ bioremediation.

- The results of several sampling events conducted at Site 4 in 2003 have shown that there has been a substantial increase in dissolved TCE concentrations immediately below the Site 4 source area. This increase has coincided with, and may be due to near-record rainfall over the past 24 months. This rainfall has resulted in increased infiltration through the contaminated soil in the source area and a substantial rise in the groundwater levels at the site of over 14 feet. The infiltration and water level rise have both likely flushed TCE out of the subsurface soil and have submerged contaminated soil that was proposed to have been treated through SVE as discussed in section 2.12.

- As a result of these recent events and findings, the Navy and EPA have determined that *in-situ* enhanced reductive dechlorination, with institutional controls and long-term monitoring combined with the continued operation of the existing groundwater extraction and treatment system would be the most effective alternative for treating the groundwater at Site 4.

An initial evaluation of MNA (i.e.: natural reductive dechlorination) at Site 4 was conducted in the OU-1 RI. The high concentration of ethene in the groundwater beneath Site 4, as well as low dissolved oxygen (DO) and oxidation/reduction potential (ORP), indicate that reductive dechlorination is happening in the area but that it is severely limited by lack of a carbon source. Providing a carbon source, such as that proposed in the selected remedy, should significantly increase the rate of dechlorination at the site and, together with soil remediation via SVE and downgradient groundwater remediation via continued operation of the existing extraction and treatment system, should clean-up the plume in a manner that is as timely and cost effective as possible.

### 2.16.2 Description of the Selected Remedy

The primary components of the selected remedy are:

- Installation of injection wells and injection of electron donor at the former Site 4 disposal pits
- Installation of injection wells and injection of electron donor in the areas of higher concentrations of TCE in the downgradient portion of the Site 4 plume between the former Site 4 disposal pits and the centrifuge extraction wells.
- Continued operation of existing groundwater extraction wells and trench and associated treatment system
- Long-term monitoring of the *in-situ* reductive dechlorination area, existing extraction system areas and downgradient portions of the plume
- Preparation of annual technical memoranda and 5-year reports
- Implementation of institutional controls until PRGs are met

#### *2.16.2.1 Installation of Injection Wells and Injection of Electron Donor in the Source Area*

The electron donor, is metabolized by naturally occurring microorganisms, resulting in the creation of anaerobic aquifer conditions and the production of hydrogen. The electron donor is typically a food-grade liquid that can be injected under pressure into the saturated zone for plume remediation.

The electron donor substrate will be injected using injection wells in the groundwater directly beneath the area of the former Site 4 disposal pits. This area is approximately 175 feet by 80 feet. Injection wells will be used because the site geology (which contains an abundance of boulders) precludes direct push technology. The electron donor substrate is assumed to have an estimated radius of influence of 6 to 10 feet under site conditions, therefore, the injection wells will be spaced at 16 feet. The re-usable injection wells will consist of 2 to 4-inch diameter, Schedule 40 PVC pipe with a 15-foot screened interval. The wells will be 55 feet deep on average in order to allow delivery of the electron donor throughout the depth of the saturated zone. The

electron donor chemical will be mixed into a slurry and using a pressurized pumping system, pumped into each injection well. The pressure of the injection would depend upon the head loss within the formation. The exact number and location of injection wells and the electron donor type and injection dosages will be calculated in the basis of design and the remedial action work plan and will be approved by EPA and MDE. It is likely that multiple injections of the electron donor substrate will be needed.

#### *2.16.2.2 Installation of Injection Wells and Injection of Electron Donor in the Downgradient Portions of the Plume*

Biological treatment barriers will be established at key locations in the plume between the source area and the existing centrifuge extraction wells to degrade the TCE and 1,1,2,2-PCA. Each barrier will consist of a line of injection wells constructed perpendicular to the direction of groundwater flow (See Figure 2-11). Treatment will focus on the areas of greatest contamination (greater than 100 to 500 µg/L). It is expected that if the higher levels are treated, it will cut off the source to the areas of lower concentration. It is anticipated that the barriers will be installed in a phased approach so that the most effective approach can be determined before the entire system is installed. The number of barriers needed will be determined based on the initial results. The exact number and location of injection wells, the details of the phased approach, and the type and dosage of the electron donor, will be calculated in the basis of design and the remedial action work plan and will be approved by EPA and MDE.

#### *2.16.2.3 Continued Operation of the Existing Groundwater Extraction and Treatment Systems*

The existing extraction systems (the centrifuge extraction wells and the Site W Swale extraction trench) will continue to be operated to extract and treat groundwater until exit criteria are met in those specific areas of the plume. The air stripper treating the discharge from the Army ALC Building 500 storm sewer system and underdrain will continue to be operated until it is determined that it is no longer needed to meet the surface water discharge requirements. The treatment-system monitoring requirements will be revisited during the design phase and documented in the O&M plan for the overall remediation system.

#### *2.16.2.4 Long-term Groundwater Monitoring*

Various groundwater monitoring programs would take place throughout the plume area to meet several monitoring needs.

First, the effectiveness of *in-situ* enhanced reductive dechlorination will be monitored by collecting and analyzing groundwater samples from selected wells (approximately 8) prior to, and throughout the duration of, the treatment. The number of wells may be increased as the treatment system is expanded. Sampling and analysis will be conducted to track removal of contaminants and byproduct generation, and the dispersion of the electron donor, to determine the remedies effectiveness and if additional electron donor applications are necessary.

During each sampling event, the groundwater will be sampled for VOCs, perchlorate (where appropriate) and the primary reductive dechlorination indicator parameters including dissolved manganese and iron, sulfate/sulfide, chloride, nitrate/nitrite, ethane, ethene, methane. Field parameters such as DO, temperature, pH, conductivity, and ORP will also be collected. Laboratory analysis of the initial sampling rounds will involve analysis of additional parameters, particularly metabolic organic acids, to track the degradation of the electron donor.

Baseline sampling will be conducted prior to the injection of the electron donor, quarterly for the next year, and then semiannually until PRGs are achieved. Field sampling efforts may be conducted more frequently for parameters such as DO and ORP. The frequency of sampling events may be adjusted based on the results of the early sampling events. Locations of sampling points are estimated to be as follows: one upgradient, three at the source area, and four downgradient. A sampling and analysis plan for *in-situ* enhanced reductive dechlorination will be developed during the work plan and will be submitted to EPA and MDE for approval.

Groundwater monitoring also will be performed at approximately 22 wells every 9 months to track contaminant concentrations within the Site 4 groundwater plume within and downgradient of the target remediation zone. Groundwater monitoring on a 9-month schedule allows collection of data in each of the four seasons. These data will be used during the 5-year reviews to determine the effectiveness of the controls. It was assumed that 22 wells will be sampled for VOCs, and a smaller number of these wells will also be sampled for explosives and perchlorate. A sampling and analysis plan for the plume will be developed during the design phase and approved by EPA and MDE.

#### *2.16.2.5 Reporting*

A 5-year report will be prepared that documents the effectiveness of the treatment system and meets the requirements of CERCLA. Technical memoranda will be prepared on a quarterly basis to report groundwater extraction and treatment system performance, and every third quarter to present 9-month plume sampling data to the BCT. Separate technical memoranda will be prepared after each sampling round related to the in-situ bioremediation area.

#### *2.16.2.6 Institutional Controls*

Institutional controls will be implemented to meet the following LUC Objectives:

- Ensure no withdrawal of groundwater for any purpose (including as drinking water) from within the restricted area shown on Figure 2-6 until the PRGs are met and risks from groundwater use are shown to be reduced to acceptable levels.

- Ensure adequate protection to minimize potentially adverse health and environmental effects of work or development in the restricted area.

- Ensure adequate protection to minimize physical disruption of any remedial equipment, such as monitoring wells, or remedial operations in the restricted area.

- Ensure adequate notification of pertinent use restrictions to current and future owners.

Institutional controls will be maintained until the concentrations of hazardous substances in the groundwater are at such levels as to allow for unrestricted use and exposure.

The Navy is responsible for implementing, inspecting, reporting, and enforcing the LUC Objectives in accordance with a LUC Remedial Design. The LUC Remedial Design will be developed during the design phase, submitted to EPA and MDE within 180 days of signature of this ROD, and will be subject to review and approval by the EPA and MDE.

Although the Navy retains ultimate responsibility for meeting the LUC Objectives, the Navy may arrange, by contract or otherwise, for another party to carry out the LUC Remedial Design implementing actions. In addition, since the particular sites subject to this ROD are presently under the jurisdiction of GSA, the Navy will work with GSA to ensure that the LUC Objectives are met in accordance with the LUC Remedial Design.

Should any LUC Remedial Design implementing action fail or any LUC objective not be met, the Navy will ensure that appropriate actions are taken to reestablish the action and ensure compliance with the LUC Objectives. The Navy may initiate legal action against a third party to compel action and/or to recover the costs for remedying any LUC violation.

#### *2.16.2.7 Exit Strategy for Centrifuge Area Groundwater Extraction System*

The selected remedy for groundwater at Site 4 includes an exit strategy that identifies performance objectives for helping to determine when it is appropriate to turn off the centrifuge extraction wells and treatment system and transition to a less aggressive approach such as MNA and LTM.

Once the area of high concentrations in the plume upgradient of the centrifuge extraction wells is cleaned up or cut off from the portion of the plume being contained by the extraction wells, the concentrations of COCs in the extracted water are expected to decrease. However, if groundwater extraction is the only process removing contaminant mass, concentrations will likely decrease to a certain value and then level off. The asymptotic concentration will depend on several factors such as the contaminant's equilibrium concentrations partitioned between the aquifer soil and the water, the heterogeneity in the aquifer soil, etc. It is unlikely that the asymptotic concentrations achieved in the groundwater will be below the PRGs established for all COCs. The achievement of an asymptotic concentration is an indication that the groundwater extraction and treatment system may no longer be cost effective, or may not have the technical capability of meeting PRGs in the aquifer.

It is also possible that, once the source area and plume is treated, and the enhancement of *in-situ* enhanced reductive dechlorination becomes established in the aquifer, the data will show that biological activity is remediating the aquifer at a rate that will make the extraction system unnecessary: i.e.: that remediation will occur in a similar time frame even if the extraction system is turned off.

This ROD establishes a set of performance objectives to help determine when it is appropriate to turn off the centrifuge extraction wells. Performance objectives are different from RAOs. RAOs are the overall objectives of the remedial action, while performance objectives are based on the practical technical limitations of the various components of the remedy, and are used to identify decision points and transitions for the remedial action. The establishment of performance objectives and the transitions in the remedial action approach that they trigger is referred to as the exit strategy.

***Centrifuge Area Groundwater Extraction and Treatment System Performance Objectives-***

Performance objectives established for the centrifuge area groundwater extraction system are:

- Asymptotic COC levels in the extraction wells and select monitoring wells upgradient of the extraction system, achieved after temporary shutdown periods (to evaluate rebound) and appropriate system optimization.

- Evidence that natural attenuation (NA) will effectively remediate the plume within an acceptable time frame.

- The operation of the extraction (and treatment) system is no longer cost effective, based on a comparison of the operating costs per unit mass removed to the associated risk or to alternative cleanup technologies including MNA, or enhanced in-situ bioremediation.

All three of these performance objectives will be monitored during the operation of the remedial action. Meeting one or more of these performance criteria to the satisfaction each of the Navy, EPA, and MDE will be considered adequate evidence for considering discontinuing groundwater extraction and transitioning to a more appropriate technology.

To determine if performance objectives are met, concentrations of COCs in the extraction wells, and in upgradient monitoring wells, will be monitored to determine if these concentration approach asymptotic levels.

Select wells upgradient of the extraction wells will also be monitored for NA parameters to evaluate if, once the Site 4 source is cut off or remediated, NA or enhanced bioremediation would be the appropriate remedy and would be more cost effective than continued groundwater extraction.

The exit strategy considers system optimization and contingencies for rebound in determining when system shutdown and transition to other technologies is warranted. The need for further active or passive treatment to meet RAOs will then be evaluated based on the remaining groundwater conditions and associated risk.

The specific sampling protocol used to collect the data to be evaluated when making these decisions will be

outlined in the Site 4 groundwater long-term monitoring plan to be prepared as part of the remedial design process. The monitoring plan will be subject to review and approval by EPA and MDE.

***Groundwater Extraction and Treatment System Optimization-***

Steps to improve optimization of the groundwater extraction system will be taken at various intervals of operation based on an evaluation of capture, mass removal rates and operating costs. Optimization will also be evaluated prior to the decision to shut the system down once performance objectives have been met. Optimization steps may include:

- Shutting down individual extraction wells
- Cyclic operation of wells

***Groundwater Extraction and Treatment System Rebound Contingency-***

Once the preliminary performance objectives have been met (i.e.: asymptotic mass removal even after system optimization has been achieved and/or evidence of the effectiveness of MNA or enhanced bioremediation is found) a rebound evaluation will be conducted. The rebound evaluation will consist of putting the system on standby for a minimum period of 1 year. During that time, data will be collected in support of the next step in the treatment train (LTM, MNA, enhanced bioremediation). Appropriate data collected after one year will be used to determine whether rebound is occurring using the following formula:

Rebound = [log(Cr/Cf)]/[log(Co/Cf)

Where:

Co = the initial concentration of a COC (at system startup)

Cf = the final asymptotic concentration of a COC

Cr = the concentration of a COC after 1 year of system shut-down.

A rebound of 0.2 or less reflects a permanent reduction and confirmation that performance objectives for groundwater extraction and treatment have been met.

A decision to turn off permanently all or portions of the centrifuge area extraction system will be made by the Navy with consent and written approval of EPA and MDE. Any decision to permanently turn off the centrifuge area extraction system will be documented in a technical report and will also be addressed during subsequent 5-year reviews.

### *2.16.2.8 Exit Strategy for Building 502 Stormwater/Groundwater Treatment System*

The Building 502 air stripper treats storm water and groundwater that is collected passively in the storm sewer system and underdrain of the Building 500 complex. Because the Building 500 underdrain will continually discharge water to the system, this exit strategy pertains to the continued use of the air stripper to reduce VOC concentrations only.

Operation of the Building 502 air stripper may be discontinued and the water collected in the system may be discharged directly to the storm water outfall when it is determined that the combined ILCR associated with the VOCs in the influent water is below $1x10^{-5}$ and the HI for a given target organ is less than 1, based on site-specific exposure parameters for the receiving outfall/surface water body. The data used to evaluate whether the risks and hazards are below the acceptable limits will be the maximum influent concentration to the Building 502 air stripper collected over the most recent 12 month period. Influent samples currently are and

will continue to be collected and analyzed quarterly; however, if the air stripper is shut down samples will then be collected and analyzed on an annual basis for a period of five years. These data will be evaluated by the BCT. Assuming concentrations are still below acceptable human health risk-based levels for surface water, monitoring will be discontinued.

A decision to turn off permanently all or portions of the Building 502 stormwater/groundwater trealment system will be made by the Navy with consent and written approval of EPA and MDE. Any decision to permanently turn off the Building 502 stormwater/groundwater treatment system will be documented in a technical report and will also be addressed during subsequent 5-year reviews.

#### *2.16.2.9 Exit Strategy for Site W Swale Groundwater Extraction Trench and Treatment System*

The Site W Swale extraction trench is a passive, gravity-operated extraction system. The extracted water is treated in the same air stripper as the water extracted by the centrifuge area extraction wells. While the centrifuge area wells supply approximately 6 gpm of groundwater with relatively high (and consistent) concentrations of VOCs to the stripper, the trench collects approximately 17 gpm of water with low (and continually decreasing) concentrations of VOCs. Therefore, it is likely that the groundwater from the centrifuge extraction wells will continue to require treatment (see section 2.16.2.7) long after the need to treat the water from the trench has ceased. Significant savings in operating costs can be realized by discontinuing the treatment of water collected in the Site W Swale trench once concentrations have receded to an acceptable level. As such, this exit strategy presents a rationale for the discharge of water collected in the trench directly to surface water without treatment for VOCs in the air stripper.

The water collected in the Site W Swale extraction trench will be able to be discharged directly to the surface water (the stream that currently receives the effluent from the Site W Swale air stripper) when it is shown that the combined ILCR associated with the VOCs in the groundwater collected by the trench is below $1 \times 10^{-5}$ and the HI for a given target organ is less than 1, based on site-specific exposure parameters for the receiving surface water body. The data used to evaluate whether the risks and hazards are below the acceptable limits will be the maximum concentration found in monitoring wells located immediately upgradient of the extraction trench (well C-08) collected over the last four sampling events. Well data had been collected quarterly through 2004 and is now collected annually. If the Site W Swale extraction trench is shut down samples will continue to be collected and analyzed on an annual basis from wells C-08 and either 46GW210 or 46GW124 for a period of five years. These data will be evaluated by the BCT. Assuming concentrations are still below acceptable human health risk-based levels for surface water, monitoring will be discontinued. The Site W Swale air stripper will continue to be operated to treat water from the centrifuge area extraction wells until the criteria in Section 2.16.2.7 are met.

A decision to turn off permanently all or portions of the Site W swale groundwater extraction trench and treatment system will be made by the Navy with consent and written approval of EPA and MDE. Any decision to permanently turn off the Site W swale groundwater extraction trench and treatment system will be documented in a technical report and will also be addressed during subsequent 5-year reviews.

## 2.17 STATUTORY DETERMINATIONS FOR SOIL AND GROUNDWATER REMEDIES

The selected remedies for both soil and groundwater satisfy the statutory requirements of Section 121 of CERCLA, 42 U.S.C. Section 9621. Under CERCLA, remedial actions sites must achieve protection of human health and the environment, comply with federal and state ARARs, be cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element are preferred. The following discussion addresses how these statutory requirements and preferences are met by the selected remedies.

### 2.17.1 Protection of Human Health and the Environment

The selected remedies for both soil and groundwater will be protective of human health and the environment. Institutional controls will minimize the risk of direct exposure to the contaminated groundwater until concentrations of COCs have been reduced to PRGs. There are no short-term threats associated with the selected remedies that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the selected remedies. Monitoring will ensure that the selected remedies are effective, that the source in the soil is removed and that the plume of COCs is not expanding or unexpectedly increasing in concentration.

### 2.17.2 Compliance with ARARs

The selected remedies will comply with all location-, chemical- and action-specific ARARs. The ARARs analysis is summarized in Appendix B.

### 2.17.3 Cost Effectiveness

In the Navy and EPA's judgment, the selected remedies are cost effective and represent reasonable value for the money to be spent. In making this determination, the following definition was used (40 CFR 300.430(f)(1)(ii)(D)): "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." The Navy and EPA made this determination by evaluating the "overall protectiveness" of the selected remedy, which satisfied the threshold criteria (i.e., it was both protective of human health and the environment and complies with ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of the selected remedies was determined to be proportional to its costs; therefore, the selected remedies represent a reasonable value for the money to be spent.

The estimated net present worth (NPW) of the selected remedy for soil is $313,000. This is one-half to one-third the price of each of the other two active remedies evaluated. It was also the least costly remedy developed that was capable of meeting the RAOs.

The estimated NPW of the selected remedy for groundwater is $2,750,000 over 30 years. This is slightly less than other active remedies based on post FS information, and approximately twice as much as passive remedies such as institutional controls with long-term monitoring.

### 2.17.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

The Navy and EPA, with MDE concurrence, have determined that the selected remedies represent the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. The Navy and EPA have determined that the selected remedies provide the best balance of trade-offs in terms of the five balancing criteria. The Navy and EPA also considered the statutory preference for treatment as a principal element, the bias against off-site treatment and disposal, and state and community acceptance.

### 2.17.5 Preference for Treatment as a Principal Element

The selected remedies for both soil and groundwater satisfy the statutory preference for treatment as a principal element, employing soil vapor extraction for soil and both the enhancement of in-situ natural biological processes and groundwater extraction and treatment to contain and remediate the groundwater plume.

### 2.17.6 Five-Year Review Requirements

Because the selected remedy for groundwater will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure for an estimated 20 years, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment, and every five years thereafter.

## 2.18 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for Site 4 soil and groundwater at the former NSWC-White Oak, Silver Spring, Maryland was released for public comment on June 24, 2003. The Proposed Plan identified soil vapor extraction as the preferred alternative for soil. The Navy reviewed all comments received during the public comment period. It was determined that no significant changes to the soil remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

The Proposed Plan identified groundwater extraction and treatment with institutional controls and monitoring as the preferred alternative for groundwater. The Navy reviewed all comments received during the public comment period as well as groundwater data that continue to be collected from the site as part of the interim monitoring program. Based on public comment (see Section 3 of this ROD) and the other issues discussed below, the remedy selected by this ROD differs from the preferred remedy that had been identified in the Proposed Plan. The selected remedy was one of the alternatives presented to the public in the Proposed Plan (Alternative 4).

- In April 2004 the Navy finalized groundwater remediation guidance that strongly discouraged the use of groundwater extraction and treatment as a final remedy. The guidance was based on site experience that shows that this technology very rarely achieves clean-up goals and almost always results in significant increases in treatment duration and cost accompanied by serious treatment inefficiencies.

- A more detailed look at remediation costs in 2004 indicated that costs for ex-situ groundwater treatment (Alternatives 6 and 7) would likely be greater than that indicated in the FS because of the need to treat for iron in the water. At the same time it was determined that *in-situ* enhanced reductive dechlorination costs would likely be less than that indicated in the FS because recent market pressures have reduced the price of the various substrates typically used for *in-situ* enhanced reductive dechlorination.

- The results of several sampling events conducted at Site 4 in 2003 have shown that there has been a substantial increase in dissolved TCE concentrations immediately below the Site 4 source area. This increase has coincided with, and may be due to near-record rainfall over the past 24 months. This rainfall has resulted in increased infiltration through the contaminated soil in the source area and a substantial rise in the groundwater levels at the site of over 14 feet. The infiltration and water level rise have both likely flushed TCE out of the subsurface soil and have submerged contaminated soil that was proposed to have been treated through SVE as discussed in section 2.12.

As a result of public comment and these recent events and findings, the Navy and EPA have determined that *in-situ* enhanced reductive dechlorination, with institutional controls and long-term monitoring combined with the continued operation of the existing groundwater extraction and treatment system would be the most effective alternative for treating the groundwater at Site 4.

# 3.0 RESPONSIVENESS SUMMARY

## 3.1 OVERVIEW

This Responsiveness Summary provides a summary of comments received during the public comment period for Site 4 groundwater and soil, along with responses to those comments. The public comment period for the proposed remedy for Site 4 groundwater and soil began on June 24, 2003 and ended on July 24, 2003. A public meeting was held on July 8, 2003 at the Sheraton College Park in Beltsville, Maryland to describe the proposed remedy and to solicit and accept either written comments or verbal comments. This Responsiveness Summary was prepared in accordance with guidance in "Community Relations in Superfund: A Handbook" [Office of Solid Waste and Emergency Response (OSWER) Directive 9320.3B, January 1992].

## 3.2 BACKGROUND ON COMMUNITY INVOLVEMENT

The Navy has had a comprehensive community relations program for NSWC-White Oak since research activities commenced at the Base. Recent community relations activities have been conducted in accordance with the NSWC-White Oak Community Relations Plan, originally developed in 1991 and revised in 1998, 2000, and 2003. These activities have included regular technical and Restoration Advisory Board (RAB) meetings with local officials and residents, the distribution of fact sheets, site tours for the community, the establishment of the information repository at the local library, and the development of a web-page for the dissemination of information to the White Oak community.

The Navy organized a Technical Review Committee (TRC) in 1989 to review and discuss the NSWC-White Oak environmental issues with local community officials and concerned citizens. The TRC was reorganized into the RAB in 1995. The RAB consists of representatives of the Navy, EPA, MDE, the Prince George's County Health Department, Maryland-National Park and Planning Commission, and members of the community. The RAB has met frequently since its inception and now meets quarterly. The RAB has been assisting in the planning and review of environmental investigation, remedial alternative evaluation, and remediation activities. The Remedial Investigation, Feasibility Study, and Proposed Plan for Site 4 groundwater and soil were discussed at the RAB meetings.

RAB meeting minutes and reports presenting the findings of the investigations are maintained at the local information repository. The repository is located at the Montgomery County Public Library, White Oak Branch, located at 11701 New Hampshire Avenue, Silver Spring, Maryland. The Administrative Record for NSWC-White Oak is located at NAVFAC Washington, 1314 Harwood Street, S.E, Washington Navy Yard, District of Columbia.

Community relations activities for the final selected remedy include the items below:

- The documents concerning the investigation and analysis of Site 4 groundwater and soil were presented at the RAB meetings and copies were provided to RAB members for review, discussion, and comment.
- The documents concerning the investigation and analysis of Site 4 groundwater and soil, as well as copies of the Feasibility Study and Proposed Plan, were placed in the information repository.
- The Navy mailed copies of the Proposed Plan to members of the RAB.
- Newspaper announcements on the availability of documents and the public meeting and comment period were published in the *Washington Post, Burtonsville Gazette, College Park Gazette,* and *Silver Spring Gazette* during the week prior to the beginning of the public comment period.
- The Navy established a 30-day public comment period for this Proposed Plan starting June 24, 2003 and ending July 24, 2003.
- A public meeting was held on July 8, 2003 to present the Proposed Plan and to answer questions concerning Site 4 groundwater and soil

## 3.3 SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND NAVY RESPONSES

Questions were received during the information session held on July 8, 2003. Two other formal comments were received during the public comment period. A summary of the questions and responses provided are provided below. A copy of the transcript of the open discussion portion of the public information session is provided in Appendix C.

The Navy and the EPA have taken the comments received during the public comment period into consideration and continue to believe that soil vapor extraction adequately and appropriately addresses Site 4 soil in a cost-effective and responsible manner.

Based on the public comments, recent site data and Navy guidance, the Navy and the EPA have revised the preferred remedy for Site 4 groundwater that had been presented in the Proposed Plan, as described in Section 2.18 above. The Navy and EPA believe that this revised remedy: *in-situ* enhanced reductive dechlorination, with institutional controls and long-term monitoring combined with the continued operation of the existing groundwater extraction and treatment system, adequately and appropriately addresses Site 4 groundwater in a cost-effective and responsible manner.

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**Comments received during the June 24 - July 24, 2003 public comment period (and responses)**

**Comment 1:** The presentation says that risks were evaluated for White Oak residents, but does not mention risks to people who live in Adelphi, which is the community south of Site 4 where the contamination is.

**Response 1:** The term "White Oak residents and tenants" (in the presentation), refers to people who may live or work on the former NSWC White Oak in the future (i.e.: the property currently owned by GSA or the Army). It does not refer to the residents of the town of White Oak. Current and future risks have been evaluated for people living outside of the boundaries of the government property (such as Adelphi). These people are referred to as "the surrounding community" in the presentation. There are no current unacceptable risks from site contaminants to people living in the surrounding community.

**Comment 2:** The RI states that Paint Branch is a natural boundary. However there are people living within this contaminated area between the former NSWC White Oak and Paint Branch. It's been clearly established that two former residential wells are contaminated. There is also contamination in two small creeks located on private property. So there is risk to the community.

**Response 2:** It is recognized in the Operable Unit (OU)-1 RI (a public document) that several private properties are located within the natural boundaries of the groundwater plume in OU-1, and that it is known or is possible that the groundwater and surface water contain site-related contaminants. For that reason extensive sampling was conducted at representative "worst-case" points where exposure of humans and/or animals and plants to contaminants might be possible. Areas that have been sampled extensively include the two wells and the two creeks mentioned in Comment 2, along with Paint Branch and the stream that runs along the east side of Floral Drive and the eastern boundary of the government property (referred to as the Floral Drive stream). In addition to extensive sampling, detailed human health and ecological risk assessments were conducted to evaluate risk from exposure to surface water and sediment present in each of these streams. The results of the sampling and risk assessments concluded that although low levels of site-related chemicals were detected in the surface water in some of these streams and in the groundwater underlying small portions of some of the private properties, the concentrations found do not present an unacceptable risk to any of the receptors evaluated.

Risks from groundwater exposure at the two referenced residential wells were evaluated and found to be acceptable, because there is in fact no exposure. The two residents are currently serviced by the public water supply and, as a result, the wells were abandoned in accordance with County requirements.

**Comment 3:** The commenter noted that he had not been aware that contamination extended to certain areas at the site. Have the owners of all affected properties been notified of the potential for contamination on their properties?

**Response 3:** This comment is addressed by the response to Comment 15 below.

**Comment 4:** The seep that feeds the creek on the Paint Branch Home was 200 parts per billion (of TCE) for a long time. That's way above EPA standard of 50 parts per billion.

**Response 4:** The standard that is being applied to the surface water in the stream is a risk-based concentration based on a site-specific exposure scenario, and not the federal drinking water standard of 5 parts per billion (ppb) (which is what we believe the author of the comment is referring to). For example the risk assessment performed on the surface water in the stream on the Paint Branch Home property, (which stream is only a foot or two wide and several inches deep), assumed a worst-case exposure of a 33-pound child playing in the stream for 2.6 hours per day, 52 days per year, throughout their childhood. Each day the bare skin of their hands, feet, and lower legs were assumed to be exposed to the water for 2.6 hours and that they ingested 7 ounces of the water daily. Under this scenario, 200 ppb does not represent an unacceptable risk based on the criteria used by EPA under CERCLA. No unacceptable risk means that the risk of developing cancer from this exposure would be less that 1 in 1,000,000, and that there would be no risk of any non-cancer illnesses.

Additionally, the 200 ppb referenced is a maximum TCE concentration detected several years ago at the point that the groundwater seep reaches the ground surface. Concentrations of TCE in samples collected during the same period, 50 feet further down the stream, were only 10 ppb.

Furthermore, the Navy took action in 1998 to prevent further off-site migration of contamination in groundwater in this area by constructing a groundwater extraction trench as an interim measure approximately 200 feet upgradient of the seep. The surface water at the seep has been sampled regularly since the trench was installed and quarterly since January 2001. TCE concentrations at the seep have been below 35 ppb for the last six quarters. Concentrations in all other sampled points in this stream since January 2001 have ranged from 0.1 to 2 ppb.

**Comment 5:** Has the Navy checked to see if there are other wells in the area?

**Response 5:** Yes. While there are other supply wells in the area, none are located within the boundary of Operable Unit 1. Any supply wells located across Paint Branch from OU-1 would not be impacted by Site 4 because the groundwater is intercepted by Paint Branch.

**Comment 6:** Will the groundwater contamination affect the city water?

**Response 6:** No. The public water line to the residential properties between the government property and Paint Branch property (which was constructed in 2001) was designed and installed with the consideration that, where the water line is situated below the groundwater table, the surrounding groundwater may contain low concentrations of TCE and 1,1,2,2-PCA (5 to 10 ppb). As a result it was constructed of material (pipe and joints) that are compatible with (resistant to) these contaminants and will not allow them to enter into the water line. There are no other public water lines located below the water table within the area that is or may be impacted by site-related contamination.

**Comment 7:** The risk assessment may show that there is no risk at this moment to offsite residents, but there has been risk in the past and that's not indicated in this presentation at all

**Response 7:** None of the data collected at the site, over the course of many years, suggested that there was an unacceptable risk posed to offsite residents. Moreover, the purpose of the proposed plan and the preferred

remedy is to address the current and possible future conditions, and to present what's proposed to mitigate risks caused or potentially caused by those conditions. Whether or not there were risks associated with the contamination in the past is beyond the scope of the Navy's current work at the site.

Comments 8, 9, 12 and 14, along with the responses, reflect that the preferred remedy for groundwater at the time was pump and treat. The selected remedy is *in-situ* enhanced reductive dechlorination, with institutional controls and long-term monitoring combined with the continued operation of the existing groundwater extraction and treatment system.

**Comment 8:** Can you clarify how the groundwater treatment system will work, specifically how the contaminants will be removed and how it will be monitored? How would you know what types of contaminants are placed in the air?

**Response 8:** The extracted groundwater will be run through an air stripper. The type of air stripper to be used is a countercurrent stripper, which is one of the most common (and acceptable) forms of treatment for volatile organic compounds such as TCE and 1,1,2,2-PCA. Contaminated water enters the stripper from the top and trickles down through a series of perforated trays while air is blown upward. The contaminants, which prefer to be in the vapor phase under atmospheric conditions, readily transfer to the air.

The water flowing into and out of the stripper would be sampled and analyzed on a regular basis (to be determined and approved by EPA and the State of Maryland). The water exiting the stripper would meet the conditions established in the ROD.

The concentration of VOCs vented to the atmosphere would be calculated by assuming that all of the TCE, 1,1,2,2-PCA, and other organic compounds entering the stripper in the water are removed and transferred to the air. The air discharges would be compared to allowable limits. If the VOC concentration in the untreated groundwater indicates that the air emissions limits will be exceeded, then treatment will be required for the air discharging from the stripper. Treatment could consist of passing the air through an activated carbon filter prior to discharge to the atmosphere. The conceptual design calculations indicate that air treatment will not be necessary.

**Comment 9:** Would discharges from the air stripper to the air be continually monitored, or how would they be monitored?

**Response 9:** The need for treatment of air discharges from the stripper would be frequently evaluated by monitoring the VOC concentration in the water entering the stripper. If, as part of the design of the treatment system, it was determined that air treatment was needed, control/treatment equipment will be added and air monitoring would be performed on a regular basis (i.e., monthly, quarterly), in conjunction with the monitoring of the air stripper operation. The timeframe for monitoring would be approved by EPA and the State of Maryland.

**Comment 10:** You're talking about a goal of 22 years to clean up of the plume. Does that refer to both the groundwater and surface water?

**Response 10:** The 22-year cleanup period refers to the groundwater and reflects treatment in the area of the contaminant plume with the slowest groundwater flow.

Cleanup times for the surface water have not been calculated because none of the chemical concentrations found in any of the surface water bodies exceeds levels that represent unacceptable risks and, therefore the surface water does not require remediation.

Nevertheless, it is appropriate to conclude that when groundwater concentrations have been reduced to the established cleanup goals (which are based on residential drinking water standards) the concentrations in the receiving streams will also be below these drinking water standards; there is no significant lag time

**Comment 11**: Is any of the contaminated groundwater plume hitting the main stem of Paint Branch or is it all going off into the tributary streams? And are any of these discharges to streams off the former NSWC White Oak.

**Response 11:** No volatile organic compounds, or explosives compounds have been detected in Paint Branch during any round of sampling, however, TCE has been detected at concentrations of 1 to 2 ppb in monitoring wells within 20 feet of Paint Branch. The Building 500 outfall and the Site W swale stream are the only 2 surface water bodies where TCE has been detected.

**Comment 12:** Will the operation of the air strippers be monitored continually?

**Response 12:** The two air strippers that are in place are equipped with a cellular-phone based autodialer system. If a part of the system malfunctions, a phone call is made automatically to a responsible person who will address the problem. The new air stripper will be equipped with a similar system.

**Comment 13:** When was (the current autodialer system) installed?

**Response 13:** The cellular-phone based autodialer system was installed in 2002. Prior to that, a land-based telephone system served the same function. A switch was made to cellular technology because the land-based system was not always dependable

**Comment 14:** When will we have information as to how the new system will actually be monitored or are you definite that it will be on the phone system as well?

**Response 14:** A cellular phone system will be incorporated into the new air stripper's performance monitoring system. Specifics on the performance monitoring program will be developed in a long-term monitoring plan to be developed in consultation with, and approved by, USEPA and MDE. This plan will be made available in the information repository for public review and discussed with the White Oak RAB.

**Written Questions and Comments Received During the 30-day Public Comment Period (June 24 through July 24, 2003)**

**Comment 15:** As indicated by Navy maps and discussion at the meeting, the off base contamination has reached properties on Pleasant Acres Drive and Powder Mill Road. The Navy admitted that they have not notified these property owners of the contamination on their properties. I find this decision to keep the citizens uninformed about contamination of their property deplorable, unethical, and even criminal. The citizens and neighbors need to know the truth. They should have been informed of this situation years ago. This indicates negligence on the part of the Navy. The Navy must be required to inform these property owners of all types of contamination, all testing dates and all levels of contamination that have been found on their property. The contamination testing should have been intensive in this area since at least 1996.

I also find statements such as creeks being "natural boundaries of contamination" to be extremely misleading. Some creeks that are contaminated by these sites are in fact "natural carriers' of contamination to off base civilian properties.

I find your lack of complete disclosure of off base contamination to be quite alarming. There needs to be a completely new section added to the document presented at the public meeting, and a new public meeting. This section should include a detailed, accurate and complete disclosure of all contaminated off base civilian properties. The off base contamination is a serious issue that needs to be addressed by the Navy.

If the Navy continues to refuse to inform the neighbors and citizens about their contaminated properties, I will take whatever means I feel necessary to inform these citizens of this serious situation. If the Navy does not take the necessary action to remedy this situation by August 15, 2003, as a concerned citizen, neighbor, and founder of Paint Branch Citizen Association, I will inform the property owners.

**Response 15:** The map in question (which shows the estimated extent of the TCE contaminant plume extending off-site onto portions of several private properties before discharging into the Floral Drive stream) appears in the Operable Unit (OU) 1 RI, the OU-1 FS, and the proposed plan for Site 4. These documents and the findings discussed therein have been discussed at regularly scheduled RAB meetings and are available for review by the public at the information repositories, the locations which have been advertised in the local papers. Further, the Navy has collected groundwater samples on several of these properties (with owners' consent) which show that groundwater from the government property does not flow beyond the Floral Drive stream. The Navy has also collected surface water and sediment samples (with property owner consent) from the Floral Drive stream where it flows through private property.

While the groundwater sampling was conducted to verify the assumption that the stream(s) were natural boundaries for groundwater flow, the extensive stream sampling was also conducted to determine if the streams surrounding the government property were "natural carriers of contamination" as the above comment alleges.

As stated in the response to comment 2, the surface water and sediment samples collected from all of the streams in question were evaluated in an EPA-approved risk assessment. While low concentrations of some site-related chemicals have been detected in several surface water samples, the assessments conclude that there are no unacceptable risks to humans or animals from chemicals in any of the streams.

**Comment 16:** Perchlorate was identified as a potential contaminant of concern (PCOC) as part of the risk assessment for groundwater at Site 4. However, in the feasibility study for Site 4, perchlorate was excluded as a contaminant of concern (COC) and subsequently, it was not part of the remedial alternative selection process. Perchlorate is a contaminant of great interest to many public health agencies. In 1999, EPA's Office of Research and Development issued an Interim Assessment Guidance for Perchlorate. The guidance states "if state or local environmental authorities decide to pursue site-specific clean-up or other water management decisions based on this provisional RfD [reference dose for perchlorate] range by applying the standard default body weight (70 kg) and water consumption level (2 L/day), the resulting provisional clean-up levels or action levels would range from 4-18 parts per billion (ppb)." In a January 22, 2003 memo from Marianne Lamont Horinko, Assistant Administrator for the Office of Solid Waste and Emergency Response at EPA, the 1999 guidance was affirmed with the added suggestion "to carefully consider the low end of the provisional 4-18 ppb range." Additionally, the State of Maryland recently issued a perchlorate advisory for levels at 1 ppb or greater in drinking water.

The EPA and Maryland Department of the Environment should consider perchlorate a contaminant of concern and follow the 1999 Guidance and 2003 suggestion in its selection of a remedial alternative for the Site 4 groundwater. Since virtually every other decision regarding remediation of contamination at White Oak has been based on drinking water standards, the assessment of remedial alternatives should include consideration of human health risks of Site 4 groundwater as a drinking water source. The Assistant Deputy Under Secretary of Defense for the Environment, John Paul Woodley, Jr, recently issued Interim Guidance on Perchlorate Activities. The guidance recognizes that the results of a study being conducted by the National Academy of Science "will likely lead to the development of an oral reference dose (RfD) for perchlorate. Once established, the RfD can be used for conducting risk assessments for environmental restoration purposes and for setting a Federal drinking water standard (i.e., maximum contaminant level under the Safe Drinking Water Act)." Given this recognition by the Department of Defense that a drinking water standard may soon exist for perchlorate, the selection of a remedial alternative for Site 4 groundwater should include consideration of perchlorate as a COC. It may prove difficult and costly to retrofit a remedial system in the future if perchlorate is not considered and unnecessary releases of perchlorate to other ecosystems would occur.

The proposed plan for Site 4 indicates that the preferred alternative would include discharge of treated groundwater to a surface water body; at the July 8, 2002 public meeting it was stated that this would be the stream along Isherwood Road. Since the preferred alternative will not remove perchlorate, this will result in discharges of perchlorate to the stream along Isherwood Road. The proposed plan indicates that perchlorate is present in the groundwater at concentrations up to 76 ppb. Perchlorate is an endocrine disruptor and has negative impacts to wildlife including amphibians. A recent study of the effects of perchlorate on amphibians at concentrations below the maximum level found in the Site 4 groundwater indicated inhibition of thyroid function

with associated developmental problems (Goleman, W.L, J.C. Carr and T. Anderson. 2002). Environmentally relevant concentrations of ammonium perchlorate inhibit thyroid function and alter sex ratios in developing Xenopus laevis. Environmental Toxicology and Chemistry (21(3): 590-597.)

The groundwater from Site 4 should not be discharged to a surface water body without treatment to remove perchlorate to a level that will have minimal environmental impact. EPA and Maryland Department of the Environment should determine what concentration of perchlorate in the groundwater will result in minimal environmental impact.

**Response 16:** Perchlorate it is not considered a COC in surface water because detected concentrations have never exceeded EPA's recently published (April 2005) human health risk-based concentration. However the Navy will continue to monitor perchlorate in the groundwater. Specific monitoring locations will be determined in the long-term monitoring plan.

It should noted that, as part of the conceptual design evaluation process for OU-1 FS, estimates were made of anticipated perchlorate concentrations in the influent to the treatment system proposed under Alternative 6. This involved identifying the average concentrations of perchlorate detected in each of the monitoring wells (13 wells) that fall within the immediate capture zone of the new extraction wells, and then using these values to calculate an average influent concentration for each of the proposed extraction wells and for the system as a whole. Only one of the 13 monitoring wells contained an average perchlorate concentration above the 5 ppb detection limit (30 ppb). The resulting predicted average perchlorate concentration in the air stripper influent would have been approximately 5 ppb.

Perchlorate has only been detected in ten of the 94 monitoring wells that have been sampled for perchlorate within the Site 4 area, and has been detected at concentrations greater than 24.5 ppb in only four wells. One of these four wells falls within the area of the formerly proposed extraction wells as discussed in the preceding paragraph. The well that had contained the greatest site concentration (76 ppb) is located immediately (30 feet) upgradient of the Site 4 source area. Under the preferred remedy, this area will be addressed using enhanced anaerobic biodegradation (injecting electron donor), which should be effective at degrading perchlorate. The other two wells are located on the periphery of the Site 4 TCE plume where the selected remedy relies on long-term monitoring.

However, since the currently selected remedy - *in-situ* enhanced reductive dechlorination with institutional controls and long-term monitoring - does not involve additional extraction and treatment in areas with high perchlorate concentrations, there will be no additional discharge of perchlorate contaminated water to any surface waters.

