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**Final**  
**Record of Decision**  
**Site 17: Building 195—Plating Shop**  
Norfolk Naval Shipyard  
Portsmouth, Virginia



**Department of the Navy**  
**Naval Facilities Engineering Command**  
**Atlantic Division**  
**Norfolk, Virginia**

**August 2006**

**Final**

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**Norfolk Naval Shipyard  
Portsmouth, Virginia**

**August 2006**

**Prepared by**



**Department of the Navy  
NAVFAC Mid Atlantic**

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# Acronyms and Abbreviations

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ARAR	Applicable or Relevant and Appropriate Requirement
Baker	Baker Environmental, Inc.
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIA	Controlled Industrial Area
COCs	chemicals of concern
COPCs	chemicals of potential concern
CSF	cancer slope factor
CSM	Conceptual Site Model
CTE	central tendency exposure
EPA	United States Environmental Protection Agency
ERA	ecological risk assessment
FFA	Federal Facility Agreement
FFS	Focused Feasibility Study
FS	Feasibility Study
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
IRP	Installation Restoration Program
LUC	Land Use Control
MCL	maximum contaminant level
NACIP	Naval Assessment and Control of Installation Pollutants
Navy	United States Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NNSY	Norfolk Naval Shipyard
NPL	National Priorities List
O&M	operation and maintenance
PAH	polycyclic aromatic hydrocarbons
PMT	Project Management Team
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RBC	risk-based concentrations
RD	Remedial Design

RfD	reference dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
UCL	upper confidence limit
UTL	upper tolerance limit
VDEQ	Virginia Department of Environmental Quality

# Declaration

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## 1.1 Site Name and Location

Site 17, Building 195 – Plating Shop

Norfolk Naval Shipyard (NNSY), Portsmouth, Virginia

United States Environmental Protection Agency (EPA) ID No. VA1170024813

## 1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the selected remedy for Site 17 (Building 195 – Plating Shop) located at NNSY, Portsmouth, Virginia. The determination was 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, with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the information contained in the Administrative Record for the site.

The United States Department of the Navy (Navy) is the lead agency and provides funding for site cleanups at NNSY. The Navy and EPA Region III issue this ROD jointly. The Virginia Department of Environmental Quality (VDEQ) concurs with the selected remedy.

## 1.3 Assessment of the Site

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from exposure to actual or threatened releases of hazardous substances into the environment from the site.

## 1.4 Description of the Selected Remedy

Site 17, Building 195 – Plating Shop, is one of several Installation Restoration Program (IRP) sites under CERCLA at NNSY. Information about the other IRP sites at NNSY can be found in the current version of the Site Management Plan (SMP), which is located in the Administrative Record.

The selected remedy to address contaminated soil at Site 17 is land use controls (LUCs). The selected remedy was determined based on the evaluation of site conditions, site-related risks, applicable or relevant and appropriate requirements (ARARs), and the Remedial Action Objectives (RAOs). LUCs provide the best alternative for restricting exposure pathways that have not been quantified to determine if unlimited use and unrestricted exposure to soil would result in potentially unacceptable risks. Consequently, the LUCs

objective for Site 17 is to prohibit use of the site for residential or child care facilities, elementary and secondary schools, or playgrounds.

The LUCs will remain in effect within the boundaries of Site 17 until such a time that the site conditions are assessed to allow for unlimited use and unrestricted exposure. Within 90 days following the execution of this ROD, the Navy shall develop and submit to EPA and VDEQ, in accordance with the Federal Facility Agreement (FFA), a Remedial Design (RD) that defines the detailed implementation actions for the remedy. LUC implementation actions will include periodic inspections and reporting to ensure that unacceptable exposure will not be allowed on the site. The Navy will implement, maintain, monitor, report on and enforce the LUCs according to the RD. LUCs will eliminate potential unacceptable exposure risks from contaminated soil.

## 1.5 Statutory Determination

The LUC remedy is protective of human health and the environment, complies with Federal and Commonwealth of Virginia regulations that are applicable or relevant and appropriate to the remedial action, and is cost-effective. While a LUC remedy does not utilize permanent solutions and alternative treatment technologies as a principal element, treatment or excavation of soil within the controlled industrial area (CIA) of NNSY does not provide the best cost-effective balance of tradeoffs, given the current active industrial operations at the site and the continuation of industrial operations in the foreseeable future.

Soil with contaminants that are above levels that do not allow for unlimited use and unrestricted exposure will remain onsite. As a result, a statutory review that is consistent with CERCLA Section 121(c), 42 U.S.C. § 9621(c), will be conducted within 5 years after commencement of the remedial action, and every 5 years thereafter for as long as the remedy remains in effect, to ensure that the remedy continues to provide adequate protection of human health and the environment.

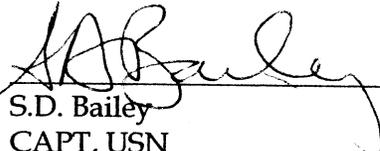
## 1.6 Record of Decision Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information for Site 17 can be found in the Administrative Record for NNSY.

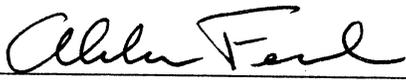
- Chemicals of concern (COCs) and their respective concentrations (Section 2.7 and associated tables)
- Baseline risks associated with exposure to the COCs (Section 2.7)
- Rationale for the lack of established remediation levels (Section 2.8)
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Section 2.12)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (Section 2.12)

- Key factors leading to the selection of the remedy (Section 2.13)

## 1.7 Authorizing Signatures

  
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S.D. Bailey  
CAPT, USN  
Chief of Staff

11 AUG 2006  
Date

  
\_\_\_\_\_  
Abraham Ferdas, Director  
Hazardous Site Cleanup Division  
EPA (Region III)

8/16/06  
Date

# Decision Summary

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This ROD describes the Navy's and EPA's selected remedial action for Site 17, Building 195 – Plating Shop, at NNSY, Portsmouth, Virginia. VDEQ concurs with the selected remedy. NNSY (EPA ID No. VA1170024813) was placed on the National Priorities List (NPL) in July 1999.

## 2.1 Site Name, Location, and Description

Site 17, Building 195 – Plating Shop, is located in the CIA of NNSY (Figure 1). The NNSY is located off Effingham Street in the City of Portsmouth, Virginia. Building 195 – Plating Shop is a brick building that houses the plating area and a newer addition used for nonplating storage. The newer addition previously contained a trailer that supported the plating operations. The area surrounding Building 195 – Plating Shop is concrete and asphalt. Topography is flat at an elevation between 8 and 10 feet above mean sea level.

## 2.2 Site History and Enforcement Activities

### 2.2.1 Site History

The NNSY, one of the largest shipyards in the world that is devoted exclusively to ship repair and overhaul, is located on the Southern Branch of the Elizabeth River. It is the oldest continuously operated shipyard in the United States, with origins dating back to 1767 when it was a merchant shipyard under British rule. The NNSY is located in the Hampton Roads Region of southeastern Virginia, approximately 15 miles from the Chesapeake Bay.

Building 195 – Plating Shop was the main plating shop at the NNSY. Spills onto the concrete floor of the building and the land surface adjacent to the building may have occurred from the early 1970s through the mid-1980s and may have involved plating solutions containing metals and cyanide. The formerly unpaved area north of Building 195 – Plating Shop was used for coal storage from the 1920s until approximately 1966.

### 2.2.2 History of Previous Investigations and Removals

Investigations at NNSY and/or Site 17 include the Initial Assessment Study (IAS), dated 1983; Interim Remedial Investigation (Confirmation Study for the IAS), dated 1989; Phase I Remedial Investigation (RI)/Feasibility Study (FS), dated 1995; and Phase II RI, dated 1999. Subsequent to the Phase II RI, a Focused Feasibility Study (FFS), dated June 2003, was performed to evaluate site-specific remedial alternatives based on the fact that Site 17 is within the CIA of the NNSY and will remain industrial for the foreseeable future. To provide additional information on the soil and groundwater for use in the human health risk assessment, two site investigations were performed in 2004; the FFS was revised in January 2006 to incorporate the results of the investigations in the development of remedial alternatives for Site 17.

### **Initial Assessment Study (1983)**

In 1983, the Navy conducted the IAS as part of the Naval Assessment and Control of Installation Pollutants (NACIP) program. The purpose was to qualitatively identify and assess sites that posed a potential threat to human health or the environment as a result of contamination from past handling of (and operations involving) hazardous materials. The study's results determined that concentrations of chromium existed in the soil surrounding Building 195—Plating Shop as a result of past site activities.

### **Interim Remedial Investigation (1989)**

Because of the levels of chromium detected in soils during the IAS, an Interim RI was conducted, which served as the confirmation study following the NACIP program. The objectives of the Interim RI included further investigation of Site 17 soil and groundwater, and an assessment of risk to human health. The Interim RI concluded that metals were present in the soil and groundwater at levels posing a potential risk to human health, and recommended additional investigation of Site 17.

