Section: 5.02
Site 20903-5640 (White Oak)
Doc. #: 0009
00559

N60921.AR.000552
NSWC WHITE OAK
5090.3a

Record of Decision

Former Naval Surface Warfare Center – White Oak
Sites 5 and 13 Soil and Groundwater

NAVFAC
Naval Facilities Engineering Command
NAVFAC WASHINGTON

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
Sites 5 and 13 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* chemical reduction with zero-valent iron and monitored natural attenuation with institutional controls to address groundwater contamination is selected to protect human health and the environment at Navy Installation Restoration Sites 5 and 13, the Open Burn Area and the Oil Sludge Disposal Area, at the former Naval Surface Warfare Center - White Oak (NSWC - White Oak) in Silver Spring, Maryland. In 1997, ownership of the property occupied by Sites 5 and 13, was transferred from the Department of the Navy (Navy) to the General Services Administration (GSA). This ROD also presents the determination that no further action is needed to address soil at these sites in order to protect human health and the environment. These determinations have 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).

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 Sites 5 and 13 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 5 consists of three adjacent open burn areas that were used from the late 1940s until 1970 as a burn site for paper, cardboard, wood and other bulky ignitable materials, as well as small quantities of hazardous materials. One or more of the areas may have also been used as a fire training area and for testing explosives and other pyrotechnic devices.

Site 13 occupies approximately 0.7 acre and between 1970 and 1978, reportedly was used as a disposal area for approximately 6,000 to 10,000 gallons of oily sludge from storage tanks containing No. 6 fuel oil.

Sites 5 and 13 groundwater data collected between 1988 and the present indicate that concentrations of volatile organic compounds (VOCs) would present risks to receptors if groundwater were used as potable water. The greatest concentration of contaminated groundwater associated with Sites 5 and 13 coincides with the area that is historically considered Site 13. Activities at Site 5 have not impacted the groundwater.

The only contaminated soil identified in the Sites 5 and 13 area was the surface and subsurface soil from the base of one open burn area related to Site 5. This soil has been excavated and disposed off-site as part of a removal action. The soil remaining at both sites 5 and 13 no longer poses an unacceptable human health or ecological risk. In addition, the soil at these sites does not represent a source of contamination to the underlying groundwater or nearby surface water.

The alternative selected to mitigate any potential risks from exposure to site groundwater combines *in-situ* chemical reduction using zero-valent iron in the source area with monitored natural attenuation and institutional controls throughout the plume. No further action is necessary to treat soil at Sites 5 and 13.

1.3 STATUTORY DETERMINATIONS

The selection of *in-situ* chemical reduction with zero-valent iron and monitored natural attenuation with institutional controls as the remedy for groundwater is based upon recent 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 Sites 5 and 13 groundwater is a part. These analyses indicate that exposure to Sites 5 and 13 groundwater as a drinking water source must be restricted for protection of human health. The results of the RCRA Facility Investigation (RFI) for Sites 5 and 13 soil indicate that the soil does not contain chemicals that represent an unacceptable risk to human health or the environment, nor does the soil represent a continuing source of groundwater contamination. Five-year reviews will be necessary for the Sites 5 and 13 groundwater since the remedy will result in hazardous substances, pollutants, or contaminants remaining on site at concentrations above levels that allow for unlimited use and unrestricted exposure for more than 5 years.

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 (page 2-18).
- Baseline risk presented by the COCs (page 2-12).
- Current and reasonably anticipated future land use assumptions (page 2-8).
- Potential land use that will be available at the site because of the selected remedy (page 2-34).
- 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 2-35).

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Commanding Officer
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9/29/04
Date

Abraham Ferdas, Director
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9/30/04
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 (detailed below). 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

Sites 5 and 13 are adjacent sites located in the northeast portion of NSWC-White Oak, along the northern property line.

Site 5 consisted of three adjacent open burn areas that were surrounded by berms of compacted soil (see Figure 2-2). The first bermed area or burn ring (BR)-1, was used from the late 1940s until 1970 as a burn site for paper, cardboard, wood, and other bulky ignitable materials, as well as small quantities of hazardous materials. In 1969-70, materials were ignited in BR-1 using pyrotechnic devices. It has also been reported that this site may have been used as a fire training area and that explosives may have been tested here. BR-2, located east of BR-1, was reportedly used for research operations. BR-3 is located north of the other two burn areas and was used to test pyrotechnic devices.

Site 13 is located adjacent to the north side of Site 5, between Dahlgren Road and the northern perimeter road. The site occupies approximately 0.7 acre. Anecdotal accounts suggest that between 1970 and 1978, approximately 6,000 to 10,000 gallons of oily sludge from storage tanks containing No. 6 fuel oil were spread over the surface of Site 13; however the location and history of Site 13 is not well documented. Because very little petroleum contamination has been found in the soil and groundwater in the area that is currently considered Site 13, it is now believed that most, if not all of the oil sludge disposal activities were actually conducted in the area defined as Site 4. Site 4 is being addressed under a separate remedial action. The past activities that resulted in the chlorinated VOC contamination that is present in the groundwater at Site 13 are not documented.

The area occupied by Sites 5 and 13 is located entirely within property currently owned by the GSA. See Figure 2-2. However, the groundwater plume emanating from the Site 5 and 13 area extends off GSA property to the northwest, on to private property owned by sand and gravel quarry (See Figure 2-3).

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 it is understood 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 both the soil and groundwater at Sites 5 and 13.

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 Sites 5 and 13 is outlined below.

Both Sites 5 and 13 were identified as Navy Installation Restoration Program (IRP) sites 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.

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 RCRA 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 November 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 an RFI to assess the presence and migration of contaminants of potential concern (COPCs). SWMU 32 is associated with Site 5 while SWMU 7 is associated with Site 13. Both sites were recommended for investigation in an RFI

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. In ensuing discussions Sites 5 and 13 were identified as sites of low to moderate priority based upon potential risk.

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, 1995.* 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 1998a).

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 (Brown and Root Environmental, September 1997).

Investigation activities specific to Sites 5 and 13 were first conducted in 1997 as part of the Site Screening Investigation for Sites 1, 5, 6, 12, 13, 28, 29, 31, 32, and 33, and EBS AOC 100. These eleven sites were considered moderate priority sites by the Navy. The site screening investigation consisted of collecting a number of surface and subsurface soil samples at each of Sites 5 and 13 and installing and sampling a total of six groundwater monitoring wells in the vicinity of these sites (TTNUS, December 1998b).

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 throughout White Oak, including the six wells that existed at and around Sites 5 and 13 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.

The groundwater impacted by Sites 5 and 13, as well as several other sites in this part of NSWC White Oak 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 5 and 13 area and Sites 3, 4, 7, 9, and 46 (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 focussed 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 showed that the surrounding streams act as barriers to groundwater migration), and (2) confirming if a connection exists between the groundwater contamination at Site 4 and that observed further downgradient at Site 46 and to the west at Site 13. 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 act as

boundaries and that the VOC-contaminated groundwater plume present within Site 46 and the Army property was emanating from Site 4. It also showed that Site 13 groundwater contamination was separate from Site 4 and 46. The OU-1 RI also delineated the extent of contamination migrating from Site 13 offsite to the northwest onto the adjoining private property by installing and sampling 19 multi-depth temporary or permanent wells. The area of the defined Site 13 groundwater plume, and the existing monitoring well network is shown in Figure 2-3. Finally, the OU-1 RI also included a baseline human health risk assessment for the groundwater and surface water.

A feasibility study (FS) was conducted for OU-1 in 2003 (CH2M HILL, June 2003). The FS included the evaluation of remedial alternatives for Site 13 groundwater.

An RFI was conducted on the soil at Sites 5 and 13 in 2002, after the 2000 removal action for the Site 5 soil. The RFI included subsurface geophysics, test trenches, and soil sampling to characterize the soil at the two adjoining sites and to try to identify a source of the chlorinated VOCs found in the groundwater at Site13 (TTNUS, May 2003). The RFI concluded that there were no risks presented by the Site 5 and 13 soil to either human or environmental receptors and that the soil did not represent a continuing source of contamination to the underlying groundwater.

2.2.4 Soil Removal Action

The site screening investigation, conducted in 1997 and 1998, identified miscellaneous fill material, discolored soil, and soil contaminated with petroleum hydrocarbons and SVOC in the area of Burn Ring 1 at Site 5. The majority of the discoloration, odors, and elevated SVOC concentrations in the soil were in the top 2 to 3 feet.

A soil removal action was conducted in 2000, during which the circular soil berms were removed and used as clean backfill at nearby Site 3 and the top three feet of contaminated soil that made up the floor of the three burn rings was excavated and disposed of in an off-site landfill. The remaining surface and subsurface soil was investigated in 2002 as part of the Site 5 RFI.

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 September 30, 2003 that presented the preferred remedy for Sites 5 and 13 groundwater and soil. The Proposed Plan for Sites 5 and 13, the RI and FS for OU-1 (including Sites 5 and 13 groundwater), and the RFI for Sites 5 and 13 soil, became available for review by the public at, or prior to, that time and are among the documents that comprise the Administrative Record file for NSWC-White Oak, which is maintained at EFACHES at the Washington Navy Yard, Washington D.C. In addition, the Proposed Plan for Sites 5 and 13, the RI and FS for OU-1, the RFI for Sites 5 and 13 soil, and other documents relevant to the remedy selection for Sites 5 and 13 groundwater and soil were made available to the public on or before September 30, 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 September 25, 2003, and in the *Silver Spring Gazette, College Park Gazette,* and *Burtonsville Gazette* on September 24, 2003. The public comment period was held from September 30, 2003 to October 30, 2003, and a public meeting was held on October 14, 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 Sites 5 and 13 groundwater and soil is the ninth prepared for sites at NSWC-White Oak.

In-situ chemical reduction with zero-valent iron and monitored natural attenuation with institutional controls is selected for groundwater at Sites 5 and 13 to protect human health and the environment. Site 5 soils were addressed as part of a removal action in 2000 and the resulting risk assessment concluded that the remaining Site 5 soils and the soils at Site 13 do not represent unacceptable risks nor do they represent a possible source of groundwater contamination; therefore no further action is the selected remedy for soil at Sites 5 and 13.

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.

The ground surface at Site 5 slopes generally to the south and southwest toward Dahlgren Road, and the maximum difference in elevation is approximately 30 feet. There are no surface water bodies within Site 5. The closest surface water body is a small, southward-flowing tributary (West Farm Branch) of Paint Branch located approximately 420 feet west of BR-1. During rain events, surface water infiltrates into the surface soil or drains off site towards drainage ditches along Dahlgren Road and ultimately to West Farm Branch.

The ground surface at Site 13 gently slopes to the west and consists of a relatively flat area. The maximum elevation relief across the site is approximately 5 feet, and the elevation of the site is approximately 260 feet. The topography immediately adjacent to Site 13 to the northwest, west and southwest drops steeply at a grade of approximately 33 percent into the valley formed by West Farm Branch. Surface water runoff from on, and around the immediate vicinity of the site, flows toward and into West Farm Branch approximately 300 feet west of the site. The steep slope between the Sites 5 and 13 area and West Farm Brach is the former location of Site 3, the Pistol Range Landfill, which was excavated in its entirety in 2000.

The soil underlying Sites 5 and 13 consists of a layer of silty sand and gravel (Coastal Plain deposits) ranging in thickness from 40 feet at the higher elevations on the east side of Site 5, to 10 feet on the west side of Site 13. The Coastal Plain is underlain by a 10 to 20-foot layer of decayed rock (saprolite). 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. Fractured rock underlies the saprolite, the competent bedrock is primarily a garnet schist; however, in the borings for the deep wells at White Oak, interbedded quartzites were observed. The subsurface geology in the vicinity of Site 13 is illustrated in Figure 2-4.

The 1997 subsurface investigation at BR-1 in Site 5 indicated that there was a black cobbly, sandy silt layer with a distinct petroleum odor between 2 feet and 12 feet bgs. Material encountered in the subsurface included pieces of rubber automobile tires, burnt wood chips, broken glass, plastic, cardboard, wire, and various metal fragments. No fill materials or discolored soil were discovered in BR- 2, BR-3, nor in any other areas of Sites 5 and 13.

The depth to the groundwater table varies from 25 feet on the east side of Site 5 to twelve feet at Site 13.

While the upper portion of the water table aquifer resides in the relatively permeable Coastal Plain deposits on the east side of Site 5, the water table at Site 13 is present in the much-less permeable saprolitic soil. Groundwater flow beneath Site 5 is primarily to the south and southwest, while the flow beneath Site 13 is primarily to the northwest, toward and into West Farm Branch. Typical water-table elevations are shown in Figure 2-5.

2.5.2 Conceptual Site Model

Figures 2-6 and 2-7 provides the conceptual site model (CSM) for exposure of human receptors to soil and groundwater respectively. 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 5 and 13 soil include: present and/or future full-time workers, maintenance/utility workers, construction workers, adult recreational user, adolescent trespasser, potential future day-care-center children and potential future child and adult residents.

Future residential use was 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 Sites 5 and 13 soil as part of the base-wide ecological risk assessment. Ecological receptors on the property would not be exposed to groundwater at Sites 5 and 13.

No site-related chemicals were detected in the surface water or sediment in West Farm Branch and therefore, risks to receptors were not evaluated for this media relative to Sites 5 and 13. Potential impacts to West Farm Branch from Site 3 are addressed in the site characterization and remediation process for that site. Neither sediment nor surface water are considered media of concern for Sites 5 and 13.

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 groundwater contamination throughout the OU. The RFI for Sites 5 and 13 (TTNUS, May 2003) presents a complete set of data and graphics defining the nature and extent of soil contamination at Sites 5 and 13. The nature and extent of contamination at Sites 5 and 13 can be summarized as follows:

- Contaminants remaining in the soil after the 2000 removal action at Site 5 are low levels of SVOCs, explosives, metals, one PCB, and one pesticide.
- The primary groundwater contaminant is 1,1,2,2-PCA. The highest concentrations are centered in the upper portion of the aquifer in the northern Site 13 area near well 13GW02. Northwest, west, and vertically down into the aquifer from this area, the predominant contaminants change to TCE and then cis-1,2-DCE, both of which are breakdown products of 1,1,2,2-PCA. Overall total VOC concentrations also decrease in these directions.
- The groundwater containing chlorinated VOCs extends to the west and northwest approximately 300 feet to West Farm Branch, which serves as a hydogeologic boundary. The contaminant plume extends over several acres of private property northwest of the source area before it reaches West Farm Branch.
- RDX is detected in 2 wells 05GW01 and 13GW03 at maximum concentrations of 110 and 20 respectively. RDX does not extend more than about 200 feet from its apparent source on the western edge of the Site 5 and 13 area.

- With the exception of PCBs, no site related contaminants have been detected in the surface water or sediments in the receiving stream, West Farm Branch; however, the source of the PCBs in West Farm Branch sediments is most likely Site 3.

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

2.5.3.1 Soil

The site screening investigation, conducted in 1997 and 1998, before the Site 5 soil removal action, identified miscellaneous fill material, discolored soil, and soil contaminated with petroleum hydrocarbons and SVOCs in the area of BR-1. The majority of the discoloration, odors, and elevated SVOC concentrations in the soil were in the top 2 to 3 feet.

Contaminants that were still present in the Site 5 soil after the 2000 removal action consisted of low levels of SVOCs, PCBs, pesticides, explosives compounds, and metals. Ten compounds slightly exceeded the risk-based screening criteria used by EPA Region 3 to identify potential risks to people in residential settings. These compounds were benzo(a)pyrene, dibenzo(a,h)anthracene, Aroclor 1260, dieldrin, 2-amino-4,6-dintitrotoluene, RDX, copper, selenium, and thallium.

Figure 2-8 shows the locations of soil samples collected in 1997 and in 2002 as part of the RFI from areas of the site that were not affected by the 2000 removal action. This figure also identifies analytical results for some of the compounds exceeding human health-based screening criteria. The complete set of Site 5 soil data can be found in the RFI for Sites 5 and 13 (TTNUS. May 2003).

At Site 13, soil samples were collected from above the water table during the 1997 Site Screening Investigation and as part of the 2002 RFI. The only contaminants that were detected above the EPA Region 3 risk-based screening criteria for residential soil were benzo(a)pyrene, dibenzo(a,h)anthracene, and several metals. While low levels of chlorinated VOCs (1,1,2,2-tetrachloroethane, trichloroethene and 1,2-dibromo-3-chloropropane) were detected near the water table, they were not at concentrations in excess of the risk-based criteria nor did they represent potential sources of groundwater contamination.

Figure 2-9 shows the locations of soil samples collected from 1997 through 2002 at Site 13. This figure also identifies analytical results for some of the compounds exceeding human health-based screening criteria. The complete set of Site 13 soil data can be found in the RFI for Sites 5 and 13 (TTNUS, May 2003).

2.5.3.2 Groundwater

The Sites 5 and 13 groundwater contamination is centered in the area between the historically recognized area of Site 13 and the northern property line of the White Oak facility. The practices that led to this contamination and the exact location of the source are unknown. Figure 2-10 presents a site plan showing the existing monitoring wells, the groundwater sampling locations from the OU-1 RI, and the total average VOC concentrations in the aquifer between 1999 and 2001. These contours are based primarily on the groundwater screening data collected from temporary wells in August and September 2001. This data is presented in Table 2-1. Table 2-2 presents results from samples collected from the permanent wells in the area in September 2001. As shown in the tables, the VOCs found at the site consist primarily of 1,1,2,2-PCA, TCE, and cis-1,2-DCE, with lesser concentrations of PCE, trans-1,2-DCE and vinyl chloride. The predominant VOC varies from well to well. The well that consistently contains the highest VOC concentrations is well 13GW02, located on the north side of Site 13. A complete set of Sites 5 and 13 groundwater data collected since 1999 can be found in the FS for OU-1 (CH2M HILL, June 2003).

The contaminants in this plume, and the maximum concentrations of each, detected since 2000 are:

1,1,2,2-Tetrachloroethane - 1,100 μg/L
Cis-1,2-Dichloroethene – 581 μg/L
Trichloroethene – 420 μg/L
Tetrachloroethene – 150 μg/L

Vinyl chloride – 20 μg/L
RDX - 110 μg/L
Iron (dissolved) – 18,900 μg/L

As discussed above, soil samples collected during the site screening of Sites 5 and 13 (1999), after the Site 3 removal action (September 2000), during the OU-1 RI (September 2001), and during the RFI for Sites 5 and 13 (May 2002) did not find any significant concentrations of chlorinated VOCs in the unsaturated zone soil. Concentrations of 1,1,2,2-PCA, the most abundant VOC found in the soil, ranged from below 0.01 mg/kg to a maximum of 0.17 mg/kg. The greatest concentrations were found in soil near the top of the water table (approximately 14 ft bgs). The highest 1,1,2,2-PCA concentrations in soil roughly coincided with the maximum groundwater concentrations.

A cross-section of the site, illustrating site geology, topography and water table and the approximate current extent of contamination is shown in Figure 2-4. The location of the cross-section transect is shown on Figure 2-3. It is aligned with the principle groundwater flow direction toward the northwest. As can be seen in the cross section, the water table is present below the top of the Coastal Plain sand and gravel / saprolite interface.

While the greatest concentrations of groundwater contamination appear to be near a groundwater elevation high point (near well 13GW02), the groundwater gradient falls off most steeply to the west and northwest, and the VOCs are migrating in that direction. Groundwater gradients fall off much more gradually to the south and east and contamination does not appear to be migrating in these directions in any significant concentrations. As previously mentioned, well 13GW02 maintains the highest levels of VOCs. The water table drops steeply and concentrations of 1,1,2,2-PCA decline rapidly northwest of well 13GW02. Maximum concentrations of 1,1,2,2-PCA and PCE are less than 10 μg/L, and TCE is found at 74.5 μg/L at monitoring well 13GW202, however the cis-DCE concentration is 581 μg/L in this well. Contaminant concentrations continue to decline at the base of the hill in the alluvial deposits near West Farm Branch.

The cross-section in Figure 2-4 does not present contaminant concentrations within the underlying bedrock formations since the alignment did not cross any monitoring wells screened within those formations. The depth of the bedrock was inferred from boring logs from nearby wells. It is assumed that the intact saprolite and bedrock formations contain significantly lower concentrations of the contamination than the upper portions of the saprolite based on the data from the temporary wells screened at varying depths in the saprolite, and from the bedrock well 13GW04.

2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

The combined area of Sites 5 and 13 consists of open field and woodlands approximately 3.5 acres in size. The area surrounding the field to the east, west and south is wooded property owned by the U.S. government. 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 contaminant plume originating in the Site 13 area and extending west and northwest to West Farm Branch consists of federal land owned by GSA and private property currently operated as a sand and gravel quarry (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 affected portion of the adjoining private property amounts to less than 1 acre and consists of an undeveloped and steeply sloped wooded hillside and floodplain of West Farm Branch.

There are no water supply wells located on the property in the area within or downgradient of the plume. Groundwater at and downgradient of Sites 5 and 13, 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 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.

For the purposes of the risk assessment, the sites were 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 soil and groundwater at the sites would pose if no action were taken beyond the soil 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 the 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 5 and 13 contaminants. The ecological risk assessment was conducted on a facility-wide basis, and results as they relate to Sites 5 and 13 are discussed in Section 2.7.4. Baseline human health risk assessments (BHHRA) were conducted separately for Site 5 soil and Site 13 soil in the *RCRA Facility Investigation for Sites 5 and 13, Tetra Tech NUS, May 2003.* The BHHRA for groundwater evaluated all groundwater in OU-1 together (in the *Remedial Investigation for Operable Unit 1, CH2M HILL, August 2002*), including the groundwater beneath Sites 5 and 13. As discussed in Section 2.5.2, surface water and sediment have been shown not to have been impacted by releases from Sites 5 and 13 at concentrations above risk-based screening criteria.

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 those that do 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. Soil, groundwater, surface water, and sediment contaminant concentrations were compared to risk-based screening levels based on direct contact with the contaminated media. Soil concentrations were also compared to leaching-to-groundwater screening levels. Chemicals of concern (COCs) are a subset of the COPCs. COCs are identified as those site related chemicals needing to be addressed by a response action because they exceed risk-based remediation goals or drinking water standards (i.e.: MCLs), or because they are present in soil at concentrations that exceed site-specific leaching-to-groundwater criteria developed by site-specific modeling.

No COCs were identified for either Site 5 or Site 13 soil under post-removal action conditions based on direct exposure to combined surface and subsurface soil. Additionally, no chemicals were identified as COCs through the leaching-to-groundwater scenario. As a result, no action is warranted for the soil to protect human health. Several COCs were identified for Site 5 and 13 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 Sites 5 and 13 soil and groundwater. Because risks to 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 sites. 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 are based on EPA Region III risk-based concentrations (RBCs) (USEPA, October 2003) 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 (USEPA, March 1991) and the most current

available reference doses (RfD) and cancer slope factors (CSF) (USEPA, October 2003). 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 Sites 5 and 13 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 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 RFI for Sites 5 and 13 (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 Sites 5 and 13. 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 Risk Characterization

Quantitative estimates of risk are calculated using exposure and toxicity values according to risk assessment methods outlined in current EPA guidance (USEPA, 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. 2.0×10^{-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 1.0×10^{-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 1.0×10^{-6} to 1.0×10^{-4} as the ILCR "target range" for most facilities containing waste or hazardous substances addressed under CERCLA. Cumulative ILCRs greater than 1.0×10^{-4} generally will indicate that some degree of remediation is required, and ILCRs below 1.0×10^{-6} normally will not require in remedial efforts. Whenever ILCRs fall between 1.0×10^{-4} and 1.0×10^{-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 contaminants of concern (COCs).

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:

$$HQ = (\text{Estimated Exposure Intake}) / (RfD)$$

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. 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.

2.7.1.5 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 realized. 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 at Sites 5 and 13 are discussed in the following sections.

2.7.2 Baseline Human Health Risk Assessment Results - Soil

Separate BHHRAs were conducted for the soil at Site 13 and the soil remaining at Site 5 after the 2000 removal action. A list of soil COPCs was developed for each site. Summaries of the COPC selection process for exposure to Site 5 soil and Site 13 soil under a residential land use scenario are presented in Table 2-3 and Table 2-4 respectively. 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 for Site 5 are:

COPCs for Soil

Site 5	Site 13
benzo(a)pyrene dibenzo(a,h)anthracene aroclor 1260 dieldrin 2-amino-4,6-dinitrotoluene RDX copper selenium thallium	benzo(a)pyrene dibenzo(a,h)anthracene thallium

The EPCs for COPCs in Site 5 soil and Site 13 soil are presented in Table 2-5 and Table 2-6 respectively. Soil EPCs are based on the 95 percent UCL because the data sets each consist of greater than ten samples. The oral/dermal RfDs and CSFs for the soil COPCs for both Sites 5 and 13 soil are presented in Table 2-7 (non-cancer RfDs) and Table 2-8 (CSFs).

Estimated HIs and ILCRs from exposure to soil at Sites 5 and 13 under the RME and CTE conditions are summarized below.

Non-Cancer Hazard Index - Cumulative Risk Summary

	Full Time Worker	Maintenance /Utility Worker	Construction Worker	Adult Recreational User	Adolescent Trespasser	Future Day Care Center Child	Future Adult Resident	Future Child Resident
				Site 5 Soil				
Total HI – RME	0.037	0.0053	0.12	0.0024	0.013	0.17	0.049	0.45
Total HI – CTE	0.015	0.0012	0.059	0.00055	0.0029	0.070	0.016	0.15
				Site 13 Soil				
Total HI – RME	0.012	0.0018	0.043	0.0008	0.0042	0.058	0.017	0.16
Total HI – CTE	0.0054	0.00045	0.021	0.0002	0.001	0.025	0.0058	0.054

Incremental Lifetime Cancer Risks - Cumulative Risk Summary

	Full Time Worker	Maintenance /Utility Worker	Construction Worker	Adult Recreational User	Adolescent Trespasser	Future Day Care Center Child	Future Adult Resident	Future Child Resident
				Site 5 Soil				
Total ILCR – RME	2.5E-06	3.7E-07	2.4E-07	2.0E-07	4.2E-07	2.7E-06	2.8E-06	5.9E-06
Total ILCR – CTE	5.5E-07	2.1E-07	1.1E-07	9.8E-09	6.2E-08	4.4E-07	2.1E-07	5.5E-07
				Site 13 Soil				
Total ILCR – RME	1.8E-06	2.6E-07	1.7E-07	1.5E-07	3.0E-07	1.9E-06	2.0E-06	4.2E-06
Total ILCR – CTE	1.8E-07	1.5E-08	8.0E-08	7.0E-09	4.5E-08	3.1E-07	1.5E-07	3.9E-07

The cumulative HIs (the sum of HQs for each COPC at both sites for all potential receptors under RME and CTE conditions are less than the EPA target of one.

The cumulative ILCRs for all potential receptors for both sites under RME conditions are within the EPA acceptable target range of $1.0X10^{-4}$ to $1.0X10^{-6}$. The PAHs, benzo(a)pyrene and dibenzo(a,h)anthracene, and PCBs account for 90 percent of the total cancer risk for Site 5 soil. The same two PAHs account for all of the cancer risk for Site 13 soil. The cumulative ILCRs for all potential receptors for both sites under the CTE conditions are less than the lower bound of the EPA acceptable target range.

The contribution of risks (both cancer and non-cancer) from each COPC under the RME and CTE conditions for soil at Site 5 and Site 13 can be found in the risk assessment backup tables provided in the RFI for Sites 5 and 13.

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 is not significantly greater than the background concentration, the metal is not identified as a COPC, even if its maximum concentration is greater than the screening level. The statistical analysis accounts for the variability in concentrations. However, at times, a review of the data may suggest that certain metals should be identified as COPCs even when the statistical analysis indicates otherwise.

Because the BHHRAs determined that the soil at both Sites 5 and 13 does not present an unacceptable risk for any receptors, no COCs have been identified for the soil at either site based on exposure to soil.

2.7.2.1 Uncertainty Analysis for Site 5 Soil

A review of the Site 5 metals data indicated that copper, lead, nickel, selenium, and thallium had

maximum detected concentrations greater than the UCL of the facility background concentrations and greater than their respective screening levels. Copper, selenium, and thallium were selected as COPCs and were evaluated in the quantitative risk assessment. Lead and nickel were not selected as COPCs because they were determined to be within background levels by the Wilcoxon Rank-Sum Test. When nickel is carried through the quantitative risk assessment for the most sensitive receptor (the future child resident), the HQ for nickel is 0.14, and the total HI for the child resident increases from 0.45 to 0.59. The cumulative HI would still have been less than unity, indicating that no toxic effects would be expected for exposure to soil at the site. If lead would have been evaluated in the quantitative risk assessment, the effects of exposure to lead would have been based on the average lead concentration (96.6 mg/kg), as specified in EPA guidance for lead (USEPA, February 1994). This concentration is less than the 400 mg/kg screening level. If lead had been evaluated at this concentration by the adult and child lead models, the predicted blood lead levels and the probability of exceeding the blood lead level of concern (10 μg/dL) would have been acceptable. Therefore, the results and conclusions of the risk assessment would not have changed if lead and nickel had been included in the quantitative risk analysis.

The risk assessment was recalculated to include all metals that were eliminated as COPCs on the basis of background only and for the most sensitive receptors, the hypothetical future child and adult resident. The results of the reanalysis were as follows: the total HI for the future adult resident increased from 0.049 to 0.18 and HI for the future child resident increased from 0.45 to 1.7. The main contributor to the risk from the background metals was iron (child HI = 0.66). Note that the RfD for iron (and calculated risks) are not based on adverse health affects but rather on an amount needed to protect against a deficiency of this metal. Although the cumulative HI for the child resident was 1.7, an analysis of the affected target organs indicated that all target organ specific HIs were less than unity. For carcinogenic risks, the total residential ILCR increases slightly from 8.6×10^{-6} to 1.9×10^{-5}. This increase is due to the inclusion of arsenic. However, the total residential ILCR is still within the USEPA's risk management range. Based on this analysis, the results and conclusions of the risk assessment are not affected by the elimination of the above mentioned metals from the quantitative risk evaluation.

2.7.2.2 Uncertainty Analysis for Site 13 Soil

A review of the Site 13 metals data indicates that aluminum, iron, manganese, and thallium had maximum detected concentrations greater than the UCL of the facility background concentrations and greater than their respective screening levels. Thallium was selected as a COPC and was evaluated in the quantitative risk assessment. Aluminum, iron and manganese were not selected as COPCs because they were determined to be within background levels by the Wilcoxon Rank-Sum Test. However, only the Site 13 UCL concentration for manganese is greater than the UCL of the site-specific background concentration and its screening levels. When manganese is carried through the quantitative risk assessment for the most sensitive receptor (the future child resident), the HQ for manganese is 0.14, and the total HI for the child resident increases from 0.16 to 0.3. The cumulative HI would still be less than unity, indicating that no toxic effects would be expected for exposure to soil at the site. Based on this evaluation, the results and conclusions of the risk assessment would not have changed if aluminum, iron, and manganese had been included quantitative risk analysis.

The risk assessment was recalculated to include all metals that were eliminated as COPCs on the basis of background only and for the most sensitive receptors, the hypothetical future child and adult resident. The results of the reanalysis were as follows: the total HI for the future adult resident increased form 0.017 to 0.17 and HI for the future child resident increased from 0.16 to 0.34. Regarding carcinogenic risks, the total residential ILCR increased from 6.2×10^{-6} to 1.3×10^{-5}, due to the inclusion of arsenic. However, the total residential ILCR is still within the USEPA's risk management range. Based on this analysis, the results and conclusions of the risk assessment are not affected by the elimination of the above mentioned metals as COPCs.

2.7.3 Leaching-to-Groundwater Analysis Results - Soil

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. Using this criteria, no COPCs were identified for Site 5 soil and two COPCs were identified for Site 13 soil: TCE and 1,1,2,2-PCA. While several chemicals were detected in one or more soil samples from the Site 5 (acetophenone, benzo(a) pyrene, aroclor 1260, dieldrin, arsenic and selenium) and Site 13 (1,2-dibromo-3-chloropropane, and arsenic) 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 preliminary remediation goals (PRGs) in any groundwater samples from this area.

Maximum TCE and 1,1,2,2-PCA concentrations in Site 13 soil are relatively low (16.2 and 171 ug/kg respectively) and were found only in samples collected near the water table and not is samples collected from the same boring several feet higher). The potential for these two contaminants to leach to groundwater was further evaluated in the Site 5 and 13 RFI using site-specific parameters in EPA-approved fate-and-transport models. Using these models it was demonstrated that the concentrations of TCE and 1,1,2,2-tetrachloroethane found in the Site 13 soil do not result in groundwater concentrations that exceed PRGs

2.7.4 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 operable unit of which Sites 5 and 13 are just a part. This approach was taken because chemicals related to several of the individual sites mix together in the groundwater, initially 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-1and 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 PRGs and identifying COCs for each area. For the purpose of the ROD, site-specific risks have been conservatively estimated for combined Sites 5 and 13 groundwater as discussed below.

