EPA/ROD/R03-98/081
1998

EPA Superfund
Record of Decision:

NORFOLK NAVAL BASE (SEWELLS POINT NAVAL COMPLEX)
EPA ID: VA6170061463
OU 07
NORFOLK, VA
09/30/1998

EPA 541-R98-081
<IMG SRC 980810>

FINAL
RECORD OF DECISION - OU 2
CD LANDFILL SITE
NAVAL BASE, NORFOLK, VIRGINIA

CONTRACT TASK ORDER 0138

SEPTEMBER 28, 1998

Prepared for:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ARARs	applicable, or relevant and appropriate requirements
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COPCs	contaminants of potential concern
CRDL	Contract Required Detection Limit
DoD	Department of Defense
DoN	Department of the Navy
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESI	Expanded Site Investigation
FS	Feasibility Study
GAC	granular activated carbon
HI	hazard index
IAS	Initial Assessment Study
ILCRs	incremental lifetime cancer risks
IDL	Instrument Detection Limit
IRP	Installation Restoration Program
LANTDIV	Atlantic Division, Naval Facilities Engineering Command
MCLs	Maximum Contaminant Levels
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEX	Naval Exchange Complex
NOAA	National Oceanic and Atmospheric Administration
OU	Operable Unit
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PRAP	Proposed Remedial Action Plan
QIs	Quotient Indices
RA	Risk Assessment
RAOs	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SSLs	sediment screening levels
SSSLs	surface soil screening levels
SVOCS	semivolatile organic compounds
SWSLs	surface water screening levels
TBC	to be considered
TCLP	toxicity characteristic leaching procedure
TOX	total organic halogens
USEPA	United States Environmental Protection Agency
VADEQ	Virginia Department of Environmental Quality
VDWM	Virginia Department of Waste Management
VHWMR	Virginia Hazardous Waste Management Regulations
VOCS	volatile organic compounds
VSWMR	Virginia Solid Waste Management Regulations
WQS	water quality standard

1.0 DECLARATION

1.1 Site Name and Location

Site 6, CD Landfill Site, Operable Unit 2 - Soil and Groundwater
Naval Base Norfolk
Norfolk, Virginia

1.2 Statement of Basis and Purpose

This Decision Document presents the selected remedy for Site 6, CD Landfill Site, Operable Unit 2 (OU 2) - Soil and Groundwater, Naval Base, Norfolk, Virginia (i.e., the "site"). The selected remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan. (NCP). This decision is based on the Administrative Record for the CD Landfill Site.

The United States Department of the Navy (Navy) and the United States Environmental Protection Agency (USEPA) Region III issue this decision document jointly. The Commonwealth of Virginia concurs with the selected remedy for OU 2 at the CD Landfill (See Appendix A).

Assessment of the Site

Actual or threatened releases of hazardous substances from OU 2, if not addressed by implementing the response actions 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 selected remedy in this ROD is the permanent remedy for controlling contaminated soil, groundwater, and surface water for the CD Landfill site. The major components of the selected remedy for OU 2 include the following:

- Installation of a composite cap over the entire 22-acre landfill designed in accordance with the requirements of the Virginia Solid Waste Management Regulations for an industrial waste landfill, Part E of 9 VAC 20-80-270;
- Land use restrictions to prevent future residential development, public access, and use of shallow groundwater for any purpose except monitoring;
- Post-closure quarterly shallow groundwater monitoring for one year that meets the requirements of the Virginia Solid Waste Management Regulations, Part D of 9 VAC 20-80-270. After an analysis of the first year of groundwater monitoring data, the sampling frequency shall change to annual sampling for the groundwater quality parameters, and semi-annually for the groundwater contamination indicator parameters. Post-closure shallow groundwater monitoring shall be conducted for ten years;
- Implementation of a quarterly groundwater monitoring program of the deep aquifer if organic contaminants are detected in the shall groundwater at the site. Monitoring requirements will be evaluated after a period of two years.
- Quarterly surface water sampling at three locations at the site boundary for a period of two years.

1.4 Statutory-Determinations

This selected remedy for OU 2, 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 selected remedy for OU 2 addresses the containment of surface soils and landfill wastes at the site. The selected remedy will provided for the long-term reduction of leachate generation and possible contamination of the groundwater beneath the landfill, and surface water in perimeter drainage ditches.

This remedy fulfills the State of Virginia solid waste regulations for closure of an industrial waste landfill by using a cap design and post-closure monitoring that meets state requirements. The installation of an engineered landfill cap will eliminate direct contact, ingestion, and inhalation threats from the contaminated soils, and will reduce the leaching of contaminants to groundwater by controlling precipitation entering the landfill and minimizing leachate generation. Capping is a permanent solution and is a common remedy for landfilled wastes.

This remedy uses 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 Operable Unit was not found to be practicable, the remedy does not satisfy the statutory preference for treatment as a principal element. Because the remedy for OU 2 will result in potentially hazardous substances remaining on-site above health-based levels, a review will be conducted, at a minimum, every five years, consistent with Section 121(c) of CERCLA, 42 U.S.C. º9621(c), after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

<IMG SRC 98081>

2.0 DECISION SUMMARY

2.1 Site Name, Location and Description

This Record of Decision (ROD) presents the Department of the Navy's (Navy) selected remedial actions for Operable Unit 2 - Soil and Groundwater, at CD Landfill (Site 6), Naval Base, Norfolk, Virginia (OU 2).

OU 2 is located on the Naval Base, Norfolk, south of Admiral Taussig Boulevard. The site is bordered by the Naval Exchange area to the north, Naval Air Station (NAS) to the east, a long-term parking facility to the south and Hampton Boulevard to the west (see Figure 2-1). Seabee Road cuts across the western portion of the site (See Figure 2-2).

The site was formerly used for the disposal of construction debris and other material. At present the majority of the 22 acre landfill is vegetated due in part to roadway construction restoration activities.

Seabee Road has been landscaped with trees and shrubbery and a fence has been installed on either side to eliminate public access from the right-of-way to the landfill area. Two drainage ditches border the site to the north and south. These drainage ditches flow eastward into culverts beneath the NAS which then convey surface water runoff to Willoughby Bay.

2.2 Site History and Enforcement Activities

The history of the site, previous site investigations, and highlights of community participation are summarized below.

2.2.1 Site History

Originally, the CD Landfill was part of the historic Bousch Creek drainage system. The Navy purchased the land in 1974. Prior to that time the land was owned and operated as a rail yard by the Western Railway Company.

The site, shown in detail in Figure 2-2, incorporates two areas of landfilling operations: the easternmost (unpermitted) section and the western (permitted) section. The unpermitted portion of the landfill was filled first and was used for demolition debris and inert solid waste, fly ash, and incinerator residue. From 1974 to 1979, ash residues, sandblasting grit and spent rice hulls were deposited in the landfill.

In 1979, soil and fill material from a portion of the southeast corner of the site was removed and regraded to allow for runway expansion at the Naval Air Station (NAS). The runway expansion design specified that excess material was to be spread over the landfill and not removed from the site.

In October 1979, the Naval Facilities Engineering Command received a permit from the Virginia Department of Health to use the landfill (western portion) for disposal of demolition debris and other non-putrescible wastes. The permit excluded the disposal of fly ash, incinerator residues, chemicals, and asbestos. Blasting grit used for sandblasting cadmium-plated aircraft parts was deposited at the landfill until 1981 when the blasting grit was tested and found to exceed the EP toxicity limit for cadmium. The grit was classified as a hazardous waste and on-site disposal of the material ceased.

Landfilling operations continued in the western portion of the site until 1987.

In April 1993, construction began on a new roadway (Seabee Road) across the CD Landfill to link Hampton Boulevard at the Base Pass Office to the Naval Exchange Complex (NEX) located just north of the site. Construction plans required only the addition of fill material; no cutting or grading into the existing landfill occurred. Seabee Road was completed and opened to the public on August 6, 1993. The road remains accessible to pedestrian and vehicular traffic.

In late September 1993, most of the existing debris mounds situated in the north central portion of the landfill were leveled and spread around the site to reduce the amount of standing water which accumulated after rain events. A small area of debris remains in the north central part of the site.

2.2.2 Previous Investigations

The following studies of the CD Landfill Site have been conducted:

- Initial Assessment Study (IAS)
- Confirmation Study
- Expanded Site Investigation (ESI)
- Limited Soils Study
- Remedial Investigation/Risk Assessment (RI/RA) and Feasibility Study (FS)

In April 1982, an IAS was conducted at the Sewell's Point Naval Complex, Norfolk Naval Base. The IAS identified 18 sites of concern with regard to potential contamination. The CD Landfill (Site 6) was included as a potential area of concern. The IAS report, completed in February 1983, documented the disposal of ash and spent blasting grit at the site. Based on the IAS findings, surface water and sediment were sampled quarterly and then semi-annually from 1983 to 1985.

In 1987, a Confirmation Study identified erosion from the landfill surface and/or chemical precipitation as two potential sources of cadmium contamination in the sediment.

An ESI, conducted from February 1990 to June 1991, detected concentrations of cadmium, iron, lead, and total organic halogens (TOX) in subsurface soils and sediment. Cadmium and lead were not detected in surface water.

In 1992 a Limited Soils Study was conducted in the northwestern portion of the landfill in the vicinity of the proposed Seabee Road. Analytical results of the study indicated total lead and cadmium concentrations in soils; however, no samples exceeded the Virginia Department of Waste Management (VDWM) action levels for TCLP-lead or TCLP-cadmium.

The results of the previous investigations guided the scoping of the RI, performed in 1993/1994.

The RI was completed in three separate rounds of sampling. Soil, sediment, groundwater, and surface water samples were collected. The results of the RI are presented later in this document, and this information was used as the basis for the FS, completed in 1996, that identified and evaluated potential remedial alternatives for the site.

2.2.3 Enforcement Actions

Based on reviews of the ESI, the Virginia Depart of Environmental Quality (VADEQ) notified the Navy on June 5, 1992 of a proposed Enforcement Order addressing concerns that hazardous waste had been disposed at the site. VADEQ was concerned that the site was not in compliance with the Virginia Hazardous Waste Management Regulations (VHWMR). The Navy and VADEQ met on August 4, 1992 to discuss the proposed enforcement action. The Navy responded to the proposed enforcement action on August 18, 1992 stating the Navy's position to address the entire site as part of the Naval Bases' Installation Restoration program (IRP), and provided supporting rationale and documentation. The VADEQ rescinded the enforcement action on December 9, 1992 based on the August meeting and the Navy's position to study the entire site under the IRP.

The Naval Base Norfolk was placed on the National Priorities List (NPL) on April 1, 1997.

2.2.4 Highlights of Community Participation

The Final RURA (December, 1995), Final FS (July 1996), as well as the Final Proposed Remedial Action Plan (PRAP) (June 1998) for OU 2 at the CD Landfill Site have been released and made available to the public in the Administrative Record at the Kirn Memorial Branch of the Norfolk Public Library in Norfolk, Virginia and at information repositories maintained at the Larchmont and Mary Pretlow Branches of the Norfolk Public Library and the Naval Station Library.

The notice of availability of the RI/RA and FS was published in the Virginian Pilot on July 15, 1996.

A public comment period for these documents was held from July 15, 1996 to August 15, 1996.

A notice of availability of the Final PRAP was published in the Virginian Pilot on June 5, 6, and 7, 1998. No written comments were received during the comment period. A public meeting was conducted on Wednesday, June 24, 1998 at the Naval Base Environmental Offices (Building N-26). No one from the local community attended the meeting and no comments or questions were raised.

2.3 Scope and Role of Response Action at OU 2

Previous waste disposal practices at the CD Landfill have impacted soil, groundwater, and surface water at the site. The selected remedy identified in this ROD addresses all contaminated media of concern at the site as identified in the RI and FS Reports, and comprises the overall cleanup strategy for the site. The selected remedy for these media are identified and the rationale for their selection is described in Section 2.7.

The selected remedy will reduce the potential risk to human health and the environment associated with the surface/subsurface soils, groundwater, and surface water. The remedy will provide effective source control and substantially reduce the potential for migration of contamination. The remedy includes the installation of an impermeable cap that meets the requirements of the Virginia Solid Waste Regulations for industrial waste landfills. The cap will reduce exposure to contaminants at the site and will reduce infiltration into the landfill. A groundwater/surface water monitoring program will track migration of groundwater contamination to ensure that the contamination is not migrating past the site boundary.

The remedy is consistent with the long-term remedial goals for soil and groundwater at the CD Landfill. The remedial action will reduce the threat of human exposure to potential contamination in soils and groundwater. The action will also minimize the movement of potential contaminants from soils to the groundwater and surface water. The cap will prevent the exposure of surface soils to ecological receptors. Groundwater monitoring will track the migration of shallow groundwater toward site boundaries. Institutional controls will prevent the future use of the Yorktown Aquifer as a potable water source at the site.

The selected remedy is expected to comply with applicable, or relevant and appropriate requirements (ARARs) and "to be considered" (TBC) requirements. ARARs and TBC requirements are federal and state environmental statutes that are either directly applicable or are considered in the development and evaluation of remedial Alternatives at a particular site. (See Appendix B for a listing of ARARs.)

2.4 Summary of Site Characteristics

This section provides a summary of the features of the site, and of the nature and extent of soil, groundwater, and surface water contamination at the site.

The fill materials encountered at the CD Landfill consist of metal, plastic, glass, wood and concrete debris, blast furnace cinders, wiring and miscellaneous construction rubble with a primary soil matrix of silt or sand. Distinguishing soil cover from surficially deposited fill material was difficult as each consisted of silt and sand. Fill material was generally encountered at or near ground surface to depths of between 3.5 and 12.0 feet below ground surface (bgs) and tends to increase in thickness from west to east, indicating a gradual topographic low existed in the eastern portion of the site prior to landfilling operations. In addition, shallow fill was encountered north of the northern drainage ditch possibly due to past rail yard activities.

Surface Water - Surface water at CD Landfill is primarily accommodated by two drainage ditches located at the northern and southern boundaries which merge at the eastern end of the site. Both ditches, (unlined and heavily sedimented) were constructed to facilitate runoff of surface water from the landfill area. Surface water in the ditches is conveyed to the Bousch Creek drainage channel which eventually empties into Willoughby Bay. Due to the proximity of this area to Willoughby Bay and the low relief of the land surface, the remnant tributaries of Bousch Creek are tidal throughout the Base. However, the drainage ditches bordering the CD Landfill are not tidal except in the immediate vicinity of the confluence with the Bousch Creek drainage channel. Surface water from the Naval Exchange parking area (located just northwest of the site) is directed via a storm sewer to the northern drainage ditch.

Groundwater - The Columbia (watertable) Aquifer and, to some extent, the underlying Yorktown Aquifer are the primary aquifer systems of concern at the CD Landfill Site. The Columbia Aquifer in the vicinity of the site is generally not suitable for potable (drinking water) use because of high concentrations of iron, manganese, and total dissolved solids, as well as low pH (less than 6). The deeper Yorktown Aquifer is generally suitable for potable uses, except near tidal waters, where the water can be brackish in quality.

Shallow groundwater is present as an unconfined aquifer with a water level ranging from approximately four to six feet bgs within the fill material. The aquifer extends about 25 to 30 feet to a confining clay unit (if present). Shallow groundwater within the fill tends to

follow the historical (now subsurface) land contours. Groundwater movement across the site, in general, appears to be to the northeast, but tends toward the direction of flow in the drainage ditches bordering the northern and eastern portions of the site in the immediate vicinity of the ditches. The maximum estimated groundwater flow velocity for the central portion of the site was calculated to be 3.5 feet per year. The maximum estimated groundwater flow velocity for the northeastern/eastern portion of the site was calculated to be 17.5 feet per year. The difference in groundwater flow velocity is based on the inconsistency of groundwater gradients throughout the site.

Based on regional information, it is believed that deeper groundwater in the Yorktown Aquifer flows in a more northerly direction towards the Elizabeth River and Willoughby Bay. Because the primary concern of the RI was to characterize groundwater conditions in the Columbia Aquifer, site-specific data was not generated to confirm deep groundwater flow direction, as only one well was installed into the Yorktown Aquifer. However, based on information generated during the RI for the Camp Allen Landfill site, located approximately 4,500 feet to the southeast, the Yorktown Aquifer is separated from the water table aquifer by a semi-confining clay unit. This leaky condition primarily is due to the presence of a breach and/or ineffective (poorly developed) portions of the confining clay unit at the base of the Columbia Group. The breached or ineffective portions allow for the downward migration of constituents. Average groundwater flow velocities in the Yorktown Aquifer range from approximately 0.001 to 0.08 feet/day.

The Yorktown Formation underlies the Columbia Group, and is characterized by coarse sand, gravel, and abundant shell fragments. Regionally, the Yorktown Formation ranges in thickness from 300 to 400 feet. In the vicinity of the site, the Yorktown was encountered at depths of 40 and 60 feet below ground surface (bgs). However, thickness of the Yorktown was not determined during the remedial investigation.

Wetlands - No federal or state regulated wetlands have been identified at the site.