### **Phase I Remedial Investigation/Feasibility Study (1995)**

The Navy conducted a Phase I RI/FS in 1995 to collect site-specific data necessary to fully evaluate site conditions, determine potential risks posed by the site, and develop and evaluate remedial action alternatives to mitigate identified risks. The Phase I RI/FS concluded that additional sampling was required to further evaluate site risk and to assess the need for remedial action.

### **Phase II Remedial Investigation (1999)**

In 1999, the Navy completed a Phase II RI to conduct the additional work recommended in the Interim RI and the Phase I RI/FS. The work included the installation of additional monitoring wells and sampling of the site's soils and groundwater. Data from this study was used to conduct a human health risk assessment (HHRA), which concluded that the soils at Site 17 would present a cancer risk, but not a noncancer risk for current/future onsite industrial workers. The cancer risk was primarily due to one sampling location where the concentration of arsenic in the surface soil was much higher than all other locations. Onsite industrial workers are not exposed to groundwater; therefore, this pathway was not evaluated. For future construction workers, the HHRA concluded that there would be no cancer risk for exposure to the Site 17 soils (surface and subsurface), but exposure to surface soils did present an unacceptable noncancer risk. Again, the risk from exposure to the soil was due to the arsenic concentration at one sampling location. The HHRA found no unacceptable risk to the future construction worker exposed to the Site 17 groundwater. The RI HHRA did not evaluate the residential exposure scenario because there was no anticipated future residential use of this site. Based on the results of the Phase II RI and the HHRA, a FFS was recommended to develop, screen, and evaluate remedial alternatives for Site 17.

### **Focused Feasibility Study (2003)**

In 2003, the Navy completed an FFS to develop and evaluate site-specific remedial alternatives for Site 17. Subsequent to the completion of the RI, the railroad lines at Site 17 were refurbished. During the refurbishment, arsenic-contaminated soils determined during

the RI to pose a risk to human health were excavated. In 2001, a sampling event was conducted to collect soils for arsenic analysis following the refurbishment. The FFS included a revised HHRA based on the 2001 sampling data to reassess the risks to human health using the current site conditions. The revised HHRA found no unacceptable risk to either the current/future onsite industrial worker or future construction workers exposed to Site 17 soils. The 2001 sampling event included an additional round of groundwater sampling for limited inorganic constituents in order to further assess the Maximum Contaminant Level (MCL) exceedances detected in the Phase II RI. Additionally, the revised HHRA contained a preliminary evaluation of the residential surface soil exposure scenario. Upon initial examination of potential risk to future residents, an unacceptable noncancer risk was identified for a future resident child exposed to site surface soil. Since future residential development of the site is highly unlikely, and no unacceptable risks were identified under the current land use scenario, it was decided that risks to the future residential receptor would not be further quantified. As a result, the FFS focused on No Action and LUCs as remedial alternatives under the existing land use scenario.

#### **Site Investigation (February 2004 and October 2004)**

Subsequent to the completion of the FFS in 2003, the NNSY identified Building 195 – Plating Shop for demolition. Although no specific reuse plans for this area have been identified, the site use will remain industrial due to its location within the shipyard. As a result of pending building demolition, the Navy conducted additional investigation of the soils beneath Building 195 – Plating Shop in February and October 2004. The HHRA was revised to incorporate the 2004 site investigation data and updated regulatory comparison criteria/standards. The revised HHRA found no unacceptable risk to either the current/future onsite industrial worker or future construction workers exposed to Site 17 soils. The 2004 sampling event included an additional round of groundwater sampling for limited inorganic constituents in order to further assess the previously detected MCL exceedances. Potential risk from residential use of groundwater was qualitatively evaluated by comparing the site data against regulatory screening criteria. Based on this comparison and the evaluation of NNSY background concentration of metals naturally occurring in groundwater, the NNSY Project Management Team (PMT) identified only arsenic as a chemical of potential concern (COPC) for the future resident exposed to the Site 17 groundwater. A technical memorandum was prepared to document the results of the investigation and the revised HHRA; the technical memorandum is included as an appendix to the revised FFS.

#### **Revised Focused Feasibility Study (2006)**

The Navy revised the FFS in 2006 to incorporate the results of the 2004 SI and the revised HHRA and to re-evaluate remedial alternatives for Site 17 based on the risk calculated in the HHRA. In addition, the Revised FFS provides a qualitative ecological risk assessment (ERA), which evaluates the potential for ecological risk. The Revised FFS evaluates two remedial alternatives developed to mitigate the identified risks to human health and the environment at Site 17: No Action and LUCs. Conclusions of the HHRA and assessment of ecological risk included in the Revised FFS are provided in the following sections of this ROD.

### Proposed Plan (2006)

In February 2006, the Navy completed a Proposed Plan describing the remedial alternatives evaluated and identified the preferred remedy for soil at the site. The Proposed Plan was made available to the public in March 2006. Comments received during the public review period are discussed in Section 3.

### 2.2.3 Enforcement Activities

No enforcement activities have occurred to date at the site.

## 2.3 Community Participation

The Navy and EPA provide information regarding the cleanup of NNSY to the public through the Community Relations Program, which includes a NNSY Restoration Advisory Board (RAB) that was formed in 1994, public meetings, the Administrative Record file, the Information Repository, and announcements published in the local newspaper. The RAB provides a forum for the exchange of information among community members, the Navy, EPA, and VDEQ. During the course of investigations at Site 17, the RAB has been apprised of all environmental activities related to the site.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from March 5 through April 5, 2006, for the Proposed Plan for Site 17. A public meeting to present the Proposed Plan was held on March 23, 2006, at the Portsmouth Main Branch Library, Portsmouth, Virginia. Public notice of the meeting and availability of documents was placed in *The Virginian-Pilot* newspaper on March 5, 2006. The Proposed Plan and previous investigation reports for Site 17 are available to the public in the Administrative Record maintained at:

NAVFAC Atlantic  
Lafayette River Annex  
6508 Hampton Boulevard  
Norfolk, Virginia 23508

Or, in the Information Repository located at:

Portsmouth Main Branch Public Library  
601 Court Street  
Portsmouth, Virginia 23704  
(757) 393-8501

## 2.4 Scope and Role of the Remedy

The selected remedy for Site 17 is based on findings of investigations as documented in the Administrative Record. The Navy, EPA, and VDEQ entered into an FFA to ensure that the environmental impacts associated with past and present activities at NNSY are thoroughly investigated and appropriate remedial action is taken, as necessary, to protect public health and welfare and the environment, and to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at NNSY in

accordance with CERCLA, as amended, and the NCP. The NNSY FFA identifies and categorizes every area of the shipyard, including annexes, that have been identified as having, or is suspected to have had, a historical release of a hazardous substance.

Site 17 is one of seven IRP sites identified in the FFA for investigation under CERCLA, with ultimate closure performed pursuant to a ROD. One of these IRP sites, Site 2—Scott Center Landfill, was closed with a No-Action ROD in October 2005. The remaining five IRP sites are Sites 3 through 7 and are part of Operable Unit (OU) 2 at NNSY. These sites are still under investigation. The NNSY FFA also identified two site screening areas (Site 10 and Site 15) for further investigation and a list of 154 sites for which no further action under CERCLA is required.

The selected remedy for Site 17 constitutes the final remedy for the site and addresses all potential risks posed by exposure to soil. The response action for Site 17 does not affect any other sites at NNSY. The selected remedy will mitigate the potential risk to human health associated with exposure to soil at Site 17 by preventing exposures to residential receptors through the implementation of LUCs. LUCs will be maintained within the boundaries of Site 17 (Figure 2) until such time that conditions at the site allow for unlimited use and unrestricted exposure. Within 90 days following the execution of this ROD, the Navy shall develop and submit to EPA and VDEQ, in accordance with the FFA, an RD that defines the detailed implementation actions for the remedy. LUC implementation actions will include periodic inspections and reporting to ensure that unacceptable exposure will not occur at the site.

## 2.5 Site Characteristics

NNSY is an industrial facility dedicated to ship repair and overhaul. The Southern Branch of the Elizabeth River is the eastern boundary of NNSY, and the area surrounding NNSY is industrial, commercial, and residential. Site 17 is located in the main industrial area of NNSY, completely within the CIA. Site 17 soil is covered by Building 195—Plating Shop, concrete, and asphalt. Based on previous investigations, past plating operations at Site 17 have resulted in metals contamination of surface and subsurface soil. Polycyclic aromatic hydrocarbons (PAHs) were also present in soil at the site.

