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SWMU 14: Q-50 Satellite Accumulation Area

Record of Decision

Naval Station Norfolk

Norfolk, Virginia

Prepared by
Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic
July 2010

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Concur and recommend for immediate implementation:

Captain Kelly M. Johnson
Commanding Officer
Naval Station Norfolk
By direction of the Commander
Navy Region Mid-Atlantic

7/26/10
Date

Ronald J. Borsellino, Director
Hazardous Site Cleanup Division
USEPA Region III

8/4/10
Date

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Abbreviations and Acronyms

µg/L	micrograms per liter
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
COPC	contaminants of potential concern
CSM	conceptual site model
CTE	central tendency exposure
DDT	dichlorodiphenyltrichloroethane
EE/CA	Engineering Evaluation/Cost Analysis
EPIC	Environmental Photographic Interpretation Center
ERA	Ecological Risk Assessment
FFS	Focused Feasibility Study
ft/day	feet per day
ft/ft	feet per foot
ft/yr	feet per year
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IDW	investigation-derived waste
IRP	Installation Restoration Program
LUC	land use control
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSN	Naval Station Norfolk
NTCRA	Non-Time-Critical Removal Action
O&M	operation and maintenance
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PP	Proposed Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act

RFA	RCRA Facility Assessment
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	Supplemental Investigation
SVOC	semivolatile organic compound
SWMU	solid waste management unit
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

SECTION 1

Declaration

1.1 Site Name and Location

Solid Waste Management Unit (SWMU) 14, Q-50 Satellite Accumulation Area
Naval Station Norfolk (NSN), Norfolk, Virginia
United States Environmental Protection Agency (USEPA)
Superfund Identification Number VA6170061463

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the Selected Remedy for SWMU 14, Q-50 Satellite Accumulation Area, NSN, Norfolk, Virginia. This determination has been made 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, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record file for the site. Information not specifically summarized in this ROD or its references, but contained in the Administrative Record, has been considered and is relevant to the selection of the remedy at SWMU 14. Thus, the ROD is based upon and relies upon the entire Administrative Record file in making the decision. As a result of the NPL listing and pursuant to CERCLA, the USEPA Region III, the Virginia Department of Environmental Quality (VDEQ), and the United States Department of the Navy (Navy) entered into a Federal Facilities Agreement (FFA) for NSN on April 1, 1997. The primary purpose of the FFA is to ensure that the environmental impacts associated with past and present activities at NSN are thoroughly investigated. The Installation Restoration Program (IRP) is responsible for ensuring that appropriate CERCLA response alternatives are developed and implemented as necessary to protect public health, welfare, and the environment. No enforcement activities have been recorded at SWMU 14.

The Navy is the lead agency and provides funding for site cleanups at NSN. The Navy and USEPA Region III issue this ROD jointly. The VDEQ, the supporting regulatory agency, concurs with the Selected Remedy.

1.3 Assessment of the Site

The response action selected in this ROD is necessary to protect public health, welfare, and/or the environment from actual or threatened releases of contaminants from SWMU 14, which may present an imminent and substantial endangerment to public health or welfare. As a result of a Non-Time-Critical Removal Action (NTCRA), exposure to surface and subsurface soil was reduced through the placement of a protective barrier, which also serves as a parking lot, to mitigate potential unacceptable risks posed by these media.

1.4 Description of the Selected Remedy

The Selected Remedy is land use controls (LUCs) to prevent human receptor exposure to contaminants remaining in place beneath the site. LUCs will be implemented to prohibit digging into or disturbance of the existing asphalt cover.

LUCs will be implemented on the entire asphalt cover and bioretention areas, which will encompass SWMU 14 and co-located Site 9. LUCs will be maintained until site conditions allow for unlimited exposure and unrestricted use. The Proposed Plan presenting the preferred alternative was completed in August 2009.

1.5 Statutory Determinations

In accordance with the NCP, the Selected Remedy meets the statutory determinations and is protective of human health and the environment, is cost-effective, and utilizes permanent solutions to the maximum extent practicable. Because this remedy will result in pollutants or contaminants remaining onsite in soil above levels that allow for unlimited use and unrestricted exposure, a statutory CERCLA Five-Year Review will be conducted within 5 years after the initiation of the remedial action to ensure that the remedy is protective of human health and the environment.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for NSN, SWMU 14.

- Current and reasonably anticipated future land use assumptions (Section 2.6)
- Risks related to the chemicals of concern (COCs) (Section 2.7)
- How source materials constituting principal threats will be addressed (Section 2.11)
- Estimated capital costs, annual operation and maintenance (O&M), and total present-worth costs, discount rate, and the number of years over which the remedy cost estimate is projected (Section 2.10 and Table 2-3)
- Key factors that led to selecting the remedy (Section 2.12)
- Potential land use that will be available at the site as a result of the Selected Remedy (Section 2.12)

If current or reasonably anticipated future land use is modified, additional evaluation would be required to ensure potential risks are mitigated or addressed as part of the change; the Navy will undertake all necessary actions to ensure continued protection of human health and the environment.

1.7 Authorizing Signatures

The Navy and USEPA selected this remedy with the concurrence of VDEQ.

Concur and recommend for immediate implementation:

Captain Kelly M. Johnson
Commanding Officer
Naval Station Norfolk
By direction of the Commander
Navy Region Mid-Atlantic

7/26/10
Date

Ronald J. Borsellino, Director
Hazardous Site Cleanup Division
USEPA Region III

8/4/10
Date

SECTION 2

Decision Summary

2.1 Site Name, Location, and Description

NSN encompasses 4,631 acres of land in the northwest corner of Norfolk, Virginia, adjacent to the Elizabeth River and Willoughby Bay near the mouth of the Chesapeake Bay (**Figure 2-1**). NSN operates in various capacities to provide support to vessels, aircraft, and other activities. NSN houses many tenants, each performing different operations involving the servicing and maintenance of vessels and aircraft. NSN is also used for recreational, commercial, and residential purposes. Land development surrounding the base is residential, commercial, and industrial.

SWMU 14 is located on the northwest corner of NSN adjacent to both Willoughby Bay and the Chesapeake Bay in an area referred to as Sewell's point. The peninsula at Sewell's Point is a manmade landmass formed from two distinct periods of fill activities. The first began in the 1950s, when the channels were dredged to allow for construction of the northernmost series of piers at the site. The resulting dredge material was used to create much of the land at Sewell's Point. The second was between 1974 and 1978, when the peninsula's eastern portion was formed from the disposal of construction debris.

SWMU 14 is composed of a former a satellite accumulation area and is co-located with Site 9 (Q-Area Landfill). The satellite accumulation area and the Q-Area landfill were initially identified in the Environmental Restoration Program as SWMU 14 and Site 9, respectively. Site 9 was recommended for No Further Action in 1997, and future investigation activities for both the landfill and the accumulation area were completed as a single site as SWMU 14. The boundary for SWMU 14 encompassed what had been previously defined as Site 9 for the investigations.

The satellite accumulation area initially consisted of a concrete storage pad surrounded by a grass-covered field that was periodically used as a temporary parking lot when adjacent lots were full (**Figure 2-2**). The original concrete pad served as a less-than-90-day hazardous waste accumulation area, where wastes from various waste streams were sampled, identified, labeled, and packaged before being shipped for disposal. The pad was later removed and replaced by a second pad, which was used for temporary storage of environmental investigation-derived waste (IDW) materials. Currently, the site is completely covered by a protective barrier which also serves as an asphalt parking lot. The protective barrier construction was implemented in 2008 by a NTCRA that was supported by and based upon an Engineering Evaluation/Cost Analysis (EE/CA) (CH2M HILL, 2008) (**Figure 2-3**). Following the 2008 NTCRA, the satellite accumulation area and a portion of the Q-Area landfill were converted to an asphalt parking lot (**Figure 2-2**).

2.2 Site History and Enforcement Activities

The SWMU was initially identified from a 1982 Environmental Photographic Interpretation Center (EPIC) aerial photograph and the site was cited during the 1992 RCRA Facility Assessment (RFA) site inspection, when areas of stained soil were observed. Site 9 (included in the evaluation of SWMU 14) was identified in the Initial Assessment Study (IAS) (ESE, 1983) where it was reportedly used for the disposal of nonhazardous construction debris. NSN initiated environmental investigation efforts at SMWU 14 and other sites by conducting two Relative Risk Rankings (RRRs) in 1995 and 1996 and a Supplemental Investigation (SI) report completed in 1999.