Ecology - The area around the CD Landfill is largely urban, and few natural resources are present. Areas of underbrush, narrow wooded strips, and opportunistic wetlands (established along the ditches) are located adjacent to the landfill.

2.4.1 Sources of Contamination

Based on the available information and analytical data, the major disposal area for the CD Landfill appears to be the central and eastern portions of the site, probably extending southeastward into the NAS glide path (See Figure 2-2). The geophysical investigation completed during the RI indicated metal disposal in the eastern portion of the landfill and isolated areas in the northern, northwestern and southwestern sections of the site. However, no "hot spots" (discrete areas of contaminated soil) were identified.

2.4.2 Description of Contamination

Based on site history, previous investigations and RI findings, contamination from prior disposal practices at the CD Landfill Site has impacted surface soil, subsurface soil, sediment, surface water, and groundwater (water table and potentially the Yorktown Aquifer systems). In general, the primary contaminants of potential concern (COPCs) are several inorganic constituents, and to a lesser extent, specific volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs).

As part of the RI chemicals detected in OU 2 soil, groundwater and surface water were compared to applicable Federal and Commonwealth of Virginia criteria and/or standards, and a preliminary list of COPCs was identified. The following brief summary of the nature and extent of contamination focuses on the primary COPCs associated with site soil and groundwater and is not intended to address all results in detail. A qualitative summary of the COPCs for each medium is presented in Table 2-1.

Specific summary tables for each medium: surface soil, subsurface soil, surface water, and groundwater, are presented in Appendix C.

Surface Soil - Analytical results indicate surficial soil to be nominally impacted by disposal activities. Inorganics and organics were detected site-wide; however, the concentrations were low and, with the exception of several inorganics, generally do not exceed risk-based concentrations for human health. The exceptions include lead and arsenic, which were detected in one surface soil sample at 1,040 milligrams per kilogram (mg/kg) and 34.9 mg/kg, respectively.

Subsurface Soil - Analytical results indicate subsurface soils to be impacted by disposal activities.

As anticipated, based on the site disposal history, inorganic contamination is widely distributed over the site, and at least to the water table. In general, concentrations do not exceed risk-based concentrations except at specific locations.

Surface Water - Results indicate various inorganic and pesticide constituent concentrations exceeding Federal Ambient Water Quality Criteria and Virginia Water Quality Standards, referred to in the ecological risk assessment as surface water screening levels (SWSLs).

Shallow Groundwater (water table) Aquifer - At some locations, inorganics were detected in shallow groundwater at levels exceeding Maximum Contaminant Levels (MCLs), Virginia Groundwater Quality Standards, and Virginia Drinking Water Standards. Water quality data were also observed at levels in excess of MCLs and Virginia Water Quality Standards. Elevated metals concentrations in unfiltered samples from shallow monitoring wells may be the result of turbidity (i.e., suspended solids) in the wells rather than actual leaching of contaminants from the soils to groundwater. No clear trends or plumes associated with inorganics are evident. Radionuclides were also observed at levels in excess of the MCL and Virginia Water Quality Standards. However, the presence of radionuclides appears to be indicative of natural origin. Chlorobenzene was detected in one shallow well at a concentration significantly above the MCL, but appears to be of relatively limited extent in the extreme eastern portion of the site. While shallow groundwater contamination does not appear to be impacting surface water leaving the site, the SVOC 1,4-dichlorobenzene was also detected in MW 05A, and in two surface water samples (SW 08 and SW 12) collected from areas near MW 05A. This may indicate that, at certain times, groundwater may be discharged to the drainage ditches along the eastern portion of the site.

Deep Groundwater (Yorktown) Aquifer - Monitoring wells MW 03B and MW 05C at the site provide data concerning the quality of groundwater in the Yorktown Aquifer. RI sampling results from these two wells indicate that the Yorktown Aquifer has been marginally impacted by the landfill. No organic contaminants were detected in these wells during two sampling rounds. During Round 1, lead was detected in an unfiltered sample at 16.9 micrograms per liter (Ig/L), which slightly exceeds the MCL of 15 Ig/L. However, the Round 2 total lead concentration was only 1.4 Ig/L, and no lead was detected in the filtered samples collected from either sampling round. Iron and manganese concentrations exceeded secondary MCLs; however, these constituents may not be site-related and may be a result of turbidity in the wells caused by well bailing during sampling.

2.4.3 Contaminant Migration

The COPCs identified at the CD Landfill consist of inorganics in surface and subsurface soil, and groundwater. VOCs and SVOCs were also detected in groundwater and surface water. These COPCs may present risks to human and ecological receptors. These contaminants are expected to migrate via surface runoff or through the soils by dissolution to groundwater, and transport by groundwater to receptors in surface water and sediment. Installation of a landfill capping system will minimize the potential for surface water runoff of contaminants, and the infiltration and transport of contaminants into the underlying groundwater. Although groundwater at the site is currently not used for any purpose, contaminated groundwater could

pose a human health risk if utilized as a drinking water source under a future residential use scenario. By implementing institutional controls and long-term monitoring, an evaluation of groundwater quality and migration can be developed over time to ensure protection of human health.

2.5 Summary Of Site Risks

The public health and ecological risks associated with exposure to contaminated media within the CD Landfill Site were evaluated in the RI/RA Report. The public health baseline risk assessment evaluated and assessed the potential public health risks which might result under current and potential future land use scenarios. It should be noted that the Navy has no plans for changing the land use of the site from its present status as landfill area. An ecological evaluation also was performed and addressed the ecological integrity at the CD Landfill Site. A summary of the public health and ecological risks associated with the site are summarized below.

2.5.1 Summary of Human Health Risks

The National Oil and Hazardous Substances Pollution Contingency Plan ("NCP") established acceptable levels of carcinogenic risk for Superfund sites ranging from one excess cancer case per 10,000 people exposed to one excess cancer case per one million people exposed. This translates to a risk range of between one in 10,000 and one in one million additional cancer cases. Expressed as scientific notation, this risk range is between 10 -4 and 10 -6. Remedial action is warranted at a site when the calculated cancer risk level exceeds 10 -4. However, since EPA's cleanup goal is generally to reduce the risk to 10 -6 or less, EPA also recommends action where tile risk is within the range between 10 -4 and 10 -6.

The NCP also states that sites should not pose a health threat due to a non-carcinogenic, but otherwise hazardous, chemical. EPA defines a non-carcinogenic threat by the ratio of the contaminant concentration at the site that a person may encounter to the established safe concentration. If the ratio, called the Hazard Index (HI), exceeds one (1.0), there may be concern for the potential non-carcinogenic health effects associated with exposure to the contaminants. The HI identifies the potential for the most sensitive individuals to be adversely affected by the non carcinogenic effects of contaminants. As a rule, the greater the value of the HI above 1.0, the greater the level of concern.

Incremental lifetime cancer risks (ILCRs) and the potential to experience non-carcinogenic adverse effects (i.e., central nervous system effects, kidney effects, etc.), as measured by a hazard index (HI), were evaluated in the RI/RA. Estimated incremental cancer risks were compared to the acceptable risk range of 10 -4 to 10 -6. The calculated HI was compared to the threshold value of one. The baseline risk assessment evaluated potential risks which might result under the following land use scenarios:

- Current Military Personnel
- Current/Future Adult and Child Trespassers
- Future Civilian Workers using Shallow Groundwater for Nonpotable Use
- Future Civilian Workers using Deep Groundwater for Nonpotable Use
- Future Construction Workers
- Future On-site Residents using Shallow Groundwater for Potable Use
- Future On-site Residents using Deep Groundwater for Potable Use

The risk assessment indicates that past practices at the CD Landfill Site have contaminated certain media to the extent that they pose a potential threat to human health only under certain potential future land use scenarios. Although future residential use scenarios are unlikely at the site, they have been incorporated into the baseline comparisons. The results of the human health risk assessment for the various exposure scenarios are summarized below.

Current Military Personnel

The current military personnel risk scenario was evaluated for military personnel stationed at the Naval Base who may contact surface soil and surface water at the site. The scenario was based on an exposure duration of 4 years, which is the typical assignment period for the military. Table 2-2 shows the results of this scenario. Results indicate that there are no unacceptable risks to current military personnel posed by any of the contaminated media (i.e., surface soils and surface water) at the CD Landfill Site.

Current/Future Adult and Child Trespassers

For the current/future adult and child trespasser scenario, it was conservatively assumed that adults and older children (ages 7-15 years old), who live in the vicinity of the site, may trespass onto the site and become exposed to site surface soil and surface water. This scenario is considered conservative since the trespasser access is restricted by a chain-link fence that encloses the CD Landfill area. As shown on Table 2-3, results indicate that cancer risks are within the acceptable range of 10 -4 to 10 -6 and the Hazard Index is less than 1.0.

Future Civilian Workers using Shallow Groundwater for Nonpotable Use

This exposure scenario was evaluated for potential future civilian workers using shallow groundwater for nonpotable uses such as lawn watering and vehicle washing. Each of the shallow groundwater COPCs was detected in only one monitoring well; therefore, all evaluation of dermal contact with these constituents represents an extremely conservative exposure scenario. As shown in Table 2-4, shallow groundwater poses a potential unacceptable risk to human health through dermal contact, for which the total ILCR is 9.1 x 10 -4 and Hl is 3.8. PCB Aroclor 1260, detected in the shallow groundwater is the greatest contributor to the cancer risk, and chlorobenzene is the primary non-carcinogen responsible for the elevated HI value. It should be noted that Aroclor 1260 was only detected in one monitoring well at a concentration of 0.12 Ig/L in sampling round 2.

Future Civilian Workers using Deep Groundwater for Nonpotable Use

This exposure scenario was evaluated for potential future civilian workers using deep groundwater (i.e., Yorktown Aquifer) for nonpotable uses such as lawn watering and vehicle washing. As shown in Table 2-5, the total ILCR is only slightly above the acceptable risk range at 1.2 x 10 -4, and the Hazard Index is 0.43.

Future Construction Workers

This exposure scenario was evaluated for potential construction workers who may contact surface and subsurface soils during any future excavation and construction activities performed at the site.

As shown in Table 2-6, the ILCR is within the acceptable risk range of 10 -4 to 10 -6 and the Hazard Index is 5.8, which exceeds the acceptable level of 1.

Future On-site Residents using Shallow Groundwater for Potable Use

This exposure scenario was evaluated based on the unlikely scenario that tile landfill would be used as a residential area in the future and that shallow groundwater would be used as a potable water source. As shown in Table 2-7, the total ILCR exceeds the acceptable range at 1.6 x 10 -3 (adults) and 7.9 x 10 -4 (children), and the HI is 17 for adults and 51 for children.

Considering a potable groundwater use scenario, shallow groundwater contributes the majority of the risk presented, including a carcinogenic risk of 1.2 x 10 -3 for adults and 5.2 x 10 -4 for children and a HI of 12 for adults and 30 for children through dermal contact and ingestion. Manganese was the greatest contributor to the risk associated with groundwater

ingestion, and Aroclor 1260 was the greatest risk driver for dermal contact.

Future On-site Residents using Deep Groundwater for Potable Use

This exposure scenario is identical to the previously described residential scenario with the exception that deep groundwater (Yorktown Aquifer) would be used as a potable water source. Although the total risk from soil, surface water, and groundwater exceeds EPA's acceptable levels under a potable use scenario, deep groundwater would not pose a carcinogenic risk (no carcinogens identified in groundwater) and the HI would be less than 1.0 (See Table 2-8).

2.5.2 Summary of Ecological Evaluation

In addition to the human health risks identified for the CD Landfill, an ecological risk assessment (ERA) was also completed as part of the RI/RA Report. The ERA considered the same media as the human health risk assessment: soils, surface water (from site drainage ditches), sediments, and groundwater. The Decision Document for OU 1 summarized the ecological risks presented by the site sediments, and a separate remedial action is in process for site sediments. Therefore, site sediments are not included in this section.

The ERA evaluated and analyzed the results from the RI, including sampling and chemical analysis of the media of concern. Potential ecological receptors were determined from observations during the RI, and from a habitat evaluation that was conducted to identify potential aquatic and terrestrial ecological receptors. Contaminants detected in these media were evaluated to determine if they posed a risk to either aquatic or terrestrial receptors.

Quantifying an ecological risk for all contaminants identified can distract from the dominant risk driving contaminants at the site. Therefore, the overall list of identified contaminants was reduced to a list of COPCs. The COPCs are site-related contaminants used to estimate ecological exposures and potential adverse effects on the site receptors. The following criteria were used in selecting COPCS:

- Historical Information - contaminants that were not related to the site, such as calcium, magnesium, potassium, and sodium were not retained as COPCs.
- Prevalence (frequency of positive detections) - contaminants that were detected in five percent or less of the samples were not retained as COPCs.
- Toxicity - several of the contaminants detected were prevalent, but their inherent toxicity to ecological receptors was low, therefore, they were not retained as COPCs.
- Comparison to Federal and State criteria - this includes State Water Quality Standards (WQS) for surface water; USEPA Region III Surface Water Screening Levels (SWSLs), and Surface Soils Screening Levels (SSSLs). These standards or criteria are also based on the toxicity of the contaminant.
- Comparison to Field and Laboratory Blank Data - common laboratory contaminants were not retained as COPCs.

Summaries of the ecological risks to aquatic or terrestrial receptors are presented on the following page.

Aquatic Risks - Potential ecological risks to aquatic receptors were evaluated based on analytical data from both surface water and groundwater samples. For both media, a list of COPCs was determined by comparing the concentration of the COPC to the SWSLs (SWSLs have been developed for both acute and chronic toxicity). A contaminant with a concentration that exceeded the SWSL was retained as a COPC. When evaluating the inorganic contaminant data, both total and dissolved concentrations were considered. However, it is generally accepted that only the dissolved fraction of an inorganic is bioavailable to aquatic receptors.

After a COPC was identified, the risk characterization of that contaminant was estimated. The risk characterization evaluated the likelihood of adverse effects that may occur as a result of exposure to a contaminant. This evaluation was based on a calculated Quotient Indices (QI), which is the ratio of the actual contaminant concentration in the surface water or groundwater sample to the respective SWSL. A QI that exceeded a value of 1 indicates that exposure to a contaminant could potentially cause adverse effects to the receptor.

A summary of the aquatic risks indicates that the QI for total dieldrin, 4,4'-DDD, and 13 of the inorganics exceeded the recommended level of "1". However, only five of tile dissolved inorganics had QIs that exceeded "1" (copper, cobalt, iron, manganese, and nickel), and the concentrations of these were several orders of magnitude less than the total concentrations for most of the contaminants. This is significant in that, primarily, it is only the dissolved fraction of inorganics that is bioavailable to aquatic receptors.

Dieldrin and 4,4'-DDD may cause a moderate risk to aquatic receptors via toxicity. The source of the pesticides at this site was most likely from years of surface applications of pesticides for the control of pests/vermin during landfilling operations.

Cobalt, copper, and nickel only slightly exceeded their respective SWSLs; therefore, there is a slight potential risk to aquatic receptors from these contaminants. Potential risks to aquatic life from iron are expected to be high, and iron increases in concentration in the downstream samples. Iron may be site-related.

Some of the contaminants detected in the surface water have a high potential for bioaccumulating in biota (i.e., pesticides, PCBs, and some inorganics). Therefore, there is the potential for some aquatic and terrestrial receptors to become exposed to contaminants that have bioaccumulated in the biota.

Terrestrial Risks - Several inorganics, and a few organics, were detected at concentrations in the surface soils above the SSSLs. There are some small areas of underbrush, narrow wooded strips, and wetlands located on site. Therefore, potential adverse impacts to terrestrial flora and fauna may be possible. However, the terrestrial environment appeared to be unaffected by site contaminants based on visual observations. Gross effects of contamination (i.e., death or illness of wildlife, vegetative stress) were not observed. Although the terrestrial study was qualitative only, habitats appeared to be diverse and included species to be expected, particularly in an urban environment.

Threatened and Endangered Species - No federal or state endangered or threatened species are expected to be present at the CD Landfill Site. The peregrine falcon has been sighted near Camp Allen, which is located southeast of the CD Landfill site. There is a low potential that the falcon will be feeding on fish in the drainage ditches at the site, since the ditches are not large enough to support a significant fish population. Therefore, the risk of potential impacts to threatened or endangered species from contaminants associated with the CD Landfill is very small.

Wetlands - No federal or state regulated wetlands were identified at the site.

2.6 Description of Alternatives

A detailed analysis of the possible remedial alternatives for tile soil, sediment and groundwater at the CD Landfill Site was conducted as part of the FS Report. The detailed analysis was conducted in accordance with the USEPA document entitled "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" and the NCP. Based on the results of this analysis, the Navy is proceeding with a remedial action for sediments at the site which was presented in a separate decision document for sediments, which was categorized as OU 1. A summary of the remedial alternatives evaluated for OU 2, soil and groundwater, is presented below.

2.6.1 Soil Remedial Alternatives

The primary contaminants of concern in soils are benzo[a]pyrene, dieldrin, and various inorganics.