Site geology is based on lithologic descriptions from soil boring logs and monitoring-well installation logs. Typically, the upper 3 feet of soil materials consist of brown/dark brown sand and clayey silt fill with traces of brick fragments. The soil from 3 feet to approximately 15 feet below ground surface (bgs) is composed of brown to gray sand and clay/silt. Beneath 15 feet, the soil is gray to light brown silty sand. Generally, a gray silty clay layer is encountered at approximately 20 feet bgs. Groundwater was encountered at depths ranging from 3 to 5 feet bgs and flows east toward the Southern Branch of the Elizabeth River. Groundwater was characterized as part of the Interim RI, Phase II RI, and Site Investigation (February 2004). Surface water runoff flows into catch basins that connect to the NNSY stormwater system, which discharges into the Southern Branch of the Elizabeth River.

### 2.5.1 Conceptual Site Model

The Conceptual Site Model (CSM) for the HHRA is illustrated on Figure 3. The CSM integrates physical characteristics of the site, potentially exposed populations, sources of

contamination, and contaminant mobility (fate and transport) to identify exposure routes and receptors evaluated in the risk assessment for soil. Historical sources at Site 17 were most likely spills of plating solutions (containing metals and cyanide) onto the concrete floor of the building or leakage from the plating tank systems. Following release to the soil, the potential contaminant transport pathway at Site 17 is leaching of soil contaminants to groundwater. Because the site is covered by building, concrete, or asphalt, and all surface water runoff is directed to the stormwater system, there is little opportunity for infiltration to contribute to potential leaching of metals in soil.

Activities at the industrialized area of NNSY Site 17 are anticipated to continue for the foreseeable future. The site is located within the CIA, a secure area with fencing and guarded entry points requiring security clearance for access. Therefore, current/future human receptors potentially exposed to chemicals detected in surface and subsurface soil at Site 17 are limited to onsite industrial and construction workers. Future adult construction workers were considered to be potentially exposed to constituents in the groundwater. Total inorganic concentrations are considered to be more representative of groundwater exposures from direct contact with the aquifer (that is, shallow groundwater contacted during ditch excavation) than dissolved concentrations.

## 2.5.2 Sampling Strategy

Investigations of Site 17 that involved sampling of environmental media were conducted in several phases, including the 1989 interim RI, 1995 Phase I RI/FS, 1999 Phase II RI, and supplemental data collection efforts in 2001 and 2004. Field sampling activities included the collection of surface and subsurface soil samples from both hollow stem auger and direct push technology sampling methods. Groundwater samples were collected from monitoring wells using low flow sampling methods. A summary of sampling and analyses conducted at Site 17 for use in risk evaluation is provided in Table 1, and sample locations are shown in Figure 2.

## 2.5.3 Nature and Extent of Contamination

Based on the evaluation of all groundwater data, the Navy, in partnership with EPA and VDEQ, determined there are no COCs in groundwater. This determination is based on comparison to background concentrations, the absence of a discernable plume, and the 95% upper confidence limit (UCL) site concentrations for inorganics are below corresponding MCLs.

- Metals, PAHs, and a few pesticides are present in surface soil (sampled from 0 to 6 inches) and subsurface soil (sampled from 1 to 3 feet and 3 to 6 feet) at concentrations elevated above background. Concentrations of metals are generally higher in soils beneath Building 195—Plating Shop. Table 2 presents a summary of the surface soil COPCs for the current and future onsite industrial worker receptor; surface soil, subsurface soil, and groundwater COPCs for the current and future construction worker receptor; and the groundwater COPC screening process for the future residential receptor.

## 2.5.4 Current and Potential Future Surface and Subsurface Routes of Exposure and Receptors

Site 17 is covered by asphalt, concrete, and Building 195 – Plating Shop and is located within the CIA. The land use is not anticipated to change in the foreseeable future; therefore, the only current/future exposure potential is to a construction worker, allowed access to the CIA, conducting intrusive activities resulting in contact with soil. The primary migration pathway for contaminants in soil is through potential leaching to groundwater. The potential for leaching contaminants from the soil is low since the area is impervious to infiltration and all runoff is directed through the NNSY stormwater system. Additionally, metals naturally adhere to soil particles and are not transported easily.

## 2.5.5 Aquifer Characteristics

Groundwater, encountered at depths ranging from 3 to 5 feet bgs, flows east to discharge to the Southern Branch of the Elizabeth River. The hydraulic gradient of the water table aquifer (Columbia Aquifer) is very flat (0.004 ft/ft) from northwest to southeast. The average estimated hydraulic conductivity is 2.80 feet/day, and the estimated average linear groundwater velocity is 0.032 feet/day. Existing data do not indicate groundwater impacts from leaching of contaminants in soil at Site 17.

## 2.6 Current and Potential-Future Land and Resource Uses

Current use of the site for plating operations is limited and a portion of the plating tanks have been removed. Even though the Navy plans to relocate the plating shop and demolish Building 195 – Plating Shop, the land use will remain industrial and access to the site will remain restricted. There are no other planned future land use changes, and the LUC remedy will remain in place until contaminant concentrations are reduced to levels that allow for unrestricted use and unlimited exposure or other remedial actions under CERCLA are taken to ensure that site conditions are sufficiently protective to allow for unrestricted use and unlimited exposure.

Shallow groundwater is currently not used as a water supply at, or in the vicinity, of NNSY. The City of Portsmouth supplies water to NNSY and surrounding communities using a combination of surface water and deep groundwater (aquifers greater than 500 feet bgs). The Southern Branch of the Elizabeth River is 1,875 feet downgradient of Site 17; therefore, only limited use of the groundwater down gradient of the site can be expected and current or future use of shallow or deep groundwater is, or will be, hydraulically upgradient from the site.

## 2.7 Summary of Site Risks

The potential human health risks associated with exposure to soil within Site 17 were quantitatively evaluated for industrial land use exposure scenarios as part of the Phase I and Phase II RI Report, and subsequent 2001 and 2004 supplemental data collection efforts. Potential human health risks associated with residential soil exposure scenarios were qualitatively evaluated and assumed to be unacceptable for Site 17. Therefore, the response

action selected in this ROD is necessary to protect the public health and welfare associated with potential unacceptable soil risk to residential receptors.

The potential human health risks associated with exposure to groundwater within Site 17 was quantitatively evaluated for the construction worker as part of the Phase II RI Report, and it determined that there was no unacceptable risk to the construction worker. Onsite industrial workers are not exposed to groundwater; therefore, risk to this receptor was not evaluated. Additional groundwater sampling for limited inorganic constituents was conducted subsequent to the Phase II RI to further assess the MCL exceedances. Potential risk from residential use of groundwater was initially qualitatively evaluated by comparing all the groundwater data against regulatory screening criteria. Based on this comparison and the evaluation of NNSY background concentration of metals naturally occurring in groundwater, the NNSY PMT identified only arsenic as a COPC for the future resident exposed to the Site 17 groundwater. The NNSY PMT concluded that human health risks associated with residential use of groundwater are not unacceptable based on background concentrations, statistical evaluation, and absence of a discernable plume in groundwater.

Details of the HHRA and the ecological risks are presented in the revised FFS Report (Baker, 2006). This information is summarized in the following sections.

### **2.7.1 Human Health Risk Assessment**

The source of potential human health risk is soil containing metals elevated above background levels associated with potential releases from former plating operations. The baseline HHRA estimates the risks that exposure to groundwater and soil at the site would pose if no remedial action were taken. It provides the basis for taking action and identifies the site-related contaminants and exposure pathways that may need to be addressed by a remedial action. It can also be used to support the determination that no remedial action is necessary to protect human health.

No unacceptable risks from soil exposure were identified in the HHRA for current and future onsite industrial or construction worker scenarios. No unacceptable risks from groundwater exposure were identified in the HHRA for current and future construction worker scenarios. The on-site workers are not exposed to groundwater; therefore, risk to the on-site worker from exposure to groundwater is not evaluated.

Unlimited use and unrestricted exposure to soil is assumed to pose potentially unacceptable risk. Potential unacceptable risk from potable use of groundwater was initially qualitatively evaluated through comparison to MCLs. Based on this comparison and the evaluation of NNSY background concentration of metals naturally occurring in groundwater, the Navy in partnership with EPA (project manager, toxicologist, and hydrogeologist) and VDEQ agreed that human health risks associated with potable use of groundwater are not unacceptable.

#### **Identification of Chemicals of Concern**

The selection of COPCs is a conservative screening process that identifies those chemicals that may be present at the site at concentrations that could result in risks to exposed receptors. The maximum detected concentration of each constituent in each medium (surface soil, subsurface soil, and groundwater) was compared to a screening value to select

the COPCs. If the maximum detected concentration of a constituent exceeded the screening value, the constituent was selected as a COPC and retained for further evaluation.

