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RECORD OF DECISION STE 36 CLOSED LANDFILL NSWC INDIAN HEAD MD
8/1/2011
NSF INDIAN HEAD

# RECORD OF DECISION

Site 36 - Closed Landfill
for
Naval Support Facility, Indian Head
Indian Head, Maryland

August 2011

# 1.0 DECLARATION

## 1.1 SITE NAME AND LOCATION

Site 36 – Closed Landfill at Naval Support Facility Indian Head (NSF-IH), Maryland, United States Environmental Protection Agency (EPA) ID number MD7170024684.

## 1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the Selected Remedy for Site 36 (see Figure 1-1), which was chosen by the Navy and EPA in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record for the site. The Maryland Department of the Environment (MDE) concurs with the Selected Remedy.

## 1.3 ASSESSMENT OF SITE

The response action selected in this ROD is necessary to protect the public health and welfare or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment. A CERCLA action is required because concentrations of arsenic, iron, and manganese in shallow groundwater pose unacceptable risk to human health under a residential exposure scenario. There is also inherent risk from exposure to buried landfill waste.

## 1.4 DESCRIPTION OF SELECTED REMEDY

The major components of the Selected Remedy for Site 36 include the following:

- Land use controls (LUCs) to prevent unauthorized excavation, residential development, and use of shallow groundwater at the site until contaminants at the site are at levels that allow for unlimited use and unrestricted exposure.
- Maintenance of the existing soil and vegetative cover to prevent direct exposure to landfill contents and to minimize erosion by surface water and wind.
- Long-term monitoring of shallow groundwater to confirm that groundwater contaminant migration is not occurring at unacceptable levels.
- Removal and recycling of large pieces of metal debris along the shoreline.
- Five-year reviews.

Through the use of LUCs, the Selected Remedy eliminates potential future unacceptable risk associated with potable use of groundwater within the boundaries of the landfill and also addresses the inherent risks associated with exposure to buried landfill material. Risks associated with soil and groundwater outside of the landfill boundaries and adjacent surface water and sediment were within acceptable levels. The Selected Remedy is expected to achieve substantial long-term risk reduction and to be protective under the current and reasonably anticipated future non-residential use of the site. This ROD documents the final remedial action for Site 36 and does not include or affect any other sites at the facility. Implementation of this remedy will allow industrial/commercial use of the site, which is consistent with the current use and the overall cleanup strategy for NSF-IH of restoring sites to support base operations.

FIGURE 1-1. SITE LOCATION MAP

## 1.5 STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action (except as noted below), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. Although arsenic concentrations in shallow groundwater beneath the landfill exceed the EPA drinking water Maximum Contaminant Level (MCL), this groundwater is not within the area of attainment as defined by EPA (i.e., the area within which cleanup levels must be met) because it is within the boundaries of the landfill waste that will be managed on site. This remedy does not comply with state closure standards for sanitary landfills that require an impermeable cap; however, a variance to the design was accepted by MDE because the existing soil cover protects public health, protects and conserves natural resources and the environment, and controls air, water, and land pollution to the same extent as would be obtained by an engineered cover. The Selected Remedy does not satisfy the statutory preference for remedies that use treatment as a principal element to reduce the toxicity, mobility, or volume of hazardous substances, pollutants, and contaminants. Treatment was deemed impractical because of the heterogeneous nature of waste materials and contaminants at Site 36, the relatively low concentrations and inert nature of the contaminants, and the fact that the only potential for risk is from exposure to shallow groundwater within the footprint of the landfill under a hypothetical future residential exposure scenario.

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

## 1.6 ROD DATA CERTIFICATION CHECKLIST

The locations in Section 2.0, Decision Summary, of the information required to be included in the ROD are summarized in Table 1-1. Additional information can be found in the Administrative Record file for NSF Indian Head.

**TABLE 1-1. ROD DATA CERTIFICATION CHECKLIST**

| DATA | LOCATION IN ROD |
|---|---|
| Chemicals of concern (COCs) and their respective concentrations | Sections 2.5 and 2.7 |
| Baseline risk represented by the COCs | Section 2.7 |
| Cleanup levels established for COCs and the basis for these levels | Sections 2.7 and 2.8 |
| How source materials constituting principal threats are addressed | Section 2.11 |
| Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the risk assessment | Section 2.6 |
| Potential land and groundwater uses that will be available at the site as a result of the Selected Remedy | Section 2.12.3 |
| Estimated capital, operating and maintenance (O&M), and total net present worth (NPW) costs; discount rate; and number of years over which the remedy costs are projected | Appendix A |
| Key factors that led to the selection of the remedy | Section 2.12.1 |

## 1.7 AUTHORIZING SIGNATURES

Peter R. Nette

27 SEPT 2011

P. R. NETTE
Captain, U.S. Navy
Commanding Officer
NSA South Potomac

Date

K. Borsellino for

9/30/2011

Ronald J. Borsellino, Director
Hazardous Site Cleanup Division
US Environmental Protection Agency

Date

# 2.0 DECISION SUMMARY

## 2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

NSF-IH, EPA ID number MD7170024684, is located in northwestern Charles County, Maryland and consists of the Main Installation on Cornwallis Neck Peninsula and the Stump Neck Annex on Stump Neck Peninsula. NSF-IH was established in 1890 and is the Navy's oldest continuously operating ordnance station. At various times during its operation, NSF-IH has served as a gun and armor proving ground, powder factory, propellant plant, and research facility. Current military uses included operations and training; maintenance and utilities; research, development, and testing and evaluation; explosives storage; supply and non-explosives storage; administration; community facilities and services; housing; and open space.

Site 36 is located on approximately 3 acres in the western portion of Stump Neck Annex along Roach Road adjacent to Chickamuxen Creek. The landfill was used from 1972 to 1974 and has been inactive since that time. The filled area was most likely part of Chickamuxen Creek and/or a wetland or marsh adjacent to the creek, and the fill was believed to contain metal casings from mines, bombs, and torpedoes. The contents were reportedly certified inert and did not contain any explosives or chemicals when buried. Wood fragments were also buried in the landfill. Subsequent anecdotal information from personnel who formerly worked in Building 2010, which is located northeast of the landfill, indicated that disassembled metal parts were disposed of in the creek across (west of) Roach Road from Building 2010.

NSF-IH is an active facility, and environmental investigations and remediation at the base are funded under the Environmental Restoration, Navy (ER,N) program. The Navy is the lead agency for CERCLA activities at the facility, EPA jointly selects the remedy and is the lead regulatory agency, and MDE is the support regulatory agency.

## 2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Table 2-1 provides brief summaries of previous investigations at Site 36. Results of these investigations indicated that **elevated concentrations of metals**[1] were present in shallow **groundwater** and sediment at the site. The nature and extent of contamination is discussed in Section 2.5.

Although metals concentrations in groundwater exceed screening criteria, the groundwater exceedances are found only within the footprint of the landfill and not within the area of attainment designated by the EPA. Therefore, no action for groundwater is required.

**TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION**

| INVESTIGATION | DATE | ACTIVITIES |
|---|---|---|
| Initial Assessment Study (IAS) | 1983 | During a site visit, metal debris was observed on the surface of the site. The IAS did not contain a recommendation concerning future actions. |
| Site Screening Investigation (SSI) | 2002 | **Geophysical anomalies** were identified throughout the area of the suspected landfill indicating potential waste disposal, and surface debris was observed along the shoreline. Recommended additional investigation. |
| Site Visit | 2003 | Materials observed along the shoreline including tires, empty 55-gallon drums, a large cube-shaped tank, a part from an airplane, and a large item that appeared to be a part of a piece of farm machinery. |
| Site Screening Process (SSP) Investigation | 2005 | Included **installation of three monitoring wells** where shallow groundwater samples were taken, six surface soil samples, six surface water and sediment samples from Chickamuxen Creek and four sediment pore water samples from the landfill perimeter. Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), explosives, metals, and polynuclear |

[1] **Bold blue text** identifies detailed site information available in the Administrative Record and listed in the Detailed Administrative Record Reference Table of the ROD.

| | | |
|---|---|---|
| | | aromatic hydrocarbons (PAHs) were detected. Human health and ecological risk screening evaluations were conducted to compare Site 36 chemical concentrations to EPA screening levels. Unacceptable risks to human health from exposure to shallow groundwater, sediment pore water, and sediment based on residential land use were found and no unacceptable risks to ecological receptors were found. Additional investigation on potential ecological risks, particularly to benthic organisms in Chickamuxen Creek, was recommended. |
| Benthic Macroinvertebrate Study | 2007 | Included collection of sediment samples from **nine locations** for macroinvertebrate analysis as well as analysis for PAHs, Target Analyte List (TAL) metals, cyanide, acid volatile sulfide (AVS)/simultaneously extracted metals (SEM) (cadmium, copper, lead, nickel, silver, and zinc), total organic carbon, and grain size. |
| Feasibility Study | 2010 | **Remedial alternatives** that could permanently and significantly reduce potential risk associated with landfill wastes and groundwater were developed and evaluated. |

There have been no cited violations under federal or state environmental law or any past or pending enforcement actions pertaining to the cleanup of Site 36.

## 2.3 COMMUNITY PARTICIPATION

The Navy performs public participation activities in accordance with CERCLA and the NCP throughout the site cleanup process at NSF-IH, including establishment of an Information Repository at three locations within the area of the base for dissemination of information to the community. The NSF-IH Information Repository can be accessed at:

- Indian Head Town Hall, 4195 Indian Head Highway, Indian Head, Maryland
- Charles County Public Library, 2 Garrett Avenue, LaPlata, Maryland
- NSF-IH, building 620, 101 Strauss Avenue, Indian Head, Maryland

Documents and other relevant information relied on in the remedy selection process are available for public review at the Information Repository, which includes a copy of the Administrative Record. For access to the Administrative Record or additional information about the Installation Restoration (IR) Program at NSF-IH, contact Gary Wagner, Public Affairs Officer, 6509 Sampson Rd., Code 00P, Dahlgren, Virginia, 22448, 540-653-1475, gary.wagner@navy.mil.

A Restoration Advisory Board (RAB) made up of community members and Navy, federal, and state officials meets twice a year. The RAB is designed to act as a focal point for the exchange of information between NSF-IH and the local community regarding restoration activities.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from April 12 to May 12, 2010, for the proposed remedial action described in the Proposed Plan for Site 36. A public meeting to present the Proposed Plan was held on April 15, 2010, at the Senior Center, 100 Cornwallis Square, Indian Head, Maryland. **Public notice** of the meeting and availability of documents were published in the Maryland Independent on April 9th, 2010.

## 2.4 SCOPE AND ROLE OF OPERABLE UNIT

Site 36 is part of a comprehensive environmental investigation and cleanup program currently being performed at NSF-IH under CERCLA. Sixty-seven IR sites have been identified at NSF-IH. Thirty-one of these have been identified as needing no further action, two are undergoing long-term monitoring, and nine have had a Preliminary Assessment/Site Inspection. Three have had Remedial Action and one Remedial Design. Sixteen are at the Remedial Investigation or Feasibility Study stage, and five are at the SSP stage. The Site Management Plan (SMP) for NSF-IH further details the schedule for CERCLA activities and is updated annually.

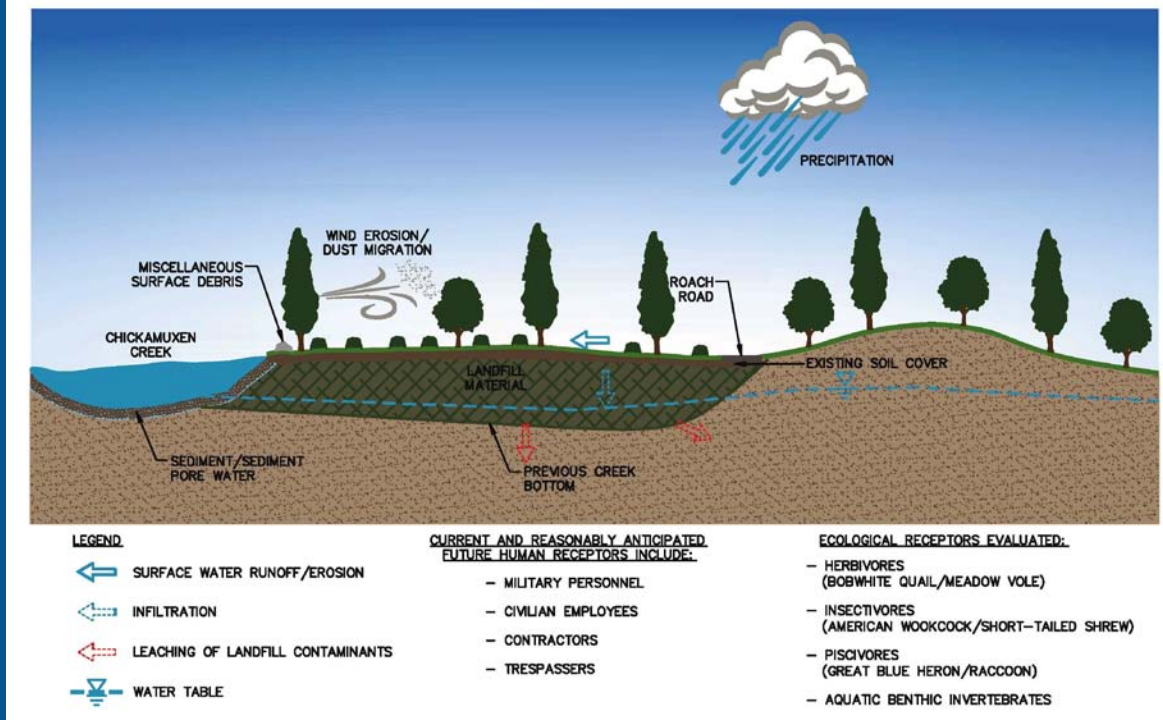
Investigations at Site 36 indicated the presence of groundwater contamination that poses unacceptable human health risk to hypothetical future receptors using groundwater within the landfill boundaries as a potable supply. No previous actions have been taken in response to the contamination at Site 36. The remedy documented in this ROD will achieve the Remedial Action Objectives (RAOs) for Site 36, as listed in Section 2.8. Implementation of this remedy will allow industrial/commercial use of the site, which is consistent with current and reasonably anticipated future use and the overall cleanup strategy for NSF-IH of restoring sites to support base operations.

This is the only ROD contemplated for Site 36. Separate investigations and assessments are being conducted for the other IR sites at NSF-IH in accordance with CERCLA. Therefore, this ROD only applies to Site 36. Separate RODs or other CERCLA decision documents will be prepared for the other IR sites.

## 2.5 SITE CHARACTERISTICS

Figure 2-1 presents the Site 36 conceptual site model (CSM), which identifies contaminant sources, contaminant release mechanisms, transport routes, and receptors under current and future land use scenarios. The source of contamination at Site 36 is the landfill and surrounding surface debris and contaminant release and transport mechanisms including runoff to surface soil and sediment and vertical infiltration to groundwater. Human health and ecological receptors are discussed in Sections 2.7.1 and 2.7.2, respectively.

FIGURE 2-1. CONCEPTUAL SITE MODEL



### 2.5.1 Physical Characteristics

Site 36 is relatively flat, with elevations of approximately 5 feet above mean sea level, and slopes gradually to the west from Roach Road to Chickamuxen Creek (see Figure 2-2). The surface of the site is mostly covered with grasses and brushy vegetation, which become very dense near the shoreline adjacent to the site. Some small and large trees are also present.

Boring logs for monitoring wells installed at the site indicate that shallow geologic materials consist of fill (e.g., wood fragments) mixed with sand, silt, clay, and gravel. Wood fragments mixed with soil were encountered in one soil boring from 4 to 8 feet below ground surface (bgs) and in the other from 8 to 12 feet bgs and were overlain by soil fill consisting of gravel, sand, silt, and clay. The material beneath the fill consists of peat and river mud underlain by sand. The peat and river mud most likely correspond to former creek sediments present before the area was filled. Miscellaneous surface debris is present along Chickamuxen Creek, which is adjacent to the northern, western, and southern boundaries of the site. There are no obvious drainage channels at the site. Precipitation either infiltrates into the soil or runs off into the creek. Shallow groundwater beneath the site is encountered at a depth of approximately 4 feet bgs and flows toward and discharges to Chickamuxen Creek.

### 2.5.2 Nature and Extent and Fate and Transport of Contamination

The sources of **contamination** at Site 36 are the landfill and surrounding debris. Various organic (mainly PAHs in soil and sediment) and inorganic chemicals were detected in soil and groundwater samples from the site and in surface water, sediment, and sediment pore water samples from adjacent Chickamuxen Creek. Based on the specific chemicals detected in the various media, only metals may have potentially migrated from soil to groundwater, and only PAHs and metals may have potentially migrated from the site to the creek (Tetra Tech, 2008).

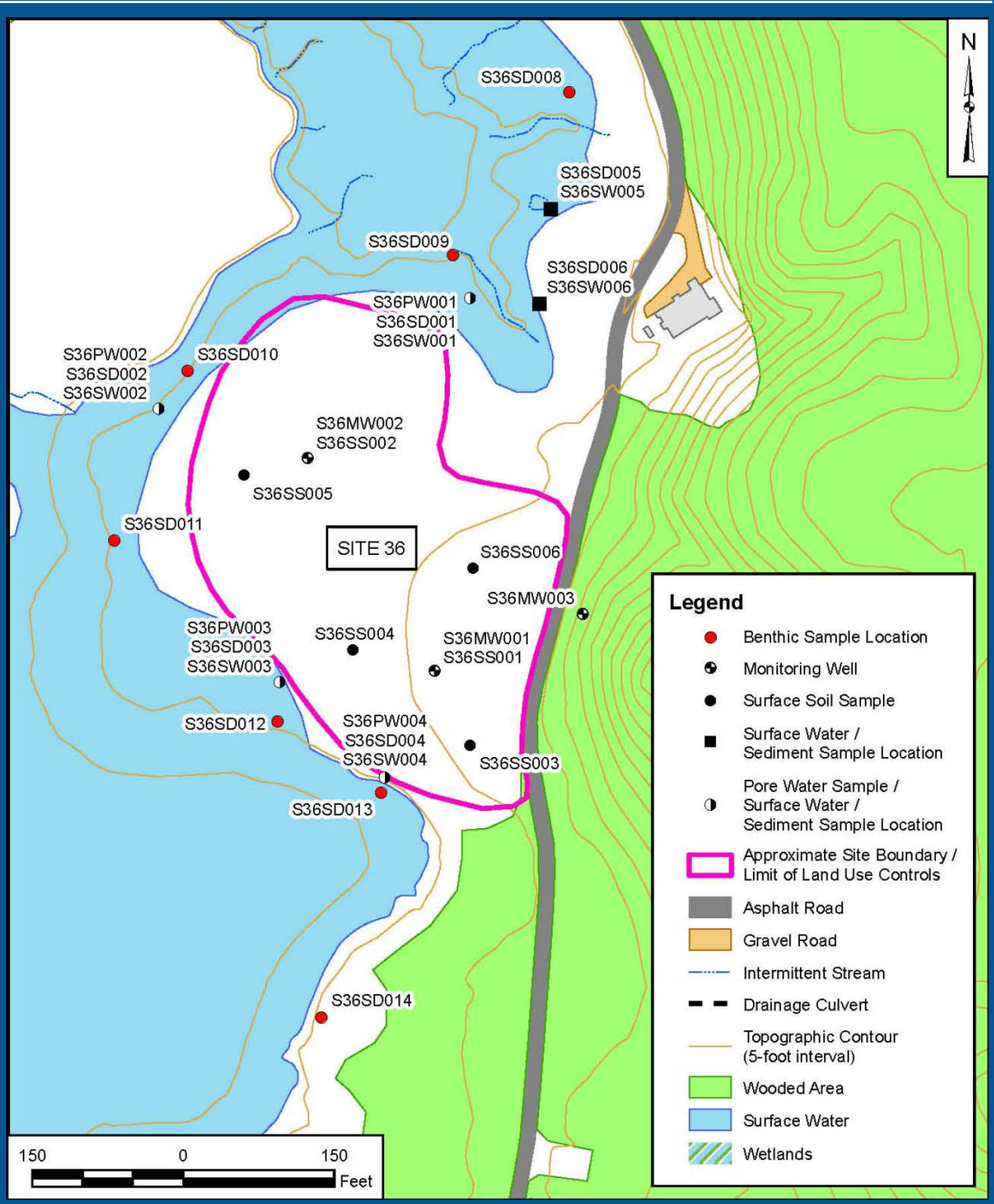
Inorganics are highly persistent and when released to the environment generally adsorb to the soil matrix and remain bound to particulate matter. In general, PAHs are also relatively persistent and preferentially adsorb to particulate matter. Because of this, these chemicals tend to migrate from source areas via bulk movement processes (e.g., transport by wind erosion of small particles), and if leaching from soil to groundwater or surface water occurs, it usually results in transportation over relatively short distances.