The following four remedial alternatives were considered for site soils:

- Alternative SO-1: No Action
- Alternative SO-2: Institutional Controls
- Alternative SO-3: Solid Waste Landfill Cap with Institutional Controls and Post Closure Groundwater Monitoring
- Alternative SO-4: Hazardous Waste Landfill Cap with Institutional Controls

Descriptions of these remedial alternatives, as well as estimated alternative costs, are provided below.

Alternative SO-1: No Action

Description: No action would be taken to remediate soils or to restrict site access.

Cost: The estimated costs of Alternative SO-1 are as follows:

- Capital: $ 0
- Annual operation and maintenance: $ 5,000
- Net present worth (30-year): $15,400

Alternative SO-2: Institutional Controls

Description: Under this alternative, the Navy would implement several institutional controls to limit site access and restrict site use. Controls would be implemented on the landfill site itself and drainage ditches located on and adjacent to the landfill and within any fenced area.

The Navy would commit to the following land use restrictions to protect the integrity of the landfill cover and to limit exposure due to the continuing presence of solid waste at the site:

- The Navy would allow no future residential development on the site;
- The Navy would allow no use of shallow groundwater, potable or nonpotable, underlying the site for any purpose except for monitoring;
- The Navy would allow no public access to the site;
- The Navy would not take or allow any other action that would disturb the integrity of the landfill cover or disturb the function of the monitoring systems.
- The Navy would implement the following institutional controls to ensure that the above limitations are properly and effectively carried out:
- The Navy would maintain the existing fences and gates at the site to limit access to the former landfill. The Navy also would install warning signs at each gate entrance to indicate that solid waste is buried at the site.

- The Navy would note the changes and restrictions associated with the site in the next revision to the Naval Base Norfolk Master Plan. The Master Plan is a comprehensive planning document consulted by both Naval Base personnel and the Atlantic Division, Naval Facilities Engineering Command when making on-base planning, development and construction decisions. The Master Plan would identify a land use category for the site that would prohibit residential use of the area as well as any invasive construction activities. The Master Plan would reflect the location and dimensions of the site, the location of any fencing, signs and monitoring wells, and would incorporate the land use restrictions stated above.

- The Naval Base Norfolk real property file and any base planning maps or other documents maintained at the base and the Atlantic Division, Naval Facilities Engineering Command also would be revised to note the land use restrictions established for land comprising the site and to cross reference these restrictions in the Naval Base Norfolk Master Plan.

- The Navy would provide the general public with notice of the past use of the site and information on land use restrictions to be implemented by taking the following actions:

    - Preparing a survey plat that indicates the location and dimensions of the site and the location of all monitoring wells. The survey plat also would state that use of the site is limited as stated above. The Navy would submit the survey plat to the local recording authority.

    - Recording a notation on real property documents evidencing the United States' ownership of the property on which the site is located that will notify interested parties that the site was previously used to manage solid waste.

    - The Navy would conduct an annual inspections to insure that land use at the site has remained consistent with the restrictions imposed. Based oil these inspections, the Navy would certify to USEPA Region III and to the Commonwealth of Virginia that institutional controls are in place and operational.

Note that Federal government entities are subject to extensive requirements under CERCLA 120(h) regarding cleanup of real property to be transferred out of Federal hands. In addition to complying with statutory requirements, to insure that the above land use restrictions are adhered to if the Navy or the United States relinquishes control or disposes of the property on which the site is situated, the Navy commits to taking the following future actions:

- If the property on which the site is located is transferred to another Federal government entity, the Navy would insure that the institutional controls described above will remain in effect after the transfer. Transfer documents would specifically require continued implementation of land use restrictions and would impose upon the transferee Federal government entity the obligation to maintain the fencing, warning signs and monitoring well heads. The Navy would prepare a site map that would be marked with the location and dimensions of the former landfill on the site and the location of fencing, warning signs and monitoring wells, and include this site map as an attachment to the appropriate transfer documents. As between the Navy and the Federal government transferee, any Navy obligations to the transferee for continued responsibility for the transferred site would be made contingent on the transferee's adherence to the limitations on the use of the site spelled out in tile transfer documents and site map.

- If the property on which the site is located is conveyed to a non-Federal government entity, and the Navy is empowered to dispose of the property directly, The Navy would insure that the deed effecting such action contains an casement or covenant in favor of the U.S. Government that will impose the land use restrictions. The Navy

also would prepare a survey plat, similar to the site map described above, that reflects the existence of this deed and land use restrictions that have been imposed on the site therein. Upon conveyance of the property, both the deed and the survey plat would be recorded, and the Navy would make arrangements to insure that the integrity of the fencing, warning signs and monitoring well heads are maintained, as well as insuring that the land use restrictions are complied with by the grantee. As between the Navy and its transferee, any Navy obligation to the transferee non-Federal entity for continued responsibility for the site would be made contingent on the transferee non-Federal entity's adherence to the limitations on the use of the site indicated in the site map and transfer documents.

- If the property on which the site is located is conveyed to a non-Federal entity, and the Navy is not empowered to dispose of the property, the Navy would take all steps necessary and permissible to ensure that the Federal entity disposing of the property takes the steps outlined above, unless the property is remediated to residential standards prior to such transfer.

Cost: The estimated costs of Alternative SO-2 are as follows:

- Capital: $ 1,000
- Annual operation and maintenance: $ 4,400
- Net present worth (30-year): $69,000

Alternative SO-3: Solid Waste Landfill Cap with Institutional Controls and Post-Closure Groundwater Monitoring

Description: This alternative would include the construction of a capping system that meets the closure requirements of the Virginia Solid Waste Management Regulations (VSWMR) for an Industrial Waste Landfill (9 VAC 20-80-270E). This alternative would include:

- Construction of a capping system over the entire 22 acre site (inclusive of the permitted and un-permitted landfill areas). The capping system would be divided into three sections or areas, with Seabee Road dividing the western portion of the cap, and a drainage ditch along the southeast corner separating the portion of the cap constructed over the landfill area within the airfield runway approach from the remainder of the landfill. Seabee Road would remain intact along with its right-of-way, and the capping system shall be extended to the edge of the roadway. Access to the site would be accommodated via improved gravel roadways along the perimeter fencing, as shown in Figure 2-3.

- Implementation of institutional controls, as described under Alternative SO-2, to restrict access to the entire landfill and limit the site to non-residential use. Existing fencing and new fencing to be constructed (as shown on Figure 2-3) would limit site access.

- Initiating a shallow groundwater monitoring program that meets the requirements of Part D of 9 VAC 20-80-270. The groundwater monitoring program will meet the Phase I monitoring requirements specified in Part D.5, which includes groundwater quality parameters and indicator parameters. (Note that a separate groundwater monitoring program, that is not related to the VSWMR requirements, is proposed for groundwater remedial alternative GW-2). The monitoring program would start after the cap is constructed, and would include:

    - Quarterly sampling for one year (four consecutive quarterly sampling events), for the groundwater quality parameters and groundwater contamination indicator parameters.

    - Samples would be collected from the following six existing groundwater monitoring wells: MW0lB, MW02B, MW03A, MW04A, MW05B, and MW06B (shown on Figure 2-2); plus one additional monitoring well to be installed between

MW02B and MW03A.

- After an analysis of the first year of groundwater monitoring data, the sampling frequency would change to annual sampling for the groundwater quality parameters, and semi-annually for the groundwater contamination indicator parameters.

- In accordance with Part F of 9 VAC 20-80-270, the post-closure shallow groundwater monitoring shall be conducted for 10 years.

As allowed by Part E of 9 VAC 20-80-270, two options would be considered for this capping alternative for the site. These options are as follows:

Alternative SO-3A: Soil/Clay Capping System

This alternative would meet the requirements of Part E.1., which includes:

- Construction of a final cover system that includes an infiltration layer that contains a minimum of 18 inches of earthen material, and with a hydraulic conductivity less than or equal to the hydraulic conductivity of the subsoils present, or a hydraulic conductivity no greater than 1 x 10 -5 cm per second, whichever is less.

- Installation of an erosion control layer (topsoil) that contains a minimum of 6 inches of earthen material that is capable of sustaining native plant growth.

Alternative SO-3B: Soil/Synthetic Flexible Liner Capping System

This alternative would meet the requirements of Part E.l.c., which includes:

- Installation of an infiltration layer that achieves an equivalent reduction in Infiltration as that provided by the 18 inches of earthen material. This criteria would most likely be met with the use of a synthetic flexible liner system.

- Installation of an erosion control layer (topsoil) that provides equivalent protection from wind and water as that provided by 24 inches of earthen material, and is capable of sustaining plant growth.

Cost: The estimated costs of this alternative are as follows:

Alternative S0-3A:

- Capital: $3,857,000
- Annual operation and maintenance: $ 6,400
- Net present worth (30-year): $3,981,000

Alternative S0-3B:

- Capital: $2,532,000
- Annual operation and maintenance: $ 6,400
- Net present worth (30-year): $2,656,000

Alternative SO-4: Hazardous Waste Landfill Cap with Institutional Controls

Description: This alternative would include the construction of a cover system over the entire landfill in accordance with 9 VAC 20-60-870. The capping system would be divided into three sections or areas, with Seabee Road dividing the western portion of the cap, and a drainage ditch along the southeast corner separating the portion of the cap constructed over the landfill area within the airfield runway approach from the remainder of the landfill.

Seabee Road would remain intact along with its right-of-way; and the capping system shall be extended to the edge of the roadway.

Site access would be accommodated via improved gravel roadways along the perimeter fencing.

Institutional controls, as described under Alternative SO-2, would also be implemented under this alternative to restrict access to the landfill and limit the site to non-residential use. Existing fencing and new fencing to be constructed would limit site access.

The estimated costs of this alternative are as follows:

- Capital: $5,916,500
- Annual operation and maintenance: $ 4,000
- Net present worth (30-year): $5,978,000

2.6.2 Groundwater Remedial Alternatives

Three groundwater remedial alternatives were developed and evaluated for the CD Landfill Site. As noted previously, surface water has also been included under the groundwater category for purpose of alternative development and evaluation. The three groundwater remedial alternatives include:

- No Action
- Institutional Controls with Monitoring
- Limited Groundwater Extraction/Treatment with Institutional Controls and Monitoring.

A brief description of each groundwater alternative, as well as the estimated cost, is provided below:

Alternative GW-1: No Action

Description: Under the No Action Alternative, no remedial action for groundwater would be performed at the CD Landfill Site.

Cost: The estimated costs of Alternative GW-1 are as follows:

- Capital: $ 0
- Annual operation and maintenance: $ 1,000
- Net present worth (30-year): $15,400

Alternative GW-2: Institutional Controls with Monitoring

Description: Under this alternative, institutional controls would be implemented to restrict access to the site and the use of groundwater at the site. These controls would be similar to those presented in Alternative SO-2 for soil, and would include prohibiting the installation of water supply wells (for either potable or nonpotable use) on site. As stated in Alternative SO-2, documents would be recorded in the City of Norfolk property records indicating that the site has been used to manage solid wastes, and would include notations that would identify any use restrictions which apply to the site, as a result of closure of the site.

A focused groundwater and surface water monitoring program would be implemented to track trends in contamination at the site boundary. The program would focus on monitoring the migration of specific volatile and semi-volatile organic contamination from shallow groundwater to points outside the site boundary, downgradient of MW 05A or in the drainage

ditch near this point. In addition, this monitoring program would include the contingent requirement to sample the deeper (Yorktown) aquifer, if contaminants are detected in the shallow aquifer. This monitoring would be performed in addition to the post-closure groundwater monitoring to be implemented for the soil remedy, and would be limited to the scope presented below. The monitoring program would be structured to meet the overall intent of 9 VAC 20-80-270, Part D, and would include the following:

- Quarterly sampling and analysis for chlorobenzene and 1,4-dichlorobenzene from the down-gradient well MW 05B.

- If chlorobenzene or 1,4-dichlorobenzene is detected in MW 05B, then a deep groundwater sample shall be collected from MW 05C, and from a new monitoring well to be installed into the Yorktown aquifer, hydraulic down-gradient of the landfill. These deep groundwater samples shall be analyzed for the same contaminants.

- Three surface water samples will be collected (down-gradient of MW 05A), on a quarterly basis.

- Quarterly sampling shall be conducted for two consecutive years. After this period, if two consecutive sampling events show that the concentrations of chlorobenzene and 1,4-dichlorobenzene are below USEPA Region III Risk Based Concentrations RBCs) of 39 Ig/L and 0.44 I/L, respectively, the Navy shall request approval to eliminate this sampling from the site post-closure monitoring.

Cost: The estimated costs of this alternative are as follows:

- Capital: $ 0
- Annual monitoring: $ 8,100
- Net present worth (30-year): $125,000

Alternative GW-3: Limited Groundwater Extraction with Institutional Controls and Monitoring

Description: The objective of this alternative is to use groundwater extraction and treatment technology, also referred to as "pump and treat", over a limited area near monitoring well MW 05A to contain shallow groundwater, and to render it suitable for its most likely potential beneficial use (i.e., nonpotable use such as lawn watering and vehicle washing).

Under this alternative, groundwater would be pumped using three shallow (approximately 25 feet deep) pumping wells, located near MW 05A, connected to a common treatment system. Each well would pump water at approximately 5 gallons per minute, for a total pumping rate of about 15 gallons per minute.

The conceptual treatment system design is based on a granular activated carbon (GAC) system for removal of organic contaminants (primarily chlorobenzene). Sand and cartridge filters were included in the treatment system for removal of suspended solids and inorganics to minimize clogging of the GAC units. Treated groundwater would be discharged into the existing on-site drainage ditch in accordance with effluent standards established in accordance with the Virginia Pollutant Discharge Elimination System.

This alternative would also include the implementation of institutional controls at the site. As with Alternative GW-2, controls would be implemented to restrict access to the site, and the use of groundwater at the site. These controls would be similar to those presented in Alternative SO-2 for soil, and would include prohibiting the installation of water supply wells (for either potable or nonpotable use) on site. With respect to surface water at the site, the institutional controls and fencing would prevent potential future exposure to potential contaminants in the surface water.

A groundwater and surface water monitoring program, as presented in Alternative GW-2, would be implemented to track trends in contamination at the site near MW 05A, and at locations hydraulically downgradient.

Cost: The estimated costs of this alternative are as follows:

- Capital: $ 954,900
- Annual operation, maintenance and monitoring: $ 97,600
- Net present worth (30-year): $2,455,000

2.7 Summary of Comparative Analysis of Alternatives

In order to determine the preferred alternatives, the remedial alternatives for soil and groundwater (including surface water) presented in Section 2.6 were evaluated against nine evaluation criteria identified in the NCP at 40 C.F.R. Section 300.430(e)(9) and discussed in the USEPA publication entitled "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA."

A summary of the nine evaluation criteria is presented in Table 2-9.

Two of the nine evaluation criteria are state acceptance and community acceptance. With respect to state acceptance, the VADEQ concurs with the preferred alternatives. However, based on new information and/or public comments, the Navy, in consultation with USEPA and VADEQ, may modify the preferred alternatives or select other remedial alternatives than those presented in the FS Report and this PRAP. The community acceptance criteria is assessed in the Responsiveness Summary (Section 3.0 of this document).

The following information summarizes and compares the remedial alternatives developed for soil and groundwater (including surface water) using the remaining seven evaluation criteria.

2.7.1 Comparison of Soil Alternatives

Overall Protection of Human Health and the Environment: With respect to surface soils, Alternatives SO-3 and SO-4 would provide the greatest amount of overall protection. Although the institutional controls noted in Alternative SO-2, would help to minimize the chance for exposure to potential contaminants, the solid waste or hazardous waste capping systems would provide added protection. The No Action Alternative, Alternative SO-1, is not protective of human health and the environment and therefore is not considered in the remainder of the analysis.

With respect to potential contamination in subsurface soils, Alternative SO-3 and 4 would provide the highest level of protection through formal institutional controls and installation of a capping system. Alternative SO-2 would provide protection through formal institutional controls, including land use restrictions, and maintenance of the existing landfill soil cover and fencing.

With respect to groundwater protection, Alternatives SO-3 and SO-4, which include an impermeable cover, would provide the greatest levels of protection. These alternatives should reduce infiltration and thus reduce the amount of contaminant leaching to groundwater. However, the overall effectiveness of either cap would be limited because the landfill is not lined with a low-permeability material, and the groundwater is very shallow. Alternative SO-2 would not minimize leaching of potential contaminants from soil to groundwater. However, as previously indicated, the threat of contaminants leaching to groundwater may be minimal.

Compliance with ARARs: Since the environmental investigation and remediation of the CD Landfill is being performed in accordance with CERCLA, ARARs (applicable, or relevant and appropriate requirements) were identified and considered for the soil alternatives. Summaries of all the ARARs identified in the Final FS report are included in Appendix B to this document. The purpose of identifying ARARs is to make a CERCLA response action consistent with other pertinent federal and state environmental requirements. A summary of how the remedial alternatives for soil comply with the identified ARARs is presented below.

