EPA/ROD/R03-98/070
1998

EPA Superfund
Record of Decision:

NAVAL SURFACE WARFARE CENTER - DAHLGREN
EPA ID: VA7170024684
OU 05
DAHLGREN, VA
09/30/1998

EPA 541-R98-070

<IMG SRC 980700>

SITE 17 1400 AREA LANDFILL

NAVAL SURFACE WARFARE CENTER
DAHLGREN SITE
DAHLGREN, VIRGINIA

RECORD OF DECISION

September 1998

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1.0 THE DECLARATION

1.1 SITE NAME AND LOCATION

Site 17 1400 Area Landfill
Naval Surface Warfare Center Dah1gren Site
Dahigren, Virginia

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial acton for Site 17, 1400 Area Landfill at the Naval Surface Warfare Center, Dahlgren Site (NSWCDL), Dahlgren, Virginia. This document focuses on remedial decisions for Site 17 at the NSWCDL and the term "site" in this document refers to Site 17. This determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

The Commonwealth of Virginia concurs with the selected remedy (see Appendix A).

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

1.3 DESCRIPTION OF THE SELECTED REMEDY

The Navy will manage the remediation of the 1400 Area Landfill as a single remedial action. The remedial action selected in this ROD addresses contamination associated with Site 17 1400 Area Landfill contents, surface soils, surface water, sediment, and groundwater.

The selected remedy for Site 17 is to use phytoremediation to address both soils and groundwater. Institutional controls, as well as groundwater, surface water, and sediment monitoring will also be a portion of the remedy.

The major componenis of the selected remedy are:

The landfill area will be capped, to address surface soil contamination, with a 2 -foot-thick vegetative soil layer. Natural vegetation such as hybrid poplars and evergreens will be planted on this layer to control erosion and reduce infiltration and subsequent groundwater discharge to the tributaries via evapotranspiration. This vegetation will also provide a habitat enhancement. The cap will achieve an equivalent net reduction in infiltration and provide equivalent erosion protection per 9 Virginia Administrative Code (VAC) 20-80-250. (infiltration calculations using the Hydrological Evaluation of Landfill Performance (HELP) model were performed to determine whether there can be a functional equivalency between a Commonwealth of Virginia sanitary landfill cap [Alternative 2] and a soil cap coupled with phytoremediation [Alternative 4]. According to these calculations, there is a similar reduction of infiltration through the landfill using either the sanitary landfill cap or the soil cap with the phytoremediation alternative.)

Groundwater discharging to surface water bodies at Site 17 will be primarily contained using

natural vegetation such as hybrid poplars and evergreens.

Waste/fill within 100 feet of the tributaries shall be excavated to address Commonwealth of Virginia regulation 9 VAC 20-80-250 which requires a 100 foot setback for waste adjacent to surface water bodies. It is estimated that 17,600 cubic yards would have to be excavated and consolidated beneath the cap.

The marsh area near monitoring well GW17-13 will be remediated to address residual mercury contamination even though sediment criteria are not exceeded. Approximately 970 cubic yards of marsh sediment would be transported to an offsite treatment and disposal facility.

Institutional controls will be implemented to limit future site land use. For Site 17, an institutional control plan will be developed as part of the remedial action design and include: access controls, signs along the perimeter of the site, restrictions on shallow groundwater use for drinking water, description of land use controls in the base master plan, periodic inspection, monitoring, and re-evaluation of land use controls, annual certification that institutional controls are in place, notification to the U.S. EPA and state regulators whenever the Navy anticipates any major changes in land use restrictions, public notice, and a deed notification.

The Navy shall institute the following institutional controls within 90 days of completion of the installation of the phytoremediation system: a real property description notation, Base Master Plan notations, and limited site access. The Base Master Plan shall note the area as one in which residential development cannot occur, shallow groundwater cannot be used, and site access shall be limited. A notation shall be filed in the real property file maintained at Engineering Field Activity, Chesapeake (EFA Ches) (US Navy) for this site indicating the extent of the area and the fact that solid wastes are present. The institutional controls shall also include the following: within 90 days after completion of the remedy, the Navy shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of the disposal area and the extent of groundwater contamination. Monitoring well locations shall be included and identified on the survey plat. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict disturbance (excavation or construction) of the property; post-closure use of the property shall prohibit residential use, access or use of groundwater underlying the property for any purpose except monitoring, and the function of the monitoring systems shall not be disturbed. When landfill closure is complete, the owner of the property shall submit the survey plat to the local recording authority, and shall record a notation with the deed (or some other instrument which is normally examined during title search at the local land recording authority) notifying any potential purchaser of the property that the land has been used to manage solid waste and the integrity of the cover system or the function of the monitoring system may not be disturbed.

The Navy shall institute groundwater monitoring to ensure that remedial action objectives (RAOs) are being maintained. The frequency of analysis and the length of time for monitoring shall be developed in the Operation and Maintenance Plan.

The Navy shall monitor the surface waters and sediments in the tributaries adjacent to Site 17 to ensure RAOs are being maintained. The frequency of analysis and the length of time for monitoring shall be developed in the Operation and Maintenance Plan.

Implementation of the selected remedy is expected to fully address the principal threats at the site by reducing the potential risk to human health and the environment associated with the soils and groundwater.

1.4 STATUTORY DETERMINATIONS

The selected remedy for Site 17 is protective of human health and the environment complies with federal and state requirements that are legally applicable or relevant and appropriate to this action, and is cost-effective.

The remedy addresses the remediation of surface soil and groundwater contamination at Site 17. The selected remedy will provide for the long-term containment of contamination in surface soils and groundwater beneath the site. The installation of a phytoremediation system will reduce direct contact and ingestion threats and reduce risks to ecological receptors from contaminated surface soils and groundwater by containing contaminants within these media.

The selected remedy for Site 17 will be implemented to meet all applicable or relevant and appropriate requirements (ARARs) whether chemical-, action-, or location-specific. No waivers of any ARARs are requested. Phytoremediation is a permanent solution and is an appropriate remedy for the contamination in soils and groundwater. Phytoremediation is an innovative technology whose application at Site 17 is considered technically superior to other alternatives.

This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable for this operable unit. However, because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy provides adequate protection of human health and the environment.

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2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

This ROD is issued to describe the Department of the Navy's (Navy) selected remedial actions for Site 17, 1400 Area Landfill, at the Naval Surface Warfare Center, Dahlgren Site (NSWCDL), Dahlgren, Virginia (Figure 2-1). Site 17 is one of several Installation Restoration (IR) sites (Figure 2-2) located at the NSWCDL facility. The 1400 Area Landfill is an inactive landfill located in the northeast corner of the NSWCDL, north of Frontage Road and south of U.S. Highway 301 (Figure 2-3). The general site configuration, based on a geophysical survey, is shown in Figure 2-4. Two unnamed drainage tributaries form the western and eastern boundaries of the site. A small pond is located in the western portion of the site with a marsh on the eastern portion. Building 1400 is located between the landfill and Frontage Road and is encompassed by a chain link fence. The site was used as a landfill, where municipal solid waste and construction debris were deposited, compacted, and covered on a periodic basis during the early 1970s and possibly until 1978. During the 1993 Phase 1 geophysical survey of the landfill, exposed metallic debris was visible along the eastern slope of the landfill where cover material thinned.

Elevations at the site range from approximately 14 feet above mean sea level (msl) along the drainage ditches to over 20 feet msl along the high ground between the streams. Slopes are gentle and generally less than 5 percent. Surface drainage generally flows overland to the tributaries that flow into Hideaway Pond approximately 600 feet south of Building 1400. The landfill is fully vegetated with tall grass. Soil cover exists over the majority of the landfill. The area bordering the site to the north and west is undeveloped and heavily wooded.

Land within a 2-mile radius of the 1400 Area Landfill is mainly undeveloped. Buildings housing various base operations are located about 200 feet east of the site, and more facilities are being constructed in this general area. Southeast of the site, on the east side of Hideaway Pond, is a former bombing range that is undeveloped.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 History of Site Activities

Based on aerial photographic evidence, Site 17 was used for sand and gravel extraction beginning as early as 1952. Prior to this, the site was a plowed field. On 1943 aerial photographs, a cleared, square area was visible directly south of U.S. Highway 301. In 1952, a shallow pit was evident in aerial photographs west of the western tributary that bounders the site. Several other clearings and a gravel pit were also evident on the site proper. Sand and gravel removal continued at the site until approximately 1969.

Landfilling operations at Site 17 began during the early 1970s, midway between the two tributaries, and continued possibly until 1978. According to the Environmental Photographic Interpretation Center (EPIC), red water (source unknown) was visible in the large bare areas north of Building 1400. By 1981, the area between the tributaries had been filled and covered, while other portions of the site were revegetating.