## 2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

NSF-IH has been an active military facility since 1890 and is expected to remain active for the foreseeable future. Current military uses included operations and training; maintenance and utilities; research, development, and testing and evaluation; explosives storage; supply and non-explosives storage; administration; community facilities and services; housing; and open space. The main tenant at NSF-IH is the Naval Explosive Ordnance Technology Center, and its mission is to provide Explosive Ordnance Disposal (EOD) technology and logistics management and to develop war-essential elements of intelligence, equipment, and procedures.

The unconfined shallow groundwater beneath the site is not used for any purpose. There is no shallow groundwater downgradient (west) of the landfill boundary, beyond which is the shoreline of Chickamuxen Creek which borders the site to the north, west, and south. Contaminated groundwater was only detected beneath the site and does not extend beyond the site boundaries and the Navy has no plans to develop this resource in the future. The shallow unconfined groundwater at the site is not hydraulically connected to deeper aquifers that are the principal sources of water for domestic use at NDW-IH. It is unlikely that the site area will be developed for residential use because land use at NSF-IH is expected to be associated with explosives research, testing, and evaluation for the foreseeable future. Previous landfilling at the site is also a limiting factor for future residential development.

FIGURE 2-2. SITE SAMPLING LOCATIONS



## 2.7 SUMMARY OF SITE RISKS

Risk assessments estimate what risks the site would pose if no action were taken, provide the basis for taking action, and identify the contaminants and exposure pathways that need to be addressed by the remedial action. **Human health and ecological risk screening** evaluations were conducted as part of the SSP (TtNUS, 2008).

### 2.7.1 Summary of Human Health Risk

The quantitative human health risk screening evaluation was conducted using chemical concentrations detected in surface soil, groundwater, surface water, sediment, and sediment pore water samples. Key steps in the risk assessment process included identification of chemicals of potential concern (COPCs), exposure assessment, toxicity assessment, and risk characterization. Tables summarizing data used in the HHRA and associated results are presented in Appendix B.

#### Identification of COPCs

Tables 4-8 through 4-12 (from the SSP Report) in Appendix B present exposure point concentrations (EPCs) for the COPCs identified in surface soil, groundwater, surface water, sediment, and pore water respectively, at Site 36. EPCs are the concentrations used in the risk assessment to estimate exposure and risk from each COPC. For each COPC, the table includes the range of detected concentrations, frequency of detection (i.e., the number of times the chemical was detected in samples collected at the site), EPC, and the concentration used for screening (maximum concentration).

#### Exposure Assessment

The **exposure assessment** defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the COPCs. Potential human exposure to environmental media at Site 36 is expected to be limited. Based on the current and anticipated future land use and location of the site, military personnel, civilian employees, contractors, and trespassers are the most likely individuals exposed. However, to evaluate the site on a conservative basis, risks were evaluated based on a hypothetical future residential exposure scenario. For purposes of the risk screening analysis, maximum detected site concentrations and exposure assumptions used to derive the EPA Region 3 Risk-Based Concentrations (RBCs) for soil and tap water ingestion (for soil and sediment and groundwater, surface water, and pore water, respectively) and soil screening levels (SSLs) for inhalation (transfers from soil to air) were used to assess potential exposure to environmental media. The risk evaluation conservatively assumed that shallow groundwater, surface water, and sediment pore water would be used as sources of drinking water and also assumed residential exposure to surface soil and sediment in Chickamuxen Creek.

#### Toxicity Assessment

Toxicity assessment involves identifying the types of adverse health effects caused by exposure to site COPCs and determining the relationship between the magnitude of exposure and the severity of adverse effects (i.e., dose-response relationship) for each COPC. Because only a risk screening evaluation (comparisons to RBCs) was conducted for Site 36, site-specific toxicity values were not derived, and the default toxicity values used to generate the residential soil and tap water RBCs were used to estimate risk.

#### Risk Characterization

The baseline risks (cancer risks and non-cancer hazards) at the site were conservatively estimated by dividing maximum concentrations by RBCs, assuming no action was taken to address the contamination. For carcinogens, the incremental lifetime cancer risk (ILCR) was calculated for each COPC by first dividing the maximum concentration by the RBC based on an ILCR of $1X10^{-6}$ and then multiplying the result by 1E-06. The individual ILCRs were then added and compared to the EPA acceptable risk range of $1X10^{-6}$ to $1X10^{-4}$. A carcinogenic risk range of $1X10^{-6}$ to $1X10^{-4}$ means that between one in one million

and one in ten thousand individuals exposed to contaminants present at the site will contract cancer as a result of that exposure. If the total ILCR is within or less than this range, no action is needed at a site based on potential carcinogenic risk. For non-carcinogens, the hazard quotient (HQ) was calculated for each COPC by dividing the maximum concentration by the RBC, the level at which no adverse health effects are anticipated to occur. An HQ of 1.0 would, therefore, indicate that no adverse health effects were anticipated. The individual HQs were added to calculate the hazard index (HI), which was compared to the EPA acceptable level of 1.0. If the HI is less than this value, no action is needed based on potential non-carcinogenic hazards. The results of these calculations are presented in Table 4-13 (from the SSP Report) in Appendix B.

The estimated total ILCR for the future resident is $7.6X10^{-4}$, which is greater than the EPA acceptable risk range of $1X10^{-6}$ to $1X10^{-4}$. The main component of this risk is from exposure to arsenic in shallow groundwater (ILCR of $5.2X10^{-4}$). The estimated ILCR for exposure to sediment pore water is $1.1X10^{-4}$, which is slightly greater than the EPA acceptable risk range. The primary risk driver is arsenic. The evaluation conservatively assumed that sediment pore water would be used as a source of drinking water; however, this assumption is very conservative, and the risk estimate is considered to be biased high. The estimated ILCR for exposure to sediment is $1.1X10^{-4}$, which is also slightly greater than the EPA acceptable risk range. The primary risk drivers are benzo(a)pyrene, benzo(b)fluoranthene, and arsenic. The evaluation conservatively assumed that exposure to sediment would be the same as exposure to surface soil under a residential land use scenario (350 days per year). However, this assumption is very conservative, and the risk estimate is considered to be biased high because exposure to sediment under a realistic residential exposure scenario would be much less frequent. There are no unacceptable carcinogenic risks from exposure to surface soil or surface water.

The estimated total cumulative HI is 21, which is greater than the EPA threshold of 1.0. HIs are greater than 1.0 for shallow groundwater (7.7), sediment pore water (8.0), and sediment (4.6). Risk drivers for shallow groundwater are arsenic (HI = 2.0), iron (HI = 2.6), and manganese (HI = 2.1). Risk drivers for pore water are iron (HI = 3.2) and manganese (HI = 3.7), and the only risk driver for sediment is iron (HI = 1.7). The non-carcinogenic risk estimates for exposure to sediment pore water and sediment are considered to be biased high for the reasons stated above. There are no unacceptable non-carcinogenic risks for exposure to surface soil or surface water.

In summary, the only estimated unacceptable human health risk is associated with exposure to shallow groundwater as a potable supply. COCs include arsenic, iron, and manganese. There is also an inherent risk from exposure to buried landfill waste.

### 2.7.2 Summary of Ecological Risk

The screening-level ecological risk assessment (ERA) was conducted in accordance with EPA guidance (EPA, 1997 and 1998) and Navy policy (DoN, 1999). Step 1 of the ERA consisted of pathway identification/problem formulation, and Step 2 included exposure assessment and calculation of risk based on conservative exposure assumptions. Step 3a involved refinement of the list of previously identified COPCs and recalculation of risks based on more realistic exposure assumptions. Ecological risks were evaluated using data from surface soil, surface water, sediment, and pore water samples; groundwater was not evaluated because ecological receptors are not directly exposed to this medium.

Analytical results from the SSP were first compared to conservative screening criteria to develop an initial list of COPCs. Soil screening values included EPA Ecological SSLs and Region 3 Biological Technical Assistance Group (BTAG) soil screening levels. Region 3 BTAG screening levels for freshwater were used as surface and pore water screening values, and Region 3 BTAG screening levels for freshwater sediment were used as sediment screening values. A chemical was selected as a COPC if its maximum site concentration exceeded the applicable screening criterion (concentrations of inorganics in surface soil were also compared to background concentrations). Ecological COPCs were identified in all media evaluated based on the initial conservative evaluation (see Tables 4-14 through 4-19 from the SSP in Appendix B).

To further evaluate these COPCs, Step 3A was conducted to reduce uncertainties associated with the conservative screening process. As part of this step, COPCs were evaluated with respect to alternative screening values, and other factors such as frequency of detection and spatial analyses were included to provide a more realistic estimation of ecological risk. In addition, because potential risk was estimated for benthic macroinvertebrates based on contaminant concentrations in sediment (based on conservative screening), **site-specific benthic macroinvertebrate** analyses were conducted and **AVS/SEM concentrations** were measured to provide bioavailability data. The results of these two analyses were used in a weight-of-evidence approach to determine whether benthic invertebrates were being impacted as a result of Site 36 contamination. Also as part of COPC refinement, food-chain modeling was conducted to evaluate risks to wildlife (upper trophic-level receptors) from bioaccumulative chemicals detected in soil, surface water, and sediment. Representative receptors identified for Site 36 included herbivores (bobwhite quail and meadow vole), insectivores (American woodcock and short-tailed shrew), and piscivores (great blue heron and raccoon). Results are summarized in Table 4-20 through 4-21 from the SSP in Appendix B.

Based on the results of COPC refinement evaluations, unacceptable risks were estimated for aquatic organisms from exposure to surface water and for benthic macroinvertebrates from exposure to sediment and sediment pore water. Although unacceptable risks to aquatic organisms were estimated in the initial SSP report based on a comparison of chemical concentrations in surface water to criteria, a subsequent more detailed ecological evaluation determined that the primary receptors of concern at the site were benthic macroinvertebrates exposed to chemicals in the sediment and sediment pore water. Therefore, further evaluation of risks to aquatic organisms was not necessary and only a study to evaluate the health of the benthic community in the creek was necessary to assess the ecological impact of site-related contaminants on the creek.

Results from benthic macroinvertebrate surveys indicate that the benthic community is not being adversely affected by chemicals detected in sediment near Site 36. Additionally, metals detected in sediment are not expected to be bioavailable based on evaluation of AVS/SEM results. Based on the results of this site-specific evaluation of benthic macroinvertebrate toxicity, risks to these organisms from site contaminants were determined to be acceptable. In addition, results from food-chain modeling indicate that terrestrial wildlife is not at risk from detected chemical concentrations in surface soil and sediment. Therefore, there are **no unacceptable ecological risks** at Site 36.

### 2.7.3 Basis for Action

Unacceptable human health risks were estimated for exposure to arsenic, iron, and manganese in shallow groundwater under a residential exposure scenario, and there is also an inherent risk from exposure to buried landfill waste. Because unacceptable risks were identified, the response action selected in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

## 2.8 REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals that help to define the objective of the remedial actions to protect human health and the environment. RAOs specify the COCs, potential exposure routes and receptors, and acceptable concentrations (i.e., cleanup levels) for a site and provide a general description of what the cleanup will accomplish. RAOs typically serve as the design basis for the remedial alternatives described in Section 2.8. The RAOs for Site 36 are as follow:

- Prevent direct exposure of human and environmental receptors to contaminant sources at the landfill and to contaminants migrating from the landfill via surface water runoff and erosion, infiltration to groundwater and groundwater migration, or wind erosion and dust migration.

- Prevent human exposure to contaminants in site groundwater that exceed MCLs.

## 2.9 DESCRIPTION OF ALTERNATIVES

To address potential unacceptable human health risks associated with Site 36, a **preliminary technology screening** evaluation was conducted in the FS (TtNUS, 2010). The general response actions that were considered are presented in Table 2-2. In-situ treatment options were not considered based on the heterogeneous nature of the waste materials and type of contamination at Site 36 (i.e., relatively low concentrations of metals with relatively low toxicities).

**Table 2-2. General Response Actions**

| General Response Action | Process Options |
|---|---|
| No Action | None |
| Institutional Action | Shallow Groundwater and Land Use Restrictions |
| Containment | Soil Cover |
| | Multimedia Cap |
| | Riprap Erosion Control |
| | Vegetative Erosion Control |
| Removal | Excavation |
| Disposal | On-Site Consolidation |
| | Off-Site Landfill |

The technologies and process options retained after detailed screening were assembled into five alternatives. Consistent with the NCP, the no action alternative was evaluated as a baseline for comparison with other alternatives during the comparative analysis. Table 2-3 describes the major components and provides estimated costs for each remedial alternative identified for Site 36.

**TABLE 2-3. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED**

| ALTERNATIVE | COMPONENTS | DETAILS | COST |
|---|---|---|---|
| **Alternative 1 – No Action** *No action to address contaminated groundwater or landfill materials and no use restrictions* | None | No action; five-year reviews would be implemented. | **Capital: $0** **30-Year NPW of O&M Cost:** $42,700 **Discount rate:** 7% **Time frame to achieve RAOs:** N/A |
| **Alternative 2 – Debris Removal, LUCs and Monitoring** *Limiting site use and access to control exposure to contaminated groundwater and landfill materials* | Debris Removal | Removal of metal debris along shoreline and resale as scrap. | **Capital**: $91,000 **30-Year NPW of O&M Cost**: $267,000 **30-Year NPW**: $358,000 **Discount rate**: 7% **Time frame to achieve RAOs**: ~1 month |
| | LUCs | Implementation of LUCs to prevent unauthorized excavation, residential development, and use of shallow groundwater. Refer to Section 2.12.2 for additional information related to LUCs. | |
| | Maintenance of existing soil and vegetative cover | Periodic inspection and maintenance of soil cover to prevent direct exposure to landfill waste. | |
| | Monitoring | Sampling to confirm that no groundwater contaminants are migrating from the site at unacceptable levels. Refer to Section 2.12.2 for additional information related to monitoring. | |
| | Five-Year Reviews | Site reviews to evaluate monitoring results and site status to review laws and to provide direction for further action if required to ensure continued protectiveness of the remedy. | |
| **Alternative 3 – Soil Cover, LUCs, and Monitoring** *Installation of a soil cover and implementation of LUCs to prevent exposure to and* | Debris Removal | Removal of metal debris along shoreline and resale as scrap. | **Capital**: $1,094,000 **30-Year NPW of O&M Cost**: $267,000 |
| | Soil Cover | Covering of 3.4 acres with a minimum of 18 inches of clean fill and 6 inches of topsoil, grading, and revegetation. | |
| | LUCs | Implementation of LUCs to prevent unauthorized | |

**TABLE 2-3. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED**

| ALTERNATIVE | COMPONENTS | DETAILS | COST |
|---|---|---|---|
| *migration of landfill materials and contaminated groundwater* | | excavation, residential development, and use of shallow groundwater. | 30-Year NPW: $1,361,000 **Discount rate**: 7% **Time frame**: ~2 months |
| | Monitoring | Sampling to confirm that no groundwater contaminants are migrating from the site at unacceptable levels. | |
| | Five-Year Reviews | Site reviews to evaluate monitoring results and site status to review laws and to provide direction for further action if required to ensure continued protectiveness of the remedy. | |
| **Alternative 4 – Engineered Cap, LUCs, and Monitoring** *Installation of a multilayer cap and implementation of LUCs to prevent exposure to and migration of landfill materials and contaminated groundwater* | Debris Removal | Removal of metal debris along shoreline and resale as scrap. | **Capital**: $2,887,000 **30-Year NPW of O&M**: $267,000 30-Year NPW: $3,154,000 **Discount rate**: 7% **Time frame**: ~4 months |
| | Engineered Cap | Installation over 3.4 acres of a multilayer cap system including a synthetic geomembrane and with vegetative stabilization on the final grade (in compliance with COMAR 26.04.07.21). | |
| | LUCs | Implementation of LUCs to prevent unauthorized excavation, residential development, and use of shallow groundwater. | |
| | Monitoring | Sampling to confirm that no groundwater contaminants are migrating from the site at unacceptable levels. | |
| | Five-Year Reviews | Site reviews to evaluate monitoring results and site status to review laws and to provide direction for further action if required to ensure continued protectiveness of the remedy. | |
| **Alternative 5 – Landfill Removal** *Excavation and off-site disposal of the entire landfill to eliminate all human health and environmental exposure pathways* | Debris Removal | Removal of metal debris along shoreline and resale as scrap. | **Capital**: $18,952,000 30-Year NPW **of O&M**: $0 **30-Year NPW**: $18,952,000 **Discount rate**: 7% **Time frame**: 16 months |
| | Landfill Removal | Removal of an estimated 56,000 cubic yards of waste, transportation to and disposal in an off-site permitted non-hazardous waste landfill, and backfilling to allow the site to revert to open water in Chickamuxen Creek or be converted into a wetland. | |

## 2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 2-4 and subsequent text in this section summarize the comparison of the remedial alternatives with respect to the **nine CERCLA evaluation criteria**, which are categorized as threshold, primary balancing, and modifying, and are outlined in the NCP at 40 Code of Federal Regulations (CFR) 300.430(e)(9)(iii). Further information on the detailed comparison of remedial alternatives is presented in the Site 36 FS.

**TABLE 2-4. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES**

| CERCLA CRITERION | 1 - NO ACTION | 2 - LUCS AND MONITORING | 3 - SOIL COVER, LUCS, AND MONITORING | 4 - ENGINEERED CAP, LUCS, AND MONITORING | 5 - LANDFILL REMOVAL |
|---|---|---|---|---|---|
| Overall Protection of Human Health and the Environment | ○ | ● | ● | ● | ● |
| Compliance with **Applicable or Relevant and Appropriate Requirements** (ARARs) | ○ | ● | ● | ● | ● |
| Long-Term Effectiveness and Permanence | ○ | ◍ | ◍ | ◍ | ● |
| Reduction of Toxicity, Mobility, and Volume through Treatment | ○ | ○ | ○ | ○ | ○ |

**TABLE 2-4. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES**

| CERCLA CRITERION | 1 - NO ACTION | 2 - LUCS AND MONITORING | 3 - SOIL COVER, LUCS, AND MONITORING | 4 - ENGINEERED CAP, LUCS, AND MONITORING | 5 - LANDFILL REMOVAL |
|---|---|---|---|---|---|
| Short-Term Effectiveness | ○ | ● | ◎ | ◎ | ○ |
| Implementability | ● | ● | ● | ● | ◎ |
| Total Cost (Present Net Worth) | $42,700 | $358,000 | $1,361,000 | $3,154,000 | $18,952,000 |
| State Acceptance | ○ | ● | ● | ● | ● |
| Community Acceptance | ○ | ●* | ●* | ●* | ●* |

● - High. ◎ - Medium. ○ - Low.