Alternatives SO-3 and SO-4 would meet all their respective federal and state ARARs:

- Alternatives SO-3 and SO-4 would meet all federal and state location-specific ARARs, including protection of floodplains, consideration of endangered species habitats, natural preserve areas, and endangered plant and insect species.

- SO-3 and SO-4 would meet all state action-specific ARARs for the proper disposal of solid or hazardous wastes generated during the construction of the landfill cap.

- Alternative SO-3 would meet state action-specific ARARs for the design, construction, monitoring, and closure requirements for a capping system for an industrial waste landfill as required by the VSWMRs (9 VAC 20-80-270).

- SO-3 would meet the state chemical-specific ARAR addressing the presence, and control of methane gas from the landfill (9 VAC 20-80-280). An evaluation of methane gas requirements would be addressed during the design of the capping system.

- SO-3 and SO-4 would meet state action-specific ARARs for the proper disposal of solid or hazardous wastes generated during the construction of the landfill cap.

The remedy is expected to comply with all ARARS. There are no chemical, location, or action-specific ARARs associated with Alternative SO-2.

Long-term Effectiveness and Permanence: Estimated risk levels for exposure to surface soils are currently within acceptable levels except that the hazard index for children is greater than 1.0. Therefore, Alternatives SO-3 and SO-4 would reduce potential human health risks by preventing dermal contact or ingestion of contaminated surface soil.

A number of Remedial Action Objectives (RAOs) for OU 2 were identified in the PRAP. With respect to the first RAO for soils (prevent human exposure to potential contaminants within subsurface soil and debris), Alternatives SO-3 and SO-4 would provide the greatest level of long-term protection through both institutional controls and installation of a permanent cap.

With respect to the second RAO for soils (minimize movement of potential contaminants from soils and debris to groundwater and surface water), installation of a cap under Alternative SO-3 and Alternative SO-4 would help to reduce infiltration and thus leaching of potential contaminants from soil to groundwater. However, as previously indicated, the effectiveness of either the solid waste or hazardous waste cap would be limited by the fact that the site is not underlain by a low permeability liner and the depth to groundwater is very shallow. Alternative SO-2 would not provide any actions to minimize leaching of potential contaminants from soil to groundwater. However, as previously indicated, the threat of contaminants leaching to groundwater may be minimal.

With respect to the third RAO for soils, Alternatives SO-3 and SO-4 would minimize direct ecological exposure to the surface soils; Alternative SO-2 would not prevent ecological exposure to surface soil.

Reduction of Toxicity, Mobility, or Volume: None of the soil remedial alternatives would actively reduce the toxicity or volume of contaminants through treatment. Some reduction may be achieved under these alternatives through natural processes, such as volatilization and biodegradation.

Installation of a cap under Alternatives SO-3 and SO-4 would help to reduce the mobility of potential contaminants in the soil, but the degree of reduction may be marginal because of the absence of a confining layer and a very shallow groundwater depth.

Short-term Effectiveness: Alternative SO-2 would not pose potential risks to human health or the environment during implementation. Construction of a cap under Alternatives SO-3 and SO-4 would require extensive clearing, grubbing, and regrading activities that would disturb some of the landfill contents and potentially pose a risk to workers, nearby Base personnel, and

the environment.

Implementability: There are no major implementability considerations under Alternative SO-2. Alternatives SO-3 and SO-4 would be more difficult to implement because of the large area to be capped (approximately 21.6 acres); the extensive clearing, grubbing, and regrading required; and the necessary human health and environmental protection measures. However, landfill capping is a proven technology, and there should be no difficulty in obtaining the required materials or a qualified construction contractor.

Cost: The 30-year net present worth costs for the four alternatives are summarized below. Note that two capping options were considered for SO-3:

- Alternative SO-1: $ 0
- Alternative SO-2: $ 69,000
- Alternative SO-3A: $3,981,000
- Alternative SO-3B: $2,656,000
- Alternative SO-4: $5,978,000

2.7.2 Comparison of Groundwater Alternatives

Overall Protection: Alternative GW-3 would provide the highest level of protection since the groundwater extraction and treatment system would contain and treat the chlorobenzene in the shallow aquifer and prevent it from discharging into one or both of the perimeter drainage ditches.

Alternative GW-2 would provide more overall protection than would Alternative GW- 1 through the use of institutional controls and monitoring. Alternative GW-1, No Action, is not protective of human health and the environment and therefore is not considered in the remainder of this comparison.

Compliance with ARARs: Under Alternative GW-2, surface water runoff from the site may not comply with Federal and Virginia Water Quality Standards, which are chemical-specific ARARs. However, Alternative GW-2 would enable contaminant levels in surface water and groundwater to be monitored and compared to federal and state water quality standards, federal MCLs, and state PMCLs. Both Alternatives GW-2 and GW-3 would prevent potential future consumption of groundwater exceeding federal MCLs and state PMCLs through institutional controls.

There are no location-or action-specific ARARs associated with Alternative GW-2.

Alternative GW-3 would meet the chemical-specific ARARs covering the discharge of water from a groundwater treatment plant to a surface water. (i.e., the more stringent or substantive requirements of the Clean Water Act NPDES discharge regulations [40CFR Sections 122.41-122.50]; the Virginia Pollution Discharge Elimination System regulations [9 VAC 25-31-10 to 940] and Virginia Water Protection Permit Regulations [9 VAC 25-210-10 to 260]; and the Virginia Water Quality Standards [9 VAC 25-260-10 to 540]).

Long-term Effectiveness and Permanence: Alternative GW-2 would provide a permanent solution through use of institutional controls to prevent future potential exposure to shallow groundwater and future potable use of the Yorktown Aquifer on site. Alternatives GW-2 and GW-3 would include actively monitoring the migration of shallow groundwater toward site boundaries, and would also include monitoring for any discharge of contaminated shallow groundwater to surface water.

Alternative GW-3 would be a permanent long-term remedy.

Reduction of Toxicity, Mobility, or Volume: Alternative GW-2 would not actively reduce the toxicity, mobility, or volume of contaminants through remedial actions. Some reduction may be achieved under this alternative through natural processes, such as dispersion, volatilization, and biodegradation. Only Alternative GW-3 would reduce the toxicity, mobility, and volume of contaminants through groundwater extraction and treatment.

Short-term Effectiveness: Alternative GW-2 would not pose potential risks to human health or the environment during implementation. Alternative GW-3 would pose a risk to human health and the environment during installation of underground piping for the groundwater extraction system and construction of the treatment building foundation. Proper personnel health and safety procedures and environmental protection measures (e.g., dust and erosion controls) would be used to minimize these risks.

Implementability: There are no major implementability considerations associated with Alternative GW-2. Alternatives GW-2 and GW-3 would involve administrative actions as well as long-term monitoring activities. Alternative GW-3 would be the most difficult to implement but should not pose any significant implementability concerns.

Cost: The 30-year net present worth costs for the three groundwater alternatives are presented below:

- Alternative GW-1: $ 0
- Alternative GW-2: $ 125,000
- Alternative GW-3: $2,455,000

2.8 The Selected Remedy

The selected remedy for OU 2, contaminated soils, groundwater and surface water at the CD Landfill Site is identified below:

Soil: Alternative SO-3B - Solid Waste Landfill Cap with Institutional Controls and Post-Closure Groundwater Monitoring

Groundwater: Alternative GW-2 - Institutional Controls with Monitoring

A description of the selected remedy is presented below.

2.8.1 Selected Soil Alternative

The selected soil remedy for OU 2 at the CD Landfill Site is Alternative SO-3B, the construction of a solid waste landfill cap that meets the closure requirements of the VSWMR (9 VAC 20-80-270) for an industrial waste landfill, and the implementation of institutional controls.

The major components of the selected soil remedy are:

Landfill Capping System: The Navy shall construct a landfill cap over the entire 22-acre landfill, as shown on Figure 2-3. The capping system shall be divided into three sections or areas, with Seabee Road dividing the western portion of the cap, and a drainage ditch along the southeast corner separating the portion of the cap constructed over the landfill area within the airfield runway approach from the eastern portion of the landfill cap. The capping system shall include the installation of an infiltration layer that achieves an equivalent reduction in infiltration as that provided by 18 inches of earthen material. These criteria shall most likely be met with the use of a synthetic flexible liner system, the installation of an erosion control layer (topsoil) that provides equivalent protection from wind and water as that provided by 24 inches of earthen material, and is capable of sustaining plant growth. Seabee Road shall remain intact along with its right-of-way, and the capping system shall be

extended to the edge of the roadway. Access to the site would be accommodated via improved gravel roadways along the perimeter fencing. Figure 2-4 shows a preliminary cross-section of the cap.

The design of the capping system shall include an evaluation to determine the need for a methane gas collection system. The Navy shall also develop and implement an operating and maintenance plan for the landfill site.

Groundwater Monitoring Program: The Navy shall initiate a groundwater monitoring program that meets the requirements of Part D of 9 VAC 20-80-270. The groundwater monitoring program will meet the Phase I monitoring requirements specified in Part D.5, which includes groundwater quality parameters and indicator parameters. (Note that a separate groundwater monitoring program, that is not related to the VSWMR requirements, will be included in the selected groundwater remedy). The monitoring program shall start after the cap is constructed, and shall include:

- Quarterly sampling for one year (four consecutive quarterly sampling events), for the groundwater quality parameters and groundwater contamination indicator parameters.

- Samples shall be collected from the following six existing groundwater monitoring wells: MW01B, MW02B, MW03A, MW04A, MW05B, and MW06B (shown on Figure 2-1); plus one additional monitoring well to be installed between MW02B and MW03A.

- After an analysis of the first year of groundwater monitoring data, the sampling frequency shall change to annual sampling for the groundwater quality parameters, and semi-annually for the groundwater contamination indicator parameters.

- In accordance with Part F of 9 VAC 20-80-270, the post-closure shallow groundwater monitoring shall be conducted for ten years.

Land Use Restrictions: The Navy shall implement the following land use restrictions to protect the integrity of the landfill cover and to limit exposure due to the continuing presence of solid waste at the site:

- The Navy would allow no future residential development on the site;

- The Navy would allow no use of shallow groundwater, potable or nonpotable, underlying the site for any purpose except for monitoring;

- The Navy would allow no public access to the site;

- The Navy would not take or allow any other action that would disturb the integrity of the landfill cover or disturb the function of the monitoring systems.

Institutional Controls: The Navy shall implement the following institutional controls to ensure that the above limitations are properly and effectively carried out:

- The Navy shall maintain the existing fences and gates at the site to limit access to the former landfill. The Navy shall install warning signs at each entrance gate to indicate that solid waste is buried at the site.

- The Navy shall note the changes and restrictions associated with the site in the next revision to the Naval Base Norfolk Master Plan. These changes shall identify a land use category for the site that prohibits residential use of the area as well as any invasive construction activities. The Master Plan shall reflect the location and dimensions of the site, the location of any fencing, signs and monitoring wells, and shall incorporate the land use restrictions stated above.

- The Naval Base Norfolk real property file and any base planning maps or other documents maintained at the base and the Atlantic Division, Naval Facilities Engineering Command shall be revised to note the land use restrictions established for land comprising the site and to cross reference these restrictions in the Naval Base Norfolk Master Plan.

- The Navy shall provide the general public with notice of the past use of the site and information on land use restrictions to be implemented by taking the following actions:

    - Preparing a survey plat that indicates the location and dimensions of the site and the location of all monitoring wells. The survey plat shall state that use of the site is limited as stated above. The Navy shall submit the survey plat to the local recording authority.

    - Recording a notation on real property documents evidencing the United States' ownership of the property on which the site is located that shall notify interested parties that the site was previously used to manage solid waste.

    - The Navy shall conduct annual inspections to ensure that land use at the site has remained consistent with the restrictions imposed. Based on these inspections, the Navy shall certify to USEPA Region III and to the Commonwealth of Virginia that institutional controls are in place and operational.

Future Actions is Case of Property Transfer: In order to meet the extensive requirements under CERCLA 120(h) regarding cleanup of real property to be transferred out of Federal hands, and in addition to complying with statutory requirements, the Navy commits to taking the following future actions if the Navy or the United States relinquishes control or disposes of the property on which the site is situated:

- If the property on which the site is located is transferred to another Federal government entity, the Navy shall ensure that the institutional controls described above remain in effect after the transfer. Transfer documents shall specifically require continued implementation of land use restrictions and would impose upon the transferee Federal government entity the obligation to maintain the fencing, warning signs and monitoring well heads. The Navy shall prepare a site map that shall be marked with the location and dimensions of the former landfill on the site and the location of fencing, warning signs and monitoring wells, and include this site map as an attachment to the appropriate transfer documents. As between the Navy and the Federal government transferee, any Navy obligations to the transferee for continued responsibility for the transferred site shall be made contingent on the transferee's adherence to the limitations on the use of the site spelled out in the transfer documents and site map.

- If the property on which the site is located is conveyed to a non-Federal government entity, and the Navy is empowered to dispose of the property directly, the Navy shall ensure that the deed effecting such action contains an easement or covenant in favor of the U.S. Government that will impose the land use restrictions. The Navy shall also prepare a survey plat, similar to the site map described above, that reflects the existence of this deed and land use restrictions that have been imposed on the site therein. Upon conveyance of the property, both the deed and the survey plat shall be recorded, and the Navy shall make arrangements to insure that the integrity of the fencing, warning signs and monitoring well heads are maintained, as well as insuring that the land use restrictions are complied with by the grantee. As between the Navy and its transferee, any Navy obligation to the transferee non-Federal entity for continued responsibility for the site shall be made contingent on the transferee non-Federal entity's adherence to the limitations on the use of the site indicated in the site map and transfer documents.

- If the property on which the site is located is conveyed to a non-Federal entity, and the Navy is not empowered to dispose of property, the Navy shall take all steps necessary and permissible to ensure that the Federal entity disposing of the property takes the steps outlined above, unless the property is remediated to residential standards prior to such transfer.

This selected soil remedy provides for the containment of surface soil and waste materials at the CD Landfill site, and provides a permanent solution by preventing both human and ecological future exposure to potential contamination. The selected remedy will provide for long-term reduction of leachate generation and will reduce potential future contamination of groundwater beneath the site.

2.8.2 Selected Groundwater/Surface Water Alternative

The selected groundwater remedy for OU 2 at the CD Landfill Site is Alternative GW-2, institutional controls with monitoring. The selected alternative shall include the implementation of a groundwater and surface monitoring program, land use restrictions, and institutional controls. The Navy shall implement the same institutional controls as described for the selected soil remedy (SO-3B). The major components of the selected soil remedy are:

Groundwater Monitoring Program: A focused groundwater and surface water monitoring program shall be implemented to track trends in contamination at the site boundary. The program shall focus on monitoring the migration of specific volatile and semi-volatile organic contamination from shallow groundwater to points outside the site boundary, downgradient of MW 05A or in the drainage ditch near this point. In addition, this monitoring program shall include the contingent requirement to sample the deeper (Yorktown) aquifer, if contaminants are detected in the shallow aquifer. This monitoring shall be performed in addition to the post-closure groundwater monitoring to be implemented for the soil remedy, and will be limited to the scope presented below. The monitoring program shall be structured to meet the intent of 9 VAC 20-80-270, Part D, and shall include the following:

- Quarterly sampling and analysis for chlorobenzene and 1,4-dichlorobenzene from the down-gradient well MW 05B.

- If chlorobenzene or 1,4-dichlorobenzene is detected in MW 05B, then a deep groundwater sample shall be collected from MW 05C, and from a new monitoring well to be installed into the Yorktown aquifer, hydraulically down-gradient of the landfill. These deep groundwater samples shall be analyzed for the same contaminants.

- Three surface water samples shall be collected (down-gradient of MW 05A), on a quarterly basis.

- Quarterly sampling shall be conducted for two consecutive years. After this period, if two consecutive sampling events show that the concentrations of chlorobenzene and 1,4-dichlorobenzene are below USEPA Region III Risk Based Concentrations (RBCs) of 39 Ig/L and 0.44 Ig/L, respectively, the Navy shall request approval to eliminate this sampling from the site post-closure monitoring.

Land Use Restrictions: Implementation of the land use restrictions for the selected soil remedy (SO-3B) shall also apply to the groundwater remedy.

Institutional Controls: The institutional controls implemented for the selected soil remedy (SO-3B) shall also apply to control of the groundwater and surface water.

The selected groundwater remedy shall include institutional controls to restrict groundwater use (for either potable or nonpotable use) at the site, prohibit installation of water supply wells, and the implementation of a sediment, surface water and groundwater monitoring program. This preferred groundwater alternative shall provide overall protection through long-term monitoring of contaminant levels and the prevention of potential future consumption

of groundwater.

2.8.3 Performance Standards

The landfill cap shall be designed, constructed, operated, and maintained to meet the performance requirements of the VSWMR (9 VAC 20-80-270E and F) for closure of an industrial waste landfill.