2.7.4.1 Risks from OU-1 Groundwater

The list of groundwater COPCs for the entire OU-1 was developed using the samples identified in Table 2-9. 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 2-10. 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 2-11. 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 2-12. 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 2-13 and 2-14, 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	Not Applicable
Total HI - CTE	0.04	6.8	13	Not Applicable

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 1.0×10^{-4} to 1.0×10^{-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	Not Applicable	5.6E-03
Total ILCR – CTE	Not Calculated	5.5E-05	Not Applicable	1.0E-03

Table 2-15 summarizes the contribution of risks (both cancer and non-cancer) from each COPC under the RME conditions. Table 2-16 summarizes the contribution of risks from each COPC under the CTE conditions.

2.7.4.2 Site-Specific Risks from Sites 5 and 13 Groundwater

Site specific risks were estimated for combined Sites 5 and 13 groundwater using the results of the OU-1-wide risk assessment. Because the Sites 5 and 13 area is a sub-area of OU-1 and many of the COPCs identified for OU-1 are not found in Sites 5 and 13 groundwater, it is assumed the risks from Sites 5 and 13 will be less than those from the entire OU-1. Also, it is assumed that the only exposure scenarios that might experience unacceptable risks from groundwater at Sites 5 and 13 are those where unacceptable risks are present for OU-1, i.e. residential child, adult, and age-adjusted. The COPCs for the Sites 5 and 13 area 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 13 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 Sites 5 and 13 at concentrations that do not exceed base-wide background levels were excluded as COPCs for Sites 5 and 13 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 concentrations 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.

The following chemicals were retained as COPCs in Sites 5 and 13 groundwater:

- Five chlorinated VOCs: 1,1,2,2-PCA, tetrachloroethene (PCE), TCE, cis-1,2-dichloroethene (DCE), and vinyl chloride
- One explosives compounds: RDX
- One inorganic: iron

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 Sites 5 and 13. This approach is conservative because it uses the maximum concentrations for the Site 5 COPCs found throughout OU-1 and not necessarily in the groundwater at Sites 5 and 13. The incremental risks used to calculate the Sites 5 and 13 risks are highlighted in Tables 2-15 for the RME conditions and in Table 2-16 for the CTE conditions.

Estimated HIs from exposure to Sites 5 and 13 groundwater in the Coastal Plain/saprolite under the RME and CTE conditions are summarized below. The cumulative HIs for possible future adult and child residents exceed 1 for the RME conditions. Only the HI for the possible future child resident exceeds 1 under the CTE conditions.

Estimated Hazard Index for Sites 5 and 13 Groundwater in the Coastal Plain/Saprolite Cumulative Risk Summary

	Adult Resident	Child Resident	Age-adjusted Resident
Total HI – RME	9	21	Not Applicable
Total HI – CTE	0.6	1.9	Not Applicable

Estimated ILCRs from exposure to Sites 5 and 13 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 Sites 5 and 13 Groundwater in the Coastal Plain/Saprolite Cumulative Risk Summary

	Adult Resident	Child Resident	Age-adjusted Resident
Total ILCR - RME	5.0E-04	Not Applicable	1.7E-03
Total ILCR - CTE	3.7E-05	Not Applicable	2.8E-04

2.7.5 Ecological Risk Assessment

The Navy has conducted a phased ecological risk assessment (ERA) at the former NSWC-White Oak, to characterize the potential risks to ecological receptors from site-related chemicals found throughout the facility including at Sites 5 and 13. The procedures followed in conducting the BERA are outlined in the April 2001 final report.

At Site 5, one surface soil sample was collected for toxicity testing (14-day earthworm test) during the Baseline Ecological Risk Assessment (BERA) because of elevated levels of PAHs in that sample. The sample was toxic versus the control sample, but still had a high mean survival of 87.5 percent. The surface soil from Site 5 was excavated as part of a removal action, so the soil from the location of the toxicity test is no longer present. No other samples from Site 5 had chemical concentrations that exceeded the risk-based levels

developed during the BERA so risks to ecological receptors at Site 5 are expected to be negligible.

All chemical concentrations in surface soil samples collected at Site 13 were below the risk-based levels developed during the BERA so risks to ecological receptors at Site 13 are expected to be negligible.

As groundwater exposure is not associated with ecological receptors, Sites 5 and 13 groundwater poses no ecological risks. No site-related chemicals were detected in the surface water or sediment in West Farm Branch and therefore, risks to ecological receptors were not evaluated for this media relative to Sites 5 and 13.

2.7.6 Conclusions of Risk Assessments

Under current conditions, there is no significant human health risk associated with contaminants in groundwater because groundwater at Sites 5 and 13 is not being used as a potable source.

Non carcinogenic HIs associated with exposure to Sites 5 and 13 groundwater under a hypothetical future residential scenario (adult or child) exceeded the EPA's acceptable target of unity. The ILCRs associated with exposure to groundwater under a hypothetical future residential scenario exceeded the EPA's acceptable range.

The presence of these carcinogenic and non-carcinogenic risks warrant that an evaluation of remedial alternatives be conducted to determine if remedial action or institutional controls are needed to reduce groundwater contaminant concentrations or mitigate exposure.

The BHHRA determined that the Site 13 soil and the Site 5 soil remaining after the 2000 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 1.0×10^{-4}, nor does it represent a continuing source of groundwater contamination through leaching. The site soil also does not pose an unacceptable ecological risk.

2.8 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) identify receptors, pathways, and action levels. The RAOs for the contaminated groundwater at Sites 5 and 13 are:

- To 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 Sites 5 and 13. 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 Groundwater COCs and PRGs

PRGs were developed for each of the COPCs identified for the Sites 5 and 13 groundwater. The PRGs were developed based on combined risks from the COPCs in the Sites 5 and 13 groundwater 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 is being addressed by a separate actions and RODs.) PRGs for groundwater in OU-1 are set with the goal of reducing the cumulative risk from all contaminants to an acceptable level in an area that one might be exposed to if a supply well was installed and used. 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 receptors 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 short list of COPCs was identified for each. The PRG attainment areas for OU-1 are shown in Figure 2-11. As shown on this figure, a separate attainment area has been established for Sites 5 and 13 (referred to as the Site 13 PRG attainment area) because of the unique set of contaminants found in the groundwater above risk-based screening levels in this area of OU-1.

Groundwater risk-based PRGs were calculated for the COPCs in the Site 13 PRG attainment area (as well at the other five 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 Sites 5 and 13 COPC. The proposed PRG for each COPC in the Site 13 attainment area was then calculated so that the overall cancer risk does not exceed 5×10^{-5}, and the hazard to a target organ does not exceed 1. These calculations are presented in Tables 2-17 through 2-20.

The PRGs for each COPC in the Site 13 groundwater attainment area are shown in Table 2-21. 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 Sites 5 and 13 PRGs were then compared to the maximum detected contaminant concentration in the Site 5 and 13 groundwater in order to identify contaminants of concern (COCs). As noted earlier, 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 Sites 5 and 13 groundwater exceeds the PRG then that chemical is considered a COC; COCs are identified in Table 2-21 and are listed below with their PRGs.

COC for Sites 5 and 13 Groundwater	PRGs (µg/L)	Basis
1,1,2,2-Tetrachloroethane	3	RB
Tetrachloroethene	5	MCL
Trichloroetene	5	MCL
Cis-1,2- Dichloroethene	70	MCL
Vinyl Chloride	2	MCL
RDX	6	RB
Iron (dissolved)	4,600	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.

2.8.3 Estimated Volumes of Contaminated Groundwater

The dissolved-phase plume originating at Sites 5 and 13 encompasses an area of approximately 6 acres. A major focus of the remedial alternatives for the dissolved phase contamination in the Sites 5 and 13

groundwater is the areas of greatest chlorinated VOC concentration. This area, referred to as the Site 13 groundwater target remediation zone is characterized by total VOC concentrations greater than 1000 µg/L (Figure 2-10)

No significant or widespread area of soil contamination has been found above or below the water table that would indicate a zone of saturated soil and groundwater that may have been exposed to nonaqueous phase liquid (NAPL). Treatment of the source will allow attenuation of the remainder of the dissolved contaminant plume through mechanisms such as dilution, volatilization, biodegradation, adsorption, and dispersion.

The target remediation zone is approximately 15,000 sf. The vertical extent of the aquifer across this area is approximately 20 ft and the water table is encountered below the Coastal Plain sediment/saprolite interface. The estimate of contaminant mass within the target remediation zone is based on the following assumptions:

- Target Treatment Area = 15,000 sf
- Thickness of Aquifer = 20 ft
- Porosity = 0.25
- Average 1,1,2,2-PCA Concentration = 650 µg /L
- Average PCE Concentration = 50 µg /L
- Average TCE Concentration = 200 µg /L
- Average DCE Concentration = 450 µg /L
- Average VC Concentration = 5 µg /L
- Average Total chlorinated VOC Concentration = 1,500 µg/L

This translates into an approximate volume of 75,000 cf (0.6 million gallons) of contaminated groundwater containing approximately 3 lbs. of 1,1,2,2-PCA and a total of 7 lbs. of chlorinated VOCs. It is likely that additional chlorinated VOC mass is present adsorbed to the saturated soil within the target remediation zone, but no sampling data was available to estimate it.

Calculations of contaminant mass were also made for the portions of the plume west (downgradient) of the groundwater target remediation zone. This portion of the plume, which encompasses 5 acres, contains lower concentrations of chlorinated VOCs ranging from 1000 to 5 µg/L, and averaging about 100 µg/L. The thickness of contamination is estimated to be the entire saturated zone, approximately 20 feet averaged over the entire area. There are an estimated 4.3 million cf or about 32 million gallons of groundwater within this area containing approximately 12 kg or about 26 pounds of chlorinated VOCs in the dissolved phase.

2.9 DESCRIPTION OF ALTERNATIVES FOR GROUNDWATER

Seven remedial alternatives were developed for the groundwater plume originating at Sites 5 and 13.

- Alternative 1: No Action
- Alternative 2: Institutional Controls (ICs) and Long-term Monitoring (LTM)
- Alternative 3: Monitored Natural Attenuation with ICs
- Alternative 4: *In-Situ* Enhanced Reductive Dechlorination with MNA and ICs
- Alternative 5: *In-Situ* Chemical Oxidation (ISCO) with MNA and ICs
- Alternative 6: Groundwater Extraction and Treatment with MNA and ICs
- Alternative 7: Air Sparging with MNA and ICs
- Alternative 8: Groundwater Extraction and Wetlands Treatment with MNA and ICs
- Alternative 9: *In-Situ* Chemical Reduction using Zero-valent Iron with MNA and ICs

The following sections outline the components of each of the remedial alternatives to address the Sites 5 and 13 groundwater.

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 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. 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 would be a small part of a larger 5-year report that addresses the entire OU-1 as well as other sites at White Oak.

2.9.2 Alternative 2: Institutional Controls (ICs) and Long-term Monitoring (LTM)

The primary components of this alternative are:

- Institutional controls
- Installation of additional monitoring wells to delineate extent of ICs
- Long-term monitoring of the groundwater
- Preparing annual and 5-year reports

2.9.2.1 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 2-11 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.

2.9.2.2 Installation of Additional Wells

It is assumed that two new saprolite monitoring well would be needed to monitor the presence of contamination downgradient of the site.

2.9.2.3 Long-term Groundwater Monitoring

Under this alternative, groundwater monitoring would be performed at approximately 5 wells every 9 months to track contaminant concentrations within the Sites 5 and 13 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 the 5 wells would be sampled for VOCs, explosives and several metals.

2.9.2.4 Reporting

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

2.9.3 Alternative 3: Monitored Natural Attenuation (MNA) with ICs

The primary components of this alternative are:

- Installation of additional wells to establish an optimum groundwater monitoring network
- 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
- Implementation of institutional controls until PRGs are met

2.9.3.1 Installation of Additional Wells

Two additional monitoring wells would be installed in the upper portion of the aquifer in the Site 13 target remediation zone to provide adequate monitoring locations for MNA. A third well would be installed in the bedrock directly beneath the Site 13 target remediation zone to monitor NA in the vertical direction of groundwater flow. The bedrock well would be double-cased.

2.9.3.2 Long-term Groundwater Monitoring

Under this alternative, groundwater samples would be collected annually from a monitoring well network of approximately 6 wells. Groundwater samples would be collected semiannually for the first year and annually thereafter. In addition to VOCs, the samples would also be analyzed for NA indicating parameters such as dissolved oxygen, oxidation-reduction potential, temperature, nitrate, sulfate, ferrous iron, methane, ethane, ethene, alkalinity, chloride, total organic carbon, and carbon dioxide. The following field parameters: dissolved oxygen, temperature, pH, conductivity, and redox potential also would be collected. Target remediation area concentrations would be compared to background levels and threshold levels to assess whether NA is occurring.

2.9.3.3 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.

2.9.3.4 Contingency Remedy

Provisions for a contingency remedy would be made 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 may 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. A contingency remedy, if necessary, would be selected jointly by the Navy and EPA with support from MDE, in accordance with CERCLA, the NCP, and the terms of the RCRA 7003 order (and any subsequent orders from EPA)

2.9.3.5 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.

2.9.4 Alternative 4: In-Situ Enhanced Reductive Dechlorination with MNA and ICs

The primary components of this alternative are:

- Installation of additional wells to define treatment area and establish a groundwater monitoring network
- Performance of a source area pilot test (if necessary)
- Installation of injection wells/borings
- Pneumatic fracturing of the saprolite to enhance electron donor distribution
- Injection of electron donor in the target remediation zone
- Groundwater monitoring of baseline and post-injection conditions
- Preparation of annual technical memoranda and 5-year report
- Monitoring for natural attenuation of the plume outside of the target remediation zone
- 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 1000 μg/L VOCs) identified as the Site 13 groundwater target remediation zone (see Figure 2-10). The assumption is that the remainder of the plume would be addressed by MNA.

In this alternative, the naturally occurring process of chemical decomposition under reducing conditions would be enhanced through injection and distribution of an electron donor in the groundwater target remediation zone at Site 13, 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 is expected to occur, resulting in the removal of chlorine atoms from the chlorinated hydrocarbon contaminants. The major components of this alternative are discussed below.

2.9.4.1 Installation of Additional Wells

A design phase investigation involving the installation of an estimated four temporary wells and three

permanent monitoring wells would be conducted. The temporary wells would be used to more precisely define the treatment area to avoid injecting electron donor in areas not needing treatment. Of the three permanent wells, two would be installed in the upper portion of the aquifer within the Site 13 target remediation zone to provide adequate monitoring locations for evaluating the effectiveness of ERD. The third permanent well would be installed in the bedrock directly beneath the Site 13 target remediation zone to monitor current and future conditions in the vertical direction of groundwater flow. The bedrock well would be double-cased.

2.9.4.2 Performance of a Pilot Test

Amendments such as Hydrogen Releasing Compound™ (HRC) by Regenesis, sodium lactate, vegetable oil, and molasses have been used for ERD. A literature review has been conducted and determined that HRC and sodium lactate would be suitable for the site contaminants.

A field pilot test would then be performed within the target treatment zone to determine the ability to distribute the electron donor in the subsurface. Because the low permeability of the saprolite formation will hinder effective chemical distribution, technologies to increase permeability, such as pneumatic fracturing, are proposed. A pilot test for pneumatic fracturing has already been conducted at nearby Site 9, which has similar geologic conditions. Results of this test were favorable and may eliminate the need for conducting a similar test at Site 13.

2.9.4.3 Installation of Injection Wells, Pneumatic Fracturing of Saprolite, and Hydrogen Releasing Compound Injection

Pneumatic fracturing would be conducted to create a more permeable matrix in the saprolite and allow the greater distribution of the electron donor. This process involves injecting gas (nitrogen) at high pressures into packered intervals of an open borehole. Fractures are propagated outward from the borehole to various distances depending on the site geology. Experience at similar saprolite conditions at Site 9 indicate that fractures radiating 30 feet from the borehole can be expected. It is assumed that the electron donor (e.g.: HRC) can them be injected out to a radius of 20 feet. Because of the viscosity of the HRC, it is unlikely that it could be injected to the full 30-foot radius. Under current (unfractured) conditions, a five to eight-foot radius is expected.

A series of 15 - 4-inch diameter open boreholes would be installed with steel casings to the water table and temporary inner PVC casings to 38 feet bgs. The borings would be placed at 30 foot centers to allow some overlap of treatment area.

HRC is a proprietary polylactate ester that, upon being deposited into the subsurface, slowly releases lactate. Lactate is metabolized by naturally occurring microorganisms, resulting in the creation of anaerobic aquifer conditions and the production of hydrogen. HRC is manufactured as a viscous gel that can be injected into the saturated zone for plume remediation.

After the saprolite is fractured, the electron donor chemical would be mixed into a slurry and injected one well at a time in 3-foot packered intervals from bottom to top over the 20 foot thick aquifer using a pressurized pumping system. The pressure of the injection would depend upon the headloss within the aquifer formation, but is estimated to be near 500 psig. Pressurized injection achieves better distribution of the chemical within the contaminated zone and results in higher treatment efficiencies. The HRC would be heated for injection using a heated grout pump, to reduce the viscosity and allow improved migration of the HRC into the formation.

It was assumed that two HRC injections and approximately five years would be required to achieve PRGs in the groundwater using ERD if there is no significant residual DNAPL. Long-term monitoring of the downgradient portions of the plume would continue for an estimated 17 years.

The estimated application configurations for the HRC injection are as follows:

- Size of Target Remediation Zone 0.34 acres

• Radius of Influence	20 ft
• Number of Injection Wells and Spacing	15 wells spaced at 30 ft
• Dose Rate in lbs/vertical ft of Injection	9 lbs HRC per lf
• Material Requirement	2,640 lbs of HRC

2.9.4.4 Baseline and Post-injection Monitoring

Bioremediation effectiveness would be monitored by collecting and analyzing groundwater samples from selected wells prior to, and throughout the duration of, the treatment. Sampling and analysis would be conducted to track disappearance of contaminants, byproduct generation, and the dispersion of the HRC, to determine effectiveness. These data would be used to determine if additional applications are necessary. The scope of each sampling event would be similar to that of Alternative 3 (six wells sampled per event), with modifications to better understand the effectiveness of the electron donor injection.

Baseline sampling would be conducted prior to the injection of the electron donor. Sampling would continue quarterly for the first year, and then semiannually until PRGs are achieved. Field sampling efforts to support the injection effort would include testing monitoring wells for temperature, pH, DO, ORP, and specific conductance using standard field instrumentation. Laboratory samples would be collected from the monitoring wells and analyzed for COCs, methane, ethene, ethane, major ions, nitrate, sulfate, chloride, TOC, and alkalinity. Laboratory analysis of the initial sampling rounds would involve analysis of additional parameters to track the HRC degradation (metabolic organic acids). 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 two downgradient.

2.9.4.5 Long-term Groundwater Monitoring

Groundwater in the plume downgradient of the target remediation zone would be subject to annual monitoring to track the cleanup of the contaminant plume. It was assumed that 6 monitoring wells would be sampled for VOCs and MNA parameters. Monitoring would continue until PRGs are met. This is estimated to require at total of 17 years.

2.9.4.6 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 as part of the 5-year review report, to determine contaminant biodegradation rates, reevaluate the data collected, and evaluate the effectiveness of the remedy.

2.9.4.7 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. LUCs would remain in effect until groundwater PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

2.9.5 Alternative 5: *In-situ* Chemical Oxidation with MNA and ICs

The primary components of this alternative are:

- Installation of additional wells to define treatment area and establish a groundwater monitoring network
- Performance of a source area pilot test (if necessary)
- Installation of injection wells
- Pneumatic fracturing of the saprolite to enhance reagent distribution
- Injection of oxidizing reagent in the target remediation zone
- Groundwater monitoring of baseline and post-injection conditions
- Preparation of a remediation completion report and five-year reviews
- Monitoring for natural attenuation of the plume outside the target remediation zone

- Implementation of institutional controls until PRGs are met

ISCO, which involves the injection of an oxidizing agent into the contaminated aquifer, 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 groundwater to less than PRGs at multiple sites similar to Site 13. It is assumed that Fenton's Reagent would be used for Site 13 because it is a strong oxidizer and, unlike potassium permanganate, has shown promise in oxidizing chlorinated ethanes as well as chlorinated ethenes. The major components of this alternative are discussed below.

2.9.5.1 Installation of Additional Wells

A design phase investigation involving the installation of an estimated four temporary wells and three permanent monitoring wells would be conducted. The temporary wells would be used to more precisely define the treatment area to avoid injecting reagent in areas not needing treatment. Of the three permanent wells, two would be installed in the upper portion of the aquifer within the Site 13 target remediation zone to provide adequate monitoring locations for evaluating the effectiveness of ISCO. The third well would be installed in the bedrock directly beneath the Site 13 target remediation zone to monitor current and future conditions in the vertical direction of groundwater flow. The bedrock well would be double-cased.

2.9.5.2 Performance of a Pilot Test

Because ISCO has not been proven to be effective in treating chlorinated ethanes such as 1,1,2,2-PCA, a pilot test would be performed within the target treatment zone. COC degradation would be tracked with time at surrounding monitoring points to determine the feasibility of full-scale application.

Additionally, the low permeability of the saprolite formation will likely hinder effective chemical distribution. Technologies to increase permeability, such as pneumatic fracturing, are proposed. A pilot test for pneumatic fracturing has already been conducted at nearby Site 9, which has similar geologic conditions. Results of this test were favorable and may eliminate the need for conducting a similar test at Site 13.

2.9.5.3 Installation of Injection Wells, Pneumatic Fracturing of Saprolite, and Oxidizing Reagent Injection

Pneumatic fracturing, as discussed under Alternative 4, would be conducted to create a more permeable matrix in the saprolite and allow the greater distribution of the oxidizing reagent. Because Fenton's Reagent is not very viscous, it is assumed that the oxidizing reagent can them be injected out to the full 30-foot radius.

A series of 7 - 4-inch diameter open boreholes would be installed in the target remediation zone with temporary PVC casings to 38 feet bgs. The borings would be placed at 50 foot centers to allow some overlap of treatment area. After the saprolite is fractured, the Fenton's Reagent would be injected one well at a time in 3-foot packered intervals working from the bottom of the boring to the top over the 20-foot thickness of the target remediation zone.

It is estimated that approximately 99,000 lb. of hydrogen peroxide (at a 50-percent solution) would be required to destroy approximately 7 lb. of chlorinated VOCs in the groundwater. The hydrogen peroxide would be combined with equal parts (by weight) of catalyst solution made of ferrous sulfate, calcium phosphate, and sulfuric/phosphoric acid to create the Fenton's Reagent. Ferrous sulfate is added to initiate the reaction at sites where the ferrous iron concentration is less than 25 mg/L; the average ferrous iron concentration in source area wells at Site 13 is approximately 2 mg/L. The calcium phosphate is used to stabilize the hydrogen peroxide. Either sulfuric and/or phosphoric acid is used to reduce the pH of the groundwater to less than 6; the average pH in source area wells at Site 13 is approximately 5. Therefore, minimal, if any acid would be needed at this site. Groundwater conditions are reported to return to background conditions within several days after injection.

It is estimated that approximately 7 working days would be required to fracture and perform chemical injection into all the points. The estimated design parameters are summarized below:

• Size of Target Remediation Zone	0.34 acres
• Radius of Influence	30 ft
• Number of Injection Wells and Spacing	7 wells, spaced at 50 ft
• Fenton's Reagent Dose Rate and Concentration	3000 gals of reagent per boring at 25% H_2O_2
• Hydrogen Peroxide Requirement	99,000 total pounds

A typical industry practice is to undertake two chemical treatments, an initial injection followed by a polishing injection within a small fraction of the target treatment zone where monitoring well data shows COC rebound. A polishing injection would typically be required where conditions of solubility and chemical partitioning cause further desorption of the contaminant of concern. This is likely the case at Site 13. Since ISCO is a relatively rapid treatment process, it is assumed that the site can be treated to PRGs within two years. The fractured borings 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. Long-term monitoring of the downgradient portions of the plume to continue for an estimated 17 years.

2.9.5.4 Baseline and Post-injection Monitoring

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

Baseline sampling would be conducted prior to the injection of the oxidant, and then at 2 to 6 weeks after the initial injection to determine if a second injection is needed. After the final injection, two additional sampling rounds would be performed (after 12 and 24 months) to confirm remediaton. Field sampling efforts to support the injection effort would include testing monitoring wells for the oxidant concentration using a field test kit and temperature, pH, DO, ORP, and specific conductance using standard field instrumentation. Laboratory samples would be collected from the monitoring wells and analyzed for chlorinated VOCs, metals, major ions, nitrate, sulfate, chloride, TOC, and alkalinity. Locations of sampling points are estimated to be as follows: one upgradient, three at the source area, and two downgradient.

2.9.5.5 Long-term Groundwater Monitoring

Groundwater in the plume downgradient of the target remediation zone would be subject to annual monitoring to track the cleanup of the contaminant plume. It was assumed that 6 monitoring wells would be sampled for VOCs and MNA parameters. Monitoring would continue until PRGs are met. This is estimated to require at total of 17 years.

2.9.5.6 Reporting

A closeout report would be generated to document the result of the ISCO treatment. Technical memoranda would also be generated to document the results of the out-year verification sampling rounds. 5-year reports would be generated to document MNA of the downgradient plume.

2.9.5.7 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. LUCs would remain in effect until PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

2.9.6 Alternative 6: Groundwater Extraction and Treatment with MNA and ICs

The primary components of this alternative are:

- Installation, testing and startup of groundwater extraction wells and piezometers
- 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
- Discharging the treated water to West Farm Branch
- Annual operation and maintenance to monitor performance and assure proper operation
- Groundwater monitoring for contaminant concentrations and hydraulic capture
- Preparation of annual technical memoranda and 5-year report
- Monitoring for natural attenuation of the plume outside the target remediation zone
- Implementation of institutional controls until PRGs are met

Each primary component is discussed below.

2.9.6.1 Installation of Groundwater Extraction Wells and Piezometers

Groundwater extraction serves two purposes: it allows for contaminant mass removal and also can provide hydraulic containment, by altering the natural hydraulic gradient to prevent contaminated groundwater flow either horizontally or vertically. A network of seven groundwater extraction wells pumping at 0.1 gpm each would be installed to control the Site 13 source area groundwater. Approximately five piezometers would also be installed to monitor water levels around the extraction wells and determine if the necessary capture zones were being established.

A predesign pumping test is recommended for Site 13 to ensure that groundwater can be extracted from the saprolite at a reasonable rate. The test would comprise installing an extraction well and several piezometers in an area with significant levels of contamination and performing and evaluating a pumping test.

2.9.6.2 Groundwater Treatment System

Contaminated groundwater would be extracted at the rate of approximately 1 gpm and directed to a central treatment system consisting of a filter, equalization tank, and liquid-phase granular activated carbon (LGAC) system with gravity drain to West Farm Branch.

LGAC was selected as a preferred technology for groundwater treatment of the COCs due to its low maintenance and relatively good treatment efficiency. 1,1,2,2-PCA is not volatile enough for treatment using air-stripping technology at the high concentrations found at the site. The treatment system would be equipped with instrumentation to record flow rates and calculate total volume treated, and to shut down the system and notify maintenance personnel in the event of malfunction.

2.9.6.3 Discharge of Treated Water

The treated water would be pumped to the nearest surface water stream, assumed to be West Farm Branch, under a National Pollutant Discharge Elimination System (NPDES) permit. Discharge concentrations would have to meet the State of Maryland surface water discharge requirements.

2.9.6.4 Annual O&M and Groundwater Monitoring

The time estimated to achieve PRGs in the target remediation zone via groundwater extraction and treatment is approximately 6 to 10 years. It would require an estimated total of 17 years for the downgradient portions of the plume to meet PRGs.

During this 10-year period, annual O&M and monitoring would be performed. In addition to routine mechanical system maintenance and checks, O&M would include sampling the discharge from each well and LGAC influent and effluent monthly, and collecting water levels in the surrounding wells and piezometers monthly. Groundwater monitoring would include collecting groundwater samples from a network of an estimated six wells quarterly for 2 years and then semiannually for the duration of the remediation (estimated at 10 years).

2.9.6.5 Long-term Groundwater Monitoring

Groundwater in the plume downgradient of the target remediation zone would be subject to annual monitoring to track the cleanup of the contaminant plume. It was assumed that 6 monitoring wells would be sampled for VOCs and MNA parameters. Monitoring would continue until PRGs are met. This is estimated to require at total of 17 years.

2.9.6.6 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 during the first year and semiannually thereafter to report treatment performance.

2.9.6.7 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. LUCs would remain in effect until PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

2.9.7 Alternative 7: Air Sparging with ICs and LTM

The primary components of this alternative are:

- Installation of additional wells to define treatment area and establish a groundwater monitoring network
- Installation of air sparging wells with pneumatic fracturing of the saprolite
- Operation of the air sparging system
- Groundwater monitoring of baseline and post-injection conditions
- Preparation of a remediation completion report and five-year review
- Monitoring for natural attenuation of the plume outside the target remediation zone
- 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 1000 μg/L VOCs) identified as the Site 13 groundwater target remediation zone (see Figure 2-10). The remainder of the plume would be addressed by MNA. Each of the components is discussed in detail below.

2.9.7.1 Installation of Additional Wells

A design phase investigation involving the installation of an estimated four temporary wells and three permanent monitoring wells would be conducted. The temporary wells would be used to more precisely define the treatment area to avoid unnecessary air sparging in areas not needing treatment. Of the three permanent wells, two would be installed in the upper portion of the aquifer within the Site 13 target remediation zone to provide adequate monitoring locations for evaluating the effectiveness of air sparging. The third well would be installed in the bedrock directly beneath the Site 13 target remediation zone to monitor current and future conditions in the vertical direction of groundwater flow. The bedrock well would be double-cased.

2.9.7.2 Pneumatic Fracturing of the Saprolite and Installation of Air Sparging System

Pneumatic fracturing, as discussed under Alternative 4, would be conducted to create a more permeable matrix in the saprolite and allow the greater distribution of sparging air. It is assumed that the effective radius of the air sparging operation would be a full 30-feet. Under current (unfractured) conditions, a five to eight-foot radius is expected.

A series of 7 - 4.5-inch diameter open boreholes would be installed in the target remediation zone with temporary PVC casings to 38 feet bgs. The borings would be placed at 50 foot centers to allow some overlap of treatment area. Once the saprolite is fractured, the sparge wells would be constructed in each boring.

The air sparging wells would be constructed of 2-inch PVC, with a two-ft screen at the base of the fractured zone (top of the rock) from approximately 33 to 35 ft bgs. An air-sparging blower would be connected to the well network. A blower of 750 scfm and 12-psig capacity would be provided to inject approximately 20 scfm of air into each of the sparge wells. The estimated design parameters are summarized below:

• Size of Target Remediation Area	0.34 acres
• Radius of Influence	30 ft
• Number of Air Sparging Wells and Spacing	7 wells spaced at 50 ft
• Air Injection Rate	30 scfm per well
• Blower Demand	250 scfm at 12 psig

Once the contaminants are stripped from the saturated zone, they would pass through the vadose zone and be discharged directly into the atmosphere. Since the total mass of contamination is only 7 pounds, it was assumed that fugitive ground surface emissions would be compliant with local air emissions regulations. Therefore, this alternative does not include costs for soil vapor extraction (SVE) and off-gas treatment system.

A treatment time of approximately 3 years was estimated based on engineering experience at similar sites. However the effectiveness of the technology at removing 1,1,2,2-PCA creates significant uncertainty with this estimate. Long-term monitoring of the plume downgradient of the target remediation zone would continue for a total of approximately 17 years.

2.9.7.3 Baseline and Post-injection Monitoring

Effectiveness of the treatment would be monitored by collecting and analyzing groundwater samples from selected wells prior to and during the treatment. 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. Laboratory samples would be collected from the monitoring wells and analyzed for chlorinated VOCs and metals.

2.9.7.4 Long-term Groundwater Monitoring

Groundwater in the plume downgradient of the target remediation zone would be subject to annual monitoring to track the cleanup of the contaminant plume. It was assumed that 6 monitoring wells would be sampled for VOCs and MNA parameters. Monitoring would continue until PRGs are met. This is estimated to require at total of 17 years.

2.9.7.5 Reporting

A closeout report would be generated to document the result of the air sparging treatment. Technical memoranda would also be generated to document the results of the out-year verification sampling rounds. 5-year reports would be prepared to document MNA of the downgradient plume if the air sparging is successful within the estimated time frame of 3 years.

2.9.7.6 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.

2.9.8 Alternative 8: Groundwater Extraction with Wetlands Treatment with MNA and ICs

The primary components of this alternative are:

- Installation, testing and startup of groundwater extraction trench and monitoring piezometers
- Construction of 0.4 acre treatment wetlands and necessary inflow and outflow structures
- Instrumentation to monitor and record flow rates

- Discharging the treated water to West Farm Branch
- Annual operation and maintenance to monitor performance and assure proper operation
- Groundwater monitoring for contaminant concentrations and hydraulic capture
- Preparation of annual technical memoranda and 5-year report
- Implementation of institutional controls until PRGs are met

Alternative 8 involves using a passive groundwater extraction trench to collect contaminated groundwater and prevent it from migrating offsite. The collected groundwater would be discharged to a constructed wetlands for treatment. Each primary component is discussed below.