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2.2.2 Previous Investigations

The first investigation at Site 17 was the Initial Assessment Study (IAS) conducted in 1981. The IAS included a record search, interviews, and an on-site survey. The IAS concluded that Site 17 was used as a sanitary landfill and that no evidence of hazardous waste disposal had been documented. As a result, Site 17 was not recommended for a Confirmation Study. However, Site 17 was included in the Confirmation Study because it was a suspected source of the mercury contaminaton detected at Site 10 (Hideaway Pond).

The Confirmation Study was conducted in 1983 and 1984. As part of the Confirmation Study field investigation at Site 17, five monitoring wells were installed. The wells were located to characterize groundwater quality at one upgradient and four downgradient locations, based on assumed groundwater flow directions. During well installation, soil samples were collected for mercury analyses. Groundwater samples were collected in November 1984 and were analyzed for mercury, total organic carbon (TOC), and total organic halides (TOX). Groundwater samples were later collected from four monitoring wells in 1991 by the NSWCDL. Sampling of stream sediment at various depths upstream and downstream of the landfill was also conducted during the Confirmation Study. The sediment samples were analyzed only for mercury.

Mercury was detected at 3.1 Ig/L in one of the groundwater samples collected within the site. Mercury was not detected in any of the soil samples collected from well borings. TOX concentrations ranged from undetectable levels to 220 Ig/L. Concentrations were not significantly lower in the upgradient well. Mercury was not detected in sediment samples collected upstream of the landfill, while mercury was detected in sediment collected from downstream locations in both adjacent tributaries. Mercury was not detected in any of the three surface water samples.

2.2.3 Enforcement Actions

No enforcement actions have been taken at Site 17. The Navy has owned this property since the early 1900's and is identified as the responsible party.

2.2.4 Highlights of Community Participation

In accordance with Section 113 and 117 of CERCLA, the Navy held a public comment period from August 18, 1998 through September 16, 1998 for the proposed remedial acton described in the Feasibility Study and in the Proposed Plan for Site 17.

These documents were available to the public in the Administrative Record and information repositories maintained at the Smoot Memorial Library, King George, Virginia; the NSWCDL General Library, Dahlgren, Virginia; and the NSWCDL Public Record Room, Dahlgren, Virginia. Public notice was provided in The Freelance Star newspaper on August 18, 1998 and The Journal on August 19, 1998. A Public Meeting was held in the King George Courthouse on August 27, 1998. No written comments were received during the comment period. A summary of comments and responses given at the Public Meeting and a transcript of the Public Meeting are presented in Appendix B.

2.3 SCOPE AND ROLE OF RESPONSE ACTION AT SITE 17

Past disposal operations at Site 17 have resulted in contaminated soil and groundwater. The proposed remedial actions identified in this ROD address contamination associated with Site 17, 1400 Area Landfill, as identified in the Draft Final Remedial Investigations (RI) Report, the Addendum RI Report, and the Feasibility Study (FS) Report for Site 17. Several alternatives for response actions for contaminated media are identified in Section 2.6. The rationale for selecting one of those alternatives as the remedy for this site is described in Section 2.7. The selected remedial action is discussed in Section 2.8.

The selected remedial action is to cover contaminated soils with a 2-foot-thick soil cap to prevent semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), chromium, and thallium from contacting plants and animals (ecological receptors). Phytoremediation will be utilized to address mercury contamination in groundwater. Phytoremediation is the use of shallow and deep-rooted plants to remove, contain, or otherwise, render harmless, environmental contaminants. The plants can chemically hold or remove metals from the soil and groundwater. Waste/fill within 100 feet of the tributaries shall be excavated, dewatered, and consolidated in the landfill beneath the soil cap. Marsh area sediments shall be excavated, dewatered, and sent to an off site landfill for disposal.

This remedy is consistent with long-term remedial goals for Site 17. The remedial action will help to reduce the principal threats to ecological receptors.

2.4 SUMMARY OF SITE CHARACTERISTICS

The RI at Site 17 was completed in phases. Geophysical investigations were initiated in 1993. Sampling activities, consisting of soil sampling, surface water and sediment sampling, and the installation and sampling of groundwater monitoring wells, were completed in 1994. Additional RI sampling, consisting of additional surface and subsurface soil sampling and groundwater monitoring activities. was completed in 1996. The results of the RI are summarized below.

2.4.1 Sources of Contamination

Geophysical and hydrogeologic investigations at Site 17 were conducted to identify disturbed

areas and buried metallic objects, and to determine the extent of the landfill. The results of the geophysical survey indicated the presence of metallic objects and other geophysical anomalies in the landfill. Based on groundwater sampling results, the source of groundwater contamination is the waste in the landfill.

2.4.2 Description of Contamination

Soil, groundwater, surface water, and sediment samples were collected and analyzed to determine the nature and extent of contamination at Site 17 (Figure 2-5). The major contamination concerns at Site 17 are associated with the landfill. Surface soil, groundwater, sediment and sunlace water have been impacted by the waste disposal activities that occurred there. Table 2-1 presents the contaminants of concern (COCs) for each medium and the maximum concentration detected for each COC. The results of the sampling and analyses are presented below.

Surface and Subsurface Soils

Low-level polynuclear aromatic hydrocarbon (PAH) contamination (0.020 to 4.6 mg/kg) and volatile organic compounds (VOCs) (0.270 to 6.8 mg/kg) were identified in surface soils. These compounds, however, were not present in the subsurface soils and do not appear to be migrating downward. Aroclor 1260 was also detected in surface soils but was not detected in any subsurface soil sample from Site 17. In general, concentrations of inorganic constituents in surface soils detected at Site 17 fall within the range of background concentrations for surface soils of the Maryland coastal plain. In the subsurface soils, the majority of inorganic constituents detected were within the range of background subsurface soil values for the NSWCDL.

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TABLE 2-1

MAXIMUM DETECTED CONCENTRATIONS FOR COCs REQUIRING REMEDIATION
SITE 17: 1400 AREA LANDFILL
NSWCDL, DAHLGREN, VIRGINIA

Analyte	Maximum Detected Concentrations
SURFACE SOILS	
SEMIVOLATILES (mg/kg)	
Benzo(a)anthracene	2.2
Chrysene	2.5
Benzo(b)fluoranthene	2.0
Benzo(k)fluoranthene	2.1
2,6-Dinitrotoluene	0.074
PESTICIDES/PCBs (mg/kg)	
Aroclor-1260	2.2
METALS (mg/kg)	
Aluminum	8,140
Arsenic	6.3
Chromium	39
Iron	12,400
Thallium	2.7
Vanadium	18.6
SUBSURFACE SOILS	
METALS(mg/kg)	
Arsenic	6.7
GROUNDWATER 1	
METALS (Ig/L)	
Mercury	0.26
SEDIMENT	
VOLATILES (mg/kg)	
Acetone	0.2
MISCELLANEOUS (mg/kg)	
Phenols	729
TCL PESTICIDES/PCBs (mg/kg)	
Arochlor-1260	0.58
METALS (mg/kg)	
Aluminum	13,500
Cobalt	73.3
Mercury, Low Level	0.65598
Cyanide	1.1
SURFACE WATER	
METALS (Ig/L)	
Mercury, low level	0.02165

1 Groundwater COCs were developed based on the expected industrial use scenario

Groundwater

A potentiometric surface map (Figure 2-6) was prepared based on 1996 water level measurements. Low levels of volatile organic constituents were detected in only two out of nine groundwater samples from Site 17. A wide range of semivolatile compounds, including primarily PAH and phthalate compounds, were detected at Site 17. However, the distribution was random, and the concentrations were generally very low. No primary maximum contaminant levels (MCLs) were exceeded in the groundwater directly beneath the landfill. Lead was detected at a maximum concentration of 42.3 Ig/L, which is above the associated action level of 15 Ig/L. Mercury analysis of groundwater samples from Site 17 produced detectable concentrations in 6 of the 10 wells sampled. The highest concentration of mercury in 1996 was 0.26 Ig/L, detected in monitoring well MW 17-15, near the center of the landfill and was an order of magnitude higher than the results from any other well. The remaining wells with detectable concentrations of mercury are distributed throughout the landfill area. No hot spots or mercury plumes were identified in the landfill. Three groundwater samples were also collected from seepage in three test pits and analyzed for mercury only. The highest concentration of mercury in these samples was 0.12 Ig/L, below 0.14 Ig/L, the identified PRG for mercury.

Site 17 is located between two tributaries, to which the local groundwater discharges. The shallow groundwater beneath Site 17 is not currently or reasonably expected in the future to be a source of drinking water. When institutional controls are implemented, groundwater will be restricted from such use. No primary maximum contaminant level (MCL) exceedences were detected in the groundwater beneath Site 17.