Landfill Cap Design Criteria: The cap design shall minimize infiltration, and control surface water run on/runoff. The landfill cap shall be constructed, at a minimum to the following performance standards:

- Installation of an infiltration layer that achieves an equivalent reduction in infiltration as that provided by 18 inches of earthen material, with a hydraulic conductivity less than or equal to the hydraulic conductivity of the subsoils present, or a hydraulic conductivity no greater than 1 x 10 -5 cm per second, whichever is less. These criteria will be met with the use of a synthetic flexible liner system, and

- Installation of an erosion control layer (topsoil) that provides equivalent protection from wind and water as that provided by 24 inches of compacted earthen material, and is capable of sustaining plant growth.

- Surface water drainage controls shall be constructed to prevent erosion of the cap. As determined by the final design, drainage channels shall be installed in certain areas on the top and perimeter of the landfill cap to channel runoff away from the landfill.

- The landfill cap design shall evaluate the presence of methane gas, and if warranted, the design will include a gas collection and monitoring system that meets VSWMR requirements.

Closure Plan: The Navy shall prepare a written closure plan that meets the requirements of 9 VAC 220-80-270 for an industrial landfill.

Post-Closure Groundwater Monitoring: The Navy shall implement a groundwater monitoring program that meets the requirements of Part D of 9 VAC 20-80-270. The groundwater monitoring program will meet the Phase I monitoring requirements specified in Part D.5, which includes groundwater quality parameters and indicator parameters. (Note that a separate groundwater monitoring program, that is not related to the VSWMR requirements, is proposed for groundwater remedial alternative GW-2). The monitoring program shall start after the cap is constructed, shall evaluate any future contaminant transport, and shall include:

- Quarterly sampling for one year (four consecutive quarterly sampling events), for the groundwater quality parameters and groundwater contamination indicator parameters.

- Samples shall be collected from the following six existing groundwater monitoring wells: MW01B, MW02B, MW03A, MW04A, MW05B, and MW06B (shown on Figure 2-2); plus one additional monitoring well to be installed between MW02B and MW03A.

- After an analysis of the first year of groundwater monitoring data, the sampling frequency shall change to annual sampling for the groundwater quality parameters, and semi-annually for the groundwater contamination indicator parameters.

Institutional Controls: The Navy shall implement institutional controls, as described under Alternative SO-2, to restrict access to the entire landfill and limit the site to non-residential use. Fencing shall completely enclose the site and signs shall be posted indicating solid wastes are present. The next revision to the Base Master Plan shall note

that the CD Landfill is an area in which construction changes are prohibited, residential development is prohibited, shallow groundwater use is prohibited, and site access shall be limited. A notation shall be filed in the real property file maintained by the Navy for this site indicating the extent of the area and the fact that solid wastes are present.

Within 60 days of closure (capping), the Navy shall produce a survey plat indicating the location and dimensions of the landfill with respect to permanently surveyed benchmarks. This plat shall be prepared and certified by a professional land surveyor. The plat shall contain a note, prominently displayed, which states the owner's obligation to restrict disturbance of the landfill; post-closure use shall prohibit residential use, shall prohibit access or use of groundwater underlying the property for any purpose except monitoring, and shall never be allowed to disturb the integrity of the final cover, liners, or any other components of the containment system, or the function of the facility's monitoring systems. No later than 60 days after closure, the Navy shall to submit to the local property office a record of the location of the facility.

If and when the property is transferred out of the federal government, the deed shall contain the survey plat, (the notation that the property was previously used to manage solid wastes, that its future use is restricted, and other deed restrictions as appropriate apply.

In a yearly Closure Report, the Navy shall certify that the institutional controls as outlined above are still in place and effective. The Navy shall notify USEPA and VADEQ 60 days before changing any of the use restrictions in the Base Master Plan related to the CD Landfill.

2.9 Statutory Determinations

A selected remedy must satisfy the statutory requirements of CERCLA Section 121, which include:

- Protection of human health and the environment
- Compliance with ARARs (or justification of a waiver)
- Cost-effectiveness
- Utilization of permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable
- Preference for treatment that reduces toxicity, mobility, or volume as a principal element, or explanation as to why this preference is not satisfied

The evaluation of how the selected remedy for the CD Landfill site satisfies these requirements is presented below.

2.9.1 Protection of Human Health and the Environment

The selected remedy will protect human health and the environment. Installation of a solid waste landfill cap will eliminate direct contact, inhalation, and ingestion threats from contaminated soils and will reduce the leaching of contaminants from the landfill to groundwater. Institutional controls will restrict future land use, further mitigating the potential for direct exposure and potential risks.

Groundwater monitoring in the vicinity of the landfill will provide a warning mechanism for potential groundwater contamination and ensure the landfill cap is effective in protecting human health. Since the remedy will leave contaminants at the site, a review will be performed within five years to ensure continued protection of human health and the environment.

2.9.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will comply with applicable or relevant and appropriate requirements (ARARS). ARARs are identified in Appendix B.

2.9.3 Cost-Effectiveness

The selected remedy provides overall cost-effectiveness. The total present worth cost of the selected remedy in this ROD is $2,781,000.

2.9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized while providing the best balance among the other evaluation criteria.

The selected landfill cap is a permanent solution and is a common remedy for large landfills with high volumes of waste such as CD Landfill.

2.9.5 Preference for Treatment as a Principal Element

The selected remedy does not utilize permanent treatment technologies due to the large volume of waste in the landfill requiring treatment or disposal.

3.0 RESPONSIVENESS SUMMARY

3.1 Background on Community Involvement

Community relations activities to date for the CD Landfill site include establishment of an Administrative Record, briefings to the Restoration Advisory Board regarding findings of the RI and FS, release of the PRAP for public review and comment on June 5, 1998, and a public meeting conducted on June 24, 1998.

3.2 Summary of Public Comments

No written comments were received during the comment period. A public meeting was conducted on Wednesday, June 24, 1998 at the Naval Base Environmental Offices (Building N-26). No one from the local community attended the meeting and no comments or questions were raised.

TABLE 2-1
QUALITATIVE SUMMARY OF COPCs
CD LANDFILL - OU 2
NAVAL BASE NORFOLK, VIRGINIA

Media	Contaminants	Location
Surface Water	SVOCs (primarily 1,4-dichlorobenzene)	Northern and eastern drainage area
	Pesticides (primarily dieldrin)	Northern and eastern drainage area
	Metals (Sb, As, Ba, Cr, Cu, Mn, Ni, Th, V, Zn	Northern and eastern drainage area
Shallow Sediment	SVOCs	Southern drainage area and SD09
	Pesticides/PCBs	Northern and southern drainage area
	Metals (As, Cr, Cu, Mn, Ni, V)	Northern and southern drainage area
Deep Sediment	SVOC	Eastern drainage area
	Pesticides/PCBs	Northern and southern drainage area
	Metals (As, Ba, Mn)	Southern drainage area
Surface Soil	SVOCs [primarily benzo(a)pyrene]	SB-09S
	Pesticides (primarily dieldrin)	SB-09S
	Metals (As, Be, Mn, V)	Site-wide
Subsurface Soil	SVOCs [primarily benzo(a)pyrene]	SB-17 and SB-18
	Metals (Sb, As, Be, Cd, Cr, Cu, Mn, Ni, Zn)	Arsenic found site-wide. Other metals primarily in East/Central to extreme eastern portion of site
Groundwater	VOCs (primarily chlorobenzene)	SB/MW-05A
	SVOCs (primarily 1,4-dichlorobenzene)	SB/MW-05A
	Pesticides (primarily dieldrin)	Northern length of site
	PCBs (primarily Aroclor 1260)	MW-04A
	Metals (Sb, As, Ba, Be, Cd, Cu, Mn, Ni, V, Zn)	As, Be, Mn, V - Site Wide Cd, Cu, Ni, Zn - MW-03A, 04A, 05A, 10A Be - MW03A and 10A Sb - 04A and 10A
Surface Water	SVOCs (primarily 1,4-dichlorobenzene)	Northern and eastern drainage area
	Pesticides (primarily dieldrin)	Northern and eastern drainage area
	Metals (Sb, As, Ba, Cr, Cu, Mn, Ni, Th, V, Zn	Northern and eastern drainage area
Shallow Sediment	SVOCs	Southern drainage area and SD09
	Pesticides/PCBs	Northern and southern drainage area
	Metals (As, Cr, Cu, Mn, Ni, V)	Northern and southern drainage area
Deep Sediment	SVOC	Eastern drainage area
	Pesticides/PCBs	Northern and southern drainage area
	Metals (As, Ba, Mn)	Southern drainage area
Surface Soil	SVOCs [primarily benzo(a)pyrene]	SB-09S
	Pesticides (primarily dieldrin)	SB-09S
	Metals (As, Be, Mn, V)	Site-wide
Subsurface Soil	SVOCs (primarily benzo(a)pyrene]	SB-17 and SB-18
	Metals (Sb, As, Be, Cd, Cr, Cu, Mn, Ni, Zn)	Arsenic found site-wide. Other metals primarily in East/Central to extreme eastern portion of site
Groundwater	VOCs (primarily chlorobenzene)	SB/MW-05A
	SVOCs (primarily 1,4-dichlorobenzene)	SB/MW-05A
	Pesticides (primarily dieldrin)	Northern length of site
	PCBs (primarily Aroclor 1260)	MW-04A
	Metals (Sb, As, Ba, Be, Cd, Cu, Mn, Ni, V, Zn)	As, Be, Mn, V - Site Wide Cd, Cu, Ni, Zn - MW-03A, 04A, 05A, 10A Be - MW03A and 10A Sb - 04A and 10A

TABLE 2-2

INCREMENTAL LIFETIME CANCER RISKS (ILCRs)
AND HAZARD INDICES (HIs)
FOR CURRENT MILITARY PERSONNEL
CD LANDFILL SITE
NAVAL BASE, NORFOLK, VIRGINIA

	Receptor Adult Military Personnel	
Medium/Pathway	ILCR	HI
Surface Soil		
Ingestion	7.6×10^{-7}	3.4×10^{-2}
Dermal Contact	4.8×10^{-6}	7.3×10^{-2}
Inhalation (1)	8.2×10^{-10}	7.8×10^{-4}
Subtotal	5.6×10^{-6}	1.1×10^{-1}
Surface Water		
Ingestion	1.7×10^{-7}	1.7×10^{-2}
Dermal Contact	1.0×10^{-6}	9.9×10^{-3}
Subtotal	1.2×10^{-6}	2.7×10^{-2}
TOTAL	6.8×10^{-5}	1.4×10^{-1}

Notes:

(1) Inhalation of fugitive dusts.

TABLE 2-3

INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR CURRENT/FUTURE ADULT AND CHILD TRESPASSERS
CD LANDFILL SITE
NAVAL BASE, NORFOLK, VIRGINIA

	Receptors			
	Adults		Children (7-15 years)	
Medium/Pathway	ILCR	HI	ILCR	HI
Surface Soil				
Ingestion	9.2 x 10 -7	5.4 x 10 -3	5.2 x 10 -7	1.0 x 10 -2
Dermal Contact	5.8 x 10 -6	1.2 x 10 -2	2.4 x 10 -6	1.6 x 10 -2
Subtotal	6.7 x 10 -6	1.7 x 10 -2	2.9 x 10 -6	2.6 x 10 -2
Surface Water				
Ingestion	3.9 x 10 -6	4.0 x 10 -2	2.2 x 10 -6	7.7 x 10 -2
Dermal Contact	1.5 x 10 -5	2.0 x 10 -2	6.9 x 10 -6	3.0 x 10 -2
Subtotal	1.9 x 10 -5	6.0 x 10 -2	9.1 x 10 -6	1.1 x 10 -1
TOTAL	2.6 x 10 -5	7.7 x 10 -2	1.2 x 10 -5	1.3 x 10 -1

TABLE 2-4

INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE CIVILIAN WORKERS (GROUNDSKEEPERS)
SHALLOW AQUIFER USED AS NON-POTABLE SOURCE
CD LANDFILL SITE
NAVAL BASE, NORFOLK, VIRGINIA

	Receptor Civilian Worker	
Medium/Pathway	ILCR	HI
Surface Soil		
Ingestion	4.0 x 10 -6	2.8 x 10 -2
Dermal Contact	4.1 x 10 -5	1.0 x 10 -1
Inhalation (1)	1.0 x 10 -8	1.6 x 10 -3
Subtotal	4.5 x 10 -5	1.3 x 10 -1
Shallow Groundwater		
Ingestion	2.2 x 10 -5	4.5 x 10 -1
Dermal Contact	7.7 x 10 -4	2.9 x 10 +0
Subtotal	7.9 x 10 -4	3.4 x 10 +0
Surface Water		
Ingestion	1.6 x 10 -5	2.0 x 10 -1
Dermal Contact	6.4 x 10 -5	1.0 x 10 -1
Subtotal	8.0 x 10 -5	3.0 x 10 -1
TOTAL	9.1 x 10 -4	3.8 x 10 +0

Notes:

(1) Inhalation of fugitive dusts.

TABLE 2-5

INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE CIVILIAN WORKERS (GROUNDSKEEPERS)
DEEP AQUIFER (WELL LOCATION GW-05C) USED AS NON-POTABLE SOURCE
CD LANDFILL SITE
NAVAL BASE, NORFOLK, VIRGINIA

	Receptor: Civilian Worker	
Medium/Pathway	ILCR	HI
Surface Soil		
Ingestion	4.0 x 10 -6	2.8 x 10 -2
Dermal Contact	4.1 x 10 -5	1.0 x 10 -1
Inhalation (1)	1.0 x 10 -1	1.6 x 10 -3
Subtotal	4.5 x 10 -5	1.3 x 10 -1
Deep Groundwater		
Ingestion	--	5.5 x 10 -4
Dermal Contact	--	4.4 x 10 -3
Subtotal		5.0 x 10 -3
Surface Water		
Ingestion	1.6 x 10 -5	2.0 x 10 -1
Dermal Contact	6.4 x 10 -5	1.0 x 10 -1
Subtotal	8.0 x 10 -5	3.0 x 10 -1
TOTAL	1.2 x 10 -4	4.3 x 10 -1

Notes:

(1) Inhalation of fugitive dusts.
-- No COPCs identified for evaluation.

TABLE 2-6

INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE CONSTRUCTION WORKERS
CD LANDFILL SITE
NAVAL BASE, NORFOLK, VIRGINIA

	Receptor	
	Adult Construction Worker	
Medium/Pathway	ILCR	HI
Surface Soil		
Ingestion	1.5 x 10 -6	2.7 x 10 -2
Dermal Contact	1.7 x 10 -6	1.0 x 10 -1
Inhalation (1)	4.1 x 10 -10	1.6 x 10 -3
Subtotal	3.2 x 10 -6	3.7 x 10 -1
Subsurface Soil		
Ingestion	1.8 x 10 -6	3.1 x 10 +0
Dermal Contact	5.6 x 10 -6	2.3 x 10 +0
Inhalation (1)	9.5 x 10 -9	1.9 x 10 -2
Subtotal	7.4 x 10 -6	5.4 x 10 +0
Total	1.1 x 10 -5	5.8 x 10 +0

Note:

(1) Inhalation of fugitive dusts.

TABLE 2-7

INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE ADULT AND YOUNG CHILD ON-SITE RESIDENTS
SHALLOW AQUIFER USED AS POTABLE SOURCE
CD LANDFILL SITE
NAVAL BASE, NORFOLK, VIRGINIA

	Receptors			
	Adults		Young Children (1-6 years)	
Medium/Pathway	ILCR	HI	ILCR	HI
Surface Soil				
Ingestion	1.3 x 10 -5	7.8 x 10 -2	2.5 x 10 -5	7.3 x 10 -1
Dermal Contact	8.5 x 10 -5	1.7 x 10 -1	4.8 x 10 -5	4.8 x 10 -1
Inhalation (1)	1.4 x 10 -9	1.8 x 10 -4	2.7 x 10 -9	1.7 x 10 -3
Subtotal	9.8 x 10 -5	2.5 x 10 -1	7.3 x 10 -5	1.2 x 10 +0
Subsurface Soil				
Ingestion	1.6 x 10 -5	9.1 x 10 -1	3.0 x 10 -5	8.5 x 10 +0
Dermal Contact	2.9 x 10 -4	3.9 x 10 +0	1.6 x 10 -4	1.1 x 10 +1
Inhalation (1)	3.3 x 10 -8	2.2 x 10 -3	6.2 x 10 -8	2.1 x 10 -2
Subtotal	3.1 x 10 -4	4.8 x 10 +0	1.9 x 10 -4	2.0 x 10 +1
Shallow Groundwater (2)				
Ingestion	7.6 x 10 -4	9.9 x 10 +0	3.6 x 10 -4	2.3 x 10 +1
Dermal Contact	4.3 x 10 -4	1.3 x 10 +0	1.6 x 10 -4	2.4 x 10 +0
Inhalation (3)	4.3 x 10 -7	9.2 x 10 -1	4.0 x 10 -7	4.3 x 10 +0
Subtotal	1.2 x 10 -3	1.2 x 10 +1	5.2 x 10 -4	3.0 x 10 +1
Surface Water				
Ingestion	3.9 x 10 -6	4.0 x 10 -2	3.7 x 10 -6	1.9 x 10 -1
Dermal Contact	1.5 x 10 -5	2.0 x 10 -2	8.0 x 10 -6	5.3 x 10 -2
Subtotal	1.9 x 10 -5	6.0 x 10 -2	1.2 x 10 -5	2.4 x 10 -1
TOTAL	1.6 x 10 -3	1.7 x 10 +1	7.9 x 10 -4	5.1 x 10 +1

Notes:

(1) Inhalation of fugitive dusts.
(2) Risk levels presented are associated with potential exposures to organic and dissolved inorganic COPCs.
(3) Inhalation of volatilized organic COPC concentrations in shower air as determined by the Foster and Chrostowski Shower Model.