The EPA Region III risk-based concentrations (RBCs) for industrial land use were used as the screening levels to identify COPCs in soil for the current and future onsite industrial or construction worker receptors. All soil data collected as part of the Phase II RI and the FFS (including the 2001 and 2004 sampling events) were evaluated in the COPC selection process. The MCLs and EPA Region III Tapwater RBCs were used as the groundwater screening criteria to identify the COPCs to evaluate potential risk to the construction worker. The groundwater data collected as part of the Phase II RI were evaluated in the COPC selection process for this receptor.

Potential human health risks associated with residential soil exposure scenarios were qualitatively evaluated against residential RBCs and an unacceptable risk for this exposure scenario is assumed; therefore, no specific COPCs for this receptor are identified. The MCLs were used as the groundwater screening criteria to identify the COPCs to evaluate potential risk to the future residential receptor. The groundwater data collected as part of the Phase II RI and the FFS (including the 2001 and 2004 sampling events) were evaluated in the COPC selection process for this receptor.

Table 2 presents a summary of the surface soil COPCs for the current and future onsite industrial worker receptor; surface soil, subsurface soil, and groundwater COPCs for the current and future construction worker receptor; and the groundwater COPC screening process for the future residential receptor. Vanadium was originally included in HHRA calculations based upon a maximum detected concentration of 318 mg/kg in surface soil. Based upon the Dixon statistical outlier test as documented in Appendix C and Appendix F of the *Revised Final FFS for Site 17* (Baker, 2005) and as referenced in the technical memorandum *Human Health Risk Assessment Summary Site 17, Building 195 and Vicinity, Norfolk Naval Shipyard, Portsmouth, Virginia* (CH2M HILL, November 2005), vanadium was subsequently removed from the list of COPCs for Site 17 and excluded from risk calculations for the site.

COCs are a subset of the COPCs. COCs are identified as those site-related chemicals posing potential unacceptable risk. Because human health risks were not quantified for residential use scenarios and unacceptable risk from residential exposure to soil is assumed, no specific residential COCs for soil are identified. Similarly, because the Navy, in partnership with EPA and VDEQ, determined that potential human health risks associated with potable use of groundwater are not unacceptable, there are no COCs for groundwater identified.

## Exposure Assessment

The human health exposure assessment identifies and evaluates the contaminant sources, release mechanisms, exposure pathways, exposure routes, and receptors. The elements of the exposure assessment for Site 17 are identified in the CSM (Figure 3). An estimate of risk was developed for Site 17, evaluating exposure to surface soil for current and future onsite industrial workers and future construction workers. The reasonable maximum exposure (RME) scenario was evaluated for each receptor. The RME scenario represents the highest level of human exposure that could reasonably be expected to occur. For scenarios where the RME hazard or risk was greater than the EPA target level, the central tendency exposure

(CTE) scenario was evaluated to provide additional information. The CTE scenario portrays the median exposure estimate and corresponding risk rather than the upper limit or maximum exposure estimate.

Pathway-specific information for these receptors, such as the values of exposure parameters used to quantify exposure, is presented in the Phase II RI and updated HHRA in the FFS (Baker, 1999; Baker, 2005). Exposure factors used in the HHRA were compiled from EPA sources and professional judgment when necessary, as described in the baseline HHRA included in the RI report (Baker 1999; Baker 2005).

### Toxicity Assessment

This section provides the methodologies for the characterization of the potential human health risks associated with the potential exposure to media at Site 17. The toxicity assessment identifies the potential adverse health effects in exposed populations. Toxicity values used in the HHRA were obtained from EPA sources.

The toxicity value used to evaluate carcinogenic effects is the cancer slope factor (CSF). The CSF is an upper-bound estimate of the probability that a person will develop cancer over a lifetime based on a given dose. The toxicity value used to evaluate noncarcinogenic effects is the reference dose (RfD). The RfD is an estimate of the daily exposure level for the human population that is likely to be without appreciable risk during an established period of time, ranging from several weeks to a lifetime, depending on the exposure scenario being evaluated. The RfDs and CSFs used in this HHRA are summarized on Tables 3 and 4 for noncancer and cancer toxicity data, respectively.

### Risk Characterization

The results of the exposure and toxicity assessments were used to develop numerical estimates and characterize the potential health risks associated with site-related contamination. For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. These risks are probabilities, which usually are expressed in scientific notation (e.g.,  $1 \times 10^{-6}$ ). An excess lifetime cancer risk of  $1 \times 10^{-6}$  indicates that an individual experiencing the RME exposure has a 1 in 1,000,000 one chance in a million of developing cancer as a result of site-related exposure. This risk is referred to as “excess lifetime cancer risk” because it would be in addition to the risks of cancer individuals face from other causes such as smoking. The NCP at 40 Code of Federal Regulations (CFR) Section 300.430(e)(2)(i)(A)(2) indicates that a generally acceptable risk range for site-related exposures is  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ .

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (for example, lifetime) with an RfD derived for a similar exposure period. An RfD represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor’s dose of a single contaminant is less than the RfD and that toxic noncarcinogenic effects from that chemical are unlikely, even in sensitive subpopulations. The hazard index (HI) is generated by adding the HQs for all COPCs that affect the same target organ (for example, the liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI of less than 1 indicates that, based on the sum of all HQs

from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI of greater than 1 indicates that site-related exposures may present a risk to human health.

### Current/Future Onsite Industrial Workers

Current and future onsite industrial workers were evaluated for exposures to surface soil at Site 17. A summary of risk characterization results for these receptors is provided in Table 5. The total site carcinogenic risk ( $7.5 \times 10^{-5}$ ) for this receptor group was within EPA's acceptable target range. The total site HI for RME (0.29) was below the EPA's target risk level (1).

### Future Adult Construction Workers

Future adult construction workers were evaluated for exposures to surface and subsurface soil and to groundwater. A summary of risk characterization results for these receptors is provided in Table 5. The total carcinogenic risk ( $9.1 \times 10^{-6}$ ) for this receptor was within EPA's acceptable target risk range. The RME HI for exposure to groundwater was equal to the target HI of 1. Although the HI for RME exposure to all media (2.5) exceeds the EPA target HI, the CTE HI (0.60) for a future construction worker across all media is below the target HI of 1; therefore, the Navy, in partnership with EPA and VDEQ, have determined the risk to be acceptable.

### Future Residential Receptors

The human health risk associated with future residential exposure to soil is assumed based on a qualitative evaluation; therefore, a quantitative risk assessment, with risk characterization, was not completed for this exposure scenario. The human health risk associated with the potable use of the groundwater is based on the comparison of groundwater data from the Phase II RI and the FFS (including the 2001 and 2004 sampling events) to MCLs, and the evaluation of NNSY background concentration of metals naturally occurring in groundwater. Upon the evaluation of this data, the NNSY PMT agreed only to further quantify the risk posed by arsenic in the potable use of the groundwater. A summary of risk characterization results for this exposure scenario is provided in Table 6. The Navy in partnership with EPA (project manager, toxicologist, and hydrogeologist) and VDEQ determined that human health risks associated with potable use of groundwater are acceptable based on the following findings:

- Although maximum concentrations of aluminum, iron, and manganese exceed the secondary MCLs, mean concentrations of these metals are below background upper tolerance limits (UTL) established for NNSY groundwater.
- Exposure point concentrations for arsenic in groundwater at the MCL (10 µg/L) and background maximum (12.1 µg/L) present similar risk when compared with the site maximum concentration (20.8 µg/L).
- The 95% UCL concentration of arsenic in Site 17 groundwater is 9.2 µg/L, which is below the MCL of 10 µg/l and background maximum for NNSY.
- There is no discernable plume of arsenic in groundwater.

## Uncertainty

Various factors throughout the HHRA lead to uncertainty that can overestimate or underestimate the potential risk. For example, several of the toxicity values used to quantify risk in this assessment are considered provisional and therefore the quantitative risk estimates derived from these values are subject to greater uncertainty. Exposure factors used in the assessment for dermal contact with soil are also uncertain and were conservatively chosen. Specifically, the soil adherence factors used for both the onsite industrial worker and construction worker were more conservative than the value recommended by EPA; therefore the dermal assessments in this HHRA overestimate actual exposure (and hence risk) based on soil dermal contact. The combination of many conservative assumptions (that is, in the exposure assessment and in the toxicity assessment) have likely resulted in an overestimate of risk at the site. The risk to human receptors exposed to soil is unlikely to be greater than that predicted by the risk assessment.

### 2.7.1 Summary of Ecological Risks

The Revised FFS provides a qualitative ERA to evaluate the potential for ecological risk. Site 17 is an industrial site; because the site is entirely paved, it provides no viable ecological habitat. As such, there is no exposure pathway for ecological receptors at Site 17. In addition, the Revised FFS concluded that ecological receptors are not adversely affected by groundwater through chemical exposure routes from groundwater to surface water and/or sediment. Therefore, Site 17 poses no unacceptable ecological risk.