Surface Water and Sediment

No significant VOC, SVOC, or pesticide/PCB contamination was identified in surface water samples collected from Site 17. A review of surface water mercury results shows that mercury was detected at low levels in all samples collected. The highest mercury concentration detected in surface water was 0.02165 Ig/L. In general the eastern tributary had the higher concentrations of mercury.

No significant VOC, SVOC, or pesticide contamination was detected in sediments. Arochlor-1260 was detected in only one sample above the remedial goal at an estimated concentration of 0.58 Ig/kg. Three inorganic COCs (aluminum, cobalt and cyanide) were detected in sediments. Although not a COC, the highest mercury concentration in sediment was 0.65598 mg/kg. No other detected mercury concentration in the sediment samples was of this magnitude.

2.4.3 Contaminant Migration

Of the COCs identified in the FS, mercury is the most toxic and mobile. Mercury exists in both organic and inorganic forms and may occur as elemental mercury or ionic mercury. Elemental mercury is very dense and has a vapor pressure that increases rapidly with small increases in temperature. There is a strong tendency for mercury in all its forms to sorb to nearly every available surface, including sediments and soil organic matter. This behavior makes mercury immobile under most environmental conditions. However, mercury is known to associate with suspended solids and colloidal matter in aquatic systems, thus making it capable of mobility.

Mercury in its elemental state is very insoluble in water. In some of its ionic forms, however, it is very soluble in water. Bacterial and abiotic chemical processes can methylate mercury ions in both water and geologic materials. Many animals and certain plants can readily acquire methyl mercury. Methyl mercury is easily absorbed by fish and other aquatic fauna, either directly through the gills or by ingestion of contaminated aquatic plants and animals.

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In soils and surface waters, some forms of mercury partition to particulates, and in soils and sediments, sorption is one of the most important controlling pathways for transporting mercury. Mercury is strongly sorbed to humic material, and trenching activities during Phase 2 investigations revealed that the top 3 feet of soil material at the landfill is humus. Inorganic mercury sorbed on to soils is not readily desorbed; therefore surface runoff and colloidal transport through aquifer materials are important transport mechanisms for inorganic mercury.

Methyl mercury quickly enters the aquatic food chain and thereby begins the process of bioaccumulation and biomagnification in fish and other ecological receptors. The two tributaries that are suspected of receiving groundwater discharge are located at the western and eastern sides of the landfill, and both flow south into Hideaway Pond. Surface water and sediment samples collected from both tributaries, however, have indicated the presence of only low concentrations of mercury, with the highest concentration detected at 0.02165 Ig/L in surface water and 0.65598 mg/kg in sediment.

2.5 SUMMARY OF SITE RISKS

The human health and ecological risks associated with exposure to contaminated media at Site 17 were evaluated in the Addendum RI Report for Site 17. Residential use of the site was not evaluated. Institutional controls will be implemented to prevent future industrial and residential land use and shallow groundwater use. Exposure to surface water is not expected since the tributaries are too small to support fishing activities.

2.5.1 Human Health Risks

Exposure Pathways and Potential Receptors

Recreational users (adults and children) and construction workers were evaluated as potential receptors in the quantitative risk assessment Construction workers were evaluated for future conditions only. Base workers were eliminated from further evaluation since no base personnel are currently assigned to the site for routine or maintenance duties. Recreational users are considered for current and future conditions. Ingestion of finfish was not evaluated for adult recreational users because the small tributaries at the site are not large enough to support edible-size game fish. Construction workers were evaluated for exposure to surface/subsurface soil (0 to 12 feet), while surface soil (0 to 2 feet) exposure was considered for all other receptors. Inhalation of volatile emissions and fugitive dust was evaluated qualitatively via a comparison of site data to U.S. EPA Generic Soil Screening levels for transfers from soil to air. Inhalation exposure was considered to be relatively insignificant since all detected soil concentrations were less than the screening levels. Direct contact with surface water and sediment is not anticipated at the site. Therefore, pathways associated with these media were not quantitatively evaluated.

Exposure Assessment

The list of COCs that were evaluated and their maximum exposure point concentrations are presented on Table 2-2.

Toxicity Assessment

Cancer potency factors (CPFs) have been developed by U.S. EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are unitless, are multiplied by the estimated intake of a potential

carcinogen, in mg/kg/day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPFs. Use of this approach makes underestimation of the actual cancer risk highly unlikely.

TABLE 2-2
HUMAN HEALTH
CHEMICALS OF CONCERN AND EXPOSURE POINT CONCENTRATIONS (1)
SITE 17, 1400 AREA LANDFILL
NAVAL SURFACE WARFARE CENTER, DAHLGREN, VIRGINIA

	Organics		Inorganics	
Medium	Chemical	Exposure Point Concentration (mg/kg)	Chemical	Exposure Point Concentration (mg/kg)
Surface Soil	Benzo(a)pyrene	0.4/1.5 (2)	Arsenic	4.2/6.3 (2)
Surface/Subsurface Soil	Benzo(a)pyrene	0.44/1.5 (2)	Arsenic	6.7
Fish Tissue	Not evaluated (3)	NA	Not evaluated (3)	NA
Surface Water/Sediment	Not evaluated (4)	NA	Not evaluated (4)	NA

NA Not applicable.

1 95 Percent upper confidence limits (UCLs) on the arithmetic mean were used as exposure point concentrations for reasonable maximum exposure (RME) and central tendency exposure (CTE), unless otherwise noted.
2 Data set consists of less than 10 samples. Average and maximum concentrations were used to evaluate the CTE and RME, respectively.
3 Tributaries at the site are not large enough to support edible game fish.
4 No human exposure is anticipated because of site-specific conditions (i.e., inaccessibility, the presence of snakes and snapping turtles, etc.).

Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by the U.S. EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Risk Characterization

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer

potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., l x 10 -6). An excess lifetime cancer risk of 1 x 10 -6 indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Adult Recreational User. The cumulative noncancer hazard index from exposure via ingestion of and dermal contact with Site 17 soils under industrial land use conditions is less then 1 indicating little or no risk to human receptors. The cumulative ingestion and dermal contact cancer risk is 1.5 x 10 -6 under a reasonable maximum exposure scenario, within U.S. EPA's target risk range of 1 x 10 - 4 to 1 x 10 -6.

Child Recreational User. The cumulative noncancer hazard index and cancer risk associated with ingestion and dermal contact exposure to surface and subsurface soil at Site 17 under industrial land use scenario are less than 1 and 3.2 x 10 -6, respectively, under a reasonable maximum exposure scenario. The cancer risk is within U.S. EPA's target risk range of 1 x 10 -4 to 1 x 10 -6 .

Construction Worker. The cumulative noncancer hazard index and cancer risk associated with ingestion and dermal contact exposure to Site 17 soil under industrial land use conditions are less than 1 and 7.2 x 10 -7, respectively, under a reasonable maximum exposure scenario.

Although the incremental cancer risk for the adult and child recreational users slightly exceeded 1 x 10 -6, it is well within U.S. EPA's, target risk range of 1 x 10 -4 to 1 x 10 -6. Since the risk to all other receptors is less than 1 x 10 -6 and the hazard indices for receptors are less than 1.0, human health risks under industrial land use conditions for those receptors are within acceptable risk ranges at Site 17.

2.5.2 Environmental Evaluation

The intent of the baseline ecological risk assessment (ERA) was to characterize potential receptors and to estimate the potential hazard or risk to environmental receptors. Sample locations were selected to detect potential groundwater contamination discharging to nearby surface water bodies via the shallow aquifer as well as contaminants resulting from surface water runoff. Samples were collected from marshy areas near the site as well as points in the tributaries. Field work included sampling locations upstream, adjacent to, and downstream of Site 17. Surface water, sediment, and macroinvertebrate community samples were taken from these locations. In 1994, wetland identifications, terrestrial wildlife inventories, vegetation surveys, and macroinvertebrate inventories were performed to characterize the habitats associated with Site 17.

Ecological effects quotients (EEQs) were derived for each COC in all media. Based on EEQs and risk management factors, the following COCs are concerns:

- Mercury, lead, and zinc for surface water,

- D Benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, aroclor 1260, chromium, and thallium for surface soils.

Based on risk management decisions made for this site, the marsh area sediments near monitoring well GW17-13 will be remediated to address residual mercury contamination. Based on elevated concentrations and risk levels of metals such as mercury and zinc in all three media, waste debris at Site 17 appears to be the source of the COCs.

Exposure Pathways

The exposure pathways consist of dermal absorption and ingestion of chemicals from soil, sediments, and surface water.

Exposure Assessment

Three contaminants in surface water (mercury, lead, and zinc), five contaminants in sediment (aroclor-1260, carbazole, chlordane, cobalt, and cyanide) and seven contaminants in surface soils (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, aroclor 1260, chromium, and thalllium) were identified as COCs for ecological receptors. The EEQ for each of these contaminants was greater than 1, indicating a preliminary remediation goal (concentration) was exceeded.