2.9.8.1 Construction of Groundwater Extraction Trench and Piezometers

A 185-foot long by 38-foot deep (maximum) groundwater extraction trench would be constructed along the property line that constitutes the northern edge of Site 3 and 13 (see Figure 2-12). The trench would be constructed to serve two purposes. Its primary purpose would be to provide hydraulic containment to prevent additional contaminated groundwater from migrating from Site 13 onto the adjacent private property. Secondly it would collect and channel contaminated groundwater to a constructed wetlands for treatment.

The trench would be dug to the top on competent rock, which is estimated at 38 feet bgs at the east end of the trench and less than five feet at the west end. The trench would be about five-feet wide and the bottom would slope gradually to the west. A perforated PVC pipe would be installed in the bottom of the trench and the trench would be backfilled with pea gravel to the top of the water table. The remainder of the trench would be backfilled with the excavated soil.

It is estimated that the trench would collect about 2 gpm. Approximately five piezometers would be installed to monitor water levels on both sides of the extraction trench and determine if the necessary capture is being established.

2.9.8.2 Groundwater Treatment Wetlands

Surface flow treatment wetlands mimic natural wetlands in that water principally flows above the ground surface, as a shallow sheet, through a more or less dense growth of wetland plants. The wetland treatment system at Sites 5 and 13 would includea water distribution system, the wetland, and a collection system. Approximately 2 gpm would be conveyed from the extraction. An additional 1 gpm would enter the wetlands directly though the upgradient (eastem) side. The wetlands would be created in a 0.4 acre area at the location of the former Site 3 landfill near the property boundary and bordering West Farm Branch (Figure 2-12). The wetland effluent would discharge into West Farm Branch. Discharge would be gravity driven and require no pumping.

To achieve the necessary contact time of 60 days and maintain anaerobic conditions within the wetland the inlet structure and the first half of the wetlands would be excavated to 6 ft below the water table. The second half of the wetlands would be excavated to a depth of 1 foot below the water table, creating a surface flow wetland. This design would allow for the wetland to have an average retention time of 70 days, allowing sufficient time for the contaminant degradation and would make the design possible to fit on a 0.4 acre footprint.

2.9.8.3 Discharge of Treated Water

The treated water would be gravity fed to West Farm Branch, subject a National Pollutant Discharge Elimination System (NPDES) permit. Discharge concentrations would have to meet the State of Maryland surface water discharge requirements.

2.9.8.4 Treatment Wetlands Operation and Maintenance

Ongoing maintenance of the treatment wetlands would require only a few regular activities. A primary objective of maintenance would be to ensure that the inflow and outflow structures are working to distribute water over

the entire inflow width of the cell and to ensure collection of discharge water similarly at the other end. Periodic examination of the inflow and outflow structures would ensure that the devices are functioning properly and that they are set at the proper level. Additional maintenance would be needed to control undesired plant and wildlife within the wetland system.

Seasonal adjustments to the effluent rate may be necessary to maintain the design elevation and hydraulic residence time as a result in changes in evapotranspiration (the rate at which open water surface evaporates and the plants transpire water).

The time estimated to achieve PRGs via passive groundwater extraction and wetlands treatment is approximately 30 years. During this 30-year period, monthly to bimonthly monitoring of influent and effluent would be performed and water levels in the piezometers would be measured.

2.9.8.5 Long-term Groundwater Monitoring

Groundwater at the site would initially have quarterly sampling for the first year and then be monitored annually to track the cleanup of the contaminant plume. It was assumed that 6 monitoring wells would be sampled for VOCs and MNA parameters. Monitoring would continue until PRGs are met throughout the site. This is estimated to require at total of 30 years.

2.9.8.6 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 during the first year and annually thereafter to report treatment performance.

2.9.8.7 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. LUCs would remain in effect until groundwater PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

2.9.9 Alternative 9: In-situ Chemical Reduction with Zero-valent Iron with MNA and ICs

The primary components of this alternative are:

- Installation of additional wells to define treatment area and establish a groundwater monitoring network
- Performance of a source area pilot test (optional)
- Installation of injection wells
- Pneumatic fracturing of the saprolite to enhance ZVI distribution
- Injection of ZVI in the Site 13 target remediation zone
- Groundwater monitoring of baseline and post-injection conditions
- Preparation of annual technical memoranda and 5-year report
- Monitoring for natural attenuation of the plume outside of the target remediation zone
- Implementation of institutional controls until PRGs are met

In this alternative, atomized zero-valent iron (ZVI) powder, a strong reducing agent, would be injected into the aquifer in a carrier gas to break down the chlorinated organic compounds into ethene and chloride. The injection of ZVI into an aquifer using a liquid or gaseous carrier is a relatively new technology which follows the same basic principles as the more established approach of reactive iron barrier walls. The injection of the ZVI allows the treatment of a source area rather than having to wait for the dissolved-phase contamination in the groundwater to slowly pass through a barrier wall. The major components of this alternative are discussed below.

2.9.9.1 Installation of Additional Wells

A design phase investigation involving the installation of an estimated four temporary wells and three permanent monitoring wells would be conducted. The temporary wells would be used to more precisely define the treatment area to avoid injecting ZVI in areas not needing treatment. Of the three permanent wells, two would be installed in the upper portion of the aquifer within the Site 13 target remediation zone to provide adequate monitoring locations for evaluating the effectiveness of the treatment. The third permanent well would be installed in the bedrock directly beneath the Site 13 target remediation zone to monitor current and future conditions in the vertical direction of groundwater flow. The bedrock well would be double-cased.

2.9.9.2 Performance of a Pilot Test

Because the low permeability of the saprolite formation is expected to hinder effective chemical distribution, technologies to increase permeability, such as pneumatic fracturing, are proposed. If necessary, a field pilot test would be performed at Site 13 or at another similar site to determine the ability of pneumatic fracturing to enhance the porosity of the saprolite and distribute the ZVI in the subsurface. A pilot test for pneumatic fracturing has already been conducted at nearby Site 9, which has similar geologic conditions. Results of this test were favorable and may eliminate the need for conducting a similar test at Site 13.

2.9.9.3 Installation of Injection Wells, Pneumatic Fracturing of Saprolite, and ZVI Injection

Pneumatic fracturing, as discussed under Alternative 4, would be conducted to create a more permeable matrix in the saprolite and allow the greater distribution of the ZVI solution. It is assumed that, while fractures may be propagated to a 30-foot radius, the atomized ZVI can be injected out to a radius of 20 feet. Under current (unfractured) conditions, a five to eight-foot radius is expected.

A series of 15 - 4-inch diameter open boreholes would be installed with temporary PVC casings to 38 feet bgs. The borings would be placed at 30 foot centers to allow some overlap of treatment area. After each borehole is fractured using nitrogen gas, ZVI powder would be mixed into a gas slurry and injected into the newly fractured saprolite aquifer using a pressurized pumping system. Injection would be done one well at a time in 3-foot packered intervals from bottom to top over the 20 foot thick saturated zone above the competent rock. It is estimated that a total of 74,000 lbs of ZVI powder would be injected into the formation.

It was assumed that one injection and approximately five years would be required to achieve PRGs in the groundwater within the target remediation zone using ZVI, assuming there is no significant residual DNAPL. Long-term monitoring of the downgradient portions of the plume would continue for an estimated total of 17 years. The estimated application configurations for the ZVI injection are as follows:

• Size of Target Remediation Zone	0.34 acres
• Radius of Influence	20 ft
• Number of Injection Wells and Spacing	15 wells spaced at 30 ft
• Dose Rate in lbs/vertical ft of Injection	246 lbs ZVI per lf
• Material Requirement	74,000 lbs of ZVI

2.9.9.4 Baseline and Post-injection Monitoring

ZVI reduction effectiveness would be monitored by collecting and analyzing groundwater samples from selected wells prior to, and throughout the duration of, the treatment. Sampling and analysis would be conducted to track disappearance of contaminants, and byproduct generation, to determine effectiveness. These data would be used to determine if additional applications are necessary.

Baseline sampling would be conducted prior to the injection of the ZVI. Sampling would continue quarterly for the first year, and then annually until PRGs are achieved. Field sampling efforts to support the injection effort would include testing monitoring wells for temperature, pH, DO. ORP, and specific conductance using standard field instrumentation. Field sampling efforts may be conducted more frequently for parameters such as DO and ORP. Laboratory samples would be collected from the monitoring wells and analyzed for COCs,

methane, ethene, ethane, major ions, nitrate, sulfate, chloride, TOC, and alkalinity. 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 two downgradient.

2.9.9.5 Long-term Groundwater Monitoring

Groundwater in the plume would be subject to monitoring to track the cleanup of the contaminant plume. It was assumed that 6 monitoring wells would be sampled for VOCs and MNA parameters. Monitoring would continue until PRGs are met. This is estimated to require at total of 17 years.

2.9.9.6 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 ZVI evaluation. A detailed ZVI study would be performed as part of the 5-year review report, to determine contaminant reduction rates, reevaluate the data collected, and evaluate the effectiveness of the remedy.

2.9.9.7 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. LUCs would remain in effect until groundwater PRGs are met and risks from groundwater are shown to be reduced to acceptable levels.

2.9.10 Common Elements and Distinguishing Features of Each Alternative

The one significant element which is common to all nine alternatives is that hazardous substances would remain on site for some time at concentrations above those protective of unrestricted use. Therefore, all alternatives (other than the statutorily required "No Action" alternative) would require institutional controls. Common elements for Alternatives 3 through 7 and 9 are the use of MNA as a polishing step to address contamination outside of the area of highest concentration (the target remediation zone). A distinguishing feature of Alternatives 4, 5, 6, 7 and 9 is the use of active remediation to accelerate the removal of COCs from groundwater within the target remediation zone. Another distinguishing feature of Alternatives 4, 5, 7 and 9 is that the active remediation would occur in-situ. A distinguishing feature of Alternative 8 is the use of a passive remediation system and the side benefit of creating a ½ acre wetland along West Farm Branch.

2.9.11 Expected Outcomes of Each Alternative

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

Alternatives 2 through 9 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, 6, 7 and 9 are estimated to allow unrestricted groundwater use throughout the site within 17 years as opposed to alternatives 1, 2, 3 and 8 which are estimated to require about twice as long.

2.10 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 nine remedial alternatives developed to address Sites 5 and 13 groundwater. A summary of the evaluation is provided in Table 2-22. The cost information is repeated below for ease of comparison. The nine alternatives were then ranked relative to each other and given a relative score. This ranking is provided in Table 2-23.

	Capital Cost	O&M Cost	Net Present Worth
Alternative 1	$0	$6,000	$20,000
Alternative 2	$47,000	$16,000 - $21,000	$388,000
Alternative 3	$51,000	$23,000 - $45,000	$439,000
Alternative 4	$382,000	$19,000-$208,000	$1,040,000
Alternative 5	$329,000	$19,000-$327,000	$929,000
Alternative 6	$334,000	$100,000-$170,000	$1,250,000
Alternative 7	$273,000	$19,000-$97,000	$763,000
Alternative 8	$297,000	$41,000	$1,090,000
Alternative 9	$650,000	$19,000-$118,000	$1,140,000

Based on the criteria evaluation and ranking, Alternative 9 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 as supporting Alternative 9 as the preferred remedy for Sites 5 and 13 groundwater (see Appendix A).

Community Acceptance

Based on comments expressed at the public meeting and received during the public comment period, the community generally agrees with the preferred remedy for Sites 5 and 13 groundwater. 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 would 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, Sites 5 and 13 contains no principal threat wastes as defined by the NCP.

2.12 SELECTED REMEDY FOR GROUNDWATER

This section expands upon the details of the selected remedy for Sites 5 and 13 groundwater.

2.12.1 Summary of the Rationale for the Selected Remedy

The selected remedy for Sites 5 and 13 groundwater is Alternative 9, which combines *in-situ* chemical reduction in the source area of Sites 5 and 13 with monitored natural attenuation and institutional controls in the downgradient portions of the plume.

Table 2-23 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 the final score. The highest-ranking alternatives are as follows:

- **Alternative 9—*In situ* Chemical Reduction with Zero-valent Iron (ZVI) with MNA and ICs**
- **Alternative 4—Enhanced Reductive Dechlorination (ERD) with MNA and ICs**

Both alternatives scored equally for the criteria of protection of human health and the environment and cost. Alternative 9 ranked slightly higher for long-term effectiveness and permanence because ZVI would theoretically destroy any NAPL or adsorbed phase contamination while Alternative 4 would only degrade the dissolved phase contamination and is more likely to have some rebound affects if a significant sorbed phase is present.

Effective application of both technologies would require pneumatic fracturing of the saprolite or an extensive network of injection wells. The use of direct push technology, which typically lowers the cost of ERD or ZVI applications relative to other technologies, is not feasible in the saprolite found at Sites 5 and 13.

Alternative 5, ISCO, ranked lower in several categories (and overall) because it has been shown to be relatively ineffective at oxidizing chlorinated alkanes such as 1,1,2,2-PCA. There is also greater uncertainty in the scoring of ISCO due to limited data from similar sites available to assess its effectiveness.

Alternative 7, air sparging ranked lower because 1,1,2,2-PCA is not very volatile and as a result is difficult to strip out of the water (even using an ex-situ air stripper). (It was assumed that implementation of the air sparging alternative would not require SVE to control air emissions from the site.)

Alternatives 6 and 8, which involved active and passive groundwater extraction and treatment respectively, ranked lower because of the long time to remediation and the likelihood of rebound effects from sorbed-phase contamination in the saturated zone soils.

The overall ability to achieve ARARs for Alternatives 4, 5, 6, and 9 has some uncertainty related to the ability to distribute electron donor/reagent/air throughout the low permeability saprolite aquifer. The primary reason for conducting a pilot test is to evaluate this potential fatal flaw and evaluate the effectiveness of pneumatic fracturing for improving distribution. If a pilot test shows this to be ineffective, MNA (Alternative 3) possibly combined with wetlands treatment (Alternative 8) would appear to be the next most applicable alternative. However, preliminary results of a pneumatic fracturing pilot test at Site 9 show this technology to be effective in the saprolite found at White Oak.

Site data indicate that natural attenuation is happening at the site, but not to the degree necessary to remediate the site in a reasonable time frame if it is the sole remedy. MNA is likely to be effective as a polishing step once the high concentrations of 1,1,2,2-PCA are removed from the target remediation zone.

2.12.2 Description of the Selected Remedy

Under the selected remedy, Alternative 9, atomized zero-valent iron (ZVI) powder, a strong reducing agent,

would be injected into the aquifer in a carrier gas to break down the chlorinated organic compounds into ethene and chloride. The primary components of the selected remedy are:

- Installation of additional wells to define treatment area and establish a groundwater monitoring network
- Performance of a source area pilot test (if necessary)
- Installation of injection wells
- Pneumatic fracturing of the saprolite to enhance ZVI distribution
- Injection of ZVI in the Site 13 target remediation zone
- Groundwater monitoring of baseline and post-injection conditions
- Preparation of annual technical memoranda and 5-year report
- Monitoring for natural attenuation of the plume outside of the Target Remediation Zone
- Implementation of institutional controls until PRGs are met

The injection of ZVI into an aquifer using a liquid or gaseous carrier is a relatively new technology which follows the same basic principles as the more established approach of reactive iron barrier walls. The injection of the ZVI allows the treatment of a source area rather than having to wait for the dissolved-phase contamination in the groundwater to slowly pass through a barrier wall.

When the ZVI is placed in the aquifer it reacts with oxygen and oxidizes, forming hydrogen, raising the pH, and lowering the Eh. In the process the chlorinated organic compounds are reduced through a transfer of electrons. The primary mechanism for the breakdown of 1,1,2,2-PCA, PCE, and TCE occurs under reducing conditions via reductive dechlorination. This is the same pathway as discussed for Alternatives 3 and 4. Hydrogen atoms are sequentially substituted for a chlorine atom in the contaminant molecules. The end products of reductive dechlorination of 1,1,2,2-PCA, PCE, and TCE are chloride, ethane and ethene, which are biodegraded aerobically. Complete biodegradation would transform the contaminants to innocuous compounds such as carbon dioxide and water. The major components of this alternative are discussed below.

2.12.2.1 Installation of Additional Wells

A design phase investigation involving the installation of three monitoring wells would be conducted. Two wells would be installed in the upper portion of the aquifer within the Site 13 target remediation zone to provide adequate monitoring locations for evaluating the effectiveness of the treatment. The third well would be installed in the bedrock directly beneath the Site 13 target remediation zone to monitor current and future conditions in the vertical direction of groundwater flow. The bedrock well would be double-cased. The exact number and location of monitoring wells may be modified and would be identified in the design documents which would be reviewed and approved by EPA and MDE.

2.12.2.2 Performance of a Pilot Test

Because the low permeability of the saprolite formation would hinder effective chemical distribution, technologies to increase permeability, such as pneumatic fracturing, are proposed. If necessary, a field pilot test would be performed at Site 13 or at another similar site to determine the ability of pneumatic fracturing to enhance the porosity of the saprolite and distribute the ZVI in the subsurface. A pilot test for pneumatic fracturing has already been conducted at nearby Site 9, which has similar geologic conditions. Results of this test were favorable and should eliminate the need for conducting a similar test at Site 13.

2.12.2.3 Installation of Injection Wells, Pneumatic Fracturing of Saprolite, and ZVI Injection

Pneumatic fracturing would be conducted to create a more permeable matrix in the saprolite and allow the greater distribution of the ZVI. This process involves injecting gas (nitrogen) at high pressures into packered intervals of an open borehole. Fractures are propagated outward from the borehole to various distances depending on the site geology. Experience at similar saprolite conditions at Site 9 at White Oak indicate that fractures radiating 30 feet from the borehole can be expected. It is assumed that the atomized ZVI would then be injected out to a radius of 20 feet. Because of the viscosity of the ZVI mix, it is unlikely that it would be injected to the full 30-foot radius.

A series of 15 - 4-inch diameter open boreholes would be installed with permanent 4-inch ID steel casings extending from the ground surface to the water table and temporary 3-inch ID PVC casings slipped inside the steel casings to the bottom of each hole (38 feet bgs). The borings would be placed at 30 foot centers to allow some overlap of treatment area.

After each borehole is fractured using nitrogen gas, ZVI powder would be mixed into a gas slurry and injected into the newly fractured saprolite aquifer using a pressurized pumping system. Injection would be ~~is~~ done one well at a time in 3-foot packered intervals from bottom to top over the 20 foot thick saturated zone above the competent rock. It is estimated that a total of 74,000 lbs of ZVI powder would be injected into the formation.

It was assumed that one injection and approximately five years would be required to achieve PRGs in the groundwater within the Target Remediation Zone using ZVI if there is no significant residual DNAPL. Long-term monitoring of the downgradient portions of the plume would continue for an estimated total of 17 years.

The estimated application parameters for the ZVI injection are as follows:

- Size of Target Remediation Zone — 0.34 acres
- Radius of Influence — 20 ft
- Number of Injection Wells and Spacing — 15 wells spaced at 30 ft
- Dose Rate in lbs/vertical ft of Injection — 246 lbs ZVI per lf
- Material Requirement — 74,000 lbs of HRC

The exact number and location of injection wells and the ZVI injection dosages would be calculated in the remedial action design documents and would be approved by EPA and MDE.

2.12.2.4 Baseline and Post-injection Monitoring

ZVI reduction effectiveness would be monitored by collecting and analyzing groundwater samples from selected wells prior to, and throughout the duration of, the treatment. Sampling and analysis would be conducted to track disappearance of contaminants, and byproduct generation, to determine effectiveness. These data would be used to determine if additional applications are necessary.

Baseline sampling would be conducted prior to the injection of the ZVI. Sampling would continue quarterly for the first year, and then annually until PRGs are achieved. Field sampling efforts to support the injection effort would include testing monitoring wells for temperature, pH, DO. ORP, and specific conductance using standard field instrumentation. Field sampling efforts may be conducted more frequently for parameters such as DO and ORP. Laboratory samples would be collected from the monitoring wells and analyzed for COCs, methane, ethene, ethane, major ions, nitrate, sulfate, chloride, TOC, and alkalinity. 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 two downgradient. The sampling locations and parameters would be finalized during the design process and a sampling and analysis plan for ZVI injection would be developed and approved by EPA and MDE.

2.12.2.5 Long-term Groundwater Monitoring

Groundwater in the plume would be subject to monitoring to track the cleanup of the contaminant plume. It was assumed that 6 monitoring wells would be sampled for VOCs and MNA parameters. Monitoring would continue until PRGs are met. This is estimated to require at total of 17 years. The sampling locations, frequency, and parameters would be finalized during the design process and a long-term sampling and analysis plan for MNA would be developed and approved by EPA and MDE.

2.12.2.6 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 ZVI evaluation. A detailed ZVI study would be performed as part of the 5-year review report, to determine contaminant reduction rates,

reevaluate the data collected, and evaluate the effectiveness of the remedy.

2.12.2.7 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 2-11 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.

2.13 SELECTED REMEDY FOR SOIL

This section expands upon the details of the selected remedy for Sites 5 and 13 soil.

2.13.1 Summary of the Rationale for the Selected Remedy for Soil

The selected remedy for Site 5 and 13 soil is no further action. This is the only alternative evaluated for the soil. A removal action was conducted for the soil in 2000 and a risk assessment conducted on post-removal action verification sample results concluded that no unacceptable risks remain at the site for any exposure scenario, including a residential use scenario. Further, the soil remaining at the site does not contain contaminants at concentrations that would represent a continuing source of groundwater contamination.

2.13.2 Description of the Selected Remedy for Soil

No further action is required for the soil.

2.14 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.

2.14.1 Protection of Human Health and the Environment

The selected remedies for both groundwater and soil would be protective of human health and the environment. Institutional controls would 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 remedy for groundwater that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the selected remedy. Monitoring would ensure that the selected groundwater remedy is effective and that the plume of COCs is not expanding or unexpectedly increasing in concentration.

2.14.2 Compliance with ARARs

The selected remedies would comply with all chemical- and action-specific ARARs. There are no location-specific ARARs for Sites 5 and 13. This ROD's compliance with ARARs is summarized in Appendix B.

2.14.3 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 groundwater is $1,140,000. This is 10 percent greater than the second ranked alternative and approximately 2.5 times higher than passive remedies such as institutional controls with long-term monitoring and monitored natural attenuation. It is about 10 percent less than the pump and treat remedy.

The estimated NPW of the selected remedy for soil is $0.

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

The Navy and EPA, with MDE concurrence, has 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.

2.14.5 Preference for Treatment as a Principal Element

The selected remedy for groundwater satisfies the statutory preference for treatment as a principal element, employing in-situ chemical reduction to destroy contaminants and remediate the groundwater plume.

2.14.6 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 17 years, a statutory review would be conducted within 5 years after initiation of remedial action to ensure that the remedy is, or would be, protective of human health and the environment, and every five years thereafter.

2.15 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for Sites 5 and 13 soil and groundwater at the former NSWC-White Oak, Silver Spring, Maryland was released for public comment on September 30, 2003. The Proposed Plan identified no further action 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 *in-situ* chemical reduction with zero-valent iron in the source area of Sites 5 and 13 with monitored natural attenuation and institutional controls in the downgradient portions of the plume. The Navy reviewed all comments received during the public comment period. It was determined that no significant changes to the groundwater remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

3.0 RESPONSIVENESS SUMMARY

3.1 OVERVIEW

This Responsiveness Summary provides a summary of comments received during the public comment period for Sites 5 and 13 groundwater and soil, along with responses to those comments. The public comment period for the proposed remedy for Sites 5 and 13 groundwater and soil began on September 30, 2003 and ended on October 30, 2003. A public meeting was held on October 14, 2003 at Riderwood Village in Silver Spring, 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, 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 Investigations and Feasibility Study related to Sites 5 and 13 groundwater and soil have been 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 the Engineering Field Activity Chesapeake, Washington Navy Yard, 1314 Harwood Street, S.E, Washington, District of Columbia.

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

- The documents concerning the investigation and analysis of Sites 5 and 13 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 Sites 5 and 13 groundwater and soil, as well as copies of the Proposed Plan, were placed in the information repository.
- The Navy mailed copies of the Sites 5 and 13 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* on September 25, 2003, and in the *Silver Spring Gazette*, *College Park Gazette,* and *Burtonsville Gazette* on September 24, 2003.
- The Navy established a 30-day public comment period for this Proposed Plan starting September 30, 2003 and ending October 30, 2003.

- A public meeting was held on October 14, 2003 to present the Proposed Plan and to answer questions concerning Sites 5 and 13 groundwater and soil.

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

Questions were received during the public meeting of October 14, 2003. 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 question and answer session of the public meeting 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 no further action adequately and appropriately addresses Sites 5 and 13 soil in a cost-effective and responsible manner.

The Navy and the EPA also continue to believe that in-situ chemical reduction with zero-valent iron, along with monitored natural attenuation and institutional controls adequately and appropriately addresses Sites 5 and 13 groundwater in a cost-effective and responsible manner.

Questions and Comments from the October 14, 2003 Public Information Session

Comment 1: You are proposing to use zero-valent iron at Site 5 and 13 to treat groundwater, but at the FDA site (Site 11) you are proposing to use something else. What is the difference? Isn't the situation the same at both sites? Why don't you use the same thing at both sites, whichever is better and faster ?

Response 1: The technology proposed for Sites 5 and 13 groundwater degrades the contamination by chemical reduction (i.e.: there is a chemical reaction between the iron and contaminant), the technology proposed for Site 11 (FDA) degrades the contamination by biological reduction (i.e.: the injected material stimulates biological activity which the breaks down the contaminant). The conditions are a little different between the sites. The primary contaminant at Sites 5 and 13 is tetrachloroethane and it is present in concentrations of approximately 1,000 to 2,000 micrograms per liter (ug/L). The contaminant at Site 11 is trichloroethene and the concentrations are significantly less (100 ug/L). Whether one technology is better than the other is not a question we can answer with any certainty. Both technologies have been shown to work to varying degrees of success at similar sites, however, neither technology (in particular iron slurry injection) has an extensive history and neither can guarantee success. There are also tradeoffs with each. The zero-valent iron technology is more expensive but should work faster, should have less of a problem with higher concentrations and will degrade contamination that is sorbed to the soil. Biological remediation is less expensive, it is much more available, and it is easier to add more if need be. However, the microbes can only degrade contaminants in the dissolved phase, and higher concentrations may be toxic to the microbes.

One of the main reasons that different technologies were chosen for the two sites is that the BCT feels that it is beneficial to try different approaches and not rely too heavily on the success of one cleanup method.

Comment 2: What is the particle size of the zero-valent iron powder? I think you will have some problems with distributing the slurry through the aquifer.

Response 2:. The zero-valent iron powder particle size is approximately 40 microns. It is injected into the aquifer under high pressure in a nitrogen gas slurry. The question of adequate distribution through the aquifer at Site 5/13 is a concern because the groundwater resides in a saprolitic soil (highly decayed sedimentary rock). To address this concern we will first fracture the saprolite by injecting nitrogen under high pressure at various depths in several open (uncased) boreholes. Once the fractures are created, the gaseous iron slurry will be injected. This fracturing technique was used during a pilot test at a similar site at White Oak with good

results.

Comment 3: If you were doing a biological process (Alternative 4) would you fracture the subsurface?

Response 3: Yes. Fracturing would be performed under alternative 4 also in order to get adequate distribution of sodium lactate in the aquifer. Fracturing was performed at Site 9 (another saprolite site) in order to inject sodium lactate with favorable results.

Comment 4: Many of the proposed plans that have been presented, including this one, talk about long-term monitoring. Have you prepared a long-term monitoring plan and determined what you're going to do; when you're going to do it; and who's going to do it?

Response 4: The proposed plan describes a conceptual plan for long-term monitoring. The Record of Decision will expand on this and will state that a formal monitoring plan will be developed and must be approved by EPA and MDE. The plan will layout the scope and schedules and decision points of sampling. The monitoring plan for this site, as well as for every other site at White Oak where a ROD has been signed that requires monitoring, will be placed in the administrative record and information repository. The implementation of the plan will be the responsibility of the Navy and will be legally enforceable as part of the ROD. A long-term monitoring plan has already been developed under the ROD for Operable Unit 2 and is currently being implemented.

Comment 5: One the cross sections show that the wells were installed in the saprolite. Did you install any wells in the Coastal Plain soils. Generally on the FDA site, that seems to be where the majority of contamination is. The contaminated area looks like its right there at that interface between the Coastal Plain soil and the saprolite.

Response 5: Most of the wells were installed so that the screen intercepts the water table (the first occurrence of groundwater). It just so happens that at this site, in the area where contamination is present in the groundwater, the water table is encountered at, or immediately below, the Coastal Plain/saprolite interface. Wells were not installed in the saprolite in the area of contamination because the Coastal Plain soils were all above the water table. It is possible that the water table has or will rise up into the Coastal Plane soil, however when zero-valent iron is injected, it will be injected throughout the depth of the aquifer from the water table (wherever it happens to be at the time) to the saprolite/bedrock interface. The dry soil above the water table will not be treated because no contamination was detected in these soils.

Comment 6: Are you proposing to change the concentration or amount of the zero-valent iron that would go in some of these holes? For example, you have higher concentrations of contaminants in some areas or depths than at others, but if you treat them all equally with the same amount of iron at every point and depth you may not get all the contamination in your higher concentrated areas.

Response 6: Varying the amount of iron with location and depth is something we would look at in the design phase. Typically you can take one of two approaches. You can design for the worst case (assume the maximum concentration detected throughout the investigation process occurs everywhere) or you can try to vary the amount of iron to optimize the remediation. If you select the second route, you need to be confident that you have enough data points to get a clear picture of the distribution or you run the risk of doing what you mentioned in the comment.

Comment 7: Does the bedrock need to be treated?

Response 7: There are low levels of VOC contamination in the bedrock groundwater. The bedrock groundwater will be monitored along with the groundwater horizontally downgradient of the source area. The assumption with this approach is that if we get rid of the source through aggressive treatment, the contamination in the groundwater both horizontally and vertically (in the bedrock) downgradient of the source will gradually clean up through natural attenuation. This will be monitored to verify progress.

Comment 8: The site maps show that you have a well screened in the saprolite right on the property line (with the quarry to the north). The concentrations are 1,1,2,2-PCA (6 ug/L), TCE (75 ug/L), and cis-1,2,-DCE (648 ug/L). So it appears that the contamination is migrating off of the site. Are there additional wells on the quarry property and are you going to monitor the groundwater in that direction?

Response 8: That is correct. It has been determined that groundwater contamination has migrated from the former Navy property off site to the north onto the quarry property. The extent of contamination on this property has been defined by a line of clean wells, and three other wells have been placed within the area of groundwater contamination on this property. While the remediation with zero-valent iron will take place only on the federal government property, the wells on the quarry property will be sampled on a regular basis to monitor remediation of the groundwater until chemical concentrations are reduced to acceptable levels.

Comment 9: Just one final thought on the work that the White Oak BCT is doing. We are very, very pleased and glad to see you finishing up. So we do appreciate it. Thank you.

Response 9: Thank you very much.

Written Questions and Comments Received During the 30-day Public Comment Period (September 30 through October 30, 2003)

Comment 10: For the preferred alternative (Alternative 9), have you studied the dispersion of the iron powder into the groundwater porous medium following injection? I would think it would be difficult to get uniform dispersion of a powder into it and the zone of activity around each injection well would be smaller than another in-situ process that uses injection wells such as the next closest alternative (Alternative 4). Alternative 9 may require a lot more injection wells than Alternative 4.

Response 10: The zero-valent iron powder particle size is approximately 40 microns. It is injected into the aquifer under high pressure in a nitrogen gas slurry. The question of adequate distribution through the aquifer at Site 5/13 is a concern because the groundwater resides in a saprolitic soil (highly decayed sedimentary rock). To address this concern we will first fracture the saprolite by injecting nitrogen gas under high pressure at various depths in several open (uncased) boreholes. Once the fractures are created, the gaseous iron slurry will be injected. This fracturing approach would be used whether Alternative 4 or 9 is implemented. Research has indicated that we would expect to get a similar distribution radius for the two technologies. This fracturing technique was used during a pilot test at a similar site at White Oak with good results.

Comment 11: If the iron powder is not well dispersed in whatever carrier medium you are using during injection, there may be problems of clogging the injection wells.

Response 11: The proposed method of pneumatically fracturing the soil matrix using an open borehole (not a well) has proven to be effective in dozens of applications.

Comment 12: I didn't see the feasibility study, but it looks as if Alternative 9 scored one or two points higher than Alternative 4. However, Alternative 4 is $100,000 cheaper than Alternative 9. When the evaluation is this close, how do you make a choice?

Response 12: In a comparison of the total cost of Alternatives 4 and 9, $100,000 amounts to only about a 10 % difference in cost, so the difference in cost did not affect to numeric ranking system. However it was considered in the final selection process. The reasons that Alternative 9 ranked higher and was ultimately proposed as the preferred alternative are:

1. The site possibly contains a significant amount of contaminant still attached (sorbed) to the soil particles below the water table. ZVI should be capable of chemically attacking this sorbed contamination while microbes can only attack the dissolved contaminants. By relying solely on a biological approach, cleanup time would be limited by the rate at which the contaminant desorbs from the soil into the groundwater. Because of this, ZVI is considered to have a better chance of success and a faster cleanup time for the

source area of the site.