## 2.8 Remedial Action Objectives

The RAOs are established based on the nature and extent of contamination, the resources that are currently and/or potentially threatened, the potential for human exposure, and the reasonably anticipated future land use. The risk to potential future residents exposed to surface and subsurface soil at Site 17 was not quantified since unacceptable residential risks were assumed and LUCs to prohibit residential development or unrestricted access to the site would be effective to mitigate such exposure. Therefore, there are no specific COCs or remediation goals established for the LUC selected remedy.

The RAO for Site 17 is to prevent unrestricted exposure to contaminated soil.

## 2.9 Description of Alternatives

To achieve the RAO to prevent unrestricted exposure to surface and subsurface soil at Site 17, the Navy, in partnership with VDEQ and EPA, has determined that LUCs can be reasonably relied upon to protect human health and the environment and are warranted for Site 17. By comparison, remedial alternatives intended to treat or remove contamination would be more costly and unnecessary because the current and reasonably anticipated future land use of the site does not pose a risk to human health. Therefore, the remedial alternatives developed and evaluated for this site are:

- Alternative 1: No Action
- Alternative 2: LUCs

The No Action alternative involves no remedial action, and was included as a baseline for comparison. The LUCs alternative will effectively prevent future land use from becoming residential, and will therefore restrict residential receptor exposure.

### 2.9.1 Alternative 1: No Action

**Description.** Evaluation of the No Action Alternative is required by the NCP to provide a baseline comparison for other remediation alternatives. Under the No Action Alternative, no additional controls or remedial technologies would be implemented and no further site-related monitoring or maintenance would be conducted. Under this alternative, the RAO would not be met.

**Cost.** There are no capital or O&M costs related to this alternative.

### 2.9.2 Alternative 2: LUCs

**Description.** The LUCs will be implemented by the Navy to prohibit unrestricted access to the site and to prohibit the development and use of the property for residential housing, elementary and secondary schools, childcare facilities, or a playground. LUCs will be maintained within the boundaries of Site 17 (Figure 2) until such time that site conditions are quantitatively assessed for purposes of all potential receptors and any additional actions necessary under CERCLA are completed to remediate the site to allow for unlimited use and unrestricted exposure. Within 90 days following the execution of this ROD, the Navy shall develop and submit to EPA and VDEQ, in accordance with the FFA, an RD that defines the detailed implementation actions for LUCs. LUC implementation actions will include periodic inspections and reporting to ensure continued protection from unacceptable exposure. The Navy will implement, maintain, report on, and enforce the LUCs according to the RD. These actions will reduce unacceptable risks to receptors by eliminating direct exposure to contaminated soil.

**Cost:** Present worth costs were calculated over a 30-year period, using an interest rate of 3.2 percent. The estimated costs of Alternative 2 are as follows:

- Annual Inspections: \$1,000
- 5-Year Statutory Review: \$5,000
- Net present worth (30-year): \$38,000

### 2.9.3 Common Elements and Distinguishing Features

Both alternatives do not address remediation of the site soil and subsurface soil; however, Alternative 2 protects against exposure to soil contaminants by restricting access to the site while Alternative 1 provides no protection to receptors.

## 2.10 Comparative Analysis of Alternatives

The LUC remedy for Site 17 was evaluated during the FFS against nine criteria, as required by the NCP at 40 CFR Section 430 (e)(9). The evaluation is summarized below. The evaluation determined that Alternative 1 (No Action) is inadequate because it will not achieve the RAOs and performs far worse than Alternative 2 against the nine criteria.

- 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, 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 clean-up 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 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 operations and maintenance 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 preferred alternative.

### 2.10.1 Threshold Criteria

#### Overall Protection of Human Health and the Environment

The LUCs provided in Alternative 2 would result in a high degree of overall protection by preventing unacceptable exposure to soil and ensuring that future land use remains consistent with the LUC objectives. The No Action Alternative, Alternative 1, would not guarantee protection of human health because land use and site access would not be restricted, potentially resulting in unacceptable exposure.

## Compliance with ARARs

Alternative 2, LUCs, meets ARARs; Alternative 1, No Action, does not. ARARs applicable to the remedy in this ROD are included in Appendix A. This ROD does not waive any ARARs for this remedy.

## 2.10.2 Primary Balancing Criteria

### Long-Term Effectiveness and Permanence

Alternative 2 would allow for continued land use as an industrial site, and the remedial design would include monitoring and maintenance to ensure protectiveness and permanence over time. Although Alternative 2 will not remediate the site and will result in a residual risk remaining at the site, Alternative 2 will effectively eliminate unrestricted exposure to soil, which will achieve the RAO. Alternative 1 provides no long-term effectiveness or permanence and does not meet the RAO for the site.

### Reduction of Toxicity, Mobility, or Volume Through Treatment

Neither alternative would reduce the toxicity, mobility, or volume of potential contaminants through active treatment.

### Short-Term Effectiveness

Both alternatives will be effective in the short-term because Site 17 is located completely within the CIA, access to which is extremely restricted. Otherwise, neither alternative poses any short-term risks to human health or the environment because no active remedial actions are planned for soil other than maintenance and administrative actions associated with land use restrictions.

### Implementability

No action would be implemented under Alternative 1. For Alternative 2, the Navy has proven capability to restrict access to specific areas within the installation and to conduct periodic monitoring of the facility. Alternative 2 is easily implemented by the Navy.

### Cost

The 30-year net present worth costs for the two soil alternatives are summarized below.

- Alternative 1: \$0
- Alternative 2: \$38,000

## Modifying Criteria

### State Acceptance

The Commonwealth of Virginia was involved throughout the CERCLA process and in the selection of the remedy for Site 17. The VDEQ, as the designated state support agency in Virginia, has reviewed this ROD and has given concurrence on the selected remedy by letter included in the Administrative Record.

### Community Acceptance

No written comments, concerns, or questions were received by the Navy, EPA, or the Commonwealth of Virginia during the public comment period from March 5 through April 5. A public meeting was held on March 23, 2006 to present the Proposed Plan for Site 17 and answer questions on the Proposed Plan and documents in the Administrative Record. There was no public attendance at the public meeting and no written comments from the public were received during the public comment period.

## 2.11 Principal Threat Wastes

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site whenever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. There are no principal threat wastes present at Site 17.

## 2.12 Selected Remedy

The selected remedy for contaminated soil at Site 17 is LUCs.

### 2.12.1 Summary of the Rationale for the Selected Remedy

LUCs are the selected remedy for Site 17 to protect humans from exposure to soil or subsurface soil in a future residential scenario. Soil is the only media that was not evaluated for unrestricted land use, and therefore is assumed to pose a potential unacceptable risk for unlimited use and unrestricted exposure at Site 17. For over 200 years the site area has been industrial, and the Navy has no plans to use the property for anything other than industrial use. The area is entirely covered by concrete, asphalt, or Building 195—Plating Shop, and all surface water is directed to the NNSY stormwater system. There are no unacceptable risks to current or future onsite industrial or construction workers, and unacceptable residential risks from soil exposure scenarios are assumed. Because the area is currently industrial and is intended to remain industrial use only, LUCs can be reasonably relied upon to protect human health, and are warranted for Site 17; therefore, no remediation goals are established for the LUC remedy. The Navy, in partnership with EPA and VDEQ, considered no action and LUCs as remedial alternatives, ruling out other more costly remedial alternatives. No action would not protect against the risk of future residential exposure. Consequently LUCs are the selected remedy for Site 17.

### 2.12.2 Description of the Selected Remedy

The objectives of the selected LUC remedy are to prohibit unrestricted access to Site 17 and to prohibit the development and use of the property for residential housing, elementary and secondary schools, childcare facilities, or a playground. The Navy will delineate Site 17 on the GIS map of the installation with a notation regarding the soil contamination and the LUCs required by this ROD. The remedy will also restrict access to Site 17 by unauthorized personnel and unaccompanied children or trespassers. LUCs will be maintained within the boundaries of Site 17 (Figure 2) until such time that additional actions under CERCLA are completed to ensure that the concentrations of hazardous substances in the soil are at levels to allow for unlimited use and unrestricted exposure. Within 90 days following the execution of this ROD, the Navy shall develop and submit to EPA and VDEQ, in accordance with the FFA, an RD that defines the detailed implementation actions for LUCs. LUC implementation actions will include periodic inspections and reporting to ensure that unacceptable exposure will not occur on the site. The Navy will implement, maintain, report on, and enforce the LUCs according to the RD. These actions will reduce unacceptable risks to receptors by eliminating direct exposure to contaminated soil.