TABLE 2-8

INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE ADULT AND YOUNG CHILD ON-SITE RESIDENTS
DEEP AQUIFER (WELL LOCATION GW-05C) USED AS POTABLE SOURCE
CD LANDFILL SITE
NAVAL BASE, NORFOLK, VIRGINIA

Medium/Pathway	Receptors: Adults ILCR	Adults HI	Young Children (1-6 years) ILCR	Young Children (1-6 years) HI
Surface Soil				
Ingestion	1.3 x 10 -5	7.8 x 10 -2	2.5 x 10 -5	7.3 x 10 -1
Dermal Contact	8.5 x 10 -5	1.7 x 10 -1	4.8 x 10 -5	4.8 x 10 -1
Inhalation (1)	1.4 x 10 -9	1.8 x 10 -4	2.7 x 10 -9	1.7 x 10 -3
Subtotal	9.8 x 10 -5	2.5 x 10 -1	7.3 x 10 -5	1.2 x 10 +0
Subsurface Soil				
Ingestion	1.6 x 10 -5	9.1 x 10 -1	3.0 x 10 -5	8.5 x 10 +0
Dermal Contact	2.9 x 10 -4	3.9 x 10 +0	1.6 x 10 -4	1.1 x 10 +1
Inhalation (1)	3.3 x 10 -8	2.2 x 10 -3	6.2 x 10 -8	2.1 x 10 -2
Subtotal	3.1 x 10 -4	4.8 x 10 +0	1.9 x 10 -4	2.0 x 10 +1
Deep Groundwater (2)				
Ingestion	--	2.7 x 10 -2	--	6.3 x 10 -2
Dermal Contact	--	1.1 x 10 -3	--	2.0 x 10 -3
Inhalation (3)	--	--	--	--
Subtotal	--	2.8 x 10 -2	--	6.5 x 10 -2
Surface Water				
Ingestion	3.9 x 10 -6	4.0 x 10 -2	3.7 x 10 -6	1.9 x 10 -1
Dermal Contact	1.5 x 10 -5	2.0 x 10 -2	8.0 x 10 -6	5.3 x 10 -2
Subtotal	1.9 x 10 -1	6.0 x 10 -2	1.2 x 10 -5	2.4 x 10 -1
TOTAL	4.3 x 10 -4	5.1 x 10 +0	2.7 x 10 -4	2.1 x 10 +1

Notes:

(1) Inhalation of fugitive dusts.
(2) Risk levels presented are associated with potential exposures to organic and dissolved inorganic COPCs.
(3) Inhalation of volatilized organic COPC concentrations in shower air as determined by the Foster and Chrostowski Shower Model.
-- No COPCs identified for evaluation.

TABLE 2-9

SUMMARY OF EVALUATION CRITERIA

- Overall Protection of Human Health and Environment - addresses whether or not an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- Compliance with ARARs - addresses whether or not an alternative will meet all of the applicable or relevant and appropriate requirements (ARARs) prescribed in federal and state environmental statutes and/or provide grounds for invoking a waiver.

- Long-Term Effectiveness and Permanence - refers to the magnitude of residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

- Reduction of Toxicity, Mobility, or Volume through Treatment - refers to the anticipated performance of the treatment options that may be employed in an alternative.

- Short-Term Effectiveness - refers to the speed with which the alternative achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment during the construction and implementation period.

- Implementability - refers to the technical and administrative feasibility of an alternative, including the availability of materials and services needed to implement the chosen solution.

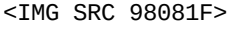
- Cost - includes capital and operation and maintenance costs, and for comparative purposes, net present worth values.

- State Acceptance - indicates whether, based on review of the RI and FS Reports and the PRAP, the State concurs with, opposes, or has no comments on the preferred alternative.

- Community Acceptance - will be addressed in the Record of Decision following a review of the public comments received on the RI and FS Reports and the PRAP.

<IMG SRC 98081B>
<IMG SRC 98081C>
<IMG SRC 98081D>
<IMG SRC 98081E>

APPENDIX A
VADEQ CONCURRENCE LETTER



APPENDIX B
ARAR TABLES

TABLE B-1a

FEDERAL CHEMICAL-SPECIFIC ARARS BY MEDIA
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 1 of 2)

Requirement	Prerequisite	Citation	ARAR Determination	Comments
		GROUNDWATER		
Safe Drinking Water Act (SDWA), 42 USC 300* National primary drinking water standards are health-based standards for public water systems (maximum contaminant levels [MCLs]).	Public water system.	40 CFR Part 141 Subparts B & G	Not relevant and appropriate for the shallow water table aquifer, which is a Class III aquifer, and is not a potential drinking water source. Relevant and appropriate to the Yorktown Aquifer.	MCLs are relevant and appropriate for groundwater determined to be a current or potential source of drinking water in cases where MCLGs are not ARARs. MCLs are relevant and appropriate for Yorktown aquifer. However, no contaminants detected in Yorktown Aquifer in excess of MCLs.
Maximum contaminant level goals [MCLGs] pertain to known or anticipated adverse health effects (also known as recommended maximum contaminant levels).	Public water system.	40 CFR Part 141 Subpart F	Relevant and appropriate for Yorktown Aquifer only, which is a Class II aquifer. The water table aquifer is a Class III aquifer.	MCLGs that have non-zero values are relevant and appropriate for groundwater determined to be a current or potential source of drinking water (40 CFR 300.430[e][2][i][B] through [D]). Relevant and appropriate at the unit boundary.

TABLE B-1a

FEDERAL CHEMICAL-SPECIFIC ARARS BY MEDIA
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 2 of 2)

Requirement	Prerequisite	Citation	ARAR Determination	Comments
National secondary drinking water regulations are standards for the aesthetic qualities of public water systems (secondary MCLs [SMCLs]).	Public water system.	40 CFR Part 143, excluding 143.5(b).	TBC for Yorktown Aquifer only.	SMCLs are nonenforceable federal contaminant levels intended as guidelines for the states. Because they are nonenforceable, federal SMCLs are not ARARs. However, they may be TBCs at the unit boundary. Iron and manganese detected above SMCLs in two Yorktown Aquifer wells (may not be site-related). Iron SMCL = 300 Ig/L, Manganese SMCL = 50 Ig/L.
		SURFACE WATER		
Water quality criteria.	Discharges to waters of the United States and groundwater.	33 USC 1314(a) and 42 USC 9621(d)(2)	Relevant and appropriate (NPDES regulations would be Relevant and appropriate).	Federal water quality criteria may be relevant and appropriate for any discharges to surface water (from contaminated groundwater or surface runoff).

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that DON accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or relevant and appropriate requirements.
CFR - Code of Federal Regulations.
USC - United States Code.
TBC - To be considered.

TABLE B-1b

FEDERAL LOCATION-SPECIFIC ARARS
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 1 of 1)

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Executive Order 11988, Within floodplain	Protection of Floodplains* Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values,	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas.	40 CFR Part 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Applicable.	Regrading activities may require compliance with this order.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that DON accepts the entire statues or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or relevant and appropriate requirements.
CFR - Code of Federal Regulations.
USC - United States Code.

TABLE B-2a

VIRGINIA CHEMICAL-SPECIFIC ARARS BY MEDIA
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 1 of 2)

Requirement	Prerequisite	Citation	ARAR Determination	Comments
		GROUNDWATER		
Virginia Drinking Water Standards* Primary drinking water standards are health-based standards for public water supplies (primary maximum contaminant levels [PMCLs]).	Public water system.	12 VAC 5-590-10 VR 355-18-001.02	Relevant and appropriate for Yorktown Aquifer only. Not relevant and appropriate for shallow, non-potable water table aquifer, which is not a potential drinking water source.	Virginia PMCLs are similar to federal MCLs. PMCLs are relevant and appropriate for groundwater determined to Be a current or potential source of drinking water. However, the shallow water table is not a potential drinking water source, and no contaminants detected in Yorktown Aquifer in excess of MCLs. Standards to be applied at unit boundary.
Secondary drinking water regulations are chemical based standards for qualities of public water supplies (secondary MCLs [SMCLs]).	Public water system.	12 VAC 5-590-390 VR 355-18-004.06	Relevant and appropriate for Yorktown Aquifer only.	Virginia SMCLs are similar to federal SMCLs. In Virginia, SMCLs are enforceable for potable water supplies. Iron and manganese detected above SMCLs in two Yorktown Aquifer wells (may not be site-related). Iron SMCL = 300 Ig/L, Manganese SMCL = 50 Ig/L.
Virginia Groundwater Standards* Establishes groundwater standards for State Antidegradation Policy.	Standards are used when no MCL is available.	9 VAC 25-260-190 to 220 VR 680-21-04.1	Relevant and appropriate when MCLs not available, or when standards are more stringent than MCLs.	MCLs available for all contaminants of concern.

TABLE B-2a

VIRGINIA CHEMICAL-SPECIFIC ARARS BY MEDIA
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 2 of 2)

Requirement	Prerequisite	Citation	ARAR Determination	Comments
		SURFACE WATER		
Virginia Water Quality Standards*				
Water quality standards based on water use and class of surface water.	Discharges to surface waters.	9 VAC 25-260-10 to 540 VR 680-21-01.1, et al.	Applicable.	Water quality standards would be applicable for any discharges to surface water (from contaminated groundwater or surface runoff).
		AIR		
Virginia Air Pollution Control Regulations				
Ambient Air Quality Standards: primary and secondary standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare.	9 VAC 5-30-20 and 9 VAC 5-30-60 VR 123-03	Applicable.	Applicable to all activities at the site that may generate regulated pollutants.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statutes or policies as potential ARARs, Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or relevant and appropriate requirements.
CFR - Code of Federal Regulations.
USC - United States Code.
TBC - To be considered criterion, not an ARAR

TABLE B-2b

VIRGINIA LOCATION-SPECIFIC ARARS
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 1 of 2)

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Virginia State Water Control Laws and Virginia Wetlands Regulations*					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands.	Wetland as defined by Virginia statutory provision.	Virginia Code Sections 62.1-44.15:5	Not applicable.	No federal or state regulated wetlands are present on and adjacent to the site which could be impacted by the response action for the site.
Chesapeake Bay Preservation Act and Chesapeake Bay Preservation Area Designation and Management Regulations*					
Chesapeake Bay areas	Under these requirements, certain locally designated tidal and nontidal wetlands, as well as other sensitive land areas, may be subject to limitations regarding land-disturbing activities, removal of vegetation, use of impervious cover, erosion and sediment control, stormwater management, and other aspects of land use that may have effects on water quality.	Federally owned area designated as a Chesapeake Bay Preservation area.	Code of Virginia Section 10.1-2100 et seq. and 9 VAC 10-20-10	TBC	This requirement is not an ARAR since the area affected by the response action is not a federally owned Chesapeake Bay Preservation area. Also, City of Norfolk does not have jurisdiction over the Naval Base, Compliance is on a voluntary basis.
Coastal Zone Management Act*; Coastal Management Plan, City of Norfolk, NOAA Regulations on Federal Consistency with approved State Coastal Zone Management Programs					
Within coastal zone	Conduct activities within a coastal Management Zone in a manner consistent with local requirements.	Activities affecting the coastal zone including lands thereunder and adjacent shore land.	Section 307(c) of 16 USC 1456(c); also see 15 CFR 930 and 923.45	TBC	This requirement is not an ARAR since the City of Norfolk does not have jurisdiction Over the Naval Base. Compliance is on a voluntary basis.

TABLE B-2b

VIRGINIA LOCATION-SPECIFIC ARARs
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 2 of 2)

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Virginia Endangered Species Act*					
Critical habitat upon which endangered species or threatened species depend	Action to conserve endangered species or threatened species, including consultation with the Virginia Board of Game and Inland Fisheries.	Determination of effect upon endangered or threatened species or its habitat.	Code of Virginia Sections 29.1-563 through 568 4 VAC 15-20-130	Applicable because peregrine falcons have been seen near the site.	Virginia Board of Game and Inland Fisheries will be notified of this project, The Navy will request determination if proposed activities will threaten endangered species or habitats.
Virginia Natural Areas Preserves Act*					
Natural preserves area	Action to conserve natural preserve areas and restrict certain activities in these areas	Applicable to sites that meet natural preserve area criteria as determined by the Virginia Department of Conservation and Recreation	Code of Virginia Sections 10.1-209 through 217	Relevant and Appropriate	Virginia Department of Conservation and Recreation will be notified of this project. The Navy will request a determination if proposed activities will threaten natural heritage resources.
Virginia Endangered Plant and Insect Species Act; Virginia Board of Game and Inland Fisheries*					
Endangered plant and insect species	Action to conserve endangered or protected plant and insect species	Applies to actions that affect endangered or protected plant and insect species.	Code of Virginia Sections 29.1-100 and 29.1-565 2 VAC 5-320-10	Relevant and Appropriate	Virginia Department of Agriculture and Consumer Services will be notified of this project. The Navy requests determination if proposed activities will affect endangered plants or insects.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statues or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or relevant and appropriate requirements.

TABLE B-2c

VIRGINIA ACTION-SPECIFIC ARARS
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 1 of 2)

Action	Requirement	Prerequisites	Citation	ARAR Determination** A	RA	TBC	Comments
Virginia Air Pollution Control Regulations*							
Discharge to air	Virginia Ambient Air Quality Standards - standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare.	VR 120-03-02, VR-120-030-06 & 9 VAC 5-30-10			X	Applicable for all site remediation Activities that may generate air discharges.
Discharge of visible emissions and fugitive dust	Fugitive dust/emissions may not be discharged to the atmosphere at amounts in excess of standards.	Any source of fugitive dust/ emissions.	VR 120-05-01 & VAC 5-50-60 to 120	X			Applicable for any site remediation activities that generate fugitive dust.
Discharge of toxic pollutants	Toxic pollutants may not be discharged to the atmosphere at amounts in excess of standards.	Any emission from the disturbance of soil, or treatment of soil or water, that do not qualify for the exemption under Rule 4-3.	VR 120-05-01& VAC 5-50-160 to 230		X		Applicable for any site remediation activities that generate toxic air pollutants.
Virginia Stormwater Management Regulations and Virginia Erosion and Sediment Control Regulations							
Stormwater Management	Regulates stormwater management and erosion/sedimentation control practice.	Land disturbing activities	VR 215-02-00 & VR 625-02-00 & 4 VAC 50-30-10		X		Applicable for any site remediation activities involving surface water runoff and erosion.
Virginia Solid Waste Regulations							
Closure of Construction/ Demolition Debris Landfills and Industrial Waste Landfills	Closure and post-closure care requirements for construction/demolition debris and for industrial waste landfills.	Landfill used to dispose construction/demolition debris and/or landfills industrial waste	VR 672-20-10, Section 5.2; 9 VAC 20-80-260; VR 672-20-10, Section 5.3; 9 VAC 20-80-270		X		Industrial waste landfill requirements of 9 VAC 20-80-270 are applicable for the entire landfill.

TABLE B-2c
VIRGINIA ACTION-SPECIFIC ARARS
CD LANDFILL SITE - OU 2 SOIL AND GROUNDWATER
NAVAL BASE, NORFOLK, VIRGINIA
(Sheet 2 of 2)

Action	Requirement	Prerequisites	Citation	ARAR Determination** A	RA	TBC	Comments
Virginia Pollutant Discharge Elimination System (VPDES)) Permit Regulations*							
Discharge of Treated Water to Surface Waters, and certain storm water discharges	Regulated point-source discharges through VPDES permitting program. Permit requirements include compliance with corresponding water quality standards, establishment of a discharge monitoring system, and completion of regular discharge monitoring records.	Applicable to discharge of treated water to surface water, and to storm water discharges from certain facilities, including landfills.	VR 680-14-01, VR 680-15-01; 9 VAC 25-31-10 to 940	X			Substantive requirements of VPDES permit will be used to determine the discharge limits for the discharge of the treated water to surface water on site.
Virginia Solid Waste Management Regulations, Regulations Applicable to Generators and Transporters of Hazardous Waste; and Regulations Governing the Transportation of Hazardous Materials							
Hazardous Materials Preparation and Transportation	Hazardous materials must be packaged, marked, labeled, placarded, loaded, and transported in the manner required.	Intrastate carriers transporting hazardous waste and substances by motor vehicle.	VR 672-10-01 Parts VI and VII, 9 VAC 20-60-420 to 500; VR 672-30-1, 9 VAC 20-110-10 to 130, 9 VAC 20-60-330 to 410, and 9VAC 20-60-600	X			Applicable to the generation, storage, preparation and off-site transportation of materials classified as hazardous.
Solid Waste Management Regulations, Solid Waste Disposal Facility Standards (9 VAC 20-80-240 to 310 and 9 VAC 20-80-60); Virginia Waste Management Act*							
Solid Waste Staging Transport, and Disposal	These regulations and laws define the requirements for the staging, transportation, and disposal of solid wastes. The disposal facility must be properly permitted and in compliance with all operational and monitoring requirements of the permit and regulations.	Wastes must meet definition of solid waste.	VR 672-20-10, Part V; 9 VAC 20-80-240 to 310 (disposal facility); 9 VAC 20-80-60 (staging of solid wastes)	X			Applicable to staging, transportation, and off-site disposal of any soil, debris, sludge, or other material classified as a solid waste.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific potential ARARs are addressed in the table below each general heading.
** A - Applicable, RA - Relevant and appropriate, TBC - To be considered
ARAR - Applicable or relevant and appropriate requirement.
CFR - Code of Federal Regulations USC - United States Code.