A four-phase Remedial Investigation (RI) with a Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) was conducted to further define the nature and extent of soil, groundwater, sediment, and surface water contamination and assess potential risks to human health and the environment. No enforcement activities have been recorded at SWMU 14.

2.2.1 Previous Investigations

A summary of the previous investigation efforts is provided below. **Figure 2-3** illustrates soil, sediment, surface water, and groundwater sample locations.

Phase I Relative Risk Ranking Study

The Phase I RRR was prepared to evaluate the presence of contamination and potential exposure pathways associated with SWMUs at NSN. Surface soil and groundwater samples were collected at SWMU 14 and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals (and cyanide) in 1995 during the Phase I RRR. Several VOCs, SVOCs, and metals were detected in each media at SWMU 14 above applicable screening and regulatory criteria, warranting further investigation.

Phase II Relative Risk Ranking Study

The Phase II RRR investigation began in 1996 to further delineate the areas of surface soil and groundwater contamination where the Phase I results indicated further investigation was warranted. The Phase II RRR included the collection of surface water, sediment, surface soil, and groundwater samples. All media were analyzed for VOCs, SVOCs, and metals. Soil and groundwater samples were also analyzed for pesticides and polychlorinated biphenyls (PCBs). Several VOCs, SVOCs, pesticides, PCBs, and metals were detected in one or more of the media at SWMU 14 above applicable screening and regulatory criteria. Therefore, an additional investigation was recommended to help determine the scope of a RI at SWMU 14 and other SWMUs.

Supplemental Investigation Report

A SI was performed in 1998 for SWMUs 9, 10, 12, 14, 16, 28, 32, 33, 34, 35, 38, 40, 41, and 42. The objectives were to determine the extent of contamination at each SWMU, to develop and evaluate economically feasible remedial alternatives for each SWMU, and to close out appropriate SWMUs. Groundwater, surface soil, and subsurface soil samples were collected from new locations at SWMU 14 and analyzed for VOCs, SVOCs, pesticides, PCBs, and

metals. The data showed several VOC, SVOC, PCB, or metal concentrations above applicable screening and regulatory criteria in soil and groundwater at SWMU 14. Therefore, a RI was initiated at SWMU 14.

Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment

Soil, sediment, surface water, and groundwater were sampled and analyzed for VOCs, SVOCs, metals, and pesticides/PCBs. VOCs, SVOCs, pesticides, and metals were detected in groundwater above screening criteria. Surface soil and subsurface soil sample concentrations exceeded the initial screening criteria used to evaluate the nature and extent of contamination in the RI for VOC, SVOCs, pesticides, PCBs, metals, and dioxins/furans. Sediment samples collected at the SWMU 14 lagoon indicated arsenic and iron concentrations above human health and ecological screening values. Exposure to surface soil via incidental ingestion, dermal contact, and inhalation of fugitive dust was evaluated in the HHRA. For subsurface soil, it was assumed these receptors would be exposed to soil through incidental ingestion, dermal contact, and inhalation of fugitive emissions from soil, the last of which was not evaluated for trespassers since they are assumed to spend minimal time at the site. For groundwater, risk estimates for exposure to shallow aquifer groundwater were calculated for the hypothetical future child and adult residents. Exposure to the shallow aquifer groundwater by a construction worker during excavation was also evaluated as a potential future exposure scenario. It was assumed that a residential user would ingest the water, have dermal contact while bathing (child only), and inhale volatile constituents while showering (adult only). Future construction workers were evaluated based on exposure via inhalation and the dermal contact.

USEPA conducted further analysis of the groundwater analytical data and determined that potentially unacceptable risk to a future resident consuming shallow groundwater is limited to arsenic. The basis for this determination is the sporadic nature of COCs in groundwater. Only arsenic was found to exist in a manner which would be considered relevant in a residential exposure scenario.

The HHRA concluded that there were potential unacceptable risks to the following receptors: the future site worker; future adult resident; future child resident; future lifetime resident; future construction worker; and future recreational child exposed to one or more media. Potential ecological risks associated with surface soil and sediment were considered to be negligible, based on current and reasonably anticipated land use, limited habitat, and the frequency and magnitude of screening value exceedances. Potential unacceptable risks to ecological receptors for contaminants in groundwater discharging to Willoughby Bay were identified. A summary of the HHRA and ERA for SWMU 14 is presented in Section 2.7.

Human Health Groundwater Evaluation Summary

An evaluation of the groundwater analytical results from the Remedial Investigation indicated exceedances of the screening criteria for VOCs, SVOCs, pesticides, and metals. However, a further evaluation of the groundwater by USEPA suggests that groundwater does not pose an unacceptable risk. Arsenic was the only contaminant found in an aerial extent large enough to be considered a plume. The arsenic data, which was collected prior to completion of the NTCRA exceeds the current MCL; however, is within an acceptable risk

range based upon USEPA's OSWER Directive 9355.0-30. Four groundwater wells at SWMU 14 exceed the current arsenic MCL of 10 micrograms per liter (µg/L): MW09S (13 µg/L), MW06S (14 µg/L), MW05S (14 µg/L), and MW07S (16 µg/L). The associated risk range for arsenic at 10 µg/L to 16 µg/L is 2.2E-04 to 3.6E-04. The wells with MCL exceedances located within the site were abandoned during the NTCRA and are no longer available for sampling. USEPA's OSWER Directive 9355.0-30 indicates the upper boundary of the risk range is not a discrete value at 1E-04; therefore, specific risk estimates around 1E-04 may be considered acceptable if justified based on site-specific conditions. As a result, based upon maximum concentrations of arsenic in groundwater and site specific conditions, the groundwater MCL exceedances are considered acceptable at SWMU 14.

Ecological Sampling Investigation Summary of Groundwater/Pore Water

A Trident Probe Study evaluated potential ecological concerns regarding the discharge of site groundwater to the surrounding surface water bodies as identified in the RI/HHRA/ERA. The results of the study indicated that there were no strong areas of groundwater discharge from SWMU 14 to the James River or Willoughby Bay and that there was significant attenuation by mixing with surface water in the weak discharge zones identified. The potential impact of possible chemical migration via groundwater from SWMU 14 to the James River and Willoughby Bay was considered negligible because pore water concentrations for site-related ecological risk drivers were less than detection limits, less than screening values, or were consistent with background. Based on this additional information, it was determined that there is no unacceptable ecological risk from groundwater discharging from beneath SWMU 14 to the surrounding water bodies.

Engineering Evaluation/Cost Analysis

Evaluated removal alternatives to address soils in SWMU 14 impacted by polycyclic aromatic hydrocarbons (PAHs), antimony, arsenic, iron, manganese, thallium, and vanadium from past landfilling and waste storage activities onsite based on a comparative analysis of effectiveness, implementability, and cost of each alternative. Based on the EE/CA findings, Alternative 3, the asphalt cover (parking lot), was recommended as the Preferred Alternative. Under Alternative 3, soil and groundwater that was found to potentially pose unacceptable risks to human receptors remained at the site, but were covered to prevent exposure. The EE/CA was made available for public review and comment and the NTCRA was implemented in 2008.

Non-Time-Critical Removal Action

In 2008, the NTCRA recommended in the EE/CA was implemented. Following site preparation activities, stormwater drainage and utility trenches were excavated, and clean backfill was placed to amend the grade as necessary. Subgrade stormwater drainage piping, bioretention areas, and electrical conduits were installed onsite and the area was then paved with asphalt for use as a parking lot. Soil and groundwater that was found to potentially pose unacceptable risks to human receptors remained at the site. **Figure 2-2** demonstrates the layout of the site with the completed parking lot. The new parking lot covers SWMU 14 and a section of co-located Site 9. While the asphalt cover prevents exposure to soil and groundwater, future construction workers could be exposed to impacted soil or groundwater during excavations or other intrusive activities. The Proposed Plan

recommended LUCs as a means of achieving the remedial action objective (RAO) to limit site use and prevent exposure to any unacceptable risks in soil and groundwater.

Focused Feasibility Study

Two remedial alternatives to address potential human health risks were identified and were considered—no action and LUCs. Based on the results of the 2004 RI/HHRA/ERA and the remedial actions, removal actions and asphalt cover conducted to date; no exposure pathways to contaminated site media exist as long as LUCs are implemented and enforced. The two alternatives were evaluated against National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria in preparation for the SWMU 14 Proposed Plan (PP).