The estimated costs of LUCs are:

- Annual Inspection: \$1,000
- 5-Year Statutory Review: \$5,000
- Net present worth (30-year): \$38,000

### 2.12.3 Expected Outcome of the Selected Remedy

The current restricted industrial land use is expected to continue at Site 17, and there is no other planned land use in the foreseeable future. Once LUCs are implemented, exposure will be controlled until such time that additional actions under CERCLA are completed that allow for unlimited use and unrestricted exposure. The effectiveness of the LUCs will be monitored through implementation of maintenance actions, including periodic inspections and reporting, which will be documented in accordance with the LUC RD.

## 2.13 Statutory Determinations

The 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 as a principal element of the remedy to the extent practicable

The evaluation of how the selected remedy for Site 17 satisfies these requirements is presented below.

### **2.13.1 Protection of Human Health and the Environment**

The selected remedy will protect human health and the environment by preventing exposure to soil at Site 17. The LUCs will prevent exposure in the short- and long-term, and will afford an effective level of protection.

### **2.13.2 Compliance with ARARs**

The selected remedy will meet all identified ARARs, as described in Appendix A.

### **2.13.3 Cost-Effectiveness**

The selected remedy is cost-effective and represents a reasonable value for maintaining LUCs. The remedy is cost-effective because its costs are proportional to its overall effectiveness. Overall effectiveness was evaluated by assessing balancing criteria in combination. The total present worth cost of the selected remedy in this ROD is \$38,000. The selected remedy is cost-effective because it provides maximum protection of human health and the environment and is proportional to the cost.

### **2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable**

The Navy, EPA, and VDEQ determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at Site 17.

### **2.13.5 Preference for Treatment as a Principal Element**

The use of a treatment alternative for soil, in lieu of disposal, is not cost-effective or practicable for this site.

### **2.13.6 Five-Year Review Requirement**

The Navy will maintain LUCs and conduct a statutory remedy review within 5 years after initiating remedial action, every 5 years thereafter, to ensure LUCs continue to provide adequate protection of human health and the environment.

## **2.14 Documentation of Significant Changes**

No significant changes to the remedy have been made since the time it was presented as the Preferred Alternative in the Proposed Plan.

SECTION 3

# Responsiveness Summary

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Public input is a key element in the decision making process. The Proposed Plan was made available on March 5, 2006. In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from March 5, 2006 through April 5, 2006, for the proposed remedial action described in the Proposed Plan for Site 17. The Proposed Plan was available to the public in the Administrative Record for NNSY. The Information Repository for the Administrative Record is maintained at the following location:

Portsmouth Main Branch Public Library  
601 Court Street  
Portsmouth, Virginia 23704  
(757) 393-8501

A public meeting was held on March 23, 2006, at the Portsmouth Main Branch Public Library, to formally present the Proposed Plan for Site 17. Public notice of the meeting and availability of documents was published in *The Virginian-Pilot* newspaper on March 5, 2006. Navy representatives were available to present the Proposed Plan for Site 17 and to answer any questions on the Proposed Plan and on the documents in the Information Repository. No one from the public attended the public meeting, and no comments were received from the public during the public comment period.

## SECTION 4

# References

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**Table 1  
Sampling Summary  
Site 17 Record of Decision  
Norfolk Naval Shipyard  
Portsmouth, Virginia**

<b>1997 Phase II Investigation</b>								
Sample Locations	Date of Sampling	TCL Volatiles	TCL Semivolatiles	TCL Pesticides/PCBs	TAL Total Metals	TAL Dissolved Metals	TAL Cyanide	
<b>Monitoring Wells (groundwater samples):</b>								
17-MW14	3/24/1997	X	X	X	X	X	X	
17-MW15	3/25/1997	X	X	X	X	X	X	
17-MW16	3/25/1997	X	X	X	X	X	X	
17-MW17	3/24/1997	X	X	X	X	X	X	
17-MW18	3/25/1997	X	X	X	X	X	X	
17-MW19	3/24/1997	X	X	X	X	X	X	
17-MW20	3/24/1997	X	X	X	X	X	X	
<b>2001 Phase II Investigation</b>								
<b>Monitoring Wells (groundwater samples for total and dissolved arsenic, cadmium, lead, and thallium only)</b>								
17-MW14	5/2001				X	X		
17-MW15	5/2001				X	X		
17-MW16	5/2001				X	X		
17-MW17	5/2001				X	X		
17-MW18	5/2001				X	X		
17-MW19	5/2001							
17-MW20	5/2001				X	X		
<b>Soil Samples (surface soil - arsenic only)</b>								
17-SS00-01B	4/19/2001				X			
<b>Soil Samples (direct push borings)</b>								
Sample Locations	Depth Interval Identification	Depth of Borehole (feet, bgs) <sup>(1)</sup>	Sampling Interval	TCL Volatiles	TCL Semivolatiles	TCL Pesticides/PCBs	TAL Metals	TAL Cyanide
17-SB01	00	16.0	1.0 - 2.0	X	X	X	X	X
	01		2.0 - 4.0	X	X	X	X	X
17-SB02	00	16.0	1.0 - 2.0	X	X	X	X	X
<b>Soil Samples (monitoring well borings)</b>								
Sample Locations	Depth Interval Identification	Depth of Borehole (feet, bgs) <sup>(1)</sup>	Sampling Interval	TCL Volatiles	TCL Semivolatiles	TCL Pesticides/PCBs	TAL Metals	TAL Cyanide
17-MW17	00	13.0	1.0 - 2.0	X	X	X	X	X
17-MW18	00	13.0	1.0 - 2.0	X	X	X	X	X
17-MW19	00	13.0	1.0 - 2.0	X	X	X	X	X
17-MW20	00	13.0	1.0 - 2.0	X	X	X	X	X
<b>2004 February Investigation:</b>								
<b>Soil Sampling</b>								
Sample Locations	Boring Depth (ft, bgs) <sup>(1)</sup>	Depth Interval ID	Sampling Interval (ft, bgs)	TCL VOCs	TCL SVOCs	TCL Pesticides	TCL PCBs	TAL Metals
17-195B01	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x
17-195B02	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x
17-195B03	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x
17-195B04	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x

**Table 1  
Sampling Summary  
Site 17 Record of Decision  
Norfolk Naval Shipyard  
Portsmouth, Virginia**

Sample Locations	Boring Depth (ft, bgs) <sup>(1)</sup>	Depth Interval ID	Sampling Interval (ft, bgs)	TCL VOCs	TCL SVOCs	TCL Pesticides	TCL PCBs	TAL Metals
<b>February 2004 Soil Sampling, continued</b>								
17-195B05	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x
17-195B06	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x
17-195B07	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x
17-195B08	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x
17-MW21	6.0	00	1 - 3.0	x	x	x	x	x
		02	3.0 - 6.0	x	x	x	x	x
17-195CS01	6.0	00	1 - 3.0	composite samples for full suite TCLP				
17-195CS02	6.0	02	3.0 - 6.0	composite samples for full suite TCLP				
<b>Groundwater Samples</b>								
Sample Locations	Date of Sampling	TCL Volatiles	TCL Semivolatiles	TCL Pesticides/PCBs	TAL Total Metals	TAL Dissolved Metals	TAL Ar/Cd/Pb/Th (total)	
17-MW14	2/15/2004						X	
17-MW15	2/15/2004						X	
17-MW16	2/15/2004						X	
17-MW18	2/15/2004						X	
17-MW20	2/15/2004						X	
17-MW21	2/15/2004	X	X	X	X	X		
<b>2004 October Investigation:</b>								
<b>Soil Samples</b>								
Sample Locations	Boring Depth (ft, bgs) <sup>(1)</sup>	Depth Interval ID	Sampling Interval (ft, bgs)	Total Chromium	Hexavalent Chromium			
17-195SB201	6.0	02		X	X			
17-195SB202	6.0	02		X	X			
17-195SB203	6.0	02		X	X			
17-195SB204	6.0	02		X	X			
17-195SB205	6.0	02		X				
17-195SB206	6.0	02		X				
17-195SB207	6.0	02		X				
17-195SB208	6.0	02		X				

Table 2  
Summary of Chemicals of Potential Concern  
Site 17 Record of Decision  
Norfolk Naval Shipyard  
Portsmouth, Virginia