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AOC | area of concern |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| BCT | BRAC Cleanup Team |
| BERA | Baseline Ecological Risk Assessment |
| bgs | below ground surface |
| BHHRA | Baseline Human Health Risk Assessment |
| BRAC | Base Realignment and Closure |
| B&R Environmental | Brown & Root Environmental |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CERFA | Community Environmental Response Facilitation Act |
| cfm | cubic feet per minute |
| CMS | Corrective Measures Study |
| COC | chemical of concern |
| CSF | Cancer Slope Factor |
| CSM | Conceptual Site Model |
| CTE | Central Tendency Exposure |
| DCA | dichloroethane |
| DCE | dichloroethene |
| DO | dissolved oxygen |
| DOD | Department of Defense |
| DPT | direct-push technology |
| DRO | diesel range organics |
| DVSAP | Design Verification Sampling and Analysis Plan |
| EA | EA Engineering Science and Technology |
| EBS | Environmental Baseline Survey |
| EFACHES | Engineering Field Activity Chesapeake |
| EPA | United States Environmental Protection Agency |
| EPC | exposure point concentration |
| ERD | enhanced reductive dechlorination |
| FDA | United States Food and Drug Administration |
| FS | Feasibility Study |
| gpm | gallon(s) per minute |
| GRO | gasoline range organics |
| GSA | General Services Administration |
| HI | Hazard Index |

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|---|---|
| HNUS | Halliburton NUS Corporation |
| HQ | Hazard Quotient |
| HRC® | hydrogen release compound |
| HSA | hollow stem auger |
| HSWA | Hazardous and Solid Waste Amendments |
| HQ | Hazard Quotient |
| IAS | Initial Assessment Study |
| IC | Institutional Controls |
| ILCR | incremental lifetime cancer risks |
| IM | interim measure |
| IRP | Installation Restoration Program |
| ISCO | *in situ* chemical oxidation |
| LTM | long-term monitoring |
| LUCs | land use controls |
| MCL | Maximum Contaminant Level |
| MDE | Maryland Department of the Environment |
| msl | mean sea level |
| µg/kg | microgram(s) per kilogram |
| µg/L | microgram(s) per liter |
| Navy | Department of the Navy |
| NCEA | National Center for Environmental Assessment |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NEEP | North East Environmental Products |
| NEESA | Naval Energy and Environmental Support Activity |
| NIOSH | National Institute for Occupational Safety and Health |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| NPW | net present worth |
| NSWC | Naval Surface Warfare Center |
| O&M | operation and maintenance |
| ORP | oxidation/reduction potential |
| OSWER | Office of Solid Waste and Emergency Response |
| OU-1 | Operable Unit 1 |
| PAH | polycyclic aromatic hydrocarbon |
| PCA | 1,1,2,2-tetrachloroethane |
| PCBs | polychlorinated biphenyls |
| PCOC | potential chemicals of concern |

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|---|---|
| PEL | permissible exposure level |
| PRG | preliminary remediation goal |
| RAB | Remedial Action Board |
| RAO | remedial action objective |
| RBC | Risk-Based Concentration |
| RCRA | Resource Conservation and Recovery Act |
| RFA | RCRA Facility Assessment |
| RfD | reference dose |
| RFI | RCRA Remedial Feasibility Investigation |
| RI | Remedial Investigation |
| RME | reasonable maximum exposure |
| ROD | Record of Decision |
| SARA | Superfund Amendments and Reauthorization Act |
| scfm | standard cubic ft per minute |
| SI | site investigation |
| SVE | soil vapor extraction |
| SVOC | semivolatile organic compound |
| SWMU | Solid Waste Management Unit |
| TBC | to-be-considered |
| TOC | total organic carbon |
| TRC | Technical Review Committee |
| TSDF | Treatment, Storage, and Disposal Facility |
| TtNUS | Tetra Tech NUS, Inc. |
| UCL | 95% Upper Confidence Limit of the Mean |
| USACOE | U.S. Army Corps of Engineers |
| UTL | upper tolerance limit |
| VOC | volatile organic compound |

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Table 2-1
Compounds Detected in Subsurface Soil Samples at Site 4, September 2001
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Site | Site 4 | | | | |
|---|---|---|---|---|---|
| Boring | 04GW203 | | | 04SB204 | |
| Sample Number | 04GW203-20 | 04GW203-26 | 04GW203-30 | 04SB204-23 | 04SB204-31 |
| Sample Depth (ft bgs) | 20 | 26 | 30 | 23 | 31 |
| Sample Date | 09/09/2001 | 09/09/2001 | 09/09/2001 | 09/10/2001 | 09/10/2001 |
| Chemical Name | | | | | |
| | | | | | |
| Volatile Organic Compounds (ug/kg) | | | | | |
| 1,1,1-Trichloroethane | 15 U | 10 U | 9.5 U | 15 | 11 U |
| 1,1,2,2-Tetrachloroethane | 27 | 10 U | 9.5 U | 120 | 24 |
| 1,2,4-Trichlorobenzene | 60 B | 10 U | 9.5 U | 12 U | 3 J |
| 1,2-Dibromo-3-Chloropropane | 15 U | 10 U | 9.5 U | 12 U | 3 J |
| 1,2-Dichlorobenzene | 15 U | 10 U | 9.5 U | 12 U | 1 JB |
| 1,2-Dichloroethane | 15 U | 10 U | 9.5 U | 4 J | 11 U |
| 1,4-Dichlorobenzene | 15 U | 10 U | 9.5 U | 12 U | 11 U |
| 2-Hexanone | 15 U | 10 U | 9.5 U | 12 U | 11 U |
| Acetone | 15 U | 10 U | 9.5 U | 12 U | 11 U |
| Carbon Disulfide | 4 J | 10 U | 9.5 U | 12 U | 11 U |
| Carbon Tetrachloride | 15 U | 10 U | 9.5 U | 12 J | 11 U |
| Chlorobenzene | 2 J | 10 U | 9.5 U | 12 U | 11 U |
| Chloromethane | 4 J | 4 J | 2 J | 3 J | 2 J |
| cis-1,2-Dichloroethene | 15 U | 10 U | 9.5 U | 5 J | 2 J |
| Cyclohexane | 15 U | 10 U | 9.5 U | 14 | 11 U |
| Ethylbenzene | 3 J | 2 J | 9.5 U | 32 | 11 U |
| Isopropylbenzene | 3 J | 3 J | 9.5 U | 48 | 11 U |
| Methyl Acetate | 15 U | 10 U | 9.5 U | 6 J | 11 U |
| Methylcyclohexane | 7 J | 2 J | 9.5 U | 77 | 11 U |
| Styrene | 15 U | 1 J | 9.5 U | 12 U | 11 U |
| Tetrachloroethene | 5 J | 10 U | 9.5 U | 37 | 11 U |
| Trichloroethene | 3,200 D | 120 | 2 J | 11,000 D | 6 JB |
| Xylenes, Total | 17 | 15 | 9.5 U | 240 | 11 U |
| | | | | | |
| Wet Chemistry | | | | | |
| Percent Solids (%) | 93.6 | 88.7 | 91 | NA | NA |
| Total Organic Carbon (mg/kg) | NA | NA | 2,260 | NA | NA |

NA - Not analyzed
U - Not Detected
J - Estimated Concentration
B - Compound found in blank at similar concentration
D - result from diluted sample

Table 2-2
Compounds Detected in Subsurface Soil Samples at Site 4, April 2002
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Station ID | 04SB301 | | 04SB302 | | | 04SB303 | |
|---|---|---|---|---|---|---|---|
| Sample ID | 04SB3013436[Q2] | 04SB3012426[Q2] | 04SB3022729[Q2] | 04SB3022729-D[Q2] | 04SB3021719[Q2] | 04SB3033133 | 04SB3031921 |
| Sample Date | 04/24/02 | 04/24/02 | 04/25/02 | 04/25/02 | 04/25/02 | 04/29/02 | 04/29/02 |
| Depth | 34-36 | 24-26 | 27-29 | 27-29 | 17-19 | 31-33 | 19-21 |
| Notes | | | Duplicates | | | | |
| Chemical Name | | | | | | | |
| | | | | | | | |
| **Volatile Organic Compounds (UG/KG)** | | | | | | | |
| 1,1,1-Trichloroethane | 9.8 U | 18 | 10 U | 11 U | 9.6 U | 8.8 UJ | 10 UJ |
| 1,1,2,2-Tetrachloroethane | 9.8 U | 49 | 590 | 430 | 830 | 8.8 UJ | 10 UJ |
| 1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113) | 9.8 U | 110 | 10 U | 11 U | 9.6 U | 8.8 UJ | 10 UJ |
| 1,1,2-Trichloroethane | 9.8 U | 11 U | 10 U | 11 U | 9.6 U | 8.8 UJ | 10 UJ |
| 1,2,4-Trichlorobenzene | 9.8 U | 11 U | 10 U | 11 U | 9.6 U | 8.8 UJ | 10 UJ |
| 1,2-Dichlorobenzene | 9.8 U | 11 U | 10 U | 11 U | 9.6 U | 11 J | 10 UJ |
| 1,2-Dichloroethane | 9.8 U | 11 U | 3.4 J | 5.7 J | 9.7 | 8.8 UJ | 1.1 J |
| 1,3-Dichlorobenzene | 9.8 U | 11 U | 10 U | 11 U | 9.6 U | 81 J | 10 UJ |
| 1,4-Dichlorobenzene | 9.8 U | 11 U | 10 U | 11 U | 9.6 U | 170 J | 130 J |
| Acetone | 5.4 B | 3.4 B | 9.6 B | 5.3 B | 12 B | 190 J | 15 B |
| Benzene | 9.8 U | 2.3 J | 10 U | 11 U | 9.6 U | 5.8 J | 5.1 J |
| Carbon tetrachloride | 9.8 U | 3.1 J | 10 U | 11 U | 9.6 U | 8.8 UJ | 10 UJ |
| Chlorobenzene | 9.8 U | 2.1 J | 10 U | 11 U | 9.6 U | 290 J | 510 J |
| Cumene | 9.8 U | 48 | 10 U | 11 U | 9.6 U | 57 J | 120 J |
| Cyclohexane | 9.8 U | 11 U | 10 U | 11 U | 9.6 U | 37 J | 96 J |
| Ethylbenzene | 9.8 U | 70 | 10 U | 11 U | 9.6 U | 27 J | 190 J |
| Methylcyclohexane | 9.8 U | 40 | 10 U | 11 U | 9.6 U | 200 J | 650 |
| Methylene chloride | 9.8 U | 11 U | 1.3 B | 11 U | 1 B | 1.2 J | 10 UJ |
| Tetrachloroethene | 9.8 U | 11 U | 10 U | 11 U | 9.6 U | 8.8 UJ | 10 UJ |
| Toluene | 9.8 U | 51 | 10 U | 11 U | 9.6 U | 1.8 J | 3 J |
| Trichloroethene | 50 | 37000 | 2.3 J | 3.1 J | 23 | 2.5 J | 1.2 J |
| Trichlorofluoromethane(Freon-11) | 9.8 U | 1.6 J | 10 U | 11 U | 9.6 U | 8.8 UJ | 10 UJ |
| Vinyl chloride | 9.8 U | 11 U | 10 U | 11 U | 9.6 U | 1.8 J | 10 UJ |
| Xylene, total | 9.8 U | 400 | 10 U | 11 U | 9.6 U | 24 J | 450 J |
| cis-1,2-Dichloroethene | 1.3 J | 9.6 J | 10 U | 11 U | 1.3 J | 10 J | 10 UJ |
| | | | | | | | |
| **Wet Chemistry** | | | | | | | |
| % Solids (%) | 92.5 | 88.2 | 87.3 | 89.5 | 89.5 | 99.3 | 91.6 |
| Total organic carbon (TOC) (MG/KG) | 190 | 1,300 | 100 UL | 130 UL | 480 L | 210 UL | 900 L |
| | | | | | | | |
| **Total Petroleum Hydrocarbons (MG/KG)** | | | | | | | |
| TPH-diesel range | 11 U | 6400 | 11 U | 11 U | 11 U | 1000 | 1500 |
| TPH-gas range | 0.11 U | 360 | 1.1 UJ | 0.12 J | 1.1 U | 190 | 190 |

NA - Not analyzed
B - Blank contamination
J - Estimated
L - Biased low
U - Undetected

UJ - Undetected, estimated limit
UL - Undetected, limit biased low

Table 2-2
Compounds Detected in Subsurface Soil Samples at Site 4, April 2002
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Station ID | 04SB304 | | | 04SB305 | | | 04SB306 | |
|---|---|---|---|---|---|---|---|---|
| Sample ID | 04SB3042527[Q2] | 04SB3042527-D[Q2] | 04SB3041719[Q2] | 04SB3053739[Q2] | 04SB3053133[Q2] | 04SB3052123[Q2] | 04SB3064345[Q2] | 04SB3063739[Q2] |
| Sample Date | 05/02/02 | 05/02/02 | 05/02/02 | 04/25/02 | 04/25/02 | 04/25/02 | 05/01/02 | 05/01/02 |
| Depth | 25-27 | 25-27 | 17-19 | 37-39 | 31-33 | 21-23 | 43-45 | 37-39 |
| Notes | Duplicates | | | | | | | |
| Chemical Name | | | | | | | | |
| **Volatile Organic Compounds (UG/KG)** | | | | | | | | |
| 1,1,1-Trichloroethane | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| 1,1,2,2-Tetrachloroethane | 530 U | 550 U | 11 U | 49 | 11 U | 3.5 J | 12 U | 71 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113) | 530 U | 550 U | 1.5 J | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| 1,1,2-Trichloroethane | 530 U | 550 U | 11 U | 2 J | 11 U | 11 U | 12 U | 11 U |
| 1,2,4-Trichlorobenzene | 530 U | 550 U | 35 | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| 1,2-Dichlorobenzene | 530 U | 550 U | 2.9 J | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| 1,2-Dichloroethane | 530 U | 550 U | 11 U | 2.1 J | 11 U | 1.2 J | 12 U | 11 U |
| 1,3-Dichlorobenzene | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| 1,4-Dichlorobenzene | 530 U | 550 U | 44 | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Acetone | 700 B | 780 B | 3 B | 190 B | 4.4 B | 48 B | 14 B | 29 B |
| Benzene | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Carbon tetrachloride | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Chlorobenzene | 530 U | 550 U | 4 J | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Cumene | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Cyclohexane | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Ethylbenzene | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 26 |
| Methylcyclohexane | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Methylene chloride | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 1.2 J | 11 U |
| Tetrachloroethene | 530 U | 550 U | 23 | 9.4 U | 11 U | 11 U | 12 U | 7.7 J |
| Toluene | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Trichloroethene | 5700 | 6700 | 13000 | 2.1 J | 11 U | 8.3 J | 1.2 J | 1200 J |
| Trichlorofluoromethane(Freon-11) | 530 UJ | 550 UJ | 11 UJ | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Vinyl chloride | 530 U | 550 U | 11 U | 9.4 U | 11 U | 11 U | 12 U | 11 U |
| Xylene, total | 530 U | 550 U | 3.7 J | 9.4 U | 11 U | 11 U | 12 U | 80 |
| cis-1,2-Dichloroethene | 530 U | 72 J | 32 | 1.2 J | 11 U | 11 U | 12 U | 11 U |
| **Wet Chemistry** | | | | | | | | |
| % Solids (%) | 89.1 | 90.6 | 93.5 | 90.4 | 88.7 | 85.1 | 97.1 | 94.3 |
| Total organic carbon (TOC) (MG/KG) | 630 L | 390 L | 830 L | 140 UL | 270 L | 170 L | 110 UL | 540 L |
| **Total Petroleum Hydrocarbons (MG/KG)** | | | | | | | | |
| TPH-diesel range | 1900 J | 840 J | 2400 | 60 | 11 U | 12 U | 10 U | 2300 |
| TPH-gas range | 130 J | 64 J | 93 | 0.77 | 0.11 U | 0.12 U | 0.1 U | 190 |

NA - Not analyzed
B - Blank contamination
J - Estimated
L - Biased low
U - Undetected

UJ - Undetected, estimated limit
UL - Undetected, limit biased low

Table 2-3
Compounds Detected in Subsurface Soil Samples at Site 4, January 2003
*ROD for Site 4*
Former NSWC White Oak, Silver Spring, Maryland

| Boring | 04SB401 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | 004SU40112 | 004SU40114 | 004SU40116 | 004SU40118 | 004SU40120 | 004SU40122 | 004SU40124 | 004SU40199 | 004SU40126 | 004SU40128 | 004SU40130 | 004SU40132 | 004SU40134 |
| Sample Depth (ft bgs) | 10-12 | 12-14 | 14-16 | 16-18 | 18-20 | 20-22 | 22-24 | 22-24 | 24-26 | 26-28 | 28-30 | 30-32 | 32-34 |
| Sample Date | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 |
| Notes | | | | | | | Duplicates | | | | | | |
| Chemical Name | | | | | | | | | | | | | |
| **Volatile Organic Compounds (UG/KG)** | | | | | | | | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | 8.1 U | 8.7 U | 9.2 U | 3.8 J | 84 | 47 | 5 J | 3.8 J | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 8.9 | 0.92 J | 9.7 U | 9.6 U | 1 J | 8.5 U | 8.6 U | 9.4 U | 5.9 J |
| 1,1,2-TRICHLOROETHANE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 12 | 18 | 3.6 J | 2.9 J | 1.2 J | 1.2 J | 8.6 U | 9.4 U | 9 U |
| 1,1-DICHLOROETHENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 7.9 U | 8.2 U | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| 1,2,4-TRICHLOROBENZENE | 8.1 U | 8.7 U | 9.2 U | 1.6 J | 6.8 | 8.2 U | 8.7 U | 8.5 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 11 |
| 1,2-DICHLOROBENZENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 4.1 J | 2.1 J | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 4.9 J | 9.4 U | 7.2 J |
| 1,2-DICHLOROETHANE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 1.7 J | 8.2 U | 3 J | 8.6 U | 2.3 J | 2 J | 8.6 U | 9.4 U | 9 U |
| 1,3-DICHLOROBENZENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 42 | 4.8 J | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 3.5 J | 9.4 U | 16 |
| 1,4-DICHLOROBENZENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 66 | 17 | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 3.2 J | 9.4 U | 23 |
| 2-BUTANONE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 0.93 J | 1.6 J | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| BENZENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 7.9 U | 8.2 U | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 1.4 J |
| CARBON DISULFIDE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 7.9 U | 8.2 U | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| CHLOROBENZENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 47 | 42 | 1.2 J | 8.6 U | 1.6 J | 1.8 J | 15 | 9.4 U | 26 |
| CHLOROFORM | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 7.9 U | 8.2 U | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| CIS-1,2-DICHLOROETHENE | 8.1 U | 8.7 U | 9.2 U | 30 | 35 | 3.6 J | 38 | 16 | 11 | 7.2 J | 8.6 U | 9.4 U | 1.3 J |
| CYCLOHEXANE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 1.6 J | 3.5 J | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 3.4 J | 9.4 U | 8.4 J |
| ETHYLBENZENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 1.2 J | 3.4 J | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 7.2 J | 9.4 U | 21 |
| ISOPROPYLBENZENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 1.7 J | 11 | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 7.8 J | 9.4 U | 15 |
| METHYL ACETATE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 7.9 U | 8.2 U | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| METHYLCYCLOHEXANE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 6.9 J | 18 | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 12 | 9.4 U | 28 |
| METHYLENE CHLORIDE | 1.4 J | 1.4 J | 1.8 J | 1.7 J | 1.4 J | 2 J | 1.8 J | 1.7 J | 2 J | 1.9 J | 1.5 J | 1.8 J | 1.9 J |
| TETRACHLOROETHENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 19 | 6.4 J | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| TOLUENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 7.9 U | 1.4 J | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 3.1 J |
| TRANS-1,2-DICHLOROETHENE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 7.9 U | 8.2 U | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| TRICHLOROETHENE | 1.7 J | 1.6 J | 1.1 J | 25 | 140 | 70 | 13 | 8.5 J | 5.6 J | 4 J | 8.6 U | 1.3 J | 2.2 J |
| TRICHLOROFLUOROMETHANE | 3.1 J | 8.7 U | 9.2 U | 3 J | 8.2 | 8.2 U | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 8.6 U | 9.4 U | 9 U |
| VINYL CHLORIDE | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 7.9 U | 8.2 U | 1.8 J | 8.6 U | 2.5 J | 2.1 J | 8.6 U | 9.4 U | 9 U |
| XYLENES (TOTAL) | 8.1 U | 8.7 U | 9.2 U | 9.3 U | 3.2 J | 31 | 8.7 U | 8.6 U | 8.7 U | 8.5 U | 16 | 9.4 U | 27 |
| **Wet Chemistry (%)** | | | | | | | | | | | | | |
| PERCENT SOLIDS | 89.3 | 87.6 | 88.9 | 84 | 94.2 | 93 | 90 | 90 | 89 | 90.1 | 87.7 | 90.1 | 94 |
| TOTAL ORGANIC CARBON | NA | NA | NA | NA | NA | 6,800 | NA | NA | NA | NA | NA | NA | 1,200 |
| **Total Petroleum Hydrocarbons (MG/KG)** | | | | | | | | | | | | | |
| TPH (AS DIESEL) | NA | NA | NA | NA | NA | 3,500 | NA | NA | NA | NA | NA | NA | 400 |
| TPH (AS GASOLINE) | NA | NA | NA | NA | NA | 52,000 | NA | NA | NA | NA | NA | NA | 32,000 |

NA - Not analyzed

Table 2-3
Compounds Detected in Subsurface Soil Samples at Site 4, January 2003
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Boring | 04SB402 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | 004SU40212 | 004SU40214 | 004SU40216 | 004SU40220 | 004SU40222 | 004SU40224 | 004SU40239 | 004SU40226 | 004SU40228 | 004SU40230 | 004SU40232 | 004SU40234 | 004SU40236 | 004SU40238 |
| Sample Depth (ft bgs) | 10-12 | 12-14 | 14-16 | 18-20 | 20-22 | 22-24 | 22-24 | 24-26 | 26-28 | 28-30 | 30-32 | 32-34 | 34-36 | 36-38 |
| Sample Date | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 | 1/17/03 |
| Notes | | | | | | Duplicates | | | | | | | | |
| Chemical Name | | | | | | | | | | | | | | |
| **Volatile Organic Compounds (UG/KG)** | | | | | | | | | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 6.2 J | 380 U | 10 U |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| 1,1,2-TRICHLOROETHANE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| 1,1-DICHLOROETHENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| 1,2,4-TRICHLOROBENZENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 1,000 J | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| 1,2-DICHLOROBENZENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| 1,2-DICHLOROETHANE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| 1,3-DICHLOROBENZENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| 1,4-DICHLOROBENZENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| 2-BUTANONE | 8.8 U | 8.1 U | 1.4 J | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| BENZENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| CARBON DISULFIDE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| CHLOROBENZENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| CHLOROFORM | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| CIS-1,2-DICHLOROETHENE | 8.8 U | 8.1 U | 8.9 U | 13 | 790 J | 640 U | 500 U | 300 J | 440 U | 490 U | 130 J | 5 J | 95 J | 10 U |
| CYCLOHEXANE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| ETHYLBENZENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 79 J | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| ISOPROPYLBENZENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 67 J | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| METHYL ACETATE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| METHYLCYCLOHEXANE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 94 J | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| METHYLENE CHLORIDE | 1.9 J | 1.8 J | 2 J | 1.4 J | 2100 U | 120 J | 500 U | 2900 U | 440 U | 490 U | 420 U | 1.8 J | 380 U | 2.1 J |
| TETRACHLOROETHENE | 8.8 U | 8.1 U | 0.89 J | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| TOLUENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| TRANS-1,2-DICHLOROETHENE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| TRICHLOROETHENE | 8.8 U | 0.93 J | 4.7 J | 21 | 32,000 | 9,100 | 5,400 | 41,000 | 1,100 | 1,900 | 4,000 | 100 | 3,000 | 5 J |
| TRICHLOROFLUOROMETHANE | 8.8 U | 8.1 U | 2 J | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| VINYL CHLORIDE | 8.8 U | 8.1 U | 8.9 U | 8.2 U | 2100 U | 640 U | 500 U | 2900 U | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| XYLENES (TOTAL) | 8.8 U | 8.1 U | 8.9 U | 2.7 J | 2100 U | 430 J | 290 J | 980 J | 440 U | 490 U | 420 U | 7.9 U | 380 U | 10 U |
| **Wet Chemistry (%)** | | | | | | | | | | | | | | |
| PERCENT SOLIDS | 92.1 | 93.8 | 89 | 87.9 | 88.2 | 87.8 | 87.8 | 88.6 | 87.7 | 83.3 | 89.8 | 97.4 | 94.2 | 90 |
| TOTAL ORGANIC CARBON | NA | NA | NA | NA | 1,100 | NA | NA | NA | NA | NA | NA | NA | NA | 1,100 |
| **Total Petroleum Hydrocarbons (MG/KG)** | | | | | | | | | | | | | | |
| TPH (AS DIESEL) | NA | NA | NA | NA | 95 | NA | NA | NA | NA | NA | NA | NA | NA | 11 U |
| TPH (AS GASOLINE) | NA | NA | NA | NA | 22,000 | NA | NA | NA | NA | NA | NA | NA | NA | 110 U |

NA - Not analyzed

Table 2-3
Compounds Detected in Subsurface Soil Samples at Site 4, January 2003
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Boring | 04SB403 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | 004SU40312 | 004SU40314 | 004SU40316 | 004SU40318 | 004SU40320 | 004SU40322 | 004SU40324 | 004SU40399 | 004SU40326 | 004SU40396 | 004SU40328 | 004SU40332 | 004SU40334 | 004SU40336 | 004SU40398 |
| Sample Depth (ft bgs) | 10-12 | 12-14 | 14-16 | 16-18 | 18-20 | 20-22 | 22-24 | 22-24 | 24-26 | 24-26 | 26-28 | 30-32 | 32-34 | 34-36 | 36-38 |
| Sample Date | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 |
| Notes | | | | | | | Duplicates | | Duplicates | | | | | | |
| Chemical Name | | | | | | | | | | | | | | | |
| Volatile Organic Compounds (UG/KG) | | | | | | | | | | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 130 J |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| 1,1,2-TRICHLOROETHANE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| 1,1-DICHLOROETHENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| 1,2,4-TRICHLOROBENZENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| 1,2-DICHLOROBENZENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| 1,2-DICHLOROETHANE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| 1,3-DICHLOROBENZENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| 1,4-DICHLOROBENZENE | 8.5 U | 9.1 U | 8.8 U | 1 J | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| 2-BUTANONE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| BENZENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| CARBON DISULFIDE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| CHLOROBENZENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| CHLOROFORM | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| CIS-1,2-DICHLOROETHENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 1,300 J | 1,200 J | 560 J | 110 J | 210 J | 550 J | 480 U |
| CYCLOHEXANE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| ETHYLBENZENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 220 J | 270 J | 450 | 350 J | 1,000 J | 730 J | 420 J | 490 U | 410 U | 4100 U | 480 U |
| ISOPROPYLBENZENE | 8.5 U | 9.1 U | 8.8 U | 2.4 J | 260 J | 280 J | 410 J | 300 J | 850 J | 450 J | 390 J | 490 U | 410 U | 4100 U | 51 J |
| METHYL ACETATE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| METHYLCYCLOHEXANE | 8.5 U | 9.1 U | 8.8 U | 4.1 J | 350 J | 250 J | 280 J | 250 J | 770 J | 580 J | 390 J | 490 U | 410 U | 780 J | 55 J |
| METHYLENE CHLORIDE | 0.92 J | 1 J | 8.8 U | 1 J | 90 J B | 61 J B | 57 J B | 61 J B | 390 J B | 240 J B | 180 J B | 83 J B | 66 J B | 540 J B | 73 J B |
| TETRACHLOROETHENE | 8.5 U | 7.9 J | 1.7 J | 7.5 J | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| TOLUENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 43 J | 440 U | 480 J | 400 J | 350 J | 490 U | 410 U | 4100 U | 480 U |
| TRANS-1,2-DICHLOROETHENE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| TRICHLOROETHENE | 8.5 U | 9.2 | 0.97 J | 36 | 9,600 | 5,900 | 8,300 | 7,600 | 37,000 | 29,000 | 22,000 | 340 J | 2,200 | 59,000 | 2,800 |
| TRICHLOROFLUOROMETHANE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| VINYL CHLORIDE | 8.5 U | 9.1 U | 8.8 U | 9 U | 620 U | 410 U | 420 U | 440 U | 3100 U | 2100 U | 1200 U | 490 U | 410 U | 4100 U | 480 U |
| XYLENES (TOTAL) | 8.5 U | 9.1 U | 8.8 U | 9 U | 1,700 | 2,100 | 3,500 | 2,600 | 8,100 | 5,700 | 3,300 | 490 U | 410 U | 440 J | 110 J |
| Wet Chemistry (%) | | | | | | | | | | | | | | | |
| PERCENT SOLIDS | 91 | 84.6 | 89.1 | 85.6 | 89 | 94.6 | 92.2 | 92.2 | 87.9 | 87.9 | 89.1 | 89.3 | 92.3 | 90.5 | 89.9 |
| TOTAL ORGANIC CARBON | NA | NA | NA | NA | NA | 2,400 | NA | NA | NA | NA | NA | NA | NA | NA | 1,200 |
| Total Petroleum Hydrocarbons (MG/KG) | | | | | | | | | | | | | | | |
| TPH (AS DIESEL) | NA | NA | NA | NA | NA | 980 | NA | NA | NA | NA | NA | NA | NA | NA | 350 |
| TPH (AS GASOLINE) | NA | NA | NA | NA | NA | 250,000 | NA | NA | NA | NA | NA | NA | NA | NA | 140 |

NA - Not analyzed

Table 2-3
Compounds Detected in Subsurface Soil Samples at Site 4, January 2003
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Boring | 04SB404 | | 04SB405 | | | | | 04SB406 | | | | 04SB407 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | 004SU40418 | 004SU40422 | 004SU40518 | 004SU40526 | 004SU40536 | 004SU40538 | 004SU40599 | 004SU40616 | 004SU40630 | 004SU40632 | 004SU40634 | 004SU40716 | 004SU40722 | 004SU40724 | 004SU40734 |
| Sample Depth (ft bgs) | 16-18 | 20-22 | 16-18 | 24-26 | 34-36 | 36-38 | 36-38 | 14-16 | 28-30 | 30-32 | 32-34 | 14-16 | 20-22 | 22-24 | 32-34 |
| Sample Date | 1/21/03 | 1/21/03 | 1/14/03 | 1/14/03 | 1/14/03 | 1/14/03 | 1/14/03 | 1/14/03 | 1/15/03 | 1/15/03 | 1/15/03 | 1/15/03 | 1/15/03 | 1/15/03 | 1/15/03 |
| Notes | | | | | | Duplicates | | | | | | | | | |
| Chemical Name | | | | | | | | | | | | | | | |
| **Volatile Organic Compounds (UG/KG)** | | | | | | | | | | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | 9.6 U | 8.1 U | 9.1 U | 24 | 420 U | 2 J | 490 U | 8.6 U | 13 | 5.3 J | 33 | 11 | 98 | 25 | 280 J |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 2.4 J | 1.4 J | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| 1,1,2-TRICHLOROETHANE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 1.4 J |
| 1,1-DICHLOROETHENE | 1.4 J | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| 1,2,4-TRICHLOROBENZENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| 1,2-DICHLOROBENZENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| 1,2-DICHLOROETHANE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.8 U | 9.4 U | 2.7 J | 2.5 J | 22 |
| 1,3-DICHLOROBENZENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| 1,4-DICHLOROBENZENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 2.1 J | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| 2-BUTANONE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| BENZENE | 9.6 U | 8.1 U | 9.1 U | 2 J | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| CARBON DISULFIDE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| CHLOROBENZENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 1.6 J | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| CHLOROFORM | 58 | 7.3 J | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| CIS-1,2-DICHLOROETHENE | 9.6 U | 8.1 U | 9.1 U | 19 | 420 U | 1.6 J | 490 U | 8.6 U | 5.4 J | 5 | 10 | 5.4 J | 9.2 U | 8.4 | 4.7 J |
| CYCLOHEXANE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| ETHYLBENZENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| ISOPROPYLBENZENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| METHYL ACETATE | 9.6 U | 8.1 U | 1.9 J | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| METHYLCYCLOHEXANE | 9.6 U | 8.1 U | 9.1 U | 1.4 J | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 1.5 J | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| METHYLENE CHLORIDE | 1.3 J | 8.1 U | 1.3 J | 8.5 J | 420 U | 0.85 J | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 0.91 J | 8.8 U |
| TETRACHLOROETHENE | 9.6 U | 8.1 U | 9.1 U | 1.1 J | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 5.7 J | 9.4 U | 9.2 U | 8.3 U | 1.1 J |
| TOLUENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| TRANS-1,2-DICHLOROETHENE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 1.8 J | 8.8 U |
| TRICHLOROETHENE | 12 | 2.1 J | 2.7 J | 1,700 E | 650 | 34 | 170 J | 3.3 J | 230 J | 360 J | 340 J | 2.6 J | 7.1 J | 1.3 J | 100 |
| TRICHLOROFLUOROMETHANE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| VINYL CHLORIDE | 9.6 U | 8.1 U | 9.1 U | 9.6 U | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 J | 8.3 U | 8.8 U |
| XYLENES (TOTAL) | 9.6 U | 8.1 U | 9.1 U | 1.1 J | 420 U | 8.3 U | 490 U | 8.6 U | 8.8 U | 8.7 U | 8.5 U | 9.4 U | 9.2 U | 8.3 U | 8.8 U |
| **Wet Chemistry (%)** | | | | | | | | | | | | | | | |
| PERCENT SOLIDS | 86.4 | 99.7 | 96.4 | 89.4 | 91.9 | 90.5 | 90.5 | 92.2 | 88.4 | 88 | 95.9 | 91.5 | 85.2 | 94.4 | 85.5 |
| TOTAL ORGANIC CARBON | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total Petroleum Hydrocarbons (MG/KG)** | | | | | | | | | | | | | | | |
| TPH (AS DIESEL) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| TPH (AS GASOLINE) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

NA - Not analyzed

Table 2-3
Compounds Detected in Subsurface Soil Samples at Site 4, January 2003
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Boring | 04SB408 | | | | | 04SB409 | | | | 04SB410 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | 004SU40818 | 004SU40828 | 004SU40830 | 004SU40834 | 004SU40839 | 004SU40916 | 004SU40922 | 004SU40926 | 004SU40928 | 004SU41016 | 004SU41032 | 004SU41039 | 004SU41034 | 004SU41038 |
| Sample Depth (ft bgs) | 16-18 | 26-28 | 28-30 | 32-34 | 32-34 | 14-16 | 20-22 | 24-26 | 26-28 | 14-16 | 30-32 | 30-32 | 32-34 | 36-38 |
| Sample Date | 1/15/03 | 1/15/03 | 1/15/03 | 1/15/03 | 1/15/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/16/03 | 1/20/03 | 1/20/03 | 1/20/03 | 1/20/03 | 1/20/03 |
| Notes | | | | Duplicates | | | | | | | Duplicates | | | |
| Chemical Name | | | | | | | | | | | | | | |
| Volatile Organic Compounds (UG/KG) | | | | | | | | | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | 9.9 U | 510 U | 460 U | 9.7 U | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | 9.9 U | 510 U | 460 U | 3.9 J | 1.5 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 1,1,2-TRICHLOROETHANE | 9.9 U | 510 U | 460 U | 9.7 U | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 1,1-DICHLOROETHENE | 9.9 U | 510 U | 460 U | 9.7 U | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 1,2,4-TRICHLOROBENZENE | 9.9 U | 650 B | 460 U | 9.7 U | 18 | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 1,2-DICHLOROBENZENE | 9.9 U | 510 U | 460 U | 9.7 U | 1.2 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 1,2-DICHLOROETHANE | 9.9 U | 510 U | 460 U | 1.3 J | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 1,3-DICHLOROBENZENE | 9.9 U | 510 U | 460 U | 9.7 U | 1.9 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 1,4-DICHLOROBENZENE | 9.9 U | 71 J | 460 U | 13 | 12 | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| 2-BUTANONE | 9.9 U | 510 U | 460 U | 2.1 J | 2.5 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| BENZENE | 9.9 U | 510 U | 460 U | 1.5 J | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| CARBON DISULFIDE | 9.9 U | 510 U | 460 U | 9.7 U | 1.7 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| CHLOROBENZENE | 9.9 U | 510 U | 460 U | 12 | 3.9 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| CHLOROFORM | 9.9 U | 510 U | 460 U | 9.7 U | 9.7 U | 5.8 J | 18 | 5.3 J | 0.98 J | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| CIS-1,2-DICHLOROETHENE | 9.9 U | 750 | 800 | 35 | 88 | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| CYCLOHEXANE | 9.9 U | 510 U | 460 U | 6.7 J | 1.7 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| ETHYLBENZENE | 9.9 U | 510 U | 460 U | 4.2 J | 1.5 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| ISOPROPYLBENZENE | 9.9 U | 510 U | 460 U | 12 | 3.3 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| METHYL ACETATE | 9.9 U | 510 U | 460 U | 9.7 U | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| METHYLCYCLOHEXANE | 9.9 U | 510 U | 460 U | 40 | 9.2 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| METHYLENE CHLORIDE | 9.9 U | 510 U | 460 U | 9.7 U | 1.4 J | 0.9 J | 0.92 J | 9.3 U | 8.4 U | 1.5 J | 1.8 J | 47 J | 2.2 J | 1.4 J |
| TETRACHLOROETHENE | 9.9 U | 67 J | 460 U | 2.2 J | 4.1 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| TOLUENE | 9.9 U | 510 U | 460 U | 1.1 J | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| TRANS-1,2-DICHLOROETHENE | 9.9 U | 510 U | 460 U | 9.7 U | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| TRICHLOROETHENE | 1.1 J | 1,300 | 68 J | 12 | 45 | 8.9 U | 74 | 120 | 98 | 3.9 J | 210 J | 160 E | 9.4 U | 13 |
| TRICHLOROFLUOROMETHANE | 9.9 U | 510 U | 460 U | 9.7 U | 9.7 U | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| VINYL CHLORIDE | 9.9 U | 510 U | 460 U | 3.5 J | 5 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| XYLENES (TOTAL) | 9.9 U | 510 U | 460 U | 6.4 J | 1.9 J | 8.9 U | 8.6 U | 9.3 U | 8.4 U | 9.1 U | 8.8 U | 8.8 U | 9.4 U | 8.3 U |
| Wet Chemistry (%) | | | | | | | | | | | | | | |
| PERCENT SOLIDS | 91.6 | 89 | 90.1 | 83.6 | 83.6 | 90.3 | 88.2 | 82.6 | 92.3 | 93.9 | 85 | 84.8 | 88.6 | 92.0 |
| TOTAL ORGANIC CARBON | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Total Petroleum Hydrocarbons (MG/KG) | | | | | | | | | | | | | | |
| TPH (AS DIESEL) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| TPH (AS GASOLINE) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

NA - Not analyzed

Table 2-3
Compounds Detected in Subsurface Soil Samples at Site 4, January 2003
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Boring | 04SB411 | | | | |
|---|---|---|---|---|---|
| Sample Number | 004SU41116 | 004SU41124 | 004SU41130 | 004SU41138 | 004SU41199 |
| Sample Depth (ft bgs) | 14-16 | 22-24 | 28-30 | 36-38 | 36-38 |
| Sample Date | 1/21/03 | 1/21/03 | 1/21/03 | 1/21/03 | 1/21/03 |
| Notes | | | | Duplicates | |
| Chemical Name | | | | | |
| | | | | | |
| Volatile Organic Compounds (UG/KG) | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | 10 U | 7.9 U | 9.5 U | 8.5 J | 8.3 J |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| 1,1,2-TRICHLOROETHANE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| 1,1-DICHLOROETHENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| 1,2,4-TRICHLOROBENZENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| 1,2-DICHLOROBENZENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| 1,2-DICHLOROETHANE | 10 U | 7.9 U | 9.5 U | 3.1 J | 3 J |
| 1,3-DICHLOROBENZENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| 1,4-DICHLOROBENZENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| 2-BUTANONE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| BENZENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| CARBON DISULFIDE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| CHLOROBENZENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| CHLOROFORM | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| CIS-1,2-DICHLOROETHENE | 10 U | 7.9 U | 9.5 U | 1.4 J | 1.3 J |
| CYCLOHEXANE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| ETHYLBENZENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| ISOPROPYLBENZENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| METHYL ACETATE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| METHYLCYCLOHEXANE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| METHYLENE CHLORIDE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| TETRACHLOROETHENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| TOLUENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| TRANS-1,2-DICHLOROETHENE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| TRICHLOROETHENE | 10 U | 1.5 J | 1.4 J | 34 | 42 |
| TRICHLOROFLUOROMETHANE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| VINYL CHLORIDE | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| XYLENES (TOTAL) | 10 U | 7.9 U | 9.5 U | 9.3 U | 9.3 U |
| | | | | | |
| Wet Chemistry (%) | | | | | |
| PERCENT SOLIDS | 87.5 | 91.5 | 87 | 86.7 | 86.7 |
| TOTAL ORGANIC CARBON | NA | NA | NA | NA | NA |
| | | | | | |
| Total Petroleum Hydrocarbons (MG/KG) | | | | | |
| TPH (AS DIESEL) | NA | NA | NA | NA | NA |
| TPH (AS GASOLINE) | NA | NA | NA | NA | NA |

NA - Not analyzed

Table 2-4
Detected Compounds in Groundwater Monitoring Well Samples from Site 4 (Round 8, September 2001)
ROD for Site 4
Former NSWC White Oak, Silver Spring, Maryland

| Well ID | | 04GW10 | 04GW50 | 04GW79 | 04GW100 | 04GW103 | 04GW104 | 04GW105 | 04GW200 | 04GW203 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | | 004GW0100008 | 004GW0500008 | 004GW0790008 | 004GW1000008 | 004GW1030008 | 004GW1040008 | 004GW1050008 | 004GW2000008 | 004GW2030008 |
| Sample Date | | 09/26/2001 | 09/25/2001 | 09/26/2001 | 09/26/2001 | 09/28/2001 | 09/26/2001 | 09/25/2001 | 09/25/2001 | 09/25/2001 |
| Notes | | | | | | | | | | |
| Chemical Name | Units | Conc | Conc | Conc | Conc | Conc | Conc | Conc | Conc | Conc |
| Volatile Organic Compounds | | | | | | | | | | |
| 1,1,1-Trichloroethane | UG/L | 1 U | 3.6 | 1 U | 1 U | 1 U | 1 U | 3.4 | 1 U | 1 U |
| 1,1,2,2-Tetrachloroethane | UG/L | 1 U | 50 J | 2.5 | 0.6 J | 3.7 | 1 U | 317 | 11.6 | 5.8 |
| 1,1,2-Trichloroethane | UG/L | 1 U | 1.4 | 1 U | 1 U | 0.7 J | 1 U | 7.6 | 1.3 | 1 U |
| 1,1-Dichloroethane | UG/L | 1 U | 0.6 J | 1 U | 1 U | 0.6 J | 1 U | 1.6 | 1 U | 1 U |
| 1,1-Dichloroethene | UG/L | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 2.3 | 1.6 | 0.7 J |
| 1,2-Dichlorobenzene | UG/L | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 0.5 J | 1 U | 1 U |
| 1,2-Dichloroethane | UG/L | 1 U | 3.5 | 1 U | 1 U | 0.8 J | 1 U | 19.3 | 0.9 J | 1 U |
| 1,3-Dichlorobenzene | UG/L | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1.5 | 1 U | 1 U |
| 1,4-Dichlorobenzene | UG/L | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 3.8 | 1 U | 1 U |
| Benzene | UG/L | 1 U | 1 U | 1 U | 1 U | 1.8 | 1 U | 3.7 | 5.9 | 1 U |
| Carbon Disulfide | UG/L | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Chlorobenzene | UG/L | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 13.2 | 2.4 | 1 U |
| Chloroethane | UG/L | 1 U | 1 U | 1 U | 1 U | 0.7 J | 1 U | 0.5 J | 1 U | 1 U |
| Chloroform | UG/L | 1 U | 1.3 | 1 U | 1 U | 1 U | 1 U | 1.4 | 0.7 J | 1 U |
| Chloromethane | UG/L | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 0.7 J | 1 U |
| cis-1,2-Dichloroethene | UG/L | 1 U | 43 J | 1.1 U | 1 U | 181 | 1 U | 402 | 87.5 | 24.1 |
| Ethane | UG/L | 5.8 U | 5.8 U | NA | NA | 13.7 | NA | 4.55 J | 5.8 U | 13.2 |
| Ethene | UG/L | 3.99 J | 6.2 U | NA | NA | 28 | NA | 16.7 | 7 | 19.3 |
| Ethylbenzene | UG/L | 1 U | 1 U | 1 U | 1 U | 0.5 J | 1 U | 1 U | 1 U | 1 U |
| Methane | UG/L | 29.6 | 6.27 | NA | NA | 284 | 4.01 | 350 | 237 | 406 |
| Tetrachloroethene | UG/L | 1 U | 4.4 | 1 U | 0.6 J | 0.7 J | 1 U | 1.7 | 0.6 J | 1 U |
| Toluene | UG/L | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Total Xylenes | UG/L | 1 U | 1 U | 1 U | 1 U | 1.3 | 1 U | 1 U | 1 U | 1.1 |
| trans-1,2-dichloroethene | UG/L | 1 U | 0.7 J | 1 | 1 U | 1 U | 1 U | 3 | 0.8 J | 1 U |
| Trichloroethene | UG/L | 1 U | 436 | 19.6 | 2.5 | 41 | 1 U | 1,190 | 442 | 104 |
| Vinyl Chloride | UG/L | 1 U | 1.7 | 1 U | 1 U | 2.5 | 1 U | 73 | 19.2 | 1.8 |

U=undetected
J=Estimated
R=Rejected
NA=Not analyzed

**Table 2-4**
**Detected Compounds in Groundwater Monitoring Well Samples from Site 4 (Round 8, September 2001)**
**ROD for Site 4**
**Former NSWC White Oak, Silver Spring, Maryland**

| Well ID | | 04GW10 | 04GW50 | 04GW79 | 04GW100 | 04GW103 | 04GW104 | 04GW105 | 04GW200 | 04GW203 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | | 004GW0100008 | 004GW0500008 | 004GW0790008 | 004GW1000008 | 004GW1030008 | 004GW1040008 | 004GW1050008 | 004GW2000008 | 004GW2030008 |
| Sample Date | | 09/26/2001 | 09/25/2001 | 09/26/2001 | 09/26/2001 | 09/28/2001 | 09/26/2001 | 09/25/2001 | 09/25/2001 | 09/25/2001 |
| Notes | | | | | | | | | | |
| | | | | | | | | | | |
| **Explosives** | | | | | | | | | | |
| 1,3,5-Trinitrobenzene | UG/L | NA | NA | NA | NA | NA | 0.26 U | NA | NA | NA |
| 2,4,6-Trinitrotoluene | UG/L | NA | NA | NA | NA | NA | 0.26 U | NA | NA | NA |
| 2-Amino-4,6-Dinitrotoluene | UG/L | NA | NA | NA | NA | NA | 0.26 U | NA | NA | NA |
| 4-Amino-2,6-Dinitrotoluene | UG/L | NA | NA | NA | NA | NA | 0.26 U | NA | NA | NA |
| HMX | UG/L | NA | NA | NA | NA | NA | 0.519 U | NA | NA | NA |
| Perchlorate | UG/L | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| RDX | UG/L | NA | NA | NA | NA | NA | 0.519 U | NA | NA | NA |
| | | | | | | | | | | |
| **Wet Chemistry** | | | | | | | | | | |
| Alkalinity, Total (as CaCO3) | MG/L | 170 | 30.4 | NA | NA | 71 | 11 | 136 | 34.3 | 30.4 |
| Carbon Dioxide | MG/L | 108 | 64.8 | NA | NA | 122 | 92.2 | 144 | 112 | 74.4 |
| Chloride | MG/L | 10.7 | 11.3 | NA | NA | 22.3 | NA | 15.3 | 7.79 | 21.9 |
| Nitrate | MG/L | 0.7 | 0.34 | NA | NA | 0.3 | 1 | 0.1 U | 0.1 U | 0.1 U |
| Sulfate | MG/L | 174 | 22 | NA | NA | 92.4 | 42.2 | 83.8 | 24.2 | 112 |
| Total Organic Carbon | MG/L | 3.69 | 1.19 | NA | NA | 9.4 | 6 | 3.79 | 1.38 | 3.01 |
| | | | | | | | | | | |
| **Field Parameters** | | | | | | | | | | |
| Ferrous Iron | MG/L | - | 0 | NA | 0 | NA | 0 | 8 | 3 | 4.4 |
| Hydrogen Sulfide | MG/L | - | 0 | NA | 0 | NA | 0 | 0 | 0 | 0 |
| pH | | 5.93 | 5.07 | 5.17 | 4.52 | NA | 4.73 | 5.78 | 5.09 | 5.35 |
| Specific Conductivity (SC) | MS/CM | 0.62 | 0.195 | 0.254 | 0.151 | NA | 0.206 | 0.548 | 0.184 | 0.355 |
| Dissolved Oxigen (DO) | MG/L | 5.44 | 3.05 | 0.9 | 1.43 | NA | 1.9 | <0.1 | <0.1 | 0 |
| Temperature | C | 15.7 | 15.2 | 15.3 | 14.8 | NA | 15.3 | 15 | | 18 |
| Oxidation Reduction Potential (EH/ORP) | MV | 132 | 190 | 215 | 222 | NA | 259 | -91 | 100 | -226 |

U=undetected
J=Estimated
R=Rejected
NA=Not analyzed

## Table 2-5
## Detected Compounds in Groundwater Well Samples from Site 4 (Interim Sampling, May 2002)
## ROD for Site 4
## Former NSWC White Oak, Silver Spring, Maryland

| Station ID | 04GW301 | | 04TW02 | | 04TW03 | | 04TW04 | |
|---|---|---|---|---|---|---|---|---|
| Location | Source Area | | Source Area | | Upgradient | | Source Area | |
| Sample ID | 04GW301[Q2] | | 04WP02[Q2] | | 04TW03[Q2] | | 04TW04 | |
| Sample Date | 05/17/02 | | 05/16/02 | | 05/17/02 | | 05/20/02 | |
| Notes | | | Temporary Well | | Temporary Well | | Temporary Well | |
| Chemical Name | Conc | | Conc | | Conc | | Conc | |
| | | | | | | | | |
| Volatile Organic Compounds (UG/L) | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 10 | | 6.1 | | 1 | U | 5 | U |
| 1,1,2-Trichloroethane | 0.52 | J | 0.25 | J | 1 | U | 5 | U |
| 1,1-Dichloroethane | 0.56 | J | 0.46 | J | 0.62 | J | 5 | U |
| 1,2-Dichloroethane | 0.59 | J | 0.68 | J | 1 | U | 5 | U |
| 1,3-Dichlorobenzene | 0.13 | J | 1 | U | 1 | U | 5 | U |
| 1,4-Dichlorobenzene | 0.43 | J | 0.18 | J | 0.16 | J | 0.77 | J |
| Benzene | 0.19 | J | 0.14 | J | 0.13 | J | 5 | U |
| Chlorobenzene | 1.1 | | 0.65 | J | 0.61 | J | 4.3 | J |
| Chloroethane | 3 | | 2.2 | | 0.92 | J | 5 | U |
| Chloroform | 1 | U | 1 | U | 0.21 | J | 0.54 | J |
| Toluene | 1 | U | 0.13 | J | 1 | U | 5 | U |
| Trichloroethene | 21 | | 4 | | 0.57 | J | 120 | |
| Vinyl chloride | 1.1 | | 1 | U | 1 | U | 5 | U |
| cis-1,2-Dichloroethene | 2.9 | | 1.5 | | 0.11 | J | 4.4 | J |
| trans-1,2-Dichloroethene | 0.19 | J | 0.17 | J | 1 | U | 5 | U |