Proposed Plan

In August 2009 the Proposed Plan presenting the preferred alternative, LUCs, was made available for the public to review and comment. A public meeting was held on August 26, 2009. Representatives from the Navy, USEPA, and VDEQ attended the meeting. No community members attended the meeting.

2.3 Community Participation

The Navy and USEPA provide information regarding the cleanup of NSN to the public through the community relations program, which includes a Restoration Advisory Board (RAB) that was formed in 1996, public meetings, the Administrative Record file for SWMU 14, the information repository, and announcements published in the local newspapers. During the course of investigations at SWMU 14, the RAB has been apprised of all environmental cleanup activities related to the site.

In accordance with Section 117(a) of CERCLA, the Navy provided a public comment period between August 5, 2009, and September 5, 2009, for the SWMU 14 Proposed Plan. A public meeting to present the PP was held on August 26, 2009, at the Larchmont Public Library. Public notice of the meeting and availability of documents was placed in The Virginian-Pilot newspaper on August 4, 2009.

The Proposed Plan was available during the public comment period at the Norfolk Main Library. The Proposed Plan and previous investigation reports for SWMU 14 are available to the public in the Administrative Record. The Administrative Record is accessible to the public via:

Norfolk Main Library
235 East Plume Street
Norfolk, Virginia 23510
(757) 664-7323

The index is available online at:
http://public.lantops-ir.org/sites/public/nsn/Site%20Files/AdminRecords.aspx

No comments were submitted by the public during the public comment period. There were no attendees at the public meeting.

2.4 Scope and Role of Response Action

SWMU 14 is one of the 18 SWMUs in the IRP that are part of the comprehensive environmental investigation and cleanup currently being performed at NSN under the CERCLA program. The status of all the IRP sites at NSN can be found in the current version of the Site Management Plan (SMP), which is located in the Administrative Record. This ROD documents the final remedial action for SWMU 14 and does not include any other sites at the facility. SWMU 14 encompasses what was formerly identified as Site 9 (Section 2.1).

2.5 Site Characteristics

2.5.1 Site Overview

The subsurface material at SWMU 14 is characterized by two distinct classifications: dredge fill and construction-debris fill. The dredge fill consists mainly of fine-to medium-grained sand and shell hash in the western half of the Sewell's Point peninsula. Similar material is found below the construction debris fill at 6 to 14 feet deep in the site's eastern portion. The eastern section of the peninsula (Site 9 fill area) consists of construction debris fill composed of black to brown silts and sands with some gravel pockets. Large amounts of metal debris were observed during test pit and drilling activities. Additionally, coal and glass fragments were noted as well as what appeared to be buried wood pilings. Excavation activities to construct subsurface features associated with the drainage system for the parking lot constructed in the NTCRA encountered similar materials. These materials were characterized and disposed of offsite at a permitted facility.

There are two significant groundwater aquifer systems located beneath NSN—the water-table (Columbia) aquifer and the underlying Yorktown Aquifer. The water-table aquifer at NSN is generally thin and consists of discontinuous heterogeneous sand and shell lenses in the upper 20 to 40 feet below ground surface (bgs) of the Columbia group. The depth to the water-table is usually less than 8 feet. The Yorktown Aquifer is semiconfined beneath a clay layer in the upper Yorktown Formation. Water-bearing zones in the Yorktown Aquifer consist of fine to coarse sand, gravel, and shells. The shallow groundwater at SWMU 14 is located within dredge fill and construction debris fill materials.

The groundwater-level data from the SWMU 14 RI (CH2M HILL, 2004) indicated that the water table was relatively flat across the site with a fluctuation of approximately 0.6 feet, and the highest groundwater elevations were found near the abandoned concrete pad. This created a slight groundwater mound near the center of the site and was likely due to the infiltration of precipitation. Groundwater flow was generally east and north towards Willoughby Bay, and west towards the Elizabeth River. In addition, a slight hydraulic divide appeared to occur along the site's western edge, separating the groundwater flow to the east and west.

2.5.2 Nature and Extent of Contamination

The SWMU 14 conceptual Site model (CSM) (**Figure 2-4**) depicts the site characteristics, nature and extent of contamination, and transport pathways at SWMU 14. There are several

VOC, SVOC, PCB, or metal concentrations above applicable screening and regulatory criteria in soil and groundwater at SWMU 14.

2.5.3 Contaminant Fate and Transport

The primary mechanisms for contaminant transport from the site, leaching of contaminants from waste/waste-contaminated soil through precipitation and infiltration to groundwater, has been greatly reduced through the construction of the asphalt cover. Currently, groundwater at SWMU 14 is not used as a potable water source.

2.6 Current and Potential Future Site and Resource Uses

SWMU 14 and the surrounding areas are industrial and recreational in nature. SWMU 14 is surrounded by piers, recreational areas (ball fields to the southeast), and parking lots for Navy fleet operations. Industrial, recreational, and operational future land use activities may be implemented on the site provided the activities remain protective of human health and the environment. The groundwater is not currently used as source of drinking water. Drinking water is provided by the City of Norfolk.

LUCs will be employed to maintain the asphalt cover, prevent intrusive activities, and limit land use at SWMU 14 to serve as a parking lot. LUC requirements will be specifically defined in a limited Remedial Action document.

2.7 Summary of Risks

Detailed results of the HHRA and ERA conducted at SWMU 14 prior to the 2008 NTCRA are presented in the RI/HHRA/ERA. In summary, prior to any interim removal actions at the site, potential unacceptable human health risks associated with exposure to soil and groundwater by future site workers, construction workers, adult/child residents, lifetime residents, and recreational children were identified. There were no unacceptable risks identified to ecological receptors from exposure to site soils (based on current and anticipated future land use) or sediment. Based upon the results of the 2006 Trident Probe study, there are no unacceptable ecological risks associated with groundwater discharging from beneath SWMU 14 to surrounding water bodies. Because the installation of the parking lot did not remove or reduce the presence of contaminants in the soil, contact with soil may result in unacceptable risk to human receptors.

2.7.1 Human Health Risk Summary

A Human Health Risk Assessment evaluated potential exposure under current risk scenarios to construction workers and adult/adolescent trespassers and under potential future land use scenarios to site workers, construction workers, adult/child residents, and recreational users. Potential cancer risks and non-cancer hazards were calculated based on reasonable maximum exposure (RME) and central tendency exposure (CTE) point concentrations. The RME assumed the highest level (maximum concentration) of human exposure that could reasonably be expected to occur, whereas the CTE reflected a more realistic human exposure to levels (mean detected concentrations and more realistic exposure scenarios) across the site.

For known or suspected carcinogens, acceptable exposure levels are generally concentrations that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} (a 1 in 10,000 chance of developing cancer) and 10^{-6} (a 1 in 1,000,000 chance of developing cancer). The 10^{-6} risk level is used as the point of departure for determining acceptable risk.

Noncarcinogenic hazards for an individual constituent through an individual exposure pathway are expressed as hazard quotients (HQs), which are ratios of the actual or expected exposure levels to levels at which no adverse effects are expected to occur (reference doses). An HQ is developed for each individual constituent and associated exposure pathway, and then all the HQs are summed to derive the noncarcinogenic hazard index (HI). Adverse effects from exposure are not expected if the calculated HI is equal to or less than 1. If the HI is greater than 1, separate HIs are derived based on the target organ/effect for each constituent. Different constituents affect different organs or systems of the body. For example, iron affects the gastrointestinal tract, while vanadium affects the kidneys. It is more appropriate and technically sound to sum up the hazard quotients for constituents that affect the different organs of the body separately. If the HIs are less than 1 for each target organ/effect, then adverse effects are not expected.

Under current site use, there were no noncarcinogenic hazards or carcinogenic risks identified that exceeded USEPA's target levels. Although the cumulative noncarcinogenic hazard for current site workers (HI = 1.5) exceeded USEPA's target value, the constituents contributing to this hazard do not affect the same organs. Because there are no individual target organs with an HI greater than 1, there are no unacceptable noncarcinogenic hazards from soil, groundwater, sediment, or surface water at SWMU 14.