2. ZVI would work two ways; it would chemically reduce the contamination and also would help enhance bioremediation by creating reducing conditions.

3. At four other sites at White Oak, enhanced bioremediation is being proposed. The BCT feels it is advantageous to use more than one type of remedy in the event that in-situ bioremediation is not as effective as anticipated.

Comment 13: The proposed plan states that State and community acceptance will be evaluated as part of the ROD. I am inclined to support Alternative 4 over Alternative 9, especially since we are planning to use (or have used) enhanced reductive dechlorination with sodium lactate on other parts of the site. It seems there is an opportunity to learn from previous experiences on the base that will allow for more efficient application at Site 5/13. Do we have any preliminary results back from the other applications? I am familiar with zero valent iron (ZVI) and Fenton's reagent technologies, however, I have never seen them proposed to be injected into a porous medium. I am not confident that this type of application of ZVI will work.

Response 13: While this application of ZVI is relatively new, there have been several site-scale applications to date and the results have been positive. The ZVI slurry injection approach was developed particularly for addressing source areas with high concentrations and potential for sorbed contamination on the saturated soil. These are conditions where remedies that rely strictly on biological processes have experienced problems. Also, the pneumatic fracturing process has been shown to be effective for distributing slurries of sodium lactate at another site at White Oak, and should be just as successful at injecting a ZVI slurry at Site 5/13.

While there are benefits in keeping with one technology throughout the facility, we currently have not implemented a sodium lactate approach at any of the chlorinated VOC sites at White Oak. At the one site at White Oak where sodium lactate has been implemented, preliminary results are promising, but the contaminants are explosives compounds (RDX, TNT, HMX) rather than chlorinated VOCs.

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
BR	Burn Ring
BRAC	Base Realignment and Closure
B&R Environmental	Brown & Root Environmental
CDI	chronic daily intake
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
COMAR	Code of Maryland Regulations
COPC	chemical of potential 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
ERA	ecological risk assessment
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
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
LGAC	liquid-phase granular activated carbon
LTM	long-term monitoring
LUCs	land use controls
MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
mg/kg	milligram(s) per kilogram
MNA	monitored natural attenuation
msl	mean sea level
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
NAPL	non-aqueous-phase liquid
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
PCE	tetrachloroethene
PCOC	potential chemicals of concern
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
TCE	trichloroethene
TRC	Technical Review Committee
TSDF	Treatment, Storage, and Disposal Facility
TtNUS	Tetra Tech NUS, Inc.
UCL	95% Upper Confidence Limit of the Mean
UTL	upper tolerance limit
VOC	volatile organic compound
ZVI	zero-valent iron

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Table 2-1
Compounds Detected in Groundwater Screening Samples from Temporary Wells near Site 13, Aug-Sep, 2001
Record of Decision for Sites 5 and 13
Former NSWC-White Oak, Silver Spring, Maryland

Station ID	13DP204			13DP205		13DP206			13DP207		13DP208	13DP209
Sample ID	13DP204-15	13DP204-20	13DP204-28	13DP205-20	13DP205-28	13DP206-20	13DP206-20P	13DP206-28	13DP207-20	13DP207-28	13DP208-21	13DP209-19
Sample Date	08/22/01	08/22/01	08/24/01	08/23/01	08/23/01	08/23/01	08/23/01	08/23/01	08/25/01	08/25/01	08/26/01	08/26/01
Top Depth (feet bgs)	10	15	23	15	23	15	15	23	15	23	16	14
Bottom Depth (feet bgs)	15	20	28	20	28	20	20	28	20	28	21	19
Notes						Duplicates						
Chemical Name												
Volatile Organic Compounds (UG/L)												
1,1,2,2-Tetrachloroethane	946 D	659 D	29.6	664 D	35 JD	215 D	196 D	4.67	25.9 D	303 D	683 D	1 U
1,1,2-Trichloroethane	3.81	4.62	1.48	13	1 J	1.91	2.35	1 U	1 U	4.25	14.5	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.78 J	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.87 J	1.52	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	1 U	1 U	1 U	5 U	1 U	5 U	5 U	2.69 J	5 U
Acetone	13.2	5 U	5 U	17.7	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	6.25	6.43	1 U
Carbon disulfide	0.65 J	1 U	1 U	0.54 J	1 U	12.7	1 U	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	0.66 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.96 J	1 U
Chloromethane	1.38	1.3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	0.54 J	0.59 J	0.53 J	0.79 JB	1.04	0.69 JB	1 U	0.5 JB	1.32 B	1.53 B	1.6 B	1 U
Tetrachloroethene	18.4	38.9 D	1.15	28.6 D	11.3	8.48	8.92	6.76	3.76	26.5 JD	113 D	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.67 J	1 U
Trichloroethene	72 D	98 D	24.8	111 D	135 D	41.5 JD	30.5 JD	153 D	5.47	151 D	535 D	1 U
Vinyl chloride	1 U	1 U	1 U	1.06	9.92	1 U	1 U	12.1	1 U	14.7	10.3	1 U
Xylene, total	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2.11	1 U
cis-1,2-Dichloroethene	5.6	17.2	49.9 D	120 D	270 D	35.5 JD	41.8 D	265 D	4.57	86 D	558 D	1 U
trans-1,2-Dichloroethene	1 U	4.51	18.4	53 D	77.5 D	50 U	14.1	79.8 D	2.43	88.5 D	148 D	1 U
Explosives (UG/L)												
2,4,6-Trinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Amino-4,6-dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Amino-2,6-dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HMX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Perchlorate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA=Not analyzed
B=Analyte not detected above associated blank
D=Result came from a diluted sample
J=Reported value is estimated
U=Analyte not detected

Table 2-1
Compounds Detected in Groundwater Screening Samples from Temporary Wells near Site 13, Aug-Sep, 2001
Record of Decision for Sites 5 and 13
Former NSWC-White Oak, Silver Spring, Maryland

Station ID	13DP210	13DP211			13DP212		13DP213		13DP214		13DP215	
Sample ID	13DP210-14	13DP211-30	13DP211-30P	13DP211-38	13DP212-24	13DP212-33	13DP213-25	13DP213-33	13DP214-32	13DP214-40	13DP215-26	13DP215-34
Sample Date	08/26/01	08/27/01	08/27/01	08/28/01	08/27/01	08/28/01	08/27/01	08/27/01	08/28/01	08/28/01	09/05/01	09/05/01
Top Depth (feet bgs)	9	25	25	33	19	28	20	28	27	35	21	29
Bottom Depth (feet bgs)	14	30	30	38	24	33	25	33	32	40	26	34
Notes		Duplicates										
Chemical Name												
Volatile Organic Compounds (UG/L)												
1,1,2,2-Tetrachloroethane	1 U	66 D	69.5 D	1 U	311 D	138 D	7.88	1 U	2.13	25.4	4.53	1.93
1,1,2-Trichloroethane	1 U	2.06	1.99	1 U	1.56	1.65	1 U	1 U	1 U	0.57 J	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	0.63 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.62 J	1 U	1 U
2-Butanone	5 U	5 U	5 U	5 U	5 U	3.59 J	5 U	5 U	5 U	3.77 J	2.3 J	5 U
2-Hexanone	5 U	5 U	12.1	5 U	5 U	6.14	5 U	5 U	5 U	5 U	11	5 U
4-Methyl-2-pentanone	2.95 J	3.3 J	3.17 J	5 U	3.15 J	5 U	5 U	5 U	5 U	5 U	1.61 J	5 U
Acetone	5 U	22.1	21.4	65 JD	5 U	12.3	5 U	5 U	5 U	19	4.86 J	6.93
Benzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	1 U	0.55 J	1 U	1 U	1 U	1 U	1.64	1.36	1 U	0.93 J	1 U	1 U
Carbon tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.6	1 U
Methylene chloride	1.05 B	1 U	1 U	32 JBD	1 U	1 U	1 U	1 U	0.76 JB	0.6 JB	0.58 JB	0.57 JB
Tetrachloroethene	1 U	5.04	4.98	1 U	6.16	5.97	1 U	0.72 J	22.8	15.8	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	154 D	172 D	71	54 D	50 D	4.97	18.2	190 D	50 U	1.28	4.18
Vinyl chloride	1 U	5.12	5.08	1 U	1 U	3.25	0.9 J	6.14	26.3 D	11.3	1 U	0.75 J
Xylene, total	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	526 D	740 D	613	41.8 D	259 D	49.8 D	276 D	794 D	542 D	3.28	16.2
trans-1,2-Dichloroethene	1 U	168 D	245 D	102	9.18	50.5 D	2.51	16.6	181 D	129 D	0.57 J	2.92
Explosives (UG/L)												
2,4,6-Trinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Amino-4,6-dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Amino-2,6-dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HMX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Perchlorate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA=Not analyzed
B=Analyte not detected above associated blank
D=Result came from a diluted sample
J=Reported value is estimated
U=Analyte not detected

Table 2-1
Compounds Detected in Groundwater Screening Samples from Temporary Wells near Site 13, Aug-Sep, 2001
Record of Decision for Sites 5 and 13
Former NSWC-White Oak, Silver Spring, Maryland

Station ID	13DP216	13DP217		13DP218	
Sample ID	13DP216-16	13DP217-38	13DP217-46	13DP218-20	13DP218-28
Sample Date	09/05/01	09/11/01	09/11/01	09/20/01	09/20/01
Top Depth (feet bgs)	21	33	41	15	23
Bottom Depth (feet bgs)	26	38	46	20	28
Notes					
Chemical Name					
Volatile Organic Compounds (UG/L)					
1,1,2,2-Tetrachloroethane	72.8 D	1 U	1 U	490	21.7
1,1,2-Trichloroethane	0.85 J	1 U	1 U	4.98	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U
2-Butanone	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U
Acetone	5 U	3.56 J	3.53 J	7.13	15.2
Benzene	1 U	1 U	1 U	1 U	1.13
Carbon disulfide	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	3.27	1 U	1 U	1 U
Chloromethane	0.8 J	1 U	1 U	1 U	1 U
Methylene chloride	0.76 JB	1 U	1 U	0.83 JB	0.82 JB
Tetrachloroethene	6.38	1 U	1 U	6.89	1.54
Toluene	1 U	1 U	1 U	1 U	1 U
Trichloroethene	26.7 D	1 U	1 U	48	55
Vinyl chloride	1 U	1 U	1 U	1 U	11
Xylene, total	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	39.2 D	1 U	1 U	142	755
trans-1,2-Dichloroethene	5.28	1 U	1 U	33.5	83.5
Explosives (UG/L)					
2,4,6-Trinitrotoluene	NA	NA	NA	NA	NA
2-Amino-4,6-dinitrotoluene	NA	NA	NA	NA	NA
4-Amino-2,6-dinitrotoluene	NA	NA	NA	NA	NA
4-Nitrotoluene	NA	NA	NA	NA	NA
HMX	NA	NA	NA	NA	NA
Perchlorate	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	NA

NA=Not analyzed
B=Analyte not detected above associated blank
D=Result came from a diluted sample
J=Reported value is estimated
U=Analyte not detected

Table 2-2
Detected Compounds and other Parameters in Groundwater Monitoring Well Samples from Site 13, Round 8, September 2001
Record of Decision for Sites 5 and 13
Former NSWC White Oak, Silver Spring, Maryland

Well ID		13GW02		13GW200		13GW201		13GW202		13GW203			
Sample ID		013GW0020008		013GW2000008		013GW2010008		013GW2020008		013GW2030008		013GW2039908	
Sample Date		9/25/2001		9/26/2001		9/26/2001		9/26/2001		9/26/2001		9/26/2001	
Notes										Duplicates			
Chemical Name	**Units**	**Conc**		**Conc**		**Conc**		**Conc**		**Conc**		**Conc**	
Volatile Organic Compounds													
1,1,1-Trichloroethane	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
1,1,2,2-Tetrachloroethane	UG/L	872		0.8	J	1	U	5.8		1	U	1	U
1,1,2-Trichloroethane	UG/L	7.6		1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethane	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethene	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichlorobenzene	UG/L	1.3		1	U	1	U	1	U	1	U	1	U
1,2-Dichloroethane	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
1,3-Dichlorobenzene	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
1,4-Dichlorobenzene	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
Benzene	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
Carbon Disulfide	UG/L	1	U	1	U	1	U	0.9	J	1	U	1	U
Chlorobenzene	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
Chloroethane	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
Chloroform	UG/L	0.6	J	1	U	1	U	1	U	1	U	1	U
Chloromethane	UG/L	0.9	J	1	U	1	U	1	U	1	U	1	U
cis-1,2-Dichloroethene	UG/L	430		1	U	1	U	581		1	U	1	U
Ethane	UG/L	5.8	U	5.8	U	5.8	U	5.74	J	NA		NA	
Ethene	UG/L	3.02	J	3.36	J	5.36	J	6.06	J	NA		NA	
Ethylbenzene	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
Methane	UG/L	4.75		70.8		108		5.13		NA		NA	
Tetrachloroethene	UG/L	69		1	U	1	U	8.1		1	U	1	U
Toluene	UG/L	1	U	1	U	1	U	1.6		1	U	1	U
Total Xylenes	UG/L	1	U	1	U	1	U	1	U	1	U	1	U
trans-1,2-dichloroethene	UG/L	153		1	U	1	U	67		1	U	1	U
Trichloroethene	UG/L	293		1	U	1	U	74.5		1	U	1	U
Vinyl Chloride	UG/L	0.6	J	1	U	1	U	11.2		1	U	1	U

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

Table 2-2
Detected Compounds and other Parameters in Groundwater Monitoring Well Samples from Site 13, Round 8, September 2001
Record of Decision for Sites 5 and 13
Former NSWC White Oak, Silver Spring, Maryland

Well ID		13GW02		13GW200		13GW201		13GW202		13GW203			
Sample ID		013GW0020008		013GW2000008		013GW2010008		013GW2020008		013GW2030008		013GW2039908	
Sample Date		9/25/2001		9/26/2001		9/26/2001		9/26/2001		9/26/2001		9/26/2001	
Notes										Duplicates			
Explosives													
1,3,5-Trinitrobenzene	UG/L	NA		NA		NA		NA		NA		NA	
2,4,6-Trinitrotoluene	UG/L	NA		NA		NA		NA		NA		NA	
2-Amino-4,6-Dinitrotoluene	UG/L	NA		NA		NA		NA		NA		NA	
4-Amino-2,6-Dinitrotoluene	UG/L	NA		NA		NA		NA		NA		NA	
HMX	UG/L	NA		NA		NA		NA		NA		NA	
Perchlorate	UG/L	NA		NA		NA		NA		NA		NA	
RDX	UG/L	NA		NA		NA		NA		NA		NA	
Wet Chemistry													
Alkalinity, Total (as CaCO3)	MG/L	2.55		95		34		31		NA		NA	
Carbon Dioxide	MG/L	78		129		225		46.7		NA		NA	
Chloride	MG/L	101		15.5		17.9		79.4		NA		NA	
Nitrate	MG/L	0.45		0.1	U	0.27		0.1	U	NA		NA	
Sulfate	MG/L	5.4		85		199		28.4		NA		NA	
Total Organic Carbon	MG/L	1	U	5.92		2.42		2.88		NA		NA	
Field Parameters													
Ferrous Iron	MG/L	0		1.1		4		4.6		0.7		0.7	
Hydrogen Sulfide	MG/L	0		0		0		0		0		0	
pH		4.49		5.57		5.02		5.56		5.4		5.4	
Specific Conductivity (SC)	MS/CM	0.474		0.365		0.491		0.389		0.515		0.515	
Dissolved Oxigen (DO)	MG/L	1		0.5		0.1		0.52		0.6		0.6	
Temperature	C	15.6		18.2		15.3		13.8		15.6		15.6	
Oxidation Reduction Potential (EH/ORP)	MV	290		107		120		49		-164		-164	

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

TABLE 2-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 5 - OPEN BURN AREAS
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)	Site Above Background ? (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)
Volatile Organics (mg/kg)																	
98-86-2	Acetophenone	0.12	J	0.25	J	mg/kg	05TP12WS0204[Q2]	5/8	0.15 - 0.27	0.25	NA	780	N	0.00022	SSL_MIGR SSL_INH	No	BSL
67-64-1	Acetone	0.086		0.13		mg/kg	05-SB-05-2_OLD	2/18	0.0014 - 0.015	0.13	NA	780	N	2.5 100000	SSL_MIGR SSL_INH	No	BSL
108-88-3	Toluene	0.092		0.092		mg/kg	05-SB-05-2_OLD	1/18	0.011 - 0.015	0.092	NA	1600	N	8.8 650	SSL_MIGR SSL_INH	No	BSL
Semivolatile Organics (mg/kg)																	
83-32-9	Acenaphthene	0.06	J	0.06	J	mg/kg	05TP01SB0507[Q2]	1/18	0.36 - 0.51	0.06	NA	470	N	100	SSL_MIGR SSL_INH	No	BSL
120-12-7	Anthracene	0.056	J	0.14	J	mg/kg	05-SB-05-2_OLD	4/18	0.36 - 0.44	0.14	NA	2300	N	470	SSL_MIGR SSL_INH	No	BSL
56-55-3	Benzo(a)anthracene	0.081	J	0.55	J	mg/kg	05-SB-05-2_OLD	6/18	0.36 - 0.4	0.55	NA	0.87	C	1.5	SSL_MIGR SSL_INH	No	BSL
50-32-8	Benzo(a)pyrene	0.062	J	0.5	J	mg/kg	05-SB-05-2_OLD	8/18	0.36 - 0.4	0.5	NA	0.087	C	0.37	SSL_MIGR SSL_INH	Yes	ASL
205-99-2	Benzo(b)fluoranthene	0.085	J	0.63	J	mg/kg	05-SB-05-2_OLD	6/18	0.36 - 0.4	0.63	NA	0.87	C	4.5	SSL_MIGR SSL_INH	No	BSL
191-24-2	Benzo(g,h,i)perylene	0.061	J	0.55	J	mg/kg	05-SB-02-22_OLD	8/18	0.36 - 0.4	0.55	NA	230(6)	N	680(6)	SSL_MIGR SSL_INH	No	BSL
207-08-9	Benzo(k)fluoranthene	0.073	J	0.29	J	mg/kg	05-SB-05-2_OLD	6/18	0.36 - 0.4	0.29	NA	8.7	C	45	SSL_MIGR SSL_INH	No	BSL
117-81-7	Bis(2-Ethylhexyl)phthalate	0.051	J	0.23	J	mg/kg	05-SB-04-6_OLD	6/18	0.36 - 0.44	0.23	NA	46	C	2900 31000	SSL_MIGR SSL_INH	No	BSL
86-74-8	Carbazole	0.041	J	0.078	J	mg/kg	05-SB-05-2_OLD	2/18	0.36 - 0.51	0.078	NA	32	C	0.47	SSL_MIGR SSL_INH	No	BSL
218-01-9	Chrysene	0.093	J	0.49	J	mg/kg	05-SB-05-2_OLD	6/18	0.36 - 0.4	0.49	NA	87	C	150	SSL_MIGR SSL_INH	No	BSL
84-74-2	Di-n-butyl phthalate	0.039	J	2.7		mg/kg	05TP01WS0204[Q2]	2/18	0.36 - 0.51	2.7	NA	780	N	5000 2300	SSL_MIGR SSL_INH	No	BSL
53-70-3	Dibenzo(a,h)anthracene	0.043	J	0.12	J	mg/kg	05-SB-05-2_OLD	3/18	0.36 - 0.51	0.12	NA	0.087	C	1.4	SSL_MIGR SSL_INH	Yes	ASL
84-66-2	Diethyl Phthalate	0.042	J	0.042	J	mg/kg	05TP12WS0204[Q2]	1/18	0.36 - 0.51	0.042	NA	6300	N	450 2000	SSL_MIGR SSL_INH	No	BSL
206-44-0	Fluoranthene	0.21	J	0.96	J	mg/kg	05-SB-05-2_OLD	6/18	0.36 - 0.4	0.96	NA	310	N	6300	SSL_MIGR SSL_INH	No	BSL
86-73-7	Fluorene	0.066	J	0.066	J	mg/kg	05-SB-05-2_OLD	1/18	0.36 - 0.51	0.066	NA	310	N	140	SSL_MIGR SSL_INH	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	0.082	J	0.33	J	mg/kg	05-SB-05-2_OLD	7/18	0.36 - 0.4	0.33	NA	0.87	C	13	SSL_MIGR SSL_INH	No	BSL
91-20-3	Naphthalene	0.055	J	0.097	J	mg/kg	05-SB-05-2_OLD	2/18	0.36 - 0.51	0.097	NA	160	N	0.15	SSL_MIGR SSL_INH	No	BSL
85-01-8	Phenanthrene	0.12	J	0.6	J	mg/kg	05-SB-05-2_OLD	6/18	0.36 - 0.4	0.6	NA	230(6)	N	680(6)	SSL_MIGR SSL_INH	No	BSL
129-00-0	Pyrene	0.16	J	0.88	J	mg/kg	05-SB-05-2_OLD	7/18	0.36 - 0.4	0.88	NA	230	N	680	SSL_MIGR SSL_INH	No	BSL

TABLE 2-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 5 - OPEN BURN AREAS
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)	Site Above Background ? (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)
Pesticides/PCBs (mg/kg)																	
72-54-8	4,4'-DDD	0.00065	J	0.005	J	mg/kg	05TP12WS0204[Q2]	2/15	0.0019 - 0.005	0.005	NA	2.7	C	11	SSL_MIGR SSL_INH	No	BSL
72-55-9	4,4'-DDE	0.0003	J	0.022	J	mg/kg	05-SB-05-2_OLD	5/18	0.0019 - 0.005	0.022	NA	1.9	C	35	SSL_MIGR SSL_INH	No	BSL
5103-71-9	alpha-Chlordane	0.00089	J	0.16	J	mg/kg	05-SB-05-2_OLD	4/18	0.0018 - 0.0025	0.16	NA	1.8(7)	C	0.92(7) 20(7)	SSL_MIGR SSL_INH	No	BSL
11096-82-5	Aroclor-1260	0.019	J	1.2	J	mg/kg	05-SB-05-2_OLD	7/18	0.036 - 0.05	1.2	NA	0.32	C	0.41	SSL_MIGR SSL_INH	Yes	ASL
60-57-1	Dieldrin	0.0017	J	0.053	J	mg/kg	05-SB-05-2_OLD	4/18	0.0019 - 0.005	0.053	NA	0.04	C	0.0022 1	SSL_MIGR SSL_INH	Yes	ASL
33213-65-9	Endosulfan II	0.0006	J	0.0081	J	mg/kg	05TP01WS0204[Q2]	5/17	0.0019 - 0.0049	0.0081	NA	47(8)	N	20(8)	SSL_MIGR SSL_INH	No	BSL
53494-70-5	Endrin Ketone	0.0026	J	0.011	J	mg/kg	05-SB-05-2_OLD	2/18	0.0019 - 0.004	0.011	NA	2.3(9)	N	5.4(9)	SSL_MIGR SSL_INH	No	BSL
5103-74-2	gamma-Chlordane	0.1	J	0.14	J	mg/kg	05-SB-05-2_OLD	2/18	0.0018 - 0.0025	0.14	NA	1.8(7)	C	0.92(7) 20(7)	SSL_MIGR SSL_INH	No	BSL
76-44-8	Heptachlor	0.0057	J	0.0057	J	mg/kg	05-SB-04-6_OLD	1/18	0.0018 - 0.0025	0.0057	NA	0.14	C	0.84 4	SSL_MIGR SSL_INH	No	BSL
1024-57-3	Heptachlor Epoxide	0.00017	J	0.00027	J	mg/kg	05-SB-02-10_OLD	3/18	0.0018 - 0.0025	0.00027	NA	0.07	C	0.025 5	SSL_MIGR SSL_INH	No	BSL
319-86-8	delta-BHC	0.00022	J	0.0003	J	mg/kg	05-SB-02-10_OLD	2/18	0.0018 - 0.0025	0.0003	NA	0.1(10)	C	0.00089(10) 0.8(10)	SSL_MIGR SSL_INH	No	BSL
Energetics (mg/kg)																	
118-96-7	2,4,6-Trinitrotoluene	9.82	J	9.82	J	mg/kg	05-SB-05-2_OLD	1/18	0.0356 - 0.25	9.82	NA	21	C	NA	SSL_MIGR SSL_INH	No	BSL
35572-78-2	2-Amino-4,6-dinitrotoluene	1.07	J	1.07	J	mg/kg	05-SB-05-2_OLD	1/18	0.0467 - 0.25	1.07	NA	0.47	N	NA	SSL_MIGR SSL_INH	Yes	ASL
2691-41-0	HMX	0.23	J	5.48	J	mg/kg	05-SB-05-2_OLD	2/18	0.0705 - 0.5	5.48	NA	390	N	NA	SSL_MIGR SSL_INH	No	BSL
121-82-4	RDX	30.8	J	30.8	J	mg/kg	05-SB-05-2_OLD	1/18	0.0509 - 0.5	30.8	NA	5.8	C	NA	SSL_MIGR SSL_INH	Yes	ASL
Inorganics (mg/kg)																	
7429-90-5	Aluminum	507	K	10300		mg/kg	05-SB-05-2_OLD	18/18	---	10300	No	7800	N	NA	SSL_MIGR SSL_INH	No	BKG
7440-36-0	Antimony	0.2	L	3.1	L	mg/kg	05-SB-05-2_OLD	7/18	0.18 - 0.79	3.1	No	3.1	N	13	SSL_MIGR SSL_INH	No	BSL, BKG
7440-38-2	Arsenic	1.1		6.6	J	mg/kg	05-SB-03-12_OLD	14/18	0.71 - 3	6.6	No	0.43	C	0.026 750	SSL_MIGR SSL_INH	No	BKG
7440-39-3	Barium	1.9		312		mg/kg	05-SB-05-2_OLD	18/18	---	312	No	550	N	2100 690000	SSL_MIGR SSL_INH	No	BSL, BKG
7440-43-9	Cadmium	0.43	K	5.6		mg/kg	05TP01WS0204[Q2]	5/18	0.019 - 0.31	5.6	No	7.8(11)	N	55(11) 1800	SSL_MIGR SSL_INH	No	BSL, BKG
7440-70-2	Calcium	37.8		42400		mg/kg	05-SB-05-2_OLD	11/18	40.4 - 154	42400	No	NA		NA	SSL_MIGR SSL_INH	No	NUT, BKG
7440-47-3	Chromium	2.6		40.9		mg/kg	05TP01WS0204[Q2]	18/18	---	40.9	No	23(12)	N	42(12) 270	SSL_MIGR SSL_INH	No	BKG
7440-48-4	Cobalt	0.12		9.5		mg/kg	05TP01WS0204[Q2]	11/18	0.092 - 0.59	9.5	No	160	N	NA	SSL_MIGR SSL_INH	No	BSL, BKG

TABLE 2-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 5 - OPEN BURN AREAS
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)	Site Above Background ? (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)
7440-50-8	Copper	2.6		701	J	mg/kg	05TP01WS0204[Q2]	18/18	---	701	Yes	310	N	11000	SSL_MIGR SSL_INH	Yes	ASL
7439-89-6	Iron	1700		24900		mg/kg	05-SB-04-6_OLD	18/18	---	24900	No	2300	N	NA	SSL_MIGR SSL_INH	No	BKG
7439-92-1	Lead	1.3	J	687	K	mg/kg	05-SB-04-6_OLD	17/18	1	687	No	400(13)		NA	SSL_MIGR SSL_INH	No	BKG
7439-95-4	Magnesium	33.9		3340		mg/kg	05TP01WS0204[Q2]	16/18	48.9 - 63.8	3340	No	NA		NA	SSL_MIGR SSL_INH	No	NUT, BKG
7439-96-5	Manganese	1.4		285	J	mg/kg	05TP01WS0204[Q2]	18/18	---	285	No	160(14)	N	950(14)	SSL_MIGR SSL_INH	No	BKG
7439-97-6	Mercury	0.02		2.3		mg/kg	05-SB-04-6_OLD	18/18	---	2.3	Yes	2.3(15)	N	NA	SSL_MIGR SSL_INH	No	BSL
7440-02-0	Nickel	0.2		198	J	mg/kg	05TP01WS0204[Q2]	15/18	0.19 - 1.2	198	No	160	N	NA 13000	SSL_MIGR SSL_INH	No	BKG
7440-09-7	Potassium	32.3		898		mg/kg	05TP01WS0204[Q2]	18/18	---	898	No	NA		NA	SSL_MIGR SSL_INH	No	NUT, BKG
7782-49-2	Selenium	1.1	J	49.6	J	mg/kg	05-SB-02-10_OLD-D	17/18	0.6 - 0.85	49.6	Yes	39	N	19	SSL_MIGR SSL_INH	Yes	ASL
7440-22-4	Silver	0.24		17.8		mg/kg	05-SB-05-2_OLD	6/18	0.067 - 0.21	17.8	No	39	N	31	SSL_MIGR SSL_INH	No	BSL, BKG
7440-23-5	Sodium	364		837	J	mg/kg	05-SB-05-2_OLD	4/18	23.3 - 185	837	No	NA		NA	SSL_MIGR SSL_INH	No	NUT, BKG
7440-28-0	Thallium	0.47		0.95		mg/kg	05TP01SB0507[Q2]	7/18	0.38 - 0.88	0.95	Yes	0.55	N	3.6	SSL_MIGR SSL_INH	Yes	ASL
7440-62-2	Vanadium	5.9		48.5		mg/kg	05-SB-05-2_OLD	18/18	---	48.5	No	55	N	5100	SSL_MIGR SSL_INH	No	BSL, BKG
7440-66-6	Zinc	1.2		1420		mg/kg	05TP01WS0204[Q2]	14/18	1.8 - 2.6	1420	No	2300	N	14000	SSL_MIGR SSL_INH	No	BSL, BKG
57-12-5	Cyanide	0.34		0.35		mg/kg	05-SB-05-2_OLD	2/10	0.19 - 0.28	0.35	NA	160	N	150	SSL_MIGR SSL_INH	No	BSL
Miscellaneous Parameters																	
TTNUS291	Percent Solids	75.5		90.9		mg/kg	05TP11SB0203[Q2]	8/8	---	90.9	NA	NA		NA	SSL_MIGR SSL_INH	No	NTX
TTNUS002	Ph	4.66		8.39		mg/kg	05-SB-05-2_OLD	10/10	---	8.39	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.