NA - Not analyzed
J - Estimated
U - Undetected

Table 2-6
Detected Compounds in Groundwater Monitoring Well Samples for Site 4 (Round 9, February 2003)
ROD for Site 4
Former NSWC White Oak, Silver Spring Maryland

| Well ID | | 04GW48 | 04GW50 | 04GW105 | 04GW203 | 04GW301 | 04GW302 | |
|---|---|---|---|---|---|---|---|---|
| Location | | Source Area | Downgradient | Downgradient | Source Area | Source Area | Downgradient/Bedrock | |
| Sample ID | | 004GW0480009 | 004GW0500009 | 004GW1050009 | 004GW2030009 | 004GW3010009 | 004GW3020009 | 004GW3029909 |
| Sample Date | | 02/12/03 | 02/12/03 | 02/12/03 | 02/11/03 | 02/11/03 | 02/11/03 | 02/11/03 |
| Notes | | | | | | | | Duplicates |
| Chemical Name | Units | Conc | Conc | Conc | Conc | Conc | Conc | Conc |
| **Volatile Organic Compounds** | UG/L | | | | | | | |
| 1,1,1-Trichloroethane | | 1 U | 6.7 U | 6.7 U | 1 U | 3.4 J | 1 U | 1 U |
| 1,1,2,2-Tetrachloroethane | | 1 U | 94 | 120 | 1 U | 34 | 1 U | 1 U |
| 1,1,2-Trichloroethane | | 1 U | 3.9 J | 4.6 J | 1 U | 5 U | 1 U | 1 U |
| 1,1-Dichloroethene | | 1 U | 5.3 J | 5.5 J | 1 U | 5 U | 1 U | 1 U |
| 1,2,4-Trichlorobenzene | | 2.3 | 6.7 U | 6.7 U | 1 U | 5 U | 1 U | 1 U |
| 1,2-Dichloroethane | | 1 U | 6.7 U | 5.7 J | 1 U | 5 U | 1 U | 1 U |
| Chloroform | | 130 | 6.7 U | 6.7 U | 1 U | 5 U | 1 U | 1 U |
| Tetrachloroethene | | 1.3 | 6.7 U | 6.7 U | 1 U | 5 U | 1 U | 1 U |
| Trichloroethene | | 98 | 1,600 | 1,700 | 0.56 J | 1,200 | 1 U | 1 U |
| Vinyl chloride | | 1 U | 15 | 27 | 1 U | 3.4 J | 1 U | 1 U |
| cis-1,2-Dichloroethene | | 3.2 | 240 | 250 | 1 U | 34 | 1 U | 1 U |
| **Wet Chemistry** | MG/L | | | | | | | |
| Total organic carbon | | 2 | 4 | 5 | 2 | 6 | 1 | 1 |
| **Total Petroleum Hydrocarbons** | UG/L | | | | | | | |
| TPH-diesel range | | 100 U | 330 | 270 | 1,300 K | 800 | 100 U | 100 U |
| TPH-gas range | | 100 U | 120 K | 130 K | 100 U | 100 U | 100 U | 100 U |
| **Field Parameters** | | | | | | | | |
| pH | | 5.65 | 8.82 | 7.66 | 6.2 | 7.38 | 9.77 | 9.77 |
| Specific Conductivity | MS/CM | 0.113 | 0.381 | 0.458 | 0.263 | 0.559 | 0.151 | 0.151 |
| Dissolved Oxigen | MG/L | 4.13 | 0.43 | 1.24 | 0.31 | 3.43 | 2.89 | 2.89 |
| Temperature | °C | 14.5 | 15.6 | 14.79 | 16.4 | 15.03 | 10.6 | 10.6 |
| Oxidation Reduction Potential (EH/ORP) | MV | 166 | 29 | -88 | -77 | 43 | 21 | 21 |

NA - Not analyzed
J - Reported value is estimated
K - Reported value may be biased high
U - Analyte not detected

Table 2-7
Detected Compounds in Groundwater Monitoring Well Samples for Site 4 (Round 10, May 2003)
ROD for Site 4
Former NSWC White Oak, Silver Spring Maryland

| Well ID<br>Location<br>Sample ID<br>Sample Date | | 04GW48<br>Source Area<br>004GW0480011<br>05/08/03 | 04GW50<br>Downgradient<br>004GW0500011<br>05/08/03 | 04GW105<br>Downgradient<br>004GW1050011<br>05/08/03 | 04GW203<br>Source Area<br>004GW2030011<br>05/08/03 | 04GW301<br>Source Area<br>004GW3010011<br>05/08/03 | 04GW302<br>Downgradient/Bedrock<br>004GW3020011<br>05/07/03 |
|---|---|---|---|---|---|---|---|
| Chemical Name | Units | Conc | Conc | Conc | Conc | Conc | Conc |
| | | | | | | | |
| **Volatile Organic Compounds** | UG/L | | | | | | |
| 1,1,1-Trichloroethane | | 10 U | 10 U | 83 U | 10 U | 250 U | 1 U |
| 1,1,2,2-Tetrachloroethane | | 10 U | 13 | 130 | 10 U | 130 J | 1 U |
| Chloroform | | 170 | 10 U | 83 U | 10 U | 250 U | 1 U |
| Methylene chloride | | 10 U | 10 U | 11 B | 1.7 B | 29 J | 1 U |
| Trichloroethene | | 57 | 92 | 1,600 | 10 U | 4,300 | 1 U |
| Vinyl chloride | | 10 U | 10 U | 22 J | 10 U | 250 U | 1 U |
| cis-1,2-Dichloroethene | | 10 U | 4.2 J | 240 | 10 U | 120 J | 1 U |
| | | | | | | | |
| **Wet Chemistry** | MG/L | | | | | | |
| Total organic carbon | | 1 U | 1 U | 3 | 1 | 7 | NA |
| | | | | | | | |
| **Total Petroleum Hydrocarbons** | UG/L | | | | | | |
| TPH-diesel range | | 110 | 100 U | 460 | 330 | 1,900 | 100 U |
| TPH-gas range | | 100 U | 100 U | 110 K | 100 U | 170 K | 100 U |
| | | | | | | | |
| **Field Parameters** | | | | | | | |
| pH | | 5.28 | 4.89 | 7.87 | 8.51 | 6.68 | 6.9 |
| Specific Conductivity | MS/CM | 0.123 | 0.172 | 0.542 | 0.327 | 0.531 | 0.175 |
| Dissolved Oxigen | MG/L | 4.38 | 6.93 | 1.91 | 1.81 | 2.26 | 14.93 |
| Temperature | °C | 16.04 | 17.12 | 16.36 | 16.46 | 18.11 | 15.5 |
| Oxidation Reduction Potential (EH/ORP) | MV | 173 | 178 | -46 | -92 | 32 | NA |

NA - Not analyzed
J - Reported value is estimated
K - Reported value may be biased high
U - Analyte not detected

TABLE 2-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND


Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface / Subsurface Soil
Exposure Point: Entire Site

| CAS Numb | Chemical | Minimum Concentration | Minimum Qualifier | Maximum Concentration | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects (1) | Concentration Used for Screening(2) | Background Value(3) | Risk-Based Residential PCOC Screening Level(4) | | Potential ARAR/ TBC Value | Potential ARAR/ TBC Source | PCOC Flag | Rationale for Contaminant Deletion or Selection(5) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 0.006 | J | 0.03 | | mg/kg | 0004-SB-31 | 3/64 | 0.01 - 0.11 | 0.03 | NA | 3.2 | N | 0.00068<br>0.6 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 78-93-3 | 2-Butanone | 0.0015 | J | 0.0015 | J | mg/kg | 0004-SB-35-0403 | 1/64 | 0.004 - 0.11 | 0.0015 | NA | 4700 | N | 7.9 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 67-64-1 | Acetone | 0.002 | J | 0.38 | J | mg/kg | 0004-SB-29 | 11/64 | 0.01 - 0.12 | 0.38 | NA | 780 | N | 3.5<br>1.00E-05 | SSL_MIGR<br>SSL_INH | No | BSL |
| 71-43-2 | Benzene | 0.012 | J | 0.012 | J | mg/kg | 0004-SB-29 | 1/64 | 0.01 - 0.057 | 0.012 | NA | 12 | N | 0.0018<br>0.8 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 74-83-9 | Bromomethane | 0.001 | J | 0.002 | | mg/kg | 0004-SB-09-2420 | 3/64 | 0.01 - 0.11 | 0.002 | NA | 11 | N | 0.041 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 108-90-7 | Chlorobenzene | 0.0007 | J | 0.0058 | J | mg/kg | 0004-SB-28 | 2/64 | 0.01 - 0.11 | 0.0058 | NA | 160 | N | 0.8<br>100 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 75-09-2 | Methylene Chloride | 0.0015 | J | 0.006 | J | mg/kg | 0004-SB-23-1207 | 9/64 | 0.002 - 0.11 | 0.006 | NA | 85 | N | 0.019<br>13 | SSL_MIGR<br>SSL_INH | No | BSL |
| 127-18-4 | Tetrachloroethene | 0.001 | J | 0.0059 | J | mg/kg | 0004-SB-28 | 2/64 | 0.01 - 0.11 | 0.0059 | NA | 12 | N | 0.029<br>11 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 108-88-3 | Toluene | 0.0004 | J | 0.043 | J | mg/kg | 0004-SB-29 | 10/64 | 0.01 - 0.057 | 0.043 | NA | 1600 | N | 8.8<br>650 | SSL_MIGR<br>SSL_INH | No | BSL |
| 540-59-0 | Total 1,2-Dichloroethene | 0.027 | J | 0.027 | J | mg/kg | 0004-SB-29 | 1/64 | 0.01 - 0.057 | 0.027 | NA | 70 | N | 0.37<br>1200 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 1330-20-7 | Total Xylenes | 0.003 | J | 0.18 | | mg/kg | 0004-SB-29 | 3/64 | 0.01 - 0.12 | 0.18 | NA | 16000 | N | 170<br>410 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 79-01-6 | Trichloroethene | 0.003 | J | 7.7 | | mg/kg | 0004-SB-29 | 3/66 | 0.01 - 0.12 | 7.7 | NA | 1.6 | N | 0.00026<br>5 | SSL_MIGR<br>SSL_INH | No | FREQ |
| **Semivolatile Organics (ug/kg)** | | | | | | | | | | | | | | | | | |
| 91-57-6 | 2-Methylnaphthalene | 0.26 | J | 1.8 | J | mg/kg | 0004-SB-29 | 3/66 | 0.24 - 3.8 | 1.8 | NA | 160 | N | 22 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 83-32-9 | Acenaphthene | 0.056 | J | 0.27 | J | mg/kg | 4SS1030100 | 5/85 | 0.34 - 3.9 | 0.27 | NA | 470 | N | 100 | SSL_MIGR<br>SSL_INH | No | BSL |
| 208-96-8 | Acenaphthylene | 0.04 | J | 0.37 | J | mg/kg | 0004-SB-26-2210 | 3/66 | 0.34 - 3.9 | 0.37 | NA | 470 | | 100 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 120-12-7 | Anthracene | 0.055 | J | 0.44 | J | mg/kg | 0004-SB-26-2210 | 8/66 | 0.34 - 3.9 | 0.44 | NA | 2300 | N | 470 | SSL_MIGR<br>SSL_INH | No | BSL |
| 56-55-3 | Benzo(a)anthracene | 0.042 | J | 1.1 | | mg/kg | 0004-SB-26-2210 | 12/66 | 0.34 - 3.9 | 1.1 | NA | 0.87 | C | 1.5 | SSL_MIGR<br>SSL_INH | Yes | ASL |
| 50-32-8 | Benzo(a)pyrene | 0.057 | J | 1.3 | | mg/kg | 0004-SB-26-2210 | 12/66 | 0.34 - 3.9 | 1.3 | NA | 0.087 | C | 0.37 | SSL_MIGR<br>SSL_INH | Yes | ASL |
| 205-99-2 | Benzo(b)fluoranthene | 0.037 | J | 1.2 | | mg/kg | 4SS1030100 | 14/66 | 0.34 - 3.9 | 1.2 | NA | 0.87 | C | 4.5 | SSL_MIGR<br>SSL_INH | Yes | ASL |
| 191-24-2 | Benzo(g,h,i)perylene | 0.037 | J | 0.73 | | mg/kg | 0004-SB-26-2210 | 11/66 | 0.34 - 3.9 | 0.73 | NA | 230(6) | N | 880 | SSL_MIGR<br>SSL_INH | No | BSL |
| 207-08-9 | Benzo(k)fluoranthene | 0.042 | J | 0.41 | | mg/kg | 4SS1030100 | 12/66 | 0.34 - 3.9 | 0.41 | NA | 8.7 | C | 45 | SSL_MIGR<br>SSL_INH | No | BSL |
| 117-81-7 | Bis(2-Ethylhexyl)phthalate | 0.034 | J | 1.4 | | mg/kg | 0004-SB-32-0903 | 27/66 | 0.34 - 3.9 | 1.4 | NA | 46 | C | 2900<br>31000 | SSL_MIGR<br>SSL_INH | No | BSL |
| 86-74-8 | Carbazole | 0.05 | J | 0.16 | J | mg/kg | 4SS1030100 | 3/66 | 0.34 - 3.9 | 0.16 | NA | 32 | C | 0.47 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 218-01-9 | Chrysene | 0.04 | J | 1.2 | | mg/kg | 0004-SB-26-2210 | 14/66 | 0.34 - 3.9 | 1.2 | NA | 87 | C | 150 | SSL_MIGR<br>SSL_INH | No | BSL |

TABLE 2-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND


Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface / Subsurface Soil
Exposure Point: Entire Site

| CAS Numb | Chemical | Minimum Concentration | Minimum Qualifier | Maximum Concentration | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects (1) | Concentration Used for Screening(2) | Background Value(3) | Risk-Based Residential PCOC Screening Level(4) | | Potential ARAR/ TBC Value | Potential ARAR/ TBC Source | PCOC Flag | Rationale for Contaminant Detention or Selection(5) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 84-74-2 | Di-n-butyl phthalate | 0.036 | J | 4.8 | | mg/kg | 0004-SB-07-0302 | 11/66 | 0.035 - 3.8 | 4.8 | NA | 780 | C | 5000<br>2300 | SSL_MIGR<br>SSL_INH | No | BSL |
| 53-70-3 | Dibenzo(a,h)anthracene | 0.045 | J | 0.16 | J | mg/kg | 0004-SB-26-2210 | 8/66 | 0.34 - 3.8 | 0.16 | NA | 0.087 | N | 7.4 | SSL_MIGR<br>SSL_INH | Yes | ASL |
| 132-64-9 | Dibenzofuran | 0.047 | J | 0.091 | J | mg/kg | 4SS1020100 | 3/66 | 0.34 - 3.8 | 0.091 | NA | 31 | N | 7.7 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 84-66-2 | Diethyl Phthalate | 0.047 | J | 3.8 | | mg/kg | 0004-SB15-0912 | 2/66 | 0.34 - 3.8 | 3.8 | NA | 6300 | N | 450<br>2000 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 206-44-0 | Fluoranthene | 0.045 | J | 2.7 | | mg/kg | 0004-SB-26-2210 | 14/66 | 0.34 - 3.8 | 2.7 | NA | 310 | N | 6300 | SSL_MIGR<br>SSL_INH | No | BSL |
| 86-73-7 | Fluorene | 0.07 | J | 0.45 | J | mg/kg | 0004-SB-26-2210 | 4/66 | 0.34 - 3.8 | 0.45 | NA | 310 | C | 140 | SSL_MIGR<br>SSL_INH | No | BSL |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 0.057 | J | 0.61 | J | mg/kg | 0004-SB-26-2210 | 11/66 | 0.34 - 3.8 | 0.61 | NA | 0.87 | N | 13 | SSL_MIGR<br>SSL_INH | No | BSL |
| 91-20-3 | Naphthalene | 0.063 | J | 0.14 | J | mg/kg | 0004-SB-26-2210 | 4/66 | 0.34 - 3.8 | 0.14 | NA | 160 | N | 0.15 | SSL_MIGR<br>SSL_INH | No | BSL |
| 85-01-8 | Phenanthrene | 0.036 | J | 2.6 | | mg/kg | 0004-SB-26-2210 | 18/66 | 0.34 - 3.8 | 2.6 | NA | 230(6) | N | 680 | SSL_MIGR<br>SSL_INH | No | BSL |
| 129-00-0 | Pyrene | 0.039 | J | 3.9 | | mg/kg | 0004-SB-26-2210 | 19/66 | 0.34 - 3.8 | 3.9 | NA | 230 | N | 680 | SSL_MIGR<br>SSL_INH | No | BSL |
| Pesticides/PCBs (ug/kg) | | | | | | | | | | | | | | | | | |
| 72-54-8 | 4,4'-DDD | 0.0022 | | 0.0062 | | mg/kg | 0004-SB-09-2420 | 4/55 | 0.0034 - 0.02 | 0.0062 | NA | 2.7 | C | 11 | SSL_MIGR<br>SSL_INH | No | BSL |
| 72-55-9 | 4,4'-DDE | 0.000037 | | 0.025 | | mg/kg | 4SS1080100 | 12/56 | 0.0034 - 0.02 | 0.025 | NA | 1.9 | C | 35 | SSL_MIGR<br>SSL_INH | No | BSL |
| 50-29-3 | 4,4'-DDT | 0.0021 | J | 0.024 | | mg/kg | 0004-SB-12-0202 | 7/55 | 0.0034 - 0.02 | 0.024 | NA | 1.9 | C | 1.2 | SSL_MIGR<br>SSL_INH | No | BSL |
| 309-00-2 | Aldrin | 0.00029 | J | 0.0016 | J | mg/kg | 0004-SB-29 | 2/54 | 0.0017 - 0.0059 | 0.0016 | NA | 0.038 | C | 0.0077<br>3 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 5103-71-9 | Alpha-Chlordane | 0.00006 | | 0.011 | | mg/kg | 4SS1080100 | 24/54 | 0.0017 - 0.0097 | 0.011 | NA | 1.8(7) | C | 0.92<br>20 | SSL_MIGR<br>SSL_INH | No | BSL |
| 12672-29-6 | Aroclor-1248 | 0.014 | | 0.014 | | mg/kg | 0004-SB-19-0315 | 1/57 | 0.0034 - 0.2 | 0.014 | NA | 0.32 | C | NA | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 11097-69-1 | Aroclor-1254 | 0.035 | J | 0.1 | | mg/kg | 0004-SB-11-1412 | 2/57 | 0.0034 - 0.2 | 0.1 | NA | 0.32 | C | 1.1 | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 11096-82-5 | Aroclor-1260 | 0.0049 | | 1.6 | | mg/kg | 0004-SB-28 | 46/57 | 0.034 - 0.038 | 1.6 | NA | 0.32 | C | NA | SSL_MIGR<br>SSL_INH | Yes | ASL |
| 60-57-1 | Dieldrin | 0.0001 | | 0.013 | | mg/kg | 0004-SB-13-2420 | 21/55 | 0.0034 - 0.0041 | 0.013 | NA | 0.04 | C | 0.0022<br>1 | SSL_MIGR<br>SSL_INH | No | BSL |
| 959-98-8 | Endosulfan I | 0.00011 | | 0.0006 | | mg/kg | 0004-SB-22-1007 | 10/54 | 0.0017 - 0.0097 | 0.0006 | NA | 47(8) | C | 20 | SSL_MIGR<br>SSL_INH | No | BSL |
| 33213-65-9 | Endosulfan II | 0.0029 | J | 0.023 | | mg/kg | 0004-SB-32-0903 | 6/53 | 0.0034 - 0.02 | 0.023 | NA | 47(8) | C | 20 | SSL_MIGR<br>SSL_INH | No | BSL |
| 1031-07-8 | Endosulfan Sulfate | 0.0012 | | 0.017 | | mg/kg | 0004-SB-13-2420 | 7/57 | 0.0034 - 0.02 | 0.017 | NA | 47(8) | C | 20 | SSL_MIGR<br>SSL_INH | No | BSL |
| 72-20-8 | Endrin | 0.00018 | | 0.015 | J | mg/kg | 0004-SB-28 | 14/57 | 0.0034 - 0.02 | 0.015 | NA | 2.3 | C | 5.4 | SSL_MIGR<br>SSL_INH | No | BSL |
| 7421-93-4 | Endrin Aldehyde | 0.000089 | | 0.048 | | mg/kg | 0004-SB-28 | 14/56 | 0.0034 - 0.02 | 0.048 | NA | 2.3(9) | C | 5.4 | SSL_MIGR<br>SSL_INH | No | BSL |

TABLE 2-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND


Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface / Subsurface Soil
Exposure Point: Entire Site

| CAS Numb | Chemical | Minimum Concentration | Minimum Qualifier | Maximum Concentration | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects (1) | Concentration Used for Screening(2) | Background Value(3) | Risk-Based Residential PCOC Screening Level(4) | | Potential ARAR/ TBC Value | Potential ARAR/ TBC Source | PCOC Flag | Rationale for Contaminant Deletion or Selection(5) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5103-74-2 | Gamma-Chlordane | 0.000079 | | 0.014 | | mg/kg | 0004-SB-26-2210 | 13/56 | 0.0017 - 0.0099 | 0.014 | NA | 1.8(7) | C | 0.92 | SSL_MIGR SSL_INH | No | BSL |
| 76-44-8 | Heptachlor | 0.00021 | | 0.001 | | mg/kg | 0004-SB-20-0202 | 10/56 | 0.0017 - 0.0099 | 0.001 | NA | 0.14 | C | 0.84 J | SSL_MIGR SSL_INH | No | BSL |
| 1024-57-3 | Heptachlor Epoxide | 0.000033 | | 0.0072 | J | mg/kg | 4SS1080100 | 4/57 | 0.0017 - 0.0099 | 0.0072 | NA | 0.07 | C | 0.025 5 | SSL_MIGR SSL_INH | No | BSL |
| 72-43-5 | Methoxychlor | 0.00087 | | 0.028 | | mg/kg | 0004-SB-09-2420 | 3/57 | 0.004 - 0.0097 | 0.028 | NA | 39 | C | 310 | SSL_MIGR SSL_INH | No | BSL |
| 319-84-6 | alpha-BHC | 0.000049 | | 0.00017 | | mg/kg | 0004-SB-22-1007 | 3/57 | 0.0017 - 0.0099 | 0.00017 | NA | 0.1 | C | 0.00089 0.8 | SSL_MIGR SSL_INH | No | BSL |
| 319-85-7 | beta-BHC | 0.000069 | | 0.00016 | | mg/kg | 0004-SB-18-2315 | 4/57 | 0.0017 - 0.0099 | 0.00016 | NA | 0.35 | C | 0.0031 | SSL_MIGR SSL_INH | No | BSL |
| 319-86-8 | delta-BHC | 0.000035 | | 0.000042 | | mg/kg | 0004-SB-17-1715 | 2/57 | 0.0017 - 0.0099 | 0.000042 | NA | 0.1(10) | C | 0.00089 0.8 | SSL_MIGR SSL_INH | No | BSL, FREQ |
| 58-89-9 | gamma-BHC (Lindane) | 0.000055 | | 0.0011 | | mg/kg | 0004-SB-26-2210 | 4/57 | 0.0017 - 0.0099 | 0.0011 | NA | 0.49 | N | 0.0043 | SSL_MIGR SSL_INH | No | BSL |
| **Dioxins/Furans (mg/kg)** | | | | | | | | | | | | | | | | | |
| 3268-87-9 | 1,2,3,4,6,7,8,9-OCDD | 1.40E-04 | J | 1.29E-02 | | mg/kg | 0004-SB-05-0515 | 34/38 | 3E-4 - 7E-4 | 1.29E-02 | NA | 4.30E-02 | N | 8.60E-02 | SSL_MIGR SSL_INH | No | BSL |
| 35822-46-9 | 1,2,3,4,6,7,8-HPCDD | 9.00E-05 | J | 9.00E-05 | J | mg/kg | 0004-SB-22-1207 | 1/38 | 2E-5 - 5E-4 | 9.00E-05 | NA | 4.30E-04 | N | 8.60E-04 | SSL_MIGR SSL_INH | No | BSL |
| 55673-89-7 | 1,2,3,4,7,8,9-HPCDF | 2.10E-02 | | 2.10E-02 | | mg/kg | 0004-SB-26 | 1/38 | 1E-5 - 3E-4 | 2.10E-02 | NA | 4.30E-04 | N | 8.60E-04 | SSL_MIGR SSL_INH | Yes | ASL |
| 57653-85-7 | 1,2,3,6,7,8-HXCDD | 1.80E-03 | | 1.80E-03 | | mg/kg | 0004-SB-26 | 1/38 | 1E-5 - 3E-4 | 1.80E-03 | NA | 4.30E-05 | N | 8.60E-05 | SSL_MIGR SSL_INH | Yes | ASL |
| 57117-44-9 | 1,2,3,6,7,8-HXCDF | 5.00E-05 | J | 5.00E-05 | J | mg/kg | 0004-SB-23-1207 | 1/38 | 5E-6 - 2E-4 | 5.00E-05 | NA | 4.30E-05 | N | 8.60E-05 | SSL_MIGR SSL_INH | Yes | ASL |
| 60851-34-5 | 2,3,4,6,7,8-HXCDF | 1.30E-04 | J | 1.30E-04 | J | mg/kg | 0004-SB-23-1207 | 1/38 | 1E-5 - 2E-4 | 1.30E-04 | NA | 4.30E-05 | N | 8.60E-05 | SSL_MIGR SSL_INH | Yes | ASL |
| 57117-31-4 | 2,3,4,7,8-PECDF | 2.50E-05 | | 5.00E-05 | | mg/kg | 0004-SB-35-1803 | 1/38 | 1E-5 - 4E-4 | 5.00E-05 | NA | 8.60E-06 | N | 1.72E-05 | SSL_MIGR SSL_INH | Yes | ASL |
| 1746-01-6 | 2378-TCDD TEQ | 2.17E-05 | | 5.87E-04 | J | mg/kg | 0004-SB-12-0202 | 34/38 | NA | 5.87E-04 | NA | 4.30E-06 | N | 8.60E-06 | SSL_MIGR SSL_INH | Yes | ASL |
| **Explosives (mg/kg)** | | | | | | | | | | | | | | | | | |
| 99-35-4 | 1,3,5-Trinitrobenzene | 0.061 | J | 0.061 | J | mg/kg | 0004-SB-02-2012 | 1/63 | 0.0402 - 0.25 | 0.061 | NA | 230 | N | NA | SSL_MIGR SSL_INH | No | BSL, FREQ |
| 99-65-0 | 1,3-Dinitrobenzene | 0.02 | J | 0.02 | J | mg/kg | 0004-SB-01-1815 | 1/63 | 0.00721 - 0.25 | 0.02 | NA | 0.78 | N | 0.037 | SSL_MIGR SSL_INH | No | BSL, FREQ |
| 121-14-2 | 2,4-Dinitrotoluene | 0.035 | J | 0.17 | J | mg/kg | 0004-SB-02-2012 | 6/63 | 0.05157 - 0.25 | 0.17 | NA | 16 | N | 0.57 | SSL_MIGR SSL_INH | No | BSL |
| 118-96-7 | 2,4,6-Trinitrotoluene | 0.023 | J | 0.46 | | mg/kg | 4SS1000100 | 4/63 | 0.03559 - 0.25 | 0.46 | NA | 21 | N | NA | SSL_MIGR SSL_INH | No | BSL |
| 606-20-2 | 2,6-Dinitrotoluene | 0.09 | J | 0.09 | J | mg/kg | 0004-SB-02-2012 | 1/63 | 0.04765 - 0.25 | 0.09 | NA | 7.8 | N | 0.25 | SSL_MIGR SSL_INH | No | BSL, FREQ |
| 35572-78-2 | 2-Amino-4,6-dinitrotoluene | 0.036 | J | 0.078 | J | mg/kg | 0004-SB-07-0302 | 3/63 | 0.04567 - 0.25 | 0.078 | NA | 0.47 | N | NA | SSL_MIGR SSL_INH | No | BSL, FREQ |
| 88-72-2 | 2-Nitrotoluene | 0.076 | J | 0.13 | J | mg/kg | 0004-SB-02-2012 | 4/63 | 0.03139 - 0.25 | 0.13 | NA | 78 | N | NA | SSL_MIGR SSL_INH | No | BSL |

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OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND


Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface / Subsurface Soil
Exposure Point: Entire Site

| CAS Numb | Chemical | Minimum Concentration | Minimum Qualifier | Maximum Concentration | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects (1) | Concentration Used for Screening(2) | Background Value(3) | Risk-Based Residential PCOC Screening Level(4) | | Potential ARAR/ TBC Value | Potential ARAR/ TBC Source | PCOC Flag | Rationale for Contaminant Deletion or Selection(5) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99-08-1 | 3-Nitrotoluene | 0.093 | J | 0.18 | J | mg/kg | 0004-SB-06-1712 | 5/63 | 0.08179 - 0.25 | 0.18 | NA | 160 | N | NA | SSL_MIGR<br>SSL_INH | No | BSL |
| 19406-51-0 | 4-Amino-2,6-dinitrotoluene | 0.057 | J | 0.14 | J | mg/kg | 0004-SB-05-0515 | 6/63 | 0.04085 - 0.25 | 0.14 | NA | 0.47 | N | NA | SSL_MIGR<br>SSL_INH | No | BSL |
| 99-99-0 | 4-Nitrotoluene | 0.11 | J | 0.21 | J | mg/kg | 0004-SB-04-1015 | 2/63 | 0.08725 - 0.25 | 0.21 | NA | 79 | N | NA | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 2691-41-0 | HMX | 0.084 | J | 0.084 | J | mg/kg | 0004-SB-02-2012 | 1/63 | 0.07049 - 0.25 | 0.084 | NA | 990 | N | NA | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| 121-82-4 | RDX | 0.025 | J | 0.1 | J | mg/kg | 4SU1030200 | 3/63 | 0.0509 - 0.5 | 0.1 | NA | 5.8 | N | NA | SSL_MIGR<br>SSL_INH | No | BSL, FREQ |
| Inorganics (mg/kg) | | | | | | | | | | | | | | | | | |
| 7429-90-5 | Aluminum | 506 | J | 25300 | | mg/kg | 004-SB-03 | 66/66 | --- | 25300 | NA | 7800 | | NA | SSL_MIGR<br>SSL_INH | No | BKG |
| 7440-36-0 | Antimony | 0.37 | | 2.1 | | mg/kg | 0004-SB-12-0202 | 17/66 | 0.19 - 4.4 | 2.1 | NA | 3.1 | C | 5 | SSL_MIGR<br>SSL_INH | No | BSL, BKG |
| 7440-38-2 | Arsenic | 0.34 | | 5.8 | | mg/kg | 4SS1030100 | 61/66 | 0.19 - 0.78 | 5.8 | NA | 0.43 | N | 0.026<br>750 | SSL_MIGR<br>SSL_INH | No | BKG |
| 7440-39-3 | Barium | 2.1 | | 187 | | mg/kg | 0004-SB-12-0202 | 62/66 | 3.7 - 9.6 | 187 | NA | 550 | | 2100<br>690000 | SSL_MIGR<br>SSL_INH | No | BSL, BKG |
| 7440-41-7 | Beryllium | 0.03 | | 0.22 | | mg/kg | 0004-SB-08-1207 | 12/66 | 0.01 - 1.14 | 0.22 | NA | 16 | N | 1200<br>1300 | SSL_MIGR<br>SSL_INH | No | BSL, BKG |
| 7440-43-9 | Cadmium | 0.06 | | 6.7 | | mg/kg | 0004-SB-30 | 15/66 | 0.04 - 0.73 | 6.7 | NA | 3.9(11) | | 55<br>1800 | SSL_MIGR<br>SSL_INH | No | BKG |
| 7440-70-2 | Calcium | 38.6 | | 6450 | | mg/kg | 4SU1030200 | 56/62 | 32.5 - 278 | 6450 | NA | NA | N | NA | SSL_MIGR<br>SSL_INH | No | NUT |
| 7440-47-3 | Chromium | 1.8 | | 154 | | mg/kg | 0004-SB-10-0116 | 66/66 | --- | 154 | NA | 23(12) | N | 42<br>270 | SSL_MIGR<br>SSL_INH | No | BKG |
| 7440-48-4 | Cobalt | 0.19 | | 16.5 | | mg/kg | 004-SB-04 | 49/66 | 0.16 - 7.98 | 16.5 | NA | 160 | N | NA | SSL_MIGR<br>SSL_INH | No | BSL, BKG |
| 7440-50-8 | Copper | 1.7 | | 816 | | mg/kg | 0004-SB-12-0202 | 61/66 | 1.6 - 8.7 | 816 | NA | 310 | N | 11000 | SSL_MIGR<br>SSL_INH | No | BKG |
| 57-12-5 | Cyanide | 0.07 | | 2.3 | | mg/kg | 0004-SB-28 | 19/58 | 0.14 - 3 | 2.3 | NA | 160 | N | 150 | SSL_MIGR<br>SSL_INH | No | BSL |
| 7439-89-6 | Iron | 588 | J | 27000 | | mg/kg | 004-SB-05 | 66/66 | --- | 27000 | NA | 2300 | | NA | SSL_MIGR<br>SSL_INH | No | BKG |
| 7439-92-1 | Lead | 0.55 | | 403 | | mg/kg | 0004-SB-12-0202 | 64/66 | 1.4 - 1.9 | 403 | NA | 400(13) | | NA | SSL_MIGR<br>SSL_INH | No | BKG |
| 7439-95-4 | Magnesium | 49.1 | | 7310 | | mg/kg | 4SU1060200 | 64/66 | 4.2 - 52.8 | 7310 | NA | NA | N | NA | SSL_MIGR<br>SSL_INH | No | BKG, NUT |
| 7439-96-5 | Manganese | 1.9 | | 553 | | mg/kg | 0004-SB-12-0202 | 66/66 | --- | 553 | NA | 160(14) | N | 950 | SSL_MIGR<br>SSL_INH | No | BKG |
| 7439-97-6 | Mercury | 0.06 | | 1.5 | | mg/kg | 0004-SB-22-1007 | 29/66 | 0.05 - 0.15 | 1.5 | NA | 2.3(15) | N | NA | SSL_MIGR<br>SSL_INH | No | BSL, BKG |
| 7440-02-0 | Nickel | 0.45 | | 85.2 | J | mg/kg | 4SU1060200 | 52/66 | 0.94 - 3.8 | 85.2 | NA | 160 | | NA<br>13000 | SSL_MIGR<br>SSL_INH | No | BSL, BKG |
| 7440-09-7 | Potassium | 16.9 | | 1540 | J | mg/kg | 004-SB-03 | 60/66 | 56.4 - 135 | 1540 | NA | NA | | NA | SSL_MIGR<br>SSL_INH | No | BKG, NUT |
| 7782-49-2 | Selenium | 0.342 | | 7 | | mg/kg | 004-SB-03 | 21/66 | 0.18 - 1.4 | 7 | NA | 39 | N | 19 | SSL_MIGR<br>SSL_INH | No | BSL, BKG |

TABLE 2-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND


Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface / Subsurface Soil
Exposure Point: Entire Site

| CAS Numb | Chemical | Minimum Concentration | Minimum Qualifier | Maximum Concentration | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects (1) | Concentration Used for Screening(2) | Background Value(3) | Risk-Based Residential PCOC Screening Level(4) | | Potential ARAR/ TBC Value | Potential ARAR/ TBC Source | PCOC Flag | Rationale for Contaminant Deletion or Selection(5) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7440-22-4 | Silver | 0.24 | | 25.2 | | mg/kg | 0004-SB-12-0202 | 13/65 | 0.07 - 0.52 | 25.2 | NA | 39 | N | 31 | SSL_MIGR SSL_INH | No | BSL, BKG |
| 7440-23-5 | Sodium | 24.1 | | 77.7 | | mg/kg | 0004-SB-12-0202 | 29/66 | 16.9 - 70.8 | 77.7 | NA | NA | N | NA | SSL_MIGR SSL_INH | No | BKG, NUT |
| 7440-28-0 | Thallium | 0.86 | | 0.86 | | mg/kg | 0004-SB-36-2002 | 1/65 | 0.2 - 1.5 | 0.86 | NA | 0.55 | N | 3.6 | SSL_MIGR SSL_INH | No | FREQ |
| 7440-62-2 | Vanadium | 2.2 | | 75.5 | | mg/kg | 0004-SB-22-1007 | 65/66 | 3.3 | 75.5 | NA | 55 | N | 5100 | SSL_MIGR SSL_INH | No | BKG |
| 7440-66-6 | Zinc | 2.1 | | 594 | | mg/kg | 0004-SB-12-0202 | 61/66 | 0.67 - 13.3 | 594 | NA | 2300 | N | 14000 | SSL_MIGR SSL_INH | No | BSL, BKG |
| Petroleum Hydrocarbons (mg/kg) | | | | | | | | | | | | | | | | | |
| TPNUS001 | Total Petroleum Hydrocarbons | 7.7 | | 5900 | | mg/kg | 0004-SB-29 | 32/38 | 36 - 110 | 5900 | NA | NA | | NA | SSL_MIGR SSL_INH | No | NTX |

Shaded cells indicate that the maximum concentration exceeds the specified criterion or constituent has been selected as a PCOC.

Footnotes:

1. Values presented are sample-specific quantitation limits.
2. The maximum detected concentration is used for screening purposes.
3. To determine whether metal concentrations are within background levels, a comparison of site concentrations with Base-wide background data was made by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significantly different from background, that chemical was not selected as a PCOC.
4. The risk-based soil COPC screening level for residential land use is presented. The value is based on a target hazard quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (USEPA, Region III, April 2002).
5. The chemical is selected as a PCOC if the maximum detected concentration exceeds the risk-based PCOC screening level and facility-wide background levels.
6. Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
7. Value for chlordane is used.
8. Value for endosulfan is used.
9. Value for endrin is used.
10. Value for alpha-BHC is used.
11. Cadmium - Water
12. Chromium as hexavalent chromium
13. OSWER soil screening level for residential land use (USEPA, July 1994)
14. Manganese-Nonfood.
15. Mercury as Mercuric Chloride.

Rationale Codes:

For Selection as a PCOC:
ASL = Above PCOC Screening Level

For Elimination as a PCOC:
BKG = Within background levels
BSL = Below PCOC Screening Level
FREQ = Frequency
NUT = Essential Nutrient

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogen
J = Estimated Value
K = Value Estimated with a High Bias
L = Value Estimated with a Low Bias
N = Noncarcinogen
NA = Not Applicable/Not Available
PCOC = Potential Constituent of Concern
SSL-INH = Soil Screening Level for transfers from soil to air (Inhalation) (USEPA, May 1996)
SSL-MIGR = Soil Screening Level for transfers from soil to groundwater for a Dilution and Attenuation Factor of 20 (USEPA, Region 3, April 2002)

TABLE 2-9

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY - SURFACE/SUBSURFACE SOIL
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

| Chemical of Potential Concern | Units | Arithmetic Mean | 95% UCL of Normal Data | Maximum Detected Concentration | Maximum Qualifier | EPC Units | Reasonable Maximum Exposure | | | Central Tendency Exposure | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Medium EPC Value | Medium EPC Statistic | Medium EPC Rationale | Medium EPC Value | Medium EPC Statistic | Medium EPC Rationale |
| Benzo(a)anthracene | mg/kg | 2.69E-01 | 3.37E-01 | 1.10E+00 | | mg/kg | 2.81E-01 | 95% UCL-T | W - Test (1) | 2.81E-01 | 95% UCL-T | W - Test (1) |
| Benzo(a)pyrene | mg/kg | 2.71E-01 | 3.40E-01 | 1.30E+00 | | mg/kg | 2.83E-01 | 95% UCL-T | W - Test (1) | 2.83E-01 | 95% UCL-T | W - Test (1) |
| Benzo(b)fluoranthene | mg/kg | 2.81E-01 | 3.52E-01 | 1.20E+00 | | mg/kg | 3.02E-01 | 95% UCL-T | W - Test (1) | 3.02E-01 | 95% UCL-T | W - Test (1) |
| Dibenzo(a,h)anthracene | mg/kg | 2.26E-01 | 2.88E-01 | 1.60E-01 | J | mg/kg | 1.60E-01 | Maximum | W - Test (2) | 1.60E-01 | Maximum | W - Test (2) |
| AROCLOR-1260 | mg/kg | 2.12E-01 | 2.85E-01 | 1.60E+00 | | mg/kg | 3.74E-01 | 95% UCL-T | W - Test (1) | 3.74E-01 | 95% UCL-T | W - Test (1) |
| 2378-TCDD TEQ | mg/kg | 1.41E-04 | 1.88E-04 | 5.87E-04 | J | mg/kg | 1.89E-04 | 95% UCL-T | W - Test (1) | 1.89E-04 | 95% UCL-T | W - Test (1) |

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W Test is inconclusive. Data are assumed to be log-normally distributed.
(2) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration is used for EPC.

TABLE 2-10

## CANCER TOXICITY DATA -- ORAL/DERMAL
## SITE 4 - CHEMICAL BURIAL AREA
## NSWC-WHITE OAK, SILVER SPRING, MARYLAND

| Chemical of Potential Concern | Oral CSF | Oral to Dermal Adjustment Factor[1] | Adjusted Dermal Cancer Slope Factor[2] | Units | Weight of Evidence/ Cancer Guideline Description | Source | Date[3] |
|---|---|---|---|---|---|---|---|
| Aroclor-1260 | 2.0E+00 | 1 | 2.00E+00 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 7/21/2002 |
| Benzo(a)anthracene | 7.3E-01 | 1 | 7.30E-01 | $(mg/kg\text{-}day)^{-1}$ | B2 | Region 3 | 4/2/2002 |
| Benzo(a)pyrene | 7.3E+00 | 1 | 7.30E+00 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 7/21/2002 |
| Benzo(b)fluoranthene | 7.3E-01 | 1 | 7.30E-01 | $(mg/kg\text{-}day)^{-1}$ | B2 | Region 3 | 4/2/2002 |
| Dibenzo(a,h)anthracene | 7.3E+00 | 1 | 7.30E+00 | $(mg/kg\text{-}day)^{-1}$ | B2 | Region 3 | 4/2/2002 |
| 2378-TCDD TEQ | 1.5E+05 | 1 | 1.50E+05 | $(mg/kg\text{-}day)^{-1}$ | B2 | Region 3 | 4/2/2002 |

(1) RAGS-PART E (USEPA, September 2001).
(2) CSFdermal = CSForal/(Oral to Dermal Adjustment Factor)
(3) Date of IRIS

Notes:
CSF = Cancer Slope Factor
IRIS = Integrated Risk Information System, on-line database search (USEPA, July1999)
HEAST = Health Effects Assessment Summary Tables (USEPA, July 1997)
Region 3 - USEPA Region III RBC Table, April 2, 2002

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

TABLE 2-11

REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FULL TIME WORKER
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Full Time Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 7.2E-08 | | 6.2E-08 | 1.3E-07 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 7.2E-07 | | 6.2E-07 | 1.3E-06 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 7.7E-08 | | 6.6E-08 | 1.4E-07 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 4.1E-07 | | 3.5E-07 | 7.6E-07 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 2.6E-07 | | 2.4E-07 | 5.0E-07 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 9.9E-06 | | 2.0E-06 | 1.2E-05 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 1.5E-05 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 1.5E-05

TABLE 7-12

REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - MAINTENANCE / UTILITY WORKER
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Maintenance / Utility Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 1.0E-08 | | 3.1E-09 | 1.3E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 1.0E-07 | | 3.1E-08 | 1.4E-07 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 1.1E-08 | | 3.3E-09 | 1.4E-08 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 5.9E-08 | | 1.8E-08 | 7.6E-08 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 3.8E-08 | | 1.2E-08 | 5.0E-08 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 1.4E-06 | | 9.9E-08 | 1.5E-06 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 1.8E-06 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 1.8E-06

TABLE 2-13

REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CONSTRUCTION WORKER
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 9.9E-09 | | 2.7E-09 | 1.3E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 1.0E-07 | | 2.7E-08 | 1.3E-07 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 1.1E-08 | | 2.9E-09 | 1.3E-08 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 5.6E-08 | | 1.5E-08 | 7.2E-08 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 3.8E-08 | | 1.0E-08 | 4.7E-08 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 1.4E-06 | | 8.5E-08 | 1.5E-06 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 1.7E-06 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 1.7E-06

TABLE 2-14

REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT RECREATIONAL USER
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 5.5E-09 | | 5.2E-09 | 1.1E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 5.5E-08 | | 5.2E-08 | 1.1E-07 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 5.9E-09 | | 5.5E-09 | 1.1E-08 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 3.1E-09 | | 2.9E-09 | 6.1E-09 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 2.0E-09 | | 2.0E-09 | 4.0E-09 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 7.6E-07 | | 1.6E-07 | 9.3E-07 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 1.2E-06 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 1.2E-06

TABLE 2-15

REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADOLESCENT TRESPASSER
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Adolescent

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 9.7E-09 | | 1.2E-08 | 2.2E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 9.8E-08 | | 1.2E-07 | 2.2E-07 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 1.0E-08 | | 1.3E-08 | 2.4E-08 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 5.5E-08 | | 7.0E-08 | 1.3E-07 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 3.5E-09 | | 4.9E-08 | 5.4E-08 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 1.3E-06 | | 3.9E-07 | 1.7E-06 | 2378-TCDD TEQ | | | | | |
| | | | Total Risk Across Surface Soil | | | | 2.2E-06 | Total Hazard Index Across All Media and All Exposure Routes | | | | | |

Risk Across All Media and All Exposure Routes: 2.2E-06

TABLE 2-16

REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - DAY CARE CENTER CHILD
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Day Care Center Child
Receptor Age: Child (0-6 Years)

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 8.0E-08 | | 8.8E-08 | 1.7E-07 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 8.1E-07 | | 8.9E-07 | 1.7E-06 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 8.6E-08 | | 9.4E-08 | 1.8E-07 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 4.6E-07 | | 5.0E-07 | 9.6E-07 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 2.9E-07 | | 3.4E-07 | 6.4E-07 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 1.1E-05 | | 2.8E-06 | 1.4E-05 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 1.8E-05 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 1.8E-05

TABLE 2-17

REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE ADULT RESIDENT
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 9.8E-08 | | 5.0E-08 | 1.5E-07 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 9.7E-07 | | 5.0E-07 | 1.5E-06 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 1.0E-07 | | 5.4E-08 | 1.6E-07 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 5.5E-07 | | 2.8E-07 | 8.3E-07 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 3.5E-07 | | 2.0E-07 | 5.5E-07 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 1.0E-05 | | 1.6E-06 | 1.5E-05 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 1.8E-05 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 1.8E-05

TABLE 2-18

REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CHILD RESIDENT
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child (0 - 6 years)

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 2.3E-07 | | 6.2E-09 | 3.1E-07 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 2.3E-06 | | 8.2E-07 | 3.1E-06 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 2.4E-07 | | 6.8E-08 | 3.0E-07 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 1.3E-06 | | 4.7E-07 | 1.7E-06 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 8.2E-07 | | 3.2E-07 | 1.1E-06 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 3.1E-05 | | 2.6E-06 | 3.4E-05 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 4.0E-05 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes: 4.0E-05

TABLE 2-19

CENTRAL TENDENCY EXPOSURE (CTE)

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CHILD RESIDENT

SITE 4 - CHEMICAL BURIAL AREA

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child (0 - 6 years)

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 2.5E-08 | | 3.7E-09 | 2.9E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 2.5E-07 | | 3.7E-08 | 2.9E-07 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 2.7E-08 | | 3.9E-09 | 3.1E-08 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 1.4E-07 | | 2.1E-08 | 1.6E-07 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 9.1E-08 | | 1.4E-08 | 1.1E-07 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 3.5E-08 | | 1.2E-07 | 3.5E-08 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 4.2E-06 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 4.2E-06

TABLE 4-20

CENTRAL TENDENCY EXPOSURE (CTE)

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE ADULT RESIDENT

SITE 4 - CHEMICAL BURIAL AREA

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 9.4E-09 | | 1.4E-09 | 1.1E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 9.5E-08 | | 1.4E-08 | 1.1E-07 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 1.0E-08 | | 1.5E-09 | 1.2E-08 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 5.3E-08 | | 7.9E-09 | 6.1E-08 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 3.4E-08 | | 5.5E-09 | 4.0E-08 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 1.3E-06 | | 4.4E-08 | 1.3E-06 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 1.6E-06 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 1.6E-06

TABLE -21

CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - DAY CARE CENTER CHILD
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Day Care Center Child
Receptor Age: Child (0-6 Years)

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 1.8E-08 | | 5.1E-09 | 2.3E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 1.8E-07 | | 5.2E-08 | 2.3E-07 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 1.9E-08 | | 5.5E-09 | 2.4E-08 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 1.0E-07 | | 2.9E-08 | 1.3E-07 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 6.4E-08 | | 2.0E-08 | 8.4E-08 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 2.4E-06 | | 1.6E-07 | 2.6E-06 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 3.1E-06 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 3.1E-06

CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADOLESCENT TRESPASSER
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Adolescent