Six of the potential future exposure scenarios evaluated for total Reasonable Maximum Exposure (RME) identified either noncarcinogenic hazards or carcinogenic risks that exceeded USEPA's target levels. These scenarios were future site worker, future recreational adult, construction worker, adult and child residents, lifetime residents, and recreational child.

The cumulative noncarcinogenic hazard for the future site worker and future recreational adult exposed to surface and subsurface soil exceeded USEPA's target value. As with the case of the current site worker, the constituents contributing to this hazard do not affect the same organs and there are no individual target organ effects with an HI greater than 1. As such, there are no unacceptable hazards for these receptors.

Surface and Subsurface Soil

Cancer risks and noncancer hazards above USEPA target levels were identified for future site workers, construction workers, adult/child residents, lifetime residents, and recreational children (**Table 2-1** and **Table 2-2**). Metals detected in the soil are the main contributors to the noncarcinogenic hazard associated with exposure to surface soil (thallium and iron) and subsurface soil (antimony, arsenic, iron, manganese, thallium, and vanadium). There are no carcinogenic risks that exceeded USEPA target levels in the surface soil. The main contributor to the carcinogenic risk in subsurface soil is benzo(a)pyrene. A comparison of the maximum detected concentrations to facility-wide background soil concentration levels indicated that the concentrations of metals detected at SWMU 14 are likely site related.

Exposure to the lead in soil by future child residents could result in levels above USEPA acceptable levels for lead exposure. However, because elevated lead concentrations in soil were found to be randomly distributed across the site regardless of depth, exposure point concentrations used to evaluate risks for exposure to lead are biased high by specific locations not indicative of site-wide concentrations, therefore no further action for lead is required.

Surface Water and Sediment

In the HHRA, no unacceptable human health risks were identified from exposure to surface water or sediment. Cancer risks and non-cancer hazards are within or below USEPA's acceptable levels.

Groundwater

As documented in the RI, cancer risks and non-cancer hazards above USEPA target levels were identified for hypothetical future construction workers, adult or child residents, and lifetime residents (**Table 2-1** and **Table 2-2**). The main contributors to the groundwater noncarcinogenic hazard are 2-methylnaphthalene, 4-methylphenol, dibenzofuran, naphthalene, arsenic, iron, manganese, and thallium. The main contributors to the carcinogenic risk are vinyl chloride, n-nitroso-d-n-propylamine, pentachlorophenol, aldrin, and arsenic.

USEPA conducted analysis of the groundwater analytical data and determined that the potential risk to a hypothetical future resident consuming shallow groundwater is limited to arsenic. The basis for this determination is the sporadic nature of the distribution of COCs in groundwater. Only arsenic was found to exist in a manner which would be considered relevant in a residential scenario. Four groundwater wells at SWMU 14 exceed the current arsenic MCL of 10 µg/L: MW09S (13 µg/L), MW06S (14 µg/L), MW05S (14 µg/L), and MW07S (16 µg/L). The associated risk range for arsenic at 10 µg/L to 16 µg/L is 2.2E-04 to 3.6E-04. The wells with MCL exceedances located within the site were abandoned during completion of the NTCRA and are no longer available for sampling. USEPA's OSWER Directive 9355.0-30 indicates the upper boundary of the risk range is not a discrete value at 1E-04; therefore, specific risk estimates around 1E-04 may be considered acceptable if justified based on site-specific conditions. As a result, the groundwater MCL exceedances and associated potential risk for arsenic are considered acceptable at SWMU 14.

2.7.2 Ecological Risk Summary

Six metals (antimony, copper, lead, nickel, thallium, and zinc) and PAHs in surface soil exceeded surface soil screening values or facility-wide background soil concentrations. Copper, lead, and zinc were the inorganics that exceeded both screening values and background concentrations most frequently and at the highest magnitudes. Site-wide, potential risks to terrestrial receptors from exposure to PAHs in surface soils were likely to be limited. There were possible risks to lower-trophic-level receptors utilizing some portions of the terrestrial habitats on SWMU 14; however, these risks were likely to be minimal under both existing and reasonably anticipated future land uses because exposures were likely to be limited based upon the poor surrounding habitat quality (a grassy field that is periodically mowed), and the site's isolated nature (i.e., developed areas to the south and west as well as open water to the north and east). Potential risks to upper-trophic-level terrestrial receptors were minimal as no chemical exceeded a Lowest Observed Adverse

Effect Level (LOAEL)-based screening value for such receptors even assuming that they would obtain all of their food from the site (an unrealistically conservative assumption given the limited habitat that was present on the site).

Relatively few chemicals exceeded screening values in sediment in the lagoon located southeast of the site. Arsenic was the only inorganic chemical with a mean hazard quotient (HQ) greater than or equal to one based upon detected concentrations. However, arsenic was not found to exceed screening values in site surface soils or groundwater, suggesting that these low-magnitude sediment exceedances are not site related. Four pesticides (4,4′-DDE, 4,4′-DDT, alpha-chlordane, and gamma-chlordane) and one PCB (Aroclor-1260) exceeded screening values based upon mean detected concentrations. While the mean detected concentrations of five individual PAH compounds exceeded screening values, maximum HQs were less than 2 and the mean HQ for total PAHs was less than 1. This suggests that potential risks related to PAHs are minimal in lagoon sediments. A comparison of sediment concentrations to equilibrium partitioning-based sediment values, which provide a measure of bioavailability, suggested that potential exposures and risks were very low for all these organic compounds.

The potential magnitude of contaminant transport via groundwater from SWMU 14 to Willoughby Bay was qualitatively and conservatively evaluated through a comparison of groundwater concentrations with surface water screening values. Total cyanide, manganese, and 4,4′-DDT had mean HQs exceeding one, based upon detected groundwater concentrations and a dilution factor of 10, which is very conservative for this site. Amenable cyanide was not detected in any of the five wells at the same reporting limit as total cyanide. Thus, the cyanide in groundwater is not likely to be present in bioavailable forms and would likely pose a minimal risk to aquatic receptors in Willoughby Bay following discharge. Since no site-specific upgradient wells or facility-specific background wells are available, it was unclear if the observed manganese concentrations are within the range of naturally occurring concentrations in groundwater. However, the maximum manganese concentration in groundwater was found far removed from the source areas and main groundwater flow direction. This suggested that manganese is likely to be present at background levels in groundwater or is not site-related.

The results of the Trident Probe Study indicated there was no preferential pathway for the discharge of groundwater from SMWU 14 into the adjacent surface water bodies.

Soil

Based on the results of the ERA, low, spatially-restricted ecological risks associated with metals and PAHs were identified for potential receptors exposed to site surface soil. These potential risks were addressed as a result of the 2008 NTCRA through the capping of affected soil, which removed this potential exposure pathway. Thus, given the current habitat conditions onsite and the likely future site uses, risk to ecological receptors from exposure to soils is minimal (acceptable).

Sediment

Based on the ERA, limited potential ecological risks associated with exposure to metals, pesticides, PAHs, and PCBs in lagoon sediment were identified. Each of the compounds identified was deemed to either pose minimal (acceptable) risk (based upon the magnitude and frequency of screening value exceedance and bioavailability considerations) or not to be site related (based on distribution and concentration levels).

Groundwater

The potential magnitude of contaminant transport via groundwater from SWMU 14 to Willoughby Bay was qualitatively evaluated through a comparison of groundwater concentrations with surface water screening values. Total cyanide, manganese, and 4,4'-DDT had mean HQs exceeding 1 based upon detected groundwater concentrations and a dilution factor of 10. Based upon the results of the follow-up 2006 Trident Probe study (Section 2.2), there were no unacceptable ecological risks associated with groundwater discharging from beneath SWMU 14 to surrounding water bodies.

2.7.3 Basis for Action

It is the current judgment of the Navy and USEPA, in conjunction with VDEQ, that the Selected Remedy documented in this ROD is necessary to protect public health, welfare, and the environment from exposure to hazardous substances in the surface and subsurface soil remaining in place at SWMU 14. Based on the results of the 2004 HHRA and ERA, the 2006 Trident Probe study, the completion of the NTCRA, and the additional assessment of groundwater as presented in this ROD, potential risks associated with sediment and groundwater are acceptable.

2.8 Remedial Action Objectives

The site-specific RAO for NSN SWMU 14 is to implement measures to reduce or eliminate exposure routes that pose a potential unacceptable risk to human health. Based on future use of SWMU 14 as a parking lot, the existing asphalt cover prevents exposure to soil; however, future construction workers could be exposed to impacted soil during excavations or other intrusive activities. LUCs are proposed to prevent unacceptable exposure to future construction workers, maintain the integrity of the asphalt cover, and prohibit future recreational and residential uses at the site.