Surface Soil COPCs - Construction and Onsite Industrial Workers						
Contaminant	Criteria <sup>(1)</sup>	Contaminant Frequency / Range / Location			Exposure Point Concentration Selection	
	Region III Industrial Soil RBC Values	Detection Frequency	Range of Positive Detections	Location of Maximum Detection	95% UCL <sup>(2)</sup>	Exposure Point Concentration
<b>Semivolatiles (µg/kg)</b>						
Benzo(a)anthracene	3,920 C	6/13	53 J - 4000	MW2000	1,037	1,037
Benzo(a)pyrene	392 C	7/13	58 J - 4800	MW2000	1,194	1,194
Benzo(b)fluoranthene	3,920 C	7/13	68 J - 4700	MW2000	1,172	1,172
Benzo(k)fluoranthene	39,200 C	7/13	38 J - 3300 J	MW2000	867	867
Chrysene	392,000 C	8/13	72 J - 4400	MW2000	1,110	1,110
Indeno(1,2,3-cd)pyrene	3,920 C	6/13	56 J - 2900 J	MW2000	779	779
<b>Pesticides (µg/kg)</b>						
Aldrin	168 C	5/13	2.6 - 640	17-195SB04-00	197	197
Dieldrin	179 C	6/13	1.9 J - 1400	17-195SB04-00	336	336
<b>Total Inorganics (mg/kg)</b>						
Arsenic	1.91 C	12/13	1.3 K - 34.3	17-195SB07-00	30.2	30.2

Subsurface Soil COPCs - Construction Workers						
Contaminant	Criteria <sup>(1)</sup>	Contaminant Frequency / Range / Location			Exposure Point Concentration Selection	
	Region III Industrial Soil RBC Values	Detection Frequency	Range of Positive Detections	Location of Maximum Detection	95% UCL <sup>(2)</sup>	Exposure Point Concentration
<b>Pesticides (µg/kg)</b>						
Aldrin	168 C	2/6	2.1 - 190	17-195SB04-02	96.1	96.1
Dieldrin	179 C	2/6	2.3 J - 490	17-195SB04-02	247	247
<b>Total Inorganics (mg/kg)</b>						
Arsenic	1.91 C	4/6	4.6 - 9.8 K	SB0101	7.79	7.79
Cadmium	51.1 N	3/6	0.22 - 52.6	17-195SB04-02	26.5	26.5
Chromium VI <sup>(3)</sup>	307 N <sup>(3)</sup>	5/5	2.99L - 56.7L	17-195SB202-01	NC	56.7

Groundwater COPCs - Construction Workers							
Contaminant	Comparison Criteria		Site Analytical Results				Exposure Point Concentration
	MCL (4)	RBC <sup>(5)</sup>	Detection Frequency	Range of Positive Detections	Location of Maximum Detected Concentration	Number of Detections Above Comparison Criteria	
<b>Volatiles (µg/L)</b>							
1,2-Dichloroethene (Total)	100	5.5	1/7	15	MW1601	0	15
Benzene	5	0.36	1/7	5J	MW1601	0	5
Tetrachloroethene	5	1.1	1/7	8J	MW2001	1	8
<b>Semivolatiles (µg/L)</b>							
Naphthalene	-	0.65	1/7	30	MW1601	1	30
<b>Total Inorganics (µg/L)</b>							
Arsenic	10	0.045	2/7	5.8-8.5	MW1601	0	8.5
Cadmium	5	1.8	4/7	0.53-5.3	MW1401	1	5.3
Iron	300	1,100	7/7	587-10,200	MW1601	7	10,200
Manganese	50	73	7/7	44.8-547	MW1801	7	547
Nickel	100	73	7/7	5.8-419	MW1801	1	419
Thallium	0.5	0.26	1/7	9.8K	MW1601	1	9.8

Groundwater COPCs - Residential Receptors and Groundwater Exposure Point Summary for Residential Receptors						
	Data Set	Detection Frequency	Range of Positive Detections	Location of Maximum Detected Concentration	Number of Detections Above Comparison Criteria	Exposure Point Concentration <sup>(6)</sup>
Arsenic	Site Max.	8/18	2.3J-20.8	MW14	4	20.8
Arsenic	Background Max.					12.1
Arsenic	MCL					10

ILCR - Incremental Lifetime Cancer Risk (USEPA acceptable risk range 1.0E-06 to 1.0E-04)  
HI - Hazard Index (USEPA acceptable HI <= 1)

\* These compounds were retained because one or more of its related carcinogenic PAHs were retained, and these compounds are known to exist together in mixtures

- All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals  
USEPA Region III COC Screening Value (derived from USEPA Region III RBC Table - April, 200)
- Estimate of the 95 % upper confidence limit of the mean (95% UCL), based on the Shapiro-Wilks (W-) or D-Agostino (D-) distribution test
- The results shown here are for hexavalent chromium which was collected and analyzed for in October 200
- USEPA's Maximum Contaminant Level for drinking water
- Final Phase II Remedial Investigation Report Operable Unit 4, Site 17 (Building 195 and Vicinity), Baker Environmental Inc., November 199
- See Table 6

COPC - Chemical of Potential Concern  
C = Carcinogenic  
J - Analyte present - Reported value is estimate  
K - Analyte present - Reported value is biased high  
µg/kg - micrograms per kilogram  
µg/L - micrograms per liter  
mg/kg - milligrams per kilogram  
N = Non-Carcinogenic  
NA - Not Applicable  
UCL - Upper Confidence Limit

**Table 3  
Non-Cancer Toxicity Data  
Site 17 Record of Decision  
Norfolk Naval Shipyard  
Portsmouth, Virginia**

ORAL/DERMAL										
Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Aldrin	Chronic	3.0E-05	mg/kg-day	N/A	3.0E-05	mg/kg-day	Liver	1000/1	IRIS	02/01/05
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin/vascular	3/1	IRIS	02/01/05
Benzo(a)anthracene	Chronic	N/A	mg/kg-day	N/A	N/A	mg/kg-day	N/A	N/A	IRIS	02/01/05
Benzo(a)pyrene	Chronic	N/A	mg/kg-day	N/A	N/A	mg/kg-day	N/A	N/A	IRIS	02/01/05
Benzo(b)fluoranthene	Chronic	N/A	mg/kg-day	N/A	N/A	mg/kg-day	N/A	N/A	IRIS	02/01/05
Benzo(k)fluoranthene	Chronic	N/A	mg/kg-day	N/A	N/A	mg/kg-day	N/A	N/A	IRIS	02/01/05
Chrysene	Chronic	N/A	mg/kg-day	N/A	N/A	mg/kg-day	N/A	N/A	IRIS	02/01/05
Dieldrin	Chronic	5.0E-05	mg/kg-day	N/A	5.0E-05	mg/kg-day	Liver	100/1	IRIS	02/01/05
Indeno(1,2,3-cd)pyrene	Chronic	N/A	mg/kg-day	N/A	N/A	mg/kg-day	N/A	N/A	IRIS	02/01/05
Vanadium	Chronic	1.0E-03	mg/kg-day	2.6%	2.6E-05	mg/kg-day	Kidney	300	NCEA	05/01/00

N/A = Not Applicable

- (1) Refer to RAGS, Part E. No adjustment was made if factor is greater than 50%.
- (2) Adjusted Dermal RfD = Oral RfD x Oral to Dermal Adjustment Factor
- (3) For IRIS values, provide the date IRIS was searched.  
For NCEA values, provide the date of the article provided by NCEA.

IRIS = Integrated Risk Information System

NCEA = National Center for Environmental Assessment

**Table 4  
Cancer Toxicity Data  
Site 17 Record of Decision  
Norfolk Naval Shipyard  
Portsmouth, Virginia**

ORAL/DERMAL							
Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	Weight of Evidence/Cancer Guideline Description	Source	Date (2) (MM/DD/YY)
Aldrin	1.7E+01	NA	1.7E+01	(mg/kg-day) <sup>-1</sup>	B2	IRIS	02/01/05
Arsenic	1.5E+00	95%	1.5E+00	(mg/kg-day) <sup>-1</sup>	A	IRIS	02/01/05
Benzo(a)anthracene	7.3E-01	58%-89%	7.3E-01	(mg/kg-day) <sup>-1</sup>	B2	NCEA	07/01/93
Benzo(a)pyrene	7.3E+00	58%-89%	7.3E+00	(mg/kg-day) <sup>-1</sup>	B2	IRIS	02/01/05
Benzo(b)fluoranthene	7.3E-01	58%-89%	7.3E-01	(mg/kg-day) <sup>-1</sup>	B2	NCEA	07/01/93
Benzo(k)fluoranthene	7.3E-02	58%-89%	7.3E-02	(mg/kg-day) <sup>-1</sup>	B2	NCEA	07/01/93
Chrysene	7.3E-03	58%-89%	7.3E-03	(mg/kg-day) <sup>-1</sup>	B2	NCEA	07/01/93
Dieldrin	1.6E+01	NA	1.6E+01	(mg/kg-day) <sup>-1</sup>	B2	IRIS	02/01/05
Indeno(1,2,3-cd)pyrene	7.3E-01	58%-89%	7.3E-01	(mg/kg-day) <sup>-1</sup>	B2	NCEA	07/01/93
Vanadium	NA	2.6%	NA	NA	NA	IRIS	02/01/05