Potential Receptors

The organisms most likely to be ecological receptors include mice, voles, rabbits, earthworms and other ground insects, fish, and a variety of birds. Because of the natural setting of Site 17 and the variety of nearby habitats, Site 17 is likely to have a diversity of wildlife.

Risk Characterization

Based on risk management factors as well as potential risk levels, mercury is a concern for surface water, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, aroclor 1260, chromium, and thallium are concerns for surface soils.

2.5.3 Development of Preliminary Remediation Goals

Contaminant fate and transport modeling is used to evaluate the potential for COCs identified by the human health and ERA to migrate to other media and present unacceptable risks. For example, contaminants present in soils could migrate to groundwater or be carried with precipitation to surface water or sediments at a site. In order to evaluate this potential, fate and transport modeling was conducted for Site 17 using the ECTran model. The model uses contaminant properties, such as the adsorption coefficient, and site-specific characteristics, such as groundwater velocity, to predict acceptable levels of COCs in soil and groundwater that would be protective of surface water and sediment. Using regulatory criteria for surface water (water quality criteria) and toxicity data for sediment, preliminary remediation goals (PRGs) are developed during modeling to determine if existing levels of COCs are acceptable. A complete discussion of the use of modeling and assumptions is presented in Appendix A of the Site 17 FS.

Potential migration of COCs evaluated for Site 17 by the ECTran model included:

- D Surface soil to surface water via runoff
- D Surface soil to sediment via runoff
- D Surface soil to surface water via groundwater
- D Subsurface soil to surface water via groundwater

- D Subsurface soil to sediment via groundwater
- D Groundwater to surface water
- D Groundwater to sediment

Based on potential migration, the following remedial action objectives (RAOs) are anticipated for Site 17 soil, sediment, and groundwater to address the primary exposure pathways. RAOs, may be modified (become more stringent) during the Remedial Design based on more detailed evaluation.

- D Prevent ecological receptors from being exposed to benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and Aroclor 1260 present in surface soils at concentrations greater than 1.0 mg/kg (for each).

- D Prevent ecological receptors from being exposed to chromium and thallium present in surface soils at concentrations greater than 0.4 mg/kg and 1.0 mg/kg, respectively.

- D Prevent mercury at concentrations greater than 0.14 Ig/L present in groundwater from migrating to surface water and causing adverse effects in ecological receptors.

- D Prevent ecological receptors from being exposed to mercury in sedimient in the marsh east of the landfill where mercury was detected at 0.65598 mg/kg (although the mercury concentration in sediment did not exceed the PRG, it was decided that mercury contaminated sediments should be removed as a precautionary measure).

2.6 DESCRIPTION OF ALTERNATIVES

A detailed analysis of the possible remedial alternatives for Site 17 is included in the Site 17 Feasibility Study report. The detailed analysis was conducted in accordance with the U.S. EPA document entitled Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA and the National Oil Hazardous Substances Pollution Contingency Plan.

For every alternative, except the No Action alternative, an institutional control plan will be developed as part of remedial action design and will include: access controls, signs along the perimeter of the site, restrictions on shallow groundwater use for drinking water, description of land use controls in the base master plan, periodic inspection, monitoring, and re-evaluation of land use controls, annual certification that institutional controls are in place, notification to the U.S. EPA and state regulators whenever the Navy anticipates any major changes in land use restrictions, public notice, and a deed notification.

The following specific institutional controls are part of every alternative except the No Action alternative, and shall be undertaken within 90 days of completion of remedial construction: a real property description notation, Base Master Plan notations, and limited site access. The Base Master Plan shall note the area as one in which residential development can not occur, shallow groundwater can not be used, and site access shall be limited. A notation shall be filed in the real property file maintained at EFA Ches for this site indicating the extent of the area and the fact that solid wastes are present.

The institutional controls shall also include the following: within 90 days after completion of the remedy, the Navy shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of disposal area and the extent of groundwater contamination. Monitoring well locations shall be included and identified on the survey plat. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict disturbance (excavation or construction) of the property; post-closure use of the property shall prohibit residential use, access or use of

groundwater underlying the property for any purpose except monitoring, and the function of the monitoring systems shall not be disturbed. When landfill closure is complete, the owner of the property shall submit the survey plat to the local recording authority, and shall record a notation with the deed (or some other instrument which is normally examined during title search at the local land recording authority) notifying any potential purchaser of the property that the land has been used to manage solid waste and the integrity of the cover system or the function of the monitoring system may not be disturbed.

A summary of the remedial alternatives which were developed to address contamination associated with Site 17 is presented below.

Alternative 1 - No Action

CERCLA requires an evaluation of the No Action alternative. Under this alternative, no action would be taken to reduce the toxicity, mobility, or volume of the contaminated surface soil or groundwater at Site 17. Alternative 1 serves as a baseline against which the effectiveness of other alternatives is measured.

The following costs are associated with this alternative:

Present Worth ($):	15,550/5 yr (Estimated administrative cost of 5-year review of remedial action over a 30-year period
Time to Implement:	0 months

Alternative 2 - Commonwealth of Virginia Sanitary Landfill Cap (Soils and Waste/Fill); Excavation, and Consolidation (Waste/Fill Within 100 Feet of Tributaries); Excavation and A.) On-site Consolidation or B.) Off-site Landfilling (Marsh Sediments); Natural Attenuation (Groundwater); Institutional Controls (Soils, Wastefill, Sediments, Surface Water, and Groundwater).

This alternative consists of remedial actions conducted on surface soils, waste/fill, marsh sediments, and groundwater at Site 17. The components of this alternative are as follows:

D The landfill area would be capped to address surface soil contamination and to comply with Commonwealth of Virginia regulations 9 VAC 20-80-210 and 9 VAC 20-80-250, which require a cap over an unpermitted sanitary landfills consisting of the following minimum components:

- 6-inch vegetative and protective layer
- 18-inch infiltration layer with a hydraulic conductivity less than or equal to any natural soils below the waste but not greater than 1 x 10 -5 cm/s

D Waste/fill within 100 feet of the tributaries would be excavated to address Commonwealth of Virginia regulation 9 VAC 20-80-250 which requires a 100 foot setback from waste material. It is estimated that 17,600 cubic yards (cy) would have to be excavated and consolidated beneath the cap.

D The marsh area near GW17-13 would be remediated to address residual mercury contamination, even though the sediment criteria are not exceeded. Two options have been developed:

Option A - Excavate 970 cy of marsh sediment stabilize, and consolidate on site under the landfill) cap.

Option B - Excavate 970 cy of marsh sediment and transport to an off-site treatment and disposal facility.

- The movement of groundwater at Site 17 would be slightly reduced after the placement of the sanitary landfill cap. This reduction in groundwater flow would reduce the mass of mercury contamination as it discharges into the marshes, ponds, and tributaries adjacent to Site 17. Mercury concentration levels are already very low in groundwater.

- Institutional controls would be implemented to limit future site land use. Residential and industrial/commercial land use restrictions will be implemented. An institutional control plan will be developed as part of the remedial action design and will include: access controls, signs along the perimeter of the site, restrictions on shallow groundwater use for drinking water, description of land use controls in the base master plan, periodic monitoring and re-evaluation of land use controls, annual certification that institutional controls are in place, notification to the U.S. EPA and state regulators whenever the Navy anticipates any major changes in land use restrictions, public notice, and a deed notification. Off-site migration of impacted groundwater is not anticipated to be a human health concern since the discharge location (tributaries) is located immediately adjacent to the site. Therefore, it is unlikely that there will be downgradient off-site groundwater users. Monitoring of sediment, surface water, and groundwater will be conducted to ensure that no adverse effects to ecological receptors are occurring due to release of Site 17 contaminants. This alternative maintains institutional controls on the media of concern until a residential land-use scenario has been evaluated in the risk assessment and a decision is made at that time to either maintain or delete the institutional controls on one or all of these media.

The following costs are associated with this alternative:

Capital ($):	Option A: 2,100,000 Option B: 2,300,000
Operating/Maintenance (O&M)($/Yr):	37,000/yr + 15,550/5 yr
Present Worth	Option A: 2,500,000 Option B: 2,700,000
Time to Implement	6 months

Alternative 3 - Impermeable Landfill Cap (Soils and Waste/Fill); Excavation and Consolidation (Waste/Fill Within 100 Feet of Tributaries); Excavation and A.) Consolidation or B.) Offsite Disposal (Marsh Sediments); Slurry Wall (Groundwater); Institutional Controls (Soils, Waste/Fill, Sediments, Surface Water, and Groundwater).