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

TABLE 2-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 5 - OPEN BURN AREAS
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)	Site Above Background ? (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)

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 - Food
12 Chromium as hexavalent chromium.
13 OSWER soil screening level for residential land use (USEPA, July 1994)
14 Manganese-Nonfood.
15 Mercury as Mercuric Chlori

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)

Associated Samples:

05-SB-01-8_OLD	05-SB-05-25_OLD	05TP12WS0204[Q2]	05TP09SB0506[Q2]
05-SB-02-22_OLD	05TP01SB0507[Q2]	05-SB-02-10_OLD	05TP09SB0506[Q2]-AVG
05-SB-03-12_OLD	05TP01WS0204[Q2]	05-SB-02-10_OLD-AVG	05TP09SB0506[Q2]-D
05-SB-03-25_OLD	05TP08SB0506[Q2]	05-SB-02-10_OLD-D	05TP09SB0506[Q2]-AVG
05-SB-04-20_OLD	05TP10SB0506[Q2]	05-SB-100_OLD	05TP09SB0506[Q2]-D
05-SB-04-6_OLD	05TP11SB0203[Q2]	05-SB-100_OLD-AVG	05TP09SB0506[Q2]-AVG
05-SB-05-2_OLD	05TP12SB0708[Q2]	05-SB-100_OLD-D	05TP09SB0506[Q2]-D

TABLE 2-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 13 - OIL SLUDGE DISPOSAL 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)	Site Above Background ? (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)
Volatile Organics (mg/kg)																	
79-34-5	1,1,2,2-Tetrachloroethane	0.0015	J	0.171		mg/kg	13SB207-14	7/27	0.01 - 0.0216	0.171	NA	3.2	C	0.00068 0.6	SSL_MIGR SSL_INH	No	BSL
95-50-1	1,2 Dichlorobenzene	0.0027		0.0027		mg/kg	13SB203-06	1/21	0.00267 - 0.0136	0.0027	NA	700	N	4.6 560	SSL_MIGR SSL_INH	No	BSL, FREQ
96-12-8	1,2-Dibromo-3-chloropropane	0.00598	J	0.00598	J	mg/kg	13SB201-08	1/21	0.00359 - 0.0136	0.00598	NA	0.46	C	0.00087	SSL_MIGR SSL_INH	No	BSL, FREQ
106-46-7	1,4 Dichlorobenzene	0.00247	J	0.0027	J	mg/kg	13SB201-08	2/21	0.00976 - 0.0136	0.0027	NA	27	C	0.0071	SSL_MIGR SSL_INH	No	BSL
78-93-3	2-Butanone	0.0019	J	0.0019	J	mg/kg	13TP04WS0203	1/13	0.01 - 0.014	0.0019	NA	4700	N	7.9	SSL_MIGR SSL_INH	No	BSL
591-78-6	2-Hexanone	0.00775	J	0.0132	J	mg/kg	13SB203-06	2/27	0.00976 - 0.0172	0.0132	NA	310	N	NA	SSL_MIGR SSL_INH	No	BSL
67-64-1	Acetone	0.00335	J	0.00405	J	mg/kg	13SB206-10	2/27	0.0015 - 0.0172	0.00405	NA	780	N	2.5 100000	SSL_MIGR SSL_INH	No	BSL
74-87-3	Chloromethane	0.00192	J	0.00513	J	mg/kg	13SB207-14	14/27	0.01 - 0.014	0.00513	NA	49	C	0.01	SSL_MIGR SSL_INH	No	BSL
79-20-9	Methyl Acetate	0.00215	J	0.0107		mg/kg	13SB206-10	4/19	0.01 - 0.014	0.0107	NA	7800	N	25	SSL_MIGR SSL_INH	No	BSL
127-18-4	Tetrachloroethene	0.001	J	0.00254	J	mg/kg	13SB207-14	4/27	0.01 - 0.0216	0.00254	NA	12	C	0.029 11	SSL_MIGR SSL_INH	No	BSL
1330-20-7	Total Xylenes	0.06		0.06		mg/kg	13TP04WS0203	1/27	0.00976 - 0.0216	0.06	NA	16000	N	170 410	SSL_MIGR SSL_INH	No	BSL, FREQ
79-01-6	Trichloroethene	0.00246	J	0.0162	J	mg/kg	13SB201-08	4/27	0.01 - 0.0216	0.0162	NA	1.6	C	0.00026 5	SSL_MIGR SSL_INH	No	BSL
Semivolatile Organics (mg/kg)																	
91-57-6	2-Methylnaphthalene	0.044	J	0.044	J	mg/kg	13TP04WS0203	1/13	0.35 - 0.47	0.044	NA	160	N	22	SSL_MIGR SSL_INH	No	BSL
83-32-9	Acenaphthene	0.062	J	0.062	J	mg/kg	13-SS-01	1/13	0.35 - 0.47	0.062	NA	470	N	100	SSL_MIGR SSL_INH	No	BSL
120-12-7	Anthracene	0.042	J	0.14	J	mg/kg	13-SS-01	4/13	0.36 - 0.47	0.14	NA	2300	N	470	SSL_MIGR SSL_INH	No	BSL
56-55-3	Benzo(a)anthracene	0.058	J	0.48	J	mg/kg	13-SB-02	5/13	0.36 - 0.47	0.48	NA	0.87	C	1.5	SSL_MIGR SSL_INH	No	BSL
50-32-8	Benzo(a)pyrene	0.041	J	0.39	J	mg/kg	13-SS-01	5/13	0.36 - 0.47	0.39	NA	0.087	C	0.37	SSL_MIGR SSL_INH	Yes	ASL
205-99-2	Benzo(b)fluoranthene	0.095	J	0.78		mg/kg	13-SS-02	4/13	0.36 - 0.47	0.78	NA	0.87	C	4.5	SSL_MIGR SSL_INH	No	BSL
191-24-2	Benzo(g,h,i)perylene	0.2	J	0.29	J	mg/kg	13-SS-01	3/13	0.36 - 0.47	0.29	NA	230(6)	N	680(6)	SSL_MIGR SSL_INH	No	BSL
207-08-9	Benzo(k)fluoranthene	0.19	J	0.25	J	mg/kg	13-SS-01	2/13	0.35 - 0.47	0.25	NA	8.7	C	45	SSL_MIGR SSL_INH	No	BSL
117-81-7	Bis(2-Ethylhexyl)phthalate	0.056	J	0.26	J	mg/kg	13-SB-02	3/13	0.35 - 0.47	0.26	NA	46	C	2900 31000	SSL_MIGR SSL_INH	No	BSL
86-74-8	Carbazole	0.096	J	0.096	J	mg/kg	13-SS-01	1/13	0.35 - 0.47	0.096	NA	32	C	0.47	SSL_MIGR SSL_INH	No	BSL
218-01-9	Chrysene	0.047	J	0.5	J	mg/kg	13-SB-02	5/13	0.36 - 0.47	0.5	NA	87	C	150	SSL_MIGR SSL_INH	No	BSL

TABLE 2-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 13 - OIL SLUDGE DISPOSAL 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)	Site Above Background ? (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)
53-70-3	Dibenzo(a,h)anthracene	0.088	J	0.14	J	mg/kg	13-SS-01	3/13	0.36 - 0.47	0.14	NA	0.087	C	1.4	SSL_MIGR SSL_INH	Yes	ASL
206-44-0	Fluoranthene	0.037	J	1.1		mg/kg	13-SS-01	6/13	0.36 - 0.47	1.1	NA	310	N	6300	SSL_MIGR SSL_INH	No	BSL
86-73-7	Fluorene	0.058	J	0.064	J	mg/kg	13TP04WS0203	2/13	0.36 - 0.47	0.064	NA	310	N	140	SSL_MIGR SSL_INH	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	0.2	J	0.25	J	mg/kg	13-SS-01	3/13	0.36 - 0.47	0.25	NA	0.87	C	13	SSL_MIGR SSL_INH	No	BSL
91-20-3	Naphthalene	0.068	J	0.068	J	mg/kg	13TP04WS0203	1/13	0.36 - 0.47	0.068	NA	160	N	0.15	SSL_MIGR SSL_INH	No	BSL
85-01-8	Phenanthrene	0.073	J	0.59		mg/kg	13-SS-01	5/13	0.36 - 0.47	0.59	NA	230(6)	N	680(6)	SSL_MIGR SSL_INH	No	BSL
129-00-0	Pyrene	0.041	J	0.89	J	mg/kg	13-SB-02	6/13	0.36 - 0.47	0.89	NA	230	N	680	SSL_MIGR SSL_INH	No	BSL
Pesticides/PCBs (mg/kg)																	
72-54-8	4,4'-DDD	0.00061	J	0.017	J	mg/kg	13-SS-01	3/12	0.0019 - 0.0047	0.017	NA	2.7	C	11	SSL_MIGR SSL_INH	No	BSL
72-55-9	4,4'-DDE	0.00049	J	0.071	K	mg/kg	13-SS-01	4/13	0.0019 - 0.0047	0.071	NA	1.9	C	35	SSL_MIGR SSL_INH	No	BSL
50-29-3	4,4'-DDT	0.00071	J	0.039	K	mg/kg	13-SS-01	2/12	0.0019 - 0.0047	0.039	NA	1.9	C	1.2	SSL_MIGR SSL_INH	No	BSL
5103-71-9	alpha-Chlordane	0.0017	J	0.0078	K	mg/kg	13-SS-01	2/13	0.0017 - 0.0024	0.0078	NA	1.8(7)	C	0.92(7) 20(7)	SSL_MIGR SSL_INH	No	BSL
11096-82-5	Aroclor-1260	0.059	J	0.17	J	mg/kg	13-SS-01	3/13	0.036 - 0.047	0.17	NA	0.32	C	0.41	SSL_MIGR SSL_INH.	No	BSL
60-57-1	Dieldrin	0.00029	J	0.015	J	mg/kg	13-SS-01	2/13	0.0019 - 0.0047	0.015	NA	0.04	C	0.0022 1	SSL_MIGR SSL_INH	No	BSL
5103-74-2	gamma-Chlordane	0.0016	J	0.0037	K	mg/kg	13-SS-01	2/13	0.0017 - 0.0024	0.0037	NA	1.8(7)	C	0.92(7) 20(7)	SSL_MIGR SSL_INH	No	BSL
Inorganics (mg/kg)																	
7429-90-5	Aluminum	768		21600		mg/kg	13-SB-03	13/13	---	21600	No	7800	N	NA	SSL_MIGR SSL_INH	No	BKG
7440-38-2	Arsenic	0.62		3.9	L	mg/kg	13-SB-03	13/13	---	3.9	No	0.43	C	0.026 750	SSL_MIGR SSL_INH	No	BKG
7440-39-3	Barium	1.8		71.1		mg/kg	13-SS-03	13/13	---	71.1	No	550	N	2100 690000	SSL_MIGR SSL_INH	No	BSL, BKG
7440-41-7	Beryllium	0.08		0.97		mg/kg	13TP05WS0103	3/13	0.02 - 0.76	0.97	Yes	16	N	1200 1300	SSL_MIGR SSL_INH	No	BSL
7440-43-9	Cadmium	0.062	K	0.4		mg/kg	13-SS-01	4/13	0.019 - 0.08	0.4	No	7.8(8)	N	55(8) 1800	SSL_MIGR SSL_INH	No	BSL, BKG
7440-70-2	Calcium	254		20700		mg/kg	13-SS-02	7/13	33.6 - 213	20700	Yes	NA		NA	SSL_MIGR SSL_INH	No	NUT
7440-47-3	Chromium	2.2		28.1	J	mg/kg	13-SB-03	13/13	---	28.1	No	23(9)	N	42(9) 270	SSL_MIGR SSL_INH	No	BKG
7440-48-4	Cobalt	0.16		21.5		mg/kg	13-SS-03	11/13	0.094 - 0.63	21.5	No	160	N	NA	SSL_MIGR SSL_INH	No	BSL, BKG
7440-50-8	Copper	1.3	J	68.4		mg/kg	13-SS-01	13/13	---	68.4	No	310	N	11000	SSL_MIGR SSL_INH	No	BSL, BKG

TABLE 2-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 13 - OIL SLUDGE DISPOSAL 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)	Site Above Background ? (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)
7439-89-6	Iron	1760		39000	J	mg/kg	13TP05WS0103-D	13/13	---	39000	No	2300	N	NA	SSL_MIGR SSL_INH	No	BKG
7439-92-1	Lead	0.9		40.6		mg/kg	13-SS-01	13/13	---	40.6	No	400(10)		NA	SSL_MIGR SSL_INH	No	BSL, BKG
7439-95-4	Magnesium	35.4		5370		mg/kg	13TP05WS0103-D	13/13	---	5370	No	NA		NA	SSL_MIGR SSL_INH	No	NUT, BKG
7439-96-5	Manganese	3	J	699		mg/kg	13-SS-03	13/13	---	699	No	160(11)	N	950(11)	SSL_MIGR SSL_INH	No	BKG
7439-97-6	Mercury	0.022		0.16		mg/kg	13-SS-01	12/13	0.02	0.16	No	2.3(12)	N	NA	SSL_MIGR SSL_INH	No	BSL, BKG
7440-02-0	Nickel	0.38	J	65.5	J	mg/kg	13TP05WS0103-D	13/13	---	65.5	No	160	N	NA 13000	SSL_MIGR SSL_INH	No	BSL, BKG
7440-09-7	Potassium	26.9		3400		mg/kg	13-SS-03	13/13	---	3400	No	NA		NA	SSL_MIGR SSL_INH	No	NUT, BKG
7782-49-2	Selenium	0.43		3.8	J	mg/kg	13-SB-03	11/12	0.37	3.8	Yes	39	N	19	SSL_MIGR SSL_INH	No	BSL
7440-22-4	Silver	0.073		0.21		mg/kg	13TP05WS0103-D	1/13	0.067 - 0.22	0.21	No	39	N	31	SSL_MIGR SSL_INH	No	BSL, BKG
7440-23-5	Sodium	106		106		mg/kg	13-SS-03	1/13	16.1 - 101	106	No	NA		NA	SSL_MIGR SSL_INH	No	NUT, BKG
7440-28-0	Thallium	0.48		3	K	mg/kg	13TP05WS0103-D	7/13	0.39 - 0.76	3	Yes	0.55	N	3.6	SSL_MIGR SSL_INH	Yes	ASL
7440-62-2	Vanadium	4.1		39.4		mg/kg	13-SB-03	13/13	---	39.4	No	55	N	5100	SSL_MIGR SSL_INH	No	BSL, BKG
7440-66-6	Zinc	6.3	J	70		mg/kg	13-SS-01	8/13	1.4 - 3.8	70	No	2300	N	14000	SSL_MIGR SSL_INH	No	BSL, BKG
57-12-5	Cyanide	0.24		0.24		mg/kg	13-SB-03	1/6	0.18 - 0.32	0.24	NA	160	N	150	SSL_MIGR SSL_INH	No	BSL
Miscellaneous Parameters																	
TTNUS291	Percent Solids (%)	83.8		95.6		mg/kg	13SB202-08	17/17	---	95.6	NA	NA		NA	SSL_MIGR SSL_INH	No	NTX
TTNUS002	Ph (s.u.)	5.65		7.98		mg/kg	13-SB-02	6/6	---	7.98	NA	NA		NA	SSL_MIGR SSL_INH	No	NTX
TTNUS003	Total Organic Carbon	434		434		mg/kg	13SB201-10	1/1	---	434	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 significanty 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).

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

TABLE 2-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF POTENTIAL CONSTITUENTS OF CONCERN
POST-REMOVAL SURFACE/SUBSURFACE SOIL - SITE 13 - OIL SLUDGE DISPOSAL 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)	Site Above Background ? (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)

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 Cadmium - Food
9 Chromium as hexavalent chromium.
10 OSWER soil screening level for residential land use (USEPA, July 1994)
11 Manganese-Nonfood.
12 Mercury as Mercuric Chloride.

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)

Associated Samples:

13-SB-01	13SB201-08	13SB205-10	13TP04WS0203
13-SB-02	13SB201-10	13SB205-4	13TP05SB0607
13-SB-03	13SB202-08	13SB206-10	13TP05WS0103
13-SB-03-AVG	13SB202-12	13SB206-14	13TP05WS0103-AVG
13-SB-03-D	13SB203-06	13SB207-10	13TP05WS0103-D
13-SS-01	13SB203-12	13SB207-14	13TP06SB0203
13-SS-02	13SB204-10	13TP03SB0405	13TP07SB0304
13-SS-03	13SB204-14	13TP04SB0405	

TABLE 2-5

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY - SURFACE / SUBSURFACE SOIL
SITE 5 - OPEN BURN AREAS
NSWC WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface / SubsurfaceSoil
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)pyrene	mg/kg	1.93E-01	2.29E-01	5.00E-01	J	mg/kg	2.36E-01	95% UCL-T	W - Test (1)	2.36E-01	95% UCL-T	W - Test (1)
Dibenzo(a,h)anthracene	mg/kg	1.73E-01	1.94E-01	1.20E-01	J	mg/kg	1.20E-01	Maximum	W - Test (2)	1.20E-01	Maximum	W - Test (2)
Aroclor-1260	mg/kg	1.67E-01	2.98E-01	1.20E+00	J	mg/kg	4.46E-01	95% UCL-T	W - Test (1)	4.46E-01	95% UCL-T	W - Test (1)
Dieldrin	mg/kg	4.74E-03	9.71E-03	5.30E-02	J	mg/kg	5.72E-03	95% UCL-T	W - Test (1)	5.72E-03	95% UCL-T	W - Test (1)
2-Amino-4,6-dinitrotoluene	mg/kg	1.27E-01	2.25E-01	1.07E+00	J	mg/kg	2.37E-01	95% UCL-T	W - Test (1)	2.37E-01	95% UCL-T	W - Test (1)
RDX	mg/kg	1.83E+00	4.80E+00	3.08E+01	J	mg/kg	3.24E+00	95% UCL-T	W - Test (1)	3.24E+00	95% UCL-T	W - Test (1)
Copper	mg/kg	1.36E+02	2.32E+02	7.01E+02	J	mg/kg	7.01E+02	Maximum	W - Test (2)	7.01E+02	Maximum	W - Test (2)
Selenium	mg/kg	7.34E+00	1.07E+01	2.56E+01	J	mg/kg	1.56E+01	95% UCL-T	W - Test (3)	1.56E+01	95% UCL-T	W - Test (3)
Thallium	mg/kg	4.50E-01	5.44E-01	9.50E-01		mg/kg	5.67E-01	95% UCL-T	W - Test (3)	5.67E-01	95% UCL-T	W - Test (3)

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.
3 Shapiro-Wilk W Test indicates data are log-normally distributed.

TABLE 2-6

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY - SURFACE / SUBSURFACE SOIL
SITE 13 - OIL SLUDGE DISPOSAL AREA
NSWC WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface / SubsurfaceSoil
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)pyrene	mg/kg	2.00E-01	2.46E-01	3.90E-01	J	mg/kg	2.46E-01	95% UCL-N	W - Test (1)	2.46E-01	95% UCL-N	W - Test (1)
Dibenzo(a,h)anthracene	mg/kg	1.76E-01	1.94E-01	1.40E-01	J	mg/kg	1.40E-01	Maximum	W - Test (2)	1.40E-01	Maximum	W - Test (2)
Thallium	mg/kg	6.09E-01	8.49E-01	2.10E+00		mg/kg	8.84E-01	95% UCL-T	W - Test (3)	8.84E-01	95% UCL-T	W - Test (3)

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 indicates data are normally distributed.
2 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration is used for EPC.
3 Shapiro-Wilk W Test indicates data are log-normally distributed.

TABLE 2-7

NON-CANCER TOXICITY DATA - ORAL/DERMAL
SITES 5 AND 13
NSWC WHITE OAK, SILVER SPRING, MARYLAND

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD	Oral RfD Units	Oral to Dermal Adjustment Factor[1]	Adjusted Dermal RfD[2]	Dermal RfD Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ[3]
Dieldrin	chronic	5.0E-05	mg/kg-day	1	5.00E-05	mg/kg-day	Liver	100	IRIS	05/23/03
2-Amino-4,6-dinitrotoluene	chronic	6.0E-05	mg/kg-day	1	6.00E-05	mg/kg-day			NCEA	04/25/03
RDX	chronic	3.0E-03	mg/kg-day	1	3.00E-03	mg/kg-day	Prostate	100	IRIS	05/23/03
Copper	chronic	4.0E-02	mg/kg-day	1	4.00E-02	mg/kg-day	NA		HEAST	07/97
Selenium	chronic	5.0E-03	mg/kg-day	1	5.00E-03	mg/kg-day	Blood/Skin/CNS	3	IRIS	05/23/03
Thallium	chronic	7.0E-05	mg/kg-day	1	7.00E-05	mg/kg-day	Liver		NCEA	04/25/03

1 USEPA, September, 2001.
2 RfD dermal = RfDoral x (Oral to Dermal Adjustment Factor)
3 Dates of IRIS, HEAST, or NCEA

Notes: RfD = Reference dose
CNS = Central Nervous System
IRIS = Integrated Risk Information System, on-line database search (USEPA, May 2003)
HEAST = Health Effects Assessment Summary Tables (USEPA, July 1997)
NCEA = USEPA National Center for Environmental Assessment (USEPA RBC Table, April 25, 2003)
NA = Not applicable since an oral RfD is not available for this compound data

TABLE 2-8

CANCER TOXICITY DATA - ORAL/DERMAL
SITES 5 AND 13
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	5/23/2003
Dieldrin	1.6E+01	1	1.60E+01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	5/23/2003
Benzo(a)pyrene	7.3E+00	1	7.30E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	5/23/2003
Dibenzo(a,h)anthracene	7.3E+00	1	7.30E+00	$(mg/kg\text{-}day)^{-1}$	B2	Region 3	4/25/2003
RDX	1.1E-01	1	1.10E-01	$(mg/kg\text{-}day)^{-1}$	C	IRIS	4/25/2003

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, May 2003)
HEAST = Health Effects Assessment Summary Tables (USEPA, July 1997)
Region 3 - USEPA Region III RBC Table, April 25, 2003

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 2-9
Summary of Data Quantitatively Used in Risk Assessment for OU-1 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

Medium	Date of Sampling	Sample ID	Parameters
Groundwater - Bedrock*			
Jan - Feb 2000	2/9/2000	003GW1020005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/10/2000	009GW1050005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/15/2000	009GW1060005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/1/2000	009GW201D005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/1/2000	009GW201S005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/2/2000	046GW125D005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/3/2000	046GW200D005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/4/2000	046GW214D005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/15/2000	046GWC12005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
April 2000	4/24/2000	009GW1050006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/13/2000	046GW125D006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/17/2000	046GW200D006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/11/2000	046GW213D006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/26/2000	046GW2200006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/19/2000	046GWC12006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/19/2000	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
	11/9/1999	4GW1030004	VOC, SVOC, metals, and pest/PCB
	11/2/1999	9GW1010004	VOC, SVOC, metals, and pest/PCB
Jan - Feb 2000	2/9/2000	003GW0190005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/6/2000	004GW1050005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/1/2000	004GW2000005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/9/2000	004GW2010005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/5/2000	007GW0430005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/15/2000	007GW1040005	LC VOC, inorg, cyanide, perchlorate, explosives
	2/7/2000	009GW0010005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/7/2000	009GW1030005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/6/2000	013GW0020005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/15/2000	013GW2000005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/3/2000	046GW123D005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/16/2000	046GW1280005	LC VOC, inorg, cyanide, perchlorate, explosives
	2/15/2000	046GW1320005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/4/2000	046GW2190005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/16/2000	046GWA20005	LC VOC, inorg, cyanide, perchlorate, explosives
	2/8/2000	046GWC13005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	2/15/2000	046GWC50005	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
April 2000	4/14/2000	004GW2020006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/24/2000	009GW1010006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/16/2000	013GW0020006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/18/2000	013GW0030006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/15/2000	046GW1210006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/15/2000	046GW1260006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/25/2000	046GW2089906 [e)]	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/12/2000	046GW2180006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/25/2000	046GWA10006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/25/2000	046GWA20006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/25/2000	046GWA30006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/18/2000	046GWA40006	LC VOC, inorg, Fmetals, cyanide, perchlorate, explosives
	4/24/2000	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
[c)] duplicate of 004GW2010005
[d)] duplicate of 004GW2000005
[e)] duplicate of 046GW2080006

TABLE 2-10

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

ROD for Sites 5 and 13 Groundwater and Soil

Former NSWC White Oak, Silver Spring, Maryland

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 2-11

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

ROD for Sites 5 and 13, 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	0.600	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	0.116 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	26/33	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	4.78 C	N/A	N/A	YES	ASL

Table 2-11

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

ROD for Sites 5 and 13, 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	148.8	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	16.6 - 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	013GW0020006	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	0.8 - 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 2-11

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

ROD for Sites 5 and 13, 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 2-12

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

ROD for Sites 5 and 13, 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	0.867	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 2-12

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

ROD for Sites 5 and 13, 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 2-13

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

ROD for Sites 5 and 13, 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	8/26/1996
	Subchronic	N/A								
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	2.9E-04	mg/kg-day	Skin	3	IRIS	6/17/1998
	Subchronic	3.0E-04	mg/kg-day	95%	2.9E-04	mg/kg-day	Skin	3	HEAST	7/8/1998
Barium	Chronic	7.0E-02	mg/kg-day	100%	7.0E-02	mg/kg-day	Cardiovascular	3	IRIS	6/17/1998
	Subchronic	7.0E-02	mg/kg-day	100%	7.0E-02	mg/kg-day	Cardiovascular	3	HEAST	7/8/1998
Beryllium	Chronic	2.0E-03	mg/kg-day	1%	2.0E-05	mg/kg-day	GI	100	IRIS	6/17/1998
	Subchronic	5.0E-03	mg/kg-day	1%	5.0E-05	mg/kg-day	GI	100	HEAST	7/8/1998
Cadmium (Food)	Chronic	1.0E-03	mg/kg-day	2.5%	2.5E-05	mg/kg-day	Kidney	10	IRIS	6/17/1998
	Subchronic	N/A								
Cadmium (Water)	Chronic	5.0E-04	mg/kg-day	5%	2.5E-05	mg/kg-day	Kidney	10	IRIS	6/17/1998
	Subchronic	N/A								
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	1%	3.0E-05	mg/kg-day	NOAEL	500	IRIS	6/17/1998
	Subchronic	2.0E-02	mg/kg-day	1%	2.0E-04	mg/kg-day	NOAEL	100	HEAST	7/8/1998
Cobalt	Chronic	2.0E-02	mg/kg-day	30%	6.0E-03	mg/kg-day	Sensitizer	N/A	NCEA	5/24/2001
	Subchronic	N/A								
Copper	Chronic	4.0E-02	mg/kg-day	60%	2.4E-02	mg/kg-day	Gastrointestinal	N/A	HEAST	7/8/1998
	Subchronic	4.0E-02	mg/kg-day	60%	2.4E-02	mg/kg-day	Gastrointestinal	N/A	HEAST	7/8/1998
Cyanide	Chronic	2.0E-02	mg/kg-day	20%	4.0E-03	mg/kg-day	Whole body	100	IRIS	6/17/1998
	Subchronic	2.0E-02	mg/kg-day	20%	4.0E-03	mg/kg-day	Whole body	500	HEAST	7/8/1998
Iron	Chronic	6.0E-01	mg/kg-day	20%	1.2E-01	mg/kg-day	Gastrointestinal	1	NCEA	7/23/1996
	Subchronic	N/A								
Manganese (nonfood)	Chronic	2.0E-02	mg/kg-day	5%	1.0E-03	mg/kg-day	CNS	1	IRIS	6/17/1998
	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	6/17/1998
	Subchronic	NA	mg/kg-day			mg/kg-day				

TABLE 2-13

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

ROD for Sites 5 and 13, 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	6/22/1998
	Subchronic	2.0E-02	mg/kg-day	10%	2.0E-03	mg/kg-day	Whole body	300	HEAST	7/8/1998
Selenium	Chronic	5.0E-03	mg/kg-day	90%	4.5E-03	mg/kg-day	Whole body	3	IRIS	6/22/1998
	Subchronic	5.0E-03	mg/kg-day	90%	4.5E-03	mg/kg-day	Whole body	3	HEAST	7/8/1998
Silver	Chronic	5.0E-03	mg/kg-day	NA			Skin	3	IRIS	6/22/1998
	Subchronic	5.0E-03	mg/kg-day	NA			Skin	3	HEAST	7/8/1998
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	7/8/1998
	Subchronic	7.0E-03	mg/kg-day	2%	1.4E-04	mg/kg-day	NOAEL	100	HEAST	7/8/1998
Zinc	Chronic	3.0E-01	mg/kg-day	25%	7.5E-02	mg/kg-day	Blood	3	IRIS	6/22/1998
	Subchronic	3.0E-01	mg/kg-day	25%	7.5E-02	mg/kg-day	Blood	3	HEAST	7/8/1998
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	7/9/1998
	Subchronic	2.0E-02	mg/kg-day	55%	1.1E-02	mg/kg-day	Reproductive	3000	NCEA	03/28/96
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	8/22/2000
	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	8/30/2000
	Subchronic	5.0E-04	mg/kg-day	60%	3.0E-04	mg/kg-day	Liver	1000/1	IRIS	8/30/2000

TABLE 2-13

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

ROD for Sites 5 and 13, 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	8/22/2000
	Subchronic	2.0E-03	mg/kg-day	85%	1.7E-03	mg/kg-day	Nervous System	100/1	HEAST	8/22/2000
Aminodinitrotoluenes	Chronic	6.0E-05	mg/kg-day	80%	4.8E-05	mg/kg-day			NCEA	8/30/2000
	Subchronic	N/A								
Perchlorates	Chronic	5.0E-04	mg/kg-day	80%	4.0E-04	mg/kg-day			NCEA	8/30/2000
	Subchronic	N/A								
RDX	Chronic	3.0E-03	mg/kg-day	80%	2.4E-03	mg/kg-day	Prostrate	100/1	IRIS	8/22/2000
	Subchronic	3.0E-03	mg/kg-day	80%	2.4E-03	mg/kg-day	Prostrate	100/1	HEAST	8/22/2000
1,1,2, 2-Tetrachloroethane	Chronic	6.0E-02	mg/kg-day	80%	4.8E-02	mg/kg-day	Liver and Kidney		NCEA	3/30/2000
	Subchronic	N/A								
1,1,2-Trichloroethane	Chronic	4.0E-03	mg/kg-day	80%	3.2E-03	mg/kg-day	Blood	1000	IRIS	7/2/1998
	Subchronic	4.0E-02	mg/kg-day	80%	3.2E-02	mg/kg-day	Blood	100	HEAST	7/8/1998
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	3/7/1996
	Subchronic	N/A								
1,4-Dichlorobenzene	Chronic	3.0E-02	mg/kg-day	80%	2.4E-02	mg/kg-day	Liver	1000	E	4/29/1997
	Subchronic	N/A								
1,1-Dichloroethene	Chronic	9.0E-03	mg/kg-day	80%	7.2E-03	mg/kg-day	Liver	1000	IRIS	7/2/1998
	Subchronic	9.0E-03	mg/kg-day	80%	7.2E-03	mg/kg-day	Liver	1000	HEAST	7/8/1998
1,2-Dichloroethane	Chronic	3.0E-02	mg/kg-day	80%	2.4E-02	mg/kg-day	Liver	1000	NCEA	4/5/1993
	Subchronic	N/A								
cis-1,2-Dichloroethene	Chronic	1.0E-02	mg/kg-day	100%	1.0E-02	mg/kg-day	Blood	3000	HEAST	7/8/1998
	Subchronic	1.0E-01	mg/kg-day	100%	1.0E-01	mg/kg-day	Blood	300	HEAST	7/8/1998
trans-1,2-Dichloroethene	Chronic	2.0E-02	mg/kg-day	100%	2.0E-02	mg/kg-day	Blood	1000	IRIS	2/28/2000
	Subchronic	2.0E-01	mg/kg-day	100%	2.0E-01	mg/kg-day	Blood	100	HEAST	2/28/2000
1,2-Dichloropropane	Chronic	N/A								
	Subchronic	N/A								

TABLE 2-13

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

ROD for Sites 5 and 13, 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	7/2/1996
	Subchronic	3.0E-03	mg/kg-day	100%	3.0E-03	mg/kg-day	Liver	3000	NCEA	7/2/1996
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	2/28/2000
	Subchronic	N/A								
Chlorobenzene	Chronic	2.0E-02	mg/kg-day	80%	1.6E-02	mg/kg-day	Liver	1000	IRIS	7/2/1998
	Subchronic	N/A								
Chloroform	Chronic	1.0E-02	mg/kg-day	100%	1.0E-02	mg/kg-day	Liver	1000	IRIS	7/2/1998
	Subchronic	1.0E-02	mg/kg-day	100%	1.0E-02	mg/kg-day	Liver	1000	HEAST	2/28/2000
Tetrachloroethene	Chronic	1.0E-02	mg/kg-day	100%	1.0E-02	mg/kg-day	Liver	1000	IRIS	2/28/2000
	Subchronic	1.0E-01	mg/kg-day	100%	1.0E-01	mg/kg-day	Liver	100	HEAST	2/28/2000
Toluene	Chronic	2.0E-01	mg/kg-day	100%	2.0E-01	mg/kg-day	Liver, Kidney	1000	IRIS	2/28/2000
	Subchronic	2.0E+00	mg/kg-day	100%	2.0E+00	mg/kg-day	Liver, Kidney	100	HEAST	2/28/2000
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	4/2/2001
	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 2-14

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

ROD for Sites 5 and 13, 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	7/8/1998
Benzo(a)anthracene	7.3E-01	NU		$(mg/kg\text{-}day)^{-1}$	B2	E	7/1/1993
Benzo(a)pyrene	7.3E+00	NU		$(mg/kg\text{-}day)^{-1}$	B2	IRIS	7/8/1998
Benzo(b)fluoranthene	7.3E-01	NU		$(mg/kg\text{-}day)^{-1}$	B2	E	7/1/1993
bis(2-Ethylhexyl)phthalate)	1.4E-02	55%	2.5E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	7/8/1998
Benzo(b)fluoranthene	7.3E-01	NU		$(mg/kg\text{-}day)^{-1}$	B2	E	7/1/1993
Carbazole	2.0E-02	NU		$(mg/kg\text{-}day)^{-1}$	B2	HEAST	8/22/2000
Dibenz(a,h)anthracene	7.3E+00	NU		$(mg/kg\text{-}day)^{-1}$	B2	E	7/1/1993
Naphthalene	N/A						
2,4,6-Trinitrotoluene	3.0E-02	60%	5.0E-02	$(mg/kg\text{-}day)^{-1}$	C	IRIS	8/30/2000
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	8/30/2000
1,1,2,2-Tetrachloroethane	2.0E-01	80%	2.5E-01	$(mg/kg\text{-}day)^{-1}$	C	IRIS	2/1/1994
1,1,2-Trichloroethane	5.7E-02	80%	7.1E-02	$(mg/kg\text{-}day)^{-1}$	C	IRIS	7/8/1998
1,1-Dichloroethene	6.0E-01	80%	7.5E-01	$(mg/kg\text{-}day)^{-1}$	C	IRIS	7/8/1998
1,2-Dibromoethane	8.5E+01	80%	1.1E+02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	8/30/2000
1,2-Dichloroethane	9.1E-02	80%	1.1E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	7/8/1998
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	7/8/1998
1,2-Dichloropropane	6.8E-02	80%	8.5E-02	$(mg/kg\text{-}day)^{-1}$	B2	HEAST	2/29/2000
Benzene	2.9E-02	100%	2.9E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	7/8/1998
Bromodichloromethane	6.2E-02	80%	7.8E-02	(mg/kg-day)	C	IRIS	7/8/1998
Carbon tetrachloride	1.3E-01	80%	1.6E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	2/28/2000
Chlorobenzene	N/A						
Chloroform	6.1E-03	100%	6.1E-03	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	7/8/1998

TABLE 2-14

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

ROD for Sites 5 and 13, 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 2-15
Summary of Media-Specific Risks and Hazards for RME to OU-1 and Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil

Former NSWC White Oak, Silver Spring, Maryland

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**	--	--	--	**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**
Sites 5 and 13 Totals	**0**	**8.0**	**0.9**	**9**	**5.0E-04**	**N/A**	**N/A**	**5.0E-04**	**N/A**	**18.6**	**2.0**	**21**	**NA**	**NA**	**NA**	**NA**

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Sites 5 and 13 groundwater

TABLE 2-15
Summary of Media-Specific Risks and Hazards for RME to OU-1 and Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil

Former NSWC White Oak, Silver Spring, Maryland

Media: Groundwater in Coastal Plain and Saprolite

	Future Age-Adjusted Resident*							
	HQ				CR			
Chemical	**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**
Sites 5 and 13 Totals	**NA**	**NA**	**NA**	**NA**	**5.0E-04**	**1.1E-03**	**1.1E-04**	**1.7E-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 Sites 5 and 13 groundwater

TABLE 2-15
Summary of Media-Specific Risks and Hazards for RME to OU-1 and Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil

Former NSWC White Oak, Silver Spring, Maryland

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**
Sites 5 and 13 Totals	**0.00**	**--**	**0.38**	**0.38**	**1.1E-07**	**--**	**7.7E-07**	**8.8E-07**

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Sites 5 and 13 groundwater

TABLE 2-16
Summary of Media-Specific Risks and Hazards for CTE to OU-1 and Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil

Former NSWC White Oak, Silver Spring, Maryland

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	0.23	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**
OU-1 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**
Sites 5 and 13 Totals	**0.0**	**0.53**	**0.07**	**0.6**	**3.7E-05**	**N/A**	**N/A**	**3.7E-05**	**N/A**	**1.8**	**0.15**	**1.9**	**NA**	**NA**	**NA**	**NA**

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Sites 5 and 13 groundwater.