*Although no written comments were received from the public regarding the merits of the alternatives considered, the public did not voice any objections to the proposed remedy or the other active remedies at the public meeting. The questions asked at the public meeting were general inquiries for informational purposes only.

## Threshold Criteria

***Overall Protection of Human Health and the Environment.*** The no action alternative would not achieve RAOs and, therefore, would not protect human health and the environment. This alternative is not considered further in this ROD.

Alternative 5 would provide the most protection of human health and the environment because all landfill waste would be removed. Although Alternatives 3 and 4 would both provide additional cover material to further minimize direct contact with buried waste, Alternative 4 would be slightly more protective than Alternative 3 because the engineered cap would be expected to create a more effective barrier. Alternative 2 would rely on the existing cover material to minimize direct contact and, given the extent of contamination, it would protect human health adequately. Unlike Alternative 5, which would remove all waste and thus would not require LUCs, Alternatives 2, 3, and 4 would rely on LUCs to restrict land and groundwater use.

***Compliance with ARARs.*** ARARs include any federal or state standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate to the site or remedial action. Chemical-specific ARARs associated with the site are the applicable MCLs. Alternatives 2, 3, 4, and 5 equally comply with all location-specific ARARs associated with work in wetlands and surface water. Alternatives 4 and 5 both comply equally with action-specific ARARs, and Alternative 4 also would comply with state post-closure maintenance and monitoring requirements. These requirements are not applicable to Alternative 5 because all landfilled material would be removed. Unlike Alternative 4, Alternatives 2 and 3 require an MDE variance to meet the requirements in COMAR 26.04.07.21 related to the design criteria for landfill caps. ARARs associated with Site 36 are summarized in Appendix C.

## Primary Balancing Criteria

***Long-Term Effectiveness and Permanence***. Alternative 5 would be the most protective over the long term, and Alternatives 2, 3, and 4 would be potentially less protective because waste would remain on site. Alternative 2 would be equally as permanent as Alternatives 3, 4, and 5. If contamination does not migrate (as expected), Alternative 2 would be equally as effective in the long term as Alternatives 3 and 4. However, the long-term effectiveness of all of these alternatives would be monitored, and corrective

measures could be taken if necessary. The engineered cap included under Alternative 4 would reduce infiltration and contaminant migration more efficiently than the soil cover under Alternative 3. Although infiltration and off-site contaminant migration are not posing unacceptable risks to human health or the environment, prevention of exposure from infiltration to and migration of groundwater is part of the landfill closure RAO. Monitoring included under Alternatives 2, 3, and 4 would help in confirming the effectiveness of these alternatives in the long term to the same degree because the same monitoring plan would be implemented.

***Reduction in Toxicity, Mobility, or Volume Through Treatment***. None of the alternatives would utilize treatment to reduce the toxicity, mobility, or volume of hazardous substances.

***Short-Term Effectiveness***. There would be no adverse impact on the community from implementation of Alternatives 2, 3, and 4, but for Alternative 5, hauling waste off site would generate additional traffic. There would be no adverse impacts to on-site workers from implementation of Alternative 2, and exposure to contaminated materials by workers would be controlled for Alternatives 3, 4, and 5. There would be no adverse impacts to the environment for Alternative 2; however, for Alternatives 3, 4, and 5, existing vegetation would need to be removed. Alternatives 3 and 4 would require destroying the existing ecological habitat until the vegetation planted becomes established. Alternative 5 would have similar effects on the ecological habitat, but the impacts would be mitigated through site restoration following the landfill removal with the entire landfill area returned to wetland.

Alternatives 3, 4, and 5 would have short-term impacts on Chickamuxen Creek and associated wetlands because erosion and sediment controls would need to be established along the landfill perimeter (within the creek) for each of these alternatives. Alternative 2 would take approximately 1 month to achieve RAOs compared to 2 months for Alternative 3, 4 months for Alternative 4, and 16 months for Alternative 5.

***Implementability***. Alternative 2 is the easiest to implement and would be completed in the shortest amount of time. Alternative 3 would be somewhat more difficult because it would require installing a soil cap. Alternative 4 would be even more difficult and take longer because the engineered cap is more complex. Equipment and services necessary to remove debris from the shoreline, construct a soil cover, and construct an engineered cap are readily available. Land and groundwater use restrictions could be strictly enforced because the site is located within an active military facility.

Alternative 5 would be the most difficult to implement. There are implementability concerns associated with excavation of waste below the water table and dewatering excavated materials. As the landfill is removed, there would be less area available to construct dewatering pads. As NSF-IH policies require that all waste disposed off site undergo screening to detect the presence of ordnance, this alternative would involve rigorous procedures for munitions and explosives of concern (MEC) avoidance, removal, treatment/demilitarization, and disposal. It would be difficult to check for the presence of MEC during excavation below the water table.

***Cost***. The estimated present-worth cost is greatest for Alternative 5 at $18,952,000 and least for Alternative 1 at $42,700. Costs for Alternatives 2, 3 and 4 are $358,000, $1,361,000, and $3,154,000, respectively.

## Modifying Criteria

***State Acceptance***. State involvement has been solicited throughout the CERCLA process. MDE has indicated its support for Alternatives 2 through 5; MDE concurs with the Selected Remedy.

***Community Acceptance***. No written comments were received during the formal public comment period for the Proposed Plan. The questions raised at the public meeting on April 15, 2010, were general inquiries for informational purposes only; no objections to the proposed alternative were voiced.

## 2.11 PRINCIPAL THREAT WASTE

The NCP at 40 CFR 300.430(a)(1)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or that would present a significant risk to human health or the environment should exposure occur. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure. Principal threat wastes are not present at Site 36, because the arsenic, manganese and iron groundwater contamination is inert, not highly toxic, and not highly mobile.

## 2.12 SELECTED REMEDY

### 2.12.1 Rationale for Selected Remedy

The Selected Remedy for Site 36 is Alternative 2 - Debris Removal, LUCs, Monitoring, and Five-Year Reviews, which was selected because it provides the best balance of tradeoffs with respect to the nine evaluation criteria. Based on the results of investigations conducted, the Navy, EPA, and the MDE have determined that this alternative will be protective of human health and the environment by implementing land and groundwater use restrictions and monitoring. It has been determined that the existing cover will adequately meet the threshold criteria.

The principal factors in the selection of this remedy included the following:

- It is the most cost-effective solution that addresses the RAOs and can be implemented in a short time frame (approximately 1 month).
- The remedy is consistent with the reasonably anticipated future non-residential use of the site.

### 2.12.2 Description of Selected Remedy

The Selected Remedy includes the removal of metal debris along the shoreline, implementing LUCs to protect human health by prohibiting unauthorized excavation, residential land use, or shallow groundwater use. Monitoring will be performed to confirm that contaminants are not migrating off site to Chickamuxen Creek at unacceptable levels.

This remedy does not comply with state closure standards for sanitary landfills that require an impermeable cap; however, a variance to the design was accepted by MDE because the existing soil cover protects public health, protects and conserves natural resources and the environment, and controls air, water, and land pollution to the same extent as would be obtained by an engineered cover.

Maintenance of the existing soil and vegetative cover will be performed to prevent direct exposure to landfill contents and to minimize erosion by surface water and wind. Maintenance of the cover will also minimize surface water runoff and infiltration to groundwater, thereby preventing the migration of contaminants from the landfill.

Large pieces of metal debris along the shoreline will be removed and disposed off site or recycled. Land and groundwater use restrictions will be implemented to eliminate or reduce exposure pathways. LUCs will consist of maintaining records of the restrictions in the NSF-IH Geographical Information System (GIS), which will enable the Navy to take adequate measures to minimize adverse human health effects at the time of any future land development. Unauthorized excavation, residential land use, and shallow groundwater use will not be permitted.

LUCs will be implemented within the Site 36 boundaries to limit use of the property and to prevent use of groundwater (refer to Figure 2-2). Consistent with the RAOs developed for the site, the specific performance objectives for the LUCs to be implemented at Site 36 are as follows:

- To prohibit residential reuse of the site until contaminants at the site are at levels that allow for unlimited use and unrestricted exposure. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities.

- To prohibit all uses of groundwater from beneath Site 36, including, but not limited to, human consumption, dewatering, irrigation, heating/cooling purposes, and industrial processes until contaminants at the site are at levels that allow for unlimited use and unrestricted exposure, unless prior written approval is obtained from the Navy, EPA, and MDE.

- To prohibit excavation/disturbance of surface and subsurface soil from the site.

- To maintain the integrity of any existing or future monitoring or remediation system(s).

The following generally describes those LUCs that will be implemented at Site 36 to achieve the aforementioned LUC performance objectives:

- Incorporation of the LUCs and the associated site area into the facility's GIS system.

- Installation of fencing and signs to warn potential trespassers and site users of potential for exposure to landfill materials.

- Incorporation of use restrictions into any real estate property documents (i.e., deeds or leases) associated with future sale or lease of the site.

- Annual inspections to ensure that there are no violations of these restrictions. The Installation Commander will provide annual certification of the inspections to EPA and MDE.

- If a violation of the restrictions occurs, a description of the violation and the corrective actions to be taken to restore protectiveness will be reported to EPA and MDE.

Because landfill materials will be left in place, LUCs will be required as long as waste remains in place at the site. The Navy is responsible for implementing, maintaining, reporting on, and enforcing the LUCs described in this ROD. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for the remedy integrity.

The LUC implementation actions including monitoring and enforcement requirements will be provided in an LUC Remedial Design (RD) that will be prepared by the Navy as the LUC component of the overall RD. Within 90 days of ROD signature, the Navy shall prepare and submit to EPA and MDE for review and comment (pursuant to those Primary Document review procedures stipulated in the FFA) the LUC RD for Site 36 that shall contain implementation and maintenance actions, including periodic inspections. The Navy will maintain, monitor, and enforce the LUCs according to the LUC RD. LUCs will be developed as part of the remedial design Implementation of this remedy will require a survey of the site, annual visual inspections, and a five-year review with report preparation.

Monitoring of shallow groundwater will be conducted to confirm that groundwater contaminant migration to Chickamuxen Creek is not occurring at unacceptable levels A long-term monitoring plan will be developed, with EPA and MDE concurrence, to finalize the sampling program. The long-term monitoring plan will include sampling locations, analytical parameters and frequency.

At least every 5 years, a site review will be conducted to evaluate the protectiveness of the selected remedy, to evaluate site status, and to determine whether further action is necessary. These site reviews are required because this alternative will allow contaminants to remain at the site in excess of levels that allow for unlimited use and unrestricted exposure.

### 2.12.3 Expected Outcomes of Selected Remedy

The current land use, which will be supported by the Selected Remedy, is expected to continue at Site 36, and there are no other planned land uses in the foreseeable future. Because the landfill contains municipal-type waste, the existing stable landfill cover system is sufficient for addressing the RAOs. The use of shallow groundwater from Site 36 will be prohibited. Groundwater can never be used for potable uses because state regulations (COMAR 26.04.04.05.B) prohibit potable water supply wells in unconfined aquifers within 100 feet of identifiable sources of contamination. The only risks to human health are for the hypothetical future residential scenario, and LUCs will control potential exposure in this scenario. Because there is no unacceptable risk to ecological receptors, they will remain unaffected. Removal of metal debris from the Chickamuxen Creek shoreline will provide environmental and ecological benefits.

There are no anticipated socio-economic, community revitalization, or economic impacts associated with the Selected Remedy. It is estimated that the RAOs will be achieved within 1 month of implementation of the remedy.

Table 2-5 describes how the Selected Remedy mitigates risk and achieves RAOs for Site 36.

**TABLE 2-5. HOW SELECTED REMEDY MITIGATES RISK AND ACHIEVES RAOS**

| RISK | RAO | COMMENTS |
|---|---|---|
| Inherent risk from exposure to landfill materials and migration of associated contaminants | Prevent direct exposure of human and environmental receptors to contaminant sources at the landfill and to contaminants migrating from the landfill via surface water runoff and erosion, infiltration to groundwater and groundwater migration, or wind erosion and dust migration. | Maintenance of the existing soil and vegetative cover will prevent direct exposure to landfill contents and will minimize erosion by surface water and wind. It will also minimize surface water runoff and infiltration to groundwater thereby preventing the migration of contaminants from the landfill. |
| Unacceptable risk from hypothetical future use of groundwater under a residential scenario | Prevent human exposure to contaminants in site groundwater that exceed MCLs. | LUCs will prevent exposure to groundwater contaminants by prohibiting residential development and groundwater use. |

Because landfill materials will remain at the site, LUCs are expected to be required in perpetuity and it is not expected that modification or removal of the LUCs will be required.

## 2.13 STATUTORY DETERMINATIONS

In accordance with the NCP, the Selected Remedy meets the following statutory determinations:

- **Protection of Human Health and the Environment** – The Selected Remedy will protect human health by reducing the potential for human exposure to landfill waste through dermal contact and exposure to groundwater within the waste through ingestion and dermal contact.
- **Compliance with ARARs** – The Selected Remedy will comply with all associated ARARs since a variance from the state closure requirements for sanitary landfills has been granted by MDE. Appendix D provides the correspondence related to the variance.
- **Cost-Effectiveness** – The Selected Remedy is the most cost-effective alternative that complies with all associated ARARs and protects human health and the environment.
- **Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** – The Selected Remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be

used in a practical manner at Site 36. Based on the type and volume of contamination at Site 36 (i.e., large volume of soil contaminated with metals posing relatively low long-term threat), no treatment alternatives were evaluated for Site 36 in the FS (TtNUS, 2010). Implementing LUCs and monitoring provides the best balance of tradeoffs for long-term effectiveness and permanence with ease of implementation for reasonable cost.

- **Preference for Treatment as a Principal Element** – Treatment is not an element of the Selected Remedy for soil at Site 36 because there are no principal threat wastes at the site, and land use controls and monitoring provides the best balance of tradeoffs with respect to long-term effectiveness and permanence at a reasonable cost.
- **Five-Year Review Requirement** – Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action and every 5 years thereafter to ensure that the remedy is, or will be, protective of human health and the environment.

## 2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of significant changes from the selected remedy presented in the Proposed Remedial Action Plan that was published for public comment. Several general questions were asked during the public meeting held on April 15, 2010, but no formal comments were received from the public during the comment period. No significant changes to the remedy, as originally identified in the Proposed Remedial Action Plan, were necessary or appropriate.

# 3.0 RESPONSIVENESS SUMMARY

## 3.1 STAKEHOLDER COMMENTS AND LEAD AGENCY RESPONSES

The 30-day public comment period for the Selected Remedy for Site 36 began on April 12, 2010, and ended on May 12, 2010. A public meeting was held on April 15, 2010 at the Indian Head Senior Center, 100 Cornwallis Square, Indian Head, Maryland, to accept oral and written comments on this decision. No written comments were received during the formal public comment period for the Proposed Plan. The questions raised at the public meeting on April 15, 2010, were general inquiries for informational purposes only; no objections to the proposed alternative were voiced.

## 3.2 TECHNICAL AND LEGAL ISSUES

No technical or legal issues associated with the Site 36 ROD were identified.

# ACRONYMS

| | |
|---|---|
| ARAR | Applicable or relevant and appropriate requirement |
| AVS | Acid volatile sulfide |
| bgs | Below ground surface |
| BTAG | Biological Technical Assistance Group |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COC | Chemical of concern |
| COMAR | Code of Maryland Regulations |
| COPC | chemicals of potential concern |
| CSM | Conceptual Site Model |
| DoN | Department of the Navy |
| EOD | Explosives Ordnance Disposal |
| EPA | United States Environmental Protection Agency |
| EPC | Exposure Point Concentration |
| ERA | Ecological Risk Assessment |
| ER,N | Environmental Restoration, Navy |
| GIS | Geographic Information System |
| HI | Hazard index |
| HQ | Hazard quotient |
| IAS | Initial Assessment Study |
| ILCR | Incremental lifetime cancer risk |
| IR | Installation Restoration |
| LUC | Land use control |
| MCL | Maximum Contaminant Level |
| MDE | Maryland Department of the Environment |
| MEC | Munitions and explosives of concern |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NPW | Net Present Worth |
| NSF-IH | Naval Support Facility Indian Head |
| O&M | Operation and maintenance |
| PAH | Polynuclear aromatic hydrocarbon |
| RAB | Restoration Advisory Board |
| RAO | Remedial action objective |
| RBC | Risk Based Concentrations |
| RD | Remedial Design |
| ROD | Record of Decision |
| SARA | Superfund Amendments and Reauthorization Act |

| | |
|---|---|
| SEM | Simultaneously extracted metals |
| SMP | Site Management Plan |
| SSI | Site Screening Investigation |
| SSL | Soil Screening Level |
| SSP | Site Screening Process |
| SVOC | Semivolatile organic compound |
| TAL | Target Analyte List |
| Tetra Tech | Tetra Tech NUS, Inc. |
| VOC | Volatile organic compound |

# Administrative Record Reference Table

# DETAILED ADMINISTRATIVE RECORD REFERENCE TABLE

| ITEM | REFERENCE PHRASE IN ROD | LOCATION IN ROD | LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD |
|---|---|---|---|
| 1 | **elevated concentrations of metals** | Section 2.2 | Tetra Tech, 2008. Site Screening Process Report, Site 36 – Closed Landfill, Naval Support Facility, Indian Head, Maryland. Prepared for Naval Facilities Engineering Command Washington, Washington Navy Yard, D.C. King of Prussia, Pennsylvania. Page 4-3. |
| 2 | **groundwater** | Section 2.2 | Tetra Tech, 2008. Page 4-5. |
| 3 | **geophysical anomalies** | Table 2-1 | Tetra Tech, 2008. Page 4-1. |
| 4 | **installation of three monitoring wells** | Table 2-1 | Tetra Tech, 2008. Page 2-1. |
| 5 | **nine locations** | Table 2-1 | Tetra Tech, 2008. Page 2-2. |
| 6 | **Remedial alternatives** | Table 2-1 | Tetra Tech, 2010. Feasibility Study, Site 36 – Closed Landfill, Naval Support Facility, Indian Head, Maryland. Prepared for Naval Facilities Engineering Command Washington, Washington Navy Yard, D.C. King of Prussia, Pennsylvania. Page 4-3. |
| 7 | **Public notice** | Section 2.3 | Public Notice for the Proposed Remedial Action Plan for Site 36 published in the Maryland Independent, April 9, 2010. |
| 8 | **contamination** | Section 2.5.2 | Tetra Tech, 2008, Page 4-5. |
| 9 | **Human health and ecological risk screening** | Section 2.7 | Tetra Tech, 2008. Pages 4-5 and 4-8. |
| 10 | **exposure assessment** | Section 2.7.1 | Tetra Tech, 2008. Page 3-5. |
| 11 | **site-specific benthic macroinvertebrate** | Section 2.7.2 | Tetra Tech, 2008. Page 3-9. |
| 12 | **AVS/SEM concentrations** | Section 2.7.2 | Tetra Tech, 2008. Page 4-14. |
| 13 | **No unacceptable ecological risks** | Section 2.7.2 | Tetra Tech, 2008. Page 4-22. |
| 14 | **preliminary technology screening** | Section 2.9 | Tetra Tech, 2010. Table 3-1 |
| 15 | **30-Year NPW** | Table 2-3 | Tetra Tech, 2010. Appendix A. |
| 16 | **nine CERCLA evaluation criteria** | Section 2.10 | Tetra Tech, 2010. Page 5-1. |
| 17 | **chemical-, location-, and action-specific ARARs** | Table 2-4 | Tetra Tech, 2010. Page 2-2. |

# ADDITIONAL REFERENCES

DoN (Department of the Navy), 1999. Navy Policy for Conducting Ecological Risk Assessments. Memo from Chief of Naval Operations to Commander, Naval Facilities Engineering Command, 05 April 1999, Department of the Navy, Washington, D.C.