This alternative consists of remedial actions conducted on surface soils, waste/fill, marsh sediments, and groundwater at Site 17. Alternative 3 is essentially a more aggressive version of Alternative 2. The components of this alternative are as follows:

- The landfill area would be capped to address surface soil contamination and to comply with Commonwealth of Virginia regulation 9 VAC 20-80-250. This cap, however, would be more impermeable than the one described in Alternative 2 and would consist of the following components:

  - 6-inch vegetative and protective layer
  - 12-inch drainage layer

- Flexible Membrane Liner (FML) (Hydraulic Conductivity 4 x 10 -13cm/sec)
- 12-inch select fill

D To further limit discharge of shallow groundwater contamination to surface water, a slurry wall would be placed on both the northern and southern borders of the landfill to cut off upgradient groundwater flow into the site.

D The waste/fill within 100 feet of the tributaries' component is the same as Alternative 2.

D The marsh area sediment component is the same as Alternative 2.

D The instititional controls components are the same as Alternative 2.

The following costs are associated with this alternative:

Capital ($)	Option A: 4,200,000 Option B: 4,400,000
Qperating/Maintenance (O&M)($/Yr):	37,000/yr + 15,550/5 yr
Present Worth($):	Option A: 4,600,000 Option B: 4,850,000
Time to Implement:	6 months

Alternative 4 - Soil Cap and Phytoremediation (Soils and Waste/Fill); Excavation, and Consolidation (Waste/Fill) Within 100 Feet of Tributaries; Excavation, and Offsite Landfilling (Marsh Sediments); Phytoremediation (Groundwater); Institutional Controls (Soils, Waste/Fill, Sediments, Surface Water, and Groundwater).

This alternative consists of remedial actions conducted on surface soils and wastefill, marsh sediments, and groundwater at Site 17. The components of this alternative are as follows:

D The landilll area would be capped to address surface soil contamination with a 2-foot-thick vegetative soil layer. Natural vegetation such as hybrid poplars and evergreens would be planted on this layer to control erosion and reduce infiltration and groundwater discharge to the tributaries via evapotranspiration and as a habitat enhancement. The alternative cap would achieve an equivalent net reduction in infiltration and provide equivalent erosion protection per 9 VAC 20-80-250. (Infiltration calculations using the HELP model were performed to determine whether there can be a functional equivalency between a Commonwealth of Virginia sanitary landfill cap (Alternative 2) and a soil cap coupled with phytoremediation (Alternative 4). According to these calculations, there is a similar reduction of infiltration through the landfill using either the sanitary landfill cap or the soil cap with phytoremediation.)

D The waste/fill within 100 feet of the tributaries' component is the same as Alternative 2.

D The marsh sediment component is the same as Alternative 2 except that Option A is not included.

D Groundwater discharging to surface water bodies at Site 17 would be contained by reducing infiltration and evapotranspiration using natural vegetation such as hybrid poplars and evergreens.

D The institutional control components are the same as Alternative 2.

The following costs are associated with this alternative:

Capital($):	2,400,000
Operating/Maintenance (O&M)($/Yr):	37,000/yr + 15,550/5 yr
Present Worth ($):	2,800,000
Time to Implement:	6 months to 12 months

2.7 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives described in Section 2.6 were evaluated in the Feasibility Study against nine criteria identified in the NCP, as presented below.

2.7.1 Threshold Criteria

Overall Protection of Human Health and the Environment

Alternative 3 provides a high level of overall protection to human health and the environment by preventing transport of, and plant and animal contact with, contaminants through the containment of wastes within the landfill and control of groundwater passing through the landfill. Alternative 4 has the potential to provide a similar or a higher level of protection because the trees may uptake more groundwater than was used as a basis for evaluation. Alternative 2 provides a lower level of protection because, groundwater discharge is not controlled. Alternative 1 provides the least overall protection because no action would be taken to reduce contaminant movement and contaminated soil and sediment is neither removed nor contained.

Option B (off site disposal of marsh sediment) provides a higher level of overall protection than Option A (on site disposal of marsh sediment) because the contaminated sediment is removed from Site 17 and disposed in a facility designed to handle similar materials.

Every alternative except the No Action alternative implements measures to control sources of contamination and exposure to humans and the environment to residual contamination, as necessary to protect human health and the environment. This includes permanent notification in local land records of groundwater use restrictions in order to control exposure of humans to residual contamination in groundwater.

Compliance with ARARs and To Be Considered (TBCs)

All the alternatives except Alternative 1 would achieve remediation goals, ARARs, and TBCs. Alternatives 3 and 4 are anticipated to achieve these objectives in a shorter time frame than Alternative 2 due to the time required for natural processes to reduce concentrations of mercury in groundwater. Alternatives 2, 3, and 4 would achieve these objectives for surface soil. Alternative 1 would not meet remediation goals, ARARs, and TBCs because no action would be taken to reduce contaminant movement and contaminated soil and sediment is neither removed nor contained. Both Option B (off-site disposal of marsh sediments) and Option A (on-site disposal of marsh sediments) would achieve remediation goals, ARARs, and TBCs.

2.7.2 Primary Balancing Criteria

Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternatives 3 and 4 reduce the mobility of contaminants present in the groundwater by controlling groundwater flow to the tributaries. Alternative 4 has the potential to control groundwater flow to the tributaries to a greater degree than in Alternative 3 both by controlling rainfall infiltration and by direct groundwater withdrawal from underneath the landfill. Alternative 2 provides negligible control of groundwater flow to the tributaries. Alternatives 2, 3, and 4 all reduce the mobility of contaminants in the surface soil and sediment by capping the landfill and removing contaminated sediment, respectively. Alternative 1 does not provide any reduction in contaminant mobility in groundwater, surface soil, and sediment. None of the alternatives reduce toxicity or volume of waste through treatment because it would be cost prohibitive due to the large volume of waste materials present at the site.

Option B (off-site disposal of marsh sediments) provides a better control of contaminants in sediment than Option A (on-site disposal of marsh sediments) because the materials are removed from Site 17 and disposed in a facility designed to handle similar waste.

Long-Term Effectiveness

Alternative 4 has the potential to be more effective than Alternative 3 for groundwater control. Alternative 2 addresses groundwater only through natural processes to reduce concentrations of mercury in groundwater, and, therefore, is not as effective as Alternatives 3 and 4. Alternatives 2, 3, and 4 will be equally effective in reducing the risk to ecological receptors contacting surface soils. Alternative 1 would not be effective in the long term because it does not protect the environment.

Option B (off-site disposal of marsh sediments) is expected be a more effective long term option than Option A (on-site disposal of marsh sediments) because the materials are removed from Site 17 and disposed in a facility designed to handle similar waste. Option A would present the possibility of contaminant migration from the site.

Short-Term Effectiveness

Alternative 3 is expected to be somewhat more effective than Alternative 4 in the short term because contaminants in the groundwater are controlled sooner. Alternative 2 is not expected be effective in the short term because the movement of contaminants from the groundwater to the tributaries would not be significantly reduced for many years. Alternative 1 would not be effective in the short term because it does not protect the environment.

Option B (off-site disposal of marsh sediments) is expected be a more effective short-term option than Option A (on-site disposal of marsh sediments) because the materials are removed from Site 17 soon after excavation is complete. Option A would present additional short-term risks during construction because the contaminated sediment would require additional handling and preparation for disposal under the landfill cap.

Implementabillity

Alternative 4 and Option B are the most easily implemented, although all the alternatives are implementable using conventional, well-demonstrated, and commercially available technologies. Alternative 1 requires no implementation. Alternative 2 would involve construction of a multilayered cap which would involve more significant effort. Alternative 3 would be somewhat more complicated because a more complex cap and slurry wall would be constructed. Option A would be more complicated than Option B because it would require additional handling and preparation of contaminated sediment for disposal under the landfill cap.

Cost

Alternative 4 is slightly more costly ($2,800,000) than Alternative 2 with Option A ($2,500,00) while Alternative 3 with Option B is the highest cost altemative ($4,850,000).

2.7.3 Modifying Criteria

State Acceptance

The Virginia Department of Environmental Quality, on behalf of the Commonwealth of Virginia, has reviewed the information available for this site and has concurred with this ROD and the selected remedy identified below. A copy of the concurrence letter from the Commonwealth of Virginia is attached as Appendix A.

Community Acceptance

Community acceptance summarizes the public's general response to the alternatives described in the Proposed Plan and the Feasibility Study. No written comments were received during the thirty-day comment period that began on August 18, and ended on September 16, 1998. There were no formal comments or questions received at the Proposed Plan Public Meeting held on August 27, 1998. The background on community involvement is included in the Responsiveness Summary, Section 3.0 of the ROD.

2.8 THE SELECTED REMEDY

Alternative 4 is the selected remedy, using phytoremediation to address both soils and groundwater. Figure 2-7 depicts the conceptual remediation plan and Figure 2-8 depicts the layout. Based on available information and the current understanding of site conditions, Alternative 4 coupled with option B appears to provide the best balance with respect to the nine NCP evaluation criteria. In addition, the selected alternative is anticipated to meet the following statutory requirements:

- D Protection of human health and the environment.
- D Compliance with ARARs.
- D Cost-effectiveness.