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 2.4E-09 | | 3.2E-10 | 3.0E-09 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 2.4E-08 | | 8.3E-09 | 3.3E-08 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 2.6E-09 | | 8.8E-10 | 3.5E-09 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 1.4E-08 | | 4.7E-09 | 1.9E-08 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 8.9E-09 | | 3.2E-09 | 1.2E-08 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 3.4E-07 | | 2.6E-08 | 3.6E-07 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 4.3E-07 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes 4.3E-07

TABLE 2-23

CENTRAL TENDENCY EXPOSURE (CTE)

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT RECREATIONAL USER

SITE 4 - CHEMICAL BURIAL AREA

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 4.1E-10 | | 9.7E-11 | 5.1E-10 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 4.2E-09 | | 9.7E-10 | 5.1E-09 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 4.4E-10 | | 1.0E-10 | 5.5E-10 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 2.4E-09 | | 5.5E-10 | 2.9E-09 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 1.5E-09 | | 3.8E-10 | 1.9E-09 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 5.7E-08 | | 3.1E-09 | 6.0E-08 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 7.1E-08 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes: 7.1E-08

TABLE 4-24

CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CONSTRUCTION WORKER
SITE 4 - CHEMICAL BURIAL AREA
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 5.0E-09 | | 8.9E-10 | 5.8E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 5.0E-08 | | 8.9E-09 | 5.9E-08 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 5.3E-09 | | 9.5E-10 | 6.3E-09 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 2.6E-08 | | 5.0E-09 | 3.3E-08 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 1.8E-08 | | 3.5E-09 | 2.2E-08 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 6.8E-07 | | 2.8E-08 | 7.1E-07 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 8.4E-07 | | | | | Total Hazard Index Across All Media and All Exposure Routes | |

Risk Across All Media and All Exposure Routes: 8.4E-07

TABLE 4-25

CENTRAL TENDENCY EXPOSURE (CTE)

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - MAINTENANCE / UTILITY WORKER

SITE 4 - CHEMICAL BURIAL AREA

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Maintenance / Utility Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 9.3E-10 | | 8.0E-11 | 1.0E-09 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 9.4E-09 | | 8.0E-10 | 1.0E-08 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 1.0E-09 | | 9.6E-11 | 1.1E-09 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 5.3E-09 | | 4.5E-10 | 5.7E-09 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 3.4E-09 | | 3.1E-10 | 3.7E-09 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 1.3E-07 | | 2.5E-09 | 1.3E-07 | 2378-TCDD TEQ | | | | | |
| | | | | Total Risk Across Surface Soil | | | 1.5E-07 | | Total Hazard Index Across All Media and All Exposure Routes | | | | |

Risk Across All Media and All Exposure Routes: 1.5E-07

TABLE 26

CENTRAL TENDENCY EXPOSURE (CTE)

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs FULL TIME WORKER

SITE 4 - CHEMICAL BURIAL AREA

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Receptor Population: Full Time Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical | Carcinogenic Risk | | | | Chemical | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total | | Primary Target Organ | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Soil | Surface/ Subsurface Soil | Benzo(a)anthracene | 1.1E-08 | | 1.9E-09 | 1.3E-08 | Benzo(a)anthracene | | | | | |
| | | | Benzo(a)pyrene | 1.1E-07 | | 2.0E-08 | 1.3E-07 | Benzo(a)pyrene | | | | | |
| | | | Benzo(b)fluoranthene | 1.2E-08 | | 2.1E-09 | 1.4E-08 | Benzo(b)fluoranthene | | | | | |
| | | | Dibenzo(a,h)anthracene | 6.4E-08 | | 1.1E-08 | 7.5E-08 | Dibenzo(a,h)anthracene | | | | | |
| | | | AROCLOR-1260 | 4.1E-08 | | 7.6E-09 | 4.9E-08 | AROCLOR-1260 | | | | | |
| | | | 2378-TCDD TEQ | 1.5E-06 | | 6.2E-08 | 1.6E-06 | 2378-TCDD TEQ | | | | | |
| | | | | | | Total Risk Across Surface Soil | 1.9E-06 | | Total Hazard Index Across All Media and All Exposure Routes | | | | |

Risk Across All Media and All Exposure Routes 1.9E-06

TABLE 2-27
Summary of Data Quantitatively Used In Risk Assessment for OU-1 Groundwater
ROD for Site 4 Soil and Groundwater
Former NSWC White Oak

| Medium | Date of Sampling | Sample ID | Parameters |
|---|---|---|---|
| **Groundwater - Bedrock*** | | | |
| Jan - Feb 2000 | 02/09/2000 | 003GW1020005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/10/2000 | 009GW1050005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/15/2000 | 009GW1060005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/01/2000 | 009GW201D005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/01/2000 | 009GW201S005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/02/2000 | 046GW125D005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/03/2000 | 046GW200D005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/04/2000 | 046GW214D005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/15/2000 | 046GWC12005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| April 2000 | 04/24/2000 | 009GW1060006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/13/2000 | 046GW125D006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/17/2000 | 046GW200D006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/11/2000 | 046GW213D006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/26/2000 | 046GW2200006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/19/2000 | 046GWC12006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/19/2000 | 046GWC50006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| **Groundwater - Coastal Plain and Saprolite*** | | | |
| Oct - Nov 1999 | 11/11/1999 | 4GW110004 | VOC, SVOC, metals, and pest/PCB |
| | 11/03/1999 | 4GW1030004 | VOC, SVOC, metals, and pest/PCB |
| | 11/02/1999 | 9GW1010004 | VOC, SVOC, metals, and pest/PCB |
| Jan - Feb 2000 | 02/09/2000 | 003GW0190005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 2/6/2000 | 004GW1060005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/01/2000 | 004GW2000005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/09/2000 | 004GW2010005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/05/2000 | 007GW0430005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/15/2000 | 007GW1040005 | LC VOC, inorg, cyanide, perchlorate, explosives |
| | 02/07/2000 | 009GW0010005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/07/2000 | 009GW1030005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/06/2000 | 013GW0020005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/15/2000 | 013GW2000005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/03/2000 | 046GW123D005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/16/2000 | 046GW1280005 | LC VOC, inorg, cyanide, perchlorate, explosives |
| | 02/15/2000 | 046GW1320005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/04/2000 | 046GW2190005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/16/2000 | 046GWA20005 | LC VOC, inorg, cyanide, perchlorate, explosives |
| | 02/08/2000 | 046GWC13005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 02/15/2000 | 046GWC50005 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| April 2000 | 04/14/2000 | 004GW2020006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/24/2000 | 009GW1010006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 4/16/2000 | 013GW0020006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/18/2000 | 013GW0030006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/15/2000 | 046GW1210006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/15/2000 | 046GW1260006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/25/2000 | 046GW2080908 [a] | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/12/2000 | 046GW2180006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/25/2000 | 046GWA10006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/25/2000 | 046GWA20006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/25/2000 | 046GWA30006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/18/2000 | 046GWA40006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |
| | 04/24/2000 | 046GWC10006 | LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives |

* - This table only lists those samples considered the most contaminated and used in the quantitative risk assessment
LC - Low concentration
VOC - volatile organic constituents
SVOC - semivolatile organic constituents
inorg - inorganic constituents
Fmetals - dissolved inorganic constituents
Pest/PCB - pesticides/ polychlorinated biphenyls
[a] duplicate of 004GW2010005
[b] duplicate of 004GW2000005
[c] duplicate of 046GW2080006

**TABLE 2-28**

**Summary of Chemicals of Potential Concern for the HHRA for OU-1 Groundwater**

**ROD for Site 4 Soil and Groundwater**

**Former NSWC White Oak**

| Groundwater | |
|---|---|
| **Coastal Plain and Saprolite Aquifer** | **Bedrock Aquifer** |
| *Ingestion and Dermal Scenarios* | *Ingestion and Dermal Scenarios* |
| 1,1,2,2-Tetrachloroethane | 1,1,2,2-Tetrachloroethane |
| 1,1,2-Trichloroethane | 1,2-Dichloroethane |
| 1,1-Dichloroethene | Chloroform |
| 1,2-Dibromoethane | Trichloroethene |
| 1,2-Dichloroethane | Vinyl chloride |
| 1,2-Dichloropropane | cis-1,2-Dichloroethene |
| 1,4-Dichlorobenzene | 2-Amino-4,6-dinitrotoluene |
| Benzene | 4-Amino-2,6-dinitrotoluene |
| Bromodichloromethane | Perchlorate |
| Carbon tetrachloride | RDX |
| Chlorobenzene | Aluminum |
| Chloroform | Arsenic |
| Tetrachloroethene | Barium |
| Toluene | Chromium |
| Trichloroethene | Iron |
| Vinyl chloride | Manganese |
| cis-1,2-Dichloroethene | Nickel |
| trans-1,2-Dichloroethene | Vanadium |
| Naphthalene | |
| bis(2-Ethylhexyl)phthalate | |
| 2,4,6-Trinitrotoluene | |
| 2-Amino-4,6-dinitrotoluene | |
| 4-Amino-2,6-dinitrotoluene | |
| Perchlorate | |
| RDX | |
| Aluminum** | |
| Arsenic | |
| Barium | |
| Beryllium** | |
| Cadmium | |
| Chromium | |
| Cobalt | |
| Copper** | |
| Cyanide** | |
| Iron | |
| Lead | |
| Manganese | |
| Mercury** | |
| Nickel | |
| Thallium | |
| Vanadium | |

* Combines surface and subsurface soil.

** COPCs for the construction worker scenario only (based on total metals results).

Table 2-29

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN in COASTAL PLAIN and SAPROLITE GROUNDWATER THROUGHOUT OPERABLE UNIT 1

ROD for Site 4, NSWC White Oak

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Shallow Aquifer - Tap Water

| CAS Number | Chemical | Minimum [1] Concentration | Minimum Qualifier | Maximum [1] Concentration | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits | Concentration [2] Used for Screening | Background [3] Value | Screening [4] Toxicity Value | | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for [5] Contaminant Deletion or Selection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-55-6 | 1,1,1-Trichloroethane | 0.200 | J | 1.60 | K | UG/L | 004GW1050005 | 3/33 | 1 - 25 | 1.6 | N/A | 317 | N | N/A | N/A | NO | BSL |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 3.40 | | 994 | L | UG/L | 013GW0020005 | 10/33 | 1 - 25 | 993.5 | N/A | 0.0527 | C | N/A | N/A | YES | ASL |
| 79-00-5 | 1,1,2-Trichloroethane | 0.600 | J | 8.50 | | UG/L | 013GW0020006 | 6/33 | 1 - 25 | 8.5 | N/A | 0.188 | C | N/A | N/A | YES | ASL |
| 75-34-3 | 1,1-Dichloroethane | 0.270 | J | 0.800 | K | UG/L | 004GW1050005 | 4/33 | 1 - 25 | 0.8 | N/A | 79.8 | N | N/A | N/A | NO | BSL |
| 75-35-4 | 1,1-Dichloroethene | 0.500 | K | 3.30 | | UG/L | 007GW0430005 | 4/33 | 1 - 25 | 3.3 | N/A | 0.0436 | C | N/A | N/A | YES | ASL |
| 120-82-1 | 1,2,4-Trichlorobenzene | 4.30 | | 4.30 | | UG/L | 003GW0190005 | 1/33 | 1 - 25 | 4.3 | N/A | 19.4 | N | N/A | N/A | NO | BSL |
| 106-93-4 | 1,2-Dibromoethane | 20.6 | | 20.6 | | UG/L | 046GW1320005 | 1/33 | 1 - 25 | 20.6 | N/A | 7.52E-04 | C | N/A | N/A | YES | ASL |
| 95-50-1 | 1,2-Dichlorobenzene | 0.800 | K | 0.900 | J | UG/L | 013GW0020006 | 3/33 | 1 - 25 | 0.9 | N/A | 27 | N | N/A | N/A | NO | BSL |
| 107-06-2 | 1,2-Dichloroethane | 8.90 | K | 285 | J | UG/L | 046GW1320005 | 2/33 | 1 - 25 | 285 | N/A | 0.115 | C | N/A | N/A | YES | ASL |
| 78-87-5 | 1,2-Dichloropropane | 3.20 | | 3.20 | | UG/L | 046GW1320005 | 1/33 | 1 - 25 | 3.2 | N/A | 0.155 | C | N/A | N/A | YES | ASL |
| 541-73-1 | 1,3-Dichlorobenzene | 0.200 | J | 1.40 | K | UG/L | 004GW1050005 | 3/33 | 1 - 25 | 1.4 | N/A | 18 | N | N/A | N/A | NO | BSL |
| 106-46-7 | 1,4-Dichlorobenzene | 1.70 | | 3.20 | K | UG/L | 004GW1050005 | 2/33 | 1 - 25 | 3.2 | N/A | 0.473 | C | N/A | N/A | YES | ASL |
| 78-93-3 | 2-Butanone | 10.6 | J | 10.6 | J | UG/L | 046GW2089906 | 1/1 | 5 - 5 | 10.6 | N/A | 191 | N | N/A | N/A | NO | BSL |
| 67-64-1 | Acetone | 13.0 | J | 13.3 | L | UG/L | 046GW2180006 | 2/6 | 5 - 5 | 13.3 | N/A | 60.8 | N | N/A | N/A | NO | BSL |
| 71-43-2 | Benzene | 0.300 | J | 1,708 | J | UG/L | 046GW1320005 | 7/33 | 1 - 25 | 1708 | N/A | 0.319 | C | N/A | N/A | YES | ASL |
| 75-27-4 | Bromodichloromethane | 1.10 | | 2.10 | | UG/L | 009GW1030005 | 2/33 | 1 - 25 | 2.1 | N/A | 0.170 | C | N/A | N/A | YES | ASL |
| 75-15-0 | Carbon disulfide | 0.200 | J | 4.60 | | UG/L | 046GW123D005 | 4/33 | 1 - 25 | 4.6 | N/A | 104 | N | N/A | N/A | NO | BSL |
| 56-23-5 | Carbon tetrachloride | 0.600 | J | 0.600 | J | UG/L | 046GWC50005 | 1/33 | 1 - 25 | 0.6 | N/A | 0.162 | C | N/A | N/A | YES | ASL |
| 108-90-7 | Chlorobenzene | 0.130 | J | 18.6 | K | UG/L | 004GW1050005 | 6/33 | 1 - 25 | 18.6 | N/A | 10.6 | N | N/A | N/A | YES | ASL |
| 75-00-3 | Chloroethane | 0.700 | J | 0.700 | J | UG/L | 046GW1320005 | 1/33 | 1 - 25 | 0.7 | N/A | 3.64 | C | N/A | N/A | NO | BSL |
| 67-66-3 | Chloroform | 6.30 | J | 6.30 | J | UG/L | 046GWC50005 | 1/33 | 1 - 25 | 6.3 | N/A | 0.0630 | N | N/A | N/A | YES | ASL |
| 74-87-3 | Chloromethane | 1.60 | | 1.60 | | UG/L | 009GW1010006 | 1/33 | 1 - 25 | 1.6 | N/A | 2.11 | C | N/A | N/A | NO | BSL |
| 100-41-4 | Ethylbenzene | 0.810 | J | 111 | J | UG/L | 046GW1320005 | 2/33 | 1 - 25 | 111 | N/A | 134 | N | N/A | N/A | NO | BSL |
| 100-42-5 | Styrene | 3.70 | | 3.70 | | UG/L | 046GW1320005 | 1/33 | 1 - 25 | 3.7 | N/A | 162 | N | N/A | N/A | NO | BSL |
| 127-18-4 | Tetrachloroethene | 0.200 | J | 70.0 | L | UG/L | 013GW0030006 | 6/33 | 1 - 25 | 70 | N/A | 1.07 | C | N/A | N/A | YES | ASL |
| 108-88-3 | Toluene | 0.160 | J | 2,487 | J | UG/L | 046GW1320005 | 2/33 | 1 - 25 | 2487 | N/A | 74.7 | N | N/A | N/A | YES | ASL |
| 79-01-6 | Trichloroethene | 0.500 | J | 1,200 | L | UG/L | 004GW2000005 | 28/33 | 1 - 25 | 1200 | N/A | 1.55 | C | N/A | N/A | YES | ASL |
| 75-01-4 | Vinyl chloride | 0.600 | J | 49.8 | | UG/L | 004GW1050005 | 8/33 | 1 - 25 | 49.8 | N/A | 0.0150 | C | N/A | N/A | YES | ASL |
| 1330-20-7 | Xylene, total | 2.20 | | 610 | J | UG/L | 046GW1320005 | 2/33 | 1 - 25 | 610 | N/A | 1,217 | N | N/A | N/A | NO | BSL |
| 156-59-2 | cis-1,2-Dichloroethene | 0.120 | J | 208 | L | UG/L | 013GW0020006 | 19/33 | 1 - 25 | 208 | N/A | 6.08 | N | N/A | N/A | YES | ASL |
| 156-60-5 | trans-1,2-Dichloroethene | 0.200 | J | 78.0 | L | UG/L | 013GW0020005 | 9/33 | 1 - 25 | 78 | N/A | 12.2 | N | N/A | N/A | YES | ASL |
| 91-57-6 | 2-Methylnaphthalene | 3.00 | J | 3.00 | J | UG/L | 4GW1030004 | 1/3 | N/A | 3 | N/A | 12.2 | N | N/A | N/A | NO | BSL |
| 83-32-9 | Acenaphthene | 2.60 | J | 2.60 | J | UG/L | 4GW110004 | 1/3 | N/A | 2.6 | N/A | 36.5 | N | N/A | N/A | NO | BSL |
| 91-20-3 | Naphthalene | 2.10 | J | 2.10 | J | UG/L | 4GW1030004 | 1/3 | N/A | 2.1 | N/A | 0.651 | N | N/A | N/A | YES | ASL |
| 108-95-2 | Phenol | 0.590 | J | 0.590 | J | UG/L | 4GW1030004 | 1/3 | N/A | 0.59 | N/A | 2,190 | N | N/A | N/A | NO | BSL |
| 117-81-7 | bis(2-Ethylhexyl)phthalate | 4.80 | J | 4.80 | J | UG/L | 9GW1010004 | 1/3 | N/A | 4.8 | N/A | 4.76 | C | N/A | N/A | YES | ASL |

Table 2-29

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN in COASTAL PLAIN and SAPROLITE GROUNDWATER THROUGHOUT OPERABLE UNIT 1

ROD for Site 4, NSWC White Oak

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Shallow Aquifer - Tap Water

| CAS Number | Chemical | Minimum [1] Concentration | Minimum Qualifier | Maximum [1] Concentration | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits | Concentration [2] Used for Screening | Background [3] Value | Screening [4] Toxicity Value | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for [5] Contaminant Deletion or Selection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 118-96-7 | 2,4,6-Trinitrotoluene | 0.400 | J | 263 | | UG/L | 007GW1040005 | 5/33 | 1.2 - 11.7 | 262.8 | N/A | 1.80 N | N/A | N/A | YES | ASL |
| 35572-78-2 | 2-Amino-4,6-dinitrotoluene | 1.10 | J | 89.0 | | UG/L | 007GW1040005 | 2/33 | 1.2 - 11.7 | 89 | N/A | 0.22 N | N/A | N/A | YES | ASL |
| 88-72-2 | 2-Nitrotoluene | 1.50 | J | 1.50 | J | UG/L | 046GW2190005 | 1/33 | 2.6 - 26 | 1.5 | N/A | 6.08 N | N/A | N/A | NO | BSL |
| 99-08-1 | 3-Nitrotoluene | 1.50 | J | 1.50 | J | UG/L | 046GW1280005 | 1/33 | 2.6 - 26 | 1.5 | N/A | 12.2 N | N/A | N/A | NO | BSL |
| 19406-51-0 | 4-Amino-2,6-dinitrotoluene | 0.400 | J | 101 | | UG/L | 007GW1040005 | 3/33 | 1.2 - 11.7 | 100.8 | N/A | 0.22 N | N/A | N/A | YES | ASL |
| 7790-98-9 | Perchlorate | 7.00 | | 201 | | UG/L | 009GW0010005 | 6/33 | 5 - 5 | 201 | N/A | 1.8 N | N/A | N/A | YES | ASL |
| 2691-41-0 | HMX | 0.600 | J | 149 | | UG/L | 007GW1040005 | 12/33 | 2.6 - 26 | 148.9 | N/A | 183 N | N/A | N/A | NO | BSL |
| 121-82-4 | RDX | 0.400 | J | 472 | | UG/L | 007GW1040005 | 13/33 | 2.6 - 26 | 472.2 | N/A | 0.609 C | N/A | N/A | YES | ASL |
| 7429-90-5 | Aluminum | 334 | | 1,270 | | UG/L | 046GWA40006 | 2/27 | 31.7 - 35.7 | 1270 | N/A | 3,650 N | N/A | N/A | NO | BSL |
| 7440-38-2 | Arsenic | 4.80 | | 4.80 | | UG/L | 046GW1320005 | 1/27 | 2.8 - 4.1 | 4.8 | N/A | 0.0446 C | N/A | N/A | YES | ASL |
| 7440-39-3 | Barium | 10.1 | J | 501 | | UG/L | 046GWA20006 | 26/27 | 0.2 - 0.5 | 501 | N/A | 256 N | N/A | N/A | YES | ASL |
| 7440-41-7 | Beryllium | 0.110 | J | 0.390 | L | UG/L | 013GW0020005 | 6/27 | 0.1 - 0.1 | 0.39 | N/A | 7.30 N | N/A | N/A | NO | BSL |
| 7440-43-9 | Cadmium | 0.400 | J | 5.10 | | UG/L | 046GWA30006 | 9/27 | 0.3 - 0.4 | 5.1 | N/A | 1.83 N | N/A | N/A | YES | ASL |
| 7440-70-2 | Calcium | 1,820 | | 98,900 | | UG/L | 046GWA20006 | 26/27 | 27.8 - 46 | 98900 | N/A | N/A | N/A | N/A | NO | NUT |
| 7440-47-3 | Chromium | 1.000 | J | 26.0 | | UG/L | 046GWA40006 | 9/27 | 0.5 - 0.8 | 26 | N/A | 11.0 N | N/A | N/A | YES | ASL |
| 7440-48-4 | Cobalt | 0.760 | J | 83.8 | | UG/L | 004GW2020006 | 20/27 | 0.6 - 1 | 83.8 | N/A | 73 N | N/A | N/A | YES | ASL |
| 7440-50-8 | Copper | 16.7 | J | 66.5 | | UG/L | 046GWA30006 | 3/27 | 0.9 - 1 | 66.5 | N/A | 146 N | N/A | N/A | NO | BSL |
| 7439-89-6 | Iron | 279 | | 29,700 | | UG/L | 004GW1050005 | 14/27 | 18.6 - 23.9 | 29700 | N/A | 2,200 N | N/A | N/A | YES | ASL |
| 7439-92-1 | Lead | 1.40 | L | 22.4 | | UG/L | 046GW1210006 | 9/27 | 1.2 - 1.3 | 22.4 | N/A | 15.0 | N/A | N/A | YES | ASL |
| 7439-95-4 | Magnesium | 1,400 | J | 72,500 | | UG/L | 046GWA20006 | 27/27 | 20.1 - 53 | 72500 | N/A | N/A | N/A | N/A | NO | NUT |
| 7439-96-5 | Manganese | 26.7 | | 5,030 | | UG/L | 004GW2010005 | 26/27 | 0.2 - 1 | 5030 | N/A | 73.0 N | N/A | N/A | YES | ASL |
| 7439-97-6 | Mercury | 0.300 | | 0.900 | | UG/L | 004GW2020006 | 3/27 | 0.1 - 0.1 | 0.9 | N/A | 1.10 N | N/A | N/A | NO | BSL |
| 7440-02-0 | Nickel | 4.80 | J | 95.8 | | UG/L | 013GW0020005 | 17/27 | 1 - 1.1 | 95.8 | N/A | 73.0 N | N/A | N/A | YES | ASL |
| 7440-09-7 | Potassium | 1,020 | J | 18,400 | | UG/L | 046GW1210006 | 27/27 | 9.1 - 18.6 | 18400 | N/A | N/A | N/A | N/A | NO | NUT |
| 7782-49-2 | Selenium | 5.30 | | 5.30 | | UG/L | 013GW0030006 | 1/27 | 2.2 - 2.3 | 5.3 | N/A | 18.3 N | N/A | N/A | NO | BSL |
| 7440-22-4 | Silver | 1.10 | J | 3.10 | J | UG/L | 004GW2010005 | 3/27 | 0.9 - 1.2 | 3.1 | N/A | 18.3 N | N/A | N/A | NO | BSL |
| 7440-23-5 | Sodium | 6,540 | | 416,000 | | UG/L | 046GW2190005 | 27/27 | 204 - 299 | 416000 | N/A | N/A | N/A | N/A | NO | NUT |
| 7440-28-0 | Thallium | 3.40 | J | 4.60 | J | UG/L | 013GW2000005 | 2/27 | 3.1 - 3.3 | 4.6 | N/A | 0.256 N | N/A | N/A | YES | ASL |
| 7440-62-2 | Vanadium | 4.00 | J | 8.60 | J | UG/L | 046GWC13005 | 2/27 | 0.5 - 1.3 | 8.6 | N/A | 25.6 N | N/A | N/A | NO | BSL |
| 7440-66-6 | Zinc | 15.8 | J | 188 | | UG/L | 013GW0020006 | 8/27 | 1.2 - 1.9 | 188 | N/A | 1,095 N | N/A | N/A | NO | BSL |

Dissolved inorganic data for groundwater used because residents would be exposed to the groundwater that has been filtered.

[1] Minimum/Maximum detected concentration.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, September 25, 2001, U.S. EPA Region III, Jennifer Hubbard.
Tap Water RBC (Cancer benchmark value = 1E-06, adjusted HQ=0.1).

SQL = Sample Quantification Limit

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered

J = Estimated Value

K = Biased High

Table 2-29

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN in COASTAL PLAIN and SAPROLITE GROUNDWATER THROUGHOUT OPERABLE UNIT 1

ROD for Site 4, NSWC White Oak

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Shallow Aquifer - Tap Water

| CAS Number | Chemical | Minimum [1] Concentration | Minimum Qualifier | Maximum [1] Concentration | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits | Concentration [2] Used for Screening | Background [3] Value | Screening [4] Toxicity Value | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for [5] Contaminant Deletion or Selection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

RBC value for Chromium VI used for total chromium

RBC value for aminodinitrotoluenes used as surrogate for 2-Amino-4,6-dinitrotoluene, and 4-Amino-4,6-dinitrotoluene.

RBC value for perchlorate calculated based on the RfD of 0.0005 mg/kg-day, Interim Assessment Guidance for Perchlorate, June 1999, developed by ORD's NCEA.

RBC value for mercuric chloride used as surrogate for mercury.

The groundwater action level for lead of 15 ug/l used as the screening value for the COPC selection.

Chloroform screening value is calculated based on a noncarcinogenic hazard of 0.1. The noncarcinogenic screening level at HQ=0.1 is more conservative than the carcinogenic value provided in the Region III RBC table.

L = Biased Low

C = Carcinogenic

N = Noncarcinogenic

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

Table 2-30

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY in COASTAL PLAIN and SAPROLITE GROUNDWATER THROUGHOUT OPERABLE UNIT 1

ROD for Site 4, NSWC White Oak

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Shallow Aquifer - Tap Water

| Chemical of Potential Concern | Units | Arithmetic Mean | 95% UCL of Normal Data | Maximum Detected Concentration | Maximum Qualifier | EPC Units | Reasonable Maximum Exposure | | | Central Tendency | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Medium EPC Value | Medium EPC Statistic | Medium EPC Rationale | Medium EPC Value | Medium EPC Statistic | Medium EPC Rationale |
| 1,1,2,2-Tetrachloroethane | UG/L | 62.9 | 124 | 993.5 | L | UG/L | 1.75E+02 | 95% UCL-T | W-Test-(4) | 6.29E+01 | Mean | (5) |
| 1,1,2-Trichloroethane | UG/L | 1.46 | 2.26 | 8.5 | | UG/L | 2.26E+00 | 95% UCL-N | W-Test-(4) | 1.46E+00 | Mean | (5) |
| 1,1-Dichloroethene | UG/L | 0.985 | 1.61 | 3.3 | | UG/L | 1.61E+00 | 95% UCL-N | W-Test-(4) | 9.85E-01 | Mean | (5) |
| 1,2-Dibromoethane | UG/L | 1.47 | 2.66 | 20.6 | | UG/L | 2.66E+00 | 95% UCL-N | W-Test-(4) | 1.47E+00 | Mean | (5) |
| 1,2-Dichloroethane | UG/L | 9.74 | 24.3 | 285 | J | UG/L | 2.43E+01 | 95% UCL-N | W-Test-(4) | 9.74E+00 | Mean | (5) |
| 1,2-Dichloropropane | UG/L | 0.945 | 1.57 | 3.2 | | UG/L | 1.57E+00 | 95% UCL-N | W-Test-(4) | 9.45E-01 | Mean | (5) |
| 1,4-Dichlorobenzene | UG/L | 0.982 | 1.61 | 3.2 | K | UG/L | 1.61E+00 | 95% UCL-N | W-Test-(4) | 9.82E-01 | Mean | (5) |
| Benzene | UG/L | 52.7 | 140 | 1708 | J | UG/L | 1.40E+02 | 95% UCL-N | W-Test-(4) | 5.27E+01 | Mean | (5) |
| Bromodichloromethane | UG/L | 0.930 | 1.55 | 2.1 | | UG/L | 1.55E+00 | 95% UCL-N | W-Test-(4) | 9.30E-01 | Mean | (5) |
| Carbon tetrachloride | UG/L | 0.857 | 1.48 | 0.6 | J | UG/L | 6.00E-01 | Max | W-Test-(4,2) | 6.00E-01 | Max | (2) |
| Chlorobenzene | UG/L | 1.93 | 3.29 | 18.6 | K | UG/L | 3.29E+00 | 95% UCL-N | W-Test-(4) | 1.93E+00 | Mean | (5) |
| Chloroform | UG/L | 1.28 | 2.01 | 6.3 | J | UG/L | 2.01E+00 | 95% UCL-N | W-Test-(4) | 1.28E+00 | Mean | (5) |
| Tetrachloroethene | UG/L | 5.28 | 9.88 | 70 | L | UG/L | 9.88E+00 | 95% UCL-N | W-Test-(4) | 5.28E+00 | Mean | (5) |
| Toluene | UG/L | 76.2 | 204 | 2487 | J | UG/L | 2.04E+02 | 95% UCL-N | W-Test-(4) | 7.62E+01 | Mean | (5) |
| Trichloroethene | UG/L | 135 | 221 | 1200 | L | UG/L | 1.20E+03 | Max | W-Test-(4,2) | 1.35E+02 | Mean | (5) |
| Vinyl chloride | UG/L | 2.60 | 5.19 | 49.8 | | UG/L | 5.19E+00 | 95% UCL-N | W-Test-(4) | 2.60E+00 | Mean | (5) |
| cis-1,2-Dichloroethene | UG/L | 26.0 | 42.6 | 208 | L | UG/L | 1.98E+02 | 95% UCL-T | W-Test-(4) | 2.60E+01 | Mean | (5) |
| trans-1,2-Dichloroethene | UG/L | 5.30 | 10.2 | 78 | L | UG/L | 1.02E+01 | 95% UCL-N | W-Test-(4) | 5.30E+00 | Mean | (5) |
| Naphthalene | UG/L | 2.37 | 2.76 | 2.1 | J | UG/L | 2.10E+00 | Max | W-Test-(4,2) | 2.10E+00 | Max | (2) |
| bis(2-Ethylhexyl)phthalate | UG/L | 3.27 | 5.51 | 4.8 | J | UG/L | 4.80E+00 | Max | W-Test-(4,2) | 3.27E+00 | Mean | (5) |
| 2,4,6-Trinitrotoluene | UG/L | 8.82 | 22.3 | 262.8 | | UG/L | 2.23E+01 | 95% UCL-N | W-Test-(4) | 8.82E+00 | Mean | (5) |
| 2-Amino-4,6-dinitrotoluene | UG/L | 3.25 | 7.79 | 89 | | UG/L | 7.79E+00 | 95% UCL-N | W-Test-(4) | 3.25E+00 | Mean | (5) |
| 4-Amino-2,6-dinitrotoluene | UG/L | 3.59 | 8.74 | 100.8 | | UG/L | 8.74E+00 | 95% UCL-N | W-Test-(4) | 3.59E+00 | Mean | (5) |
| Perchlorate | UG/L | 10.8 | 21.1 | 201 | | UG/L | 2.11E+01 | 95% UCL-N | W-Test-(4) | 1.08E+01 | Mean | (5) |
| RDX | UG/L | 20.1 | 44.8 | 472.2 | | UG/L | 4.48E+01 | 95% UCL-N | W-Test-(4) | 2.01E+01 | Mean | (5) |
| Arsenic | UG/L | 1.84 | 2.06 | 4.8 | | UG/L | 2.06E+00 | 95% UCL-N | W-Test-(4) | 1.84E+00 | Mean | (5) |
| Barium | UG/L | 92.83 | 132.94 | 501 | | UG/L | 1.44E+02 | 95% UCL-T | W-Test-(1) | 9.28E+01 | Mean | (5) |
| Cadmium | UG/L | 0.77 | 1.17 | 5.1 | | UG/L | 1.17E+00 | 95% UCL-N | W-Test-(4) | 7.66E-01 | Mean | (5) |

Table 2-30

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY in COASTAL PLAIN and SAPROLITE GROUNDWATER THROUGHOUT OPERABLE UNIT 1

ROD for Site 4, NSWC White Oak

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Shallow Aquifer - Tap Water

| Chemical of Potential Concern | Units | Arithmetic Mean | 95% UCL of Normal Data | Maximum Detected Concentration | Maximum Qualifier | EPC Units | Reasonable Maximum Exposure | | | Central Tendency | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Medium EPC Value | Medium EPC Statistic | Medium EPC Rationale | Medium EPC Value | Medium EPC Statistic | Medium EPC Rationale |
| Chromium | UG/L | 2.03 | 3.64 | 26 | | UG/L | 3.64E+00 | 95% UCL-N | W-Test-(4) | 2.03E+00 | Mean | (5) |
| Cobalt | UG/L | 1.31 | 17.20 | 83.8 | | UG/L | 2.81E+01 | 95% UCL-T | W-Test-(1) | 1.31E+00 | Mean | (5) |
| Iron | UG/L | 4287.97 | 6898.16 | 29700 | | UG/L | 2.97E+04 | Max | W-Test-(4,2) | 4.29E+03 | Mean | (5) |
| Lead | UG/L | 2.09 | 3.49 | 22.4 | | UG/L | 3.49E+00 | 95% UCL-N | W-Test-(4) | 2.09E+00 | Mean | (5) |
| Manganese | UG/L | 827.04 | 1265.33 | 5030 | | UG/L | 4.45E+03 | 95% UCL-T | W-Test-(1) | 8.27E+02 | Mean | (5) |
| Nickel | UG/L | 23.02 | 32.47 | 95.8 | | UG/L | 7.53E+01 | 95% UCL-T | W-Test-(1) | 2.30E+01 | Mean | (5) |
| Thallium | UG/L | 1.82 | 2.04 | 4.6 | J | UG/L | 2.04E+00 | 95% UCL-N | W-Test-(4) | 1.82E+00 | Mean | (5) |

Full statistics for data included in Appendix M.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

W - Test: Developed by Shapiro and Wilk, refer to Supplemental Guidance to RAGS: Calculating the Concentration Term, OSWER Directive 9285.7-081, May 1992.

Options: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T);
Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

(2) 95% UCL (or mean) exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(3) Shapiro-Wilks W Test indicates data are normally distributed.

(4) Shapiro-Wilks W Test inconclusive. Higher of normal or log-transformed value used for EPC.

(5) Normal mean value used.

TABLE 2-

NON-CANCER TOXICITY DATA -- ORAL/DERMAL (FOR ALL OU-1 COPCs)

Site 4 ROD, NSWC White Oak

| Chemical of Potential Concern | Chronic/ Subchronic | Oral RfD Value | Oral RfD Units | Oral to Dermal Adjustment Factor (1) | Adjusted Dermal RfD (2) | Units | Primary Target Organ | Combined Uncertainty/Modifying Factors | Sources of RfD: Target Organ | Dates of RfD: Target Organ (3) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | Chronic | 1.0E+00 | mg/kg-day | 27% | 2.7E-01 | mg/kg-day | CNS | 100 | NCEA | 08/26/1996 |
| | Subchronic | N/A | | | | | | | | |
| Arsenic | Chronic | 3.0E-04 | mg/kg-day | 95% | 2.9E-04 | mg/kg-day | Skin | 3 | IRIS | 06/17/1998 |
| | Subchronic | 3.0E-04 | mg/kg-day | 95% | 2.9E-04 | mg/kg-day | Skin | 3 | HEAST | 07/08/1998 |
| Barium | Chronic | 7.0E-02 | mg/kg-day | 100% | 7.0E-02 | mg/kg-day | Cardiovascular | 3 | IRIS | 06/17/1998 |
| | Subchronic | 7.0E-02 | mg/kg-day | 100% | 7.0E-02 | mg/kg-day | Cardiovascular | 3 | HEAST | 07/08/1998 |
| Beryllium | Chronic | 2.0E-03 | mg/kg-day | 1% | 2.0E-05 | mg/kg-day | GI | 100 | IRIS | 06/17/1998 |
| | Subchronic | 5.0E-03 | mg/kg-day | 1% | 5.0E-05 | mg/kg-day | GI | 100 | HEAST | 07/08/1998 |
| Cadmium (Food) | Chronic | 1.0E-03 | mg/kg-day | 2.5% | 2.5E-05 | mg/kg-day | Kidney | 10 | IRIS | 06/17/1998 |
| | Subchronic | N/A | | | | | | | | |
| Cadmium (Water) | Chronic | 5.0E-04 | mg/kg-day | 5% | 2.5E-05 | mg/kg-day | Kidney | 10 | IRIS | 06/17/1998 |
| | Subchronic | N/A | | | | | | | | |
| Chromium (hexavalent) | Chronic | 3.0E-03 | mg/kg-day | 1% | 3.0E-05 | mg/kg-day | NOAEL | 500 | IRIS | 06/17/1998 |
| | Subchronic | 2.0E-02 | mg/kg-day | 1% | 2.0E-04 | mg/kg-day | NOAEL | 100 | HEAST | 07/08/1998 |
| Cobalt | Chronic | 2.0E-02 | mg/kg-day | 30% | 6.0E-03 | mg/kg-day | Sensitizer | N/A | NCEA | 05/24/2001 |
| | Subchronic | N/A | | | | | | | | |
| Copper | Chronic | 4.0E-02 | mg/kg-day | 60% | 2.4E-02 | mg/kg-day | Gastrointestinal | N/A | HEAST | 07/08/1998 |
| | Subchronic | 4.0E-02 | mg/kg-day | 60% | 2.4E-02 | mg/kg-day | Gastrointestinal | N/A | HEAST | 07/08/1998 |
| Cyanide | Chronic | 2.0E-02 | mg/kg-day | 20% | 4.0E-03 | mg/kg-day | Whole body | 100 | IRIS | 06/17/1998 |
| | Subchronic | 2.0E-02 | mg/kg-day | 20% | 4.0E-03 | mg/kg-day | Whole body | 500 | HEAST | 07/08/1998 |
| Iron | Chronic | 6.0E-01 | mg/kg-day | 20% | 1.2E-01 | mg/kg-day | Gastrointestinal | 1 | NCEA | 07/23/1996 |
| | Subchronic | N/A | | | | | | | | |
| Manganese (nonfood) | Chronic | 2.0E-02 | mg/kg-day | 5% | 1.0E-03 | mg/kg-day | CNS | 1 | IRIS | 06/17/1998 |
| | Subchronic | N/A | | | | | | | | |
| Mercury | Chronic | NA | | | | | | | | |
| | Subchronic | NA | | | | | | | | |
| Mercury (mercuric chloride) | Chronic | 3.0E-04 | mg/kg-day | 15% | 4.5E-05 | mg/kg-day | Nervous System | 100 | IRIS | 06/17/1998 |
| | Subchronic | NA | mg/kg-day | | | mg/kg-day | | | | |

TABLE 2-31

NON-CANCER TOXICITY DATA -- ORAL/DERMAL (FOR ALL OU-1 COPCs)

Site 4 ROD, NSWC White Oak

| Chemical of Potential Concern | Chronic/ Subchronic | Oral RfD Value | Oral RfD Units | Oral to Dermal Adjustment Factor (1) | Adjusted Dermal RfD (2) | Units | Primary Target Organ | Combined Uncertainty/Modifying Factors | Sources of RfD: Target Organ | Dates of RfD: Target Organ (3) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|---|---|
| Nickel | Chronic | 2.0E-02 | mg/kg-day | 10% | 2.0E-03 | mg/kg-day | Whole body | 300 | IRIS | 06/22/1998 |
| | Subchronic | 2.0E-02 | mg/kg-day | 10% | 2.0E-03 | mg/kg-day | Whole body | 300 | HEAST | 07/08/1998 |
| Selenium | Chronic | 5.0E-03 | mg/kg-day | 90% | 4.5E-03 | mg/kg-day | Whole body | 3 | IRIS | 06/22/1998 |
| | Subchronic | 5.0E-03 | mg/kg-day | 90% | 4.5E-03 | mg/kg-day | Whole body | 3 | HEAST | 07/08/1998 |
| Silver | Chronic | 5.0E-03 | mg/kg-day | NA | | | Skin | 3 | IRIS | 06/22/1998 |
| | Subchronic | 5.0E-03 | mg/kg-day | NA | | | Skin | 3 | HEAST | 07/08/1998 |
| Thallium | Chronic | 7.0E-05 | mg/kg-day | 100% | 7.0E-05 | mg/kg-day | Liver & Blood | | O | |
| | Subchronic | N/A | | | | | | | | |
| Vanadium | Chronic | 7.0E-03 | mg/kg-day | 2% | 1.4E-04 | mg/kg-day | NOAEL | 100 | HEAST | 07/08/1998 |
| | Subchronic | 7.0E-03 | mg/kg-day | 2% | 1.4E-04 | mg/kg-day | NOAEL | 100 | HEAST | 07/08/1998 |
| Zinc | Chronic | 3.0E-01 | mg/kg-day | 25% | 7.5E-02 | mg/kg-day | Blood | 3 | IRIS | 06/22/1998 |
| | Subchronic | 3.0E-01 | mg/kg-day | 25% | 7.5E-02 | mg/kg-day | Blood | 3 | HEAST | 07/08/1998 |
| Benzo(a)anthracene | Chronic | N/A | | | | | | | | |
| | Subchronic | N/A | | | | | | | | |
| Benzo(a)pyrene | Chronic | N/A | | | | | | | | |
| | Subchronic | N/A | | | | | | | | |
| Benzo(b)fluoranthene | Chronic | N/A | | | | | | | | |
| | Subchronic | N/A | | | | | | | | |
| bis(2-Ethylhexyl)phthalate) | Chronic | 2.0E-02 | mg/kg-day | 55% | 1.1E-02 | mg/kg-day | Liver | 1000 | IRIS | 07/09/1998 |
| | Subchronic | 2.0E-02 | mg/kg-day | 55% | 1.1E-02 | mg/kg-day | Reproductive | 3000 | NCEA | 03/28/95 |
| Carbazole | Chronic | N/A | | | | | | | | |
| | Subchronic | N/A | | | | | | | | |
| Carbazole | Chronic | N/A | | | | | | | | |
| | Subchronic | N/A | | | | | | | | |
| Dibenz(a,h)anthracene | Chronic | N/A | | | | | | | | |
| | Subchronic | N/A | | | | | | | | |
| Naphthalene | Chronic | 2.0E-02 | mg/kg-day | 80% | 1.6E-02 | mg/kg-day | Body Weight | 3000/1 | IRIS | 09/22/2000 |
| | Subchronic | N/A | | | | | | | | |
| 2,4,6-Trinitrotoluene | Chronic | 5.0E-04 | mg/kg-day | 60% | 3.0E-04 | mg/kg-day | Liver | 1000/1 | IRIS | 08/30/2000 |
| | Subchronic | 5.0E-04 | mg/kg-day | 60% | 3.0E-04 | mg/kg-day | Liver | 1000/1 | IRIS | 08/30/2000 |

TABLE 2-3

NON-CANCER TOXICITY DATA - ORAL/DERMAL (FOR ALL OU-1 COPCs)

Site 4 ROD, NSWC White Oak

| Chemical of Potential Concern | Chronic/ Subchronic | Oral RfD Value | Oral RfD Units | Oral to Dermal Adjustment Factor (1) | Adjusted Dermal RfD (2) | Units | Primary Target Organ | Combined Uncertainty/Modifying Factors | Sources of RfD: Target Organ | Dates of RfD: Target Organ (3) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2,4-Dinitrotoluene | Chronic | 2.0E-03 | mg/kg-day | 85% | 1.7E-03 | mg/kg-day | Nervous System | 100/1 | IRIS | 08/22/2000 |
| | Subchronic | 2.0E-03 | mg/kg-day | 85% | 1.7E-03 | mg/kg-day | Nervous System | 100/1 | HEAST | 08/22/2000 |
| Aminodinitrotoluenes | Chronic | 6.0E-05 | mg/kg-day | 80% | 4.8E-05 | mg/kg-day | | | NCEA | 08/30/2000 |
| | Subchronic | N/A | | | | | | | | |
| Perchlorates | Chronic | 5.0E-04 | mg/kg-day | 80% | 4.0E-04 | mg/kg-day | | | NCEA | 08/30/2000 |
| | Subchronic | N/A | | | | | | | | |
| RDX | Chronic | 3.0E-03 | mg/kg-day | 80% | 2.4E-03 | mg/kg-day | Prostrate | 100/1 | IRIS | 08/22/2000 |
| | Subchronic | 3.0E-03 | mg/kg-day | 80% | 2.4E-03 | mg/kg-day | Prostrate | 100/1 | HEAST | 08/22/2000 |
| 1,1,2, 2-Tetrachloroethane | Chronic | 6.0E-02 | mg/kg-day | 80% | 4.8E-02 | mg/kg-day | Liver and Kidney | | NCEA | 03/30/2000 |
| | Subchronic | N/A | | | | | | | | |
| 1,1,2-Trichloroethane | Chronic | 4.0E-03 | mg/kg-day | 80% | 3.2E-03 | mg/kg-day | Blood | 1000 | IRIS | 07/02/1998 |
| | Subchronic | 4.0E-02 | mg/kg-day | 80% | 3.2E-02 | mg/kg-day | Blood | 100 | HEAST | 07/08/1998 |
| 1,2-Dibromoethane | Chronic | N/A | | | | | | | | |
| | Subchronic | N/A | | | | | | | | |
| 1,3-Dichlorobenzene | Chronic | 3.0E-02 | mg/kg-day | 80% | 2.4E-02 | mg/kg-day | Liver | 1000 | E | 03/07/1996 |
| | Subchronic | N/A | | | | | | | | |
| 1,4-Dichlorobenzene | Chronic | 3.0E-02 | mg/kg-day | 80% | 2.4E-02 | mg/kg-day | Liver | 1000 | E | 04/29/1997 |
| | Subchronic | N/A | | | | | | | | |
| 1,1-Dichloroethene | Chronic | 9.0E-03 | mg/kg-day | 80% | 7.2E-03 | mg/kg-day | Liver | 1000 | IRIS | 07/02/1998 |
| | Subchronic | 9.0E-03 | mg/kg-day | 80% | 7.2E-03 | mg/kg-day | Liver | 1000 | HEAST | 07/08/1998 |
| 1,2-Dichloroethane | Chronic | 3.0E-02 | mg/kg-day | 80% | 2.4E-02 | mg/kg-day | Liver | 1000 | NCEA | 04/05/1993 |
| | Subchronic | N/A | | | | | | | | |
| cis-1,2-Dichloroethene | Chronic | 1.0E-02 | mg/kg-day | 100% | 1.0E-02 | mg/kg-day | Blood | 3000 | HEAST | 07/08/1998 |
| | Subchronic | 1.0E-01 | mg/kg-day | 100% | 1.0E-01 | mg/kg-day | Blood | 300 | HEAST | 07/08/1998 |
| trans-1,2-Dichloroethene | Chronic | 2.0E-02 | mg/kg-day | 100% | 2.0E-02 | mg/kg-day | Blood | 1000 | IRIS | 02/28/2000 |
| | Subchronic | 2.0E-01 | mg/kg-day | 100% | 2.0E-01 | mg/kg-day | Blood | 100 | HEAST | 02/28/2000 |
| 1,2-Dichloropropane | Chronic | N/A | | | | | | | | |
| | Subchronic | N/A | | | | | | | | |

TABLE 2-31

NON-CANCER TOXICITY DATA -- ORAL/DERMAL (FOR ALL OU-1 COPCs)

Site 4 ROD, NSWC White Oak

| Chemical of Potential Concern | Chronic/ Subchronic | Oral RfD Value | Oral RfD Units | Oral to Dermal Adjustment Factor (1) | Adjusted Dermal RfD (2) | Units | Primary Target Organ | Combined Uncertainty/Modifying Factors | Sources of RfD: Target Organ | Dates of RfD: Target Organ (3) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|---|---|
| Benzene | Chronic | 3.0E-03 | mg/kg-day | 100% | 3.0E-03 | mg/kg-day | Liver | 3000 | NCEA | 07/02/1996 |
| | Subchronic | 3.0E-03 | mg/kg-day | 100% | 3.0E-03 | mg/kg-day | Liver | 3000 | NCEA | 07/02/1996 |
| Bromodichloromethane | Chronic | 2.0E-02 | mg/kg-day | 80% | 1.6E-02 | mg/kg-day | Kidney | 1000 | IRIS | 01/00 |
| | Subchronic | 2.0E-02 | mg/kg-day | 80% | 1.6E-02 | mg/kg-day | Kidney | 1000 | HEAST | 07/97 |
| Carbon tetrachloride | Chronic | 7.0E-04 | mg/kg-day | 80% | 5.6E-04 | mg/kg-day | Liver | 1000 | IRIS | 02/28/2000 |
| | Subchronic | N/A | | | | | | | | |
| Chlorobenzene | Chronic | 2.0E-02 | mg/kg-day | 80% | 1.6E-02 | mg/kg-day | Liver | 1000 | IRIS | 07/02/1998 |
| | Subchronic | N/A | | | | | | | | |
| Chloroform | Chronic | 1.0E-02 | mg/kg-day | 100% | 1.0E-02 | mg/kg-day | Liver | 1000 | IRIS | 07/02/1998 |
| | Subchronic | 1.0E-02 | mg/kg-day | 100% | 1.0E-02 | mg/kg-day | Liver | 1000 | HEAST | 02/28/2000 |
| Tetrachloroethene | Chronic | 1.0E-02 | mg/kg-day | 100% | 1.0E-02 | mg/kg-day | Liver | 1000 | IRIS | 02/28/2000 |
| | Subchronic | 1.0E-01 | mg/kg-day | 100% | 1.0E-01 | mg/kg-day | Liver | 100 | HEAST | 02/28/2000 |
| Toluene | Chronic | 2.0E-01 | mg/kg-day | 100% | 2.0E-01 | mg/kg-day | Liver, Kidney | 1000 | IRIS | 02/28/2000 |
| | Subchronic | 2.0E+00 | mg/kg-day | 100% | 2.0E+00 | mg/kg-day | Liver, Kidney | 100 | HEAST | 02/28/2000 |
| Trichloroethene | Chronic | 6.0E-03 | mg/kg-day | 100% | 6.0E-03 | mg/kg-day | Liver, Kidney | | NCEA | |
| | Subchronic | N/A | | | | mg/kg-day | | | | |
| Vinyl chloride | Chronic | 3.0E-03 | mg/kg-day | 100% | 3.0E-03 | mg/kg-day | Liver | 30/1 | IRIS | 04/02/2001 |
| | Subchronic | N/A | | | | | | | | |

N/A = Not Applicable or Not Available. IRIS indicates that calculations of dermal risks may not be appropriate for this chemical.