EPA, 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. EPA-540-R-97-006, Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1998. Final Guidelines for Ecological Risk Assessment. EPA/630/R-95/002F, Risk Assessment Forum, Washington, D.C.

# Appendix A
# Cost Estimate

**NAVAL SUPPORT FACILITY - INDIAN HEAD**
**Indian Head, Maryland**
**Site 36 - Closed Landfill**
**Alternative 2: LUCs and Monitoring**
**Capital Cost**

| Item | Quantity | Unit | Unit Cost Subcontract | Unit Cost Material | Unit Cost Labor | Unit Cost Equipment | Extended Cost Subcontract | Extended Cost Material | Extended Cost Labor | Extended Cost Equipment | Subtotal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1 PROJECT PLANNING & DOCUMENTS** | | | | | | | | | | | |
| 1.1 Prepare LUC Documents | 150 | hr | | | $37.00 | | $0 | $0 | $5,550 | $0 | $5,550 |
| 1.2 Prepare Documents & Plans including Permits | 50 | hr | | | $37.00 | | $0 | $0 | $1,850 | $0 | $1,850 |
| 1.3 Prepare Monitoring Plan | 120 | hr | | | $37.00 | | $0 | $0 | $4,440 | $0 | $4,440 |
| 1.4 Completion Report | 20 | hr | | | $37.00 | | $0 | $0 | $740 | $0 | $740 |
| **2 MOBILIZATION AND DEMOBILIZATION** | | | | | | | | | | | |
| 2.1 Equipment Mobilization/Demobilization | 2 | ea | | | $170.00 | $522.00 | $0 | $0 | $340 | $1,044 | $1,384 |
| **3 FIELD SUPPORT** | | | | | | | | | | | |
| 3.1 Site Superintendent | 5 | day | | $129.00 | $384.64 | | $0 | $645 | $1,923 | $0 | $2,568 |
| 3.2 Site Health & Safety and QA/QC | 5 | day | | $129.00 | $307.68 | | $0 | $645 | $1,538 | $0 | $2,183 |
| **4 DEBRIS REMOVAL** | | | | | | | | | | | |
| 4.1 Excavator | 5 | day | | | $330.80 | $1,619.00 | $0 | $0 | $1,654 | $8,095 | $9,749 |
| 4.2 Site Labor, (3 laborers) | 5 | day | | | $690.00 | | $0 | $0 | $3,450 | $0 | $3,450 |
| 4.3 Debris Removal & Disposal | 40 | ton | $56.00 | | | | $2,240 | $0 | $0 | $0 | $2,240 |
| **Subtotal** | | | | | | | $2,240 | $1,290 | $21,486 | $9,139 | $34,155 |
| Overhead on Labor Cost @ 30% | | | | | | | | | $6,446 | | $6,446 |
| G & A on Labor Cost @ 10% | | | | | | | | | $2,149 | | $2,149 |
| G & A on Material Cost @ 10% | | | | | | | | $129 | | | $129 |
| G & A on Equipment Cost @ 10% | | | | | | | | | | $914 | $914 |
| G & A on Subcontract Cost @ 10% | | | | | | | $224 | | | | $224 |
| Tax on Materials and Equipment Cost @ 6% | | | | | | | | $77 | | $548 | $626 |
| **Total Direct Cost** | | | | | | | $2,464 | $1,496 | $30,080 | $10,601 | $44,641 |
| Indirects on Total Direct Cost @ 30% | | | | | | | | | | | $13,392 |
| Profit on Total Direct Cost @ 10% | | | | | | | | | | | $4,464 |
| **Subtotal** | | | | | | | | | | | $62,498 |
| Health & Safety Monitoring @ 0% | | | | | | | | | | | $0 |
| **Total Field Cost** | | | | | | | | | | | $62,498 |
| Contingency on Total Field Costs @ 25% | | | | | | | | | | | $15,625 |
| Engineering on Total Field Cost @ 20% | | | | | | | | | | | $12,500 |
| **TOTAL CAPITAL COST** | | | | | | | | | | | **$90,622** |

**NAVAL SUPPORT FACILITY - INDIAN HEAD**
**Indian Head, Maryland**
**Site 36 - Closed Landfill**
**Alternative 2: LUCs and Monitoring**
**Annual Cost**

| Item | Item Cost years 1 - 30 | Item Cost every 5 years | Notes |
|---|---|---|---|
| Site Inspection | $6,266 | | Labor and supplies to visit site once a year to inspect Land Use Controls with Report |
| Monitoring Sampling | $8,750 | | Labor and supplies to collect 11 samples from 3 wells and 4 sediment/surface water samples, annually years 1-30. |
| Monitoring Sampling Analysis/Water | $1,155 | | Analyze groundwater samples for iron, manganese and arsenic including QA/QC cost. |
| IDW Disposal | $250 | | Disposal of IDW waste from sampling |
| Site Review | | $18,000 | Five-Year Site Reviews |
| SUBTOTAL | $16,421 | $18,000 | |
| Contingency @ 10% | $1,642 | $1,800 | |
| **TOTAL** | **$18,063** | **$19,800** | |

**NAVAL SUPPORT FACILITY - INDIAN HEAD**
**Indian Head, Maryland**
**Site 36 - Closed Landfill**
**Alternative 2: LUCs and Monitoring**
**Present Worth Analysis**

| Year | Capital Cost | Annual Cost | Total Year Cost | Annual Discount Rate at 7% | Present Worth |
|---|---|---|---|---|---|
| 0 | $90,622 | | $90,622 | 1.000 | $90,622 |
| 1 | | $18,063 | $18,063 | 0.935 | $16,889 |
| 2 | | $18,063 | $18,063 | 0.873 | $15,769 |
| 3 | | $18,063 | $18,063 | 0.816 | $14,739 |
| 4 | | $18,063 | $18,063 | 0.763 | $13,782 |
| 5 | | $37,863 | $37,863 | 0.713 | $26,996 |
| 6 | | $18,063 | $18,063 | 0.666 | $12,030 |
| 7 | | $18,063 | $18,063 | 0.623 | $11,253 |
| 8 | | $18,063 | $18,063 | 0.582 | $10,513 |
| 9 | | $18,063 | $18,063 | 0.544 | $9,826 |
| 10 | | $37,863 | $37,863 | 0.508 | $19,234 |
| 11 | | $18,063 | $18,063 | 0.475 | $8,580 |
| 12 | | $18,063 | $18,063 | 0.444 | $8,020 |
| 13 | | $18,063 | $18,063 | 0.415 | $7,496 |
| 14 | | $18,063 | $18,063 | 0.388 | $7,008 |
| 15 | | $37,863 | $37,863 | 0.362 | $13,706 |
| 16 | | $18,063 | $18,063 | 0.339 | $6,123 |
| 17 | | $18,063 | $18,063 | 0.317 | $5,726 |
| 18 | | $18,063 | $18,063 | 0.296 | $5,347 |
| 19 | | $18,063 | $18,063 | 0.277 | $5,003 |
| 20 | | $37,863 | $37,863 | 0.258 | $9,769 |
| 21 | | $18,063 | $18,063 | 0.242 | $4,371 |
| 22 | | $18,063 | $18,063 | 0.226 | $4,082 |
| 23 | | $18,063 | $18,063 | 0.211 | $3,811 |
| 24 | | $18,063 | $18,063 | 0.197 | $3,558 |
| 25 | | $37,863 | $37,863 | 0.184 | $6,967 |
| 26 | | $18,063 | $18,063 | 0.172 | $3,107 |
| 27 | | $18,063 | $18,063 | 0.161 | $2,908 |
| 28 | | $18,063 | $18,063 | 0.150 | $2,709 |
| 29 | | $18,063 | $18,063 | 0.141 | $2,547 |
| 30 | | $37,863 | $37,863 | 0.131 | $4,960 |
| | | | | **TOTAL PRESENT WORTH** | **$357,456** |

# Appendix B
# Risk Assessment Results

**TABLE 4-8**

**HUMAN HEALTH DATA EVALUATION - SURFACE SOIL**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**


| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Background Concentration[5] | Human Health Risk Screening[6] | | | | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Region 3 RBC Residential Soil[7] | Soil to GW DAF=1 | Soil to GW DAF=20 | EPA SSL Soil to Air | | |
| **Volatiles (µg/kg)** | | | | | | | | | | | | | |
| ACETONE | 6/6 | 9 - 170 | S36SS0040001 | --- | 56.2 | 170 | NA | 7000000 | 1100 | 22000 | --- | No | BSL |
| ISOPROPYLBENZENE | 1/6 | 20 | S36SS0030001 | 11 - 16 | 8.7 | 20 | NA | 780000 | 3200 | 64000 | 850000 | No | BSL |
| METHYL ACETATE | 1/6 | 11 | S36SS0020001 | 11 - 16 | 7.5 | 11 | NA | 7800000 | 1200 | 25000 | --- | No | BSL |
| STYRENE | 1/6 | 2 | S36SS0030001 | 11 - 16 | 5.7 | 2 | NA | 1600000 | 2900 | 57000 | 1500000 | No | BSL |
| TETRACHLOROETHENE | 6/6 | 6 - 12 | S36SS0010001 | --- | 8.9 | 12 | NA | 1200 | **0.23** | **4.7** | 10000 | No | BSL |
| **Semivolatiles (µg/kg)** | | | | | | | | | | | | | |
| 2-METHYLNAPHTHALENE | 1/6 | 200 | S36SS0040001 | 350 - 380 | 183 | 200 | NA | 31000 | 220 | 4400 | --- | No | BSL |
| ACENAPHTHYLENE | 1/6 | 56 | S36SS0010001 | 350 - 380 | 160.5 | 56 | NA | 470000[8] | --- | --- | --- | No | BSL |
| ANTHRACENE | 1/6 | 89 | S36SS0010001 | 350 - 380 | 166 | 89 | NA | 2300000 | 23000 | 470000 | --- | No | BSL |
| BENZALDEHYDE | 4/6 | 58 - 98 | S36SS0050001 | 350 | 105 | 98 | NA | 780000 | 860 | 17000 | --- | No | BSL |
| **BENZO(A)ANTHRACENE** | 2/6 | 87 - 250 | S36SS0010001 | 350 - 380 | 178 | 250 | NA | **220** | **24** | 480 | --- | Yes | ASL |
| **BENZO(A)PYRENE** | 4/6 | 52 - 240 | S36SS0010001 | 350 - 370 | 134 | 240 | NA | **22** | **6.1** | **120** | --- | Yes | ASL |
| **BENZO(B)FLUORANTHENE** | 5/6 | 44 - 470 | S36SS0010001 | 370 | 161 | 470 | NA | **220** | **74** | 1500 | --- | Yes | ASL |
| BENZO(G,H,I)PERYLENE | 4/6 | 38 - 110 | S36SS0010001 | 350 - 370 | 102 | 110 | NA | 230000[9] | --- | --- | --- | No | BSL |
| BENZO(K)FLUORANTHENE | 2/6 | 80 - 190 | S36SS0010001 | 350 - 380 | 167 | 190 | NA | 2200 | 740 | 15000 | --- | No | BSL |
| CHRYSENE | 4/6 | 37 - 330 | S36SS0010001 | 350 - 370 | 152 | 330 | NA | 22000 | 2400 | 48000 | --- | No | BSL |
| **DIBENZO(A,H)ANTHRACENE** | 1/6 | 42 | S36SS0010001 | 350 - 380 | 158 | 42 | NA | **22** | **23** | 460 | --- | Yes | ASL |
| DI-N-BUTYL PHTHALATE | 3/6 | 37 - 49 | S36SS0010001 | 350 - 370 | 112 | 49 | NA | 780000 | 250000 | 5000000 | --- | No | BSL |
| FLUORANTHENE | 5/6 | 44 - 370 | S36SS0010001 | 370 | 143 | 370 | NA | 310000 | 310000 | 6300000 | --- | No | BSL |
| INDENO(1,2,3-CD)PYRENE | 2/6 | 51 - 120 | S36SS0010001 | 350 - 380 | 151 | 120 | NA | 220 | 210 | 4200 | --- | No | BSL |
| NAPHTHALENE | 1/6 | 82 | S36SS0040001 | 350 - 380 | 163 | 82 | NA | 160000 | **7.7** | 150 | 170000 | No | BSL |
| PHENANTHRENE | 2/6 | 52 - 110 | S36SS0010001 | 350 - 380 | 149 | 110 | NA | 230000[9] | --- | --- | --- | No | BSL |
| PYRENE | 5/6 | 39 - 370 | S36SS0010001 | 370 - 370 | 140 | 370 | NA | 230000 | 34000 | 680000 | --- | No | BSL |
| **Explosives (mg/kg)** | | | | | | | | | | | | | |
| NITROCELLULOSE | 6/6 | 1.5 - 3.7 | S36SS0040001 | --- | 2.1 | 3.7 | NA | --- | --- | --- | --- | No | NTX |
| **Metals (mg/kg)** | | | | | | | | | | | | | |
| ALUMINUM | 6/6 | 4340 - 6290 | S36SS0040001 | --- | 4908 | 6290 | 19700 | 7800 | **8.3** | **170** | 7090000 | No | BSL |
| ARSENIC | 6/6 | 2.6 - 6.2 | S36SS0010001 | --- | 4.1 | 6.2 | 14.9 | **0.43** | **0.0013** | **0.026** | 769 | No | BKG |
| BARIUM | 6/6 | 29.4 - 48.3 | S36SS0020001 | --- | 36.3 | 48.3 | 80.4 | 1600 | 300 | 6000 | 709000 | No | BSL |
| BERYLLIUM | 6/6 | 0.24 - 0.44 | S36SS0040001 | --- | 0.34 | 0.44 | 1.1 | 16 | 58 | 1200 | 1380 | No | BSL |
| CADMIUM | 3/6 | 0.15 - 3.1 | S36SS0050001 | 0.03 - 0.032 | 0.61 | 3.1 | **2.5** | 3.9 | **1.4** | 27 | 1843 | No | BSL |
| CALCIUM | 6/6 | 321 - 1060 | S36SS0030001 | --- | 667 | 1060 | 2060 | --- | --- | --- | --- | No | NUT |
| CHROMIUM | 6/6 | 8.7 - 12.2 | S36SS0010001 | --- | 10.2 | 12.2 | 33.4 | 12000[10] | 9.9E+07[10] | 2.0E+09[10] | 276 | No | BSL |
| COBALT | 6/6 | 3 - 11.7 | S36SS0040001 | --- | 5.9 | 11.7 | 22.3 | --- | **0.17** | **3.3** | 1180 | No | NTX, BKG |
| COPPER | 6/6 | 10.4 - 46.6 | S36SS0050001 | --- | 21.1 | 46.6 | **20.3** | 310 | 530 | 11000 | --- | No | BSL |
| IRON | 6/6 | 10900 - 16000 | S36SS0040001 | --- | 13133 | 16000 | 38500 | **5500** | --- | --- | --- | No | BKG |
| LEAD | 6/6 | 16.4 - 178 | S36SS0060001 | --- | 53.7 | 178 | **62.5** | 400 | --- | --- | --- | No | BSL |
| MAGNESIUM | 6/6 | 429 - 856 | S36SS0040001 | --- | 566 | 856 | 1620 | --- | --- | --- | --- | No | NUT |
| MANGANESE | 6/6 | 146 - 298 | S36SS0040001 | --- | 208 | 298 | 1390 | **160** | **48** | 950 | 70900 | No | BKG |
| MERCURY | 6/6 | 0.067 - 0.097 | S36SS0060001 | --- | 0.08 | 0.097 | 0.16 | 2.3 | 0.1 | 2.1 | 2.9 | No | BSL |
| NICKEL | 6/6 | 4.2 - 10.4 | S36SS0010001 | --- | 6.7 | 10.4 | 15.4 | 160 | 14 | 280 | --- | No | BSL |
| POTASSIUM | 6/6 | 256 - 432 | S36SS0030001 | --- | 342 | 432 | 1470 | --- | --- | --- | --- | No | NUT |
| SODIUM | 3/6 | 41.7 - 66.8 | S36SS0050001 | 31.5 - 38.1 | 34.9 | 66.8 | 120 | --- | --- | --- | --- | No | NUT |
| VANADIUM | 6/6 | 16.2 - 19.6 | S36SS0030001 | --- | 18.4 | 19.6 | 53.3 | **7.8** | 37 | 730 | --- | No | BKG |
| ZINC | 6/6 | 27.1 - 81 | S36SS0050001 | --- | 44.5 | 81 | **37.5** | 2300 | 680 | 14000 | --- | No | BSL |

**TABLE 4-8**

**HUMAN HEALTH DATA EVALUATION - SURFACE SOIL**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**


| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Background Concentration[5] | Human Health Risk Screening[6] | | | | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Region 3 RBC Residential Soil[7] | Soil to GW DAF=1 | Soil to GW DAF=20 | EPA SSL Soil to Air | | |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria. A chemical is selected as a COPC if the maximum concentration exceeds background (for inorganics) and the applicable risk-based criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-1
6 Table 3-2
7 RBCs for noncarcinogens are divided by 10 to correspond to a target hazard quotient of 0.1.
8 The value for acenaphthene is used as a surrogate for acenaphthylene.
9 The value for pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
10 Screening values for trivalent chromium are used because hexavalent chromium was analyzed for but not detected.

Associated Samples

S36SS0010001
S36SS0020001
S36SS0020001-D
S36SS0030001
S36SS0040001
S36SS0050001
S36SS0060001

Definitions

COPC - Chemical of potential concern
DAF - Dilution attenuation factor
EPA - United States Environmental Protection Agency
GW - Groundwater
NA - Not available/not applicable
RBC - Risk-based concentration
SSL - Soil screening level

Rationale Codes

ASL - Above screening level
BKG - Below background
BSL - Below screening level
NTX - No toxicity data
NUT - Essential nutrient

**TABLE 4-9**

**HUMAN HEALTH DATA EVALUATION - GROUNDWATER**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Human Health Risk Screening[5] Region 3 RBC Tap Water[6] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (µg/L)** | | | | | | | | | |
| ETHYLBENZENE | 1/3 | 0.99 | S36MW0020101 | 0.5 | 0.50 | 1.0 | 130 | No | BSL |
| TOLUENE | 2/3 | 0.98 - 55 | S36MW0020101 | 0.5 | 19 | 56 | 230 | No | BSL |
| **TRICHLOROETHENE** | 1/3 | 0.56 - 0.6 | S36MW0010101 | 0.5 | 0.54 | 0.6 | **0.026** | Yes | ASL |
| **Semivolatiles (µg/L)** | | | | | | | | | |
| **4-METHYLPHENOL** | 2/3 | 4 - 93 | S36MW0020101 | 10 | 34 | 90 | **18** | Yes | ASL |
| ACETOPHENONE | 1/3 | 2 | S36MW0020101 | 10 | 4 | 2 | 61 | No | BSL |
| BENZALDEHYDE | 2/3 | 1 - 2 | S36MW0010101, S36MW0020101 | 10 | 2.8 | 2 | 370 | No | BSL |
| PHENOL | 2/3 | 1 - 8 | S36MW0020101 | 10 | 4.8 | 8 | 1100 | No | BSL |
| **Explosives (µg/L)** | | | | | | | | | |
| 2,6-DINITROTOLUENE | 1/2 | 0.28 - 1.4 | S36MW0020101 | 0.1 | 0.54 | 1.4 | 3.7 | No | BSL |
| **RDX** | 2/3 | 0.58 - 0.69 | S36MW0010101 | 0.1 | 0.43 | 0.69 | **0.61** | Yes | ASL |
| TETRYL | 1/3 | 0.31 | S36MW0010101 | 0.1 | 0.09 | 0.31 | 15 | No | BSL |
| **Metals (µg/L)** | | | | | | | | | |
| ALUMINUM | 1/3 | 839 | S36MW0020101 | 23.6 - 65 | 298 | 839 | 3700 | No | BSL |
| **ANTIMONY** | 1/3 | 2.1 | S36MW0010101 | 2 | 1.2 | 2.1 | **1.5** | Yes | ASL |
| **ARSENIC** | 2/3 | 4.4 - 22.4 | S36MW0020101 | 2 | 9.7 | 22.4 | **0.045** | Yes | ASL |
| **BARIUM** | 3/3 | 51.4 - 1570 | S36MW0010101-D | --- | 577 | 1570 | **730** | Yes | ASL |
| CADMIUM | 3/3 | 0.21 - 1.1 | S36MW0010101 | --- | 0.75 | 1.1 | 1.8 | No | BSL |
| CALCIUM | 3/3 | 4700 - 121000 | S36MW0010101 | --- | 48867 | 121000 | NA | No | NUT |
| COBALT | 2/3 | 1.3 - 8.4 | S36MW0030101 | 0.4 | 3.3 | 8.4 | NA | No | NTX |
| **IRON** | 3/3 | 101 - 67700 | S36MW0010101-D | --- | 44117 | 67700 | **2600** | Yes | ASL |
| LEAD | 2/3 | 5.6 - 8.1 | S36MW0010101-D | 0.9 | 4.7 | 8.1 | 15 | No | BSL |
| MAGNESIUM | 3/3 | 2720 - 32600 | S36MW0010101 | --- | 18607 | 32600 | NA | No | NUT |
| **MANGANESE** | 3/3 | 132 - 1560 | S36MW0020101 | --- | 827.5 | 1560 | **73** | Yes | ASL |
| NICKEL | 1/3 | 6.9 | S36MW0030101 | 0.7 | 2.5 | 6.9 | 73 | No | BSL |
| POTASSIUM | 3/3 | 3580 - 16600 | S36MW0010101 | --- | 8923 | 16600 | NA | No | NUT |
| SODIUM | 3/3 | 11800 - 98500 | S36MW0020101 | --- | 56400 | 98500 | NA | No | NUT |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-3.
6 RBCs for noncarcinogens are divided by 10 to correspond to a target hazard quotient of 0.1.