The selected remedy will address the surface soil contamination at Site 17 and provide for the reduction of groundwater contamination beneath the site. The institutional controls will further protect human health and the environment by limiting future land use and by providing long-term monitoring.

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Institutional controls will be implemented to limit future site land use. For Site 17, an institutional control plan will be developed as part of the remedial action design and include: access controls, signs along the perimeter of the site, restrictions on shallow groundwater use for drinking water, description of land use controls in the base master plan, periodic inspection, monitoring, and re-evaluation of land use controls, annual certification that institutional controls are in place, notification to the U.S. EPA and state regulators whenever the Navy anticipates any major changes in land use restrictions, public notice, and a deed notification.

The Navy shall institute the following institutional controls within 90 days of completion of the installation of the remedy: a real property description notation, Base Master Plan

notations, and limited site access. The Base Master Plan shall note the area as one in which residential development can not occur, shallow groundwater can not be used, and site access shall be limited. A notation shall be filed in the real property file maintained at EFA Ches (US Navy) for this site indicating the extent of the area and the fact that solid wastes are present.

The institutional controls shall also include the following: within 90 days after completion of the remedy, the Navy shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of disposal area and the extent of groundwater contamination. Monitoring well locations should be included and identified on the survey plat. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict disturbance (excavation or construction) of the property; post-closure use of the property shall prohibit residential use, access or use of groundwater underlying the property for any purpose except monitoring, and the function of the monitoring systems shall not disturbed. When landfill closure is complete, the owner of the property shall submit the survey plat to the local recording and shall record a notation with the deed (or some other instrument which is normally examined during title search at the local land recording authority) notifying any potential purchaser of the property that the land has been used to manage solid waste and the integrity of the cover system or the function of the monitoring system may not be disturbed.

The Navy shall institute groundwater monitoring to ensure that remedial action objectives (RAOs) are being maintained. The frequency of analysis and the length of time for monitoring shall be developed in the Operation and Maintenance Plan.

The Navy shall monitor the surface waters and sediments in the tributaries adjacent to Site 17 to ensure RAOs are being maintained. The frequency of analysis, types of analyses, and the length of time for monitoring shall be developed in the Operation and Maintenance Plan.

Based on available information and the current understanding of site conditions, Alternative 4 appears to provide the best balance with respect to the nine NCP evaluation criteria. In addition, the selected alternative its anticipated to meet the following statutory requirements:

D Protection of human health and the environment.
D Compliance with ARARs.
D Cost-effectiveness.

The institutional controls will further protect human health and the environment by limiting future land use and by providing continuous monitoring.

2.8.1 Peformance Standards

The remedy shall be capable of managing residuals and achieving all RAOs within the boundaries of Site 17 and shall meet all ARARs and TBCs for the site.

Sediment Removal

All marsh area sediment, to be excavated in the areas identified on Figure 2-8, shall be removed and disposed off-site.

Soil Cap

The soil cap shall be designed, constructed, operated, and maintained to meet the performance requirements of RCRA Subtitle D regulations specified in 40 CFR °° 258.60-61 and Virginia Solid

Waste Management Regulations (VSWMR), 9 VAC 20-80-250 (Sanitary Landfill).

The soil cap design shall incorporate phytoremediation to achieve a net reduction in infiltration and provide equivalent erosion protection per 9 VAC 20-80-250.

Waste/Fill Excavation

Waste/fill within 100 feet of the tributaries and pond shall be excavated to provide a 100 foot setback from waste material as specified in 9 VAC 20-80-250. The excavated material shall be consolidated beneath the soil cap.

Monitoring Wells

A groundwater monitoring network shall be implemented in accordance with RCRA and VSWMR. It shall be installed at the perimeter of the unit to evaluate any future contaminant transport. The location and number of monitoring wells, the frequency of analyses, and the types of analyses shall be determined in the site design and operation and maintenance documents. These documents must be approved by the EPA and the Commonwealth of Virginia. Groundwater monitoring shall be determined in the site design and operation and maintenance documents, per 9 VAC 20-80-310 (Corrective Action Program). The wells shall be installed according to RCRA and Commonwealth of Virginia construction requirements.

Surface Water and Sediment Monitoring

A surface water and sediment sampling and monitoring plan shall be developed as part of the Operation and Maintenance (0 & M) Plan. The location and number of sampling locations, the frequency of analyses, the types of analyses, and the duration of monitoring shall be determined in the 0 & M Plan. This plan must be approved by the EPA and the Commonwealth of Virginia.

Institutional Controls

Institutional controls will be implemented to limit future site land use. For Site 17, an institutional control plan will be developed as part of the remedial action design and include: access controls, signs along the perimeter of the site, restrictions on shallow groundwater use for drinking water, description of land use controls in the base master plan, periodic inspection, monitoring, and re-evaluation of land use controls, annual certification that institutional controls are in place, notification to the U.S. EPA and state regulators whenever the Navy anticipates any major changes in land use restrictions, public notice, and a deed notification.

The Navy shall institute the following specific institutional controls within 90 days of completion of all remedial actions: a real property description notation, Base Master Plan notations, and limited site access. The Base Master Plan shall note the area as one in which residential development can not occur, shallow groundwater can not be used, and site access shall be limited.

A notation shall be filed in the real property file maintained at EFA Ches (US Navy) for this site indicating the extent of the area and the fact that solid wastes are present.

The institutional controls shall also include the following: Within 90 days after completion of the remedy, the Navy shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of the disposal area and the extent of groundwater contamination. Monitoring well locations should be included and identified on the survey plat. The plat shall contain a note, prominently

displayed, which states the owner's future obligation to restrict disturbance (excavation or construction) of the property; post-closure use of the property shall prohibit residential use and access or use of groundwater underlying the property for any purpose except monitoring and shall not disturb the function of the monitoring systems. When landfill closure is complete, the owner of the property shall submit the survey plat to the local recording authority, and shall record a notation with the deed (or some other instrument which is normally examined during title search at the local land recording authority) notifying any potential purchaser of the property that the land has been used to manage solid waste and the integrity of the cover system or the function of the monitoring system may not be disturbed.

The Navy shall institute groundwater monitoring to ensure remedial action objectives (RAOs) are being maintained. The frequency of analysis and the length of time for groundwater, surface water, and sediment monitoring shall be developed in the Operation and Maintenance Plan.

2.9 STATUTORY DETERMINATIONS

Remedial actions must meet the statutory requirements of Section 121 of CERCLA as discussed below. Remedial actions undertaken at National Priority List (NPL) sites must achieve adequate protection of human health and the environment, comply with ARARs, be cost-effective, and utilize, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. Also, remedial alternatives that reduce the volume, toxicity, and/or mobility of hazardous waste as the principal element are preferred. The following discussion summarizes the statutory requirements that are met by the selected remedial alternative.

2.9.1 Protection of Human Health and the Environment

The soil cap will be protective of human health and the environment by preventing direct exposure to contaminated soil and reducing the potential of contaminant migration to the surface water and sediment via groundwater. Phytoremediation utilizing natural vegetation, such as hybrid poplars and evergreens, will also minimize the potential of groundwater contaminant migration to surface water and sediment. Removal of contaminated marsh sediment from the eastern marsh will remove the potential threat of this waste from both human and ecological receptors. Implementation of institutional controls will ensure that the site will not be used for any purpose in the future that could damage the cap and potentially expose human and ecological receptors to the waste in the landfill.

The selected remedy implements measures to control sources of contamination and exposure to humans and the environment to residual contamination, as necessary to protect human health and the environment. These measures include permanent notification in local land records of groundwater use restrictions in order to control exposure of humans to residual contamination in groundwater, and control of groundwater with phytoremediation in order to control release of contaminants to the environment to levels which are protective of the environment.

2.9.2 Compliance with ARARs

The selected remedy (Alternative 4) will meet all identified ARARs. The selected remedy will protect ecological receptors in soils, sediments, and surface water from metals, SVOCs, and PCBs in surface soils and from mercury in groundwater. A mechanism (monitoring) will be implemented to evaluate the performance of the selected alternative. The waste in the landfill will not be situated within 100 feet of a flowing surface water body (the tributaries).

Alternate measures to control sources of contamination and exposure to humans or the environment to residual contamination may be implemented provided: the groundwater protection

standard cannot be practically achieved; the groundwater is not currently or reasonably expected to be a source of drinking water and is not hydraulically connected with waters to which contaminants may migrate in concentrations that would exceed applicable standards; and the alternate measures are consistent with the overall objective of the remedy, i.e., to control the sources of releases so as to reduce or eliminate, to the maximum extent practicable, further releases of solid waste constituents into the environment that may pose a threat to human health or the environment [9 VAC 20-80-310.B.2; B.5; C.3]. The selected remedy will satisfy these criteria.