TABLE 2-16
Summary of Media-Specific Risks and Hazards for CTE to OU-1 and Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil

Former NSWC White Oak, Silver Spring, Maryland

Media: Groundwater in Coastal Plain and Saprolite

	Future Age-Adjusted Resident*							
	HQ				CR			
Chemical	**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-06	**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**
OU-1 Totals	**NA**	**NA**	**NA**	**NA**	**5.5E-05**	**9.2E-04**	**5.4E-05**	**1.0E-03**
Sites 5 and 13 Totals	**NA**	**NA**	**NA**	**NA**	**3.7E-05**	**2.2E-04**	**1.5E-05**	**2.8E-04**

*** - 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 Sites 5 and 13 groundwater.

TABLE 2-16
Summary of Media-Specific Risks and Hazards for CTE to OU-1 and Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil

Former NSWC White Oak, Silver Spring, Maryland

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	--	--	0.0002	**0.0002**	--	--	--	**NA**
1,1,2-Trichloroethane	--	--	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**
OU-1 Totals	**N/A**	**N/A**	**0.04**	**0.04**	**--**	**--**	**--**	**N/A**
Sites 5 and 13 Totals	**N/A**	**N/A**	**0.01**	**0.01**	**--**	**--**	**--**	**N/A**

Shaded constituents are COPCs for OU-1 groundwater that were also detected in Sites 5 and 13 groundwater.

Table 2-17
Preliminary Remediation Goals for Groundwater
Adult Residential Scenario
Site 13 Compliance Area
ROD for Sites 5 and 13, NSWC White Oak

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/cm^2-day)	Shower Exposure (L/day)	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	4.8E-01	0.25
cis-1,2-Dichloroethene	1.00E-02	1.00E-02	NA	blood	7.2E-06	4.2E+00	1.7E-01	0.50
Tetrachloroethene	1.00E-02	1.00E-02	1.40E-01	liver	5.6E-05	3.5E+00	5.4E-02	0.25
Trichloroethene	6.00E-03	6.00E-03	NA	liver, kidney	1.5E-05	3.8E+00	4.8E-02	0.25
Vinyl Chloride	3.00E-03	2.40E-03	2.80E-02	liver	4.1E-06	5.0E+00	2.1E-02	0.25
Energetics								
RDX	3.00E-03	2.40E-03	NA	prostate	6.1E-07		1.1E-01	1.00
Inorganics								
Iron	6.00E-01	1.20E-01	NA	GI, blood	2.0E-07		1.1E+01	0.50

Noncarcinogenic calculations:

Groundwater Risk-Based PRG (mg/L) $= \dfrac{THQ \times BW \times AT_n}{EF \times ED \times (An + Bn + Cn)}$

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 (cm^2)	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 2-18
Preliminary Remediation Goals for Groundwater
Child Residential Scenario
Site 13 Compliance Area
ROD for Sites 5 and 13, NSWC White Oak

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/cm^2-day)	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	2.1E-01	0.25
cis-1,2-Dichloroethene	1.00E-02	1.00E-02	NA	blood	9.3E-06	7.3E-02	0.50
Tetrachloroethane	1.00E-02	1.00E-02	1.40E-01	liver	7.2E-05	2.5E-02	0.25
Trichloroethene	6.00E-03	6.00E-03	NA	liver, kidney	1.9E-05	2.0E-02	0.25
Vinyl Chloride	3.00E-03	2.40E-03	2.80E-02	liver	5.3E-06	1.1E-02	0.25
Energetics							
RDX	3.00E-03	2.40E-03	NA	prostate	7.8E-07	4.7E-02	1.00
Inorganics							
Iron	6.00E-01	1.20E-01	NA	GI, blood	3.3E-07	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 (cm^2)	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 2-19
Preliminary Remediation Goals for Groundwater
Lifetime Residential Scenario
Site 13 Compliance Area
ROD for Sites 5 and 13, NSWC White Oak

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)	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	1.8E-04	1.8E-03	1.8E-02
cis-1,2-Dichloroethene	NA	NA	NA	7.2E-06	9.3E-06	4.2E+00			
Tetrachloroethene	5.20E-02	5.2E-02	2.00E-03	5.6E-05	7.2E-05	3.5E+00	8.0E-04	8.0E-03	8.0E-02
Trichloroethene	1.10E-02	1.4E-02	6.00E-03	1.5E-05	1.9E-05	3.8E+00	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	4.4E-05	4.4E-04	4.4E-03
Energetics									
RDX	1.10E-01	1.4E-01	NA	6.1E-07	7.8E-07		6.0E-04	6.0E-03	6.0E-02
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 2-20
Preliminary Remediation Goals for Groundwater
Residential Scenario
Site 13 Compliance Area
ROD for Sites 5 and 13, NSWC White Oak

Chemical	Risk-Based PRG		MCL-Based PRG (mg/L)
	Value (mg/L)	Risk Basis	
VOCs			
1,1,2,2-Tetrachloroethane	1.8E-03	Lifetime, CR = 10^{-5}	
cis-1,2-Dichloroethene	7.3E-02	Child, HQ=1	7.00E-02
Tetrachloroethene	8.0E-03	Lifetime, CR = 10^{-5}	5.00E-03
Trichloroethene	2.0E-02	Child, HQ=0.25	5.00E-03
Vinyl Chloride	4.4E-04	Lifetime, CR = 10^{-5}	2.00E-03
Energetics			
RDX	6.0E-03	Lifetime, CR = 10^{-5}	
Inorganics			
Iron	4.6E+00	Child, HQ=1	
Cummulative Risk	6.2E-06		5.3E-05

Child scenario selected for noncarcinogenic PRGs since child scenario more conservative (lower PRGs).
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 2-21
PRGs for Groundwater in Site 13 Attainment Area of OU-1
ROD for Sites 5 and 13
Former NSWC White Oak, Silver Spring, Maryland

Attainment Area/Chemical	Proposed PRG (mg/L)	Source[A]	Max Conc. (mg/L)	COC?
Site 13 PRG Attainment Area				
Cis-1,2-Dichloroethene	7.00E-02	M	5.20E-01	YES
1,1,2,2-Tetrachloroethane	1.80E-03	RB	1.10E+00	YES
Tetrachloroethene	5.00E-03	M	1.50E-01	YES
Trichloroethene	5.00E-03	M	4.20E-01	YES
Vinyl chloride	2.00E-03	M	2.00E-02	YES
RDX	6.00E-03	RB	1.10E-01	YES
Iron (dissolved)	4.60E+00	RB	1.89E+01	YES

Footnotes:
[A] M=Proposed PRG is based on MCL, RB= Proposed PRG is based on calculated risk-based PRG

TABLE 2-22
Detailed Analysis of Remediation Alternatives for Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

CERCLA Criteria	ALT-1 – No Action	ALT-2 – Institutional Controls with LTM	ALT-3 – Monitored Natural Attenuation	ALT-4 – Enhanced Reductive Dechlorination
Protection of Human Health and the Environment	LOW to 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 (3) – Site specific administrative measures will be used to further control the exposure pathway to contaminated groundwater. Contaminant trend data suggests that the plume is stable.	MODERATE to HIGH (3-4) – 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. Time to remediation is estimated to be relatively long :20 years, but observations after source removal may revise this estimate.	MODERATE to HIGH (4) – Human health and the environment will be protected through treatment 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 a 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.	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 solvent sites. Analysis of the geochemical conditions suggest evidence of biodegradation of 1,1,2,2 PCA, PCE, and TCE but it is unlikely that the biodegradation mechanism has enough carbon source for complete destruction of the source chemicals. Additional groundwater monitoring data is necessary to ascertain the effects of the other loss mechanisms and whether they will be able to restore the site to MCLs (only 1-2 years of data is available). 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. If found, NAPL will likely prevent the attainment of PRGs.	MODERATE (3-4) –The indicating parameters for the biological mechanism of NA indicate that the system is TOC limited (<20 mg/L) and significant concentrations of daughter products of 1,1,2,2 PCA degradation are present. These factors indicate that it is a good candidate for ERD. However, ERD is primarily effective at treating dissolved contamination and will only treat residual NAPL, if present in the saturated soil, by enhancing its dissolution. The ability of ERD to meet ARARs (i.e., MCLs) will depend on the ability to deliver the electron donor to the aquifer effectively through the saprolite formation. Pneumatic fracturing should address this concern. If residual NAPL is present, then ERD alone will likely not meet MCLs in a reasonable timeframe.
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.	MODERATE (3) – The mechanisms of NA will act to either convert the contaminants to harmless by-products or dilute them to below MCLs. Therefore, assuming MCLs are met, the residual risk level will be low. However, as with use of any in-situ treatment technology, small pockets of contamination may remain after treatment and pose a small risk. Use of the land will be unrestricted after treatment.	MODERATE to HIGH (4) - The mechanisms of ERD 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 may remain after treatment and pose a small risk. Use of the land will be unrestricted after treatment.
Reduction in Toxicity, Mobility, or Volume	LOW (1) – 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.	LOW to MODERATE (2) – 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 lower than NA because toxicity, mobility and volume will not be monitored.	MODERATE (2-3) - The same mechanisms will be acting as in ALT 1 and 2 (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) 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 it 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 2-22
Detailed Analysis of Remediation Alternatives for Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

CERCLA Criteria	ALT-1 – No Action	ALT-2 – Institutional Controls with LTM	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 between 30 and 50 years depending on the mass of residual phase contamination in the saturated soil and if NA processes are effective.	LOW to MODERATE (2) - There is no increased risk during implementation however the remediation timeframe is estimated at between 30 and 50 years depending on the mass of residual phase contamination in the saturated soil and if NA processes are effective..	LOW to MODERATE (2) - There is no increased risk during implementation and current risks do not exist. An acceptable remediation time frame of approximately 20 years or less could be established. If MNA data indicated this would not be met after several years of monitoring, a more aggressive contingency remedy would be implemented.	MODERATE (3) – The remediation timeframe is estimated at 5 years for the Target Remediation Zone (TRZ) but 17 years for the downgradient plume. However, significant uncertainties are present due to the low permeability of the saprolite. Chemical handling of the electron donor is not especially hazardous and can be performed using typical injection wells and pumps. ERD will not negatively impact downgradient attenuation of the remainder of the dissolved plume.
Implementability	HIGH (5) – Nothing to implement.	MODERATE (3) - While this alternative is highly feasible on a technical basis, it may present significant administrative hurdles if controls are to be in place in perpetuity.	MODERATE to HIGH (4) – MNA is technically and administratively implementable, assuming that MNA will remediate the site to MCLs. Additional post-removal-action data will be needed over time to confirm remediation goals are being met. These data can be collected during implementation using the 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. Pneumatic fracturing is relatively innovative and would add complexity. A pilot test would be warranted.
Cost *	LOW (5) - $20,000 present worth cost - $0 capital cost - $6,000 Five-Year Review - $0 post-closure cost	LOW to MODERATE (4) - $388,000 present worth cost - $47,000 capital cost - $16,000 to 21,000 annual O&M cost	LOW to MODERATE (4) - $439,000 present worth cost - $51,000 capital cost - $23,000 to 45,000 annual O&M cost - $32,000 post-closure cost	MODERATE-HIGH (2) - $1,040,000 present worth cost - $382,000 capital cost - $19,000 to $208,000 annual O&M cost - $52,000 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 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 2-22 (CONTINUED)
Detailed Analysis of Remediation Alternatives for Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

CERCLA Criteria	ALT-5 – In- Situ Chemical Oxidation	ALT-6 – Groundwater Extraction and Treatment	ALT-7 – Air Sparging	ALT-8– Groundwater Extraction and WetlandsTreatment
Protection of Human Health and the Environment	MODERATE (3) – Human health and the environment will be protected through permanent insitu destruction of the contamination. ICs will be used to control exposure to contamination during implementation of the remedy. Some contaminants in groundwater will be rapidly treated to destroy them to harmless by-products, although it is unlikely to effectively treat 1,1,2,2-PCA. There are significant uncertainties as to whether ARARs can be met because the tight saprolite soils will hamper adequate distribution of reagent. Pneumatic fracturing should address this concern. These uncertainties are inherent in all of the insitu alternatives being evaluated. The theoretical time to remediation is very fast. A pilot test would be warranted.	MODERATE (3) – Plume migration will be controlled and mass removed from the site via dissolution and pumping. There are significant uncertainties as to whether ARARs can be met, and the theoretical time to remediation is varies widely from 6 to 10 years depending on the presence of a continued source below the water table.	MODERATE (3-4) – 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 is expected to be rapidly treated to remove contaminants by transferring them to the air. There are significant uncertainties as to whether ARARs can be met because the tight saprolite soils will inhibit air flow, although pneumatic fracturing should address this concern. These uncertainties are inherent in all of the insitu alternatives being evaluated. The theoretical time to remediation is relatively fast.	MODERATE (3) – Plume migration will be controlled and mass slowly removed from the edges of the site via dissolution and passive extraction. There is significant uncertainties as to whether ARARs can be met, and the theoretical time to remediation is relatively long (30 years) assuming a small continuing source below the water table.
Compliance with ARARs	MODERATE (3) – Theoretically, ISCO should be able to treat the TCE and other alkenes in groundwater to MCLs. However, there are few site case studies where MCLs have been achieved. ISCO does not have a good track record for treating chlorinated alkanes (1,1,2,2-PCA) and is unlikely to meet PRGs. Oxidant delivery problems should be solved with pneumatic fracturing.	MODERATE (2-3) – P&T systems are effective at plume control, but only marginally effective at returning groundwater to MCLs by itself. Ex-situ granular activated carbon treatment systems have been proven highly reliable to treat the extracted groundwater to surface water discharge criteria over the long-term.	MODERATE (2-3) – Air sparging has a moderate likelihood to meet MCLs in the groundwater through aggressive aeration of the source area. Uncertainties include low permeability saprolite, subsurface heterogeneities that may hinder uniform aeration, and the relatively low volatility of 1,1,2,2 PCA	MODERATE (2-3) – Passive extraction systems are effective at plume control, but only marginally effective at returning groundwater to MCLs by themselves, particularly a passive system that is not located at the hottest part of the plume. Wetlands treatment has been shown to be effective at reducing VOC concentrations to PRGs.
Long-term Effectiveness and Permanence	LOW to MODERATE (2) – ISCO mechanisms convert the contaminants to harmless by-products however ISCO does not have a good track record for treating chlorinated alkanes (1,1,2,2-PCA) and is unlikely to meet PRGs. While it would treat TCE and the other breakdown alkenes, the remaining 1,1,2,2-PCA will likely recontaminate the site.	MODERATE (3) – 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 undetected contamination may remain after treatment and pose a small risk. Rebound effects are also common in pump and treat applications as the wells may substantially (and permanently) lower the water table, leaving some residual contamination trapped in the dewatered soil. This would be a source of future contamination when the wells are deactivated.	MODERATE (3) – Air sparging 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 may remain after treatment and pose a small risk. Rebound effects are also common in air sparging applications. Use of the land will be unrestricted after treatment. Also, the ability to remove 1,1,2,2-PCA to the degree necessary is suspect because of its relatively low volatility. Existing site air-strippers are not capable of fully treating 1,1,2,2-PCA.	MODERATE (3) – The extraction system would slowly remove the contaminants from the subsurface yielding low residual risk levels. However, as with use of any in-situ treatment technology, small pockets of undetected contamination may remain after treatment and pose a small risk. Rebound effects are also common in this type of application as the extraction trench may substantially (and permanently) lower the water table, leaving some residual contamination trapped in the dewatered soil. This would be a source of future contamination if/when the trench is ever deactivated. Use of the land will be unrestricted after treatment.
Reduction in Toxicity, Mobility, or Volume	MODERATE (3) – TCE and other alkenes will be destroyed insitu through chemical oxidation to harmless by-products. Chlorinated alkanes (1,1,2,2-PCA) will remain.	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 carbon.	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. However the ability to remove 1,1,2,2-PCA to the degree necessary is suspect.	MODERATE (3-4) – The extraction 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 degraded.

TABLE 2-22 (CONTINUED)
Detailed Analysis of Remediation Alternatives for Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

CERCLA Criteria	ALT-5 – In- Situ Chemical Oxidation	ALT-6 – Groundwater Extraction and Treatment	ALT-7 – Air Sparging	ALT-8– Groundwater Extraction and WetlandsTreatment
Short-term Effectiveness	MODERATE (3) - Remediation timeframe is relatively fast if ISCO is effective: an estimated 1-2 years. ISCO is effective at treating residual TCE NAPL, if present, and therefore, can greatly reduce the remediation timeframe. Handling of hazardous chemicals presents a minimal risk to workers, but can be simply controlled using proper equipment and trained personnel. If MNA of the downgradient plume is the selected remedy, ISCO will likely negatively impact it by consuming electron donor and raising redox conditions, however rebound of favorable conditions would be expected in a relatively quick time frame (less than a year after ISCO treatment stops).	MODERATE (3) – Current data indicates a relatively moderate remediation time frame, 6 years (assuming source areas in soil are removed/treated), but experience warrants a more cautious estimate (as much as 10 years) Since the P&T system removes mass through dissolution only, it requires an extended remediation timeframe if NAPL or significant adsorbed phase is present. The ability of the P&T system to meet MCLs in a reasonable timeframe is uncertain. It will depend upon the presence of residual-NAPL stringers that will act as long-term sources of contamination. 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.	MODERATE (3-4) - Remediation timeframe is estimated at 3 years. Moderate cleanup timeframe due to subsurface heterogeneities and rate of volatilization from the aqueous and sorbed phases. Air sparging is effective at treating residual-NAPL, if present. There is very low risk to workers and the community from fugitive vapors during construction due to lack of buildings and population in the area. If MNA of the downgradient plume is the selected remedy, air sparging will likely negatively impact it by raising redox conditions. Ability to remove 1,1,2,2-PCA is suspect.	LOW to MODERATE (2-3) – Current data indicates a relatively long remediation time frame, 30 years (assuming source areas in saturated soil are minimal), Since the alt. system removes mass through dissolution only, it requires an extended remediation timeframe if NAPL or significant adsorbed phase is present. Risks to workers and the community during construction are minimal since it involves standard excavation techniques only. Extraction will not adversely affect downgradient attenuation of the dissolved contaminant plume.
Implementability	MODERATE (3) – A subsurface injection permit will be required for treatment using ISCO. Many states allow injection of ISCO chemicals, therefore, it is not expected to be a problem since the chemicals are for treatment and will be consumed as part of the process. ISCO chemicals are readily available. No subsurface utilities or structures are present to complicate injection. Substantial infrastructure (injection wells) is required to implement. Pneumatic fracturing is relatively innovative and would add complexity. Pilot test would be warranted.	MODERATE (3) – 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. P&T system components are all readily accessible.	MODERATE (3) –No additional permits, beyond well installation permits, are required for air sparging. However, since SVE will not be used, a fugitive emissions permit waiver may be necessary. All materials are readily available. Pneumatic fracturing is relatively innovative and would add complexity.	MOD-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. Construction techniques are standard and potential problems are minimal.
Cost	MODERATE (3) - $929,000 present worth cost - $329,000 capital cost - $19,000 to 327,000 annual O&M - $48,000 post-closure cost	MODERATE to HIGH (1-2) - $1,140,000 to 1,370,000 present worth cost - $334,000 capital cost - $100,000 to 170,000 annual O&M - $66,000 post-closure cost	MODERATE (3) - $763,000 present worth cost - $273,000 capital cost - $19,000 to $97,000 annual O&M - $58,000 post-closure cost	MODERATE to HIGH (2) - $1,090,000 present worth cost - $297,000 capital cost - $41,000 annual O&M - $39,000 post-closure cost

TABLE 2-22 (CONTINUED)
Detailed Analysis of Remediation Alternatives for Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

CERCLA Criteria	ALT-9 Insitu Chemical Reduction with Zero-valent Iron
Protection of Human Health and the Environment	MODERATE to HIGH (4) – Human health and the environment will be protected through treatment 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 a significant uncertainties as to whether ARARs can be met, the theoretical time to remediation is moderately fast. A pilot test would be warranted for pneumatic fracturing.
Compliance with ARARs	MODERATE to HIGH (4) –All site contaminants are known to degrade under reducing conditions. ZVI is effective at treating sorbed-phase and NAPL as well as dissolved contamination. The ability of ZVI to meet ARARs (i.e., MCLs) will depend on the ability to deliver the iron slurry to the aquifer effectively through the saprolite formation. Pneumatic fracturing should address this concern.
Long-term Effectiveness and Permanence	HIGH (4-5) - The mechanisms of chemical reduction with ZVI 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 may remain after treatment and pose a small risk. Use of the land will be unrestricted after treatment.
Reduction in Toxicity, Mobility, or Volume	HIGH (4-5) – All site contaminants should will be destroyed insitu through chemical reduction to harmless by-products The expedited remediation timeframe, will lessen the risk for potential plume migration.

TABLE 2-22 (CONTINUED)
Detailed Analysis of Remediation Alternatives for Sites 5 and 13 Groundwater
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

CERCLA Criteria	ALT-9 Insitu Chemical Reduction with Zero-valent Iron
Short-term Effectiveness	MODERATE to HIGH (4) – The remediation timeframe is estimated at 5 years for the Target Remediation Zone (TRZ) and 17 years for the downgradient plume. Significant uncertainties are present due to the low permeability of the saprolite. Chemical handling of the electron donor is not especially hazardous and can be performed using typical injection wells and pumps. ZVI will not negatively impact downgradient attenuation of the remainder of the dissolved plume.
Implementability	MODERATE (3) – A subsurface injection approval will be required for treatment using ZVI. Many states allow injection of iron, therefore, it is not expected to be a problem since the chemicals are generally harmless and will be consumed as part of the process. ZVI is proprietary but still readily available. Pneumatic fracturing is relatively innovative and would add complexity. Pilot test would be warranted.
Cost *	MODERATE-HIGH (2) - $1,140,000 present worth cost - $650,000 capital cost - $19,000 to $118,000 annual O&M cost - $52,000 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 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 2-23
Summary of Detailed Alternatives Analysis for Groundwater at Sites 5 and 13
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

CERCLA Criteria	Sites 5 and 13 Groundwater Remediation Alternatives								
	ALT-1 NFA	ALT-2 IC	ALT-3 MNA	ALT-4 ERD	ALT-5 ISCO	ALT-6 P&T	ALT-7 AS	ALT-8 Wetlands	ALT-9 ZVI
Protection of Human Health and the Environment[1]	LOW-MOD 2	MOD 3	MOD-HIGH (3–4)	MOD-HIGH 4	MOD 3	MOD 3	MOD 3–4	MOD 3	MOD-HIGH 4
Compliance with ARARs[1]	NONE 0	LOW 1	LOW-MOD (2–3)	MOD 3–4	MOD 3	MOD 2–3	MOD 2-3	MOD 2–3	MOD-HIGH 4
Long-term Effectiveness and Permanence[1]	NONE 0	MOD 3	MOD 3	MOD-HIGH 4	LOW-MOD 2	MOD 3	MOD 3	MOD 3	HIGH (4-5)
Reduction in Toxicity, Mobility, or Volume[1]	LOW 1	LOW-MOD 2	MOD (2 - 3)	MOD-HIGH 4	MOD 3	MOD (3–4)	MOD 3	MOD (3–4)	HIGH (4-5)
Short-term Effectiveness[1]	LOW 1	LOW-MOD 2	LOW-MOD 2	MOD-HIGH 4	MOD 3	MOD 3	MOD (3–4)	LOW-MOD (2–3)	MOD-HIGH 4
Implementability[1]	HIGH 5	MOD 3	MOD-HIGH 4	MOD 3	MOD 3	MOD 3	MOD 3	MOD-HIGH 4	MOD 3
Cost [2]	LOW 5	LOW-MOD 4	LOW-MOD 4	MOD-HIGH 2	MOD 3	MOD-HIGH (1–2)	MOD 3	MOD-HIGH 2	MOD-HIGH 2
TOTAL SCORE	14	18	(19–23)	(24–25)	(20)	(18–20)	(20–23)	(19–22)	(25-27)

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 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).

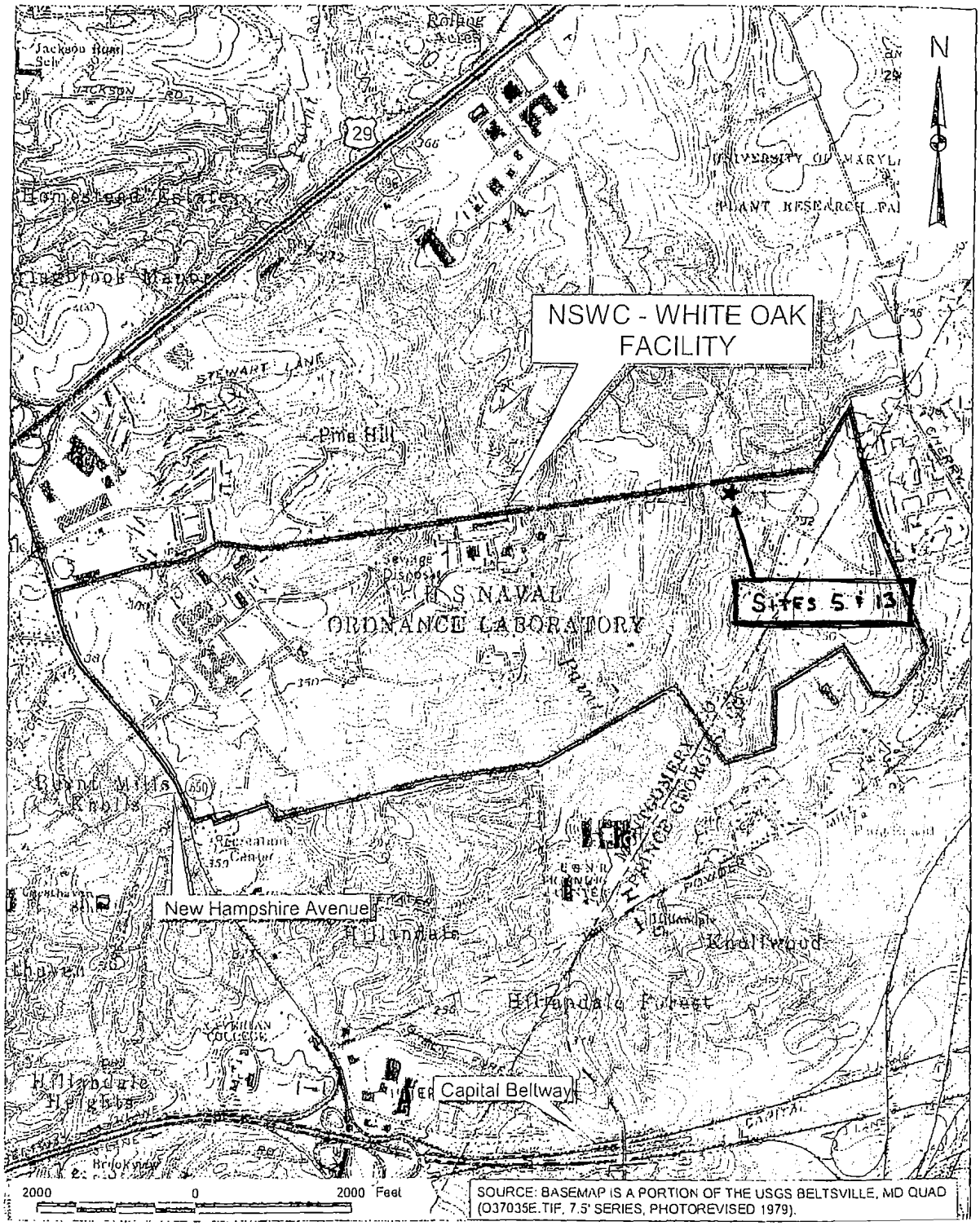
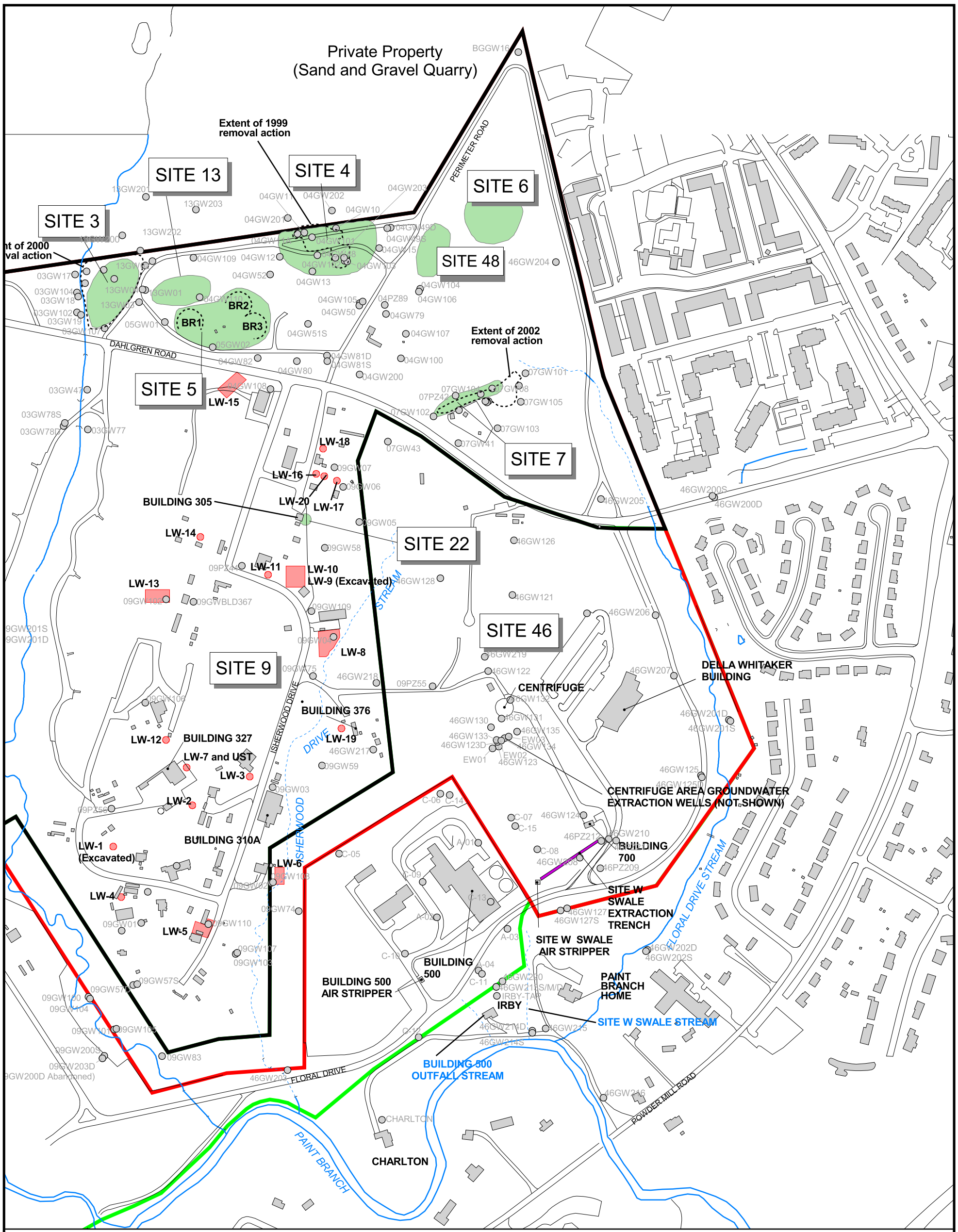