(1) Refer to RAGS, Part A. Source is EPA Region III *Oral Absorption Values for Oral-to-Dermal Extrapolation*, April 8, 1999.

For constituents not available in the Region III document the following general values were used: VOCs - 80%, Pesticides/PCBs - 50%, dioxins/furans - 50%, and metals - 20%.

ATSDR = Agency for Toxic Substances and Disease Registry

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

(2) Provide equation for derivation in text.

(3) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

RESP = Respiratory System

CNS = Central Nervous System

NOAEL = No adverse effect level

TABLE 2-32

CANCER TOXICITY DATA -- ORAL/DERMAL (FOR ALL OU-1 COPCs)

ROD for Site 4, NSWC White Oak

| Chemical of Potential Concern | Oral Cancer Slope Factor | Oral to Dermal Adjustment Factor | Adjusted Dermal Cancer Slope Factor (1) | Units | EPA Carcinogen Group | Source | Date (2) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|
| Arsenic | 1.5E+00 | 95% | 1.6E+00 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 07/08/1998 |
| Benzo(a)anthracene | 7.3E-01 | NU | | $(mg/kg\text{-}day)^{-1}$ | B2 | E | 07/01/1993 |
| Benzo(a)pyrene | 7.3E+00 | NU | | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 07/08/1998 |
| Benzo(b)flucranthene | 7.3E-01 | NU | | $(mg/kg\text{-}day)^{-1}$ | B2 | E | 07/01/1993 |
| bis(2-Ethylhexyl)phthalate) | 1.4E-02 | 55% | 2.5E-02 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 07/08/1998 |
| Benzo(b)fluoranthene | 7.3E-01 | NU | | $(mg/kg\text{-}day)^{-1}$ | B2 | E | 07/01/1993 |
| Carbazole | 2.0E-02 | NU | | $(mg/kg\text{-}day)^{-1}$ | B2 | HEAST | 08/22/2000 |
| Dibenz(a,h)anthracene | 7.3E+00 | NU | | $(mg/kg\text{-}day)^{-1}$ | B2 | E | 07/01/1993 |
| Naphthalene | N/A | | | | | | |
| 2,4,6-Trinitrotoluene | 3.0E-02 | 60% | 5.0E-02 | $(mg/kg\text{-}day)^{-1}$ | C | IRIS | 08/30/2000 |
| 2,4-Dinitrotoluene | N/A | | | | | | |
| Aminodinitrotoluenes | N/A | | | | | | |
| Perchlorates | N/A | | | | | | |
| RDX | 1.1E-01 | 80% | 1.4E-01 | $(mg/kg\text{-}day)^{-1}$ | C | IRIS | 08/30/2000 |
| 1,1,2,2-Tetrachloroethane | 2.0E-01 | 80% | 2.5E-01 | $(mg/kg\text{-}day)^{-1}$ | C | IRIS | 02/01/1994 |
| 1,1,2-Trichloroethane | 5.7E-02 | 80% | 7.1E-02 | $(mg/kg\text{-}day)^{-1}$ | C | IRIS | 07/08/1998 |
| 1,1-Dichloroethene | 6.0E-01 | 80% | 7.5E-01 | $(mg/kg\text{-}day)^{-1}$ | C | IRIS | 07/08/1998 |
| 1,2-Dibromoethane | 8.5E+01 | 80% | 1.1E+02 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 08/30/2000 |
| 1,2-Dichloroethane | 9.1E-02 | 80% | 1.1E-01 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 07/08/1998 |
| cis-1,2-Dichloroethene | N/A | | | | | | |
| trans-1,2-Dichloroethene | N/A | | | | | | |
| 1,3-Dichlorobenzene | N/A | | | | | | |
| 1,4-Dichlorobenzene | 2.4E-02 | 80% | 3.0E-02 | $(mg/kg\text{-}day)^{-1}$ | C | HEAST | 07/08/1998 |
| 1,2-Dichloropropane | 6.8E-02 | 80% | 8.5E-02 | $(mg/kg\text{-}day)^{-1}$ | B2 | HEAST | 02/29/2000 |
| Benzene | 2.9E-02 | 100% | 2.9E-02 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 07/08/1998 |
| Bromodichloromethane | 6.2E-02 | 80% | 7.8E-02 | (mg/kg-day) | C | IRIS | 07/08/1998 |
| Carbon tetrachloride | 1.3E-01 | 80% | 1.6E-01 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 02/28/2000 |
| Chlorobenzene | N/A | | | | | | |
| Chloroform | 6.1E-03 | 100% | 6.1E-03 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 07/08/1998 |

TABLE 2-32

CANCER TOXICITY DATA -- ORAL/DERMAL (FOR ALL OU-1 COPCs)

ROD for Site 4, NSWC White Oak

| Chemical of Potential Concern | Oral Cancer Slope Factor | Oral to Dermal Adjustment Factor | Adjusted Dermal Cancer Slope Factor (1) | Units | EPA Carcinogen Group | Source | Date (2) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|
| Tetrachloroethene | 5.2E-02 | 100% | 5.2E-02 | $(mg/kg\text{-}day)^{-1}$ | | NCEA | |
| Toluene | N/A | | | | | | |
| Trichloroethene | 1.1E-02 | 100% | 1.1E-02 | $(mg/kg\text{-}day)^{-1}$ | | NCEA | |
| Vinyl chloride (lifetime from birth) | 1.4E+00 | 100% | 1.4E+00 | (mg/kg-day) | A | IRIS | 5/24/2001 |
| Vinyl chloride (lifetime from adult) | 7.2E-01 | 100% | 7.2E-01 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 5/24/2001 |

NU-Did not use the oral slope factor for dermal evaluation because the chemicals may act directly at the point of contact per Memorandum from Jennifer Hubbard, 12/19/96.

N/A-Not available

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

U = Under review.

EPA Carcinogen Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

(1) Refer to RAGS, Part A. Source is EPA Region III *Oral Absorption Values for Oral-to-Dermal Extrapolation* , April 8, 1999.

Dermal carcinogenicity should not be assessed for the carcinogenic PAHs, as these chemicals may act directly at the point of contact.

For constituents not available in the Region III document the following general values were used: VOCs - 80%, Pesticides/PCBs - 50%, dioxins/furans - 50%, and metals - 20%.

(2) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide article date provided by NCEA.

TABLE 2-33

Summary of Media-Specific Risks and Hazards For RME to OU-1 and Site 4 Groundwater

ROD for Site 4 Soil and Groundwater

NSWC White Oak

Media: Groundwater in Coastal Plain and Saprolite

| | Future Resident Adult | | | | | | | | Future Resident Child | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HQ | | | | CR | | | | HQ | | | | CR | | | |
| Chemical | Inh | Ing | Der | Total | Inh | Ing | Der | Total | Inh | Ing | Der | Total | Inh | Ing | Der | Total |
| 1,1,2,2-Tetrachloroethane | N/A | 0.08 | 0.01 | 0.09 | 3.7E-04 | -- | -- | 3.7E-04 | -- | 0.2 | 0.02 | 0.2 | -- | -- | -- | NA |
| 1,1,2-Trichloroethane | N/A | 0.02 | 0.002 | 0.02 | 1.9E-06 | -- | -- | 1.9E-06 | -- | 0.04 | 0.003 | 0.04 | -- | -- | -- | NA |
| 1,1-Dichloroethene | N/A | 0.005 | 0.0007 | 0.006 | 5.7E-06 | -- | -- | 5.7E-06 | -- | 0.01 | 0.002 | 0.01 | -- | -- | -- | NA |
| 1,2-Dibromoethane | 2 | N/A | N/A | 2 | 2.5E-05 | -- | -- | 2.5E-05 | -- | N/A | N/A | 0.0 | -- | -- | -- | NA |
| 1,2-Dichloroethane | 0.9 | 0.02 | 0.001 | 0.9 | 3.8E-05 | -- | -- | 3.8E-05 | -- | 0.05 | 0.002 | 0.05 | -- | -- | -- | NA |
| 1,2-Dichloropropane | 0.07 | N/A | N/A | 0.07 | N/A | -- | -- | NA | -- | N/A | N/A | NA | -- | -- | -- | NA |
| 1,4-Dichlorobenzene | 0.0003 | 0.001 | 0.001 | 0.003 | 5.7E-07 | -- | -- | 5.7E-07 | -- | 0.003 | 0.003 | 0.006 | -- | -- | -- | NA |
| Benzene | 5 | 1 | 0.2 | 7 | 8.7E-05 | -- | -- | 8.7E-05 | -- | 3 | 0.4 | 3 | -- | -- | -- | NA |
| Bromodichloromethane | N/A | 0.002 | 0.0002 | 0.002 | N/A | -- | -- | NA | -- | 0.005 | 0.0004 | 0.005 | -- | -- | -- | NA |
| Carbon tetrachloride | 0.05 | 0.02 | 0.01 | 0.08 | 5.4E-07 | -- | -- | 5.4E-07 | -- | 0.05 | 0.02 | 0.07 | -- | -- | -- | NA |
| Chlorobenzene | 0.01 | 0.005 | 0.002 | 0.02 | N/A | -- | -- | NA | -- | 0.01 | 0.004 | 0.01 | -- | -- | -- | NA |
| Chloroform | 1 | 0.01 | 0.0004 | 1 | 2.9E-06 | -- | -- | 2.9E-06 | -- | 0.01 | 0.001 | 0.01 | -- | -- | -- | NA |
| Tetrachloroethene | 0.00 | 0.03 | 0.02 | 0.05 | 3.2E-07 | -- | -- | 3.2E-07 | -- | 0.06 | 0.03 | 0.1 | -- | -- | -- | NA |
| Toluene | 0.1 | 0.03 | 0.01 | 0.1 | N/A | -- | -- | NA | -- | 0.07 | 0.02 | 0.1 | -- | -- | -- | NA |
| Trichloroethene | N/A | 5 | 0.8 | 6 | 1.3E-04 | -- | -- | 1.3E-04 | -- | 13 | 2 | 15 | -- | -- | -- | NA |
| Vinyl chloride | 0.01 | 0.05 | 0.002 | 0.06 | 1.8E-06 | -- | -- | 1.8E-06 | -- | 0.1 | 0.004 | 0.1 | -- | -- | -- | NA |
| cis-1,2-Dichloroethene | N/A | 0.5 | 0.04 | 0.6 | N/A | -- | -- | NA | -- | 1 | 0.09 | 1.4 | -- | -- | -- | NA |
| trans-1,2-Dichloroethene | N/A | 0.01 | 0.001 | 0.02 | N/A | -- | -- | NA | -- | 0.03 | 0.002 | 0.04 | -- | -- | -- | NA |
| Naphthalene | N/A | 0.003 | 0.002 | 0.005 | N/A | -- | -- | NA | -- | 0.01 | 0.01 | 0.01 | -- | -- | -- | NA |
| bis(2-Ethylhexyl)phthalate | N/A | 0.01 | 0.01 | 0.01 | N/A | -- | -- | NA | -- | 0.02 | 0.02 | 0.03 | -- | -- | -- | NA |
| 2,4,6-Trinitrotoluene | N/A | 1 | 0.04 | 1 | N/A | -- | -- | NA | -- | 3 | 0.09 | 3 | -- | -- | -- | NA |
| 2-Amino-4,6-dinitrotoluene | N/A | 4 | 0.1 | 4 | N/A | -- | -- | NA | -- | 8 | 0.3 | 9 | -- | -- | -- | NA |
| 4-Amino-2,6-dinitrotoluene | N/A | 4 | 0.2 | 4 | N/A | -- | -- | NA | -- | 9 | 0.4 | 10 | -- | -- | -- | NA |
| Perchlorate | N/A | 1 | N/A | 1 | N/A | -- | -- | NA | -- | 3 | N/A | 3 | -- | -- | -- | NA |
| RDX | N/A | 0.4 | 0.003 | 0.4 | N/A | -- | -- | NA | -- | 1 | 0.01 | 1 | -- | -- | -- | NA |
| Arsenic | N/A | 0.2 | 0.0004 | 0.2 | N/A | -- | -- | NA | -- | 0.4 | 0.001 | 0.4 | -- | -- | -- | NA |
| Barium | N/A | 0.06 | 0.0001 | 0.06 | N/A | -- | -- | NA | -- | 0.1 | 0.0003 | 0.1 | -- | -- | -- | NA |
| Cadmium | N/A | 0.06 | 0.003 | 0.07 | N/A | -- | -- | NA | -- | 0.1 | 0.01 | 0.2 | -- | -- | -- | NA |
| Chromium | N/A | 0.03 | 0.01 | 0.04 | N/A | -- | -- | NA | -- | 0.08 | 0.02 | 0.1 | -- | -- | -- | NA |
| Cobalt | N/A | 0.04 | 0.000 | 0.04 | N/A | -- | -- | NA | -- | 0.09 | 0.001 | 0.09 | -- | -- | -- | NA |
| Iron | N/A | 1 | 0.014 | 1 | N/A | -- | -- | NA | -- | 3 | 0.04 | 3 | -- | -- | -- | NA |
| Lead | N/A | N/A | N/A | 0.00 | N/A | -- | -- | NA | -- | N/A | N/A | 0.00 | -- | -- | -- | NA |
| Manganese | N/A | 6 | 0.244 | 6 | N/A | -- | -- | NA | -- | 14 | 0.7 | 15 | -- | -- | -- | NA |
| Nickel | N/A | 0.1 | 0.0002 | 0.1 | N/A | -- | -- | NA | -- | 0.2 | 0.001 | 0.2 | -- | -- | -- | NA |
| Thallium | N/A | 0.8 | 0.002 | 0.8 | N/A | -- | -- | NA | -- | 2 | 0.005 | 2 | -- | -- | -- | NA |
| OU-1 Totals | 9.1 | 26.6 | 1.7 | 37 | 6.6E-04 | N/A | N/A | 6.6E-04 | N/A | 62.2 | 4.0 | 66 | NA | NA | NA | NA |
| Site 4 Totals | 9 | 19.1 | 1.4 | 30 | 6.6E-04 | N/A | N/A | 6.6E-04 | N/A | 44.6 | 3.2 | 48 | NA | NA | NA | NA |

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Site 4 groundwater.

## TABLE 2-33
### Summary of Media-Specific Risks and Hazards For RME to OU-1 and Site 4 Groundwater

ROD for Site 4 Soil and Groundwater

NSWC White Oak

Media: Groundwater in Coastal Plain and Saprolite

| Chemical | Future Age-Adjusted Resident* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | HQ | | | | CR | | | |
| | Inh | Ing | Der | Total | Inh | Ing | Der | Total |
| 1,1,2,2-Tetrachloroethane | -- | -- | -- | NA | 3.7E-04 | 5.2E-04 | 6.8E-05 | 9.6E-04 |
| 1,1,2-Trichloroethane | -- | -- | -- | NA | 1.9E-06 | 1.9E-06 | 1.9E-07 | 4.0E-06 |
| 1,1-Dichloroethene | -- | -- | -- | NA | 5.7E-06 | 1.4E-05 | 2.0E-06 | 2.2E-05 |
| 1,2-Dibromoethane | -- | -- | -- | NA | 2.5E-05 | 3.4E-03 | 1.9E-04 | 3.6E-03 |
| 1,2-Dichloroethane | -- | -- | -- | NA | 3.8E-05 | 3.3E-05 | 1.6E-06 | 7.2E-05 |
| 1,2-Dichloropropane | -- | -- | -- | NA | N/A | 1.6E-06 | 1.6E-07 | 1.8E-06 |
| 1,4-Dichlorobenzene | -- | -- | -- | NA | 5.7E-07 | 5.8E-07 | 4.5E-07 | 1.6E-06 |
| Benzene | -- | -- | -- | NA | 8.7E-05 | 6.1E-05 | 7.9E-06 | 1.6E-04 |
| Bromodichloromethane | -- | -- | -- | NA | N/A | 1.4E-06 | 1.2E-07 | 1.6E-06 |
| Carbon tetrachloride | -- | -- | -- | NA | 5.4E-07 | 1.2E-06 | 3.4E-07 | 2.0E-06 |
| Chlorobenzene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Chloroform | -- | -- | -- | NA | 2.9E-06 | 1.8E-07 | 0.00 | 3.1E-06 |
| Tetrachloroethene | -- | -- | -- | NA | 3.2E-07 | 7.7E-06 | 4.2E-06 | 1.2E-05 |
| Toluene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Trichloroethene | -- | -- | -- | NA | 1.3E-04 | 2.0E-04 | 2.8E-05 | 3.5E-04 |
| Vinyl chloride | -- | -- | -- | NA | 1.8E-06 | 3.0E-04 | 1.2E-05 | 3.2E-04 |
| cis-1,2-Dichloroethene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| trans-1,2-Dichloroethene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Naphthalene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| bis(2-Ethylhexyl)phthalate | -- | -- | -- | NA | N/A | 1.0E-06 | 1.1E-06 | 2.1E-06 |
| 2,4,6-Trinitrotoluene | -- | -- | -- | NA | N/A | 1.0E-05 | 3.2E-07 | 1.0E-05 |
| 2-Amino-4,6-dinitrotoluene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| 4-Amino-2,6-dinitrotoluene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Perchlorate | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| RDX | -- | -- | -- | NA | N/A | 7.4E-05 | 5.5E-07 | 7.4E-05 |
| Arsenic | -- | -- | -- | NA | N/A | 4.6E-05 | 1.1E-07 | 4.6E-05 |
| Barium | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Cadmium | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Chromium | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Cobalt | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Iron | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Lead | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Manganese | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Nickel | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Thallium | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| OU-1 Totals | NA | NA | NA | NA | 6.6E-04 | 4.6E-03 | 3.1E-04 | 5.6E-03 |
| Site 4 Totals | NA | NA | NA | NA | 6.6E-04 | 4.5E-03 | 3.1E-04 | 5.5E-03 |

* - sum of cancer risks between residential adult and child. Inhalation based on adult while showering.

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Site 4 groundwater.

TABLE 2-33

Summary of Media-Specific Risks and Hazards For RME to OU-1 and Site 4 Groundwater

ROD for Site 4 Soil and Groundwater

NSWC White Oak

Media: Groundwater in Coastal Plain and Saprolite

| | Future Construction Worker | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | HQ | | | | CR | | | |
| Chemical | Inh | Ing | Der | Total | Inh | Ing | Der | Total |
| 1,1,2,2-Tetrachloroethane | N/A | -- | 0.003 | 0.003 | 8.5E-08 | -- | 4.8E-07 | 5.6E-07 |
| 1,1,2-Trichloroethane | N/A | -- | 0.00005 | 0.00005 | 3.5E-10 | -- | 1.5E-09 | 1.9E-09 |
| 1,1-Dichloroethene | N/A | -- | 0.0003 | 0.0003 | 8.8E-10 | -- | 2.1E-08 | 2.2E-08 |
| 1,2-Dibromoethane | 0.0008 | -- | N/A | 0.0008 | 4.7E-09 | -- | 1.2E-06 | 1.2E-06 |
| 1,2-Dichloroethane | 0.004 | -- | 0.0004 | 0.004 | 6.6E-09 | -- | 1.6E-08 | 2.2E-08 |
| 1,2-Dichloropropane | 0.00009 | -- | N/A | 0.0001 | N/A | -- | 1.5E-09 | 1.5E-09 |
| 1,4-Dichlorobenzene | 0.0000004 | -- | 0.0003 | 0.0003 | 9.8E-11 | -- | 3.1E-09 | 3.2E-09 |
| Benzene | 0.002 | -- | 0.07 | 0.07 | 1.3E-08 | -- | 9.0E-08 | 1.0E-07 |
| Bromodichloromethane | N/A | -- | 0.00005 | 0.00005 | N/A | -- | 8.4E-10 | 8.4E-10 |
| Carbon tetrachloride | 0.0002 | -- | 0.002 | 0.002 | 8.8E-11 | -- | 2.5E-09 | 2.5E-09 |
| Chlorobenzene | 0.00004 | -- | 0.0006 | 0.0007 | N/A | -- | N/A | 0.0E+00 |
| Chloroform | 0.005 | -- | 0.0001 | 0.005 | 4.8E-10 | -- | 1.2E-10 | 6.0E-10 |
| Tetrachloroethene | 0.00001 | -- | 0.0004 | 0.0004 | 5.4E-11 | -- | 2.7E-08 | 2.7E-08 |
| Toluene | 0.0004 | -- | 0.0003 | 0.0007 | N/A | -- | N/A | 0.0E+00 |
| Trichloroethene | N/A | -- | 0.2 | 0.2 | 2.1E-08 | -- | 2.4E-07 | 2.6E-07 |
| Vinyl chloride | 0.00004 | -- | 0.001 | 0.001 | 2.7E-10 | -- | 2.9E-08 | 2.9E-08 |
| cis-1,2-Dichloroethene | N/A | -- | 0.002 | 0.002 | N/A | -- | N/A | 0.0E+00 |
| trans-1,2-Dichloroethene | N/A | -- | 0.00006 | 0.00006 | N/A | -- | N/A | 0.0E+00 |
| Naphthalene | N/A | -- | 0.0006 | 0.0006 | N/A | -- | N/A | 0.0E+00 |
| bis(2-Ethylhexyl)phthalate | N/A | -- | 0.004 | 0.004 | N/A | -- | 1.8E-08 | 1.8E-08 |
| 2,4,6-Trinitrotoluene | N/A | -- | 0.009 | 0.009 | N/A | -- | 1.8E-09 | 1.8E-09 |
| 2-Amino-4,6-dinitrotoluene | N/A | -- | 0.04 | 0.04 | N/A | -- | N/A | 0.0E+00 |
| 4-Amino-2,6-dinitrotoluene | N/A | -- | 0.04 | 0.04 | N/A | -- | N/A | 0.0E+00 |
| Perchlorate | N/A | -- | N/A | 0.0000 | N/A | -- | N/A | 0.0E+00 |
| RDX | N/A | -- | 0.0007 | 0.0007 | N/A | -- | 3.2E-09 | 3.2E-09 |
| Aluminum | N/A | -- | 0.01 | 0.01 | N/A | -- | N/A | 0.0E+00 |
| Arsenic | N/A | -- | 0.001 | 0.001 | N/A | -- | 6.6E-09 | 6.6E-09 |
| Barium | N/A | -- | 0.0002 | 0.0002 | N/A | -- | N/A | 0.0E+00 |
| Beryllium | N/A | -- | 0.003 | 0.003 | N/A | -- | N/A | 0.0E+00 |
| Cadmium | N/A | -- | 0.006 | 0.006 | N/A | -- | N/A | 0.0E+00 |
| Chromium | N/A | -- | 0.04 | 0.04 | N/A | -- | N/A | 0.0E+00 |
| Copper | N/A | -- | 0.001 | 0.0006 | N/A | -- | N/A | 0.0E+00 |
| Cobalt | N/A | -- | 0.0001 | 0.0001 | N/A | -- | N/A | 0.0E+00 |
| Cyanide | N/A | -- | 0.0002 | 0.0002 | N/A | -- | N/A | 0.0E+00 |
| Iron | N/A | -- | 0.1 | 0.1 | N/A | -- | N/A | 0.0E+00 |
| Lead | N/A | -- | N/A | 0.0000 | N/A | -- | N/A | 0.0E+00 |
| Manganese | N/A | -- | 0.4 | 0.4 | N/A | -- | N/A | 0.0E+00 |
| Mercury | N/A | -- | 0.0007 | 0.0007 | N/A | -- | N/A | 0.0E+00 |
| Nickel | N/A | -- | 0.0005 | 0.0005 | N/A | -- | N/A | 0.0E+00 |
| Vanadium | N/A | -- | 0.02 | 0.02 | N/A | -- | N/A | 0.0E+00 |
| OU-1 Totals | 0.01 | -- | 1.0 | 1 | 1.3E-07 | -- | 2.1E-06 | 2.3E-06 |
| Site 4 Totals | 0.01 | -- | 0.55 | 0.56 | 1.3E-07 | -- | 2.1E-06 | 2.2E-06 |

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Site 4 groundwater.

TA 2-34

# Summary of Media-Specific Risks and Hazards For CTE to OU-1 and Site 4 Groundwater

ROD for Site 4 Soil and Groundwater

NSWC White Oak

## Media: Groundwater in Coastal Plain and Saprolite

| | Future Resident Adult | | | | | | | | Future Resident Child | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HQ | | | | CR | | | | HQ | | | | CR | | | |
| Chemical | Inh | Ing | Der | Total | Inh | Ing | Der | Total | Inh | Ing | Der | Total | Inh | Ing | Der | Total |
| 1,1,2,2-Tetrachloroethane | N/A | 0.01 | 0.002 | 0.02 | 3.3E-05 | -- | -- | 3.3E-05 | -- | 0.04 | 0.005 | 0.05 | -- | -- | -- | NA |
| 1,1,2-Trichloroethane | N/A | 0.005 | 0.001 | 0.01 | 3.1E-07 | -- | -- | 3.1E-07 | -- | 0.02 | 0.001 | 0.02 | -- | -- | -- | NA |
| 1,1-Dichloroethene | N/A | 0.0014 | 0.0003 | 0.00 | 8.7E-07 | -- | -- | 8.7E-07 | -- | 0.005 | 0.001 | 0.01 | -- | -- | -- | NA |
| 1,2-Dibromoethane | 0.616 | N/A | N/A | 0.62 | 3.4E-06 | -- | -- | 3.4E-06 | -- | N/A | N/A | 0.00 | -- | -- | -- | NA |
| 1,2-Dichloroethane | 0.231 | 0.0042 | 0.0003 | 0.24 | 3.8E-06 | -- | -- | 3.8E-06 | -- | 0.01 | 0.001 | 0.01 | -- | -- | -- | NA |
| 1,2-Dichloropropane | 0.029 | N/A | N/A | 0.03 | N/A | -- | -- | NA | -- | N/A | N/A | 0.00 | -- | -- | -- | NA |
| 1,4-Dichlorobenzene | 0.000 | 0.00 | 0.000 | 0.00 | 8.7E-08 | -- | -- | 8.7E-08 | -- | 0.00 | 0.001 | 0.00 | -- | -- | -- | NA |
| Benzene | 1.287 | 0.29 | 0.038 | 1.55 | 8.2E-06 | -- | -- | 8.2E-06 | -- | 0.75 | 0.083 | 0.83 | -- | -- | -- | NA |
| Bromodichloromethane | N/A | 0.00 | 0.000 | 0.00 | N/A | -- | -- | NA | -- | 0.00 | 0.000 | 0.00 | -- | -- | -- | NA |
| Carbon tetrachloride | 0.035 | 0.01 | 0.004 | 0.05 | 1.4E-07 | -- | -- | 1.4E-07 | -- | 0.04 | 0.009 | 0.05 | -- | -- | -- | NA |
| Chlorobenzene | 0.004 | 0.00 | 0.001 | 0.01 | N/A | -- | -- | NA | -- | 0.00 | 0.001 | 0.01 | -- | -- | -- | NA |
| Chloroform | 0.518 | 0.00 | 0.000 | 0.52 | 4.6E-07 | -- | -- | 4.6E-07 | -- | 0.01 | 0.000 | 0.01 | -- | -- | -- | NA |
| Tetrachloroethene | 0.001 | 0.01 | 0.005 | 0.01 | 4.4E-08 | -- | -- | 4.4E-08 | -- | 0.02 | 0.011 | 0.03 | -- | -- | -- | NA |
| Toluene | 0.026 | 0.00 | 0.002 | 0.03 | N/A | -- | -- | NA | -- | 0.02 | 0.004 | 0.02 | -- | -- | -- | NA |
| Trichloroethene | N/A | 0.29 | 0.054 | 0.34 | 3.6E-06 | -- | -- | 3.6E-06 | -- | 0.96 | 0.118 | 1.08 | -- | -- | -- | NA |
| Vinyl chloride | 0.004 | 0.01 | 0.001 | 0.02 | 2.3E-07 | -- | -- | 2.3E-07 | -- | 0.04 | 0.001 | 0.04 | -- | -- | -- | NA |
| cis-1,2-Dichloroethene | N/A | 0.03 | 0.003 | 0.04 | N/A | -- | -- | NA | -- | 0.11 | 0.007 | 0.12 | -- | -- | -- | NA |
| trans-1,2-Dichloroethene | N/A | 0.00 | 0.000 | 0.00 | N/A | -- | -- | NA | -- | 0.01 | 0.001 | 0.01 | -- | -- | -- | NA |
| Naphthalene | N/A | 0.00 | 0.001 | 0.00 | N/A | -- | -- | NA | -- | 0.00 | 0.003 | 0.01 | -- | -- | -- | NA |
| bis(2-Ethylhexyl)phthalate | N/A | 0.00 | 0.003 | 0.00 | N/A | -- | -- | NA | -- | 0.01 | 0.006 | 0.01 | -- | -- | -- | NA |
| 2,4,6-Trinitrotoluene | N/A | 0.23 | 0.009 | 0.24 | N/A | -- | -- | NA | -- | 0.75 | 0.020 | 0.77 | -- | -- | -- | NA |
| 2-Amino-4,6-dinitrotoluene | N/A | 0.69 | 0.036 | 0.73 | N/A | -- | -- | NA | -- | 2.31 | 0.078 | 2.39 | -- | -- | -- | NA |
| 4-Amino-2,6-dinitrotoluene | N/A | 0.77 | 0.040 | 0.81 | N/A | -- | -- | NA | -- | 2.56 | 0.087 | 2.64 | -- | -- | -- | NA |
| Perchlorate | N/A | 0.29 | NA | 0.29 | N/A | -- | -- | NA | -- | 0.97 | N/A | 0.97 | -- | -- | -- | NA |
| RDX | N/A | 0.09 | 0.001 | 0.09 | N/A | -- | -- | NA | -- | 0.29 | 0.002 | 0.29 | -- | -- | -- | NA |
| Arsenic | N/A | 0.08 | 0.000 | 0.08 | N/A | -- | -- | NA | -- | 0.26 | 0.001 | 0.26 | -- | -- | -- | NA |
| Barium | N/A | 0.02 | 0.000 | 0.02 | N/A | -- | -- | NA | -- | 0.06 | 0.000 | 0.06 | -- | -- | -- | NA |
| Cadmium | N/A | 0.02 | 0.001 | 0.02 | N/A | -- | -- | NA | -- | 0.07 | 0.003 | 0.07 | -- | -- | -- | NA |
| Chromium | N/A | 0.01 | 0.002 | 0.01 | N/A | -- | -- | NA | -- | 0.03 | 0.006 | 0.04 | -- | -- | -- | NA |
| Cobalt | N/A | 0.00 | 0.000 | 0.00 | N/A | -- | -- | NA | -- | 0.00 | 0.000 | 0.00 | -- | -- | -- | NA |
| Iron | N/A | 0.09 | 0.001 | 0.09 | N/A | -- | -- | NA | -- | 0.31 | 0.003 | 0.31 | -- | -- | -- | NA |
| Lead | N/A | N/A | N/A | 0.00 | N/A | -- | -- | NA | -- | N/A | N/A | 0.00 | -- | -- | -- | NA |
| Manganese | N/A | 0.53 | 0.027 | 0.56 | N/A | -- | -- | NA | -- | 1.77 | 0.076 | 1.84 | -- | -- | -- | NA |
| Nickel | N/A | 0.01 | 0.000 | 0.01 | N/A | -- | -- | NA | -- | 0.05 | 0.000 | 0.05 | -- | -- | -- | NA |
| Thallium | N/A | 0.33 | 0.001 | 0.33 | N/A | -- | -- | NA | -- | 1.11 | 0.002 | 1.11 | -- | -- | -- | NA |
| Totals | 2.8 | 3.8 | 0.24 | 6.8 | 5.5E-05 | NA | NA | 5.5E-05 | NA | 13 | 0.53 | 13 | NA | NA | NA | NA |
| Site 4 Totals | 2.8 | 2.78 | 0.20 | 5.7 | 5.5E-05 | N/A | N/A | 5.5E-05 | N/A | 9.3 | 0.44 | 9.7 | NA | NA | NA | NA |

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Site 4 groundwater.

TABLE 2-34

Summary of Media-Specific Risks and Hazards For CTE to OU-1 and Site 4 Groundwater

ROD for Site 4 Soil and Groundwater

NSWC White Oak

Media: Groundwater in Coastal Plain and Saprolite

| Chemical | Future Age-Adjusted Resident* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | HQ | | | | CR | | | |
| | Inh | Ing | Der | Total | Inh | Ing | Der | Total |
| 1,1,2,2-Tetrachloroethane | -- | -- | -- | NA | 3.3E-05 | 6.7E-05 | 8.7E-06 | 1.1E-04 |
| 1,1,2-Trichloroethane | -- | -- | -- | NA | 3.1E-07 | 4.4E-07 | 4E-08 | 7.9E-07 |
| 1,1-Dichloroethene | -- | -- | -- | NA | 8.7E-07 | 3.1E-06 | 4E-07 | 4.5E-06 |
| 1,2-Dibromoethane | -- | -- | -- | NA | 3.4E-06 | 6.6E-04 | 4E-05 | 7.0E-04 |
| 1,2-Dichloroethane | -- | -- | -- | NA | 3.8E-06 | 4.7E-06 | 2E-07 | 8.7E-06 |
| 1,2-Dichloropropane | -- | -- | -- | NA | N/A | 3.4E-07 | 3E-08 | 3.8E-07 |
| 1,4-Dichlorobenzene | -- | -- | -- | NA | 8.7E-08 | 1.3E-07 | 1E-07 | 3.1E-07 |
| Benzene | -- | -- | -- | NA | 8.2E-06 | 8.1E-06 | 1E-06 | 1.7E-05 |
| Bromodichloromethane | -- | -- | -- | NA | N/A | 3.1E-07 | 2E-08 | 3.3E-07 |
| Carbon tetrachloride | -- | -- | -- | NA | 1.4E-07 | 4.1E-07 | 1E-07 | 6.7E-07 |
| Chlorobenzene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Chloroform | -- | -- | -- | NA | 4.6E-07 | 4.1E-08 | 3E-09 | 5.1E-07 |
| Tetrachloroethene | -- | -- | -- | NA | 4.4E-08 | 1.5E-06 | 8E-07 | 2.3E-06 |
| Toluene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Trichloroethene | -- | -- | -- | NA | 3.6E-06 | 7.9E-06 | 1E-08 | 1.3E-05 |
| Vinyl chloride | -- | -- | -- | NA | 2.3E-07 | 1.3E-04 | 5E-06 | 1.4E-04 |
| cis-1,2-Dichloroethene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| trans-1,2-Dichloroethene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Naphthalene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| bis(2-Ethylhexyl)phthalate | -- | -- | -- | NA | N/A | 2.4E-07 | 3E-07 | 5.0E-07 |
| 2,4,6-Trinitrotoluene | -- | -- | -- | NA | N/A | 1.4E-06 | 4E-08 | 1.4E-06 |
| 2-Amino-4,6-dinitrotoluene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| 4-Amino-2,6-dinitrotoluene | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Perchlorate | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| RDX | -- | -- | -- | NA | N/A | 1.2E-05 | 9E-08 | 1.2E-05 |
| Arsenic | -- | -- | -- | NA | N/A | 1.5E-05 | 4E-08 | 1.5E-05 |
| Barium | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Cadmium | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Chromium | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Cobalt | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Iron | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Lead | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Manganese | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Nickel | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Thallium | -- | -- | -- | NA | N/A | N/A | N/A | 0.0E+00 |
| Totals | NA | NA | NA | NA | 5.5E-05 | 9.2E-04 | 5.4E-05 | 1.0E-03 |
| Site 4 Totals | NA | NA | NA | NA | 5.5E-05 | 9.2E-04 | 5.4E-05 | 1.0E-03 |

* - sum of cancer risks between residential adult and child. Inhalation based on adult while showering

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Site 4 groundwater.

TA 2-34

Summary of Media-Specific Risks and Hazards For CTE to OU-1 and Site 4 Groundwater

ROD for Site 4 Soil and Groundwater

NSWC White Oak

Media: Groundwater in Coastal Plain and Saprolite

| Chemical | Future Construction Worker | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | HQ | | | | CR | | | |
| | Inh | Ing | Der | Total | Inh | Ing | Der | Total |
| 1,1,2,2-Tetrachloroethane | -- | -- | 0.0002 | 0.0002 | -- | -- | -- | NA |
| 1,1,2-Trichloroethene | -- | -- | 0.00001 | 0.00001 | -- | -- | -- | NA |
| 1,1-Dichloroethene | -- | -- | 0.00003 | 0.00003 | -- | -- | -- | NA |
| 1,2-Dibromoethane | -- | -- | N/A | NA | -- | -- | -- | NA |
| 1,2-Dichloroethane | -- | -- | 0.00003 | 0.00003 | -- | -- | -- | NA |
| 1,2-Dichloropropane | -- | -- | N/A | 0.00000 | -- | -- | -- | NA |
| 1,4-Dichlorobenzene | -- | -- | 0.00004 | 0.00004 | -- | -- | -- | NA |
| Benzene | -- | -- | 0.00544 | 0.00544 | -- | -- | -- | NA |
| Bromodichloromethane | -- | -- | 0.00001 | 0.00001 | -- | -- | -- | NA |
| Carbon tetrachloride | -- | -- | 0.00042 | 0.00042 | -- | -- | -- | NA |
| Chlorobenzene | -- | -- | 0.00008 | 0.00008 | -- | -- | -- | NA |
| Chloroform | -- | -- | 0.00002 | 0.00002 | -- | -- | -- | NA |
| Tetrachloroethene | -- | -- | 0.00005 | 0.00005 | -- | -- | -- | NA |
| Toluene | -- | -- | 0.00003 | 0.00003 | -- | -- | -- | NA |
| Trichloroethene | -- | -- | 0.00597 | 0.00597 | -- | -- | -- | NA |
| Vinyl chloride | -- | -- | 0.00009 | 0.00009 | -- | -- | -- | NA |
| cis-1,2-Dichloroethene | -- | -- | 0.00006 | 0.00006 | -- | -- | -- | NA |
| trans-1,2-Dichloroethene | -- | -- | 0.00001 | 0.00001 | -- | -- | -- | NA |
| Naphthalene | -- | -- | 0.00014 | 0.00014 | -- | -- | -- | NA |
| bis(2-Ethylhexyl)phthalate | -- | -- | 0.00082 | 0.00082 | -- | -- | -- | NA |
| 2,4,6-Trinitrotoluene | -- | -- | 0.00084 | 0.00084 | -- | -- | -- | NA |
| 2-Amino-4,6-dinitrotoluene | -- | -- | NA | 0.00000 | -- | -- | -- | NA |
| 4-Amino-2,6-dinitrotoluene | -- | -- | NA | 0.00000 | -- | -- | -- | NA |
| Perchlorate | -- | -- | NA | 0.00000 | -- | -- | -- | NA |
| RDX | -- | -- | 0.00007 | 0.00007 | -- | -- | -- | NA |
| Aluminum | -- | -- | 0.00037 | 0.00037 | -- | -- | -- | NA |
| Arsenic | -- | -- | 0.00014 | 0.00014 | -- | -- | -- | NA |
| Barium | -- | -- | 0.00003 | 0.00003 | -- | -- | -- | NA |
| Beryllium | -- | -- | 0.00022 | 0.00022 | -- | -- | -- | NA |
| Cadmium | -- | -- | 0.00075 | 0.00075 | -- | -- | -- | NA |
| Chromium | -- | -- | 0.00190 | 0.00190 | -- | -- | -- | NA |
| Cobalt | -- | -- | 0.00004 | 0.00004 | -- | -- | -- | NA |
| Copper | -- | -- | 0.00001 | 0.00001 | -- | -- | -- | NA |
| Cyanide | | -- | 0.00002 | 0.00002 | -- | -- | -- | NA |
| Iron | -- | -- | 0.00257 | 0.00257 | -- | -- | -- | NA |
| Lead | -- | -- | N/A | 0.00000 | -- | -- | -- | NA |
| Manganese | -- | -- | 0.01665 | 0.01665 | -- | -- | -- | NA |
| Mercury | -- | -- | 0.00008 | 0.00008 | -- | -- | -- | NA |
| Nickel | -- | -- | 0.00003 | 0.00003 | -- | -- | -- | NA |
| Vanadium | -- | -- | 0.00174 | 0.00174 | -- | -- | -- | NA |
| Totals | N/A | N/A | 0.04 | 0.04 | -- | -- | -- | N/A |
| Site 4 Totals | N/A | N/A | 0.02 | 0.02 | -- | -- | -- | N/A |

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Site 4 groundwater.

Table 2-35
Preliminary Remediation Goals for Site 4 ROD
Groundwater
Adult Residential Scenario
Site 4 Compliance Area

| Chemical | Chronic Oral RfD (RfDo) (mg/kg-day) | Chronic Dermal RfD (RfDd) (mg/kg-day) | Chronic Inhalation RfD (RfDi) (mg/kg-day) | Target Organ | DAevent (L/cm²-day) | Shower Exposure (L/day) | An (kg-L/mg) | Bn (kg-L/mg) | Cn (kg-L/mg) | Noncarcinogen PRG PRG (mg/L) | Noncarcinogen PRG Target HQ[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *VOCs* | | | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 6.00E-02 | 4.80E-02 | NA | liver, kidney | 1.1E-05 | 2.3E+00 | 3.3E+01 | 4.4E+00 | | 3.3E-01 | 0.17 |
| 1,1-Dichloroethene | 9.00E-03 | 7.20E-03 | NA | liver | 1.2E-05 | 4.3E+00 | 2.2E+02 | 3.2E+01 | | 4.9E-02 | 0.17 |
| 1,2-Dichloroethane | 3.00E-02 | 2.40E-02 | 1.40E-03 | liver | 3.9E-06 | 3.6E+00 | 6.7E+01 | 3.2E+00 | 2.6E+03 | 4.7E-03 | 0.17 |
| Benzene | 3.00E-03 | 3.00E-03 | 1.70E-03 | liver | 1.3E-05 | 4.5E+00 | 6.7E+02 | 8.8E+01 | 2.7E+03 | 3.6E-03 | 0.17 |
| cis-1,2-Dichloroethene | 1.00E-02 | 1.00E-02 | NA | blood | 7.2E-06 | 4.2E+00 | 2.0E+02 | 1.4E+01 | | 1.7E-01 | 0.50 |
| Trichloroethene | 6.00E-03 | 6.00E-03 | NA | liver, kidney | 1.5E-05 | 3.6E+00 | 3.3E+02 | 4.9E+01 | | 3.2E-02 | 0.17 |
| Vinyl Chloride | 3.00E-03 | 2.40E-03 | 2.80E-02 | liver | 4.1E-06 | 5.0E+00 | 5.7E+02 | 3.4E+01 | 1.8E+02 | 1.4E-02 | 0.17 |
| ***Energetics*** | | | | | | | | | | | |
| Perchlorate | NA | NA | NA | thyroid, CNS | 0.0E+00 | | NA | NA | | NA | 1.00 |
| ***Inorganics*** | | | | | | | | | | | |
| Iron | 6.00E-01 | 1.20E-01 | NA | GI, blood | 2.0E-07 | | 3.3E+00 | 3.3E-02 | | 1.1E+01 | 0.50 |

**Noncarcinogenic calculations:**

$$\text{Groundwater Risk-Based PRG (mg/L)} = \frac{THQ \times BW \times AT_n}{EF \times ED \times (An + Bn + Cn)}$$

An = 1/RfDo x IR

Bn = 1/RfDd x SA x DAevent

Cn = 1/RfDi x Shower Exposure

| EXPOSURE ASSUMPTIONS | |
|---|---|
| BW - Body weight (kilograms) | 70 |
| ATnc - Averaging time for noncarcinogens (days) | 8,760 |
| ATc - Averaging time for carcinogens (days) | 25,550 |
| EF - Exposure frequency (days/year) | 350 |
| ED - Exposure duration (year) | 24 |
| IR - Ingestion rate (L/day) | 2 |
| SA - Skin surface area (cm²) | 20,000 |

NA - No reference dose or slope factor available.