Associated Samples

S36MW0010101
S36MW0010101-D
S36MW0020101
S36MW0030101

Definitions

COPC - Chemical of potential concern
NA - Not available/Not applicable
RBC - Risk-based concentration

Rationale Codes

ASL - Above screening level
BSL - Below screening level
NTX - No toxicity data
NUT - Essential nutrient

**TABLE 4-10**

**HUMAN HEALTH DATA EVALUATION - SURFACE WATER**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Human Health Risk Screening[5] Region 3 RBC Tap Water[6] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (µg/L)** | | | | | | | | | |
| CHLOROMETHANE | 3/6 | 0.69 - 0.89 | S36SW0050101 | 0.5 | 0.47 | 0.89 | 19 | No | BSL |
| **Metals (µg/L)** | | | | | | | | | |
| ALUMINUM | 6/6 | 53.8 - 948 | S36SW0010101-D | --- | 290 | 948 | 3700 | No | BSL |
| BARIUM | 6/6 | 18.3 - 35.6 | S36SW0010101-D | --- | 27 | 35.6 | 730 | No | BSL |
| CADMIUM | 1/6 | 0.71 | S36SW0030101 | 0.2 | 0.2 | 0.71 | 1.8 | No | BSL |
| CALCIUM | 6/6 | 18100 - 20900 | S36SW0050101 | --- | 18958 | 20900 | NA | No | NUT |
| CHROMIUM | 3/6 | 0.61 - 1.5 | S36SW0010101-D | 0.5 | 0.64 | 1.5 | 5500[7] | No | BSL |
| COBALT | 2/6 | 0.55 - 0.65 | S36SW0010101-D | 0.4 | 0.30 | 0.65 | NA | No | NTX |
| COPPER | 1/6 | 7.5 | S36SW0040101 | 1 - 4.5 | 1.95 | 7.5 | 150 | No | BSL |
| **IRON** | 6/6 | 466 - 3620 | S36SW0030101 | --- | 1607 | 3620 | **2600** | Yes | ASL |
| LEAD | 3/6 | 1.2 - 13.6 | S36SW0030101 | 0.9 | 3.4 | 13.6 | 15 | No | BSL |
| MAGNESIUM | 6/6 | 8390 - 8570 | S36SW0010101 | --- | 8498 | 8570 | NA | No | NUT |
| **MANGANESE** | 6/6 | 44.8 - 492 | S36SW0050101 | --- | 362 | 492 | **73** | Yes | ASL |
| NICKEL | 6/6 | 0.93 - 2 | S36SW0010101-D | --- | 2.8 | 2 | 73 | No | BSL |
| SODIUM | 6/6 | 24200 - 26300 | S36SW0060101 | --- | 25117 | 26300 | NA | No | NUT |
| VANADIUM | 4/6 | 0.71 - 2.3 | S36SW0010101-D | 0.4 - 0.4 | 1.0 | 2.3 | 3.7 | No | BSL |
| **Miscellaneous Paramters (µg/L)** | | | | | | | | | |
| CYANIDE | 1/6 | 5.1 | S36SW0020101 | 2 | 2.5 | 5.1 | 73 | No | BSL |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-3.
6 RBCs for noncarcinogens are divided by 10 to correspond to a target hazard quotient of 0.1.
7 The RBC for trivalent chromium is used because hexavalent chromium was analyzed for but not detected.

Associated Samples

S36SW0010101
S36SW0010101-D
S36SW0020101
S36SW0030101
S36SW0040101
S36SW0050101
S36SW0060101

Definitions

COPC - Chemical of potential concern
NA - Not available/not applicable
RBC - Risk-based concentration

Rationale Codes

ASL - Above screening level
BSL - Below screening level
NTX - No toxicity data
NUT - Essential nutrient

**TABLE 4-11**

**HUMAN HEALTH DATA EVALUATION - SEDIMENT**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**


| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Human Health Risk Screening[5] Region 3 RBC Residential Soil[6] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (µg/kg)** | | | | | | | | | |
| 2-BUTANONE | 4/6 | 6 - 28 | S36SD0040001 | 12 - 13 | 15 | 28 | 4700000 | No | BSL |
| ACETONE | 6/6 | 8 - 47 | S36SD0010001 | --- | 26 | 47 | 7000000 | No | BSL |
| TRICHLOROFLUOROMETHANE | 1/6 | 3 | S36SD0040001 | 12 - 23 | 8 | 3 | 2300000 | No | BSL |
| **Semivolatiles (µg/kg)** | | | | | | | | | |
| ACENAPHTHYLENE | 1/15 | 290 | S36SD0030001 | 83 - 600 | 153 | 290 | 470000[7] | No | BSL |
| ANTHRACENE | 1/15 | 420 | S36SD0030001 | 83 - 600 | 161 | 420 | 2300000 | No | BSL |
| BENZALDEHYDE | 3/6 | 73 - 320 | S36SD0030001 | 270 - 480 | 177 | 320 | 780000 | No | BSL |
| **BENZO(A)ANTHRACENE** | 6/15 | 89 - 1200 | S36SD0030001 | 170 - 540 | 285 | 1200 | **220** | Yes | ASL |
| **BENZO(A)PYRENE** | 7/15 | 43 - 1000 | S36SD0030001 | 170 - 540 | 250 | 1000 | **22** | Yes | ASL |
| **BENZO(B)FLUORANTHENE** | 7/15 | 44 - 2300 | S36SD0030001 | 170 - 540 | 359 | 2300 | **220** | Yes | ASL |
| BENZO(G,H,I)PERYLENE | 4/15 | 39 - 490 | S36SD0030001 | 83 - 540 | 143 | 490 | 230000[8] | No | BSL |
| BENZO(K)FLUORANTHENE | 6/15 | 42 - 790 | S36SD0030001 | 170 - 540 | 172 | 790 | 2200 | No | BSL |
| CARBAZOLE | 1/6 | 61 | S36SD0030001 | 270 - 600 | 196 | 61 | 32000 | No | BSL |
| CHRYSENE | 6/15 | 62 - 1300 | S36SD0030001 | 170 - 540 | 209 | 1300 | 22000 | No | BSL |
| **DIBENZO(A,H)ANTHRACENE** | 2/15 | 45 - 210 | S36SD0030001 | 83 - 600 | 136 | 210 | **22** | Yes | ASL |
| FLUORANTHENE | 8/15 | 86 - 1300 | S36SD0030001 | 170 - 540 | 237 | 1300 | 310000 | No | BSL |
| **INDENO(1,2,3-CD)PYRENE** | 4/15 | 34 - 480 | S36SD0030001 | 430 - 540 | 142 | 480 | **220** | Yes | ASL |
| PHENANTHRENE | 5/15 | 65 - 120 | S36SD0020001 | 170 - 540 | 119 | 120 | 230000[8] | No | BSL |
| PYRENE | 9/15 | 67 - 1200 | S36SD0030001 | 170 - 540 | 218 | 1200 | 230000 | No | BSL |
| **Explosives (mg/kg)** | | | | | | | | | |
| NITROGLYCERIN | 1/6 | 0.55 | S36SD0010001 | 0.5 | 0.3 | 0.55 | 0.8 | No | BSL |
| **Metals (mg/kg)** | | | | | | | | | |
| **ALUMINUM** | 15/15 | 3950 - 30700 | S36SD0110102 | --- | 14629 | 30700 | **7800** | Yes | ASL |
| **ANTIMONY** | 6/15 | 0.45 - 4.5 | S36SD0040001 | 0.47 - 3.9 | 1.5 | 4.5 | **3.1** | Yes | ASL |
| **ARSENIC** | 15/15 | 2.5 - 17.7 | S36SD0090102 | --- | 7.3 | 17.7 | **0.43** | Yes | ASL |
| BARIUM | 15/15 | 26.8 - 255 | S36SD0090102 | --- | 132 | 255.0 | 1600 | No | BSL |
| BERYLLIUM | 15/15 | 0.25 - 1.7 | S36SD0110102; S36SD0130102 | --- | 0.9 | 1.7 | 16 | No | BSL |
| **CADMIUM** | 15/15 | 0.15 - 16 | S36SD0110102 | --- | 2.3 | 16.0 | **3.9** | Yes | ASL |
| CALCIUM | 15/15 | 711 - 5990 | S36SD0130102 | --- | 3064 | 5990 | NA | No | NUT |
| CHROMIUM | 15/15 | 11.3 - 110 | S36SD0090102 | --- | 30.0 | 110.0 | 12000[9] | No | BSL |
| COBALT | 15/15 | 2.1 - 26.8 | S36SD0130102 | --- | 13.3 | 26.8 | NA | No | NTX |
| COPPER | 13/15 | 13.4 - 127 | S36SD0110102 | 10.2 - 12.6 | 46.2 | 127.0 | 310 | No | BSL |
| **IRON** | 15/15 | 9110 - 93500 | S36SD0090102 | --- | 28396 | 93500 | **5500** | Yes | ASL |
| **LEAD** | 15/15 | 9.8 - 4100 | S36SD0090102 | --- | 326 | 4100 | **400** | Yes | ASL |
| MAGNESIUM | 15/15 | 504 - 3870 | S36SD0110102 | --- | 1985 | 3870 | NA | No | NUT |
| **MANGANESE** | 15/15 | 116 - 2080 | S36SD0110102 | --- | 904 | 2080 | **160** | Yes | ASL |
| **MERCURY** | 11/15 | 0.12 - 2.9 | S36SD0130102 | 0.056 - 0.079 | 0.35 | 2.90 | **2.3** | Yes | ASL |
| NICKEL | 14/15 | 6 - 102 | S36SD0090102 | 7.4 - 7.6 | 25.1 | 102.0 | 160 | No | BSL |

**TABLE 4-11**

**HUMAN HEALTH DATA EVALUATION - SEDIMENT**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**


| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Human Health Risk Screening[5] Region 3 RBC Residential Soil[6] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| **Metals (mg/kg) (continued)** | | | | | | | | | |
| POTASSIUM | 15/15 | 307 - 3500 | S36SD0110102 | --- | 1626 | 3500 | NA | No | NUT |
| SILVER | 8/15 | 0.35 - 4.9 | S36SD0010001 | 0.25 - 0.78 | 0.8 | 4.9 | 39 | No | BSL |
| SODIUM | 10/15 | 79.4 - 755 | S36SD0110102 | 64.5 - 755 | 330 | 755 | NA | No | NUT |
| **VANADIUM** | 15/15 | 15.3 - 66.5 | S36SD0110102 | --- | 38.0 | 66.5 | **7.8** | Yes | ASL |
| ZINC | 15/15 | 16.6 - 840 | S36SD0010001 | --- | 202 | 315 | 2300 | No | BSL |
| **Miscellaneous Parameters (mg/kg)** | | | | | | | | | |
| CYANIDE | 2/15 | 0.13 - 0.26 | S36SD0060001 | 0.12 - 0.96 | 0.27 | 0.26 | 160 | No | BSL |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-2.
6 RBCs for noncarcinogens are divided by 10 to correspond to a target hazard quotient of 0.1.
7 The value for acenaphthene is used as a surrogate for acenaphthylene.
8 The value for pyrene is used as a surrogate for genzo(g,h,i)perylene and phenanthrene.
9 The RBC for trivalent chromium is used because hexavalent chromium was analyzed for but not detected.

Associated Samples
S36SD0010001
S36SD0020001
S36SD0030001
S36SD0040001
S36SD0050001
S36SD0060001
S36SD0060001-D
S36SD0070102
S36SD0080102
S36SD0090102
S36SD0100102

Definitions
COPC - Chemical of potential concern
NA - Not available/not applicable
ND - Not detected
RBC - Risk-based concentration

Rationale Codes
ASL - Above screening level
BSL - Below screening level
NTX - No toxicity data
NUT - Essential nutrient

**TABLE 4-12**

**HUMAN HEALTH DATA EVALUATION - PORE WATER**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND]**

| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Human Health Risk Screening[5] Region 3 RBC Tap Water[6] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (µg/L)** | | | | | | | | | |
| TOLUENE | 4/4 | 0.56 - 4 | S36PW0020101 | --- | 1.8 | 4 | 230 | No | BSL |
| **Semivolatiles (µg/L)** | | | | | | | | | |
| 4-METHYLPHENOL | 1/4 | 1 | S36PW0010101 | 10 | 4 | 1 | 18 | No | BSL |
| ACETOPHENONE | 1/4 | 2 | S36PW0040101 | 10 | 4.25 | 2 | 61 | No | BSL |
| **Explosives (µg/L)** | | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 1/4 | 0.076 | S36PW0020101 | 0.1 - 0.2 | 0.07 | 0.076 | 110 | No | BSL |
| **1,3-DINITROBENZENE** | 1/4 | 0.25 - 0.65 | S36PW0010101-D | 0.1 - 0.2 | 0.16 | 0.65 | **0.37** | Yes | ASL |
| 2,4,6-TRINITROTOLUENE | 1/4 | 0.077 | S36PW0010101 | 0.1 - 0.2 | 0.07 | 0.077 | 2.2 | No | BSL |
| 4-NITROTOLUENE | 1/4 | 0.073 | S36PW0010101-D | 0.5 - 1 | 0.27 | 0.073 | 4.2 | No | BSL |
| **Metals (unfiltered) (µg/L)** | | | | | | | | | |
| ALUMINUM | 4/4 | 17.6 - 1930 | S36PW0030101 | --- | 823 | 1930 | 3700 | No | BSL |
| **ARSENIC** | 4/4 | 2.1 - 4.9 | S36PW0020101 | --- | 3.3 | 4.9 | **0.045** | Yes | ASL |
| BARIUM | 4/4 | 68.4 - 280 | S36PW0020101 | --- | 142 | 280 | 730 | No | BSL |
| CADMIUM | 4/4 | 0.23 - 1.3 | S36PW0020101 | --- | 0.59 | 1.3 | 1.8 | No | BSL |
| CALCIUM | 4/4 | 18700 - 34500 | S36PW0020101 | --- | 29212 | 34500 | NA | No | NUT |
| CHROMIUM | 4/4 | 1.6 - 19.7 | S36PW0010101 | --- | 10.5 | 19.7 | 5500[7] | No | BSL |
| COBALT | 4/4 | 0.55 - 8.1 | S36PW0010101 | --- | 5.1 | 8.1 | NA | No | NTX |
| COPPER | 4/4 | 7.6 - 33.1 | S36PW0010101 | --- | 19.7 | 33.1 | 150 | No | BSL |
| **IRON** | 4/4 | 16600 - 82800 | S36PW0020101 | --- | 39038 | 82800 | **2600** | Yes | ASL |
| LEAD | 4/4 | 1.1 - 14 | S36PW0010101 | --- | 4.6 | 14 | 15 | No | BSL |
| MAGNESIUM | 4/4 | 14800 - 27100 | S36PW0020101 | --- | 20662 | 27100 | NA | No | NUT |
| **MANGANESE** | 4/4 | 1440 - 2690 | S36PW0010101 | --- | 2105 | 2690 | **73** | Yes | ASL |
| **NICKEL** | 4/4 | 49.6 - 364 | S36PW0030101 | --- | 241 | 364 | **73** | Yes | ASL |
| POTASSIUM | 1/4 | 7130 | S36PW0040101 | 1300 - 5100 | 2813 | 7130 | NA | No | NUT |
| SODIUM | 4/4 | 59100 - 166000 | S36PW0020101 | --- | 65350 | 166000 | NA | No | NUT |
| **VANADIUM** | 3/4 | 2.6 - 3.8 | S36PW0030101 | 0.4 | 2.2 | 3.8 | **3.7** | Yes | ASL |
| ZINC | 4/4 | 42.5 - 70.4 | S36PW0040101 | 2.1 | 53.1 | 70.4 | 1100 | No | BSL |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-3.
6 RBCs for noncarcinogens are divided by 10 to correspond to a target hazard quotient of 0.1.
7 The RBC for trivalent chromium is used because hexavalent chromium was analyzed for but not detected.