Figure 2-1
SITE VICINITY MAP
NSWC - White Oak
Silver Spring, Maryland

MODIFIED FROM
BROWN & ROOT ENVIRONMENTAL, 6/12/98

CH2MHILL



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
- Buildings and Other Structures

N W E S

200 0 200 400 600 Feet

or — Former Leaching Fields Or Leaching Wells - Site 9 (approximate locations from drawing QY901-87S,SD)

IR Site Boundaries (Approximate as per 1998 BCP)

Figure 2-2
Site Features
Record of Decision for Sites 5 and 13 Groundwater and Soil
NSWC - White Oak, Silver Spring, Maryland

CH2MHILL

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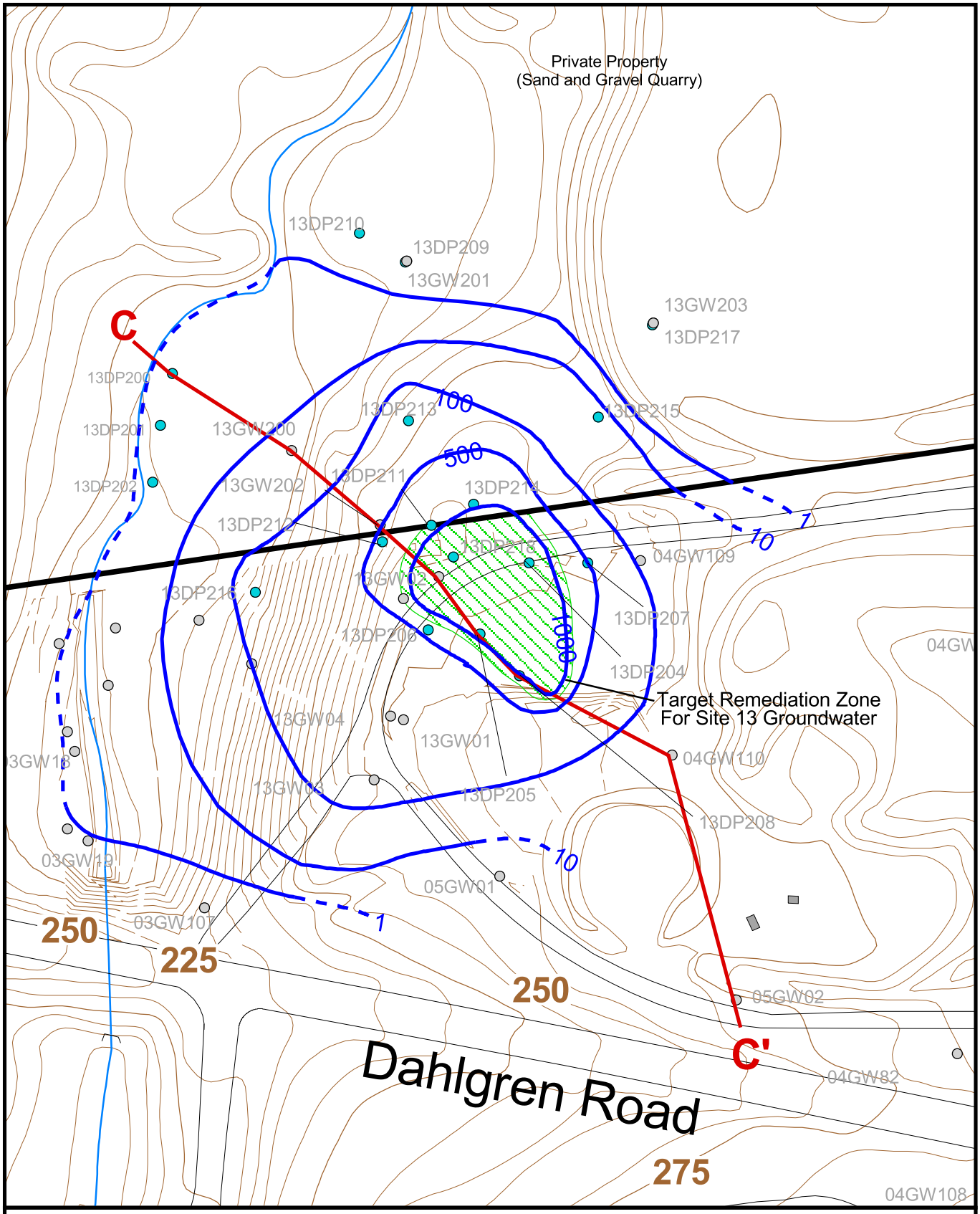

- Groundwater Screening Sample Locations During OU-1 Investigation
- Monitoring Wells

BASE MAP FEATURES

- Former NSWC White Oak Property Boundary
- Transect
- Roads and Paved Areas
- VOC Contour (Total VOCs in ug/L)
- Inferred VOC Contour
- Elevation Contours
- Buildings and Other Structures

N W E S

60 0 60 120 Feet

Figure 2-3
Extent of VOCs in Groundwater at Sites 5 and 13
Record of Decision for Sites 5 and 13
NSWC, White Oak, Silver Spring, Maryland

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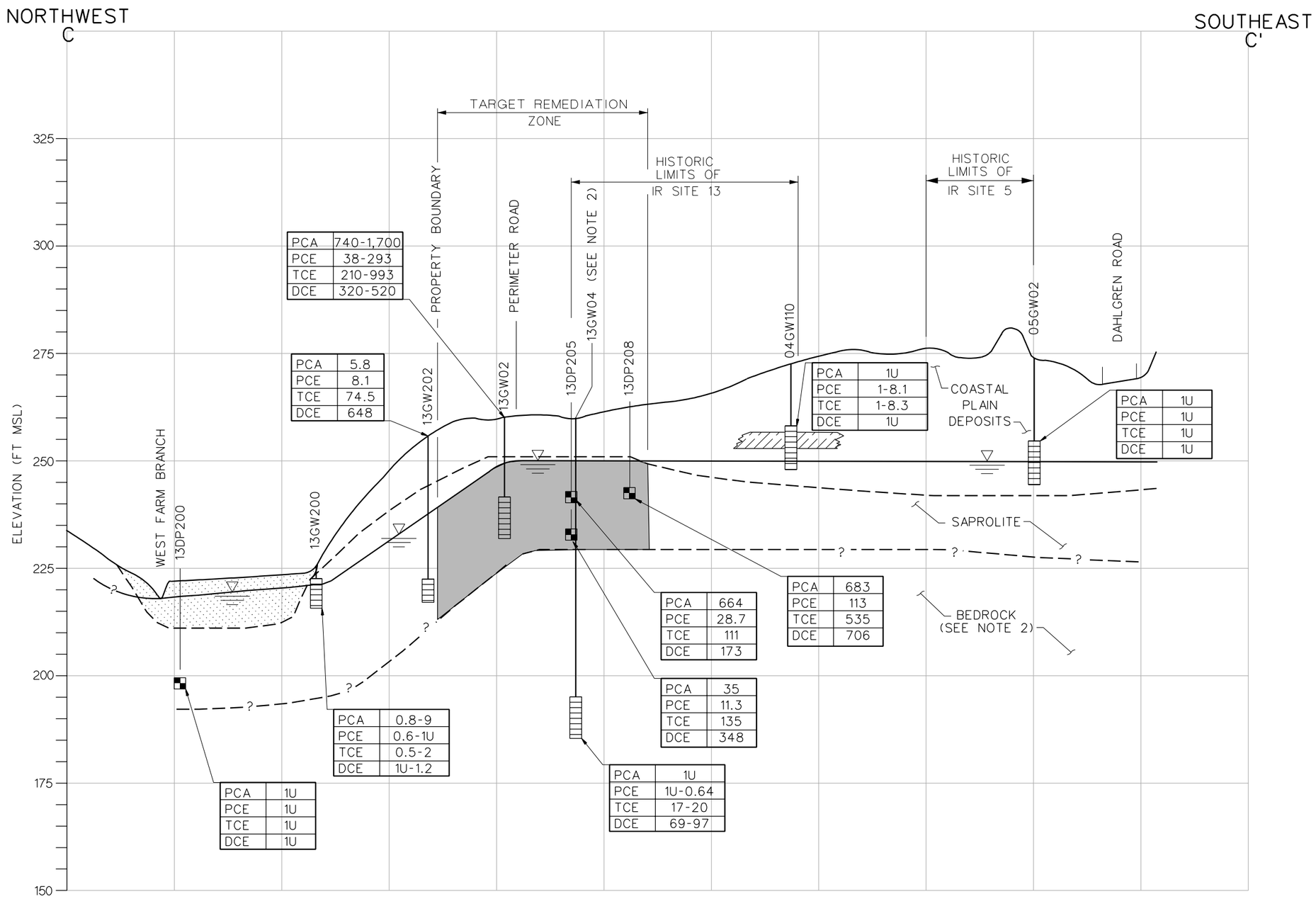

LEGEND

- TEMPORARY WELL SAMPLING LOCATION
- MONITORING WELL SCREEN
- WATER-TABLE SURFACE (APR 2000)
- INFERRED BOUNDARY BETWEEN GEOLOGIC UNITS
- TARGET REMEDIATION ZONE
- CLAY LENS
- ALLUVIAL FLOOD PLAIN DEPOSITS

PCA	5-50
PCE	100-200
TCE	5-50
DCE	5-50

RANGE OF DETECTIONS IN WELLS/DPTS FROM 1999 TO PRESENT (CONCENTRATIONS IN ug/L)

NOTES:

1. GROUNDWATER CONCENTRATION DATA IS IN ug/L. DATA ARE RANGE OF CONCENTRATIONS FROM 1999 TO PRESENT.
2. DEPTH TO BEDROCK BASED ON BORING LOG FOR 13GW04 LOCATED APPROXIMATELY 100 FEET SOUTHWEST OF THE CROSS SECTION ALIGNMENT.

25'

100'

Figure 2-4
CROSS-SECTION C-C' THROUGH SITE 13
Record of Decision for sites 5 and 13
Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

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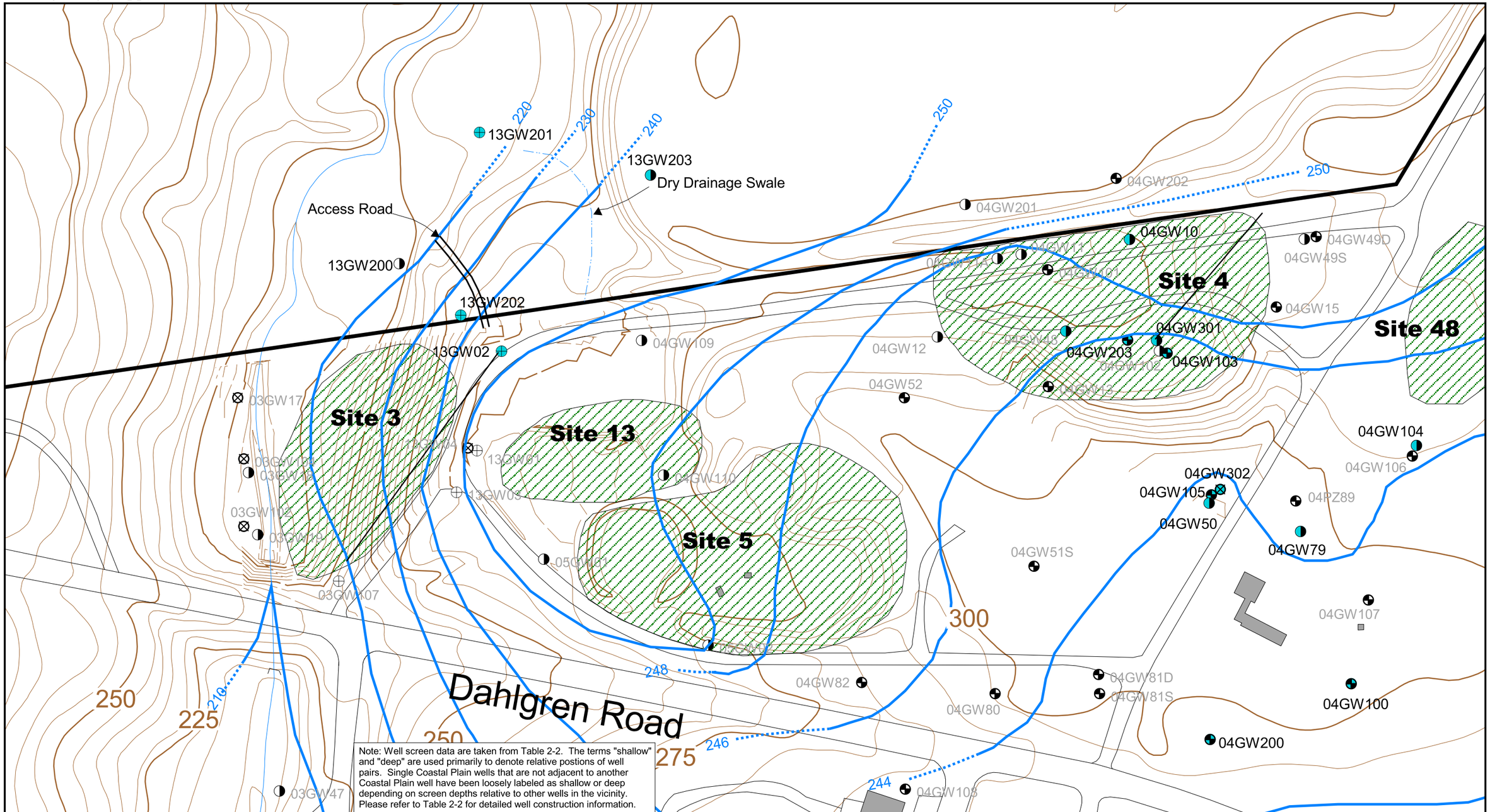

Note: Well screen data are taken from Table 2-2. The terms "shallow" and "deep" are used primarily to denote relative postions of well pairs. Single Coastal Plain wells that are not adjacent to another Coastal Plain well have been loosely labeled as shallow or deep depending on screen depths relative to other wells in the vicinity. Please refer to Table 2-2 for detailed well construction information.

Monitoring Wells With Screened Formation
- Shallow Coastal Plain or Alluvial (Sampled)
- Deep Coastal Plain (Sampled)
- Bedrock (Sampled)
- Saprolite (Sampled)
- Well Construction Details Not Available (Sampled)
- Shallow Coastal Plain or Alluvial Deposits (Not Sampled)
- Deep Coastal Plain (Not Sampled)
- Bedrock (Not Sampled)
- Saprolite (Not Sampled)
- Well Construction Details Not Available (Not Sampled)

BASE MAP FEATURES
- Elevation Contours (feet above MSL)
- Elevation Index Contours (feet above MSL)
- Former NSWC White Oak Property Boundary
- Roads and Paved Areas
- Water Table Contour (feet above MSL)
- Buildings and Other Structures

N

70 0 70 140 210 Feet

Figure 2-5
Water Table Map for April 2000
Record of Decision for Sites 5 and 13
NSWC-White Oak, Silver Spring, Maryland

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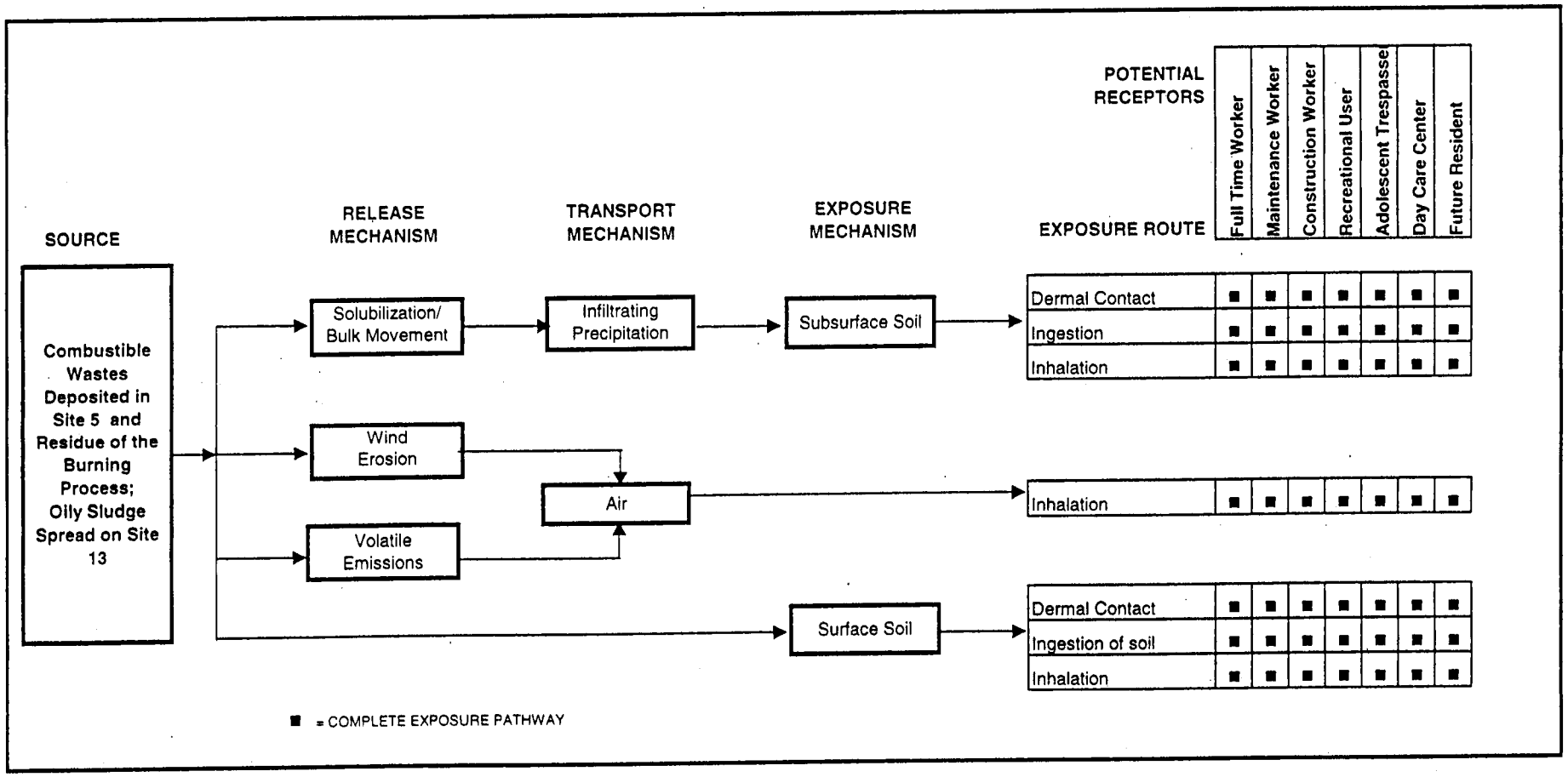
FIGURE 2-6

HUMAN HEALTH CONCEPTUAL SITE MODEL
SITES 5 AND 13
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND



Blank space indicates incomplete exposure pathway or relatively insignificant, or not applicable potential exposure.

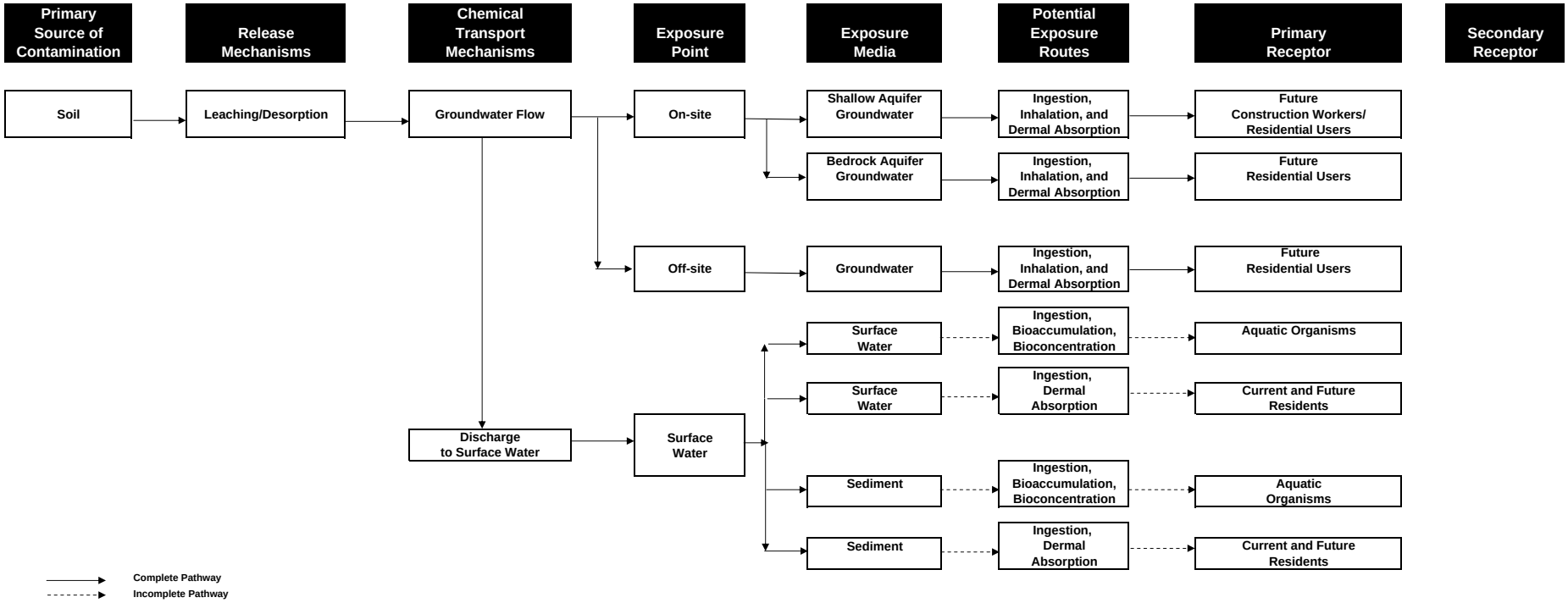
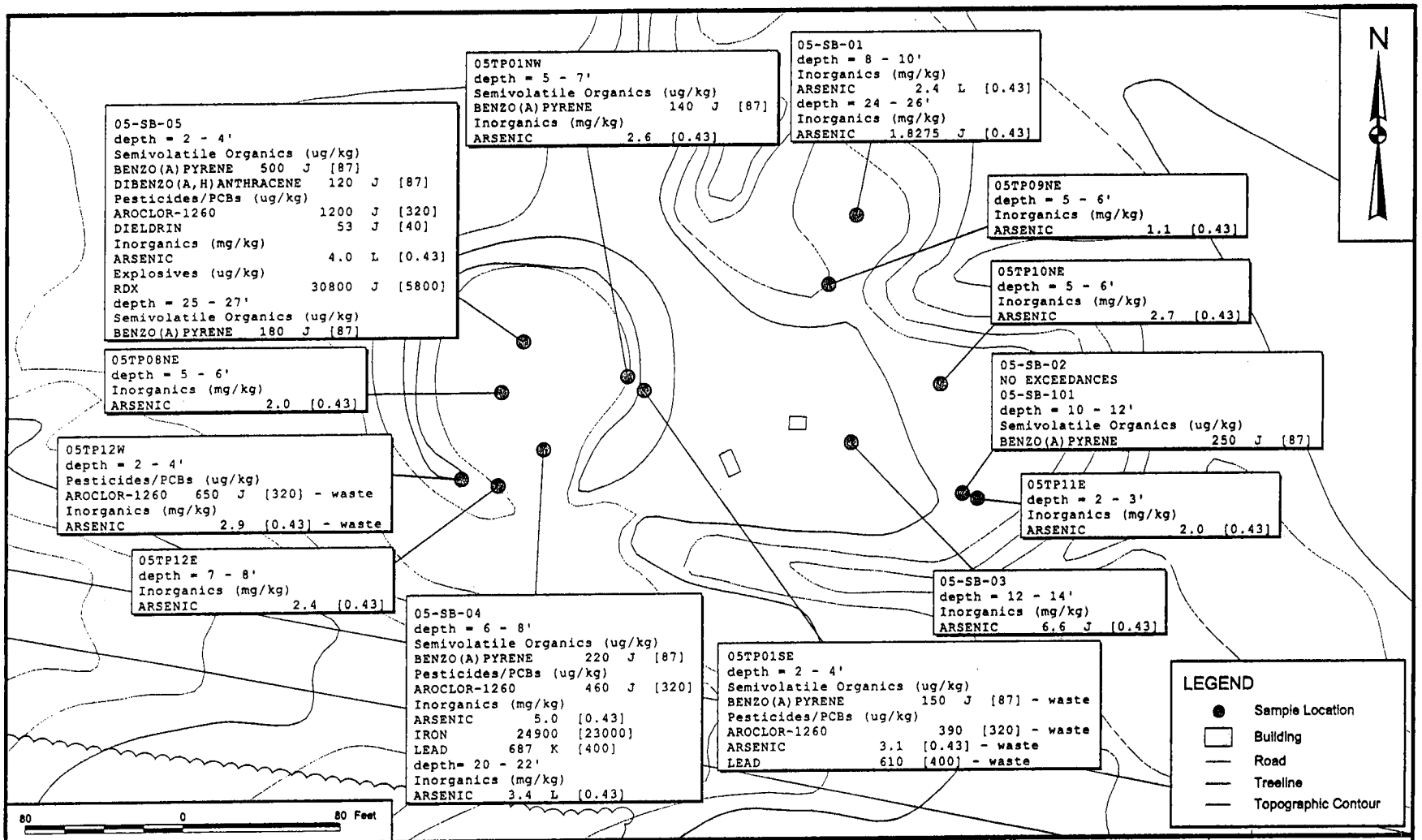
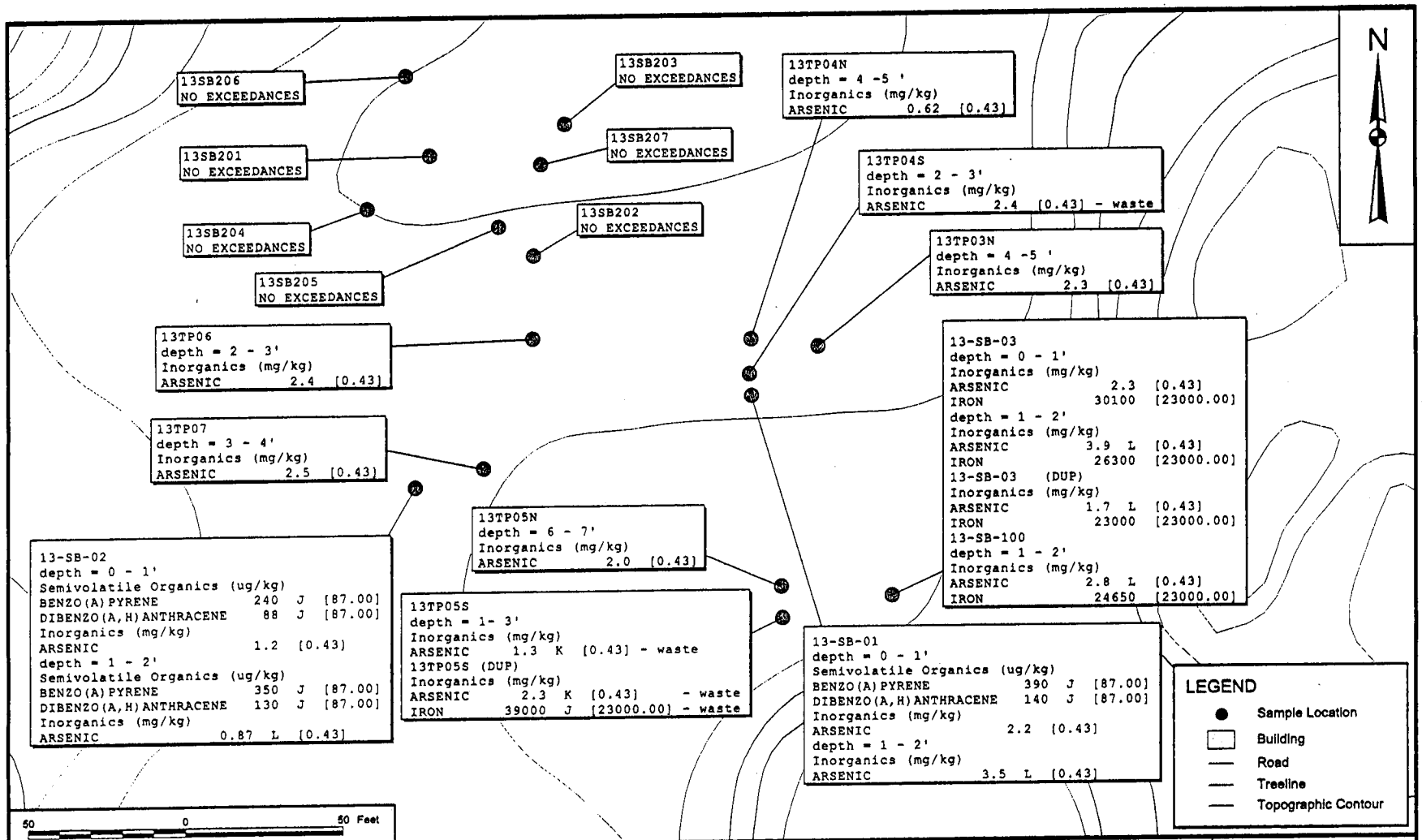


Figure 2-7
Conceptual Site Model for Potential Human Exposures to Groundwater
Record of Decision for Sites 5 and 13
NSWC - White Oak, Silver Spring, Maryland



DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER	OWNER NUMBER
A. JANOCHA	9/06/02		4246	0839
CHECKED BY	DATE	SUMMARY OF EXCEEDANCES OF HUMAN HEALTH CRITERIA SITE 5 - OPEN BURN AREA FORMER NSWC WHITE OAK SILVER SPRING, MARYLAND	APPROVED BY	DATE
R. KOTUN	9/09/02		—	—
COST/SCHEDULE-AREA			APPROVED BY	DATE
			—	—
SCALE AS NOTED			DRAWING NO. FIGURE 2-8	REV 0

P:\GIS\WHITEOAK\4246.APR SWMU 5 - TEST PIT TAGS LAYOUT 9/09/02 AJ



DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4246	OWNER NUMBER 0839
A. JANOCHA	9/06/02			
CHECKED BY	DATE	SUMMARY OF EXCEEDANCES OF HUMAN HEALTH SCREENING CRITERIA SITE 13 - OIL SLUDGE DISPOSAL AREA FORMER NSWC WHITE OAK SILVER SPRING, MARYLAND	APPROVED BY —	DATE —
R. KOTUN	9/09/02		APPROVED BY —	DATE —
COST/SCHEDULE-AREA			DRAWING NO. FIGURE 2-9	REV 0
SCALE AS NOTED				

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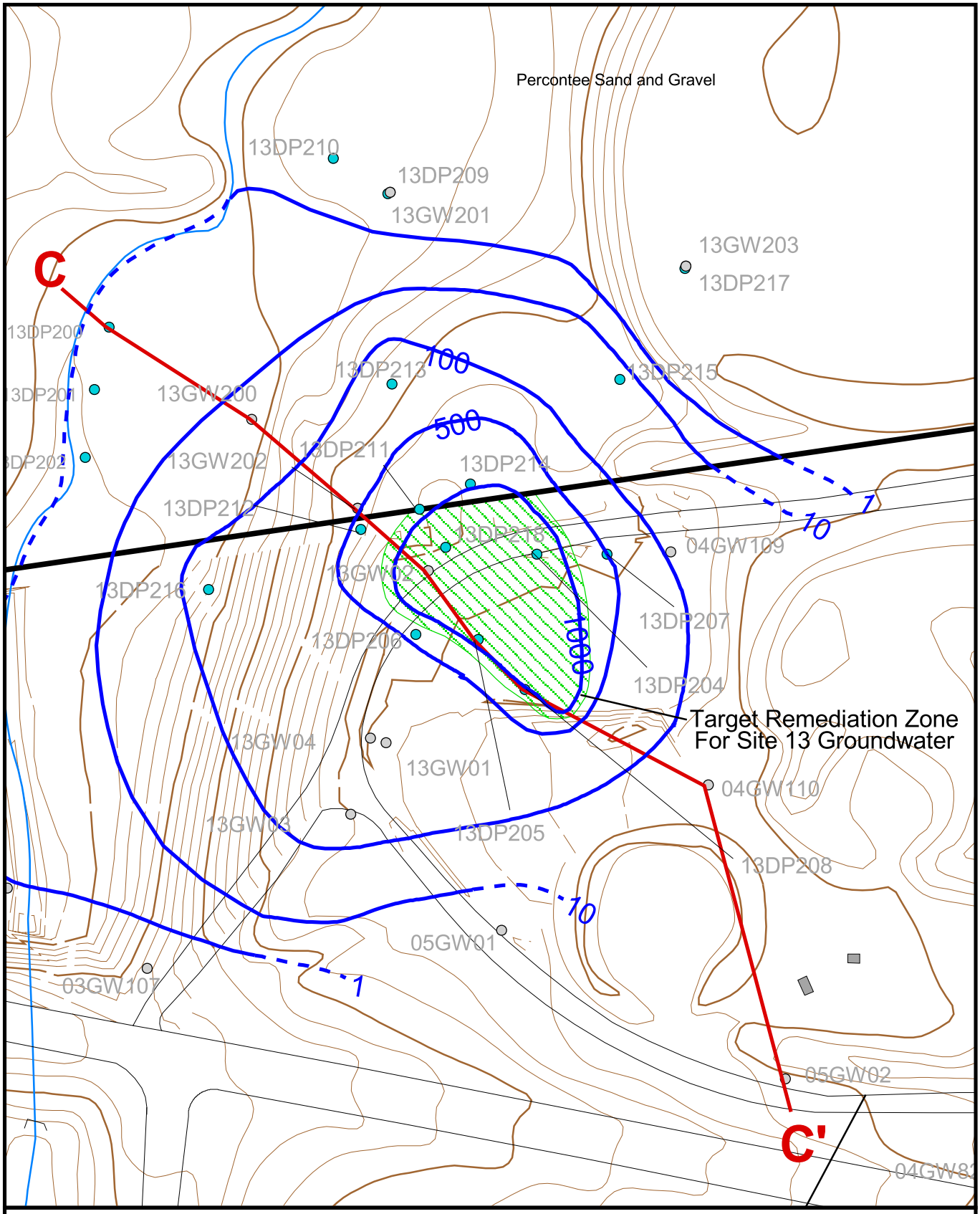