1 Applicable HQ calculated so that total HQ for a target organ does not exceed 1.

Table 2-36
Preliminary Remediation Goals for Site 4 ROD
Groundwater
Child Residential Scenario
Site 4 Compliance Area

| Chemical | Chronic Oral RfD (RfDo) (mg/kg-day) | Chronic Dermal RfD (RfDd) (mg/kg-day) | Chronic Inhalation RfD (RfDi) (mg/kg-day) | Target Organ | DAevent (L/cm²-day) | An (kg-L/mg) | Bn (kg-L/mg) | Noncarcinogen PRG PRG (mg/L) | Noncarcinogen PRG Target HQ[1] |
|---|---|---|---|---|---|---|---|---|---|
| *VOCs* | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 6.00E-02 | 4.80E-02 | NA | liver, kidney | 1.4E-05 | 1.7E+01 | 2.3E+00 | 1.4E-01 | 0.17 |
| 1,1-Dichloroethene | 9.00E-03 | 7.20E-03 | NA | liver | 1.5E-05 | 1.1E+02 | 1.6E+01 | 2.1E-02 | 0.17 |
| 1,2-Dichloroethane | 3.00E-02 | 2.40E-02 | 1.40E-03 | liver | 5.0E-06 | 3.3E+01 | 1.6E+00 | 7.6E-02 | 0.17 |
| Benzene | 3.00E-03 | 3.00E-03 | 1.70E-03 | liver | 1.7E-05 | 3.3E+02 | 4.5E+01 | 7.0E-03 | 0.17 |
| cis-1,2-Dichloroethene | 1.00E-02 | 1.00E-02 | NA | blood | 9.3E-06 | 1.0E+02 | 7.3E+00 | 7.3E-02 | 0.50 |
| Trichloroethene | 6.00E-03 | 6.00E-03 | NA | liver, kidney | 1.9E-05 | 1.7E+02 | 2.5E+01 | 1.4E-02 | 0.17 |
| Vinyl Chloride | 3.00E-03 | 2.40E-03 | 2.80E-02 | liver | 5.3E-06 | 3.3E+02 | 1.8E+01 | 7.6E-03 | 0.17 |
| *Energetics* | | | | | | | | | |
| Perchlorate | NA | NA | NA | thyroid, CNS | 0.0E+00 | NA | NA | NA | 1.00 |
| *Inorganics* | | | | | | | | | |
| Iron | 6.00E-01 | 1.20E-01 | NA | GI, blood | 3.3E-07 | 1.7E+00 | 2.2E-02 | 4.6E+00 | 0.50 |

Noncarcinogenic calculations:

$$\text{Groundwater Risk-Based PRG (mg/L)} = \frac{THQ \times BW \times AT_n}{EF \times ED \times (An + Bn)}$$

$$An = 1/RfDo \times IR$$

$$Bn = 1/RfDd \times SA \times DAevent$$

| EXPOSURE ASSUMPTIONS | |
|---|---|
| BW - Body weight (kilograms) | 15 |
| ATnc - Averaging time for noncarcinogens (days) | 2,190 |
| ATc - Averaging time for carcinogens (days) | 25,550 |
| EF - Exposure frequency (days/year) | 350 |
| ED - Exposure duration (year) | 6 |
| IR - Ingestion rate (L/day) | 1 |
| SA - Skin surface area (cm²) | 7,930 |

NA - No reference dose or slope factor available

1 Applicable HQ calculated so that total HQ for a target organ does not exceed 1

Table 2-37
Preliminary Remediation Goals for Site 4 ROD
Groundwater
Lifetime Residential Scenario
Site 4 Compliance Area

| Chemical | Oral Slope Factor (CSFo) (kg-day/mg) | Dermal Slope Factor (CSFd) (kg-day/mg) | Inhalation Slope Factor (CSFi) (kg-day/mg) | DAevent-a (L/cm²-day) | DAevent-c (L/cm²-day) | Shower Exposure (L/day) | Ac (L-yr/mg) | Bc (L-yr/mg) | Cc (L-yr/mg) | Carcinogen PRG Risk = 1E-06 (mg/L) | Carcinogen PRG Risk = 1E-05 (mg/L) | Carcinogen PRG Risk = 1E-04 (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *VOCs* | | | | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 2.00E-01 | 2.5E-01 | 2.00E-01 | 1.1E-05 | 1.4E-05 | 2.3E+00 | 2.2E-01 | 2.9E-02 | 1.6E-01 | 1.8E-04 | 1.8E-03 | 1.8E-02 |
| 1,1-Dichloroethene | 6.00E-01 | 7.5E-01 | 1.75E-01 | 1.2E-05 | 1.5E-05 | 4.3E+00 | 6.5E-01 | 9.5E-02 | 2.6E-01 | 7.2E-05 | 7.2E-04 | 7.2E-03 |
| 1,2-Dichloroethane | 9.10E-02 | 1.1E-01 | 9.10E-02 | 3.9E-06 | 5.0E-06 | 3.6E+00 | 9.9E-02 | 4.8E-03 | 1.1E-01 | 3.4E-04 | 3.4E-03 | 3.4E-02 |
| Benzene | 2.90E-02 | 2.9E-02 | 2.90E-02 | 1.3E-05 | 1.7E-05 | 4.5E+00 | 3.2E-02 | 4.2E-03 | 4.5E-02 | 9.0E-04 | 9.0E-03 | 9.0E-02 |
| cis-1,2-Dichloroethene | NA | NA | NA | 7.2E-06 | 9.3E-06 | 4.2E-00 | | | | | | |
| Trichloroethene | 1.10E-02 | 1.4E-02 | 6.00E-03 | 1.5E-05 | 1.9E-05 | 3.8E+00 | 1.2E-02 | 2.2E-03 | 7.8E-03 | 3.3E-03 | 3.3E-02 | 3.3E-01 |
| Vinyl Chloride | 1.40E+00 | 1.4E+00 | 3.00E-02 | 4.1E-06 | 5.3E-06 | 5.0E+00 | 1.5E+00 | 6.3E-02 | 5.2E-02 | 4.4E-05 | 4.4E-04 | 4.4E-03 |
| *Energetics* | | | | | | | | | | | | |
| Perchlorate | NA | NA | NA | 0.0E-00 | 0.0E+00 | | | | | | | |
| *Inorganics* | | | | | | | | | | | | |
| Iron | NA | NA | NA | 2.0E-07 | 3.3E-07 | | | | | | | |

Carcinogen calculations:

$$\text{Groundwater Risk-Based PRG (mg/L)} = \frac{TR \times AT_c}{EF \times (Ac + Bc + Cc)}$$

Ac = CSFo x IRadj

Bc = CSFd x [(SAa x DAevent-a x EDa)/BWa + (SAc x DAevent-c X EDc)/BWc]

Cc = CSFi x Shower Exposure x EDa x 1/BWa

| EXPOSURE ASSUMPTIONS | Lifetime | Adult (a) | Child (c) |
|---|---|---|---|
| BW - Body weight (kilograms) | | 70 | 15 |
| ATnc - Averaging time for noncarcinogens (days) | | 8,760 | 2,190 |
| ATc - Averaging time for carcinogens (days) | | 25,550 | 25,550 |
| EF - Exposure frequency (days/year) | | 350 | 350 |
| ED - Exposure duration (year) | | 24 | 6 |
| IR - Ingestion rate (L/day) | | 2 | 1 |
| IRdj - Ingestion rate (L-year/kg-day) | 1.09 | | |
| SA - Skin surface area (cm²) | | 20,000 | 7,930 |
| ET - Exposure Time (hours/day) | | 0.20 | 0.33 |

NA - No reference dose or slope factor available

**Table 2-38**
**Preliminary Remediation Goals for Site 4 ROD**
**Groundwater**
**Residential Scenario**
**Site 4 Compliance Area**

| Chemical | Risk-Based PRG (mg/L) | Basis | MCL-Based PRG (mg/L) |
|---|---|---|---|
| *VOCs* | | | |
| 1,1,2,2-Tetrachloroethane | 1.8E-03 | Lifetime, CR = $10^{-5}$ | |
| 1,1-Dichloroethene | 7.2E-04 | Lifetime, CR = $10^{-5}$ | 7.0E-03 |
| 1,2-Dichloroethane | 3.4E-03 | Lifetime, CR = $10^{-5}$ | 5.0E-03 |
| Benzene | 3.6E-03 | Adult, HQ=0.17 | 5.0E-03 |
| cis-1,2-Dichloroethene | 7.3E-02 | Child, HQ=0.50 | 7.0E-02 |
| Trichloroethene | 1.4E-02 | Child, HQ=0.17 | 5.0E-03 |
| Vinyl Chloride | 4.4E-04 | Lifetime, CR = $10^{-5}$ | 2.0E-03 |
| ***Energetics*** | | | |
| Perchlorate | Not Calculated | | |
| ***Inorganics*** | | | |
| Iron | 4.6E+00 | Child, HQ=0.50 | |
| Cummulative Risk | 4.8E-05 | | 1.6E-04 |

For constituents with basis of CR = $10^{-5}$, PRG for CR =$10^{-5}$ less than PRG for applicable HQ.
Used CR of $10^{-5}$ to keep overall carcinogenic risk below $10^{-4}$.
Applicabe HQ chosen to keep total HI for each target organ below 1.

Table 2-39
Preliminary Remediation Goals for Site 4 ROD
Groundwater
Adult Residential Scenario
Site 46 Compliance Area

| Chemical | Chronic Oral RfD (RfDo) (mg/kg-day) | Chronic Dermal RfD (RfDd) (mg/kg-day) | Chronic Inhalation RfD (RfDi) (mg/kg-day) | Target Organ | DAevent (L/cm²-day) | Shower Exposure (L/day) | An (kg-L/mg) | Bn (kg-L/mg) | Cn (kg-L/mg) | Noncarcinogen PRG PRG (mg/L) | Noncarcinogen PRG Target HQ[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***VOCs*** | | | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 6.00E-02 | 4.80E-02 | NA | liver, kidney | 1.1E-05 | 2.3E+00 | 3.3E+01 | 4.4E+00 | | 4.8E-01 | 0.25 |
| Trichloroethene | 6.00E-03 | 5.00E-03 | NA | liver, kidney | 1.0E-05 | 3.8E-00 | 3.3E+02 | 4.9E-01 | | 4.6E-02 | 0.25 |
| Vinyl Chloride | 3.00E-03 | 2.40E-03 | 2.90E-02 | liver | 4.1E-06 | 5.0E+00 | 6.7E+02 | 3.4E+01 | 1.8E+02 | 2.1E-02 | 0.25 |
| ***Energetics*** | | | | | | | | | | | |
| 2,4,6-Trinitrotoluene | 5.00E-04 | 3.00E-04 | NA | liver | 1.9E-06 | | 4.0E+03 | 1.3E+02 | | 4.4E-03 | 0.25 |
| 2-Amino-4,6-dinitrotoluene | 6.00E-05 | 4.80E-05 | NA | NA | 3.2E-06 | | 3.3E+04 | 1.4E+03 | | 2.1E-03 | 1.00 |
| 4-Amino-2,6-dinitrotoluene | 6.00E-05 | 4.80E-05 | NA | NA | 3.2E-06 | | 3.3E+04 | 1.4E+03 | | 2.1E-03 | 1.00 |
| Perchlorate | NA | NA | NA | thyroid, CNS | 0.0E+00 | | NA | NA | | NA | 1.00 |
| ***Inorganics*** | | | | | | | | | | | |
| Arsenic | 3.00E-04 | 2.85E-04 | NA | skin, vascular | 2.0E-07 | | 6.7E+03 | 1.4E+01 | | 1.1E-02 | 1.00 |
| Cadmium | 5.00E-04 | 2.50E-05 | 5.70E-05 | kidney | 2.0E-07 | | 4.0E+03 | 1.6E+02 | | 5.6E-03 | 0.33 |
| Iron | 6.00E-01 | 1.20E-01 | NA | GI, blood | 2.0E-07 | | 3.3E+00 | 3.3E-02 | | 2.2E+01 | 1.00 |

**Noncarcinogenic calculations:**

$$\text{Groundwater Risk-Based PRG (mg/L)} = \frac{THQ \times BW \times AT_n}{EF \times ED \times (An + Bn + Cn)}$$

An = 1/RfDo x IR

Bn = 1/RfDd x SA x DAevent

Cn = 1/RfDi x Shower Exposure

| EXPOSURE ASSUMPTIONS | |
|---|---|
| BW - Body weight (kilograms) | 70 |
| ATnc - Averaging time for noncarcinogens (days) | 8,760 |
| ATc - Averaging time for carcinogens (days) | 25,550 |
| EF - Exposure frequency (days/year) | 350 |
| ED - Exposure duration (year) | 24 |
| IR - Ingestion rate (L/day) | 2 |
| SA - Skin surface area (cm²) | 20,000 |

NA - No reference dose or slope factor available.

1 Applicable HQ calculated so that total HQ for a target organ does not exceed 1.

Table 2-40
Preliminary Remediation Goals for Site 4 ROD
Groundwater
Child Residential Scenario
Site 46 Compliance Area

| Chemical | Chronic Oral RfD (RfDo) (mg/kg-day) | Chronic Dermal RfD (RfDd) (mg/kg-day) | Chronic Inhalation RfD (RfDi) (mg/kg-day) | Target Organ | DAevent (L/cm²-day) | An (kg-L/mg) | Bn (kg-L/mg) | Noncarcinogen Groundwater PRG HQ = 0.1 (mg/L) | HQ = 0.5 (mg/L) | HQ = 1 (mg/L) | Noncarcinogen PRG PRG (mg/L) | Target HQ[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *VOCs* | | | | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 6.00E-02 | 4.80E-02 | NA | liver, kidney | 1.4E-05 | 1.7E+01 | 2.3E+00 | 8.3E-02 | 4.1E-01 | 8.3E-01 | 2.1E-01 | 0.25 |
| Trichloroethene | 6.00E-03 | 6.00E-03 | NA | liver, kidney | 1.9E-05 | 1.7E+02 | 2.5E+01 | 8.2E-03 | 4.1E-02 | 8.2E-02 | 2.0E-02 | 0.25 |
| Vinyl Chloride | 3.00E-03 | 2.40E-03 | 2.80E-02 | liver | 5.3E-06 | 3.3E+02 | 1.8E+01 | 4.5E-03 | 2.2E-02 | 4.5E-02 | 1.1E-02 | 0.25 |
| *Energetics* | | | | | | | | | | | | |
| 2,4,6-Trinitrotoluene | 5.00E-04 | 3.00E-04 | NA | liver | 2.5E-06 | 2.0E+03 | 6.5E+01 | 7.6E-04 | 3.8E-03 | 7.6E-03 | 1.9E-03 | 0.25 |
| 2-Amino-4,6-dinitrotoluene | 6.00E-05 | 4.80E-05 | NA | NA | 4.2E-06 | 1.7E+04 | 6.9E+02 | 9.0E-05 | 4.5E-04 | 9.0E-04 | 9.0E-04 | 1.00 |
| 4-Amino-2,6-dinitrotoluene | 6.00E-05 | 4.80E-05 | NA | NA | 4.2E-06 | 1.7E+04 | 6.9E+02 | 9.0E-05 | 4.5E-04 | 9.0E-04 | 9.0E-04 | 1.00 |
| Perchlorate | NA | NA | NA | thyroid, CNS | 0.0E+00 | #VALUE! | #VALUE! | NA | NA | NA | NA | 1.00 |
| *Inorganics* | | | | | | | | | | | | |
| Arsenic | 3.00E-04 | 2.85E-04 | NA | skin, vascular | 3.3E-07 | 3.3E+03 | 9.2E+00 | 4.7E-04 | 2.3E-03 | 4.7E-03 | 4.7E-03 | 1.00 |
| Cadmium | 5.00E-04 | 2.50E-05 | 5.70E-05 | kidney | 3.3E-07 | 2.0E+03 | 1.0E+02 | 7.4E-04 | 3.7E-03 | 7.4E-03 | 2.5E-03 | 0.33 |
| Iron | 6.00E-01 | 1.20E-01 | NA | GI, blood | 3.3E-07 | 1.7E-00 | 2.2E-02 | 9.3E-01 | 4.6E+00 | 9.3E+00 | 9.3E+00 | 1.00 |

Noncarcinogenic calculations:

$$\text{Groundwater Risk-Based PRG (mg/L)} = \frac{THQ \times BW \times AT_n}{EF \times ED \times (An + Bn)}$$

$$An = 1/RfDo \times IR$$

$$Bn = 1/RfDd \times SA \times DAevent$$

| EXPOSURE ASSUMPTIONS | |
|---|---|
| BW - Body weight (kilograms) | 15 |
| ATnc - Averaging time for noncarcinogens (days) | 2,190 |
| ATc - Averaging time for carcinogens (days) | 25,550 |
| EF - Exposure frequency (days/year) | 350 |
| ED - Exposure duration (year) | 6 |
| IR - ingestion rate (L/day) | 1 |
| SA - Skin surface area (cm²) | 7,930 |

NA - No reference dose or slope factor available.

1 Applicable HQ calculated so that total HQ for a target organ does not exceed 1.

Table 2-41
Preliminary Remediation Goals for Site 4 ROD
Groundwater
Lifetime Residential Scenario
Site 46 Compliance Area

| Chemical | Oral Slope Factor (CSFo) (kg-day/mg) | Dermal Slope Factor (CSFd) (kg-day/mg) | Inhalation Slope Factor (CSFi) (kg-day/mg) | DAevent-a (L/cm²-day) | DAevent-c (L/cm²-day) | Shower Exposure (L/day) | Ac (L-yr/mg) | Bc (L-yr/mg) | Cc (L-yr/mg) | Carcinogen PRG Risk = 1E-06 (mg/L) | Carcinogen PRG Risk = 1E-05 (mg/L) | Carcinogen PRG Risk = 1E-04 (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *VOCs* | | | | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 2.00E-01 | 2.5E-01 | 2.00E-01 | 1.1E-05 | 1.4E-05 | 2.3E+00 | 2.2E-01 | 2.9E-02 | 1.6E-01 | 1.8E-04 | 1.8E-03 | 1.8E-02 |
| Trichloroethene | 1.10E-02 | 1.4E-02 | 6.00E-03 | 1.5E-05 | 1.9E-05 | 3.8E+00 | 1.2E-02 | 2.2E-03 | 7.8E-03 | 3.3E-03 | 3.3E-02 | 3.3E-01 |
| Vinyl Chloride | 1.40E+00 | 1.4E+00 | 3.00E-02 | 4.1E-06 | 5.3E-06 | 5.0E+00 | 1.5E+00 | 8.3E-02 | 5.2E-02 | 4.4E-05 | 4.4E-04 | 4.4E-03 |
| *Energetics* | | | | | | | | | | | | |
| 2,4,6-Trinitrotoluene | 3.00E-02 | 5.0E-02 | NA | 1.9E-06 | 2.5E-06 | | 3.3E-02 | 1.1E-03 | | 2.2E-03 | 2.2E-02 | 2.2E-01 |
| 2-Amino-4,6-dinitrotoluene | NA | NA | NA | 3.2E-06 | 4.2E-06 | | | | | | | |
| 4-Amino-2,6-dinitrotoluene | NA | NA | NA | 3.2E-06 | 4.2E-06 | | | | | | | |
| Perchlorate | NA | NA | NA | 0.0E+00 | 0.0E+00 | | | | | | | |
| *Inorganics* | | | | | | | | | | | | |
| Arsenic | 1.50E+00 | 1.6E+00 | 1.51E+01 | 2.0E-07 | 3.3E-07 | | 1.6E+00 | 3.8E-03 | | 4.5E-05 | 4.5E-04 | 4.5E-03 |
| Cadmium | NA | NA | 6.30E+00 | 2.0E-07 | 3.3E-07 | | | | | | | |
| Iron | NA | NA | NA | 2.0E-07 | 3.3E-07 | | | | | | | |

Carcinogen calculations:

$$\text{Groundwater Risk-Based PRG (mg/L)} = \frac{TR \times AT_c}{EF \times (Ac + Bc + Cc)}$$

Ac = CSFo x IRadj

Bc = CSFd x [(SAa x DAevent-a x EDa)/BWa + (SAc x DAevent-c X EDc)/BWc]

Cc = CSFi x Shower Exposure x EDa x 1/BWa

| EXPOSURE ASSUMPTIONS | Lifetime | Adult (a) | Child (c) |
|---|---|---|---|
| BW - Body weight (kilograms) | | 70 | 15 |
| ATnc - Averaging time for noncarcinogens (days) | | 8,760 | 2,190 |
| ATc - Averaging time for carcinogens (days) | | 25,550 | 25,550 |
| EF - Exposure frequency (days/year) | | 350 | 350 |
| ED - Exposure duration (year) | | 24 | 6 |
| IR - Ingestion rate (L/day) | | 2 | 1 |
| IRdj - Ingestion rate (L-year/kg-day) | 1.09 | | |
| SA - Skin surface area (cm²) | | 20,000 | 7,930 |
| ET - Exposure Time (hours/day) | | 0.20 | 0.33 |

NA - No reference dose or slope factor available

Table 2-42
Preliminary Remediation Goals for Site 4 ROD
Groundwater
Residential Scenario
Site 46 Compliance Area

| Chemical | Risk-Based PRG (mg/L) | Basis | MCL-Based PRG (mg/L) |
|---|---|---|---|
| *VOCs* | | | |
| 1,1,2,2-Tetrachloroethane | 3.6E-03 | Lifetime, CR = $2x10^{-5}$ | |
| Trichloroethene | 2.0E-02 | Child, HQ=0.25 | 5.00E-03 |
| Vinyl Chloride | 4.4E-04 | Lifetime, CR = $10^{-5}$ | 2.00E-03 |
| *Energetics* | | | |
| 2,4,6-Trinitrotoluene | 1.9E-03 | Child, HQ=0.25 | |
| 2-Amino-4,6-dinitrotoluene | 9.0E-04 | Child, HQ=1 | |
| 4-Amino-2,6-dinitrotoluene | 9.0E-04 | Child, HQ=1 | |
| Perchlorate | Not Calculated | | |
| *Inorganics* | | | |
| Arsenic | 8.9E-04 | Lifetime, CR = $2x10^{-5}$ | 5.00E-03 |
| Cadmium | 2.5E-03 | Child, HQ=0.33 | 5.00E-03 |
| Iron | 9.3E+00 | Child, HQ=1 | |
| Cummulative Risk | 9.1E-05 | | 2.5E-03 |

Child scenario selected for noncarcinogenic PRGs since child scenario more conservative (lower PRGs).
For constituents with basis of CR = $10^{-5}$ or $2x10^{-5}$, PRG for CR = $10^{-5}$ less than PRG for applicable HQ.
Used CR of $10^{-5}$ to keep overall carcinogenic risk below $10^{-4}$.
Applicabe HQ chosen to keep total HI for each target organ below 1.

**Table 2-43**
**PRGs for Groundwater in Site 4 and Site 46 Attainment Areas of OU-1**
**ROD for Site 4**
**Former NSWC White Oak, Silver Spring, Maryland**

| Attainment Area/Chemical | PRG (mg/L) | Source[A] | Max Conc. (mg/L) | COC? |
|---|---|---|---|---|
| **Site 4 PRG Attainment Area** | | | | |
| Benzene | 5.00E-03 | M | 5.00E-03 | NO[E] |
| **1,2-Dichloroethane** | 5.00E-03 | M | 2.57E-01 | YES |
| 1,1-Dichloroethene | 7.00E-03 | M | 6.00E-03 | NO[E] |
| **Cis-1,2-Dichloroethene** | 7.00E-02 | M | 8.50E+00 | YES |
| **1,1,2,2-Tetrachloroethane** | 1.80E-03 | RB | 5.60E-01 | YES |
| **Trichloroethene** | 5.00E-03 | M | 1.10E+01 | YES |
| **Vinyl chloride** | 2.00E-03 | M | 7.60E-02 | YES |
| Perchlorate | not established | RB | 7.60E-02 | NO[C] |
| **Iron (dissolved)** | 4.60E+00 | RB | 3.85E+01 | YES |
| **Site 46 PRG Attainment Area** | | | | |
| **Benzene** | 5.00E-03 | M | 1.71E+00 | YES[F] |
| **cis-1,2-Dichloroethene** | 7.00E-02 | M | 7.40E-02 | YES[F] |
| **1,2-Dichloroethane** | 5.00E-03 | M | 2.85E-01 | YES[F] |
| **1,1,2,2-Tetrachloroethane** | 3.61E-03 | RB | 3.20E-02 | YES |
| **Toluene** | 1.00E+00 | M | 2.49E+00 | YES[F] |
| **Trichloroethene** | 5.00E-03 | M | 7.40E-01 | YES |
| **Vinyl chloride** | 2.00E-03 | M | 2.10E-03 | YES |
| **2-amino-4,6-dinitrotoluene** | 9.01E-04 | RB | 1.00E-03 | YES |
| **4-amino-2,6-dinitrotoluene** | 9.01E-04 | RB | 8.00E-04 | YES |
| Perchlorate | not established | RB | 6.75E-02 | NO[C] |
| 2,4,6-Trinitrotoluene | 1.89E-03 | RB | 6.80E-03 | NO[B] |
| Arsenic (dissolved) | 5.00E-03 | M | 3.50E-03 | NO[E] |
| Cadmium (dissolved) | 5.00E-03 | M | 3.30E-03 | NO[E] |
| **Iron (dissolved)** | 9.30E+00 | RB | 2.62E+01 | YES |

Footnotes:

[A] M=Proposed PRG is based on MCL, RB= Proposed PRG is based on calculated risk-based PRG

[B] Chemical is not considered a COC because it was only found in one or two scattered wells/samples at concentrations above the risk-based PRG

[C] Perchlorate is not considered a COC for reasons discussed in section 3.3.1.2

[D] Chemical is not considered a COC because it is present in concentrations similar to background

[E] Chemical is not considered a COC because maximum concentration does not exceed PRG

[F] Chemical is considered a COC because it exceeds MCL, but it was not considered in the cumulative risk calculations because it is present in only one isolated well

TABLE 2-44
Detailed Analysis of Remediation Alternatives for Site 4 Source Area Soil
ROD for Site 4 Soil and Groundwater
Former NSWC White Oak, Silver Spring, Maryland

| CERCLA Criteria | ALT-1 – No Action | ALT-2 – Soil Vapor Extraction | ALT-3 – Insitu Chemical Oxidation | ALT-4 – Excavation and Offsite Disposal |
|---|---|---|---|---|
| Protection of Human Health and the Environment | MODERATE (2) - – This alternative does not provide any increased protection of human health and the environment. However there are no current risks and there are local ordinances that prevent the private use of groundwater for drinking water purposes. | MODERATE to HIGH (4-5) – The soil will be treated onsite and insitu, however contaminants will be transferred to another media rather than destroyed. Treatment timeframe is relatively short. As with most insitu technologies, it is unlikely that all areas of the subsurface will be treated to meet PRGs, but removal sufficient to eliminate source is considered achievable | MODERATE to HIGH (4-5) – The soil will be treated and destroyed insitu. Treatment timeframe is relatively short. As with most insitu technologies, it is unlikely that all areas of the subsurface will be treated to meet PRGs, but removal sufficient to eliminate source is considered achievable. | HIGH (5) – The soil will be removed and disposed of at a landfill and/or treated offsite. The treatment timeframe is relatively short. With the excavation method it is likely that all of the subsurface will meet the PRGs set for this site. |
| Compliance with ARARs | NONE (0) – Soil above PRGs will be left in-place and, as a result, VOCs may continue to enter the groundwater at concentrations that will result in exceedences of PRGs | MODERATE (3-4) – SVE is a proven technology to remediate VOCs in unsaturated soil to the PRGs. However, even slight heterogeneities of the soil will limit its ability to effectively treat every cubic yard of contaminated soil. | MODERATE (3-4) – Although it is considered a relatively new technology, ISCO has proven successful to treat unsaturated soil to low CVOC levels at multiple sites. Similar to SVE, the heterogeneity of the soil may limit its ability to treat every cubic yard of contaminated soil The critical success factor for effective treatment using ISCO is uniform delivery of the oxidant to the contaminated soil zones. | MODERATE to HIGH (4-5) – Excavation is a proven technology to eliminate contaminated soil from the subsurface to meet the sites PRGs. |
| Long-term Effectiveness and Permanence | NONE (0) – No measures will be taken to manage contamination left in-place. No site-specific restrictions would be put in place to prevent future exposure. | MODERATE to HIGH- (3-4) –SVE should permanently remove the majority of contaminants from the subsurface. The overall risk of low level contamination left in-place is likely to be below acceptable levels. No land-use restrictions would be required after treatment. | MODERATE to HIGH (3-4) – ISCO will permanently destroy the majority of contaminants to harmless by-products. The overall risk of remaining low level contamination left in-place will likely be below acceptable levels. No land-use restrictions would be required after treatment. | MODERATE to HIGH (4-5) – Excavation should permanently remove the majority of contaminants from the subsurface. The overall risk of low level contamination left in-place is likely to be below acceptable levels. No land-use restrictions would be required after treatment. |
| Reduction in Toxicity, Mobility, or Volume | VERY LOW (1) – The site will be left as is and only the slow natural processes of volatilization, biodegradation, and leaching will act to reduce the levels of soil contamination. | MODERATE (4) – VOCs are removed from the subsurface and discharged into the atmosphere. It is assumed that since the mass of VOCs is low, emissions control will not be required and atmospheric dispersion will be enough to protect human health and the environment., however contaminants are not destroyed. | HIGH (5) – ISCO completely destroys the contaminants insitu to harmless by-products such as carbon dioxide and water. | MODERATE to HIGH (3-4) – Excavation completely removes the contaminants from the site, however the mass of the contamination is not destroyed if it is placed in a landfill. If, on the other hand, the contaminated soil is treated VOCs may be destroyed. Excavation will also release VOCs to the atmosphere during digging activities. |
| Short-term Effectiveness | VERY LOW (1) – Continued source of VOCs in soil would impact effectiveness of groundwater remedy. Remediation timeframe is estimated at greater than 30 years. | MODERATE (3-4)– the heterogeneity of the soil will control the remediation timeframe, but COC is highly volatile and should be readily removed. Remediation timeframe is estimated at 2 years. | HIGH (4-5) – ISCO is a rapid treatment process with a remediation timeframe estimated at 1 year, However, the heterogeneity of the soil and effectiveness of the chemical delivery will control the remediation timeframe. | HIGH (4) – Excavation is a rapid remediation process of 1 year, however there are risks to contaminant exposure during excavation activities |
| Implementability | HIGH (5) – Nothing to implement. | HIGH (5) – The technology is widely used and easily implemented by a number of vendors. There are few or no administrative barriers. Risks to workers from emissions are minor. | MODERATE (4) – While it is technically implementable it requires the handling of a significant volume of chemical oxidant.. Administrative hurdles will likely involve obtaining a underground injection control permit. | MODERATE (3) – The technology is widely used and easily implemented by a number of vendors. There are few or no administrative barriers. The depth of excavation (35 feet) would require special precautions |
| Cost * | LOW (5)<br>- $20,000 present worth cost<br>- $0 capital cost<br>- $6,000 Five-Year Review<br>- $0 post-closure cost | LOW to MODERATE (4)<br>- $313,000 present worth cost<br>- $111,000 capital cost<br>- $74,000 to 76,000 annual O&M<br>- $66,000 post-closure cost | MODERATE-HIGH (2)<br>- $736,000 present worth cost<br>- $308,000 capital cost<br>- $374,000 1-year operation<br>- $72,000 post-closure cost | HIGH (1)<br>- $1,010,000 present worth cost<br>- $1,010,000 capital cost |

* The cost estimates provided are to an accuracy of +50 percent to -30 percent and are prepared for the sole purpose of alternative comparison. The alternative cost estimates are in 2002 dollars and are based on conceptual design from information available at the time of this study. The actual cost of the project would depend on the final scope and design of the selected remedial action, the schedule of implementation, competitive market conditions, and other variables.

TABLE 2-45
Summary of Detailed Alternatives Analysis for Site 4 Source Area Soil
*ROD for Site 4 Soil and Groundwater*
*Former NSWC White Oak, Silver Spring, Maryland*

| | Site 4 Soil Remediation Alternatives | | | |
|---|---|---|---|---|
| **CERCLA Criteria** | **Alt. 1—No Action** | **Alt. 2—Soil Vapor Extraction** | **Alt. 3—In Situ Chemical Oxidation** | **Alt. 4—Excavation** |
| Protection of Human Health and the Environment[1] | MOD<br>2 | MOD–HIGH<br>(4–5) | MOD–HIGH<br>(4–5) | HIGH<br>5 |
| Compliance with ARARs[1] | NONE<br>0 | MOD<br>(3–4) | MOD<br>(3–4) | MOD–HIGH<br>(4–5) |
| Long-Term Effectiveness and Permanence[1] | NONE<br>0 | MOD–HIGH<br>(3–4) | MOD–HIGH<br>(3-4) | MOD–HIGH<br>(4–5) |
| Reduction in Toxicity, Mobility, or Volume[1] | VERY LOW<br>1 | MOD<br>4 | HIGH<br>5 | MOD–HIGH<br>(3–4) |
| Short-Term Effectiveness[1] | VERY LOW<br>1 | MOD<br>(3–4) | HIGH<br>(4–5) | HIGH<br>4 |
| Implementability[1] | HIGH<br>5 | HIGH<br>5 | MOD<br>4 | MOD<br>3 |
| Cost[2] | LOW<br>5 | LOW–MOD<br>4 | MOD-HIGH<br>2 | HIGH<br>1 |
| TOTAL SCORE | 14 | (26–30) | (25–29) | (24–27) |

[1] Alternatives are ranked relative to each other in each category with zero (0) the lowest ranking and five (5) the highest ranking. A numeric range is provided in parenthesis where significant uncertainty exists.

[2] The ranking for cost is reversed, an assessed quality of Low Cost is equivalent to the highest score of five (5).

TABLE 2-46
Detailed Analysis of Remediation Alternatives for Dissolved-Phase Groundwater Plume at Site 4
ROD for Site 4 Soil and Groundwater
Former NSWC White Oak, Silver Spring, Maryland

| CERCLA Criteria | ALT-1 – No Action | ALT-2 – Institutional Controls with Long-Term Monitoring | ALT-3 – Monitored Natural Attenuation | ALT-4 – Enhanced Reductive Dechlorination |
|---|---|---|---|---|
| Protection of Human Health and the Environment | LOW (1) – This alternative does not provide any increased protection of human health and the environment. There are no current risks and there are local ordinances that prevent the private use of groundwater for drinking water purposes. However, this alternative may actually create new risks because contaminant concentrations in surface water will likely increase when the currently operating groundwater extraction systems are shut down. | MODERATE (3) – Site specific administrative measures will be used to further control the exposure pathway to contaminated groundwater on site. Property purchases or off-site land use restrictions would prevent exposure to contaminants that have or will migrate offsite. Contaminant trend data suggests that the plume is stable. Current groundwater extraction and treatment systems have been shown to be effective at containing the plume from Site 4. | MODERATE (3) – The MNA alternative includes active groundwater monitoring and plume tracking to protect human health and the environment. ICs will also be employed until PRGs are met. Current groundwater extraction and treatment systems on the southern plume boundary would be maintained and have been shown to be effective at containing the plume from Site 4. | MODERATE to HIGH (4) – Human health and the environment will be protected through insitu treatment/destruction of the contamination. Groundwater monitoring will be performed to track the plume during treatment. ICs will be used to control exposure to contamination during implementation of the remedy. While there is significant uncertainties as to whether ARARs can be met, the theoretical time to remediation is moderately fast. A pilot test would be warranted. |
| Compliance with ARARs | NONE (0) – Groundwater above MCLs will be left in-place. Concentrations in surface water may increase to levels above RBCs (these are not ARARs). | LOW (1) – Contaminant concentrations exceeding MCLs will persist in the groundwater, however monitoring will be implemented to determine the extent of impacted groundwater. | LOW to MODERATE (2-3) – MNA is an accepted remediation approach for treatment of low-level chlorinated sites and can also be applied to explosives sites. Analysis of the geochemical conditions suggest some evidence for biodegradation of TCE and 1,1,2,2-PCA but it is unlikely that the biodegradation mechanism has enough carbon source for complete destruction of these chemicals south of Site 4. The ability of this alternative to meet ARARs in the non-source area plume may be significantly improved with the removal/treatment of the Site 4 soil source area. Additional groundwater monitoring data is necessary to ascertain the effects of the other loss mechanisms and whether they will be able to reduce the COCs to MCLs/PRGs. Contaminant concentrations exceeding MCLs will persist for an extended period of time on-site (the same conditions will exist as ALT 2); however, monitoring for NA parameters will provide assurances that remediation is occurring, and the contingency remedy will provide a fallback approach if MNA does not meet expectations. | MODERATE (2-4) – The indicating parameters for the biological mechanism of NA indicate that the system is TOC limited (<20 mg/L) and ethene is present. These factors indicate that it is a good candidate for ERD. The ability of ERD to meet ARARs (i.e., MCLs) and non-ARAR PRGs (in the case of 1,1,2,2-PCA) will depend on the ability to deliver the electron donor to the aquifer effectively. Another uncertainty is the ability of the native microorganisms to break the compounds all the way down to ethene. Current site data is promising. The creation of reducing conditions in the aquifer should also enhance the degradation of perchlorate. |
| Long-term Effectiveness and Permanence | NONE (0) – No measures will be taken to manage contamination left in-place. No site-specific restrictions would be put in place to prevent future exposure. | MODERATE (3) – Administrative measures can be effective, but only if long-term site access is managed diligently. Sale or reuse of the land will be restricted for use of groundwater. Natural groundwater controls (the surrounding streams) make it unlikely that the area under ICs will need to be expanded in the future. | MODERATE to HIGH (4) – The mechanisms of NA will act to either convert the contaminants to harmless by-products or dilute them to below MCLs/RBCs. Therefore, assuming MCLs/RBCs are met, the residual risk level will be low. However, as with use of any in-situ treatment technology, small pockets of contamination will likely remain after treatment and pose a small risk. Use of the groundwater will be unrestricted after treatment to PRGs. | MODERATE to HIGH (4) – The mechanisms of reductive dechlorination (RD) will act to convert the contaminants to harmless by-products. Therefore, assuming MCLs are met and there are no rebound effects, the residual risk level will be low. However, as with use of any in-situ treatment technology, small pockets of contamination will likely remain after treatment. Use of the groundwater will be unrestricted after treatment to PRGs. |
| Reduction in Toxicity, Mobility, or Volume | NONE (0) – Current containment and treatment measures will be removed and only the relatively slow natural processes of dilution, volatilization, biodegradation, adsorption, and dispersion will act to reduce the levels of groundwater contamination. | LOW to MODERATE (2-3) – The site will be left as is and only the relatively slow natural processes of dilution, volatilization, biodegradation, adsorption, and dispersion will act to reduce the levels of groundwater contamination. Rated higher than NA because existing pump and treat systems will remain in operation to control mobility and gradually remove mass and toxicity. Toxicity, mobility and volume will also be monitored. | MODERATE (3) The same mechanisms will be acting as in ALT 2 (groundwater extraction as well as dilution, volatilization, biodegradation, adsorption, and dispersion) and at the same rate, however this alternative offers the added benefit of verifying the reduction time and mechanisms (degradation vs dilution vs extraction) and provides a fallback contingency remedy. | MODERATE to HIGH (4) – The effect of ERD on reduction of TCE is similar to the MNA alternative, however the enhancement of the biological process would likely make that process more dominant than would otherwise be experienced in ALT 3. (more degradation and less dispersion and dilution). The expedited remediation timeframe, will lessen the risk for potential plume migration. |

TABLE 2-46
Detailed Analysis of Remediation Alternatives for Dissolved-Phase Groundwater Plume at Site 4
ROD for Site 4 Soil and Groundwater
Former NSWC White Oak, Silver Spring, Maryland

| CERCLA Criteria | ALT-1 – No Action | ALT-2 – Institutional Controls with Long-Term Monitoring | ALT-3 – Monitored Natural Attenuation | ALT-4 – Enhanced Reductive Dechlorination |
|---|---|---|---|---|
| Short-term Effectiveness | LOW (1) – No remediation activity. However the remediation timeframe is estimated at 105 years for the large plume emanating from Site 4, assuming that the Site 4 source area soil is remediated. Time is based on groundwater flow rate and retardation of TCE. | LOW to MODERATE (2) - There is no increased risk during implementation and current risks do not exist. The remediation timeframe is still estimated at 105 years assuming that the Site 4 source area soil is remediated, however the centrifuge extraction system would remove more contaminant mass earlier on in the process, and would remediate the center (highest concentrations) of the plume in slightly less time (90 years). | LOW to MODERATE (2-3) – There is no increased risk during implementation and current risks do not exist. An acceptable remediation time frame based on comparison to other alternatives would be 45 years. Data collected over the first 5 to 10 years after the soil treatment would verify this. If MNA data indicated this would not be met after several years of monitoring, a more aggressive contingency remedy would be implemented. | MODERATE (3-4) – Chemical handling of the electron donor is not especially hazardous and can be performed using typical injection wells and pumps. The remediation timeframe for the more highly contaminated TRZ is estimated at 8 years, but significant uncertainties are present. The area between the TRZ and the centrifuge wells would require 45 years. The downgradient areas of the plume would be cleaned up in 40 years. |
| Implementability | MODERATE (3) – Shutting down the existing treatment systems would be relatively easy. Nothing to implement. | MODERATE (3) - While onsite ICs are highly feasible on a technical basis, they may present significant administrative hurdles if controls are to be in place in perpetuity. Off-site property acquisition or permanent site-specific groundwater restrictions would be even more difficult to employ but may be needed for some duration under all alternatives since treatment will not be instantaneous. | MODERATE to HIGH (4) – MNA is technically and administratively implementable with the appropriate technical justification that MNA will remediate the site to MCLs. Additional post removal action NA parameter data will be needed over time to provide justification. This data can be collected during implementation using a contingency plan as a fallback. | MODERATE (3) – A subsurface injection permit will be required for treatment using ERD. Many states allow injection of ERD chemicals, therefore, it is not expected to be a problem since the chemicals are generally harmless and will be consumed as part of the process. ERD chemicals are readily available. Substantial infrastructure (injection wells) is required to implement. Pilot test would be warranted. |
| Cost * | LOW (5)<br>- $34,000 present worth cost<br>- $14,000 capital cost<br>- $6,000 Five-Year Review<br>- $0 post-closure cost | MODERATE to HIGH (2-3)<br>- $1,570,000 present worth cost<br>- $25,000 capital cost<br>- $85,000 annual O&M<br>- $0 post-closure cost | MODERATE to HIGH (2-3)<br>- $1,550,000 present worth cost<br>- $25,000 capital cost<br>- $84,000 annual O&M<br>- $55,000 post-closure cost | MODERATE to HIGH (1-3)<br>- $2,800,000 present worth cost<br>- $540,000 capital cost<br>- $80,000 - $280,000 annual O&M<br>- $100,000 post-closure cost |

* The cost estimates provided are to an accuracy of +50 percent to -30 percent and are prepared for the sole purpose of alternative comparison. The alternative cost estimates are in 2003 dollars and are based on conceptual design from information available at the time of this study. The actual cost of the project would depend on the final scope and design of the selected remedial action, the schedule of implementation, competitive market conditions, and other variables.

TABLE 2-16 (CONTINUED)
Detailed Analysis of Remediation Alternatives for Dissolved-Phase Groundwater Plume at Site 4
ROD for Site 4 Soil and Groundwater
Former NSWC White Oak, Silver Spring, Maryland

| CERCLA Criteria | ALT-5 – Air Sparging | ALT-6 – Groundwater Extraction and Treatment | ALT-7 – Mid-Plume Extraction System<br>(Alternative can be included with any of the other six alternatives except Alternative 1; it is not ranked because it is not a stand-alone alternative.) |
|---|---|---|---|
| Protection of Human Health and the Environment | MODERATE to HIGH (4) - Human health and the environment will be protected through permanent removal of the contamination. ICs will be used to control exposure to contamination during implementation of the remedy. Contaminated groundwater will be rapidly treated onsite to remove contaminants by transferring them to the air. While there are moderate uncertainties as to whether ARARs can be met, these are inherent in all of the insitu alternatives being evaluated. The theoretical time to remediation is moderately fast. | MODERATE to HIGH (4) – Plume migration will be controlled and mass removed from the site via dissolution and pumping. There are moderate uncertainties as to whether ARARs can be met, and the theoretical time to remediation is similar to alternatives 4 and 5. | IMPROVE - Plume migration will be controlled and mass removed from the site via dissolution and pumping. There are moderate uncertainties as to whether ARARs can be met. The theoretical time to remediation is 16 years (i.e the mid-plume wells could be shut down in 16 years. The existing extraction systems would operate for a total of 20 years. |
| Compliance with ARARs | MODERATE (3) – Air sparging has a relatively good likelihood to meet MCLs for TCE in the non-source area groundwater through aggressive aeration. Would have difficulty treating 1,1,2,2-PCA because of low volatility. Uncertainties include subsurface heterogeneities that may hinder uniform aeration. | MODERATE to HIGH (4)– P&T systems are effective at plume control and relatively good at removing dissolved contamination once source material (NAPL or adsorbed phase contamination) is gone. Ex-situ air stripping treatment systems have been proven highly reliable to treat the extracted groundwater to surface water discharge criteria over the long-term. Concentrations of explosives and perchlorate would not be treated by the air stripper, but concentrations of these chemicals are expected to be below the discharge requirements. | NO EFFECT - Pumping systems are effective at plume control and relatively good at removing dissolved contamination once source material (NAPL or adsorbed phase contamination) is gone. Including this alternative would not necessarily improve compliance with ARARs. |
| Long-term Effectiveness and Permanence | MODERATE (3) – Air sparging would remove TCE and the more highly volatile contaminants from the subsurface yielding low residual risk levels. However, there is considerable doubt about the technologies ability to remove 1,1,2,2-PCA, which is not as volatile. Also, as with use of any in-situ treatment technology, small pockets of contamination will likely remain after treatment. Rebound effects are also common in air sparging applications, so post treatment monitoring will be necessary for a short period. Use of the groundwater will be unrestricted after treatment to PRGs. | MODERATE to HIGH (4) – The P&T system would remove the contaminants from the subsurface yielding low residual risk levels. However, as with use of any in-situ treatment technology, small pockets of contamination will likely remain after treatment. Rebound effects are also common in pump and treat applications. Use of the groundwater will be unrestricted after treatment to PRGs. | IMPROVE - The pumping system would remove the contaminants from the subsurface yielding low residual risk levels. However, as with use of any in-situ treatment technology, small pockets of contamination will likely remain after treatment. Rebound effects are also common in pump and treat applications. Use of the groundwater will be unrestricted after treatment to PRGs. Additional mass removal should improve long-term effectiveness. |
| Reduction in Toxicity, Mobility, or Volume | MODERATE (3) - Air sparging will remove the contaminants from the groundwater by volatilizing them and discharging them to the air, but in low and acceptable concentrations. May have little effect on 1,1,2,2-PCA | MODERATE (3-4) – The P&T system will be very effective at controlling migration of the contaminants in the groundwater. It will, however, be slow at mass removal. Contaminants that are removed will be transferred to the air through air stripping, but in low and acceptable concentrations. | IMPROVE - The inclusion of Alternative 7 in the selected remedy would remove more mass faster than not including it. |

TABLE 2-46 (CONTINUED)
Detailed Analysis of Remediation Alternatives for Dissolved-Phase Groundwater Plume at Site 4
ROD for Site 4 Soil and Groundwater
Former NSWC White Oak, Silver Spring, Maryland

| CERCLA Criteria | ALT-5 – Air Sparging | ALT-6 – Groundwater Extraction and Treatment | ALT-7 – Mid-Plume Extraction System<br><br>(Alternative can be included with any of the other six alternatives except Alternative 1. It is not ranked because it is not a stand-alone alternative.) |
|---|---|---|---|
| Short-term Effectiveness | MODERATE (3-4) – There is very low risk to workers and the community from fugitive vapors during construction due to lack of occupied buildings and population in the area (as long as conditions remain so). The remediation timeframe for the more highly contaminated TRZ is estimated at 8 years, but significant uncertainties are present. The cleanup timeframe is primarily based on the time it would take groundwater contaminants to flow from one curtain to the next. The area between the TRZ and the centrifuge wells would require 45 years. The downgradient areas of the plume would be cleaned up in 40 years. | MODERATE (3-4) – Current data indicates a relatively fast remediation time frame for the more highly contaminated TRZ: 6 years of pumping. The area between the TRZ and the centrifuge wells would require 45 years. The downgradient areas of the plume would be cleaned up in 40 years. Risks to workers and the community during construction are minimal since it involves well, piping, and equipment installation only. P&T will not adversely affect downgradient attenuation of the dissolved contaminant plume. | IMPROVE - Implementation would reduce the cleanup time for the portion of the plume south of the TRZ from 40 years to 16 years. The overall time to remediation would be 20 years based on the time to remediate the area between the TRZ and the centrifuge wells. Risks to workers and the community during construction are minimal since it involves well, piping, and equipment installation only. Pumping will not adversely affect downgradient attenuation of the dissolved contaminant plume. |
| Implementability | MODERATE to HIGH (4) –No additional permits, beyond well installation permits, are required for air sparging. | MODERATE to HIGH (4) – A National Pollutant Discharge Elimination System (NPDES) permit will be required to discharge treated water to a nearby surface water stream. The facility already holds NPDES permit for an existing P&T system, therefore, this is not expected to be difficult to obtain. The air stripper will need an air permit. Since the emissions are expected to be very low, a permit waiver is likely. P&T system components are all readily available. | NO EFFECT - The NPDES permit required for treatment has already been obtained for the system serving the existing centrifuge wells and the extraction trench. Pumping system components are all readily available. |
| Cost | MODERATE to HIGH (1-3)<br>- $2,800,000 present worth cost<br>- $630,000 capital cost<br>- $80,000 - 200,000 annual O&M<br>- $100,000 post-closure cost | MODERATE to HIGH (2-3)<br>- $2,400,000 present worth cost<br>- $340,000 capital cost<br>- $80,000 - 220,000 annual O&M<br>- $56,000 post-closure cost | - $630,000 present worth cost<br>- $200,000 capital cost<br>- $31,000 - $61,000 annual O&M<br>- $35,000 post-closure cost<br>- $230,000 savings on other alts by reducing overall cleanup time<br>- $400,000 net present worth cost |

TABLE 2-47
Summary of Detailed Alternatives Analysis for Site 4 Groundwater
*ROD for Site 4 Soil and Groundwater*
Former NSWC White Oak, Silver Spring, Maryland

| CERCLA Criteria | Non-Source Area Groundwater Alternatives | | | | | | |
|---|---|---|---|---|---|---|---|
| | ALT-1 No Action | ALT-2 ICs and LTM | ALT-3 MNA | ALT-4 ERD | ALT-5 Air Sparging | ALT-6 Pump & Treat | ALT-7[3] Mid-Plume Extraction |
| Protection of Human Health and the Environment [1] | LOW<br>1 | MOD<br>3 | MOD<br>3 | MOD-HIGH<br>4 | MOD-HIGH<br>4 | MOD-HIGH<br>4 | + |
| Compliance with ARARs [1] | NONE<br>0 | LOW<br>1 | MOD<br>2-3 | MOD<br>3-4 | MOD<br>3 | MOD-HIGH<br>4 | = |
| Long-term Effectiveness and Permanence[1] | NONE<br>0 | MOD<br>3 | MOD-HIGH<br>4 | MOD-HIGH<br>4 | MOD<br>3 | MOD-HIGH<br>4 | + |
| Reduction in Toxicity, Mobility, or Volume [1] | NONE<br>0 | LOW-MOD<br>2-3 | MOD<br>3 | MOD-HIGH<br>4 | MOD<br>3 | MOD-HIGH<br>4 | + |
| Short-term Effectiveness[1] | LOW<br>1 | LOW-MOD<br>2 | MOD<br>2-3 | MOD<br>3-4 | MOD<br>3-4 | MOD<br>3-4 | + |
| Implementability[1] | MOD<br>3 | MOD<br>3-4 | MOD-HIGH<br>4 | MOD<br>3 | MOD-HIGH<br>4 | MOD-HIGH<br>4 | = |
| Cost[2] | LOW<br>5 | MOD-HIGH<br>2-3 | MOD-HIGH<br>2-3 | MOD-HIGH<br>1-3 | MOD-HIGH<br>1-3 | MOD-HIGH<br>1-3 | Net increase of $400,000 |
| TOTAL SCORE | 10 | 16-19 | 20-23 | 22-26 | 21-24 | 24-27 | + |

NOTES:
1 - Alternatives are ranked relative to each other in each category with zero (0) the lowest ranking and five (5) the highest ranking. A numerical range is provided in parenthesis where significant uncertainty exists.
2 - The ranking for cost is reversed: an assessed quality of Low Cost is equivalent to the highest score of five (5).
3 – Alternative 7 is not ranked because it is not a stand-alone alternative and may be included with any other alternative selected except for Alternative 1. Including Alternative 7 would either increase the ranking of an alternative (+) or have no effect (=). While the present worth cost of Alt 7 is $680k, the reduction in overall remediation time would reduce the O&M cost of the paired alternative by $280k .