The ARARs identified for the remedial action at Site 17 are provided in Appendix C.

2.9.3 Cost-Effectivenes

The selected remedy is cost-effective because it would provide overall effectiveness proportional to the cost. The selected remedy will achieve remediation goals more quickly and efficiently than other alternatives, provide greater long-term protection of human health and the environment, and meet all identified ARARs.

2.9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practible

The selected alternative uses a permanent solution, phytoremediation. Phytoremediation is a permanent solution and is an appropriate remedy for landfill waste and soils contaminated with SVOCs, metals, and PCBs. Containment in the form of phytoremediation is functionally equivalent to capping.

2.9.5 Preference for Treatment as a Principle Element

The selected remedial action does not use treatment technologies for this site because cost and technical considerations make treatment impracticable.

2.9.6 Documentation of Significant Changes

The selected remedy, Alternative 4, is the same alternative identified as the recommended alternative in the Proposed Remedial Action Plan and that was presented to the public at the public meeting held August 27, 1998.

There were no significant changes to the recommended remedial action alternative in the Proposed Plan.

3.0 RESPONSIVENESS SUMMARY

The selected remedy for Site 17 is Alternative 4. No written comments, concerns, or questions were received by the Navy, U.S. EPA, or the Commonwealth of Virginia during the public comment period from August 18, 1998 to September 16, 1998. A public meeting was held on August 27, 1998 to present the Proposed Plan for Site 17 and to answer any questions on the Proposed Plan and on the documents in the information repositories. A 30-minute presentation was provided during which informal questions were addressed. A period was set aside for formal questions to be recorded by the court reporter. No formal questions were asked during this period.

A summary of the informal questions that were asked at the public meeting is provided in Appendix B. Additionally, a copy of the certified transcript of the Public Meeting is attached in Appendix B.

3.1 BACKGROUND ON COMMUNITY INVOLVEMENT

The Navy and NSWCDL have had a comprehensive public involvement program for several years. Starting in 1993, a Technical Review Committee (TRC) has met, on average, twice a year to discuss issues related to investigative activities at NSWCDL. The TRC was comprised of mostly governmental personnel, however a few private citizens attended the meetings.

In early 1996, the Navy converted the TRC into a Restoration Advisory Board (RAB) and 8 - 10 community representatives joined. The RAB is co-chaired by a community member and has held meetings approximately every four to six months. The Feasibility Study and the Proposed Plan for Site 17 were both discussed at the RAB meetings and a Site 17 tour was undertaken during a special RAB meeting.

Community relations activities for the final selected remedy include:

The documents concerning the investigation and analysis at Site 17, as well as a copy of the Proposed Plan were placed in the information repository at the NSWCDL General Library and the Smoot Memorial Library in King George, Virginia.

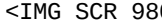
Newspaper announcements on the availability of the documents and the public comment period/meeting date was, placed in the Freelance Star Newspaper on August 18, 1998 and The Journal, on August 19, 1998.

The Navy established a 30-day public comment period starting August 18, 1998 and ending September 16, 1998 to present the Proposed Plan. No written comments were received during the 30-day public comment period.

A Public Meeting was held August 27, 1998 to answer any questions concerning the Site 17 Proposed Plan. Approximately 11 people, including federal, state and local government representatives attended the meeting.

APPENDIX A

VIRGINIA CONCURRENCE LETTER



COMMONWEALTH of VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

James S. Gilmore, III
Governor

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John Paul Woodley, Jr.
Secretary of National Resoures

http://www.deq.state.va.us

September 30, 1998

Mr. Abraham Ferdas, Division Director
Hazardous Site Cleanup Division (3HS00)
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Re: Record of Decision for Site 17 (1400 Area Landfill), Naval Surface Warfare Center, Dahlgren, Virginia

Dear Mr. Ferdas:

The Virginia Department of Environmental Quality (VDEQ) staff has reviewed the above referenced Record of Decision (ROD) for Site 17 (1400 Area Landfill) We concur with the selected remedial alternative as outlined in the ROD dated September 1999.

Should you have any questions concerning this letter, please feel free to contact Dave Gillispie at (804) 698-4209.

cc: Ryan Mayer - ChesDiv
Ann Swope - NSWC-Dahlgren
Bruce Beach - EPA Region III
Erica Dameron - VDEQ
Dave Gillispie - VDEQ

APPENDIX B

SUMMARY OF INFORMAL COMMENTS

During the Public Meeting held on August 27, 1998, an overview of the Proposed Remedial Action Plan for Site 17 was presented during a 30-minute period. The Navy, the Commonwealth of Virginia, or the EPA have received no written comments from the public. During the presentation the following comments were received from attendees. These comments included the following:

Summary of Comments Received during the Public Meeting

1 Why is phytoremediation better than the slurry wall for controlling the transport of contaminants in groundwater?

It was explained that groundwater in the landfill area is relatively shallow. Vegetation that utilizes significant volumes of water and that are planted close together can hydraulically impact groundwater so that contaminated groundwater does not discharge to the adjacent tributaries and pond. In addition, some of the contaminants in groundwater may be sorbed by the plant roots and thereby reduce the opportunities for being transported to the adjacent tributaries and pond. The vegetation will also provide an enhanced habitat for birds and other animals. The slurry wall, as proposed would lower the groundwater level but wouild not provide the ability for contaminants to sorb to plants and to be contained. Additionally, the slurry wall would not provide an enhanced habitat.

2 Is the depth of the soil cap much greater than the landfill caps as indicated in the Proposed Remedial Action Plan Summary for Site 17 (Figure 3)?

It was explained that the figure was not drawn to scale. The depth of the caps ranged from 1 to 2.5 feet. The soil cap would include a 2-foot vegetative soil layer that would enhance the growth of trees and shrubs. Unlike the landfill caps that would be designed to reduce rainfall infiltration through the soil into the buried waste material, the soil cap would allow rainfall infiltration to occur so that the vegetation removes the infiltrating water via transpiration. The vegetation would consist primarily of large trees that tend to uptake large volumes of water.

3 How deep are the plant roots?

The tree roots would be deep enough to remove groundwater that is approximately 1 to 6 feet below the ground surface.

4 In Alternative 2, why is a slurry wall both north and south of the landfill?

It was explained that groundwater north and south of the landfill flows toward the center of the landfill and radially toward the tributaries east and west of the landfill. Therefore, it would be necessary to control upgradient uncontaminated groundwater north and south of the landfill to prevent the contact with buried waste within the landfill and potential transport of contaminants to the tributaries.

NAVAL SEA SYSTEMS COMMAND

NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION

PUBLIC MEETING

THURSDAY, AUGUST 27, 1998, 7:00 P.M.
KING GEORGE COUNTY COURTHOUSE
KING GEORGE, VIRGINIA

PROPOSED REMEDIAL ACTION PLAN
Site 17, 1400 Area Landfill

USEPA Region III
Hazardous Site Cleanup Division
Federal Facilities Section
Mr. Bruce Beach
1650 Arch Street, Philadelphia, Pennsylvania 18107

Virginia Department of Environmental Quality
Mr. David Gillispie
629 East Main Street, Richmond, Virginia 23219

Public Affairs Office
Commander, Naval Surface Warfare Center
Ms. Jennifer Wilkins
17320 Dahlgren Road, Mail Code CD06 Dahlgren, Virginia 22448

Reported by: Lola Gail Serrett

FRANCES K. HALEY & ASSOCIATES, Court Reporters
10500 Wakeman Drive, Suite 300, Fredericksburg, VA 22407
PHONE: (540) 898-1527 FAX: (540) 898-6154

August 27, 1998:

There were no formal questions on the floor at this meeting.

FRANCES K. HALEY & ASSOCIATES, Court Reporters
10500 Wakeman Drive, Suite 300, Fredericksburg, VA 224077
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CERTIFICATE OF COURT REPORTER

I, Lola Gail Serrett, hereby certify that I was the Court Reporter at the Public meeting held at King George Courthouse, King George, Virginia, on August 27, 1998, at the time of the meeting herein.

I further certify that the foregoing transcript is a true and accurate record of the proceeding herein.

Given under my hand this 30th day of August, 1998.