Associated Samples

S36PW0010101
S36PW0010101-D
S36PW0020101
S36PW0030101
S36PW0040101

Definitions

COPC - chemical of potential concern
NA - Not available/not applicable
RBC - Risk-based concentration

Rationale Codes

ASL - Above screening level
BSL - Below screening level
NTX - No toxicity data
NUT - Essential nutrient

**TABLE 4-13**

**CHEMICAL-SPECIFIC HUMAN HEALTH RISKS**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**
**PAGE 1 OF 2**

| Chemical | Maximum Concentration | Carcinogenic Risks | | Noncarcinogenic Risks | | | Evaluation of Target Organ HIs | |
|---|---|---|---|---|---|---|---|---|
| | | RBC[1] | Estimated ILCR | Primary Target Organ | RBC[1] | Estimated HQ | Target Organ | Total HI |
| **Surface Soil (mg/kg)** | | | | | | | | |
| Benzo(a)anthracene | 0.25 | 0.22 | 1.1E-06 | NA[2] | NA[2] | --- | NA | NA |
| Benzo(a)pyrene | 0.24 | 0.022 | 1.1E-05 | NA[2] | NA[2] | --- | | |
| Benzo(b)fluoranthene | 0.47 | 0.22 | 2.1E-06 | NA[2] | NA[2] | --- | | |
| Dibenzo(a,h)anthracene | 0.042 | 0.022 | 1.9E-06 | NA[2] | NA[2] | --- | | |
| | | **Total ILCR** | 1.6E-05 | | **Total HQ** | 0.00 | | |
| **Groundwater (µg/L)** | | | | | | | | |
| Trichloroethene | 0.6 | 0.026 | 2.3E-05 | unspecified | 10[3] | 0.06 | blood | 2.74 |
| 4-Methylphenol | 93 | NA[2] | NA[2] | unspecified | 180 | 0.52 | cardiovascular | 2.25 |
| RDX | 0.69 | 0.61 | 1.1E-06 | prostate | 110[3] | 0.01 | CNS | 2.14 |
| Antimony | 2.1 | NA[2] | NA[2] | blood, lifespan | 15 | 0.14 | GI | 2.60 |
| Arsenic | 22.4 | 0.045 | 5.0E-04 | cardiovascular | 11[3] | 2.04 | lifespan | 0.14 |
| Barium | 1570 | NA[2] | NA[2] | cardiovascular | 7300 | 0.22 | liver | 2.60 |
| Iron | 67700 | NA[2] | NA[2] | blood, GI, liver | 26000 | 2.60 | prostate | 0.01 |
| Manganese | 1560 | NA[2] | NA[2] | CNS | 730 | 2.14 | unspecified | 0.58 |
| | | **Total ILCR** | 5.2E-04 | | **Total HQ** | 7.72 | | |
| **Surface Water (µg/L)** | | | | | | | | |
| Iron | 2790 | NA[2] | NA[2] | blood, GI, liver | 26000 | 0.11 | blood | 0.11 |
| Manganese | 492 | NA[2] | NA[2] | CNS | 730 | 0.67 | CNS | 0.67 |
| | | **Total ILCR** | 0 | | **Total HQ** | 0.78 | GI | 0.11 |
| | | | | | | | liver | 0.11 |
| **Pore Water (µg/L)** | | | | | | | | |
| 1,3-Dinitrobenzene | 0.65 | NA[2] | NA[2] | spleen | 3.7 | 0.18 | blood | 3.18 |
| Arsenic | 4.9 | 0.045 | 1.1E-04 | cardiovascular | 11[3] | 0.45 | body weight | 0.50 |
| Iron | 82800 | NA[2] | NA[2] | blood, GI, liver | 26000 | 3.18 | cardiovascular | 0.45 |
| Manganese | 2690 | NA[2] | NA[2] | CNS | 730 | 3.68 | CNS | 3.68 |
| Nickel | 364 | NA[2] | NA[2] | body weight | 730 | 0.50 | GI | 3.18 |
| Vanadium | 3.8 | NA[2] | NA[2] | NOEL | 37 | 0.10 | liver | 3.18 |
| | | **Total ILCR** | 1.1E-04 | | **Total HQ** | 8.09 | NOEL | 0.10 |
| | | | | | | | spleen | 0.18 |

**TABLE 4-13**

**CHEMICAL-SPECIFIC HUMAN HEALTH RISKS**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**
**PAGE 2 OF 2**

| Chemical | Maximum Concentration | Carcinogenic Risks | | Noncarcinogenic Risks | | | Evaluation of Target Organ HIs | |
|---|---|---|---|---|---|---|---|---|
| | | RBC[1] | Estimated ILCR | Primary Target Organ | RBC[1] | Estimated HQ | Target Organ | Total HI |
| **Sediment (mg/kg)** | | | | | | | | |
| Benzo(a)anthracene | 1.2 | 0.22 | 5.5E-06 | NA[2] | NA[2] | --- | blood | 1.85 |
| Benzo(a)pyrene | 1.0 | 0.022 | 4.5E-05 | NA[2] | NA[2] | --- | body weight | 0.39 |
| Benzo(b)fluoranthene | 2.3 | 0.22 | 1.0E-05 | NA[2] | NA[2] | --- | cardiovascular | 0.77 |
| Dibenzo(a,h)anthracene | 0.21 | 0.022 | 9.5E-06 | NA[2] | NA[2] | --- | CNS | 0.39 |
| Indeno(1,2,3-cd)pyrene | 0.48 | 0.22 | 2.2E-06 | NA[2] | NA[2] | --- | GI | 1.70 |
| Aluminum | 30700 | NA[2] | NA[2] | body weight | 78000 | 0.39 | kidney | 0.41 |
| Antimony | 4.5 | NA[2] | NA[2] | blood, lifespan | 31 | 0.15 | lifespan | 0.15 |
| Arsenic | 17.7 | 0.43 | 4.1E-05 | cardiovascular | 23[3] | 0.77 | liver | 1.70 |
| Cadmium | 16.0 | NA[2] | NA[2] | kidney | 39 | 0.41 | NOEL | 0.85 |
| Iron | 93500 | NA[2] | NA[2] | blood, GI, liver | 55000 | 1.70 | | |
| Lead | 4100 | NA[4] | NA[4] | NA[4] | NA[4] | --- | | |
| Manganese | 425 | NA[2] | NA[2] | CNS | 1600 | 0.27 | | |
| Mercury | 2.90 | NA[2] | NA[2] | CNS | 23 | 0.13 | | |
| Vanadium | 66.5 | NA[2] | NA[2] | NOEL | 78 | 0.85 | | |
| | | **Total ILCR** | 1.1E-04 | | **Total HQ** | 4.66 | | |
| | | **Total Cumulative ILCR** | 7.6E-04 | | **Cumulative HI** | 21 | | |

| Cumulative HIs | |
|---|---|
| blood | 7.88 |
| body weight | 0.89 |
| cardiovascular | 3.47 |
| CNS | 6.89 |
| GI | 7.60 |
| kidney | 0.41 |
| lifespan | 0.29 |
| liver | 7.60 |
| NOEL | 0.96 |
| prostate | 0.01 |
| spleen | 0.18 |
| unspecified | 0.58 |

Abbreviations:

| | |
|---|---|
| CNS | Central nervous system. |
| GI | Gastrointestinal |
| HI | Hazard index. |
| HQ | Hazard quotient. |
| ILCR | Incremental lifetime cancer risk. |
| NOEL | No observed effects level |
| RBC | Risk-based concentration. |

Footnotes:

1 RBCs (EPA, 2007a) for residential soil or tap water.
2 NA - Not applicable. EPA has not established a cancer slope factor or oral reference dose (RfD) for this chemical.
3 Calculated using the RfD per EPA guidance (EPA, 2003).
4 The average concentration of lead in sediment is 326 mg/kg, which is less than the screening level of 400 mg/kg. Therefore, lead does not pose a significant risk to potential receptors.

**TABLE 4-14**

**ECOLOGICAL DATA EVALUATION - SURFACE SOIL**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**


| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Background Concentration[5] | Ecological Screening Level[6] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (µg/kg)** | | | | | | | | | | |
| **ACETONE** | 6/6 | 9 - 170 | S36SS0040001 | --- | 56.2 | 170 | NA | NA | Yes | NTX |
| **ISOPROPYLBENZENE** | 1/6 | 20 | S36SS0030001 | 11 - 16 | 8.7 | 20 | NA | NA | Yes | NTX |
| **METHYL ACETATE** | 1/6 | 11 | S36SS0020001 | 11 - 16 | 7.5 | 11 | NA | NA | Yes | NTX |
| STYRENE | 1/6 | 2 | S36SS0030001 | 11 - 16 | 5.7 | 2 | NA | 100 | No | BSL |
| TETRACHLOROETHENE | 6/6 | 6 - 12 | S36SS0010001 | --- | 8.9 | 12 | NA | 300 | No | BSL |
| **Semivolatiles (µg/kg)** | | | | | | | | | | |
| 2-METHYLNAPHTHALENE | 1/6 | 200 | S36SS0040001 | 350 - 380 | 183 | 200 | NA | 29000 | No | BSL |
| ACENAPHTHYLENE | 1/6 | 56 | S36SS0010001 | 350 - 380 | 160.5 | 56 | NA | 29000 | No | BSL |
| ANTHRACENE | 1/6 | 89 | S36SS0010001 | 350 - 380 | 166 | 89 | NA | 29000 | No | BSL |
| **BENZALDEHYDE** | 4/6 | 58 - 98 | S36SS0050001 | 350 | 105 | 98 | NA | NA | Yes | NTX |
| BENZO(A)ANTHRACENE | 2/6 | 87 - 250 | S36SS0010001 | 350 - 380 | 178 | 250 | NA | 1100 | No | BSL |
| BENZO(A)PYRENE | 4/6 | 52 - 240 | S36SS0010001 | 350 - 370 | 134 | 240 | NA | 1100 | No | BSL |
| BENZO(B)FLUORANTHENE | 5/6 | 44 - 470 | S36SS0010001 | 370 | 161 | 470 | NA | 1100 | No | BSL |
| BENZO(G,H,I)PERYLENE | 4/6 | 38 - 110 | S36SS0010001 | 350 - 370 | 102 | 110 | NA | 1100 | No | BSL |
| BENZO(K)FLUORANTHENE | 2/6 | 80 - 190 | S36SS0010001 | 350 - 380 | 167 | 190 | NA | 1100 | No | BSL |
| CHRYSENE | 4/6 | 37 - 330 | S36SS0010001 | 350 - 370 | 152 | 330 | NA | 1100 | No | BSL |
| DIBENZO(A,H)ANTHRACENE | 1/6 | 42 | S36SS0010001 | 350 - 380 | 158 | 42 | NA | 1100 | No | BSL |
| **DI-N-BUTYL PHTHALATE** | 3/6 | 37 - 49 | S36SS0010001 | 350 - 370 | 112 | 49 | NA | NA | Yes | NTX |
| FLUORANTHENE | 5/6 | 44 - 370 | S36SS0010001 | 370 | 143 | 370 | NA | 29000 | No | BSL |
| INDENO(1,2,3-CD)PYRENE | 2/6 | 51 - 120 | S36SS0010001 | 350 - 380 | 151 | 120 | NA | 1100 | No | BSL |
| NAPHTHALENE | 1/6 | 82 | S36SS0040001 | 350 - 380 | 163 | 82 | NA | 29000 | No | BSL |
| PHENANTHRENE | 2/6 | 52 - 110 | S36SS0010001 | 350 - 380 | 149 | 110 | NA | 29000 | No | BSL |
| PYRENE | 5/6 | 39 - 370 | S36SS0010001 | 370 - 370 | 140 | 370 | NA | 1100 | No | BSL |
| **Explosives (mg/kg)** | | | | | | | | | | |
| **NITROCELLULOSE** | 6/6 | 1.5 - 3.7 | S36SS0040001 | --- | 2.1 | 3.7 | NA | NA | Yes | NTX |
| **Metals (mg/kg)** | | | | | | | | | | |
| ALUMINUM | 6/6 | 4340 - 6290 | S36SS0040001 | --- | 4908 | 6290 | 19700 | NA[7] | No | BKG |
| ARSENIC | 6/6 | 2.6 - 6.2 | S36SS0010001 | --- | 4.1 | 6.2 | 14.9 | 18 | No | BSL |
| BARIUM | 6/6 | 29.4 - 48.3 | S36SS0020001 | --- | 36.3 | 48.3 | 80.4 | 330 | No | BSL |
| BERYLLIUM | 6/6 | 0.24 - 0.44 | S36SS0040001 | --- | 0.34 | 0.44 | 1.1 | 21 | No | BSL |
| **CADMIUM** | 3/6 | 0.15 - 3.1 | S36SS0050001 | 0.03 - 0.032 | 0.61 | 3.1 | **2.5** | **0.36** | Yes | ASL |
| CALCIUM | 6/6 | 321 - 1060 | S36SS0030001 | --- | 667 | 1060 | 2060 | NA | No | NUT |
| CHROMIUM | 6/6 | 8.7 - 12.2 | S36SS0010001 | --- | 10.2 | 12.2 | 33.4 | 26 | No | BSL |
| COBALT | 6/6 | 3 - 11.7 | S36SS0040001 | --- | 5.9 | 11.7 | 22.3 | 13 | No | BSL |
| **COPPER** | 6/6 | 10.4 - 46.6 | S36SS0050001 | --- | 21.1 | 46.6 | **20.3** | **28** | Yes | ASL |
| IRON | 6/6 | 10900 - 16000 | S36SS0040001 | --- | 13133 | 16000 | 38500 | NA[8] | No | BKG |
| **LEAD** | 6/6 | 16.4 - 178 | S36SS0060001 | --- | 53.7 | 178 | **62.5** | **11** | Yes | ASL |
| MAGNESIUM | 6/6 | 429 - 856 | S36SS0040001 | --- | 566 | 856 | 1620 | NA | No | NUT |

**TABLE 4-14**

**ECOLOGICAL DATA EVALUATION - SURFACE SOIL**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**


| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Background Concentration[5] | Ecological Screening Level[6] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|
| **Metals (mg/kg) (continued)** | | | | | | | | | | |
| MANGANESE | 6/6 | 146 - 298 | S36SS0040001 | --- | 208 | 298 | 1390 | **220** | No | BKG |
| MERCURY | 6/6 | 0.067 - 0.097 | S36SS0060001 | --- | 0.08 | 0.097 | 0.16 | **0.058** | No | BKG |
| NICKEL | 6/6 | 4.2 - 10.4 | S36SS0010001 | --- | 6.7 | 10.4 | 15.4 | 38 | No | BKG |
| POTASSIUM | 6/6 | 256 - 432 | S36SS0030001 | --- | 342 | 432 | 1470 | NA | No | NUT |
| SODIUM | 3/6 | 41.7 - 66.8 | S36SS0050001 | 31.5 - 38.1 | 34.9 | 66.8 | 120 | NA | No | NUT |
| VANADIUM | 6/6 | 16.2 - 19.6 | S36SS0030001 | --- | 18.4 | 19.6 | 53.3 | **7.8** | No | BKG |
| **ZINC** | 6/6 | 27.1 - 81 | S36SS0050001 | --- | 44.5 | 81 | **37.5** | **46** | Yes | ASL |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-1.
6 Table 3-4.
7 Potential for ecological risk only if soil pH is less than 5.5.
8 Potential for ecological risk only is low if soil pH is between 5 and 8.

Associated Samples

S36SS0010001
S36SS0020001
S36SS0020001-D
S36SS0030001
S36SS0040001
S36SS0050001
S36SS0060001

Definitions

COPC - Chemical of potential concern
NA - Not available/not applicable

Rationale Codes

ASL - Above screening level
BKG - Below background
BSL - Below screening level
NTX - No screening level
NUT - Essential nutrient

**TABLE 4-15**

**ECOLOGICAL DATA EVALUATION - SURFACE WATER**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Ecological Screening Level[5] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (µg/L)** | | | | | | | | | |
| **CHLOROMETHANE** | 3/6 | 0.69 - 0.89 | S36SW0050101 | 0.5 | 0.47 | 0.89 | NA | Yes | NTX |
| **Metals (µg/L)** | | | | | | | | | |
| **ALUMINUM** | 6/6 | 53.8 - 948 | S36SW0010101-D | --- | 290 | 948 | **87** | Yes | ASL |
| **BARIUM** | 6/6 | 18.3 - 35.6 | S36SW0010101-D | --- | 27 | 35.6 | **4** | Yes | ASL |
| **CADMIUM** | 1/6 | 0.71 | S36SW0030101 | 0.2 | 0.2 | 0.71 | **0.25** | Yes | ASL |
| CALCIUM | 6/6 | 18100 - 20900 | S36SW0050101 | --- | 18958 | 20900 | NA | No | NUT |
| CHROMIUM | 3/6 | 0.61 - 1.5 | S36SW0010101-D | 0.5 | 0.64 | 1.5 | 85 | No | BSL |
| COBALT | 2/6 | 0.55 - 0.65 | S36SW0010101-D | 0.4 | 0.30 | 0.65 | 23 | No | BSL |
| COPPER | 1/6 | 7.5 | S36SW0040101 | 1 - 4.5 | 1.95 | 7.5 | 9 | No | BSL |
| **IRON** | 6/6 | 466 - 3620 | S36SW0030101 | --- | 1607 | 3620 | **300** | Yes | ASL |
| **LEAD** | 3/6 | 1.2 - 13.6 | S36SW0030101 | 0.9 | 3.4 | 13.6 | **2.5** | Yes | ASL |
| MAGNESIUM | 6/6 | 8390 - 8570 | S36SW0010101 | --- | 8498 | 8570 | 82000 | No | NUT |
| **MANGANESE** | 6/6 | 44.8 - 492 | S36SW0050101 | --- | 362 | 492 | **120** | Yes | ASL |
| NICKEL | 6/6 | 0.93 - 2 | S36SW0010101-D | --- | 2.8 | 2 | 52 | No | BSL |
| SODIUM | 6/6 | 24200 - 26300 | S36SW0060101 | --- | 25117 | 26300 | 680000 | No | NUT |
| VANADIUM | 4/6 | 0.71 - 2.3 | S36SW0010101-D | 0.4 - 0.4 | 1.0 | 2.3 | 20.0 | No | BSL |
| **Miscellaneous Paramters (µg/L)** | | | | | | | | | |
| **CYANIDE** | 1/6 | 5.1 | S36SW0020101 | 2 | 2.5 | 5.1 | **5** | Yes | ASL |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-5.