APPENDIX C
RI SAMPLING RESULTS

TABLE C-1

SURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

	Detection Range/Frequency		Comparison to Criteria		COPC Selection
Parameter	Range of Positive Detections (mg/kg)	No. of Positive Detects/ No. of Samples	USEPA Region III Residential COPC Screening Value (mg/kg)	No. of Positive Detects Above Residential COPC Screening Value	Selected as a COPC?
Volatile Organic Compounds:					
Tetrachloroethene	0.002J	1/6	12	0	No
Semivolatile Organic Compounds:					
Phenanthrene	0.052J - 0.092J	4/6	310 (2)	0	No
Fluoranthene	0.034J - 0.170J	5/6	310	0	No
Pyrene	0.042J - 0.160J	5/6	230	0	No
Benzo(a)anthracene	0.046J - 0.094J	3/6	0.88	0	No
Chrysene	0.031J - 0.150J	5/6	88	0	No
Bis(2-ethylhexyl)phthalate	0.038J - 10	3/6	46	0	No
Benzo(b)fluoranthene	0.028J - 0.210J	5/6	0.88	0	No
Benzo(k)fluoranthene	0.028J - 0.081J	4/6	8.8	0	No
Benzo(a)pyrene	0.019J - 0.093J	5/6	0.088	1	Yes
Indeno(1,2,3-cd)pyrene	0.039J - 0.048J	2/6	0.88	0	No
Dibenzo(a,h)anthracene	0.017J	1/6	0.088	0	No
Benzo(g,h,i)perylene	0.023J - 0.061J	3/6	310 (2)	0	No

TABLE C-1 (Continued)

SURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

Parameter	Detection Range/Frequency: Range of Positive Detections (mg/kg)	Detection Range/Frequency: No. of Positive Detects/ No. of Samples	Comparison to Criteria: USEPA Region III Residential COPC Screening Value (mg/kg)	Comparison to Criteria: No. of Positive Detects Above Residential COPC Screening Value	COPC Selection: Selected as a COPC?
Pesticides/PCBs:					
Aldrin	0.00051J - 0.00052J	2/6	0.038	0	No
Dieldrin	0.0024J - 0.051J	3/6	0.04	1	Yes
4,4'-DDD	0.0007J - 0.0007J	1/6	2.7	0	No
Endosulfan II	0.00095J	1/6	47 (3)	0	No
4,4'-DDE	0.001J - 0.0031J	3/6	1.9	0	No
4,4'-DDT	0.0025J - 0.0078L	3/6	1.9	0	No
Endrin Aldehyde	0.00029J	1/6	2.3 (4)	0	No
alpha-Chlordane	0.0003J - 0.0005J	2/6	0.49 (5)	0	No
gamma-chlordane	0.000097J	1/6	0.49 (5)	0	No
Aroclor-1260	0.012J - 0.027J	2/6	0.083	0	No
Inorganics and Cyanide:					
Aluminum	1,690J - 11,100	20/20	7800	1	Yes
Antimony	0.73J - 2.5J	2/20	3.1	0	No
Arsenic (6)	2.6 - 34.9	20/20	0.37	20	Yes
Barium	16.8B - 106	20/20	550	0	No
Beryllium	0.22B - 0.79B	13/20	0.15	13	Yes

TABLE C-1 (Continued)

SURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

Parameter	Detection Range/Frequency: Range of Positive Detections (mg/kg)	Detection Range/Frequency: No. of Positive Detects/ No. of Samples	Comparison to Criteria: USEPA Region III Residential COPC Screening Value (mg/kg)	Comparison to Criteria: No. of Positive Detects Above Residential COPC Screening Value	COPC Selection: Selected as a COPC?
Inorganics and Cyanide (Continued):					
Cadmium	0.33B - 2.3	7/20	3.9	0	No
Calcium	2,600J - 155,000J	20/20	--	--	No
Chromium (7)	7.8 - 31.8	20/20	39	0	No
Cobalt	1.3B - 6B	18/20	470	0	No
Copper	4.6 - 208	20/20	290	0	No
Iron	5,010 - 18,700	20/20	--	--	No
Lead	9 - 1,040L	20/20	400 (8)	1	Yes
Magnesium	455 - 33,600	20/20	--	--	No
Manganese	26.7J - 264J	20/20	39	18	Yes
Mercury	0.09 - 0.56	8/20	2.3	0	No
Nickel	3.3B - 40.7	20/20	160	0	No
Potassium	375 - 1,610	20/20	--	--	No
Selenium	0.28 - 0.64	9/20	39	0	No
Silver	0.69B	1/20	39	0	No
Sodium	83.3B - 1,730	20/20	--	--	No

TABLE C-1 (Continued)

SURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

Parameter	Detection Range/Frequency: Range of Positive Detections (mg/kg)	Detection Range/Frequency: No. of Positive Detects/ No. of Samples	Comparison to Criteria: USEPA Region III Residential COPC Screening Value (mg/kg)	Comparison to Criteria: No. of Positive Detects Above Residential COPC Screening Value	COPC Selection: Selected as a COPC?
Inorganics and Cyanide (Continued):					
Thallium	0.23 - 0.54	13/20	0.63 (9)	0	No
Vanadium	12.2 - 78	20/20	55	2	Yes
Zinc	12.3 - 982	20/20	2,300	0	No
Cyanide (total)	0.98L	1/16	160	0	No

Notes:

(1) Surface soils include soil samples collected from the 0 - 0.25 foot depth interval during Rounds 1, 2 and 3 of the Remedial Investigation.
(2) COPC screening value for naphthalene used as a surrogate.
(3) COPC screening value for endosulfan used as a surrogate.
(4) COPC screening value for endrin used as a surrogate.
(5) COPC screening value for chlordane used as a surrogate.
(6) Arsenic evaluated as a carcinogen.
(7) Chromium evaluated as chromium (VI).
(8) Action level for residential soils (USEPA, 1994c)
(9) COPC screening value for thallium carbonate, thallium chloride and thallium sulfate.
J Analyte was positively identified, value is estimated.
B Analyte was detected in a blank, inorganic value is estimated.
-- No criteria published

TABLE C-2

SUBSURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

	Detection Range/Frequency		Comparison to Criteria		COPC Selection
Parameter	Range of Positive Detections (mg/kg)	No. of Positive Detects/ No. of Samples	USEPA Region III Residential COPC Screening Value (mg/kg)	No. of Positive Detects Above Residential COPC Screening Value	Selected as a COPC?
Volatile Organic Compounds:					
Acetone	0.015 - 0.033	3/6	780	0	No
Carbon disulfide	0.009J	1/6	780	0	No
2-Butanone	0.002J - 0.006J	4/6	4,700	0	No
Xylenes, Total	0.008J	1/6	16,000	0	No
Semivolatile Organic Compounds:					
Phenol	0.018J - 0.034J	2/6	4,700	0	No
2-Methylphenol	0.040J	1/6	390	0	No
Naphthalene	0.042J - 0.310J	3/6	310	0	No
2-Methylnaphthalene	0.068J - 0.170J	2/6	310 (2)	0	No
Acenaphthene	0.040J	1/6	470	0	No
Dibenzofuran	0.049J	1/6	31	0	No
Fluorene	0.040J - 0.053J	2/6	310	0	No
Phenanthrene	0.038J - 0.300J	4/6	310 (2)	0	No
Anthracene	0.042J - 0.075J	2/6	2300	0	No

TABLE C-2 (Continued)

SUBSURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

	Detection Range/Frequency		Comparison to Criteria		COPC Selection
Parameter	Range of Positive Detections (mg/kg)	No. of Positive Detects/ No. of Samples	USEPA Region III Residential COPC Screening Value (mg/kg)	No. of Positive Detects Above Residential COPC Screening Value	Selected as a COPC?
Semivolatile Organic Compounds (Continued):					
Di-n-butylphthalate	0.044J	1/6	780	0	No
Fluoranthene	0.084J - 0.360J	4/6	310	0	No
Pyrene	0.064J - 0.300J	4/6	230	0	No
Benzo(a)anthracene	0.086J - 0.180J	2/6	0.88	0	No
Chrysene	0.048J - 0.190J	4/6	88	0	No
Bis(2-ethythexyl)phthalate	0.052J - 0.089J	3/6	46	0	No
Benzo(b)fluoranthene	0.053J - 0.170J	3/6	0.88	0	No
Benzo(k)fluoranthene	0.020J - 0.130J	3/6	8.8	0	No
Benzo(a)pyrene	0.035J - 0.160J	3/6	0.088	1	Yes
Indeno(1,2,3-cd)pyrene	0.023J - 0.056J	3/6	0.88	0	No
Benzo(g,h,i)perylene	0.023J - 0.048J	3/6	310 (2)	0	No
Pesticides/PCBs:					
Heptachlor	0.00052J	1/6	0.14	0	No
Dieldrin	0.0012J - 0.0056J	4/6	0.04	0	No
4,4'-DDD	0.0027 - 0.021J	4/6	2.7	0	No

TABLE C-2 (Continued)

SUBSURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

Parameter	Detection Range/Frequency: Range of Positive Detections (mg/kg)	Detection Range/Frequency: No. of Positive Detects/ No. of Samples	Comparison to Criteria: USEPA Region III Residential COPC Screening Value (mg/kg)	Comparison to Criteria: No. of Positive Detects Above Residential COPC Screening Value	COPC Selection: Selected as a COPC?
Pesticides/PCBs (Continued):					
Endrin	0.0048J	1/6	2.3	0	No
Endrin ketone	0.0078J	1/6	2.3 (3)	0	No
4,4'-DDE	0.0021J - 0.035J	4/6	1.9	0	No
4,4'-DDT	0.0013J - 0.010J	3/6	1.9	0	No
Methoxychlor	0.0012J - 0.039	2/6	39	0	No
alpha-Chlordane	0.0012J - 0.0035J	3/6	0.49 (4)	0	No
gamma-Chlordane	0.00075J - 0.0045L	4/6	0.49 (4)	0	No
Aroclor-1260	0.012J - 0.018J	2/6	0.083	0	No
Inorganics and Cyanide:					
Aluminum	1,660 - 41,000	17/17	7,800	7	Yes
Antimony	0.35J - 103L	4/17	3.1	3	Yes
Arsenic (5)	1.2 - 21.7J	17/17	0.37	17	Yes
Barium	6.1B - 688J	17/17	550	1	Yes
Beryllium	0.22B - 2.1B	9/17	0.15	9	Yes
Cadmium	1.3 - 50.4	6/17	3.9	3	Yes

TABLE C-2 (Continued)

SUBSURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

Parameter	Detection Range/Frequency: Range of Positive Detections (mg/kg)	Detection Range/Frequency: No. of Positive Detects/ No. of Samples	Comparison to Criteria: USEPA Region III Residential COPC Screening Value (mg/kg)	Comparison to Criteria: No. of Positive Detects Above Residential COPC Screening Value	COPC Selection: Selected as a COPC?
Inorganics and Cyanide (Continued):					
Calcium	168B - 108,000J	17/17	--	--	No
Chromium (6)	3.5 - 226	17/17	39	5	Yes
Cobalt	1.2B - 17.3	11/17	470	0	No
Copper	0.92 - 3,090	17/17	290	4	Yes
Iron	2,000J - 96,300J	17/17	--	--	No
Lead	2 - 3,220J	17/17	400 (7)	4	Yes
Magnesium	268J - 5,070	17/17	--	--	No
Manganese	7.2J - 1,850J	17/17	39	7	Yes
Mercury	0.12 - 0.92	6/17	2.3	0	No
Nickel	1.9 - 521	14/17	160	2	Yes
Potassium	204 - 1,760J	16/17	--	--	No
Selenium	0.27B - 0.68B	2/17	39	0	No
Silver	1.5 - 182	4/17	39	1	Yes
Sodium	45.3B - 4,340	17/17	--	--	No
Thallium	0.24 - 0.53	6/17	0.63 (8)	0	No

TABLE C-2 (Continued)

SUBSURFACE SOIL DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

Parameter	Detection Range/Frequency: Range of Positive Detections (mg/kg)	Detection Range/Frequency: No. of Positive Detects/ No. of Samples	Comparison to Criteria: USEPA Region III Residential COPC Screening Value (mg/kg)	Comparison to Criteria: No. of Positive Detects Above Residential COPC Screening Value	COPC Selection: Selected as a COPC?
Inorganics and Cyanide (Continued):					
Vanadium	5 - 349J	17/17	55	1	Yes
Zinc	2.7B - 6,220J	17/17	2,300	4	Yes
Cyanide (total)	1.1 - 1.4	2/12	160	0	No

Notes:

(1) Subsurface soils include soil samples collected from the 0.25 - 12 foot depth interval during Rounds 1, 2 and 3 of the Remedial Investigation.
(2) COPC screening value for naphthalene used as a surrogate.
(3) COPC screening value for endrin used as a surrogate.
(4) COPC screening value for chlordane used as a surrogate.
(5) Arsenic evaluated as a carcinogen.
(6) Chromium evaluated as chromium (VI).
(7) Action level for residential soils (USEPA, 1994c)
(8) COPC screening value for thallium carbonate, thallium chloride and thallium sulfate.
J Analyte was positively identified, value is estimated.
B Analyte was detected in a blank, inorganic value is estimated.
-- No criteria published

TABLE C-3

SHALLOW GROUNDWATER DATA AND COPC SELECTION SUMMARY
GROUNDWATER - ROUNDS 2 AND 3
CD LANDFILL SITE, NAVAL BASE
NORFOLK, VIRGINIA

	Groundwater Criteria			Contaminant Frequency/Range (3)		Comparison to Criteria			COPC Selection
	Federal MCL (Ig/L) (1)	Virginia PMCLs (Ig/L) (2)	USEPA Region III Tapwater COPC Screening Level (Ig/L)	No. of Positive Detects/No. of Samples	Concentration Range (3) (Ig/L)	No. of Detects Above MCL	No. of Detects Above Virginia PMCL	No. of Detects Above COPC Screening Value	Retained as a COPC?
Volatile Organic Compounds:									
Methylene Chloride	--	--	4.1	1/25	2J	--	--	0	No
Chloroform	100	--	0.15	2/25	3J-5J	0	--	2	Yes
Chlorobenzene	100	--	3.9	4/25	3J-2,000J	2	–	3	Yes
Semivolatile Organic Compounds:									
Phenol	--	--	2,200	3/25	2J-5J	--	--	0	No
2-Chlorophenol	600	--	18	2/25	10-16	0	--	0	No
1,3-Dichlorobenzene	600	--	54	2/25	4J-5J	0	--	0	No
1,4-Dichlorobenzene	75	75	0.44	2/25	9J-12	0	0	2	Yes
1,2-Dichlorobenzene	600	--	27	2/25	8J-10	0	--	0	No
4-Methylphenol	--	--	18	3/25	0.7J-2J	--	--	0	No
Naphthalene	--	--	150	5/25	1J-3J	--	--	0	No
2-Methylnaphthalene	--	--	150 (4)	5/25	0.5J-1J	--	--	0	No
Acenaphthene	--	--	220	4/25	1J-6J	--	--	0	No
Dibenzofuran	--	--	15	2/25	1J-1J	--	--	0	No
Diethyl phthalate	--	--	2,900	7/25	0.5J-6J	--	--	0	No

TABLE C-3 (Continued)

SHALLOW GROUNDWATER DATA AND COPC SELECTION SUMMARY
GROUNDWATER - ROUNDS 2 AND 3
CD LANDFILL SITE, NAVAL BASE
NORFOLK, VIRGINIA