- Groundwater Screening Sample Locations During OU-1 Investigation
- Monitoring Wells

BASE MAP FEATURES

- Former NSWC White Oak Property Boundary
- Transect
- Roads and Paved Areas
- VOC Contour (Total VOCs in ug/L)
- Inferred VOC Contour
- Elevation Contours
- Buildings and Other Structures

N W E S

50 0 50 100 Feet

Figure 2-10
Sites 5 and 13 Groundwater Target Remediation Zone
Record of Decision for Sites 5 and 13
NSWC - White Oak, Silver Spring, Maryland

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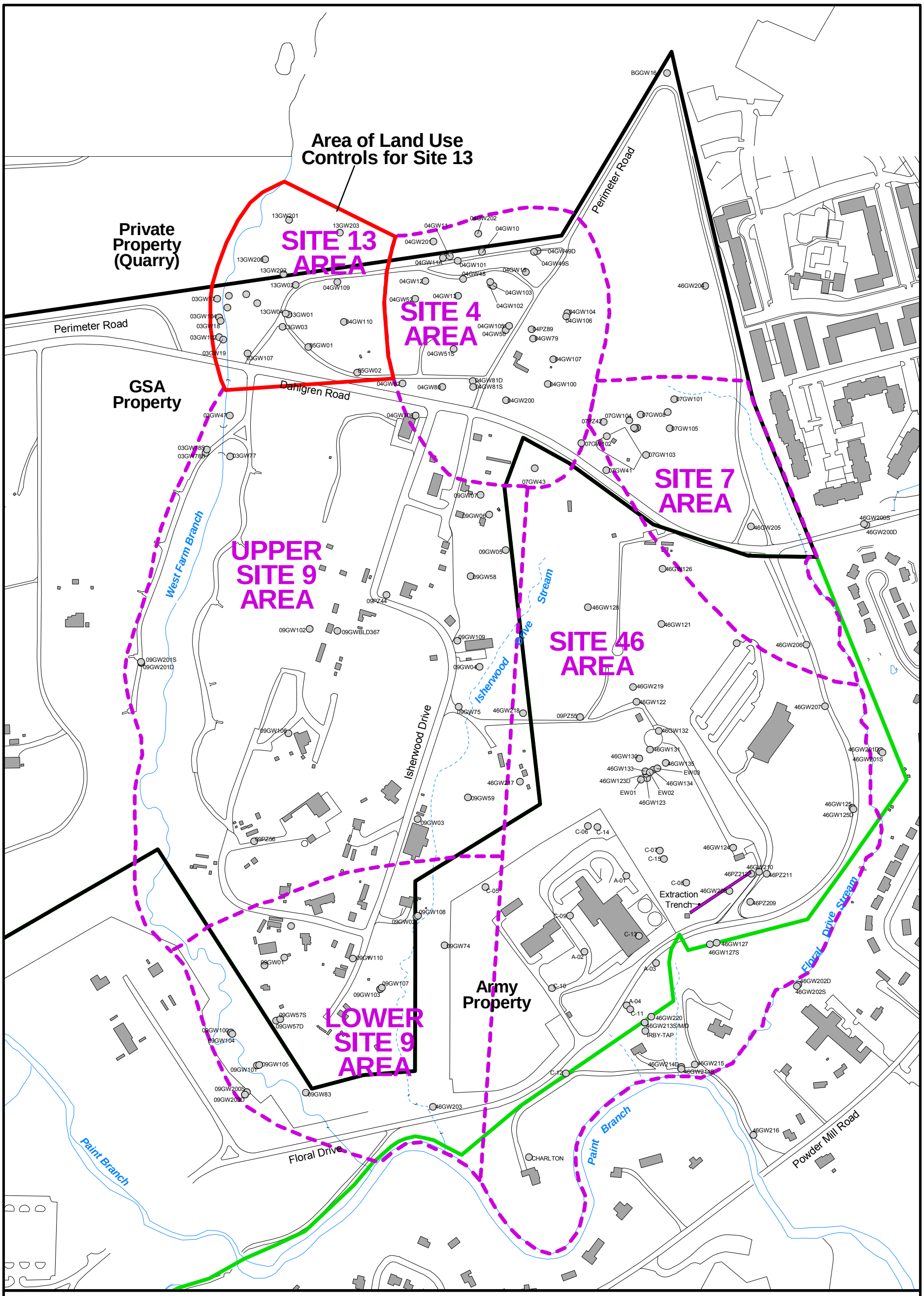

SAMPLING LOCATIONS

- Monitoring Wells
- Proposed PRG Attainment Area Boundaries

BASE MAP FEATURES

- Former NSWC White Oak Property Boundary (GSA)
- Army 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 2-11
Groundwater PRG Attainment Areas and Area of Land Use Controls
Record of Decision for Sites 5 and 13
NSWC - White Oak, Silver Spring, Maryland

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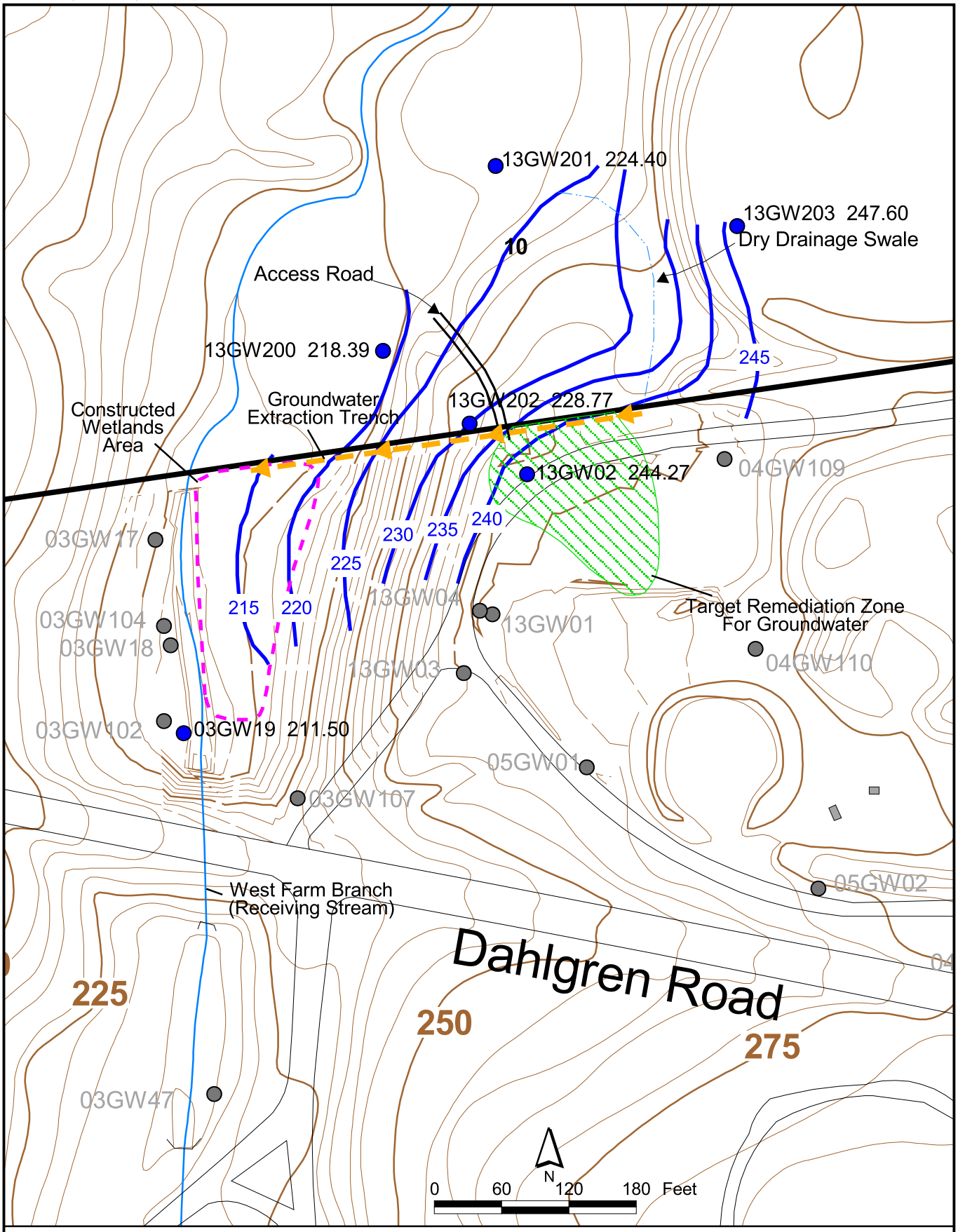

Sampling Locations

- Other Wells
- Monitoring Wells where water levels were read
- Former NSWC White Oak Property Boundary
- Groundwater Contours
- Roads and Paved Areas
- Perennial Stream
- Elevation Contours

Figure 2-12
Site 13 - Groundwater Alternative 8
Conceptual Layout - Groundwater Extraction and Treatment in Wetlands
Record of Decision for Sites 5 and 13
NSWC-White Oak, Silver Spring, Maryland

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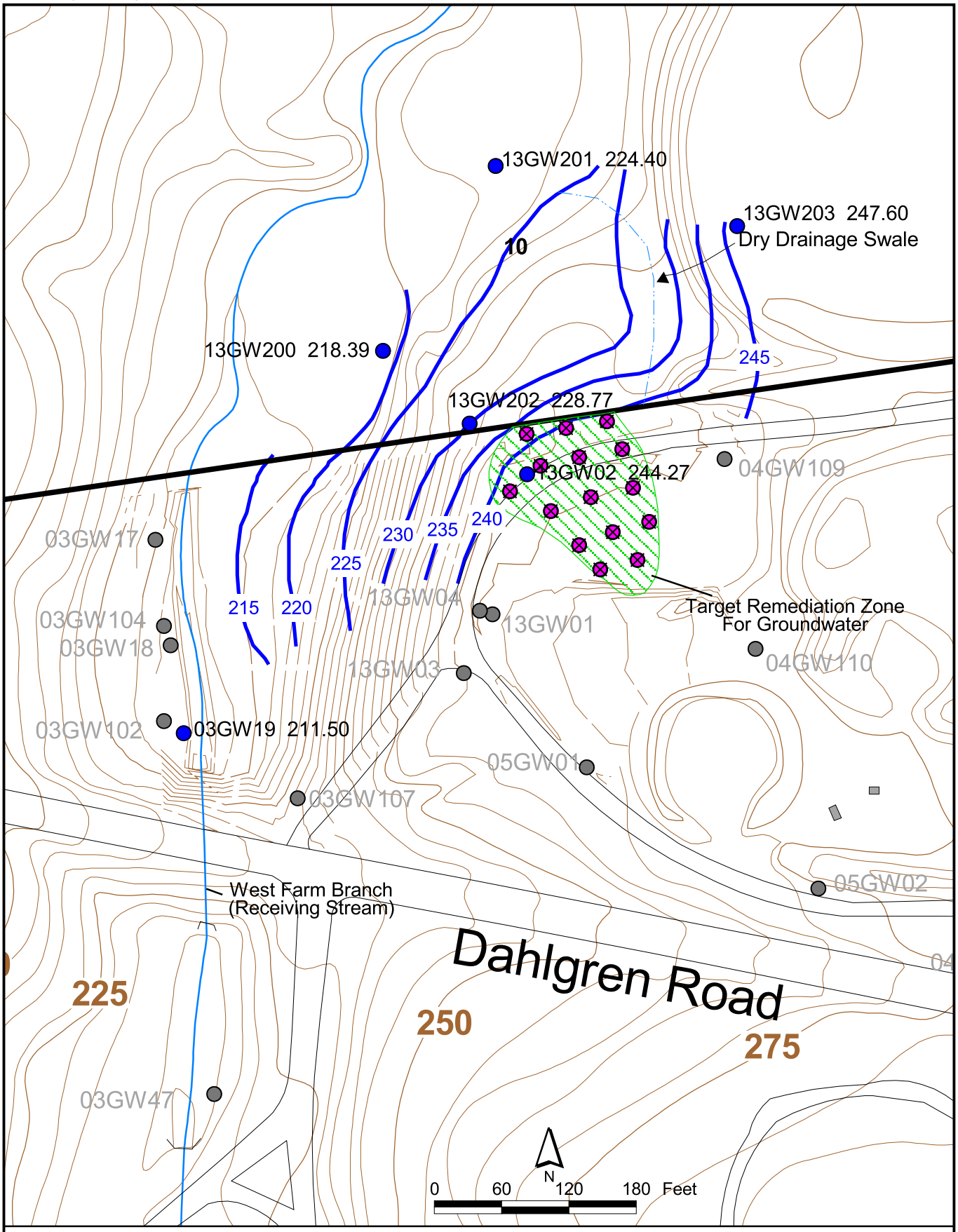

Sampling Locations

- ZVI Injection Boring
- Other Wells
- Monitoring Wells where water levels were read
- Groundwater Contours
- Roads and Paved Areas
- Perennial Stream
- Elevation Contours
- Former NSWC White Oak Property Boundary

Figure 2-13
Sites 5 and 13 - Prefered Remedy for Groundwater
Conceptual Layout for ZVI Injection
Record of Decision for Sites 5 and 13
NSWC-White Oak, Silver Spring, Maryland

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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

Michael S. Steele
Lt. Governor

Kendl P. Philbrick
Secretary

Jonas A. Jacobson
Deputy Secretary

August 13, 2004

Mr. Walter Legg
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 Sites 5 and 13 Soil and Groundwater. Dated August 2, 2004.**

Dear Mr. Legg:

The Federal Facilities Division (FFD) of the Maryland Department of the Environment's Hazardous Waste Program has reviewed the above referenced submittal. This Record of Decision (ROD) presents three remedial determinations. The first determination is the application of *in-situ* chemical reduction with zero-valent iron (ZVI) to groundwater. The second determination is that institutional controls and monitoring of groundwater will be implemented. The third determination, based on a risk assessment, is that "no further action" is needed to address site soils. Implementation of the response actions will be protective to human health and the environment at Sites 5 and 13, of the former Naval Surface Warfare Center (NSWC) White Oak, located in Silver Spring, Maryland.

The Navy and EPA have also taken the comments received during the public comment period into consideration and continue to believe that the determinations stated above adequately and appropriately addresses Sites 5 and 13 soil and groundwater in a cost-effective and responsible manner. Based upon the acceptable level of protection to human health and the environment associated with the soil and groundwater at Sites 5 and 13, the FFD concurs with the selected remedy.

If you should have any questions, please contact me at (410) 537-3419.

Sincerely,

A. Zarins

Andrew Zarins
Remedial Project Manager
Federal Facilities Division

AZ:mh
cc: Mr. Bruce Beach
Mr. Horacio Tablada
Mr. Harold Dye, Jr.

Appendix B

ARAR Tables

Table B-1
Chemical-Specific ARARs and Performance Standards
ROD for Sites 5 and 13 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 Subparts B and G, National Primary Drinking Water Regulations, CERCLA, NCP	Relevant and appropriate	Regulation does not apply where groundwater quality has concentrations of total dissolved solids (TDS) greater than 2,500 mg/L. In these instances, the Medium-Specific Concentration for groundwater may be multiplied by 100. MCL used as PRG for OU-1 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	An NPDES permit is not required; however, substantive provisions of the CWA must be complied with.
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 antidegradation of the State's surface water.	Activities that will pollute the State's surface waters	COMAR 26.08,02-01 chapters 1 through 7	Applicable	This regulation is applicable for the remedial actions that may affect surface water quality in the State of Maryland.
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	Applicable	These regulations were used in the development of PRGs for OU-1.
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, RCRA, 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 OU-1.
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 100,000.	Potential exposure	CERCLA, NCP 400CFR300.430 (e)(2)(i)(A)(2)	TBC	Use to calculate site-specific PRGs for OU-1 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	Use to calculate site-specific PRGs for OU-1 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) Parts 50 and 61	Applicable	Treatment alternatives such as air stripping, soil vapor extraction, or air sparging will 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 Sites 5 and 13 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; 40 CFR 6.301 (a)	Relevant and Appropriate	The regulation is relevant and appropriate in situations where remedial actions may adversely affect the historical structures located on Sites 5 and 13. No historically significant structures have been identified at these sites.
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.	Determination of effect upon endangered or threatened species or their habitat by conducting biological assessments.	16 USC 1531; 16 USC 1536(a); 50 CFR 81, 225, 402	Potentially applicable	There are no records of federal endangered plant and animal species located at White Oak. These regulations are applicable only if this situation changes.
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 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; 16 USC 662; 16 USC 742a; 16 USC 2901; 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); 40 CFR 6.302	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. 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; 40 CFR 231 (231.1, 231.2, 231.7, 231.8)	Applicable	Wetlands and navigable waters are present in the vicinity of OU-1. 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	Applicable	These regulations were used in the development of the PRGs for OU-1.
Hazardous Waste Control Act (HWCA)					
Within 100-year floodplain	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 OU-1 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); 40 CFR 6.302	Applicable	Portions of OU-1 are within the 100-year flood zones, therefore the requirements of this regulation are applicable 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 they depend on. 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 of a listed species or otherwise adversely affect the species.	Determination of effect upon endangered or threatened species or its habitat.	COMAR 08.03.08	Potentially applicable	There are no records 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 Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

Location	Requirement	Prerequisite	Citation	Applicability Determination	Comments
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					
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					
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. A permit or letter of exemption from the Department of Natural Resources is required if remedial activities involve activities on or in nontidal wetlands.
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 antidegradation of the State's limitations and policy for antidegradation of the State's surface water.	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 Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

Location	Requirement	Prerequisite	Citation	Applicability Determination	Comments
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 COMAR 26.17.02, 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 Sites 5 and 13 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 hazardous waste is generated. Remedial alternatives for Sites 5 and 13 may generate hazardous wastes.
Hazardous waste accumulation	Generator may accumulate 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 hazardous, any storage of the hazardous 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	Administrative requirements are not ARARs for onsite CERCLA actions, is applicable to offsite shipments.
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 Sites 5 and 13 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.	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 Sites 5 and 13 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	
	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	To be determined. Offsite transport of hazardous materials must comply with both substantive and administrative requirements.
	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 according to regulations. 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.

Table B-3
Action-Specific ARARs and Performance Standards
ROD for Sites 5 and 13 Groundwater and Soil
Former NSWC White Oak, Silver Spring, Maryland

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
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					
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	Ensures 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	Applicable	This regulation may be an ARAR for Sites 5 and 13 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, October 14, 2003

FORMER NAVAL SURFACE WARFARE CENTER, WHITE OAK

MONTGOMERY COUNTY, MARYLAND

:

:

PUBLIC MEETING FOR THE PRPOSED PLAN FOR IR SITES 5 AND 13:

A hearing in the above-entitled matter was held on Tuesday, October 14, 2003, commencing at 7:01 p.m., in the Village Square Music Room, Rider Wood Village, 3110 Gracefield Road, Silver Spring, Maryland 20850, before:

Navy Co-Chair Mr. WALTER LEGG

APPEARANCES

BRUCE BEACH
SCOTT MacEWEN
MARK CALLAGHAN
BOB RIDGWAY
SCOT NESBIT

1 PROCEEDINGS

2 MR. LEGG: Okay. I guess we're going to go ahead and get started. It's about 7 o'clock
3 now. I'm Walt Legg with the Department of Navy Engineering Field Activity Chesapeake. And this is
4 proposed plans public meeting for installation restoration sites 5 and 13 at the former Naval Warfare Center
5 at White Oak. We would like to welcome you all here tonight.

6 The players on our team again, myself; Mr. Bruce Beach for the Environmental Protection
7 Agency; Mr. Mark Callaghan with the Maryland Department of the Environment; Mr. Bob Ridgway
8 representing GSA with the Indentix Group; Scott MacEwen with CH2M Hill performed the investigation on
9 these sites; Scott Nesbit with Tetra Tech NUS also performed some of the investigations on the site. Other
10 members of the team who are not with us this evening, Dr. Ron Kotun of Tetra Tech NUS; Carrie Smith of
11 Tetra Tech NUS; and Phil Tully of Shaw Environmental & Infrastructure.

12 We have the topic for presentation tonight is the proposed plan for Installation Restoration
13 Sites 5 and 13, the groundwater and soil. And these sites are the Open Burn Area which is Site 5 and the oil
14 sludge disposal area which is in Site 13.

15 Following the presentation we are going to open the floor to questions.

16

17 **30 MINUTE SLIDE PRESENTATION OF THE PROPOSED PLAN**
18 **FOR SITES 5 and 13 (NOT PROVIDED)**

19

20 MR. LEGG: With that I welcome to the floor any questions or comments.

21 MS. BRETZ: I apologize for being late. But did you compare why you're doing this with
22 what you're doing on the FDA site? (Indiscernible) you may have gone over that. Did you go over that?

23 MR. LEGG: We didn't discuss it here tonight, no ma'am.

1 MS. BRETZ: Well, I just say as a comparison you're dealing with groundwater as
2 groundwater. Is it two different things?
3 MR. MacEWEN: It's slightly different, yeah. One is looking at more biological action. In
4 the FDA we're looking at injecting something that would degrade primarily by biological routes. It would
5 increase the microbial activity and the microbe would degrade, TCD. Here it's more chemical reaction,
6 chemically degrading the TCD.
7 MS. BRETZ: Well, you're doing as new, wouldn't this be a better one to use on the FDA
8 site?
9 MR. MacEWEN: I think the reason we went with this route at this site is because the
10 concentrations are higher. And there's also a likelihood that there may be some residual contaminations in
11 the soil below the groundwater and this chemical, the chemical route would be more likely to degrade those
12 higher contaminants faster. It can access them. It can actually work on free phase contamination whereas
13 the biological route, the microbial dissolve phase. So it's better for lower concentrations.
14 The biological route is less expensive too. So, I think when you can it's better to do that
15 route, go that route.
16 MR. CALLAGHAN: I think this is a lot faster as well. The in-situ bioremediation will
17 knock the contaminant down but at a much slower rate than the injection of zero valent iron. I mean it's been
18 shown to actually degrade contamination from high levels to relatively low levels in the space of a month
19 sometimes. So --
20 MR. MacEWEN: I think you're confusing that with chemical oxidation.
21 MR. CALLAGHAN: The zero valent iron. I thought it had been demonstrated to you,
22 what you said very quickly, not necessarily --
23 MR. MacEWEN: Not necessarily in applications like that. A wall where it's passing
24 through a real high concentration --

1 MR. CALLAGHAN: Okay.

2 MR. MacEWEN: -- might not be easy. It won't be a month.

3 MR. CALLAGHAN: No, it will be quicker.

4 MR. MacEWEN: It should be a little bit quicker, but we're talking two years versus four

5 years.

6 MS. BRETZ: Comparing the two, if this one does it so quickly why don't you just do that

7 and get it over with for the FDA site?

8 MR. LEGG: The zero valent iron injection is not so new that it wouldn't have been

9 considered for the Site 11 remediation. And through the evaluation process each site reaches its preferred

10 remediation based on all of the criteria. So for each site we arrive at what we feel is most appropriate

11 remedial action for that site.

12 MS. BRETZ: But I think one's faster but more expensive.

13 MR. CALLAGHAN: I may be wrong.

14 MR. LEGG: Well those things show identical time frame for the biological process so fast

15 is not (indiscernible).

16 MR. MacEWEN: I don't think it's perceptibly faster, theoretically maybe. It's not going to

17 be like half the time.

18 DR. DELEO: Five years, I think I would consider (indiscernible) I would consider that

19 (indiscernible).

20 MS. BRETZ: You had on there for GSA's proposed use of the site the areas closer to there.

21 COMMENT/QUESTION: (Indiscernible).

22 MR. LEGG: We don't have a plan fo the (indiscernible).

23 MS. BRETZ: Thank you.

24 MR. MacEWEN: Do you have a plan?

1 MS. BRETZ: (Indiscernible).

2 MR. LEGG: Any other questions or comments? Dr. DeLeo.

3 DR. DELEO: What's the particle size of the pattern, what I'm looking at?

4 MR. MacEWEN: I don't know what the particle size is. I can get that for you.

5 DR. DELEO: (Indiscernible) slurry, you get some kind of secondary (indiscernible) I think

6 you have some problems with infiltration (indiscernible).

7 MR. MacEWEN: But it's fine enough that it's injected with nitrogen gas so it's not even a

8 liquid slurry. It's a gaseous slurry. And it's approximately 40 microns. But they've shown it to work and

9 it's gotten through dispersions and how, you know, the diameters that we've been talking about which is at

10 15, 20 feet diameter in this type of material.

11 DR. DELEO: But you need the fracture?

12 MR. MacEWEN: Yeah, you gotta fracture it, yeah.

13 DR. DELEO: And if you were doing biological process would you fracture?

14 MR. MacEWEN: We would fracture it too. It's just a matter of what we're putting in the

15 ground. And the literature that's out there indicates you get about the same raise of influence for either one

16 of those two.

17 DR. DELEO: And I (indiscernible) process.

18 MR. MacEWEN: Well we did it at Site 9. We did about five holes and it was about

19 (indiscernible), yeah it was about $50,000 to do five holes and inject.

20 Mr. NESBIT: The fracturing offsets the placement of wells. If you didn't fracture you'd

21 have to put a larger number of wells in.

22 MR. MacEWEN: Yeah, and you know we have data from that Site 9 with the same type of

23 saprolite. You know, we took measurements of pressure changes and ground heaves and we feel that we got

1 greater than 20 foot diameter, radius of influence. This was injecting sodium lactates. We weren't injecting
2 iron here.
3 MS. BRETZ: One more thing. Walter, we've talked about several things with the long
4 term monitoring. Have you looked at a long-term monitoring plan and what you're going to do; when you're
5 going to do it; and who's going to do it?
6 MR. LEGG: We --
7 MS. BRETZ: It doesn't do any good to have a monitoring plan if you don't monitor.
8 MR. LEGG: Correct. And the monitoring will take place and it is required to assure that it
9 does take place.
10 MS. BRETZ: (Indiscernible) you have a plan for it?
11 MR. LEGG: Yes, each site has a plan and eventually the whole thing will be rolled into one
12 baseline long-term monitoring plan as also our site reviews. It will be one review each five years that will
13 address all of the sites.
14 MR. MacEWEN: As we assign the rod 3 site then we come up for the plan for monitoring,
15 we don't want prematurely (indiscernible) we know what's going to be done at each site.
16 MR. NESBIT: We've recently planned for the landfills, plans of actions, we're performing
17 that monitoring. There's a draft plan being developed for Site 11. One will follow for Sites 5 and 13. One
18 will follow for Site 4, Site 7.
19 MS. BRETZ: Is that required?
20 MR. LEGG: Not required. Sites, no further action. Any other questions, comments?
21 MR. MEYER: I have a couple questions. One the schematics show that the wells when
22 done, this is saprolite. Did you do any wells in your coastal plain soils, generally on the FDA site. That
23 seems to be your extent where the majority of contamination was.
24 MR. MacEWEN: Can you repeat that, Paul?

1 MR. MEYER: What I said was looking at the schematic here it looks like the wells were
2 done in the saprolite.
3 MR. MacEWEN: Yeah.
4 MR. MEYER: Nothing was done in the coastal plain in that particular area.
5 MR. MacEWEN: The coastal plain, wait, the water table is this dashed, this solid line here.
6 And the coastal plain is above that.
7 MR. MEYER: Right. I was saying wells up in that area, did you do --
8 MR. MacEWEN: But there's no water. There's no water up there to sample.
9 MR. MEYER: Well, it's right there at the interface of the saprolite and coastal plain?
10 MR. MacEWEN: Right here. Well here's a well in the coastal plain right here.
11 MR. MEYER: Right.
12 MR. MacEWEN: Over here we took soil samples up in the coast plan to see if there's a
13 source up there still detected. We couldn't find any type of source that would be the source of groundwater
14 contamination. But where the contamination is in the groundwater it's all in the saprolite. There's no --
15 MR. MEYER: Okay.
16 MR. MacEWEN: The groundwater doesn't occur until you get out of the coastal plain into
17 the saprolite.
18 MR. MEYER: Okay. All right.
19 MR. BEACH: And one of the soil borings did detect similar contaminants, but it was right
20 at that water interface. So it was still in the soil but it was right at the saprolite groundwater.
21 MR. MEYER: All the groundwater and saprolite, it's not laying on top of the coastal plain?
22 MR. MacEWEN: Correct. It's over in this area.
23 MR. MEYER: Oh that area, I see it. But the more --
24 MR. MacEWEN: But there's no --

1 MR. MEYER: Contaminated area looks like right there at that interface.

2 MR. MacEWEN: Yeah.

3 MR. MEYER: Based on your diagram there.

4 MR. MacEWEN: But this would, you know what we would treat is everything from the

5 water table down to the bedrock. So, if there's groundwater in the coastal plain, that's going to be treated

6 too.

7 MR. MEYER: Okay.

8 MR. MacEWEN: But at this time, there was no groundwater in the coastal plain. Maybe

9 now that it's been raining like crazy the waterfill may have risen up.

10 MR. MEYER: Fluctuate to some extent. You're going to treat those (indiscernible)?

11 MR. MacEWEN: No.

12 MR. MEYER: No.

13 MR. MacEWEN: There's nothing there.

14 MR. MEYER: There's nothing there. The other question I had was are you proposing to

15 change the concentration for amount of the zero valent iron that would go in some of these holes? What I'm

16 looking at is if you have a higher concentration of contaminant that your sites may be (indiscernible). But if

17 you treat them all equally and if that's the case you still may not get all the contamination in your higher

18 concentrated areas.

19 MR. MacEWEN: Yeah, but that's something we'd look at in the design phase, you know,

20 to minimize cost and maximize effectiveness. So that's one of the, I don't know whether we would or not,

21 but that's part of the design, what that (indiscernible).

22 MR. LEGG: Any other questions, comments? Dr. DeLeo.

23 DR. DELEO: Does the bedrock need to be treated?

1 MR. MacEWEN: There is low levels of contamination in this bedrock well and we're
2 going to monitor that. You know, the assumption is here's where the source is. If we get rid of the source,
3 you know, we monitor the bedrock for natural attenuation as well as for what's down here. We're looking at
4 say 30. There is stuff in the rock but we monitor that. It is something that we want to verify it cleans up.
5 (Indiscernible).
6 MR. BROUD: Dennis Broud, National Treasury Employees. I notice you have a well right
7 on th border there in the saprolite there. I can't read the concentrations on the copy. Yeah, that one right
8 there. Can you read yours off from there?
9 MR. MacEWEN: Yeah, the (indiscernible) is 6. TCE is 75 and then dichloroethene is 648.
10 Yeah, there is contamination in walls off site on the quarry property.
11 MR. BROUD: Right.
12 MR. MacEWEN: Yeah.
13 MR. BROUD: And so that, that's the quarry on that side of that?
14 MR. MacEWEN: That's right, the property line.
15 MR. BROUD: Right.
16 MR. MacEWEN: So, it's off of that. The well right here.
17 MR. BROUD: Yeah, okay.
18 MR. MacEWEN: The groundwater flowing down here. We have determined the non
19 detected line there is an area that's off site that has contamination. We're not going to be injecting anything
20 on that property. We're going to monitor that after we --
21 MR. BROUD: So you have monitoring wells there?
22 MR. MacEWEN: Yeah.
23 MR. BROUD: Okay.

1 MR. MacEWEN: There's 1, 2, 3 and then a couple out here. We have a line right down the
2 center, in fact how it's degrading. I think we did talk about the fact that nothing is getting in the creek. In
3 fact, nothing is even getting near the creek. You have a couple of wells that are, you know, within 10 feet of
4 the creek and it's degraded by the time it gets there. That's, there's quite a lot of higher organic content in
5 soils near the stream that may be acting to absorb the contaminants and degrade them.
6 MS. BRETZ: Just one final thought on the (indiscernible). And we're just, I don't want to
7 say we're glad to see it getting done, but we're very, very pleased and glad to see you finishing up. So we do
8 appreciate it. Thank you.
9 MR. LEGG: Any other questions, comments? Okay. I guess we'll close the meeting and
10 go right into the RAB meeting.
11 (Whereupon, at 7:52 p.m., the hearing was concluded.)
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