2.9 Description of Alternatives

Remedial alternatives to address human receptor exposure to contamination remaining at SWMU 14 were evaluated and are described in detail in the FFS. No specific remedial technologies or process options were screened as part of the FFS. Two remedial alternatives were evaluated:

- **Alternative 1** - No Action
- **Alternative 2** - LUCs

2.10 Summary of Comparative Analysis of Alternatives

Each remedial alternative for SWMU 14 was evaluated against the nine criteria listed below, as required by the NCP at 40 CFR 300.430 (e)(9)(iii). **Table 2-3** provides the major components, details, and cost of alternative 2 identified for SWMU 14.

- **Protection of Human Health and the Environment**—Addresses whether each alternative provides adequate protection of human health and the environment and

describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

- **Compliance with ARARs**—Section 121(d) of CERCLA and the NCP at 40 CFR Section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4).
- **Long-Term Effectiveness and Permanence**—Refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.
- **Reduction of Toxicity, Mobility, or Volume through Treatment**—Refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.
- **Short-Term Effectiveness**—Addresses the period of time needed to implement the remedy and reduce any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.
- **Implementability**—Addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.
- **Cost**—Refers to the estimated capital and annual O&M costs, as well as present-worth cost. Present-worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
- **State Acceptance**—Considers whether the state agrees with the analyses and recommendations.
- **Community Acceptance**—Considers whether the local community agrees with the analyses and selected remedy.

2.10.1 Threshold Criteria

Overall Protection of Human Health and the Environment

Alternative 1, No Action, does not restrict, manage, or monitor site conditions to reduce exposure to contaminants that pose potential risks to human health. Alternative 2 is protective of human health and the environment because potentially unacceptable risk exposures will be managed through the implementation and enforcement of LUCs.

Compliance with ARARs

ARARs include any federal or more stringent state environmental or facility-siting standards, requirements, criteria, or limitations that are legally applicable or relevant and appropriate to a CERCLA site or action. There are no ARARs for Alternatives 1 or 2.

2.10.2 Primary Balancing Criteria

Long-Term Effectiveness and Permanence

Alternative 1 does not achieve long-term effectiveness; the site would not be restricted, monitored, or managed to reduce exposure to contaminants that pose potential risk. Alternative 2 is effective and permanent in the long term. LUCs would prevent unacceptable exposures over the long term and achieve long-term effectiveness and permanence for future use.

Reduction in Toxicity, Mobility, or Volume through Treatment

Neither Alternative 1 nor Alternative 2 reduces the toxicity, mobility, or volume through treatment of the contaminants at SWMU 14. The completion of the NTCRA (asphalt cover) significantly reduces the potential for leaching of contaminants from soil to groundwater by reducing infiltration.

Short-Term Effectiveness

SWMU 14 is currently in use as a parking lot. As long as no intrusive activities occur onsite, there are no current receptors that would potentially be exposed to soil that would result in unacceptable risks in the short term. As a result, both Alternatives 1 and 2 would be effective in the short term; however, without the implementation of LUCs there is no mechanism to prevent site disturbance of the asphalt cover or inappropriate use of the site.

Implementability

Alternative 1, No Action, would be easier to implement because there is no effort associated with this alternative. Alternative 2, LUCs, is relatively easy to implement and has been used at other IRP sites; the alternative would require preparation of an RD for LUCs, periodic site inspections, associated reporting (including the Five-Year Review Report), and coordination among NAVFAC, NSN, USEPA, and VDEQ to ensure the LUCs are enforced.

Cost

In terms of Net Present Worth (NPW), the No Action alternative has no cost. There would be minimal costs to implement Alternative 2 (**Table 2-3**). These costs would be for the preparation of an LUC RD, periodic inspections, and periodic reporting (including the Five-Year Review Report) to maintain the LUCs. These costs are assumed to occur over the 30-year timeframe of the alternative.

2.10.3 Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA process and during the proposed plan for SWMU 14. The Commonwealth supports the Selected Remedy.

Community Acceptance

Community acceptance was solicited during the proposed plan comment period. No comments were received during the comment period or public meeting.

2.11 Principal Threat Wastes

Principal threat wastes are hazardous or highly toxic source materials that result in ongoing contamination to surrounding media, generally cannot be reliably contained, or present a significant risk to human health or the environment should exposure occur. There are no known principal threat wastes associated with SWMU 14.

2.12 Selected Remedy

Alternative 2, LUCs, is the Selected Remedy to address surface soil and subsurface soil at SWMU 14.

2.12.1 Summary of the Rationale for the Selected Remedy

The Selected Remedy for SWMU 14 is maintenance of the existing protective cover and implementation of LUCs to protect future construction workers and prohibit future recreational residential use from exposure to soil and subsurface soil remaining in place. The LUCs will be implemented on the entire asphalt cover and bioretention areas encompassing SWMU 14 and a portion of co-located Site 9. This remedy was selected because it will achieve substantial risk reduction by preventing exposure to contaminated media. Alternative 1, No Action, was eliminated because it does not meet the RAO and is not proactively protective of human health and the environment.

2.12.2 Description of the Selected Remedy

The objectives of the LUCs shall be to protect the future construction worker and prohibit future recreational and residential use by:

- Prohibit digging into or disturbance of the existing asphalt cover
- Prohibit the withdrawal of groundwater

The site will be inspected periodically, and the Navy will evaluate the effectiveness of the LUCs. The Navy will maintain LUCs until site conditions allow for unlimited use and unrestricted exposure. Within 120 days of the ROD signature, the Navy shall prepare a Remedial Design (RD) to implement the Selected Remedy and submit to USEPA and VDEQ for review and concurrence. The LUC portion of the RD will provide for implementation and maintenance actions, including periodic inspections and reporting. The RD will also include provisions that would require a re-evaluation of potential risks should an unlimited/ unrestricted exposure land use or a No Action decision be sought for the site. The Navy will implement, maintain, monitor, record, review, report on, and enforce the LUCs in accordance with the RD. Although the Navy may later transfer these responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity. A detailed cost break-down of the Selected Remedy is provided in **Table 2-3**.

2.12.3 Expected Outcome of the Selected Remedy

Currently, an asphalt cover, which serves as a parking lot, encompasses the SWMU 14 boundary. Current land use is expected to continue at SWMU 14. LUCs will be employed to restrict residential and recreational land use, maintain the asphalt cover, and prohibit the withdrawal of groundwater. Future land use such as industrial and operational activities may be implemented provided the activities are consistent with the LUC objectives.

2.13 Statutory Determinations

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

2.13.1 Overall Protection of Human Health and the Environment

The Selected Remedy will prevent potential unacceptable human health risk to from contact with surface and subsurface soil by means of restrictive controls. LUCs will maintain the asphalt cover, restrict site use, and prevent withdrawal of groundwater.

2.13.2 Compliance with ARARs

There are no ARARs associated with the Selected Remedy.

2.13.3 Cost Effectiveness

The Selected Remedy represents the most reasonable value for money spent. The cost incurred with LUCs would be for the preparation of a LUC RD, implementation of the LUCs, periodic inspections, and periodic reporting (including the Five-Year Review Report) to enforce the LUCs. These costs are assumed to occur over the 30-year timeframe of the alternative.

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

The Navy and USEPA, in partnership with the VDEQ, determined the Selected Remedy for SWMU 14 represents the maximum extent to which solutions and treatment technologies can be used in a practicable manner.

2.13.5 Preference for Treatment as a Principal Element

The Selected Remedy does not satisfy the statutory preference for treatment as a principal element. The previous construction of the asphalt cover provides a protective cover for the site. Given the size and associated volume of materials, treatment is impracticable.

2.13.6 Five-Year Review Requirements

The remedy will result in hazardous substances, pollutants or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure. Therefore, a statutory review will be conducted within 5 years of the initiation of the remedial action

(and every 5 years thereafter) to evaluate continuing remedy effectiveness and to determine if the remedy continues to be protective of human health and the environment.

2.14 Documentation of Significant Changes

The Proposed Plan for SWMU 14 was released for public comment August 5, 2009. No comments were received during the public meeting or comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate based upon input from the public.