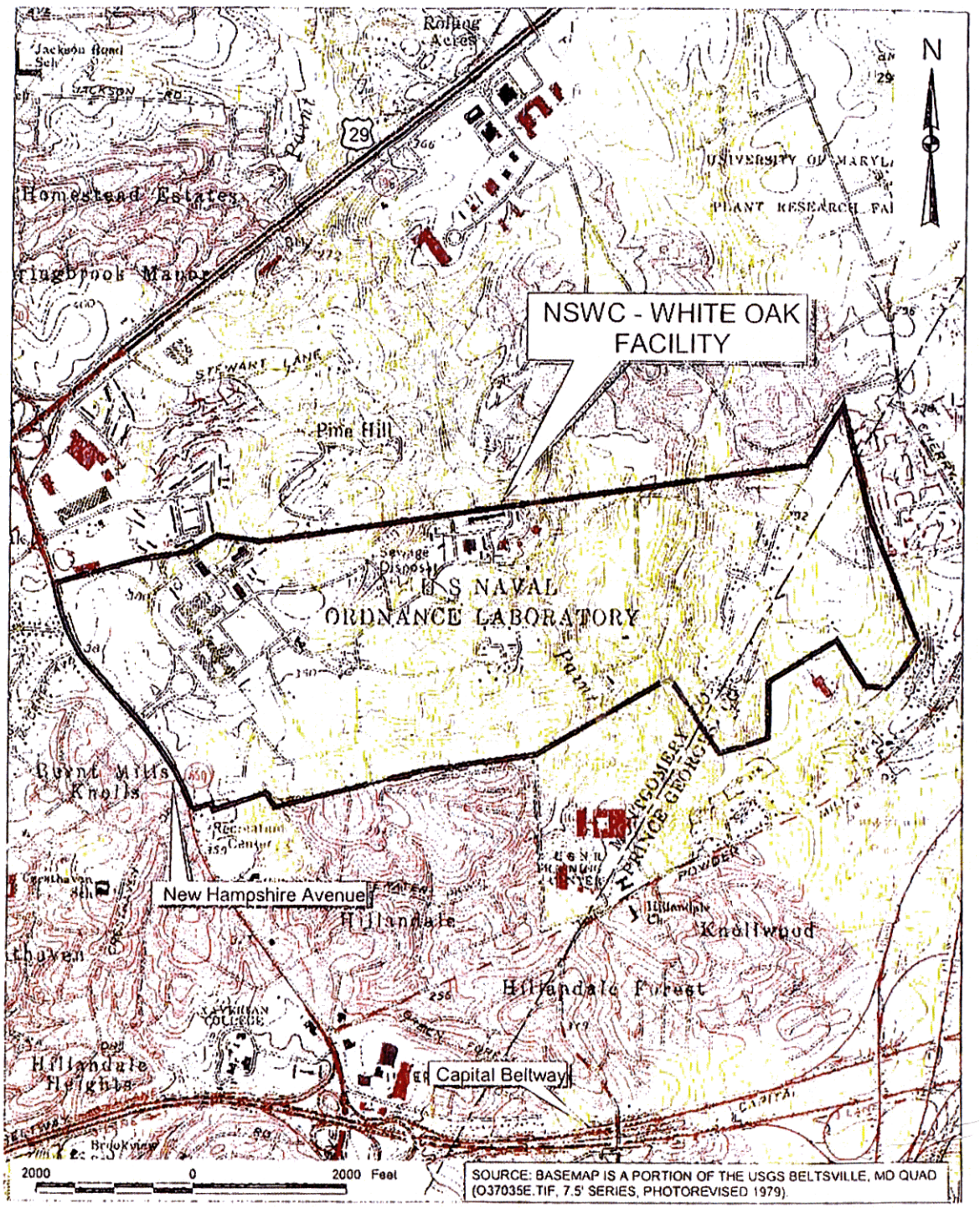


Figure 2-1
SITE VICINITY MAP
NSWC - White Oak
Silver Spring, Maryland

MODIFIED FROM
BROWN & ROOT ENVIRONMENTAL, 6/12/98

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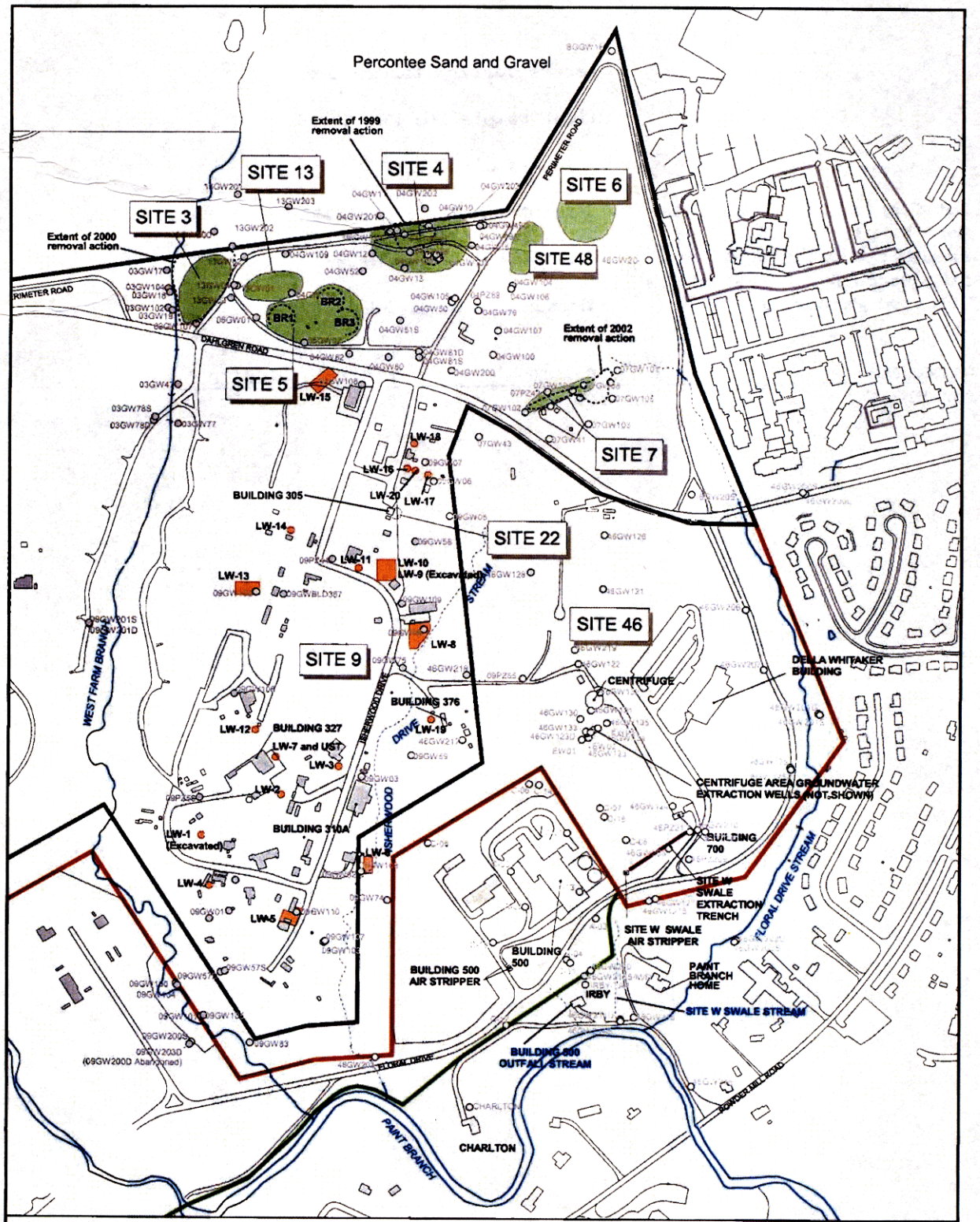


**Figure 2-2**
**Site Features**
**Record of Decision for Site 4**
**NSWC - White Oak, Silver Spring, Maryland**

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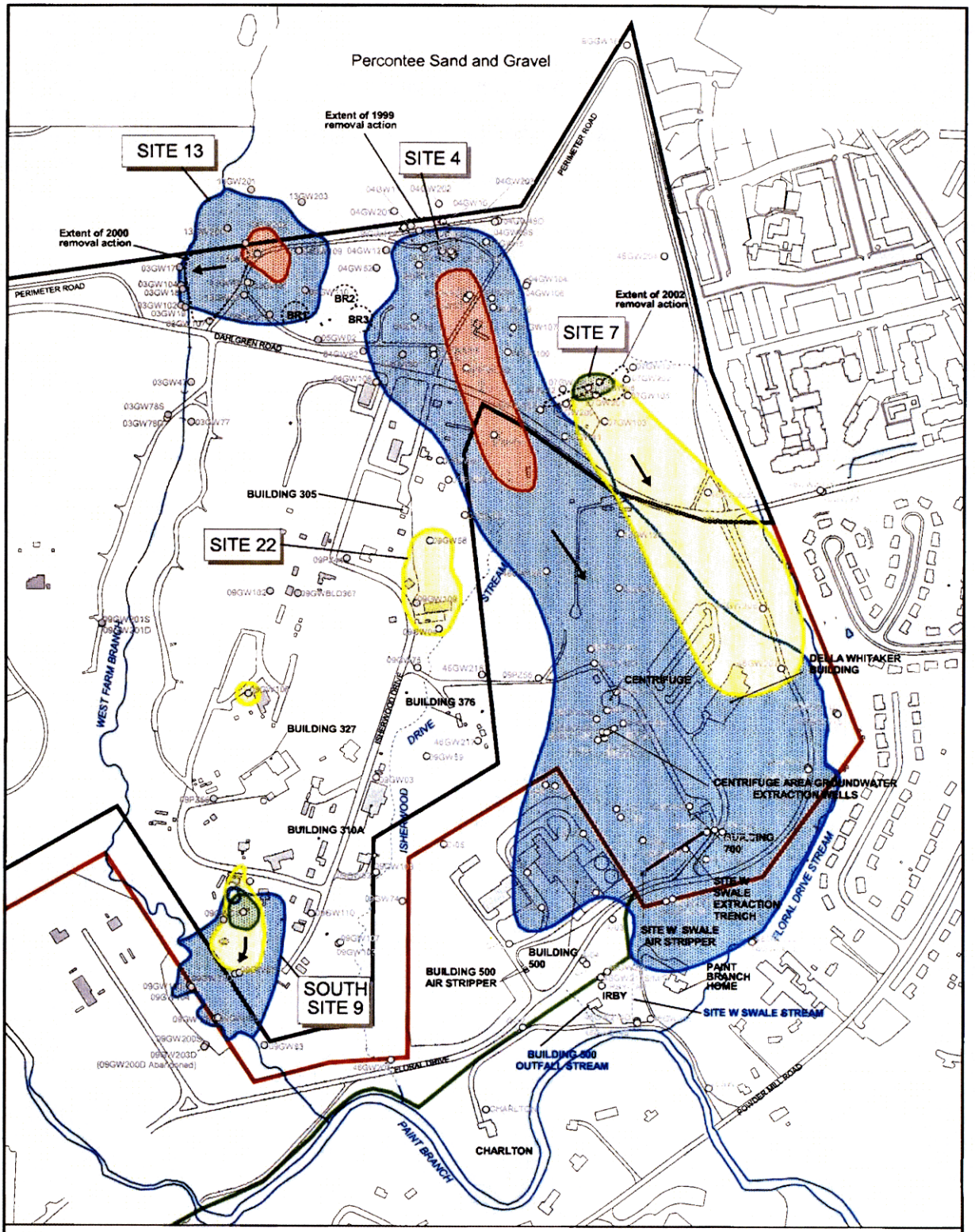


Monitoring Wells

**BASE MAP FEATURES**

- Current Boundary of NSWC White Oak
- 1969 Boundary of NSWC White Oak
- Army ALC Property (1998)
- Roads and Paved Areas
- Perennial Stream
- Intermittent Stream
- Groundwater Flow Direction
- Buildings and Other Structures

N W E S

200 0 200 400 600 Feet

- Chlorinated VOCs >500 ppb
- Chlorinated VOCs 5<500 ppb
- Explosives >100 ppb
- Explosives 5<100 ppb

**Figure 2-3**
**Approximate Extent of Groundwater Plumes at OU-1**
**Record of Decision for Site 4**
**NSWC - White Oak, Silver Spring, Maryland**

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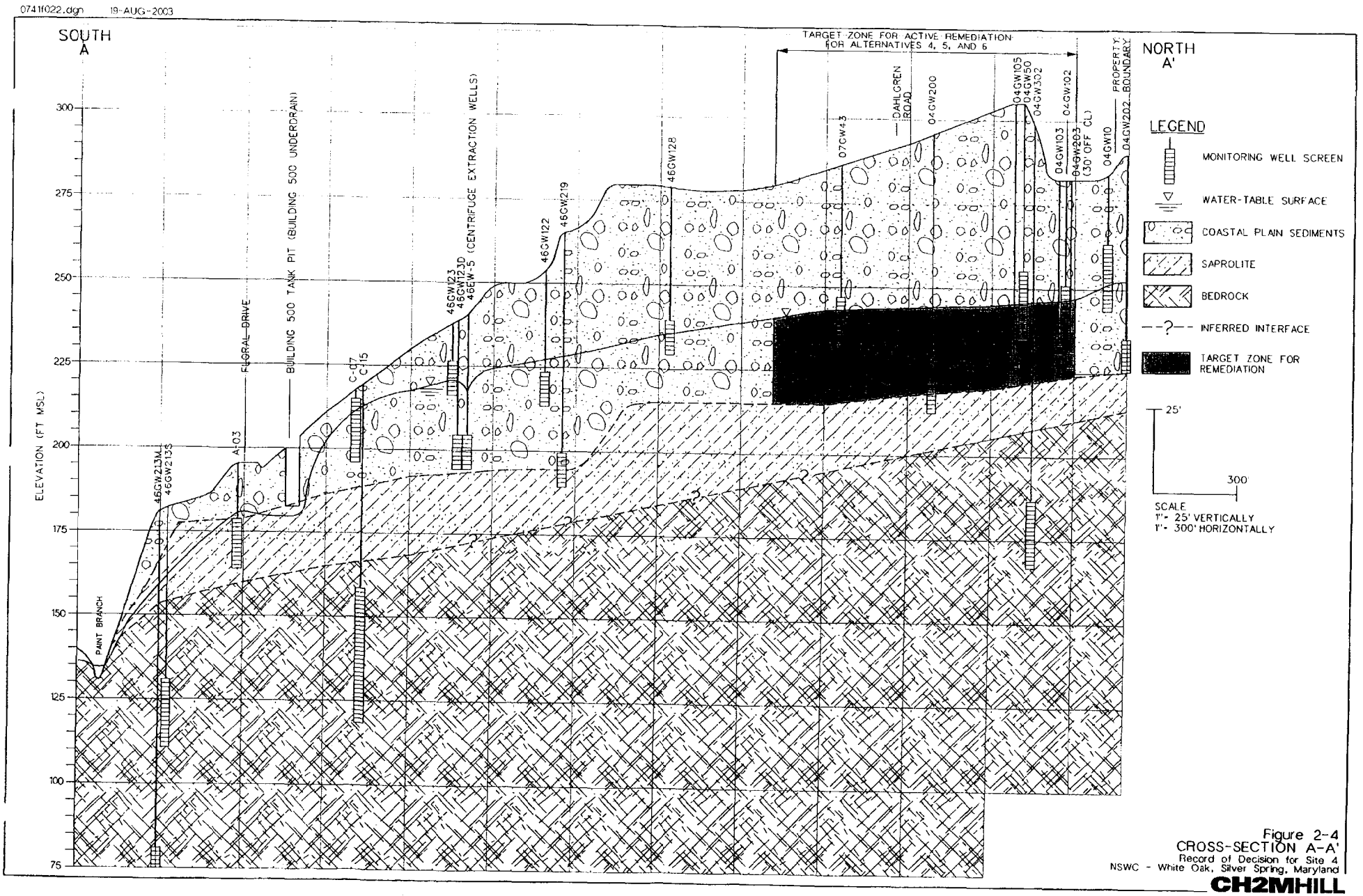


Figure 2-4
CROSS-SECTION A-A'
Record of Decision for Site 4
NSWC - White Oak, Silver Spring, Maryland

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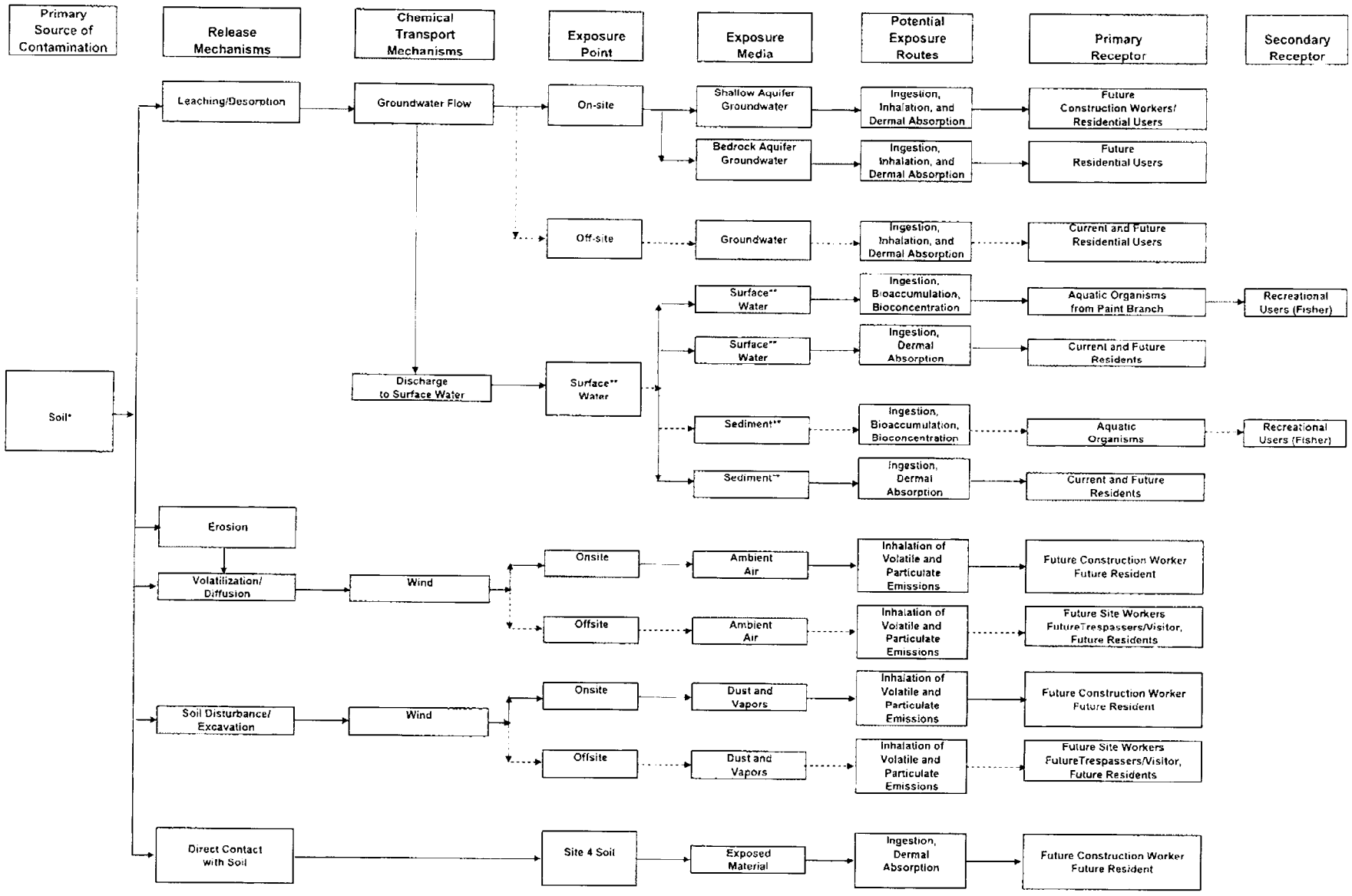
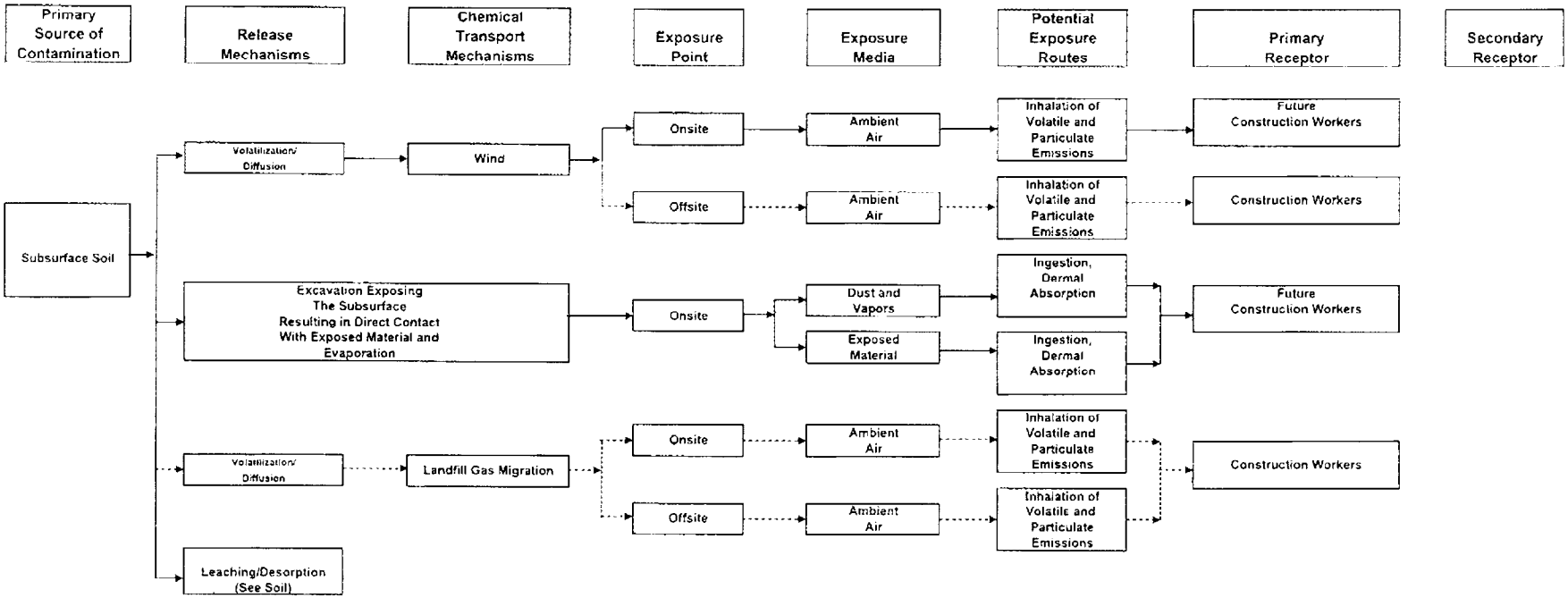



* Current scenario is for surface soil and future scenarios are for soil(surface and subsurface soil combined).
** Surface water and Sediment is from Paint Branch, Floral Drive Stream, Site W Swale, and Irby Property Stream

**Figure 2-5 (Sheet 1 of 2)**
Conceptual Site Model for Potential Human Exposures-ROD for Site 4
*White Oak, NSWC*




* Current scenario is for surface soil and future scenarios are for soil(surface and subsurface soil combined).

** Surface water and Sediment is from Paint Branch, Floral Drive Stream, Site W Swale, and Irby Property Stream.

→ Complete Pathway

- - → Incomplete Pathway

**Figure 2-5 (Sheet 2 of 2)**
Conceptual Site Model for Potential Human Exposures-ROD for Site 4
*White Oak, NSWC*

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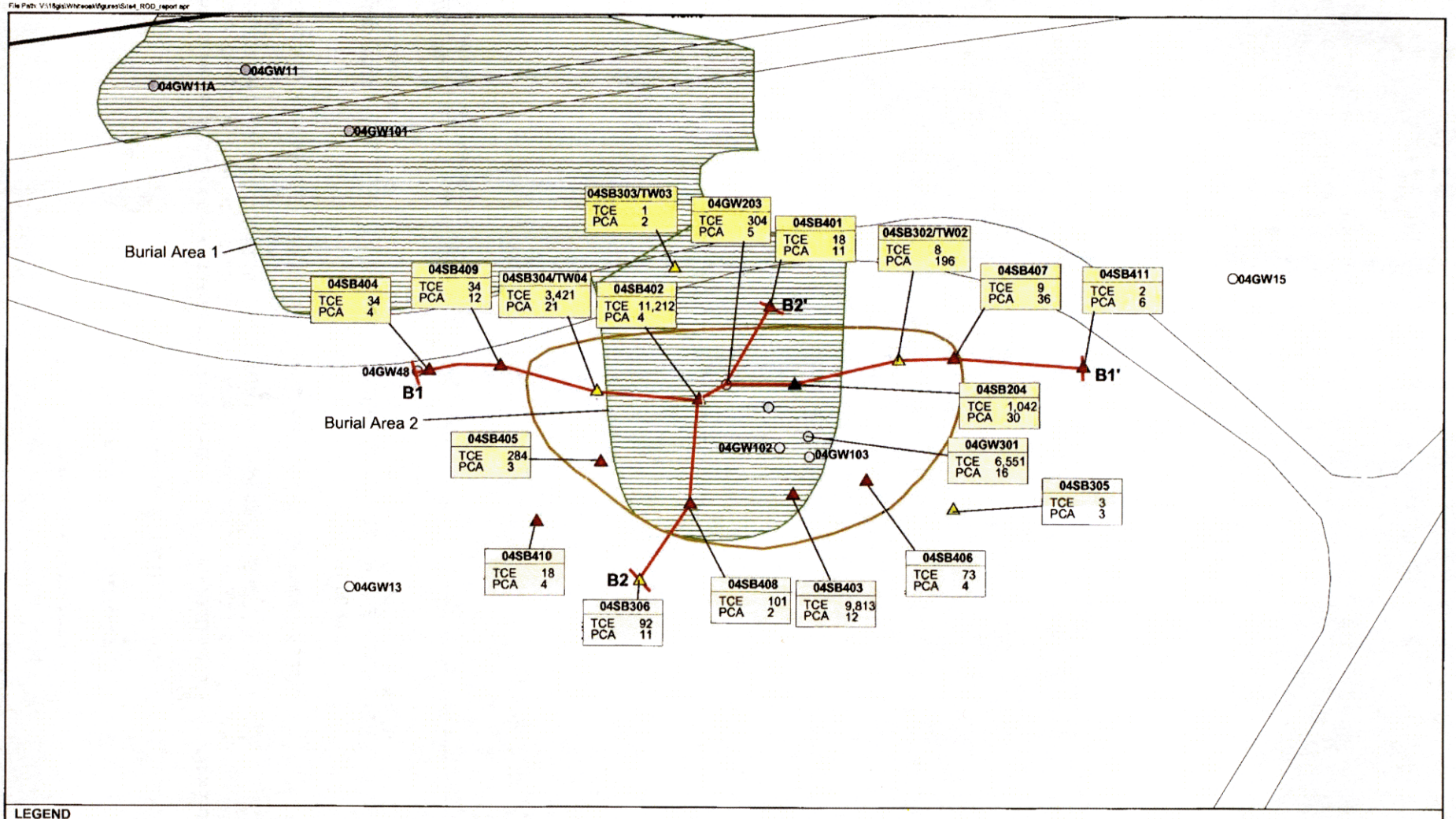


**LEGEND**

- Target Remediation Zone for Site 4 Soil (VOCs in excess of PRGs)
- January 2003 Soil Borings
- May 2002 Soil Borings
- September 2001 Soil Borings
- Monitoring Well
- Approximate Extent of 1999 Excavation
- Transect
- Roads and Paved Areas

TCE = Average concentration of Trichloroethene in ug/kg over a 30' thickness

PCA = Average concentration of 1,1,1,2-Tetrachloroethane in ug/kg over a 30' thickness

N

0 30 60 Feet

Figure 2-6
Soil Boring Locations and Target Remediation Zone for Site 4 Soil
Record of Decision for Site 4
NSWC, White Oak, Silver Spring, Maryland

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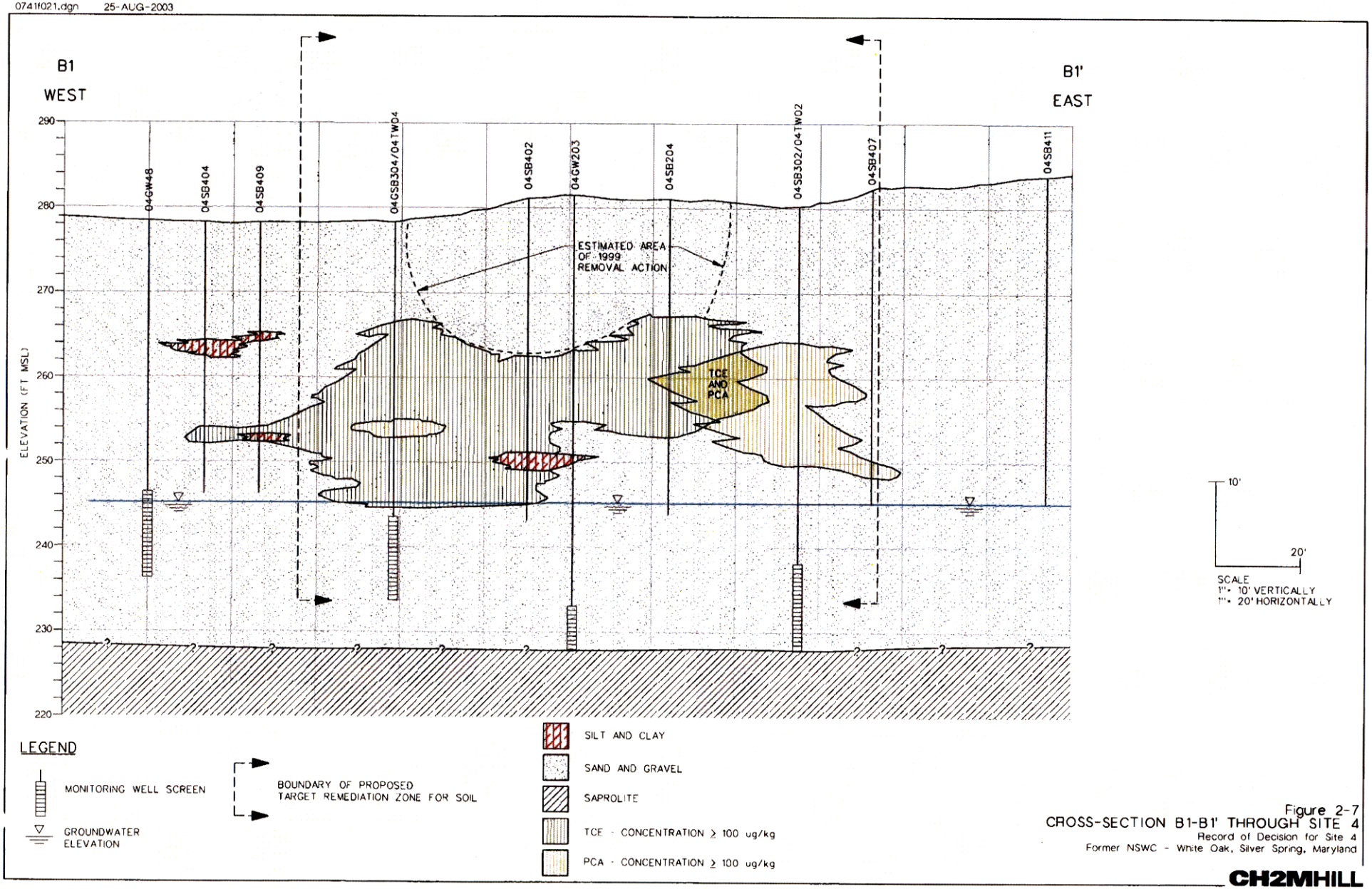


Figure 2-7
CROSS-SECTION B1-B1' THROUGH SITE 4
Record of Decision for Site 4
Former NSWC - White Oak, Silver Spring, Maryland

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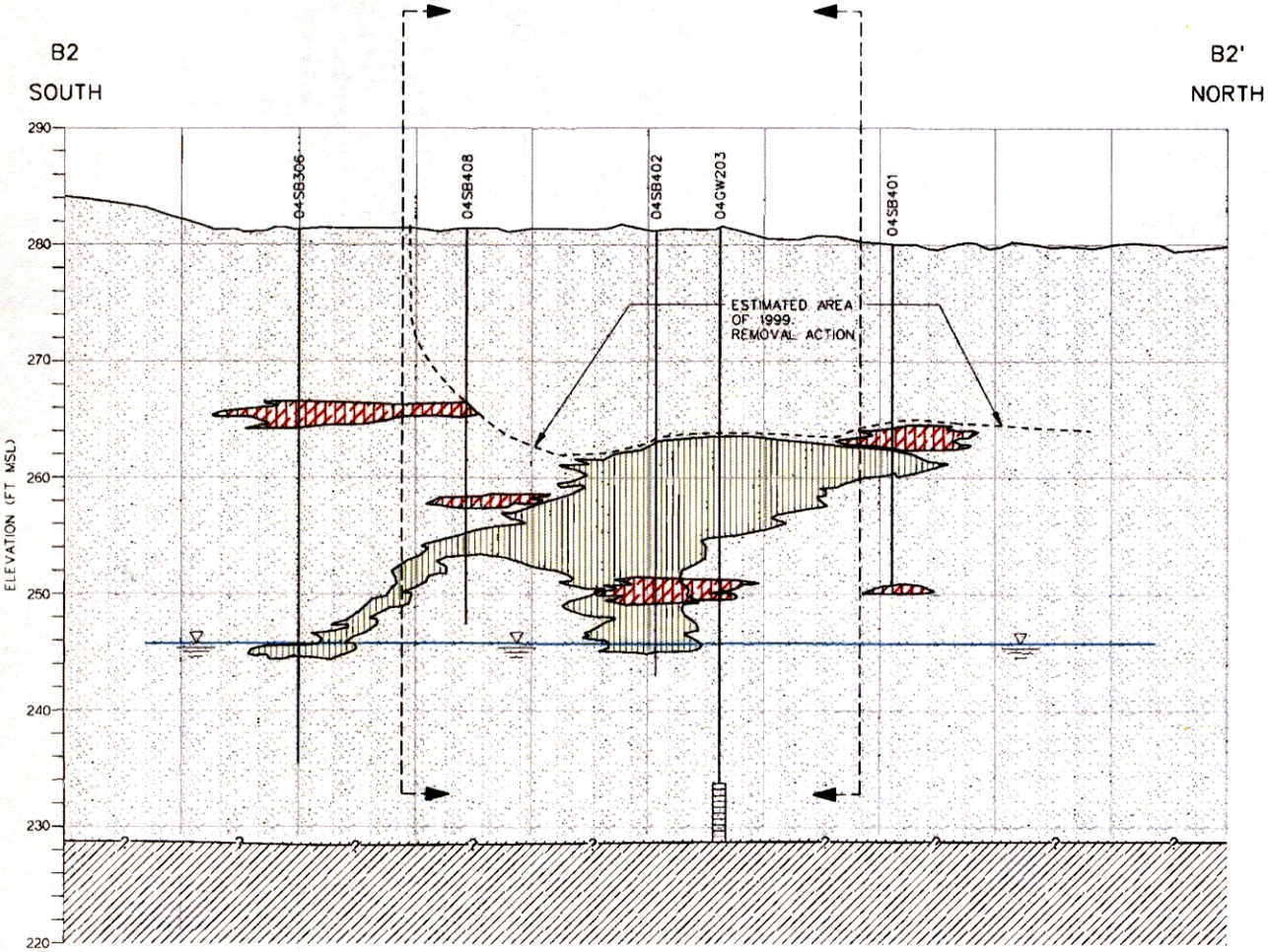


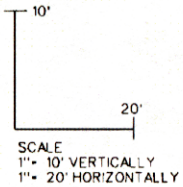


LEGEND

- MONITORING WELL SCREEN
- GROUNDWATER ELEVATION
- BOUNDARY OF PROPOSED TARGET REMEDIATION ZONE FOR SOIL
- SILT AND CLAY
- SAND AND GRAVEL
- SAPROLITE
- TCE - CONCENTRATION ≥ 100 ug/kg

Figure 2-8
CROSS-SECTION B2-B2' THROUGH SITE 4
Record of Decision for Site 4
Former NSWC - White Oak, Silver Spring, Maryland

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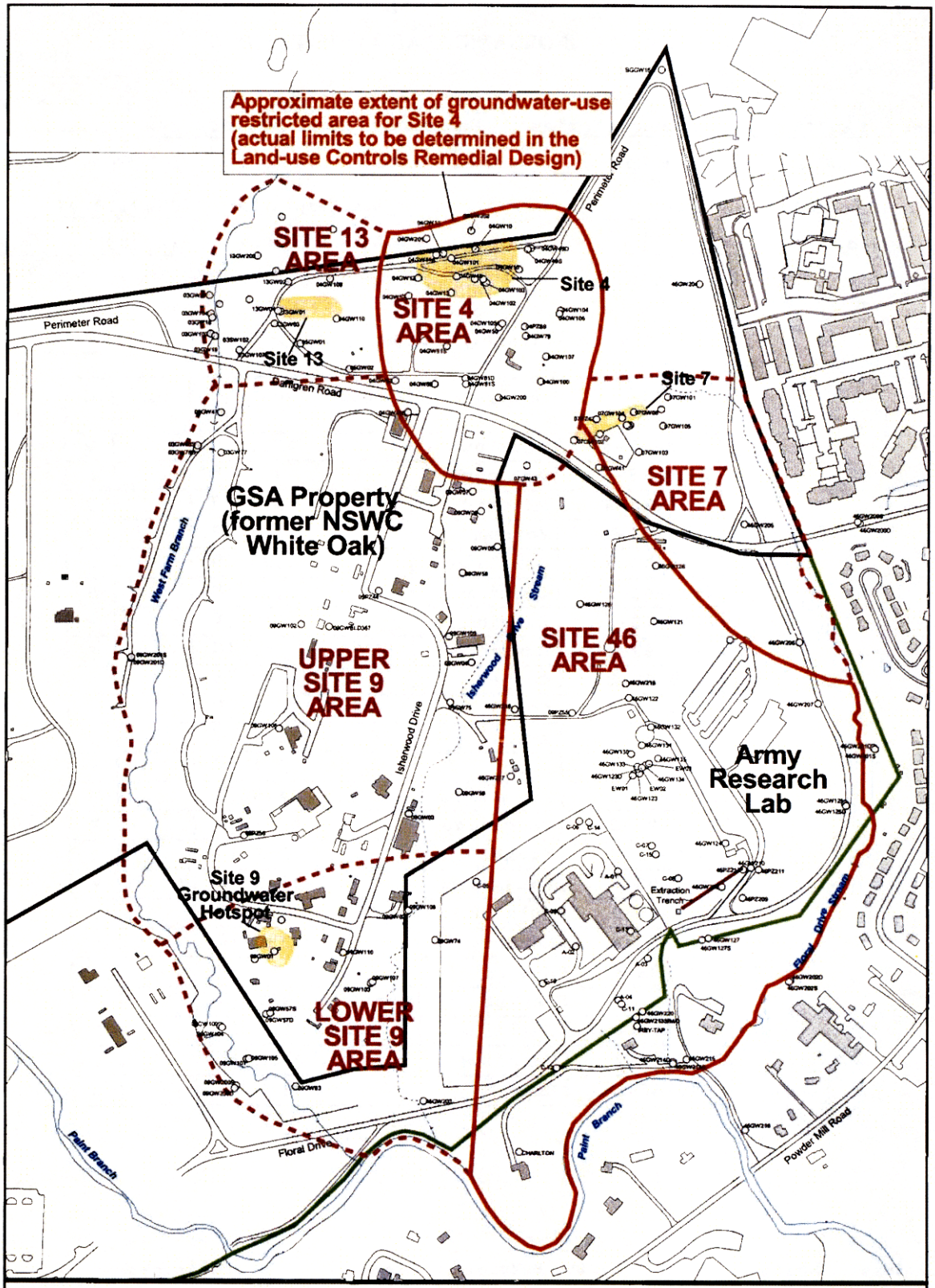


**SAMPLING LOCATIONS**
- Monitoring Wells
- PRG Attainment Area Boundaries

**BASE MAP FEATURES**
- Former NSWC White Oak Property Boundary
- Army Research Lab Property Boundary
- Roads and Paved Areas
- Perennial Stream
- Intermittent Stream
- Buildings and Other Structures

N W E S

400 0 400 800 Feet

**Figure 2-9**
**Sites 4 and 46 Groundwater PRG Attainment Areas**
**Record of Decision for Site 4**
**NSWC - White Oak, Silver Spring, Maryland**

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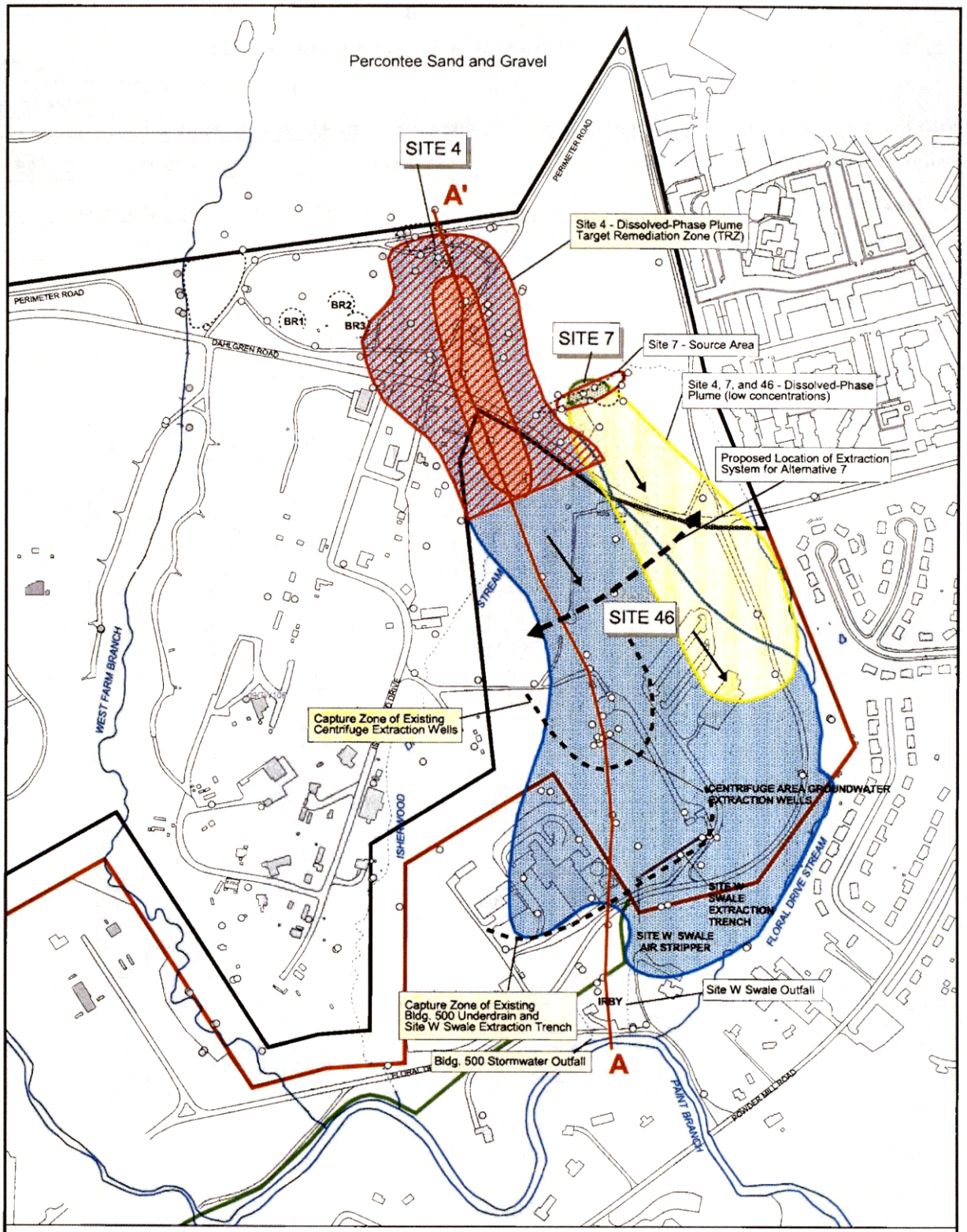


Monitoring Wells

**BASE MAP FEATURES**

- Current Boundary of NSWC White Oak
- 1969 Boundary of NSWC White Oak
- Army ALC Property (1998)
- Roads and Paved Areas
- Perennial Stream
- Intermittent Stream
- Groundwater Flow Direction
- Buildings and Other Structures

200 0 200 400 600 Feet

- Chlorinated VOCs >500 ppb
- Chlorinated VOCs 5<500 ppb
- Explosives >100 ppb
- Explosives 5<100 ppb

**Figure 2-10**
**Site 4, 7, and 46 Dissolved-Phase Groundwater Plume at OU-1**
**Record of Decision for Site 4**
**NSWC - White Oak, Silver Spring, Maryland**

CH2MHILL

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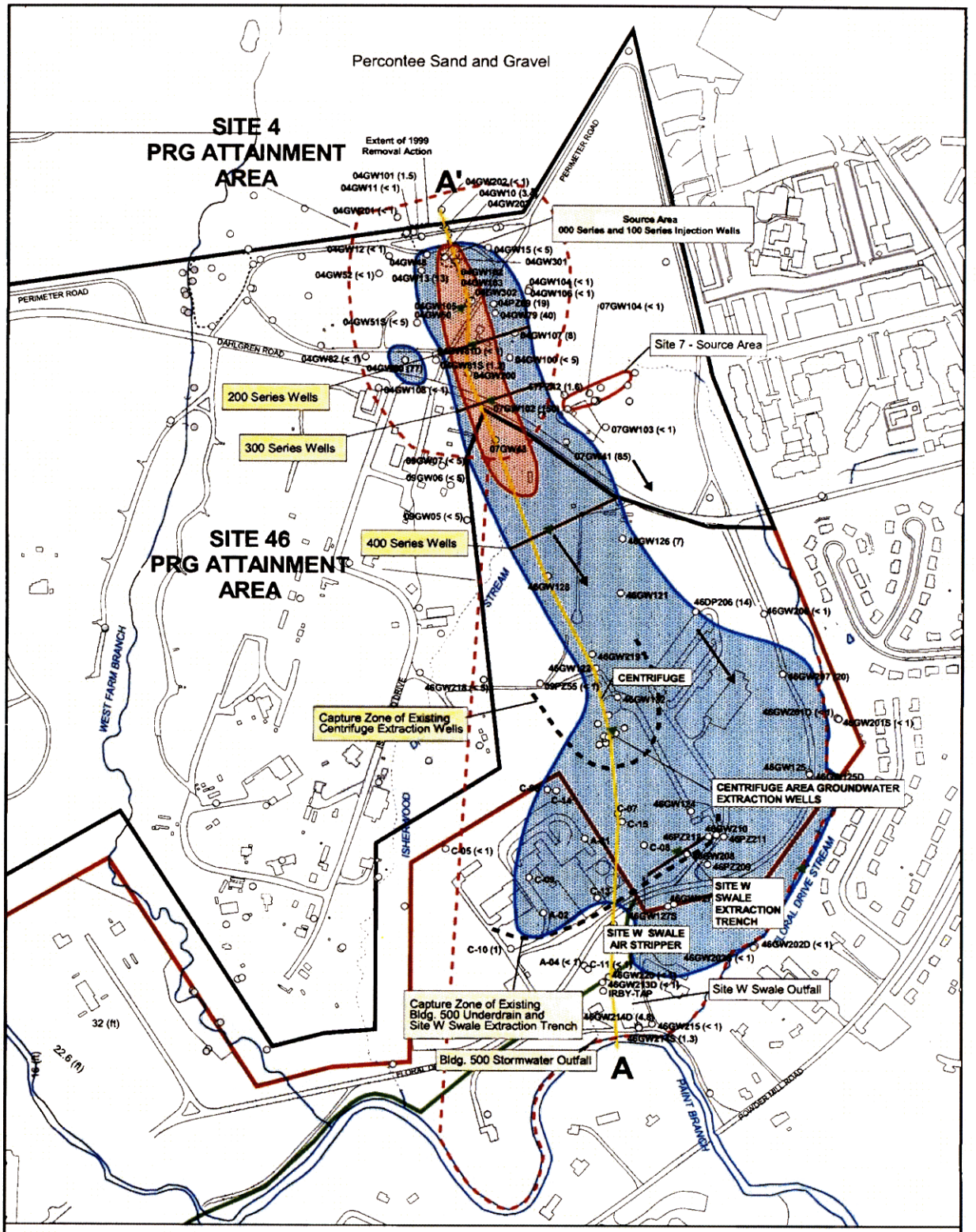


Monitoring Wells

**BASE MAP FEATURES**

- Cross Section
- Current Boundary of NSWC White Oak
- 1969 Boundary of NSWC White Oak
- Army ALC Property (1998)
- Proposed PRG Attainment Area Boundaries
- Roads and Paved Areas
- Perennial Stream
- Intermittent Stream
- Groundwater Flow Direction
- Buildings and Other Structures
- Biological Treatment Barrier Wall
- Chlorinated VOCs >500 ppb
- Chlorinated VOCs 5<500 ppb
- ( < 5 ) Concentration of TCE in µg/L from most recent well sample

200 0 200 400 600 Feet

**Figure 2-11**
**Conceptual Layout of Selected Remedy**
**Record of Decision for Site 4**
**NSWC - White Oak, Silver Spring, Maryland**

CH2MHILL

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# Appendix A

## Maryland Department of Environment

## Concurrence Letter

**MARYLAND DEPARTMENT OF THE ENVIRONMENT**
1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101

Robert L. Ehrlich, Jr.
Governor

Kendl P. Philbrick
Secretary

Michael S. Steele
Lt. Governor

Jonas A. Jacobson
Deputy Secretary

May 18, 2005

Mr. David Steckler
Department of the Navy
Naval Facilities Engineering Command Washington
Washington Navy Yard, Building 212
1314 Harwood Street SE
Washington D.C. 20374-5018

RE: Record of Decision Former Naval Surface Warfare Center--White Oak Site 4 Soil and Groundwater, CH2MHill, November 23, 2004.