	Groundwater Criteria			Contaminant Frequency/Range (3)		Comparison to Criteria			COPC Selection
Contaminant	Federal MCL (Ig/L) (1)	Virginia PMCLs (Ig/L) (2)	USEPA Region III Tapwater COPC Screening Level (Ig/L)	No. of Positive Detects/No. of Samples	Concentration Range (3) (Ig/L)	No. of Detects Above MCL	No. of Detects Above Virginia PMCL	No. of Detects Above COPC Screening Value	Retained as a COPC?
Semivolatile Organic Compounds: (Continued)									
Fluorene	--	--	150	4/25	0.6J-1J	--	--	0	No
N-Nitrosodiphenylamine	--	--	1.4	1/25	1J	--	--	0	No
Phenanthrene	--	--	150 (4)	6/25	0.5J-2J	--	--	0	No
Anthracene	--	--	1,100	2/25	0.6J-1J	--	--	0	No
Carbazole	--	--	3.4	4/25	0.5J-1J	--	--	0	No
Di-n-butyl phthalate	--	--	370	7/25	0.5J-2J	--	--	0	No
Fluoranthene	--	--	150	5/25	0.5J-2J	--	--	0	No
Pyrene	--	--	110	3/25	0.5L-2J	--	--	0	No
Butyl benzyl phthalate	--	--	730	1/25	0.6J	--	--	0	No
Bis(2-ethylhexyl)phthalate	6	--	4.8	14/25	1.5J-9J	--	--	1	Yes

TABLE C-3 (Continued)

SHALLOW GROUNDWATER DATA AND COPC SELECTION SUMMARY
GROUNDWATER - ROUNDS 2 AND 3
CD LANDFILL SITE, NAVAL BASE
NORFOLK, VIRGINIA

	Groundwater Criteria			Contaminant Frequency/Range (3)		Comparison to Criteria			COPC Selection
Contaminant	Federal MCL (Ig/L) (1)	Virginia PMCLs (Ig/L) (2)	USEPA Region III Tapwater COPC Screening Level (Ig/L)	No. of Positive Detects/No. of Samples	Concentration Range (3) (Ig/L)	No. of Detects Above MCL	No. of Detects Above Virginia PMCL	No. of Detects Above COPC Screening Value	Retained as a COPC?
Pesticides/PCBs:									
beta-BHC	--	--	0.037	1/23	0.034J	--	--	0	No
Heptachlor epoxide	0.2	--	0.0012	1/23	0.032J	0	--	1	Yes
Dieldrin	--	--	0.0042	6/23	0.006J-0.04J	--	--	6	Yes
4,4-DDD	--	--	0.28	3/23	0.015J-0.02J	--	--	0	No
4,4DDT	--	--	0.2	2/23	0.016J-0.02J	--	--	0	No
Endrin aldehyde	--	--	1.1 (1)	1/23	0.017J	--	--	0	No
gamma-Chlordane	--	--	0.052 (6)	1/23	0.0051	--	--	0	No
Aroclor-1260	--	--	0.0087	1/23	0.12J	--	--	1	Yes
Unfiltered Inorganics:									
Aluminum	--	--	3,700	25/25	83.6B-208,000	--	--	21	Yes
Antimony	6	--	1.5	7/17	1.2J-33.6	6	--	6	Yes
Arsenic	50	50	0.038	22/25	2.8L-65.6	2	2	22	Yes
Barium	2000	1,000	260	25/25	34.4-1,940	0	1	5	Yes
Beryllium	4	--	0.016	7/25	1.1B-6.4B	2	--	7	Yes
Cadmium	5	10	1.8	8/25	4.7-21.8B	7	3	8	Yes
Calcium+	--	--	--	25/25	34,500-335,000	--	--	--	No
Chromium (7)	100	50	18	21/25	7.5B-309	7	12	18	Yes
Cobalt	--	--	220	17/25	6.7-55.6	--	--	0	No
Copper	1,300 (8)	--	140	25/25	2.9B-534	0	--	3	Yes
Iron+	--	--	--	25/25	1,240-177,000	--	--	--	No
Lead	15 (8)	50	--	24/25	1.2B-864J	16	9	--	Yes
Magnesium+	--	--	--	25/25	5,540-77,900	--	--	--	No
Manganese	--	--	18	25/25	158-6,560	--	--	25	Yes
Mercury	2	2	1.1	6/25	0.26-1.1	0	0	0	No

TABLE C-3 (Continued)

SHALLOW GROUNDWATER DATA AND COPC SELECTION SUMMARY
GROUNDWATER - ROUNDS 2 AND 3
CD LANDFILL SITE, NAVAL BASE
NORFOLK, VIRGINIA

Groundwater Criteria				Contaminant Frequency/Range (3)		Comparison to Criteria			COPC Selection
Contaminant	Federal MCL (Ig/L) (1)	Virginia PMCLs (Ig/L) (2)	USEPA Region III Tapwater COPC Screening Level (Ig/L)	No. of Positive Detects/No. of Samples	Concentration Range (3) (Ig/L)	No. of Detects Above MCL	No. of Detects Above Virginia PMCL	No. of Detects Above COPC Screening Value	Retained as a COPC?
Unfiltered Inorganics: (Continued)									
Nickel	100	--	73	19/25	10.2B-138	2	--	5	Yes
Potassium+	--	--	--	25/25	2,530-56,300	--	--	--	No
Selenium	50	10	18	2/12	2.6B-5.6	0	0	0	No
Silver	--	50	18	2/25	2.9B-8.6B	--	0	0	No
Sodium+	--	--	--	25/25	11,600-539,000	--	--	--	No
Thallium	2	--	0.29 (9)	1/25	1.1B	0	--	1	Yes
Vanadium	--	--	26	24/25	5.9-504	--	--	17	Yes
Zinc	--	--	1,100	25/25	8-3,780	--	--	3	Yes
Filtered Inorganics:									
Aluminum	--	--	3,700	14/25	16-144B	--	--	0	No
Antimony	6	--	1.5	5/25	4.9B-18.8B	3	--	5	Yes
Arsenic	50	50	0.038	13/25	2.5B-41.8	0	0	13	Yes
Barium	2000	1,000	260	25/25	26.6-835	0	0	1	Yes
Calcium+	--	--	--	25/25	33,000-352,000	--	--	-	No
Chromium	100	50	18	2/25	69.6-106	1	2	2	Yes
Cobalt	--	--	220	10/25	3.5B-31	--	--	0	No
Copper	1,300	--	140	14/25	2B-17.7B	0	--	0	No
Iron+	--	--	--	24/25	75.4B-28,800	–	--	--	No
Lead	15	50	--	1/25	2.3B	0	0	--	No
Magnesium+	--	--	--	25/25	5,170-60,000	--	--	--	No
Manganese	--	--	--	25/25	106-5,790	--	--	25	Yes
Nickel	100	--	73	10/25	5B-52.9	0	--	0	No
Potassium+	--	--	--	25/25	2,020-54,500J	--	--	--	No
Selenium	50	10	18	2/25	5.6-6.3	0	0	0	No

TABLE C-3 (Continued)

SHALLOW GROUNDWATER DATA AND COPC SELECTION SUMMARY
GROUNDWATER - ROUNDS 2 AND 3
CD LANDFILL SITE, NAVAL BASE
NORFOLK, VIRGINIA

	Groundwater Criteria			Contaminant Frequency/Range (3)		Comparison to Criteria			COPC Selection
Contaminant	Federal MCL (Ig/L) (1)	Virginia PMCLs (Ig/L) (2)	USEPA Region III Tapwater COPC Screening Level (Ig/L)	No. of Positive Detects/No. of Samples	Concentration Range (3) (Ig/L)	No. of Detects Above MCL	No. of Detects Above Virginia PMCL	Detects Above COPC Screening Value	Retained as a COPC?
Filtered Inorganics: (Continued)									
Silver	--	50	18	1/25	2.3B	--	0	0	No
Sodium+	--	--	--	25/25	11,000-775,000	--	--	–	No
Thallium	2	--	0.29 (9)	1/25	1.5K	0	--	1	Yes
Vanadium	--	--	26	3/25	1.2B-7.5B	--	0	--	No
Zinc	--	--	1,100	18/25	4.1B-577	--	--	0	No

Notes:

(1) Federal MCL - Federal Safe Drinking Water Act Maximum Contaminant Level (USEPA, 1994a)
(2) Virginia Primary Maximum Contaminant Levels (Bureau of National Affairs - December, 1993)
(3) B (organics) = Not detected substantially above the level reported in laboratory or field blanks.
B (inorganics) = Less than CRDL but greater than or equal to the IDL.
J = Analyte was positively identified, value is estimated.
L = Value estimated; biased low.
K = Value estimated; biased high.
(4) COPC screening value for naphthalene used as a surrogate.
(5) COPC screening value for endrin used as a surrogate.
(6) COPC screening value for chlordane used as a surrogate.
(7) Chromium was evaluated as chromium (VI).
(8) Action level.
(9) COPC screening value for thallium carbonate, thallium chloride and thallium sulfate.

-- = No criteria published
+ = Essential Nutrient

TABLE C-4

DEEP GROUNDWATER DATA AND COPC SELECTION SUMMARY
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

	Detection Range/Frequency		Groundwater Criteria (2)			Comparison to Criteria			COPC Selection
Unfiltered Inorganics:	Concentration Range (Ig/L)	No. of Positive Detects/ No. of Samples	Federal MCL (Ig/L)	USEPA Region III Tapwater COPC Value (Ig/L)	Virginia PMCLs (Ig/L)	No. of Detects Above MCL	No. of Detects Above COPC Value	No. of Detects Above Virginia Criteria	Retained as a COPC ?
Aluminum	543B	1/1	50 - 200 (3)	3,700	--	1	0	--	No
Barium	41J	1/1	2.000	260	1,000	0	0	0	No
Calcium	182,000	1/1	--	--	--	--	--	--	No
Copper	2.2B	1/1	1,300 (4)	140	1,000 (3)	0	0	0	No
Iron	4,630	1/1	300 (3)	--	300(3)	1	--	1	No
Lead	1.4B	1/1	15 (4)	--	50	0	--	0	No
Magnesium	5,200	1/1	--	--	--	--	--	--	No
Manganese	156	1/1	50 (3)	18	50 (3)	1	1	1	Yes
Potassium	1,620J	1/1	--	--	--	--	--	--	No
Sodium	28,900	1/1	--	--	--	--	--	--	No
Vanadium	5.9	1/1	--	26	--	--	0	--	No
Zinc	11.413	1/1	5,0000 (3)	1,100	5,000 (3)	0	0	0	No

TABLE C4 (Continued)

DEEP GROUNDWATER DATA AND COPC SELECTION SUMMARY (1)
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

	Detection Range/Frequency		Groundwater Criteria (2)			Comparison to Criteria			COPC Selection
Parameter	Concentration Range (Ig/L)	No. of Positive Detects/ No. of Samples	Federal MCL (Ig/L)	USEPA Region III Tapwater COPC Value (Ig/L)	Virginia PMCLs (Ig/L)g/L)	No. of Detects Above MCL	No. of Detects Above COPC Value	No. of Detects Above Virginia Criteria	Retained as a COPC?
Dissolved Inorganics:									
Barium	33.7	1/1	2000	260	1,000	0	0	0	No
Calcium	171,000	1/1	--	--	--	--	--	--	No
Iron	734	1/1	--	--	--	--	--	--	No
Magnesium	5,260J	1/1	--	--	--	--	--	–	No
Manganese	138	1/1	50 (3)	--	50 (3)	1	1	1	Yes
Potassium	1,630J	1/1	--	--	--	--	--	--	No
Sodium	29,200	1/1	--	--	--	--	--	--	No

Notes:

(1) Data and COPC Summary is for groundwater samples collected during Round 2 of the Remedial Investigation.
(2) Federal MCL - Federal Safe Drinking Water Act Maximum Contaminant Level (USEPA, 1994a; Drinking Water Regulations and Health Advisories)
Virginia Drinking Water Standards - PMCLs - Primary Maximum Contaminant Levels (Bureau of National Affairs - December, 1994)
COPC values - USEPA Region III COPC screening value (USEPA, 1993a)
(3) Secondary MCL.
(4) Action level
B Analyte was also detected in an associated blank.
J Analyte was positively identified, value is estimated.
-- No criteria published

TABLE C-5

SURFACE WATER DATA AND COPC SELECTION SUMMARY
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

Parameter	Detection Range/Frequency: Concentration Range (Ig/L)	Detection Range/Frequency: No. of Positive Detects/ No. of Samples	Federal AWQCs (2): Water and Organisms (Ig/L)	Federal AWQCs (2): Organisms Only (Ig/L)	Commonwealth of Virginia WQSs: Public Water Supplies (Ig/L)	Commonwealth of Virginia WQSs: All Other Surface Waters (Ig/L)	No. Of Detected Concentrations Exceeding Selection Criterion: Federal AWQC Water and Organisms	Federal AWQC Organisms Only	Virginia Public Water Supplies	Virginia All Other Surface Waters	COPC Selection: Retained as a COPC?
Semivolatile Organic Compounds:											
1,4-Dichlorobenzene	0.7J - 1J	2/7	400 (2)	2,600 (2)	400	2,600	0	0	0	0	No
1,2-Dichlorobenzene	2J - 2J	2/7	2,700 (3)	17,000 (3)	2,700	17,000	0	0	0	0	No
4-Methylphenol	0.8J	1/7	--	--	--	--	NA	NA	NA	NA	No
Pesticides:											
Dieldrin	0.013J - 0.035J	4/7	0.00014 (3)	0.00014 (3)	0.0014	0.0014	4	4	4	4	Yes
4,4-DDD	0.01J - 0.016J	3/7	0.00083 (3)	0.00084 (3)	--	--	3	3	NA	NA	Yes
Inorganics and Cyanide:											
Aluminum	345J - 176,000J	7/7	--	--	--	--	NA	NA	NA	NA	No
Antimony	22.5	1/7	14 (3)	4,300 (l)	--	--	1	0	NA	NA	Yes
Arsenic	4.7-40.1	6/7	0.018 (3)	0.14 (3)	50	--	6	6	0	NA	Yes
Barium	50.8-1,420	7/7	1,000 (4)	--	2,000	--	1	NA	0	NA	Yes
Beryllium	4.9B - 9.1B	2/7	0.0076 (5)	0.131 (5)	--	--	2	2	NA	NA	Yes
Calcium	76,200 - 197,000	7/7	--	--	--	--	NA	NA	NA	NA	No
Chromium	10.9 - 299	4/7	170 (5)	3,400 (5)	170	3,400	2	0	2	0	Yes
Cobalt	9.4 - 128	3/7	--	--	--	--	NA	NA	NA	NA	No
Copper	3 - 425	7/7	1,300 (5)	--	--	--	0	NA	NA	NA	No
Iron	2,100K - 1,470,000K	7/7	300 (4)	--	300 (7)	--	7	NA	7	NA	No
Lead	7.5 - 712	6/7	50 (4)	--	15	--	2	NA	3	NA	Yes
Magnesium	9,170 - 324,000	7/7	--	--	--	--	NA	NA	NA	NA	No
Manganese	136 - 6,760	7/7	50 (4)	100 (4)	50 (7)	--	7	7	7	NA	Yes
Mercury	0.51 - 0.74	2/7	0.14 (2)	0.15 (2)	0.144	0.146	2	2	2	2	Yes
Nickel	9.2 - 253	5/7	610 (3)	4,600 (3)	607	4,583	0	0	0	0	No
Potassium	4,540J - 129,000J	7/7	--	--	--	--	NA	NA	NA	NA	No
Silver	5.2 - 7.2	3/7	91 (5)	--	--	--	0	NA	NA	NA	No
Sodium	12,100 - 3,150,000	7/7	--	--	--	--	NA	NA	NA	NA	No

TABLE C-5

SURFACE WATER DATA AND COPC SELECTION SUMMARY
CD LANDFILL
NAVAL BASE, NORFOLK, VIRGINIA

Inorganics and Cyanide (continued):

Thallium	1.9 - 5L	3/7	1.7 (3)	6.3 (3)	--	--	3	0	NA	NA	Yes
Vanadium	6-1,180	6/7	--	--	--	--	NA	NA	NA	NA	No
Zinc	15.813 - 2,640	7/7	--	--	5,000 (7)	--	NA	NA	0	NA	No
Cyanide, Total	5B - 25.1	2/7	700 (3)	220,000 (3)	700	215,000	0	0	0	0	No

Notes:
(1) All concentrations reported in Ig/L
(2) USEPA, 1992. Water Quality Standards: Establishment of Numeric Criteria for Priority Toxic Pollutants, States Compliance: Final Rule.
(3) USEPA, 1992. Water Quality Standards: Establishment of Numeric Criteria for Priority Toxic Pollutants, States Compliance: Final Rule. Criteria revised to reflect current agency q 1* or RfD, as con Integrated Risk Information System (MIS).
(4) USEPA, 1991. Water Quality Criteria Summary Published Criteria.
(5) USEPA, 1991. Water Quality Criteria Summary Recalculated values from IRIS (as of 9/90), based on a risk level of 1 x 10 1).
(6) Chromium evaluated as the hexavalent state.
(7) To maintain acceptable taste, odor or aesthetic quality of drinking water.
J = Analyte was positively identified, value is estimated.
B = Detected in associated blank(s).
L = Value is estimated; biased low.
K = Value is estimated, biased high.
-- = No criteria published.
NA = Not Applicable.