2.14.1 Changes to the Preferred Remedy Subsequent to the Proposed Plan

Subsequent to the completion of the Proposed Plan and associated public comment period and public meeting, groundwater at SWMU 14 was re-evaluated by USEPA.

Arsenic was the only contaminant found in an aerial extent large enough to be considered a plume. The arsenic data, which was collected prior to completion of the NTCRA, exceeds the current MCL but is within an acceptable risk range based upon USEPA's OSWER Directive 9355.0-30. Four groundwater wells at SWMU 14 exceed the current arsenic MCL of 10 µg/L: MW09S (13 µg/L), MW06S (14 µg/L), MW05S (14 µg/L), and MW07S (16 µg/L). The associated risk range for arsenic at 10 µg/L to 16 µg/L is 2.2E-04 to 3.6E-04. The wells with MCL exceedances located within the site were abandoned during the NTCRA and are no longer available for sampling. USEPA's OSWER Directive 9355.0-30 indicates the upper boundary of the risk range is not a discrete value at 1E-04; therefore, specific risk estimates around 1E-04 may be considered acceptable if justified based on site-specific conditions. As a result, the groundwater MCL exceedances for arsenic are considered acceptable at SWMU 14. The site-specific factors at SWMU 14 to support the acceptable risk determination include (but are not limited to):

- Based upon current and reasonably anticipated future land use (as a parking lot) combined with LUCs, the only viable exposure scenarios for groundwater are industrial and construction worker scenarios.
- Local ordinances prevent the withdrawal of shallow groundwater for potable use; drinking water is supplied by the City of Norfolk.
- The NTCRA provided for an asphalt cover, which significantly reduced the amount of infiltration through soil to groundwater.

Based on review of the risk range for arsenic in groundwater compared to arsenic risk at the MCL combined with the site-specific conditions listed above, USEPA concludes that action is not required to address groundwater at this site.

TABLE 2-1

SWMU 14 Summary Table for Risks and Hazards Across Media for All Reasonable Maximum Exposures

Naval Station Norfolk

Norfolk, VA

	Exposure Scenarios										Total Risk for Pathways	Total Hazard Index for Pathways	Chemicals with Hazard Index above 1	Chemicals with Risks above 10-4	Chemicals with Risks above 10-5
	Surface Soil		Subsurface Soil		Groundwater		Surface Water		Sediment						
	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index					
Current Site Worker*	3.0E-05	1.5E+00	--	--	--	--	--	--	--	--	3.0E-05	1.5E+00	--	--	Surface Soil- Arsenic
Current Trespasser Adult	5.6E-06	2.1E-01	--	--	--	--	--	--	--	--	5.6E-06	2.1E-01	--	--	--
Current Trespasser Adolescent	2.6E-06	2.9E-01	--	--	--	--	--	--	--	--	2.6E-06	2.9E-01	--	--	--
Future Site Worker*	3.0E-05	2.7E+00	2.7E-04	5.3E+00	--	--	--	--	--	--	2.9E-04	8.0E+00	Subsurface soil - Vanadium	Subsurface soil - Benzo(a) pyrene	Surface Soil- Arsenic; Subsurface soil - Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene
Future Resident Adult*	NA	1.6E+00	NA	5.4E+00	NA	2.2E+01	--	--	--	--	NA	2.9E+01	Subsurface soil - Vanadium; ***Groundwater - 4-Methylphenol, Thallium, Arsenic, Iron, Manganese, Vanadium	--	--
Future Resident Child	NA	8.5E+00	NA	2.3E+01	NA	5.4E+01	--	--	--	--	NA	8.5E+01	Surface Soil- Iron, Thallium; Subsurface soil - Antimony, Iron, Thallium, Vanadium; ***Groundwater - Dibenzofuran, 4-Methylphenol, Arsenic, Iron, Manganese, Thallium, Vanadium	--	--

TABLE 2-1

SWMU 14 Summary Table for Risks and Hazards Across Media for All Reasonable Maximum Exposures

Naval Station Norfolk

Norfolk, VA

	Exposure Scenarios										Total Risk for Pathways	Total Hazard Index for Pathways	Chemicals with Hazard Index above 1	Chemicals with Risks above 10-4	Chemicals with Risks above 10-5
	Surface Soil		Subsurface Soil		Groundwater		Surface Water		Sediment						
	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index					
Future Age-Adjusted Resident	5.9E-05	NA	6.0E-04	NA	7.1E-03	NA	--	--	--	--	7.7E-03	NA	--	Subsurface soil - Benzo(a)pyrene; ***Groundwater - Pentachlorophenol, n-Nitroso-di-n-propylamine, Arsenic	Surface Soil - Arsenic; Subsurface Soil - Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Dioxin, Indeno(1,2,3-cd)pyrene, Arsenic; ***Groundwater - Vinyl chloride, Carbazole
Future Construction Worker	3.6E-06	3.7E+00	1.8E-05	1.1E+01	2.3E-05	3.1E+00	--	--	--	--	4.4E-05	1.5E+01	Subsurface Soil - Antimony, Thallium, Vanadium	--	***Groundwater – Pentachlorophenol
Future Trespasser Adult	5.6E-06	2.1E-01	4.3E-05	6.8E-01	--	--	--	--	--	--	4.9E-05	8.9E-01	--	--	Subsurface Soil - Benzo(a)pyrene
Future Trespasser Adolescent	2.6E-06	2.9E-01	1.7E-05	8.4E-01	--	--	--	--	--	--	2.0E-05	1.1E+00	--	--	--
Future Recreational Adult**	1.1E-05	4.0E-01	8.3E-05	1.3E+00	--	--	No COPC	No COPC	3.0E-06	1.6E-01	9.7E-05	1.9E+00	--	--	Subsurface Soil - Benzo(a)pyrene
Future Recreational Child	1.7E-05	2.7E+00	1.1E-04	7.5E+00	--	--	No COPC	No COPC	2.7E-06	1.9E-01	1.3E-04	1.0E+01	Subsurface Soil - Thallium, Vanadium	--	Subsurface Soil - Benzo(a)pyrene

*Although total hazard index for surface soil is above target level of 1, no individual target organs with HI above 1, therefore no unacceptable hazard

**Although total hazard index for subsurface soil is above target level of 1, no individual target organs with HI above 1, therefore no unacceptable hazard

***As documented by the ROD, the USEPA has determined no action is required to address groundwater at SWMU 14.

NA - Not applicable; Highlight indicates potential unacceptable risk

No COPC - No **contaminants of potential concern (COPCs)** identified during initial screening of data to select COPCs. Therefore, risks not quantified for this media.

TABLE 2-2

SWMU 14 Summary Table for Risks and Hazards Across Media for All Central Tendencies

Naval Station Norfolk

Norfolk, VA

	Exposure Scenarios						Total Risk for Pathways	Total Hazard Index for Pathways	Chemicals with Hazard Index above 1	Chemicals with Risks above 10^{-4}	Chemicals with Risks above 10^{-5}
	Surface Soil		Subsurface Soil		Groundwater						
	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index			--	--	--
Future Site Worker	NA	--	1.4E-05	--	--	--	1.4E-05	--	--	--	
Future Resident Adult	--	--	NA	9.4E-01	NA	5.4E+00	NA	6.3E+00	*Groundwater - 4-Methylphenol	--	--
Future Resident Child	NA	1.5E+00	NA	2.9E+00	NA	1.5E+01	NA	2.0E+01	*Groundwater - Dibenzofuran, 4-Methylphenol, Arsenic, Iron, Manganese, Thallium	--	--
Future Age-Adjusted Resident	--	--	2.0E-05	NA	2.3E-03	NA	2.3E-03	NA	--	*Groundwater – Pentachloro-phenol, n-Nitroso-di-n-propylamine, Arsenic	*Groundwater- Vinyl chloride
Future Construction Worker	NA	1.3E+00	NA	2.6E+00	NA	2.9E+00	NA	6.8E+00	--	--	--
Future Recreational Child	NA	6.5E-01	NA	1.4E+00	--	--	NA	2.0E+00	--	--	--

*As documented by the ROD, the USEPA has determined no action is required to address groundwater at SWMU 14.