Dear Mr. Steckler:

The Federal Facilities Division (FFD) of the Maryland Department of the Environment's Waste Management Administration has reviewed the above referenced submittal. This Record of Decision (ROD) presents the determination that *in-situ* enhanced reductive dechlorination with institutional controls and long-term monitoring to address groundwater contamination, and soil vapor extraction to address soil contamination, are necessary to protect human health and the environment at Navy Installation Restoration Site 4, Chemical Burial Area at the former Naval Surface Warfare Center--White Oak (NSWC--White Oak), in Silver Spring, Maryland.

In response to public comments, recent site data, and new guidance, the Navy and the EPA have revised the preferred remedy for Site 4 groundwater. The Navy and the EPA believe this revised remedy (*in-situ* enhanced reductive dechlorination, with institutional controls and long-term monitoring combined with the continued operation of the existing groundwater extraction and treatment system) will adequately and appropriately address Site 4 groundwater in a cost-effective and responsible manner. The FFD of the Maryland Department of the Environment concurs with the revised remedy.

# Appendix B

## ARAR Tables

**Table B-1**
**Chemical-Specific ARARs and Performance Standards**
**ROD for Site 4 Groundwater and Soil**
**Former NSWC White Oak, Silver Spring, Maryland**

| Chemicals & Relevant Media | Requirement | Prerequisites | Citation | ARAR or TBC | Comments |
|---|---|---|---|---|---|
| Groundwater, residential water supplies | Meet National Primary Standards for maximum contaminant levels (MCLs). | Drinking water source or potential source | Safe Drinking Water Act (SDWA): 40 CFR 141 National Primary Drinking Water Regulations, CERCLA 42 USC 9621(d) | Relevant and appropriate | MCL used as PRG for Site 4 groundwater. |
| Surface water | Water Management Program approval for short-term discharges and NPDES for long-term discharges. | Surface water discharges | CWA: 40 CFR 122-123 NPDES permit program | Applicable | Only applicable so long as groundwater extraction and treatment is operating. |
| Surface waters of the State | Protect and maintain the quality of surface water in the State of Maryland. Criteria and standards for discharges. | Activities that will pollute the State's surface waters | COMAR 26.08, chapters 1 through 7 | Applicable | This regulation is applicable for remedial actions that may affect surface water quality in the State of Maryland. Limitations and policy for antidegradation of the State's surface water are to be considered. |
| Surface water | Ambient Water Quality Criteria established to protect aquatic life and human consumers of water or aquatic life. | Activities that affect or may affect the surface water onsite | 40 CFR 129 | TBC | These regulations were used in the development of PRGs for Site 4. |
| Soil as a source of groundwater contamination | Regulated substances are not to exceed the soil-to-groundwater pathway numeric value throughout the soil column. | Potential exposure to groundwater | CERCLA, EPA Region III RBC tables, and EPA soil-screening guidance (EPA/540/R 94/101) | TBC | Applies at OU-1 where contaminants in soil are also present in groundwater at concentrations above PRGs. Used to define soil PRGs for Site 4. |
| Carcinogens in groundwater and surface water | Not to exceed media-specific concentration that causes a lifetime cancer risk of between 1 in 10,000 and 1 in 1,000,000. | Potential exposure | CERCLA, NCP 400CFR300.430 (e)(2)(i)(A)(2) | TBC | Used to calculate site-specific PRGs for Site 4 groundwater and surface water. |
| Systemic toxicants in groundwater and surface water | Not to exceed media-specific levels where people could be exposed by direct ingestion or inhalation on a daily basis without appreciable risk of deleterious effects. | Potential exposure | CERCLA, NCP 400CFR300.430 (e)(2)(i)(A)(1) | TBC | Used to calculate site-specific PRGs for Site 4 groundwater and surface water |
| Air | Emissions limitations related to attainment of National Ambient Air Quality Standards and Emission Standards for Hazardous Air Pollutants. | Air emissions | Clean Air Act (CAA) 40 CFR Part 50, 61 | Applicable | Applicable to treatment alternatives such as air stripping, soil vapor extraction, or air sparging which involve air emissions. |

ARAR - Applicable or relevant and appropriate requirement
CAA - Clean Air Act
RCRA - Resource Conservation and Recovery Act
CFR - Code for Federal Regulations
CWA - Clean Water Act
EPA - U.S. Environmental Protection Agency
NPDES - National Pollutant Discharge Elimination System
OSHA - Occupational Safety and Health Administration
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
SDWA - Safe Drinking Water Act
SMCLs - Secondary Maximum Contaminant Levels
TBC - To be considered

Table B-2
Location-Specific ARARs and Performance Standards
ROD for Site 4 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

| Location | Requirement | Prerequisite | Citation | Applicability Determination | Comments |
|---|---|---|---|---|---|
| **Federal Location-Specific ARARs** | | | | | |
| **Historic Sites, Buildings, and Antiquities Act** | | | | | |
| Historic sites | Avoid undesirable impacts on landmarks. | Areas designated as historic sites. | 16 USC 461-467<br>40 CFR 6.301 (a) | TBC | The regulations are to be considered in situations where remedial actions may adversely affect any historical structures located on Site 4. No historic sites have been identified in the area of Site 4 |
| **Endangered Species Act of 1973** | | | | | |
| Critical habitat upon which endangered species or threatened species depend. | Action to conserve endangered species or threatened species, including consultation with the Department of the Interior. Reasonable mitigation and enhancement measures must be taken, including live propagation, transplantation, and habitat acquisition and improvement, where appropiate. | Determination of harmful effect upon endangered or threatened species or their habitat by conducting biological assessments. | 16 USC 1531;<br>16 USC 1536(a);<br>50 CFR 81, 225, 402 | Potentially applicable | There is no evidence of federal endangered plant and animal species located at White Oak. |
| **Fish and Wildlife Coordination Act, Fish and Wildlife Improvement Act of 1978, Fish and Wildlife Conservation Act of 1980** | | | | | |
| Area affecting streams or other water body | Provides protection for actions that would adversly affect streams, wetlands, other water bodies or protected habitats. Any action taken should protect fish or wildlife. | Diversion, channeling or other activity that modifies a stream or other water body and affects fish or wildlife | 16 USC 661;<br>16 USC 662;<br>16 USC 742a;<br>16 USC 2901;<br>50 CFR 83 | Applicable | Response actions will incorporate protection against any area water body, wetlands, or protected habitats. |
| **Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act and Executive Order 11990, Protection of Wetlands** | | | | | |
| Wetland | Action to minimize the destruction, loss, or degradation of wetlands. Wetlands of primary ecological significance must not be altered so that ecological systems in the wetlands are unreasonably disturbed. | Wetlands as defined by Executive Order 11990 Section 7 | 40 CFR 6, Appendix A, excluding Sections 6(a)(2), 6(a)(4), 6(a)(6);<br>40 CFR 6.302 | Potentially applicable | This regulation may be an ARAR for activities occurring in areas that meet the definition of a wetland. Remedial activities must minimize the destruction, loss, or degradation of the wetlands. |
| **Clean Water Act, Section 404** | | | | | |
| Wetland | The degradation Section requires degradation or destruction of wetlands and other aquatic sites be avoided to the extent possible.<br><br>Dredged or fill material must not be discharged to navigable waters if the activity, contributes to the violation of Maryland water quality standards; CWA Sec. 307; jeopardizes endangered or threatened species; or violates requirements of the Title III of the Marine Protection, Research, and Sanctuaries Act of 1972. | Wetland as defined by Executive Order 11990 Section 7 | 40 CFR 230.10;<br>40 CFR 231 (231.1, 231.2, 231.7, 231.8) | TBC | Wetlands and navigable waters are present in the vicinity of Site 4. Remedial activities will comply with the requirements of this section of the Clean Water Act. |
| Surface Water | Ambient Water Quality Criteria established to protect aquatic life and human consumers of water aquatic life. | Activities that affect or may affect the surface water onsite | 40 CFR 129 | TBC | These regulations were used in the development of the PRGs for OU-1 |
| **Resource Conservation and Recovery Act (RCRA)** | | | | | |
| Within 100-year floodplain | Hazardous waste TSD facility must be designed, constructed, operated, and maintained to avoid washout. | RCRA hazardous waste; treatment, storage, or disposal of hazardous waste. | 40 CFR 264.18 (b) | TBC | Portions of Site 4 are within the 100-year flood zones. However, actions are not expected to involve hazardous waste. This would be TBC for nonhazardous waste. |
| **Executive Order 11988, Protection of Floodplains** | | | | | |
| Within floodplain | Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values. | Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas. | 40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6);<br>40 CFR 6.302 | TBC | Portions of Site 4 are within the 100-year flood zones, therefore the requirements of this regulation are to be considered for any response actions that might involve the use of these areas. |
| **State Location-Specific ARARs** | | | | | |
| **Threatened and Endangered Species** | | | | | |
| Critical habitat upon which endangered species or threatened species depend. | Requires action to conserve endangered or threatened fish species and the critical habitats on which they depend on. Construction or other activities may not reduce the likelihood of either the survival or recovery of a listed species in the wild by reducing the reproduction, numbers or distribution | Determination of unacceptable impact upon endangered or threatened species or its habitat. | COMAR 08.03.08 | Potentially applicable | There is no evidence of state or federal endangered or threatened plant and animal species located within White Oak, based on inquiries to the Maryland DNR. These regulations are applicable if this situation changes. |

**Table B-2**
**Location-Specific ARARs and Performance Standards**
**ROD for Site 4 Groundwater and Soil**
**Former NSWC White Oak, Silver Spring, Maryland**

| Location | Requirement | Prerequisite | Citation | Applicability Determination | Comments |
|---|---|---|---|---|---|
| | of a listed species or otherwise adversely affect the species. | | | | |
| **Threatened and Endangered Fish Species** | | | | | |
| Critical habitat upon which endangered or threatened fish species depend. | Requires action to conserve endangered or threatened fish species and the critical habitats they depend on. | Determination of effect upon endangered or threatened fish species or its habitat. | COMAR 08.02.12 | Potentially applicable | These regulations are applicable if remedial actions may jeopardize endangered or threatened fish species. Currently, there are no federal or state endangered fish species at White Oak. |
| **Fish and Fisheries Title 4** | | | | | |
| Fisheries, locations where species of fish exist | Requirements to conserve species of fish for human enjoyment, for scientific purposes and to ensure their perpetuation as viable components of their ecosystems. | Determination of effect upon fish species or its habitat. | Annotated Code of Maryland Title 4 | Applicable | Fish species inhabit Paint Branch. If response actions affect these species, the requirements of this title are applicable. |
| **Wildlife Title 10** | | | | | |
| Areas inhabited by wildlife | Requirements to conserve species of wildlife for human enjoyment, for scientific purposes and to ensure their perpetuation as viable components of their ecosystems. | Determination of effect upon wildlife species or its habitat. | Annotated Code of Maryland Title 10 | Applicable | Wildlife species are present at White Oak. If response actions may affect these species, the requirements of this title are applicable. |
| **Nontidal Wetlands Protection Act, Maryland Nontidal Wetlands Regulations** | | | | | |
| Wetland | Provides regulations for activities on or near nontidal wetlands (an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions). Must obtain a permit from the State in order to conduct certain regulated activities in a nontidal wetland, or within a buffer or an expanded buffer. | Activities that will occur on or near nontidal wetlands. | COMAR 26.23; Annotated Code of Maryland, Title 5; Code of MD, Title 8-1201 | Applicable | Nontidal wetlands are present at White Oak. |
| **Wetlands and Riparian Rights** | | | | | |
| Wetlands | Requirements to preserve wetlands and prevent their destruction; requires a license for dredging or filling of wetlands. | Activities that can affect the integrity of wetlands, such as dredging or filling. | Annotated Code of Maryland Title 16 | Applicable | Wetlands (tidal and nontidal) are present at White Oak. The requirements of this title are applicable for any response actions that may affect the integrity of these wetlands. |
| **Construction on Nontidal Waters and Floodplains** | | | | | |
| Nontidal waters and floodplains | Protect and maintain nontidal waterways and/or state of Maryland floodplains must follow these regulations | Activities that affect nontidal waterways and floodplains | COMAR 08.05.03 | Potentially Applicable | Any remedial actions involving alteration to the streams bounding OU-1 or floodplains (including temporary construction) are subject to these requirements. |
| **Water Pollution Control Law** | | | | | |
| Waters of the State | Establishes effective programs and provides additional and cumulative remedies to prevent, abate, and control pollution of the waters in the state. | Activities that will pollute the waters in the state. | COMAR 9, Parts 301-351 | Applicable | This regulation is applicable for remedial actions that may affect water quality in the streams around OU-1 |
| **Maryland Water Pollution Control Regulations** | | | | | |
| Surface waters of the State | Protect and maintain the quality of surface water in the State of Maryland. Criteria and standards for discharges limitations and policy for anticegradation of the State's limitations | Activities that will pollute the surface waters of the state. | COMAR 26.08, Chapters 01-07 | Applicable | This regulation is applicable for remedial actions that may affect surface water quality in the State of Maryland. |

**Table B-2**
**Location-Specific ARARs and Performance Standards**
**ROD for Site 4 Groundwater and Soil**
**Former NSWC White Oak, Silver Spring, Maryland**

| Location | Requirement | Prerequisite | Citation | Applicability Determination | Comments |
|---|---|---|---|---|---|
| | and policy for antidegradation of the State's surface water. | | | | |
| **Water Management** | | | | | |
| Water resources of the State | Provides for the conservation and protection of the water resources of the State by requiring that any land-clearing, grading, or other earth disturbances require an erosion- and sediment-control plan. Also provides that stormwater must be managed to prevent offsite sedimentation and maintain current site conditions. | Activities that affect the water resources of the State. | COMAR 26.17.01<br>COMAR 26.17.02,<br>Annotated Code of Maryland Title 4 | Applicable | The design for the remedial actions will incorporate the requirements of this regulation. |

ARARs - Applicable or relevant and appropriate requirements.
RCRA - Resource Conservation and Recovery Act.
CFR - Code of Federal Regulations.
CWA- Clean Water Act.
DON - Department of Navy.
EO - Executive Order
FR - Federal Register.
HWCA - Hazardous Waste Control Act
USC - United States Code.
TBC - To Be Considered.

**Table B-3**
**Action-Specific ARARs and Performance Standards**
**ROD for Site 4 Groundwater and Soil**
**Former NSWC White Oak, Silver Spring, Maryland**

| Action | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| **Federal Action-Specific ARARs** | | | | | |
| **Resource Conservation and Recovery Act (RCRA) 42 USC 6901 et seq.*** | | | | | |
| Onsite waste generation | Waste generator shall determine if waste is hazardous waste. | Generator of hazardous waste. | 40 CFR 262.10 (a), 262.11 | Applicable | Applicable for any operation where waste is generated. Remedial alternatives for Site 4 may generate contaminated wastes. |
| Hazardous waste accumulation | Generator may accumulate hazardous waste on site for 90 days or less or must comply with requirements for operating a storage facility. | Accumulate hazardous waste. | 40 CFR 262.34 | Potentially applicable | If waste generated at White Oak is determined to be RCRA hazardous waste, any storage of the waste will not exceed 90 days. Accumulation of hazardous wastes onsite for longer than 90 days would be subject to the substantive RCRA requirements for storage facilities. |
| Recordkeeping | Generator must keep records. | Generate hazardous waste. | 40 CFR 262.40 | Potentially applicable | Manifests will be maintained for all offsite shipments of hazardous waste. |
| Excavation | Movement of excavated materials to new location and placement in or on land will trigger land disposal restrictions for the excavated waste or closure requirements for the unit in which the waste is being placed. | Materials containing RCRA hazardous wastes subject to land disposal restrictions are placed in another unit. | 40 CFR 268.40 | Potentially applicable | Applicable to disposal of soil to a new location and placement in or on land containing land-disposal-restricted RCRA hazardous waste. The wastes generated from response actions at White Oak may be RCRA hazardous wastes. |
| **Safe Drinking Water Act** | | | | | |
| Actions that affect drinking water supply | Promulgates National Primary Drinking Water Standard Maximum Contaminant Levels (MCLs) | Actions that affect drinking water supply | 40 CFR 141 | Relevant and appropriate | These regulations are ARARs for remedial actions at OU-1 that affect the groundwater. |
| **U.S. Department of Transportation, 49 USC 1802, et seq.*** | | | | | |
| Hazardous Materials Transportation | No person shall represent that a container or package is safe unless it meets the requirements of 49 USC 1802, et seq. or represent that a hazardous material is present in a package or motor vehicle if it is not. | Interstate carriers transporting hazardous waste and substances by motor vehicle. Transportation of hazardous material under contract with any department of the executive branch of the Federal Government must follow this regulation. | 49 CFR 171.2(f) | Potentially applicable | Offsite transport of hazardous materials must comply with both substantive and administrative requirements. |
| | No person shall unlawfully alter or deface labels, placards, or descriptions, packages, containers, or motor vehicles used for transportation of hazardous materials. | | 49 CFR 171.2(g) | Potentially applicable | |
| Hazardous Materials Marking, Labeling, and Placarding | Each person who offers hazardous material for transportation or each carrier that transports it shall mark each package, container, and vehicle in the manner required. | Person who offers hazardous material for transportation; carries hazardous material; or packages, labels, or placards hazardous material. | 49 CFR 172.300 | Potentially applicable | To be determined. Offsite transport of hazardous materials must comply with both substantive and administrative requirements. |
| | Each person offering non-bulk hazardous materials for transportation shall mark the proper shipping name and identification number (technical name) and consignee's name and address. | | 49 CFR 172.301 | Potentially applicable | |

**Table B-3**
**Action-Specific ARARs and Performance Standards**
**ROD for Site 4 Groundwater and Soil**
**Former NSWC White Oak, Silver Spring, Maryland**

| Action | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| Hazardous Materials Marking, Labeling, and Placarding (cont.) | Hazardous materials for transportation in bulk packages must be labeled with proper identification (ID) number, specified in 49 CFR 172.101 table, with required size of print. Packages must remain marked until cleaned or refilled with material requiring other marking. | Person who offers hazardous material for transportation; carries hazardous material; or packages, labels, or placards hazardous material. | 49 CFR 172.302 | Potentially applicable | To be determined. Offsite transport of hazardous materials must comply with both substantive and administrative requirements. |
| | No package marked with a proper shipping name or ID number may be offered for transport or transported unless the package contains the identified hazardous material or its residue. | | 49 CFR 172.303 | Potentially applicable | |
| | The marking must be durable, in English, in contrasting colors, unobscured, and away from other markings. | | 49 CFR 172.304 | Potentially applicable | |
| | Labeling of hazardous material packages shall be as specified in the list. | Person who offers hazardous material for transportation; carries hazardous material; or packages, labels, or placards hazardous material. | 49 CFR 172.400 | Potentially applicable | |
| | Non-bulk combination packages containing liquid hazardous materials must be packed with closures upward, and marked with arrows pointing upward. | | 49 CFR 172.312 | Potentially applicable | |
| | Each bulk packaging or transport vehicle containing any quantity of hazardous material must be placarded on each side and each end with the type of placards listed in Tables 1 and 2 of 49 CFR 172.504. | | 49 CFR 172.504 | Potentially applicable | |
| **State Action-Specific ARARs** | | | | | |
| **Maryland Hazardous Waste Regulations** | | | | | |
| Storage, treatment or disposal, and transportation of hazardous waste | Regulations and procedures for the identifications, listing, transportation, treatment, storage, and disposal of hazardous wastes must be met. | Handling of hazardous wastes | COMAR 26.13.01 through COMAR 26.13.04, Annotated Code of Maryland Title 7 | Potentially Applicable | Any hazardous waste found during site remediation will be disposed of offsite according to regulations.<br><br>Any residues or by-products from treatment systems that are hazardous must be disposed of properly. |
| **Solid Waste and Water Supply Regulations** | | | | | |
| Well Construction and Abandonment | Specifications for well construction and abandonment must be met. Also provides a mechanism to provide the State of Maryland with a database of existing and abandoned wells. Permits are required for well construction. | | COMAR 26.04.03 (A&D); COMAR 26.04.04 | Applicable | The requirements of this regulation are applicable to the response actions at White Oak if monitoring wells have to be installed or abandoned. |
| **Stormwater Management** | | | | | |
| Design and construction | Regulations require the design and construction of a system necessary to control stormwater. | Design and construction activities | COMAR 26.17.02 | Applicable | The remedial action will incorporate measures to control and manage stormwater as necessary. |
| **Erosion and Sediment Control** | | | | | |

## Table B-3
## Action-Specific ARARs and Performance Standards
## ROD for Site 4 Groundwater and Soil
## Former NSWC White Oak, Silver Spring, Maryland

| Action | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| Land clearing, grading, and earth disturbances | Regulations require the preparation and implementation of a plan to control erosion and sediment for activities involving land clearing, and grading and earth disturbances. Erosion and sediment control criteria are also established. | Land clearing, grading, and earth disturbances | COMAR 26.17.01 | Applicable | The remedial action will incorporate the standards required for clearing, grading, and other earth disturbances, including compliance with county and municipal erosion and sediment control ordinances, and the Commission's erosion- and sedimentation-control regulations. |
| **Maryland Drinking Water Law** | | | | | |
| Actions that affect state drinking water | Provides that the State has the primary enforcement responsibility for drinking water standards under the Federal Safe Drinking Water Act. | Action causing pollution of drinking water supply | COMAR 9.04, Parts 401-413 | Relevant and appropr | This regulation may be an ARAR for OU-1 if activities that affect water quality are conducted. |
| **Occupational, Industrial, and Residential Hazards** | | | | | |
| Action that will generate noise | Limits set on the levels of noise must be met; these limits are protective of the health, welfare, and property of the people in the State of Maryland. The maximum permitted levels for construction activities may not exceed 90 dBA during the day and 75 dBA during night. | Action that will generate noise | COMAR 26.02.03.02A (2) and B(2), COMAR 26.02.03.02.03A, Annotated Code of Maryland Title 3 | Applicable | During site remediation work, the maximum allowable noise levels will not be exceeded at site boundaries. |
| **Air Quality** | | | | | |
| Actions that involve emissions to air | Provides ambient air quality standards, general emissions standards, and restrictions for air emissions from construction activities, vents, and treatment technologies such as incinerators. Also includes nuisance and odor control. Construction activities may emit particulate matter into the ambient air. Remedial activities must follow regulations. | Actions that involve emissions to air above specific limits. | COMAR 26.11 | Applicable | May apply to airstrippers, SVE, or air sparging alternatives. |

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

ARAR - Applicable or relevant and appropriate requirement
CAA - Clean Air Act
RCRA - Resource Conservation and Recovery Act
CFR - Code for Federal Regulations
CWA - Clean Water Act
DOT - U.S. Department of Transportation
EPA - U.S. Environmental Protection Agency
NPDES - National Pollutant Discharge Elimination System
OSHA - Occupational Safety and Health Administration
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
SDWA - Safe Drinking Water Act
SMCLs - Secondary Maximum Contaminant Levels
TBC - To be considered
USC - United States Code

# Appendix C

## Transcript from Open Discussion at Public Information Session for Proposed Plan,

## July 8, 2003

**FORMER NAVAL SURFACE WARFARE CENTER**

**MONTGOMERY COUNTY, MARYLAND**

**PUBLIC MEETING**

to present and discuss the proposed plans for Installation Restoration Sites 4 and 7

A public information session on the above-entitled matter was held on Tuesday, July 8, 2003, commencing at 6:00 p.m., at the Sheraton College Park, 4095 Powder Mill Road, Beltsville, Maryland, chaired by:

WALTER A. LEGG/U.S. NAVY Engineering Field Activity Chesapeake
RAB Co-Chairman

APPEARANCES

BRUCE BEACH / US EPA
SCOTT MacEWEN / CH2M HILL
SCOTT NESBIT / Tetra Tech NUS
MARK CALLAGHAN / MDE
GARY IRBY / White Oak RAB Member
TONI WALTER / Neighborhood Resident
BARBARA MEDINA / White Oak RAB Member
PAUL DeLEO / White Oak RAB Member
DENNIS BROUD / NTEU
HALL CRANNELL / White Oak RAB Member
PAUL MEYER / White Oak RAB Member

P R O C E E D I N G S

MR. LEGG: Okay. I guess we'll get underway. Those folks here know me, Walt Legg with the Navy. And this is a meeting to present the proposed plans for Installation Restoration Site 4 and Site 7 at Former Naval Surface Warfare Center at White Oak. The members of our Base Realignment and Closure Cleanup Team, myself, Bruce Beach with EPA; Mark Callaghan with Maryland Department of

1 Environment; Bob Ridgway with Identix representing GSA; Scott
2 MacEwen from CH2M Hill; Scott Nesbit, Tetra Tech Nus;
3
4 **PRESENTATION OF SITE 4 PROPOSED PLAN**
5 **(NOT PROVIDED HERE)**
6
7 MR. LEGG: And also you can call me at anytime (202)
8 665-0061. And that's the end of the presentation on Site 4. So
9 we'll open the floor to questions and comments.
10 MR. IRBY: I have some comments. (Indiscernible) the
11 slide on page 13, the full map.
12 MR. MacEWEN: Can you speak your name too, so we get it
13 on the --
14 MR. IRBY: Gary Irby.
15 MR. NESBIT: Sir, excuse me, Mr. Irby, which slide did
16 you want to see?
17 MR. IRBY: On page, let's see, it's 21.
18 MR. NESBIT: Slide 21?
19 MR. IRBY: No, it's on page --
20 MR. NESBIT: There's a little slide number in the corner
21 of the slide.
22 (Discussion off the record.)
23 MR. IRBY: Can I come up there?
24 MR. MacEWEN: Yes.

1 MR. IRBY: I have some problems with this. You talk
2 about the, it's a risk to White Oak tenants. Or as you pointed
3 out contamination's here and it's coming down this way.
4 MR. CALLAGHAN: That's correct. Exposed TCE, PCBs, all
5 those contaminants coming down this way.
6 MR. IRBY: Well, White Oak is clear up here. So
7 obviously there's no risk to the White Oak people. The Adelphi
8 people who live down here in the contamination there is risk.
9 MR. CALLAGHAN: Excuse me. Where you pointed initially
10 that's at White Oak, that's not White Oak at all.
11 MR. IRBY: This is not White Oak at all down here. This
12 is White Oak up here completely away from any contamination
13 according to this map.
14 MR. LEGG: When we refer to tenants, we are actually
15 referring to the central tenants within the perimeter of the
16 former base.
17 MR. NESBIT: People that occupy and work within the
18 former government property or the government property, the
19 property owned by GSA, owned and managed by GSA or owned and
20 operated by the Army.
21 MR. IRBY: Okay.
22 MR. NESBIT: That's within --
23 MR. IRBY: Then the next thing down here is the risk to
24 the surrounding community. Well, down here there is risk. This
25 is in the surrounding community. This gentleman said that Paint

1 Branch is a natural boundary which is down here and there are
2 people living, myself included, within this contaminated area. So
3 there is risk to the community. Also, according to this map, I
4 haven't seen this map before. But it's been clearly established
5 that Charlton property is contaminated. The well there, our well,
6 our creek, the creek on the Fred Stork Nursing Home, but this
7 contamination comes back in behind all these houses on Pleasant
8 Acres and the nursing home, DelHaven Nursing Home. I hadn't seen
9 the contamination back in that area before. Have those people
10 been notified that this property is contaminated?
11 MR. LEGG: That will go to the existing surface-water
12 stream there. The groundwater contamination is not going to go
13 beyond that stream. (Indiscernible).
14 MR. IRBY: Well, this is the baseline on (indiscernible)
15 Right?
16 MR. LEGG: Correct. That's the baseline.
17 MR. IRBY: And these people that live in these houses
18 own property back to that line.
19 MR. LEGG: Again, this is an indication of the
20 groundwater (indiscernible). The surface water is not something
21 (indiscernible) that's exposed.
22 MR. IRBY: Well, saying there's no risk to the community
23 is not true. That there's been risk to the Charlton's, my family.
24 MR. MacEWEN: Scott MacEwen with CH2M Hill. When you
25 say risk, we're talking about risk here, risk that's as defined by

1 EPA as a risk to human health and the environment. A risk study
2 was conducted on the surface water that you may be exposed to.
3 The surface water that runs through your property and on the Stork
4 property. And the risk from that surface water to human health
5 and the environment were found to be within acceptable limits,
6 below what EPA considered a risk.
7 MR. IRBY: Well, I thought the risk --
8 MR. MacEWEN: And no one is drinking the groundwater
9 that is, or had in the past drank groundwater that is considered a
10 risk.
11 MR. IRBY: We think that Charlton drank the groundwater.
12 We don't --
13 MR. MacEWEN: My understanding is --
14 MR. LEGG: The groundwater as far as we can tell, all of
15 our sampling has indicated that any groundwater that you drank
16 from your well was not contaminated above any drinking water
17 levels.
18 MR. IRBY: That's been tested.
19 MR. MacEWEN: Well, we haven't found contamination in
20 the bedrock in wells right next to your well.
21 MR. IRBY: Historic surface water was 1.2 parts per
22 billion. That's way above EPA standard of 50 parts per billion.
23 MR. MacEWEN: I'm not familiar with that.
24 MR. LEGG: I'm not sure that you're right.

1 MR. IRBY: Right back at the seep that was in the creek
2 at the Charlton, and the Fred Stork Nursing Home was 200 parts per
3 billion for a long time.
4 MR. LEGG: Right at the seep we had detections of I
5 think it was up to about 200 parts per billion of TCE. Let's see,
6 just downstream you'll see (indiscernible) considering below it.
7 Also water is (indiscernible) surface water quality standard, not
8 a drinking water standard. And we've anticipated and used that as
9 a (indiscernible).
10 MR. IRBY: I'm not at all comfortable with this there's
11 no risk to the surrounding community.
12 MR. CALLAGHAN: Yes, Mark Callaghan, MDE. I guess the
13 thing to take away from this is there is, it is going slightly off
14 behind your property. But there are no residential wells that are
15 (indiscernible). So what I'm saying to you is that they're saying
16 that there's no risk to groundwater at the moment. There's no
17 risk at all because nobody is drinking that groundwater. Nobody
18 is going to drink that groundwater or the (indiscernible) near
19 future.
20 So by the time, they're going to clean this up. There
21 are no residential wells that people can use. Nobody has access
22 to the groundwater. You're not going to drink the groundwater.
23 Nobody else is going to drink the groundwater from now until a
24 very long time in the future. So that's basically what we're
25 saying that there's no risk to residential exposure to groundwater

1 or contaminants or to the public because nobody is drinking that
2 groundwater. It's way below and everybody's connected to WSSC
3 public water.
4 MR. IRBY: That's not true.
5 MR. CALLAGHAN: We're saying, what we're
6 (indiscernible). Am I correct?
7 MR. IRBY: Has the Navy checked to see if there's other
8 wells in the area?
9 MR. LEGG: We're aware that that there are drinking
10 water wells in the area, but they're outside of the extended
11 design. They will not be receiving water from this site.
12 MR. CALLAGHAN: So the next best thing you can take
13 away, it's the groundwater, nobody has access to it. So your
14 family, nobody's family is going to be affected by that
15 groundwater because nobody's going to be drinking that
16 groundwater.
17 MR. IRBY: We have dranked that. Will it affect the
18 city water?
19 MR. CALLAGHAN: Well, I don't want to go into comments
20 on that or anything like that. But what I'm saying is now I'm
21 saying there's no risk because no one has access to the
22 groundwater. You don't have access to the groundwater. Charlton
23 doesn't have access to the groundwater and nobody's going to be
24 putting a well anywhere near that for a very long time in the
25 future. So that may help to relieve some fears that you have

1 contamination that is coming over the public line in the
2 groundwater. I hope I've answered your question.
3 MR. IRBY: You answered it but it doesn't solve my
4 concern.
5 MR. CALLAGHAN: We say that there's no risk. Well,
6 again --
7 MR. IRBY: Maybe at this moment there's no risk. There
8 has been risk and that's not indicated in this at all.
9 MR. LEGG: We've been unable to determine the
10 (indiscernible) of this. All our indications are, our
11 investigations have indicated that at least going back as we can
12 ascertain it did not pose a risk. It did not, I should say, it
13 did not pose a risk outside of the accepted (indiscernible) as
14 determined by EPA. We don't know (indiscernible) drinking water
15 from your well and again, we studied that multiple years.
16 MR. NESBIT: I mean for the sake of, Scott Nesbit of
17 Tetra Tech Nus. Just for the sake of getting through this, I mean
18 we're here to talk about the current conditions and what's
19 proposed to mitigate prior releases, existing contamination. What
20 happened in the past, we really can't, I don't think anyone here
21 can speak of or really need to get into as part of this proposed
22 plan.
23 MR. IRBY: Okay. I just wanted to point out a few
24 things that are of concern.

1 MR. CALLAGHAN: Dr. Irby, your concerns are being
2 recorded and I guess we'll include them. They're being recorded.
3 MR. BEACH: They'll be in the record of decision.
4 MR. LEGG: Ms. Walter, you have a question?
5 MS. WALTER: I'm just not clear. I just need
6 clarification. I know that you're going to use the
7 (indiscernible) the utilization process and as part of the clean
8 up?
9 MR. LEGG: Correct.
10 MS. WALTER: That is part of what you're planning to do?
11 MR. LEGG: Yes, we're planning to continue the existing
12 treatment system and incorporate the new system.
13 MS. WALTER: Where you inject that it comes out into the
14 air and stuff?
15 MR. LEGG: That's right. You pull the groundwater up.
16 You run it through a machine that blows air. The water goes down.
17 The air comes up through it and it volatizes the contaminants out
18 of the water.
19 MS. WALTER: Now, how, can you just describe to me how
20 the air quality will be monitored with regard to that?
21 MR. LEGG: As part of the design process we'll be going
22 through and determining the necessity for (indiscernible)
23 monitoring. (Indiscernible) you can if you want, but historically
24 what we have planned, the levels are so low that the resultant air

1 from the stripping process would have a maximum potential
2 contamination that=s probably not even detected.
3 MS. WALTER: And is that the case that there are any
4 other contaminants that are there would they also be placed into
5 the air and would the levels also in that case be known?
6 MR. MacEWEN: This is Scott MacEwen, CH2M Hill. As part
7 of design process that Walter said, we would determine all the
8 contaminants that are in the water from the wells we're going to
9 be extracting and what's going to be going into the air stripper
10 and what will be coming out of the air stripper in the air, and
11 what will be going, still be entering the water stream. And we
12 have to make sure that those things that are still in the water
13 are going to meet the water discharge criteria. But that surface
14 water there may be some contaminants that can't get stripped out.
15 But make sure there=s low enough concentrations that they=re not
16 above the certain criteria.
17 And the air, the same thing, we have to determine what
18 kind of mass of organics are going to be going into the air,
19 compare that to the federal or state criteria. In other words how
20 much pounds or grams of volatile organics you can put into the air
21 over a certain period of time. And we're below that, we don't
22 need to treat it. If we're above that then we probably need to
23 run it through carbon absorption to collect it before it's given
24 off to the atmosphere.

1 MS. WALTER: And will that be continually monitored then
2 or how will that be?
3 MR. MacEWEN: It will be monitored by the concentration
4 in the water. So you assume that 100 percent is removed.
5 MS. WALTER: Oh, I see, okay.
6 MR. MacEWEN: It will be sampled, the water coming in
7 and out of the air stripper.
8 MS. WALTER: I see.
9 MR. MacEWEN: And typically it is not even close to what
10 the air quality criteria are.
11 MS. WALTER: Okay.
12 MR. IRBY: One final comment about the future. You're
13 talking about a goal of 22 years to clean up of the boom, I guess,
14 the groundwater and surface water? Is that --
15 MR. MacEWEN: Well, if the groundwater is cleaned up, it
16 won't be any addition to the surface water. So the surface
17 water's going to follow, yes.
18 MR. IRBY: So you're expecting that to take 22 years?
19 MR. MacEWEN: Well, the 22 years is for, let me put up
20 the picture. It is different time frames for different parts of
21 the program. For instance, the amount of time that the driving
22 factor is 22 years. It was based on modeling, contamination from
23 here not being contained by the wells in this area, moved out of
24 these wells. So after say 20 years, now most of those will be
25 cleaned by (indiscernible) is some contamination in this area. So

1 it hasn't reached here yet. The time it takes for the groundwater
2 to move from the low part of this trench to this stream down here
3 is less than that and I can't remember what the number is, but you
4 know, somewhere in the teens. I mean that's what the model shows.
5 But as far as the surface water and through the risk assessment
6 the concentrates in the surface water don't show a risk from any
7 scenario, you know, including children playing in the stream or
8 the risks have been tossed up for exactly what the parameters are.
9 I don't know off the top of my head, but right now there's no risk
10 and the concentrations would not be expected to go up because, you
11 know, frankly this source is removed in the ground where the
12 concentrations are going now.
13 MS. MEDINA: I have a question. My name is Barbara
14 Medina. Is any of the contaminated groundwater plume hitting the
15 main stem of Paint Branch or is it all going off into these
16 tributary streams?
17 MR. MacEWEN: No volatile organics have been detected in
18 Paint Branch. However, there are wells right down along Paint
19 Branch that have, you know, one or two part per billion TCE in
20 them. So to say they're not getting in there, I don't know if we
21 can say that, no, you know, zero is getting in. But it's not
22 getting in enough to be detected. It's either going volatilized
23 or whatever. But the only area that would be, in fact, would be
24 really right around here.
25 MS. MEDINA: Which is still on base or off the base?

1 MR. MacEWEN: No, that's off the base.

2 MS. MEDINA: That's off the base.

3 MR. LEGG: Ms. Walter.

4 MS. WALTER: Yeah, Toni Walter. I just had one more

5 question about the monitoring of the extraction levels. The air

6 strippers, will they be monitored continually? The

7 (indiscernible) basis, will that be monitored?

8 MR. LEGG: The actual frequency monitoring will be

9 determined as part of the design process. I'm confident it will

10 not be continuous or daily, but the actual frequency I don't know.

11 MR. NESBIT: But as an example, with the air strippers

12 that are in place right now, we have installed telemetry so if

13 there is a, something does go wrong, a phone call is made

14 automatically from the --

15 MS. WALTER: Oh, I see.

16 MR. NESBIT: B- from the system to someone who is

17 responsible to get it back --

18 MS. WALTER: That's great.

19 MR. IRBY: When was that installed?

20 MR. NESBIT: Three months ago.

21 MR. LEGG: The new system because there was an existing

22 system prior. The new system was installed a couple months ago.

23 There was a land base system that was in there for a long time and

24 then we lost our sponsor, not that I=m paying the bills. But so

25 now we bid on a cell phone service.

1 MS. WALTER: Will we have that information before the
2 contact, when that period is over as to the actual, how they will
3 actually be monitored or are you definite that it will be on the
4 phone system as well?
5 MR. LEGG: It will be on the phone system.
6 MS. WALTER: Oh, okay.
7 MR. LEGG: Yes. And I misunderstood your original
8 question. I thought you were asking about sampling type
9 monitoring.
10 MS. WALTER: No, I just meant being sure that they=re up
11 and running correctly, yeah. Thank you.
12 MR. DeLEO: Paul DeLeo with FDA and National
13 (indiscernible) Employees Union. I have a couple of questions or
14 comments about perchlorate.
15 In the proposed plan you excluded perchlorate as a
16 contaminant of concern. And the rationale used I think is rather
17 weak. Perhlorate is something that is of great interest as a
18 contaminant groundwater these days. My understanding is that EPA
19 has an interim guidance which talks about using treatment levels
20 down to 4 to 18 parts per billion as a guideline. Currently I
21 understand that Maryland has perchlorate advisory down to one part
22 per billion for drinking water. These are not requirements, but
23 there's say a lot of concern about this compound. And I think
24 this should be taken into consideration when looking at remedial
25 alternatives.

1 I understand EPA is considering a drinking water rule
2 making on this, so in a couple of years there may be a drinking
3 water standard in which case if your remedial alternative is in
4 place, you're going to have a hard time if you wanted to change
5 that for some kind, even to, including treatment of chlorate. So
6 I believe this should be considered as one of the contaminants of
7 concern that=s considered with remedial alternatives.
8 I'll also say I found it a little unusual that you have
9 iron included as a contaminant of concern and not the chlorate.
10 That doesn't really pass a lab test.
11 The other comment I have about perchlorate is the
12 preferred remedial alternative you state that there's going to be
13 discharge to surface water body. If you=re using the treatment
14 alternative it doesn't treat perchlorate, discharging for chlorate
15 to surface water bodies. The chlorate is an endocrine disrupter
16 and at the levels that it's found in the groundwater right now,
17 it's known to have negative impacts in development of amphibians.
18 So the result is that you're going to be potentially impacting
19 amphibians and other life forms in the stream that you discharge
20 to. So I believe you should have remedial alternative that
21 includes treatment of perchlorate or else discharge not to surface
22 water body, but discharge to sewer system. But not a straight
23 discharge to the environment if you don't treat for perchlorate.
24 And I'm going to send that to you, Walter.
25 MR. LEGG: Thank you.

1 MR. MacEWEN: Yes, how about we address that one at a --

2 MR. DeLEO: That's fine. I'll send Walter a more

3 detailed written comment.

4

5 **PRESENTATION AND PUBLIC COMMENT PERIOD FOR SITE 7**

6 **FOLLOWS (NOT PROVIDED HERE)**