Associated Samples

S36SW0010101
S36SW0010101-D
S36SW0020101
S36SW0030101
S36SW0040101
S36SW0050101
S36SW0060101

Definitions

COPC - Chemical of potential concern
NA - Not available/not applicable

Rationale Codes

ASL - Above screening level
BSL - Below screening level
NTX - No toxicity data
NUT - Essential nutrient

**TABLE 4-16**

**ECOLOGICAL DATA EVALUATION - SEDIMENT**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**


| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Ecological Screening Level[5] | Ecological Effects Quotient | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (µg/kg)** | | | | | | | | | | |
| 2-Butanone | 5/6 | 6 - 28 | S36SD0040001 | 12 - 13 | 14.6 | 28 | NA | NA | Yes | NTX |
| Acetone | 6/6 | 8 - 47 | S36SD0010001 | 0 | 26.4 | 47 J | NA | NA | Yes | NTX |
| Trichlorofluoromethane | 1/6 | 3 | S36SD0040001 | 12 - 23 | 7.5 | 3 J | NA | NA | Yes | NTX |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | |
| Acenapthylene | 1/15 | 290 | S36SD0030001 | 83 - 600 | 152 | 290 J | 5.9 | 49.2 | Yes | ASL |
| Anthracene | 1/15 | 420 | S36SD0030001 | 83 - 600 | 161 | 420 J | 57.2 | 7.3 | Yes | ASL |
| Benzaldehyde | 3/6 | 73 - 320 | S36SD0030001 | 270 - 480 | 177 | 320 J | NA | NA | Yes | NTX |
| Benzo(a)anthracene | 6/15 | 89 - 1200 | S36SD0030001 | 170 - 540 | 285 | 1200 | 108 | 11.1 | Yes | ASL |
| Benzo(a)pyrene | 7/15 | 43 - 1000 | S36SD0030001 | 170 - 540 | 250 | 1000 | 150 | 6.7 | Yes | ASL |
| Benzo(b)fluoranthene | 7/15 | 44 - 2300 | S36SD0030001 | 170 - 540 | 359 | 2300 | 27.2 | 84.6 | Yes | ASL |
| Benzo(g,h,i)perylene | 4/15 | 39 - 490 | S36SD0030001 | 83 - 540 | 143 | 490 J | 170 | 2.9 | Yes | ASL |
| Benzo(k)fluoranthene | 6/15 | 42 - 790 | S36SD0030001 | 170 - 540 | 172 | 790 | 240 | 3.3 | Yes | ASL |
| Carbazole | 1/6 | 61 | S36SD0030001 | 270 - 600 | 196 | 61 J | NA | NA | Yes | NTX |
| Chrysene | 6/15 | 62 - 1300 | S36SD0030001 | 170 - 540 | 209 | 1300 | 166 | 7.8 | Yes | ASL |
| Dibenzo(a,h)anthracene | 2/15 | 45 - 210 | S36SD0030001 | 83 - 600 | 136 | 210 J | 33 | 6.4 | Yes | ASL |
| Fluoranthene | 8/15 | 86 - 1300 | S36SD0030001 | 170 - 540 | 237 | 1300 | 423 | 3.1 | Yes | ASL |
| Indeno(1,2,3-c,d)pyrene | 4/15 | 34 - 480 | S36SD0030001 | 83 - 540 | 142 | 480 J | 17 | 28.2 | Yes | ASL |
| Phenanthrene | 5/15 | 65 - 120 | S36SD0020001 | 170 - 540 | 119 | 120 J | 204 | 0.6 | No | BSL |
| Pyrene | 9/15 | 67 - 1200 | S36SD0030001 | 170 - 540 | 218 | 1200 | 195 | 6.2 | Yes | ASL |
| **Explosives (mg/kg)** | | | | | | | | | | |
| Nitroglycerin | 1/6 | 0.55 | S36SD0010001 | 0.5 | 0.3 | 0.55 | NA | NA | Yes | NTX |
| **Inorganics (mg/kg)** | | | | | | | | | | |
| Aluminum | 15/15 | 3950 - 30700 | S36SD0110102 | 0 | 14629 | 30700 J | NA | NA | Yes | NTX |
| Antimony | 6/15 | 0.45 - 4.5 | S36SD0040001 | 0.47 - 3.9 | 1.55 | 4.5 L | 2 | 2.3 | Yes | ASL |
| Arsenic | 15/15 | 2.5 - 17.7 | S36SD0090102 | 0 | 7.26 | 17.7 | 9.8 | 1.8 | Yes | ASL |
| Barium | 15/15 | 26.8 - 255 | S36SD0090102 | 0 | 132 | 255 | NA | NA | Yes | NTX |
| Beryllium | 15/15 | 0.25 - 1.7 | S36SD0110102 | 0 | 0.91 | 1.7 J | NA | NA | Yes | NTX |
| Cadmium | 15/15 | 0.15 - 16 | S36SD0110102 | 0 | 2.27 | 16 J | 0.99 | 16.2 | Yes | ASL |
| Calcium | 15/15 | 711 - 5990 | S36SD0130102 | 0 | 3064 | 5990 J | NUT | NA | No | NUT |
| Chromium | 15/15 | 11.3 - 110 | S36SD0090102 | 0 | 29.9 | 110 | 43.4 | 2.5 | Yes | ASL |
| Cobalt | 15/15 | 2.1 - 26.8 | S36SD0130102 | 0 | 13.3 | 26.8 J | 50 | 0.5 | No | BSL |
| Copper | 13/15 | 13.4 - 127 | S36SD0110102 | 10.2 - 12.6 | 46.2 | 127 J | 31.6 | 4.0 | Yes | ASL |
| Iron | 15/15 | 9110 - 93500 | S36SD0090102 | 0 | 28396 | 93500 | 20000 | 4.7 | Yes | ASL |
| Lead | 15/15 | 9.8 - 4100 | S36SD0090102 | 0 | 326 | 4100 J | 35.8 | 115 | Yes | ASL |
| Magnesium | 15/15 | 504 - 3870 | S36SD0110102 | 0 | 1985 | 3870 J | NUT | NA | No | NUT |
| Manganese | 15/15 | 116 - 2080 | S36SD0110102 | 0 | 904 | 2080 J | 460 | 4.5 | Yes | ASL |
| Mercury | 11/15 | 0.12 - 2.9 | S36SD0130102 | 0.056 - 0.079 | 0.35 | 2.9 J | 0.18 | 16.1 | Yes | ASL |

**TABLE 4-16**

**ECOLOGICAL DATA EVALUATION - SEDIMENT**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**


| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Ecological Screening Level[5] | Ecological Effects Quotient | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg) (continued)** | | | | | | | | | | |
| Nickel | 14/15 | 6 - 102 | S36SD0090102 | 7.4 - 7.6 | 25.1 | 102 | 22.7 | 4.5 | Yes | ASL |
| Potassium | 15/15 | 307 - 3500 | S36SD0110102 | 0 | 1626 | 3500 J | NUT | NA | No | NUT |
| Silver | 8/15 | 0.35 - 4.9 | S36SD0010001 | 0.25 - 0.78 | 0.79 | 4.9 | 1 | 4.9 | Yes | ASL |
| Sodium | 10/15 | 79.4 - 755 | S36SD0110102 | 64.5 - 777 | 330 | 755 J | NUT | NA | No | NUT |
| Vanadium | 15/15 | 15.3 - 66.5 | S36SD0110102 | 0 | 38 | 66.5 J | NA | NA | Yes | NTX |
| Zinc | 15/15 | 16.6 - 840 | S36SD0090102 | 0 | 202 | 840 | 121 | 6.9 | Yes | ASL |
| **AVS/SEM Metals (µmol/g)** | | | | | | | | | | |
| Acid Volatile Sulfide | 7/9 | 0.67 - 37.7 | S36SD0080102 | 0.091 - 0.11 | 13.6 | 37.7 J | NA | NA | NA | NA |
| Cadmium | 8/9 | 0.0052 - 0.13 | S36SD0110102 | 0.0014 - 0.0017 | 0.022 | 0.13 J | NA | NA | NA | NA |
| Copper | 9/9 | 0.0089 - 1.3 | S36SD0110102 | 0 | 0.48 | 1.3 J | NA | NA | NA | NA |
| Lead | 9/9 | 0.002 - 0.57 | S36SD0090102 | 0 | 0.26 | 0.57 J | NA | NA | NA | NA |
| Nickel | 9/9 | 0.011 - 0.52 | S36SD0090102 | 0.0064 | 0.19 | 0.52 J | NA | NA | NA | NA |
| Zinc | 8/9 | 1.2 - 3.9 | S36SD0130102 | 0.039 - 0.18 | 1.96 | 3.9 J | NA | NA | NA | NA |
| **Miscellaneous Parameters (mg/kg)** | | | | | | | | | | |
| Cyanide | 2/15 | 0.13 - 0.26 | S36SD0060001 | 0.12 - 0.96 | 0.267 | 0.26 | 0.1 | 2.6 | Yes | ASL |
| Total Organic Carbon | 9/9 | 50300 - 162000 | S36SD0150102 | 0 | 88311 | 162000 J | NA | NA | NA | NA |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-6.

Definitions
COPC - Chemical of potential concern
NA - Not available/not applicable

Rationale Codes
ASL - Above screening level
BSL - Below screening level
NTX - No toxicity data/screening level
NUT - Essential nutrient

Associated Samples:

| | |
|---|---|
| S36SD0010001 | S36SD0070102 |
| S36SD0020001 | S36SD0080102 |
| S36SD0030001 | S36SD0090102 |
| S36SD0040001 | S36SD0100102 |
| S36SD0050001 | S36SD0110102 |
| S36SD0060001 | S36SD0120102 |
| S36SD0060001-AVG | S36SD0120102-AVG |
| S36SD0060001-D | S36SD0120102-D |

**TABLE 4-17**

**ORGANIC CARBON NORMALIZED AVS/SEM CALCULATIONS**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MD**

| Sample ID | S36SD0070102 | S36SD0080102 | S36SD0090102 | S36SD0100102 | S36SD0110102 | S36SD0120102 | S36SD0120102-AVG | S36DUP010102 | S36SD0130102 | S36SD0140102 | S36SD0150102 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous Parameters (mg/kg)** | | | | | | | | | | | |
| TOTAL ORGANIC CARBON | 78800 J | 91000 J | 50300 | 82200 J | 72300 J | 57000 J | 77800 J | 98600 J | 72400 J | 108000 J | 162000 J |
| **AVS/SEM (µmol/g)** | | | | | | | | | | | |
| ACID VOLATILE SULFIDE | 0.091 UJ | 37.7 J | 21 L | 14.3 J | 28.4 J | 0.67 J | 0.3625 J | 0.11 UJ | 13.9 J | 6.6 J | 0.11 UJ |
| CADMIUM | 0.0014 UJ | 0.0077 J | 0.0052 J | 0.018 J | 0.13 J | 0.014 J | 0.007425 J | 0.0017 UJ | 0.015 J | 0.0072 J | 0.0068 J |
| COPPER | 0.014 J | 0.36 J | 0.63 J | 0.48 J | 1.3 J | 0.25 J | 0.12945 J | 0.0089 J | 0.77 J | 0.34 J | 0.34 J |
| LEAD | 0.0038 J | 0.27 J | 0.57 J | 0.28 J | 0.48 J | 0.12 J | 0.061 J | 0.002 J | 0.34 J | 0.15 J | 0.16 J |
| NICKEL | 0.011 J | 0.19 J | 0.52 J | 0.2 J | 0.25 J | 0.094 J | 0.0486 J | 0.0064 UJ | 0.2 J | 0.14 J | 0.19 J |
| ZINC | 0.18 B | 2 J | 1.2 J | 2.6 J | 3 J | 1.6 J | 0.80975 J | 0.039 B | 3.9 J | 1.7 J | 2.3 J |
| Sum SEM | 0.2095 | 2.8277 | 2.9252 | 3.578 | 5.16 | 2.078 | 1.056225 | 0.05715 | 5.225 | 2.3372 | 2.9968 |
| Sum SEM - AVS | 0.164 | -34.8723 | -18.0748 | -10.722 | -23.24 | 1.408 | 0.693725 | 0.00215 | -8.675 | -4.2628 | 2.9418 |
| $f_{OC}$ | 0.0788 | 0.091 | 0.0503 | 0.0822 | 0.0723 | 0.057 | 0.0778 | 0.0986 | 0.0724 | 0.108 | 0.162 |
| (Sum SEM - AVS)/$f_{OC}$ | 2.08 | -383 | -359 | -130 | -321 | 24.7 | 8.92 | 0.022 | -120 | -39.5 | 18.2 |

Nondetect values were summed as 1/2 the nondetect value
AVS - Acid Volatile Sulfide
SEM - Simultaneously Extracted Metals
$f_{OC}$ - fraction organic carbon (unitless)

**TABLE 4-18**

**SUMMARY OF BENTHIC MACROINVERTEBRATE DATA**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD MARYLAND**
**PAGE 1 OF 2**

| SPECIES | T.V. | F.F.G. | Reference Samples | | | | Site Samples | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Upstream | | Downstream | | | | | | |
| | | | S36SD007 | S36SD008 | S36SD014 | S36SD015 | S36SD009 | S36SD010 | S36SD011 | S36SD012 | S36SD013 |
| | | | | | | | | | | | |
| **NEMATODA** | **6** | | | | | | | | 2 | | |
| **MOLLUSCA** | | | | | | | | | | | |
| **Bivalvia** | | | | | | | | | | | |
| **Veneroida** | | | | | | | | | | | |
| Sphaeriidae | ***8** | **FC** | | | | | | | 1 | | |
| **Gastropoda** | | | | | | | | | | | |
| **Basommatophora** | | | | | | | | | | | |
| Physidae | | | | | | | | | | | |
| *Physella sp.* | **8.8** | **CG** | | 1 | | | | | | | 1 |
| **ANNELIDA** | | | | | | | | | | | |
| **Oligochaeta** | | | | | | | | | | | |
| **Tubificida** | | | | | | | | | | | |
| Enchytraeidae | **9.8** | **CG** | | | | 1 | | | 34 | 6 | 16 |
| Naididae | ***8** | **CG** | | | 10 | | | | | | 20 |
| *Dero sp.* | **10** | **CG** | | | | | | | | | 4 |
| Tubificidae w.h.c. | **7.1** | **CG** | 44 | 4 | 10 | 4 | 30 | 28 | 40 | 12 | 12 |
| *Quistadrilus multisetosus* | **3.9** | **CG** | | | 67 | | 35 | 16 | 40 | 12 | 8 |
| Tubificidae w.o.h.c. | **7.1** | **CG** | 234 | 49 | 105 | 22 | 12 | 24 | 7 | 54 | 16 |
| *Branchiura sowerbyi* | **8.3** | **CG** | | | | | 3 | 1 | | | |
| *Limnodrilus hoffmeisteri* | **9.5** | **CG** | 15 | 20 | | 6 | 41 | 8 | 13 | 36 | |
| **Lumbriculida** | | | | | | | | | | | |
| Lumbriculidae | **7** | **CG** | | | | | | 4 | | | |
| **Hirudinea** | | | | | | | | | | | |
| **Rhynchobdellida** | | | | | | | | | | | |
| Glossiphoniidae | | **P** | | | | | | | | | |
| *Helobdella trisserialis* | **9.2** | **P** | | | | | | | | | 1 |
| **ARTHROPODA** | | | | | | | | | | | |
| **Crustacea** | | | | | | | | | | | |
| **Ostracoda** | | | 1 | 1 | 5 | | 1 | | | 1 | |
| **Amphipoda** | | | | | | | | | | | |
| Gammaridae | | | | | | | | | | | |
| *Gammarus sp.* | **9.1** | **SH** | | | 1 | | | 2 | | 4 | 21 |
| **Decapoda** | | | | | | | | | | | |
| Palaemonidae | | | | | | | | | | | |
| *Palaemonetes sp.* | **7.1** | **CG** | | | | | | | | | 1 |

**TABLE 4-18**

**SUMMARY OF BENTHIC MACROINVERTEBRATE DATA**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD MARYLAND**
**PAGE 2 OF 2**

| | | | Reference Samples | | | | Site Samples | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Upstream | | Downstream | | | | | | |
| **SPECIES** | **T.V.** | **F.F.G.** | **S36SD007** | **S36SD008** | **S36SD014** | **S36SD015** | **S36SD009** | **S36SD010** | **S36SD011** | **S36SD012** | **S36SD013** |
| **Insecta** | | | | | | | | | | | |
| **Ephemeroptera** | | | | | | | | | | | |
| Caenidae | | | | | | | | | | | |
| *Caenis sp.* | **7.4** | **CG** | | | | | | | | 1 | 1 |
| **Odonata** | | | | | | | | | | | |
| Libellulidae | | **P** | | | | | | 1 | | | |
| **Trichoptera** | | | | | | | | | | | |
| Leptoceridae | | **CG** | | | | | | | | | 1 |
| **Diptera** | | | | | | | | | | | |
| Ceratopogonidae | | **P** | | 1 | | 1 | 1 | 1 | | 1 | |
| Chironomidae | | | | | | | | | | | |
| *Chironomus sp.* | **9.6** | **CG** | | | | | | 1 | 1 | 4 | 5 |
| *Cladotanytarsus sp.* | **4.1** | **FC** | | | | 1 | | | | | |
| *Cricotopus sylvestris* | | | 1 | | | | | | | | 3 |
| *Dictotendipes modestus* | **8.7** | | 1 | | 14 | 3 | | 2 | 17 | 10 | 117 |
| *Einfeldia sp.* | **7.1** | **CG** | | | | | | 2 | | | |
| *Glyptotendipes sp.* | **9.5** | **FC** | | | | | | | | 2 | |
| *Nanocladius sp.* | **7.1** | **CG** | | | | | | | | | 2 |
| *Paracladopelma sp.* | **5.5** | **CG** | | | | 1 | | | | 2 | |
| *Parametriocnemus sp.* | **3.7** | **CG** | | | | | | | | | 1 |
| *Polypedilum halterale gp.* | **7.3** | **SH** | | | 1 | | | 1 | 1 | | 1 |
| *Polypedilum illinoense* | **9** | **SH** | | | | | | | 1 | 4 | |
| *Procladius bellus* | | | | | | | 1 | 2 | 1 | 2 | |
| *Procladius sp.* | **9.1** | **P** | | | 1 | 1 | | | | | 20 |
| *Tanypus carinatus* | | | 4 | 1 | 1 | | 12 | 16 | 1 | 41 | 15 |
| *Tanytarsus sp.* | **6.8** | **FC** | | | 2 | 2 | | 3 | 4 | 6 | 32 |
| Muscidae | | | | | | | 1 | | | | |
| Tabanidae | | **PI** | | | | | | | | | |
| *Chrysops sp.* | **6.7** | **PI** | | | 2 | | | | | 2 | |
| Tipulidae | | **SH** | | 25 | 40 | 40 | 3 | | | 12 | |
| | | | | | | | | | | | |
| **Total Number of Organisms** | | | **300** | **102** | **259** | **82** | **140** | **112** | **163** | **212** | **298** |
| **Totan Number of Taxa** | | | **7** | **8** | **13** | **11** | **11** | **16** | **14** | **19** | **21** |
| **North Carolina Biotic Index** | | | **7.23** | **7.77** | **6.25** | **7.56** | **7.02** | **6.86** | **7.25** | **7.78** | **8.25** |
| **Shannon Diversity Index** | | | **1.07** | **1.91** | **2.38** | **2.20** | **2.54** | **3.08** | **2.77** | **3.29** | **3.16** |

**T.V. - Tolerance Value (The lower the number the more sensitive the organism)**
**F.F.G. - Functional Feeding Group**
- CG - Collectors Gatherers
- FC - Filtering Collectors
- SH - Shredders
- P - Predators
- PI - Piercers

**TABLE 4-19**

**ECOLOGICAL DATA EVALUATION - PORE WATER**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND]**

| Chemical | Frequency of Detection[1] | Range of Detections[1] | Sample with Maximum Detection | Range of Nondetects[2] | Average of All Results[3] | Concentration Used for Screening[4] | Ecological Screening Level[5] | Selected as a COPC? | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (µg/L)** | | | | | | | | | |
| **TOLUENE** | 4/4 | 0.56 - 4 | S36PW0020101 | --- | 1.8 | 4 | **2** | Yes | ASL |
| **Semivolatiles (µg/L)** | | | | | | | | | |
| 4-METHYLPHENOL | 1/4 | 1 | S36PW0010101 | 10 | 4 | 1 | 543 | No | BSL |
| **ACETOPHENONE** | 1/4 | 2 | S36PW0040101 | 10 | 4.25 | 2 | NA | Yes | NTX |
| **Explosives (µg/L)** | | | | | | | | | |
| **1,3,5-TRINITROBENZENE** | 1/4 | 0.076 | S36PW0020101 | 0.1 - 0.2 | 0.07 | 0.076 | NA | Yes | NTX |
| **1,3-DINITROBENZENE** | 1/4 | 0.25 - 0.65 | S36PW0010101-D | 0.1 - 0.2 | 0.16 | 0.65 | NA | Yes | NTX |
| 2,4,6-TRINITROTOLUENE | 1/4 | 0.077 | S36PW0010101 | 0.1 - 0.2 | 0.07 | 0.077 | 100 | No | BSL |
| 4-NITROTOLUENE | 1/4 | 0.073 | S36PW0010101-D | 0.5 - 1 | 0.27 | 0.073 | 1900 | No | BSL |
| **Metals (unfiltered) (µg/L)** | | | | | | | | | |
| **ALUMINUM** | 4/4 | 17.6 - 1930 | S36PW0030101 | --- | 823 | 1930 | **87** | Yes | ASL |
| ARSENIC | 4/4 | 2.1 - 4.9 | S36PW0020101 | --- | 3.3 | 4.9 | 5 | No | BSL |
| **BARIUM** | 4/4 | 68.4 - 280 | S36PW0020101 | --- | 142 | 280 | **4** | Yes | ASL |
| **CADMIUM** | 4/4 | 0.23 - 1.3 | S36PW0020101 | --- | 0.59 | 1.3 | **0.25** | Yes | ASL |
| CALCIUM | 4/4 | 18700 - 34500 | S36PW0020101 | --- | 29212 | 34500 | 116000 | No | NUT |
| CHROMIUM | 4/4 | 1.6 - 19.7 | S36PW0010101 | --- | 10.5 | 19.7 | 85 | No | BSL |
| COBALT | 4/4 | 0.55 - 8.1 | S36PW0010101 | --- | 5.1 | 8.1 | 23 | No | BSL |
| **COPPER** | 4/4 | 7.6 - 33.1 | S36PW0010101 | --- | 19.7 | 33.1 | **9** | Yes | ASL |
| **IRON** | 4/4 | 16600 - 82800 | S36PW0020101 | --- | 39038 | 82800 | **300** | Yes | ASL |
| **LEAD** | 4/4 | 1.1 - 14 | S36PW0010101 | --- | 4.6 | 14 | **2.5** | Yes | ASL |
| MAGNESIUM | 4/4 | 14800 - 27100 | S36PW0020101 | --- | 20662 | 27100 | 82000 | No | NUT |
| **MANGANESE** | 4/4 | 1440 - 2690 | S36PW0010101 | --- | 2105 | 2690 | **120** | Yes | ASL |
| **NICKEL** | 4/4 | 49.6 - 364 | S36PW0030101 | --- | 241 | 364 | **52** | Yes | ASL |
| POTASSIUM | 1/4 | 7130 | S36PW0040101 | 1300 - 5100 | 2813 | 7130 | 53000 | No | NUT |
| SODIUM | 4/4 | 59100 - 166000 | S36PW0020101 | --- | 65350 | 166000 | 680000 | No | NUT |
| VANADIUM | 3/4 | 2.6 - 3.8 | S36PW0030101 | 0.4 | 2.2 | 3.8 | 20 | No | BSL |
| ZINC | 4/4 | 42.5 - 70.4 | S36PW0040101 | 2.1 | 53.1 | 70.4 | 120 | No | BSL |

Shaded cells indicate chemicals selected as COPCs and/or exceedances of criteria.