Highlight indicates potential unacceptable risk

Table 2-3
SWMU 14 Remedial Alternative Cost Estimates
Naval Station Norfolk
Norfolk, Virginia

Site: SWMU 14 **Description:** Institute Land Use Controls for Limits of SWMU 14
Location: Naval Station Norfolk, LP-20 Plating Shop
Phase: Focused Feasibility Study
Date: February 18, 2009

CALCULATIONS

ASSUMPTIONS

1) Long Term Monitoring
* Quarterly inspection of site and annual reporting
* 5 Year review
* No long term groundwater or soil sampling will be conducted
2) LUCs for 30 year timeframe

CAPITAL COSTS

Description	Qty	Unit	Unit Cost	Total Cost		Notes
Preparation of LUC Remedial Design	1	EA	$10,000	$10,000	Engineer's Estimate	
TOTAL CAPITAL COST				**$10,000**		

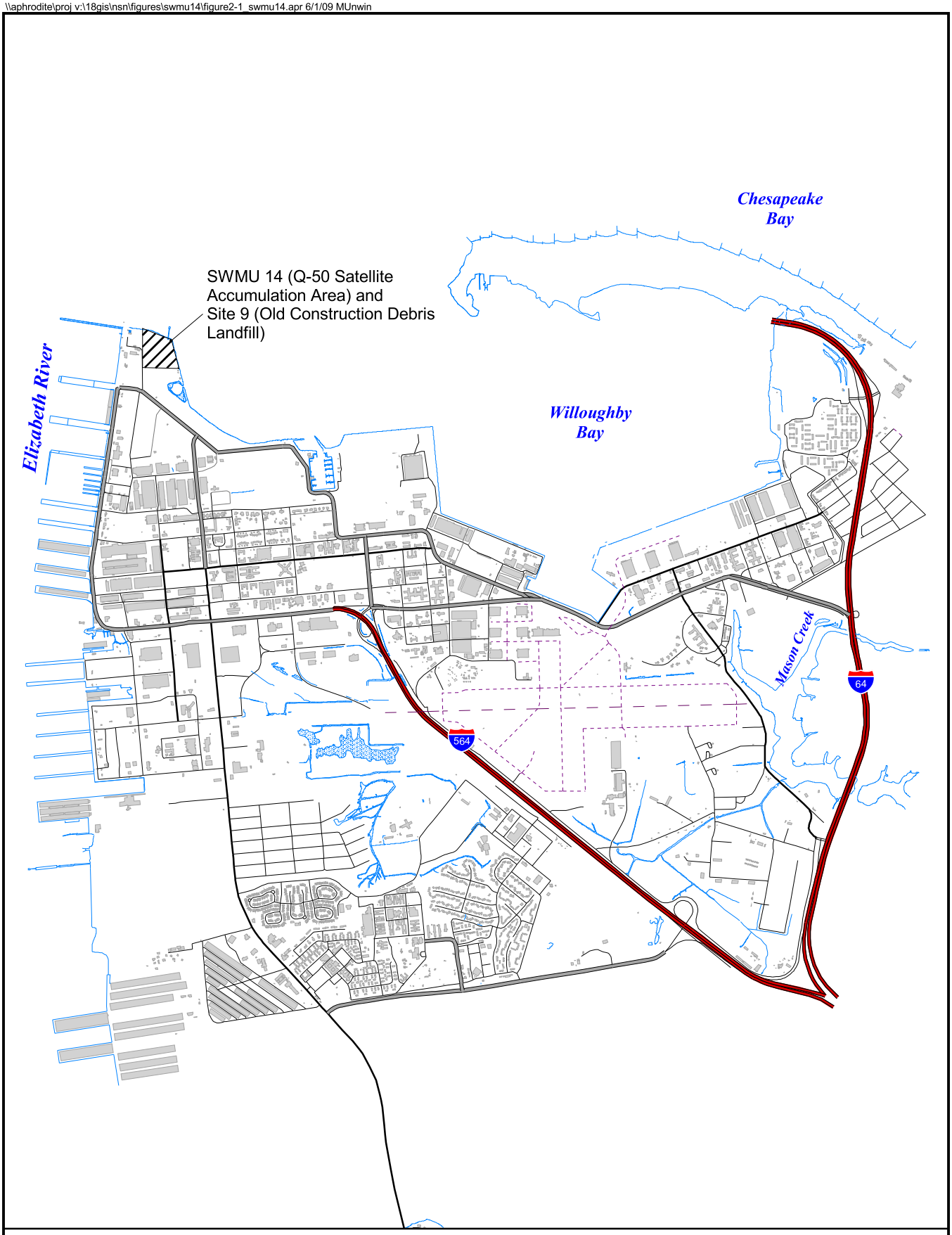
OPERATION AND MAINTENANCE COSTS (Years 1-4, 6-9, 11-14, 16-19, 21-24, 26-29)

Land Use Control Monitoring					
Quarterly site inspection and annual reporting	1	UNIT	$1,200.00	$1,200	Engineer's Estimate
SUBTOTAL				$1,200	
SUBTOTAL				$1,200	
Contingency	20%			$240	
SUBTOTAL				$1,440	
Project Management	6%			$86	
TOTAL ANNUAL OPERATION AND MAINTENANCE COST (Years 1-4, 6-9, 11-14, 16-19, 21-24, 26-29)				$1,526	

OPERATION AND MAINTENANCE COSTS (Years 5, 10, 15, 20, 25, 30)

Five Year Reviews					
Inspection	1	UNIT	$1,200.00	$1,200	Engineer's Estimate
SUBTOTAL				$1,200	
Five year review report	1	UNIT	$5,000.00	$5,000	Engineer's Estimate
SUBTOTAL					
SUBTOTAL				$6,200	
Contingency	20%			$1,240	Engineer's Estimate
SUBTOTAL				$7,440	
Project Management	6%			$446.40	
TOTAL ANNUAL OPERATION AND MAINTENANCE COST (Years 5, 10, 15, 20, 25, 30)				$7,886	
TOTAL NET PRESENT WORTH (30 Years)				**$63,398**	

NOTE: THE ESTIMATE SHOWN ABOVE IS CONSIDERED BUDGETARY-LEVEL COST ESTIMATING, SUITABLE FOR USE IN PROJECT EVALUATION AND PLANNING. ACTUAL CONSTRUCTION COSTS ARE EXPECTED TO VARY FROM THESE ESTIMATES DUE TO MARKET CONDITIONS, ACTUAL COSTS OF PURCHASED MATERIALS, QUANTITY VARIATIONS, REGULATORY REQUIREMENTS, AND OTHER FACTORS EXISTING AT THE TIME OF CONSTRUCTION.



Legend

Roads
- Arterial
- Alley
- Collector
- Interstate
- Local Road
- Ramp

- Buildings
- Shorelines

N

0 1625 3250 Feet

Figure 2-1
Site Location Map
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

\\aphrodite\proj v:\18gis\nsn\figures\smp2009\figure2-2_swmu14.apr 7/15/09 MUnwin