<IMG SCR 98070M>

FRANCES K. HALEY & ASSOCIATES, Court Reporters
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APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 17:1400 AREA LANDFILL
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
1. LOCATION SPECIFIC				
Endangered Species Act of 1978	16 USC 1531 50 C.F.R. Part 402	Appplicable	Act requires federal agencies to ensure that any action authorized by an agency is not likely to jeopardize the continued existence of any endangered or threatened species or adversely affect its critical habitat.	Potentially affected endangered species have not been identified. The remedial action will be implemented so resources are not adversely affected should any be identified in the future.
Virginia Endangered Species Regulations	4 VAC 15-20-130 to 140	Applicable	Similar Virginia requirements for submittal and review of environmental assessments.	
Regulations for the Enforcement of the Endangered Plant and Insect Species Act	2 VAC 5-310-10	Applicable		
The Archaeological and Historical Preservation Act of 1974	16 U.S.C º 469	Applicable	Requires actions to avoid potential loss or destruction of significant scientific, historical, or archaeological data	Site is not known to be within a historically significant area. If future resources are identified actions will be taken to ensure compliance.
Virginia Natural Area Preserves Act	º 10.1-209 to 217	To Be Considered	Allows for preservation of certain significant ecological systems.	If specific species are found actions will be taken to eliminate or minimize degradation to these resources.
Migratory Bird Area	16 USC Section 703	Applicable	Protects almost all species of native birds in the U.S. from, unregulated "take" which can include poisoning of hazardous waste sites.	Remedy will be implemented to ensure that wastes have no impacts to native birds.

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Chesapeake Bay Preservation Area Designation and Management Regulations	9 VAC 10-20-10 to 280	Relevant and Appropriate	Requires certain locally designated tidal and non-tidal wetlands and other sensitive areas be subject to limitations, regarding land-disturbing activities, removal of vegetation, use of impervious cover, erosion and sediment control, and stormwater management.	Remedy implementation will require construction activities. Actions will address the regulatory requirements.
Virginia Hazardous Waste Management Regulations	9 VAC 20-60-10 to 1480	Applicable	Applies to treatment storage, or disposal of hazardous waste.	During remedy implementation, if any hazardous wastes are generated, the hazardous waste will be managed consistent with Federal and Virginia requirements.
Virginia Water Protection Permit Regulation	9 VAC 25-210-10 to 260	Applicable	Facility or activity design must adequately address the issues arising from locating facilities in wetlands and delineated wellhead protection areas (determined vulnerable.)	Site contains a marsh area containing wetlands. The Remedy will minimize impacts to wetland areas and will restore the wetland areas after remedy implementation.
Executive Order 1190, Protection of Wetlands Clean Water Act	40 C.F.R 6, Appendix A	Applicable	Action to minimize the destruction, loss, or degradation of wetlands.	Site contains a marsh area containing wetlands. The Remedy will minimize impacts to wetland areas and will restore the wetland areas after remedy

(CWA) of 1972 Section 404	33 U.S.C °°1344	Applicable		implementation.
Virginia Wetlands Policy	4 VAC-25-380-10 to 40	Applicable		

ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act.	40 C.F.R. Part 6 Appendix A	Appplicable	EPA's policy for carrying out the provisions of Executive Order 11990 (Protection of Wetlands). No activity that adversely affects a wetland shall be permitted.	Site contains a marsh area containing wetlands. The Remedy will mimimize impacts to wetland areas and will restore the wetland areas after remedy implementation.
II ACTION SPECIFIC				
Capping /Closure and Post Closure for Muncipal Solid Waste Landfills	40 CFR 258.60-61	Applicable	Requirements for final cover systems to minimize infiltration and erosion. Requirements for at least a 10 year post closure care period including maintaining integrity and effectiveness of the final cover and maintenance of groundwater monitoring.	Installation of a Virginia Sanitary Landfill Cap requires adherence to these regulations or equivalent performance standards at Site 17
Virginia Solid Waste Management Regulations	9 VAC 20-80-10 to 790	Applicable		
Military Munitions Rules	(40 CFR 260-266 and 270)	To be Considered	Recently promulgated regulations in response to Section 107 of the Federal Facilities Compliance Act of 1992, identifying when conventional and chemical military munitions become hazardous waste. Applications of the rules are a 'TBC' until adopted by states authorized to administer RCRA.	Ordnance-related wastes potentially buried at Site 17 will be managed in compliance with the rules.

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DoD Guidance on Property Contaminated with Ammunition, Explosives or Chemical Agents	DoD 6055.9-STD	To Be Considered	Dod guidance document stipulating policy and procedure to provide protection of personnel resulting from DoD ammunition, explosives or chemical agent contamination. Includes property currently or formerly owned, leased or used by DoD, and calls for identification and control at active installations, and provides guidance for potential land disposal.	Capping of Site 17 will be completed to be consistent with DoD policy and procedures to address safety issues.
Erosion and Sediment Control	VR 625-02-00 4 VAC 50-30-10	Applicable	Erosion and sediment control plans are to be submitted for land-disturbing activities, and be in compliance with the locality and/or local soil and water conservation district.	Construction activities will disturb the land in the vicinity of the site. Activities will address Virginia erosion and sediment control requirements.
Virginia Solid Waste Management Regulations	9 VAC 20-80- 250 9 VAC 20-80-210 9 VAC 20-80-310	Applicable Applicable Applicable	Permanent Closure Criteria governing: Access Restriction, Closure and Post Closure Care, Gas Management, Drainage Layer, Final Cover, Run-on Run-off controls, Site Monitoring, Control of Groundwater Intrusion, Groundwater Corrective Action and compliance with other permanent closure requirements.	Virginia solid Waste Management requirements need to be addressed with the installation of the cap at Site 17. Equivalent performance standards will meet Final Cover requirements.
AIR				

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Visible and Fugitive Dust Emissions	9 VAC 5-30-20	Applicable	Control of Particulate Matter (TSP)	Visible and Fugitive Dust emissions from remedial actions shall be controlled, as necessary.
	9 VAC 5-30-60	Applicable	Control of Particulate Matter (PM10)	
	9 VAC 5-50-60 to 120	Applicable	Standards for visible and/or fugitive dust emissions.	
Standards of Performance for Toxic Pollutants	9 VAC 5-50-160 to 230	Applicable	Standards of performance for toxic pollutants.	Toxic pollutants are not expected during remedial actions; however, corrective action will be performed if problems arise.
WATER				
Criteria for Classification of Solid Waste Disposal Facilities and Practices	49 C.F.R. 257.3-3(a) 33 U.S.C. °° 1342	Potentially Applicable	A facility shall not cause a discharge of pollutants into the waters of the U.S. that is in violation of the substantive requirements of the NPDES under CWA Section 402, as amended.	No discharges under the remedy are planned. In addition, NPDES program is delegated to Virginia (VPDES). Potentially applicable for situations potentially not covered by VPDES.
Criteria for Classification of Solid Waste Disposal Facilities and Practices	49 C.F.R. 257.3-3(a) 33 U.S.C. °° 1288	Applicable	A facility or practice shall not cause nonpoint source pollution of the waters of the U. S. that violates applicable legal substantive requirements implementing an areawide or Statewide water quality management plan approved by the Administrator under CWA Section 208, as amended.	Potential future releases to groundwater could migrate to nearby tributaries or an adjacent pond. Natural vegetation, hybrid poplars and evergreens will reduce infiltration and groundwater discharge. Ongoing monitoring will monitor effectiveness.

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Criteria for Classification of Solid Waste Disposal Facilities and Practices	49 C.F.R. 257.3-4 and Appendix I	Applicable	A facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary or a court- or State-established alternative.	Potential future releases to groundwater could contaminate groundwater over risk-based criteria. Ongoing monitoring will address the requirement.
Clean Water Act	33 U.S.C. 1251 et seq.	Relevant and Appropriate	Criteria and standards for groundwater quality. Virginia regulation provides basis for risk-based remediation and discharge limitations.	Provides basis for risk-based decision making, establishes standards for groundwater quality. Ongoing monitoring at Site 17 will address the requirement.
Water Quality & Groundwater Standards	9 VAC 25-260-190 to 240	Relevant and Appropriate		
Surface Water Standards	9 VAC 25-260-5 to 150, 160-170, 310	Relevant and Appropriate	Standards and criteria for State waters, including wetlands.	Provides standards for evaluating State waters and wetlands at Site 17.
Virginia Pollution Discharge Elimination System (VPDES)	9 VAC 25-31-10 to 940	Applicable	Procedures and requirements for discharging pollutants into surface waters, or any activity which impacts physical, chemical or biological properties of surface waters.	Capping of Site 17 is not expected to produce waste liquids that would be discharged to surface waters. Any future activities or groundwater monitoring (e.g. generation of purge water) will address regulatory requirements.
Virginia Pollution Abatement (VPA) Permit Regulation	9 VAC 25-32-10 to 300	Applicable		
Virginia Solid Waste Management Regulations	9 VAC 20-80-250 (D)	Applicable	Groundwater Monitoring Design Standards.	Completion of additional soil borings, monitoring wells and subsurface investigations will be consistent with regulatory

requirements.

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ARAR or TBC	Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Stormwater Management Regulations	4 VAC 3-20-10 to 251	Applicable	Criteria for stormwater management.	Design of Site 17 cap will include applicable stormwater management requirements.