1 Sample and duplicate are counted as one sample when determining frequency of detection and as two samples when determining range of detections.
2 Values presented are sample-specific quantitation limits.
3 Averages are calculated using one half the detection limit for nondetect samples.
4 The maximum detected concentration is used for screening purposes.
5 Table 3-5.

Associated Samples

S36PW0010101
S36PW0010101-D
S36PW0020101
S36PW0030101
S36PW0040101

Definitions

COPC - chemical of potential concern
NA - Not available/not applicable

Rationale Codes

ASL - Above screening level
BSL - Below screening level
NTX - No toxicity data
NUT - Essential nutrient

**TABLE 4-20**

**TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO**
**INSECTIVOROUS AND HERBIVOROUS RECEPTORS**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Chemical | Herbivorous Receptors EEQs | | | | Insectivorous Receptors EEQs | | | |
|---|---|---|---|---|---|---|---|---|
| | Bobwhite Quail | | Meadow Vole | | American Woodcock | | Short-Tailed Shrew | |
| | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL |
| **Metals** | | | | | | | | |
| CADMIUM | 3.4E-02 | 7.9E-03 | 3.6E-01 | 4.0E-02 | 2.8E+00 | 6.6E-01 | 2.8E+00 | 3.2E-01 |
| COPPER | 1.2E-01 | 1.4E-02 | 4.1E-01 | 2.8E-02 | 1.6E+00 | 1.8E-01 | 4.8E-01 | 3.3E-02 |
| LEAD | 5.8E-01 | 2.1E-02 | 5.0E-01 | 1.3E-02 | 1.0E+01 | 3.7E-01 | 1.3E+00 | 3.3E-02 |
| ZINC | 3.2E-02 | 1.2E-02 | 1.7E-01 | 4.3E-02 | 1.1E+00 | 4.4E-01 | 5.2E-01 | 1.3E-01 |

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

**TABLE 4-21**

**TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO**
**PISCIVOROUS RECEPTORS**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Chemical | Piscivorous Receptors EEQs | | | |
|---|---|---|---|---|
| | Great Blue Heron | | Raccoon | |
| | NOAEL | LOAEL | NOAEL | LOAEL |
| **Semivolatile Organics** | | | | |
| ACENAPHTHYLENE | 4.2E-03 | 4.2E-04 | 1.7E-04 | 3.2E-05 |
| ANTHRACENE | 6.1E-03 | 6.1E-04 | 2.5E-04 | 4.6E-05 |
| BENZO(A)ANTHRACENE | 1.7E-02 | 1.7E-03 | 7.7E-02 | 1.2E-03 |
| BENZO(A)PYRENE | 1.4E-02 | 1.4E-03 | 6.4E-02 | 1.0E-03 |
| BENZO(B)FLUORANTHENE | 3.3E-02 | 3.3E-03 | 1.5E-01 | 2.4E-03 |
| BENZO(G,H,I)PERYLENE | 7.1E-03 | 7.1E-04 | 3.1E-02 | 5.0E-04 |
| BENZO(K)FLUORANTHENE | 1.1E-02 | 1.1E-03 | 5.1E-02 | 8.1E-04 |
| CHRYSENE | 1.9E-02 | 1.9E-03 | 8.3E-02 | 1.3E-03 |
| DIBENZO(A,H)ANTHRACENE | 3.0E-03 | 3.0E-04 | 1.3E-02 | 2.2E-04 |
| FLUORANTHENE | 1.9E-02 | 1.9E-03 | 7.8E-04 | 1.4E-04 |
| INDENO(1,2,3-CD)PYRENE | 6.9E-03 | 6.9E-04 | 3.1E-02 | 4.9E-04 |
| PHENANTHRENE | 1.7E-03 | 1.7E-04 | 7.2E-05 | 1.3E-05 |
| PYRENE | 1.7E-02 | 1.7E-03 | 7.7E-02 | 1.2E-03 |
| **Inorganics** | | | | |
| ARSENIC | 3.0E-01 | 1.5E-01 | 8.6E-01 | 2.0E-01 |
| CADMIUM | 4.6E+00 | 1.1E+00 | 1.1E+01 | 1.2E+00 |
| CHROMIUM | 1.1E+00 | 1.9E-01 | 1.7E+00 | 6.9E-02 |
| COPPER | 8.7E+00 | 1.0E+00 | 7.8E+00 | 5.3E-01 |
| LEAD | 8.5E+01 | 3.1E+00 | 3.9E+01 | 1.0E+00 |
| MERCURY | 6.9E+01 | 6.9E+00 | 1.7E+01 | 3.5E+00 |
| NICKEL | 1.9E+00 | 6.8E-01 | 9.4E+00 | 1.1E+00 |
| SILVER | 1.3E-01 | 4.4E-03 | 5.8E-02 | 2.9E-03 |
| ZINC | 5.1E+00 | 1.9E+00 | 5.5E+00 | 1.4E+00 |

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

**TABLE 4-22**

**TERRESTRIAL FOOD CHAIN MODEL - LESS CONSERVATIVE SCENARIO**
**INSECTIVOROUS AND HERBIVOROUS RECEPTORS**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Chemical | Herbivorous Receptors EEQs | | | | Insectivorous Receptors EEQs | | | |
|---|---|---|---|---|---|---|---|---|
| | Bobwhite Quail | | Meadow Vole | | American Woodcock | | Short-Tailed Shrew | |
| | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL | NOAEL | LOAEL |
| **Metals** | | | | | | | | |
| CADMIUM | NA | NA | NA | NA | 4.7E-01 | 1.1E-01 | 6.5E-01 | 7.2E-02 |
| COPPER | NA | NA | NA | NA | 3.7E-01 | 4.3E-02 | NA | NA |
| LEAD | NA | NA | NA | NA | 1.8E+00 | 6.5E-02 | 3.9E-01 | 9.8E-03 |
| ZINC | NA | NA | NA | NA | 5.6E-01 | 2.2E-01 | NA | NA |

Cells are shaded if the value is greater than 1.0
NA - Not applicable
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

**TABLE 4-23**

**TERRESTRIAL FOOD CHAIN MODEL - LESS CONSERVATIVE SCENARIO**
**PISCIVOROUS RECEPTORS**
**SITE 36 - CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Chemical | Piscivorous Receptors EEQs | | | |
|---|---|---|---|---|
| | Great Blue Heron | | Raccoon | |
| | NOAEL | LOAEL | NOAEL | LOAEL |
| **Inorganics** | | | | |
| CADMIUM | 4.4E-02 | 1.0E-02 | 6.7E-02 | 7.5E-03 |
| CHROMIUM | 6.7E-02 | 1.1E-02 | 7.9E-02 | 3.3E-03 |
| COPPER | 8.2E-01 | 9.5E-02 | 4.4E-01 | 3.0E-02 |
| LEAD | 9.4E-01 | 3.4E-02 | 3.7E-01 | 9.4E-03 |
| MERCURY | 2.9E+00 | 2.9E-01 | 4.4E-01 | 8.8E-02 |
| NICKEL | 8.7E-02 | 3.2E-02 | 2.8E-01 | 3.2E-02 |
| ZINC | 2.7E-01 | 1.0E-01 | 1.8E-01 | 4.5E-02 |

NA - Not applicable
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

# Appendix C
# ARARs

**ARARs AND SELECTED PERFORMANCE STANDARDS TO BE MET BY THE SELECTED REMEDY**
**SITE 36 – CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Medium | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| **CHEMICAL-SPECIFIC ARARs** AND SELECTED PERFORMANCE STANDARDS | | | | | |
| **Federal** | | | | | |
| Groundwater | SDWA standards serve to protect public water systems. Primary drinking water standards consist of federally enforceable MCLs at the tap. An MCL is the maximum level of a contaminant that is allowed in drinking water. | Impact to public water systems that have at least 15 service connections or serve at least 25 year-round residents. May also be clean-up standards for on-site groundwater that is a current or potential source of drinking water. | 40 CFR 141.2, 141.51, and 141.62 | Relevant and appropriate | Long-term groundwater monitoring will be performed to ensure that contaminants are not moving offsite at unacceptable levels. |
| **LOCATION-SPECIFIC ARARs** AND SELECTED PERFORMANCE STANDARDS | | | | | |
| **US Fish and Wildlife Service Biological Opinion, 2007** | | | | | |
| Habitat for Bald Eagles | The Navy will take the appropriate measures to minimize impacts to bald eagles including time-of-year restrictions for construction activities during the bald eagle nesting season (15 Dec – 15 June). | Actions that will impact Bald Eagle habitat. | USFWS Biological Opinion, letter to Mr. Jeffrey Bossart, August 2007 and NSFIH Bald Eagle Management Plan (2010) | Selected Performance Standard | Construction activities will be limited to time of year that will not impact Bald Eagle nesting (15 Dec – 15 June). |

**ARARs AND SELECTED PERFORMANCE STANDARDS TO BE MET BY THE SELECTED REMEDY**
**SITE 36 – CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Medium | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| **Federal Fish and Wildlife Coordination Act, Fish and Wildlife Improvement Act of 1978, and Wildlife Conservation Act of 1980** | | | | | |
| Areas affecting streams or other bodies of water | Federal agencies are to consult with appropriate state agency having jurisdiction over wildlife resources before undertaking federal action for the modification of any body of water to conserve those resources. | Diversion, channeling, or other activity that modifies a stream or other water body, including wetlands, and affects fish or wildlife. | 16 USC 662(a) | Applicable | Chicamuxen Creek and associated wetlands are in the vicinity of Site 36. Surface debris will be removed from these wetlands as part of the selected remedy. |
| **Federal Protection of Wetlands Executive Order 11990** | | | | | |
| Wetland | Federal agencies, in carrying out their responsibilities, are to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. | Wetland as defined by Executive Order 11990, Section 7. | E.O. 11990 | Selected Performance Standard | Chicamuxen Creek and associated wetlands are in the vicinity of Site 36. |
| **Federal Floodplain Management Executive Order 11988** | | | | | |
| Floodplain | Federal agencies, in carrying out their responsibilities, are to take action to avoid adverse effects, minimize potential harm, and restore and preserve the natural and beneficial uses of floodplains. | Actions that will occur in a floodplain. | E.O 11988 | Selected Performance Standard | Site 36 lies within the 100-year flood boundary of Chicamuxen Creek. |

**ARARs AND SELECTED PERFORMANCE STANDARDS TO BE MET BY THE SELECTED REMEDY**
**SITE 36 – CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Medium | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| **State** | | | | | |
| **Maryland Tidal Wetland Regulations** | | | | | |
| Tidal wetland | Avoid adverse impacts and minimize losses of tidal wetlands. | Actions that will affect tidal wetland. | COMAR 26.24.01.02 26.24.02.01B 26.24.03.01-.06 26.24.05.01 | Applicable | Chicamuxen Creek is tidal, and associated wetlands are in the vicinity of Site 36. |
| **ACTION-SPECIFIC ARARs** AND SELECTED PERFORMANCE STANDARDS | | | | | |
| **Federal Clean Water Act** | | | | | |
| Discharge to surface water | NPDES permit requirements. | Discharge of storm water from construction activity to surface water. | Substantive requirements included in 40 CFR 122.26, 122,28, and 122.41 | Applicable | Surface debris removal activities may require adherence to substantive permit requirements during construction activities. |

**ARARs AND SELECTED PERFORMANCE STANDARDS TO BE MET BY THE SELECTED REMEDY**
**SITE 36 – CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Medium | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| **Maryland Hazardous Waste Management** | | | | | |
| On-site waste generation | Waste generator to determine whether waste is hazardous waste. | Generation (e.g., excavation) of solid waste. | COMAR 26.13.02 | Applicable | Material to be transported off site would need to be tested to determine whether it is a hazardous waste. |
| Hazardous waste storage | Temporary storage of hazardous waste. | Temporary storage prior to off-site transport of hazardous waste. | COMAR 26.13.05.01 26.13.05.03 26.13.05.04 | Applicable | Applicable to temporary storage of hazardous waste prior to off-site shipment |
| **Maryland Solid Waste Management** | | | | | |
| Closure of solid waste landfill | Closure and post-closure care requirements for non-hazardous waste landfills, including capping, inspection, maintenance, and monitoring. | Landfill not closed in accordance with state regulations. | COMAR 26.04.07.21 26.04.07.22 26.04.07.26 | Applicable | Applicable for design of soil cover and impermeable capping systems. |

**ARARs AND SELECTED PERFORMANCE STANDARDS TO BE MET BY THE SELECTED REMEDY**
**SITE 36 – CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Medium | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| **Maryland Water Management** | | | | | |
| Surface water and groundwater quality | Water quality standards promulgated by the State serve to protect surface and groundwater resources | Discharge of storm water from construction activity to surface water. | COMAR<br>26.08.02.02-1<br>26.08.02.03<br>26.08.02.03-1<br>26.08.02.03-2<br>26.08.02.03-3<br>26.08.02.03-4<br>26.08.02.04-1<br>26.08.02.05<br>26.08.02.09 | Applicable | The surface debris removal activities may result in storm water discharges. |
| Land disturbing activities | Requirements for erosion and sediment control. | Land clearing, grading, and other earth disturbance. | COMAR<br>26.17.01.01<br>26.17.01.05<br>26.17.01.07 B & C<br>26.17.01.11 | Applicable | Applicable for activities that will disturb earth. The surface debris removal activities may result in the need for erosion controls. |

**ARARs AND SELECTED PERFORMANCE STANDARDS TO BE MET BY THE SELECTED REMEDY**
**SITE 36 – CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Medium | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| Land development | Requirements for storm water management. | Construction activities. | COMAR<br>26.17.02.02<br>26.17.02.06<br>26.17.02.08<br>26.17.02.09 | Applicable | Applicable where storm water management and control are needed. The surface debris removal activities may result in alterations to the site that require stormwater management enhancements. |
| **Maryland Air Quality** | | | | | |
| Air emissions | Emission standards for visible emissions and particulate matter. | Soil excavation and handling. | COMAR<br>26.11.06.02<br>26.11.06.03 | Applicable | Applicable where there may be fugitive emissions from material handling. |

**ARARs AND SELECTED PERFORMANCE STANDARDS TO BE MET BY THE SELECTED REMEDY**
**SITE 36 – CLOSED LANDFILL**
**NSF-IH, INDIAN HEAD, MARYLAND**

| Medium | Requirement | Prerequisite | Citation | ARAR Determination | Comments |
|---|---|---|---|---|---|
| **Maryland Monitoring Wells** | | | | | |
| Well construction and abandonment | Requirements for constructing and abandoning wells. | Groundwater monitoring. | COMAR 26.04.04.02 26.04.04.07 26.04.04.10 26.04.04.11 | Applicable | Applicable for construction of new monitoring wells or abandoning existing monitoring wells. Monitoring wells on the site may require abandonment. |
| **Maryland Occupational, Industrial, and Residential Hazards** | | | | | |
| Noise generation | Established limits on noise levels not to be exceeded at the property boundary. | Action that will generate noise. | COMAR 26.02.03.02A(2) & B(2) and 26.02.03.03A | Applicable | Applicable for activities that will generate noise. Construction activities will need to limit noise levels. |

| | | | |
|---|---|---|---|
| ARARs | Applicable or relevant and appropriate requirements. | MCL | Maximum Contaminant Level. |
| CFR | Code of Federal Regulations. | NPDES | National Pollutant Discharge Elimination System |
| COMAR | Code of Maryland Regulations. | SDWA | Safe Drinking Water Act. |
| EPA | United States Environmental Protection Agency. | USC | United States Code. |

# Appendix D
# MDE Variance Correspondence

**MARYLAND DEPARTMENT OF THE ENVIRONMENT**
1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101

MDE

Martin O'Malley
Governor

Anthony G. Brown
Lieutenant Governor

Shari T. Wilson
Secretary

Robert M. Summers, Ph.D.
Deputy Secretary

June 30, 2010

Mr. Joseph Rail, P.E.
NAVFAC Washington
Washington Navy Yard, Bld. 212
1314 Harwood Street SE
Washington, DC 20374-5018

Re: NSF Indian Head Site 36 – Closed Landfill Request for Variance, letter dated May 20, 2010

Dear Mr. Rail:

The Federal Facilities Division (FFD) of the Maryland Department of the Environment's (MDE) Hazardous Waste Program has completed its review of the above referenced letter. The Navy is complying with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) with regards to this site. The Code of Maryland Regulations (COMAR) 26.04.07.10 and .21 are therefore Applicable or Relevant and Appropriate Requirements to any action taken at the site.

The FFD in consultation with MDE's Solid Waste Program has reviewed the requested variance. A variance is requested at Site 36 for the following reasons: the majority of the waste present at Site 36 is hydrated as the site used to be a marsh before land filling began, a partial soil cover (ranging from 0 - 4 feet thick) already exists at the site, there are no unacceptable risks to human health from exposure to surface soil, sediment or surface water at the site. Results of the benthic macroinvertebrate study conducted at Site 36 show that the benthic community is not being adversely affected by either sediment or pore-water contamination. Site 36 lies within the Chesapeake Bay Critical Area and implementation of a fully compliant COMAR engineered cover system would destroy the existing vegetation/ecological habitat at the site. If implemented and monitored adequately, the proposed remedy should be as protective as the State's landfill closure regulations as stated in COMAR 26.04.07.10 and 26.04.07.21.

Considering the foregoing, the FFD, in accordance with the variance provision contained in COMAR 26.04.07.26, will consider favorably the Navy's request for a variance if the following conditions are adequately addressed in the Record of Decision for this site and community response to the proposed plan is favorable:

i. Long-term operations and maintenance activities will be implemented to protect the integrity of the existing cover and shoreline with monitoring adequate to meet the needs of the FFD.

ii. Long-term monitoring of groundwater will be implemented to monitor the effectiveness of the existing permeable cover at Site 36 and to evaluate the potential migration of contaminants toward Chickamuxen Creek. Again this monitoring program must meet the needs of the FFD in evaluating the adequacy of the remedy and the continued use of the variance provision contained in COMAR.

If you have any questions, please contact me at (410) 537-3791.

Sincerely,

Curtis DeTore
Section Head
Federal Facilities Division

CD:cd

cc: Mr. Dennis Orenshaw
Mr. Horacio Tablada
Mr. Harold L. Dye, Jr.
Mr. Edward Dexter