Legend

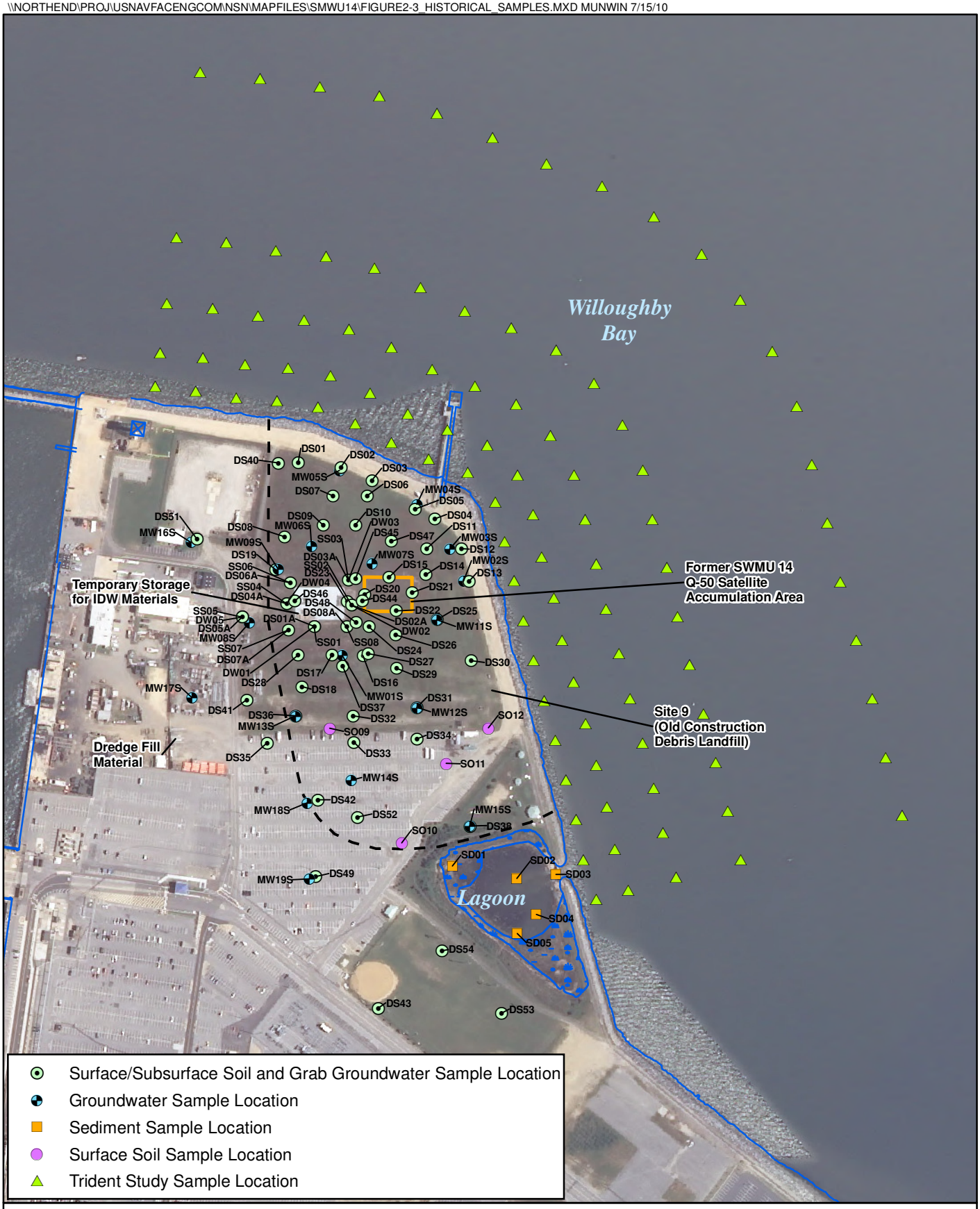
- Monitoring Wells
- Estimated Extent of Site 9 Landfill
- Asphalt Cover

N

0 100 200 Feet

Figure 2-2
SWMU 14 Site Layout (Prior to Placement of Asphalt Cover)
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL



Legend

Estimated Landfill Boundary (determined by geophysical survey in 2000)

Accumulation Area Boundary

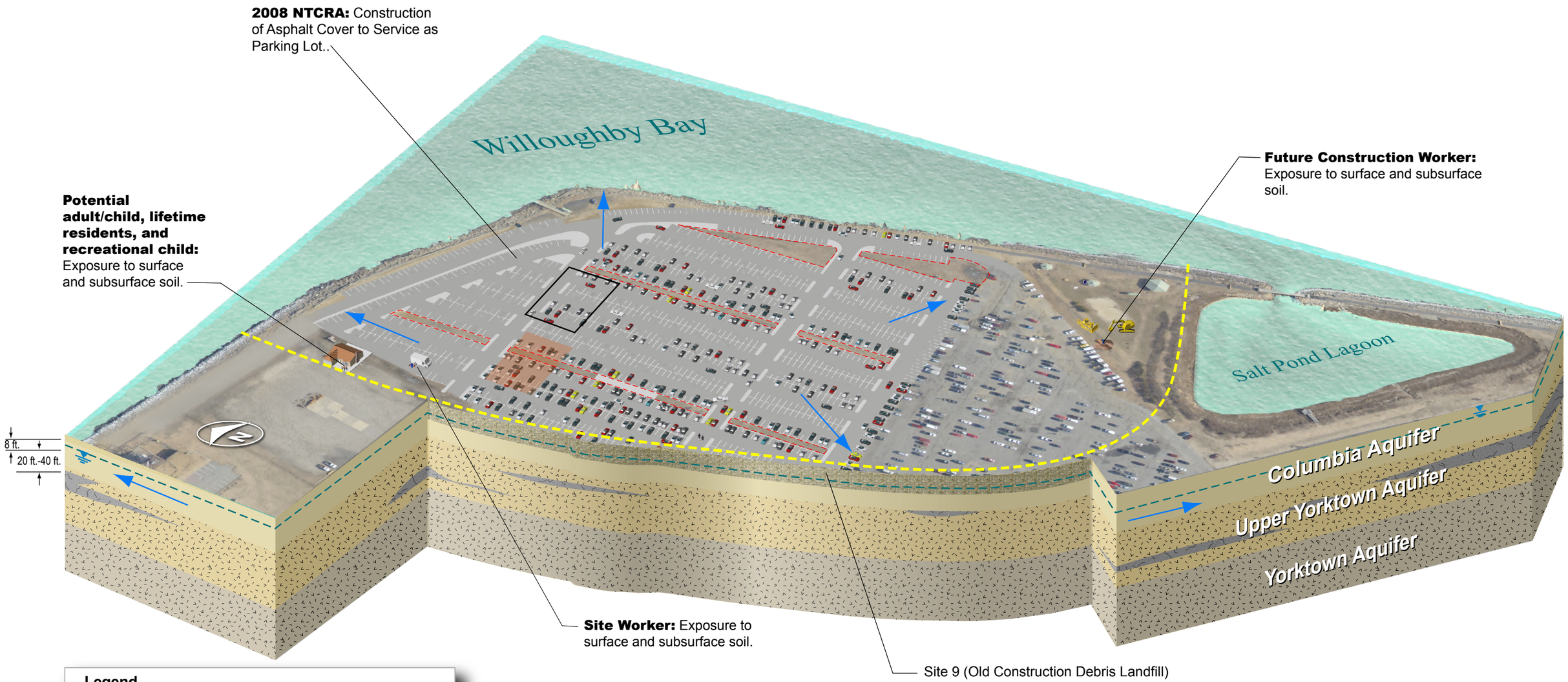
IDW: Investigation Derived Waste

N
W E
S

0 200 400 Feet

Figure 2-3
SWMU 14 Historical Sample Locations
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL



Legend

- Site 9 Boundary
- Former Temporary Storage of IDW Materials
- Former SWMU 14 Q-50 Satellite Accumulation Area
- Bioretention Areas
- Assumed Groundwater Flow Direction
- Water Table
- Fill (Old Construction Debris Landfill)
- Columbia Aquifer (Discontinuous Heterogeneous Sand and Shell Lenses)
- Upper Yorktown Aquifer (Clay)
- Yorktown Aquifer (Fine to Course Sand, Gravel, and Shells
- Shell Lenses
- IDW Investigative Derived Waste
- NTCRA Non-Time-Critical Removal Action

Notes: The material at SWMU 14 is characterized by two distinct classifications: dredge fill and construction-debris fill. The dredge fill consists mainly of fine- to medium-grained sand and shell hash in the western half of the Sewell's Point peninsula. Similar material is found below the construction debris fill at 6 to 14 feet deep in the site's eastern portion. The eastern section of the peninsula (Site 9 fill area) consists of construction debris fill composed of black to brown silts and sands with some gravel pockets. Large amounts of metal debris were observed during test pit and drilling activities. Additionally, coal and glass fragments were noted as well as what appeared to be buried wood pilings.

Ecological Risk: Minimal risk to lower-trophic-level and upper-trophic-level receptors associated with metals and PAHs in surface soil as documented by the ROD. Upon the completion of the NTCRA, no potential unacceptable risk are present.

Human Health Risk: Potential unacceptable risks to site workers, construction workers, adult/child residents, lifetime residents, and recreational child for exposure to surface and subsurface soil. Potential unacceptable risk to future adult/child resident to groundwater as documented in the ROD. The USEPA has determined no action is required to address groundwater at SWMU 14.

FIGURE 2-4
NSN SWMU 14 Conceptual Site Model
Naval Station Norfolk
Norfolk, *Virginia*

SECTION 3

Responsiveness Summary

The participants in the public meeting included representatives of the Navy, USEPA, and VDEQ. No community members attended the meeting. No questions were received during the public meeting, and no additional written comments, concerns, or questions were received from community members during the public comment period.

SECTION 4

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