INHALATION								
Chemical of Potential Concern	Unit Risk	Units	Adjustment (1)	Inhalation Cancer Slope Factor	Units	Weight of Evidence/Cancer Guideline Description	Source	Date (2) (MM/DD/YY)
Aldrin	4.9E-03	(µg/m <sup>3</sup> ) <sup>-1</sup>	3,500	1.7E+01	(mg/kg-day) <sup>-1</sup>	B2	IRIS	02/01/05
Arsenic	4.0E-03	(µg/m <sup>3</sup> ) <sup>-1</sup>	3,500	1.5E+01	(mg/kg-day) <sup>-1</sup>	A	NA	N/A
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	8.9E-04	(µg/m <sup>3</sup> ) <sup>-1</sup>	3,500	3.1E+00	(mg/kg-day) <sup>-1</sup>	B2	NCEA	11/18/94
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	4.6E-03	(µg/m <sup>3</sup> ) <sup>-1</sup>	3,500	1.6E+01	(mg/kg-day) <sup>-1</sup>	B2	IRIS	02/01/05
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA

EPA Group:

- A - Human carcinogen
- B1 - Probable human carcinogen - indicates that limited human data are available
- B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
- C - Possible human carcinogen
- D - Not classifiable as a human carcinogen
- E - Evidence of noncarcinogenicity

IRIS = Integrated Risk Information System

NCEA = National Center for Environmental Assessment

(1) Adjustment Factor applied to Unit Risk to calculate Inhalation Slope Factor =  
70kg x 1/20m3/day x 1000ug/mg

(2) For IRIS values, provide the date IRIS was searched.

For NCEA values, provide the date of the article provided by NCEA.

**Table 5**  
**Human Health Risk Summary**  
**Site 17 Norfolk Naval Shipyard**  
**Portsmouth, Virginia**

Receptor	Pathway	Constituent of Concern	RME Cancer Risk	CTE Cancer Risk	RME Non-Cancer Hazard Index	CTE Non-Cancer Hazard Index	
Current/Future Onsite Industrial Worker - Surface Soil	Dermal Absorption	Benzo(a)anthracene	1.4E-06	7.2E-08	--	--	
		Benzo(a)pyrene	1.6E-05	8.2E-07	--	--	
		Benzo(b)fluoranthene	1.6E-06	8.1E-08	--	--	
		Benzo(k)fluoranthene	1.2E-07	6.0E-09	--	--	
		Chrysene	1.5E-08	7.7E-10	--	--	
		Indeno(1,2,3-cd)pyrene	1.1E-06	5.4E-08	--	--	
		Aldrin	4.8E-06	2.4E-07	2.6E-02	3.7E-03	
		Dieldrin	7.7E-06	3.9E-07	2.7E-02	3.8E-03	
		Arsenic	1.9E-05	9.9E-07	1.2E-01	1.7E-02	
	<b>Total Across Pathway:</b>			<b>5.2E-05</b>	<b>2.7E-06</b>	<b>1.7E-01</b>	<b>2.5E-02</b>
	Ingestion (Oral)	Benzo(a)anthracene	2.6E-07	4.2E-08	--	--	
		Benzo(a)pyrene	3.0E-06	4.8E-07	--	--	
		Benzo(b)fluoranthene	3.0E-07	4.7E-08	--	--	
		Benzo(k)fluoranthene	2.2E-08	3.5E-09	--	--	
		Chrysene	2.8E-09	4.5E-10	--	--	
		Indeno(1,2,3-cd)pyrene	2.0E-07	3.1E-08	--	--	
		Aldrin	1.2E-06	1.8E-07	6.4E-03	2.8E-03	
		Dieldrin	1.9E-06	3.0E-07	6.6E-03	2.9E-03	
		Arsenic	1.6E-05	2.5E-06	9.9E-02	4.3E-02	
	<b>Total Across Pathway:</b>			<b>2.3E-05</b>	<b>3.6E-06</b>	<b>1.1E-01</b>	<b>4.9E-02</b>
	Inhalation	Benzo(a)anthracene	--	--	--	--	
		Benzo(a)pyrene	1.3E-10	6.2E-11	--	--	
		Benzo(b)fluoranthene	--	--	--	--	
		Benzo(k)fluoranthene	--	--	--	--	
		Chrysene	--	--	--	--	
		Indeno(1,2,3-cd)pyrene	--	--	--	--	
		Aldrin	1.2E-10	5.6E-11	--	--	
Dieldrin		1.9E-10	9.0E-11	--	--		
Arsenic		1.6E-08	7.6E-09	--	--		
<b>Total Across Pathway:</b>			<b>1.7E-08</b>	<b>7.8E-09</b>	<b>NA</b>	<b>--</b>	
<b>Total Across All Media and All Exposure Routes:</b>			<b>7.5E-05</b>	<b>6.3E-06</b>	<b>2.9E-01</b>	<b>--</b>	
Future Construction Worker - Surface Soil	Dermal Absorption	Benzo(a)anthracene	5.6E-08	8.0E-09	--	--	
		Benzo(a)pyrene	6.5E-07	9.2E-08	--	--	
		Benzo(b)fluoranthene	6.4E-08	9.0E-09	--	--	
		Benzo(k)fluoranthene	4.7E-09	6.6E-10	--	--	
		Chrysene	6.0E-10	8.5E-11	--	--	
		Indeno(1,2,3-cd)pyrene	4.2E-08	6.0E-09	--	--	
		Aldrin	1.9E-07	2.7E-08	2.6E-02	3.7E-03	
		Dieldrin	3.1E-07	4.3E-08	2.7E-02	3.8E-03	
		Arsenic	7.8E-07	1.1E-07	1.2E-01	1.7E-02	
	<b>Total Across Pathway:</b>			<b>2.1E-06</b>	<b>3.0E-07</b>	<b>1.7E-01</b>	<b>2.5E-02</b>
	Ingestion (Oral)	Benzo(a)anthracene	5.1E-08	2.2E-08	--	--	
		Benzo(a)pyrene	5.8E-07	2.6E-07	--	--	
		Benzo(b)fluoranthene	5.7E-08	2.5E-08	--	--	
		Benzo(k)fluoranthene	4.2E-09	1.9E-09	--	--	
		Chrysene	5.4E-10	2.4E-10	--	--	
		Indeno(1,2,3-cd)pyrene	3.8E-08	1.7E-08	--	--	
		Aldrin	2.2E-07	9.8E-08	3.1E-02	1.3E-02	
		Dieldrin	3.6E-07	1.6E-07	3.2E-02	1.4E-02	
		Arsenic	3.0E-06	1.3E-06	4.7E-01	2.1E-01	
	<b>Total Across Pathway:</b>			<b>4.4E-06</b>	<b>1.9E-06</b>	<b>5.4E-01</b>	<b>2.9E-01</b>
	Inhalation	Benzo(a)anthracene	--	--	--	--	
Benzo(a)pyrene		5.3E-12	3.6E-12	--	--		
Benzo(b)fluoranthene		--	--	--	--		
Benzo(k)fluoranthene		--	--	--	--		
Chrysene		--	--	--	--		
Indeno(1,2,3-cd)pyrene		--	--	--	--		
Aldrin	4.8E-12	3.2E-12	--	--			
Dieldrin	7.7E-12	5.2E-12	--	--			

Table 5  
Human Health Risk Summary  
Site 17 Norfolk Naval Shipyard  
Portsmouth, Virginia

Receptor	Pathway	Constituent of Concern	RME Cancer Risk	CTE Cancer Risk	RME Non-Cancer Hazard Index	CTE Non-Cancer Hazard Index
Future Construction Worker - Surface Soil cont'd	Inhalation	Arsenic	6.6E-10	4.4E-10	--	--
		<b>Total Across Pathway:</b>	<b>6.8E-10</b>	<b>4.5E-10</b>	<b>0.0E+00</b>	<b>0.0E+00</b>
	<b>Total Across Surface Soil and All Exposure Routes:</b>		<b>6.5E-06</b>	<b>2.2E-06</b>	<b>7.1E-01</b>	<b>3.8E-01</b>
Future Construction Worker - Subsurface Soil	Dermal Absorption	Aldrin	9.4E-08	1.3E-08	1.3E-02	1.8E-03
		Dieldrin	2.3E-07	3.2E-08	2.0E-02	2.8E-03
		Arsenic	2.0E-07	2.8E-08	3.1E-02	4.4E-03
		Cadmium	--	--	2.1E-02	3.0E-03
		Chromium**	--	--	3.0E-01	4.3E-02
	<b>Total Across Pathway:</b>		<b>5.2E-07</b>	<b>7.4E-08</b>	<b>3.9E-01</b>	<b>5.5E-02</b>
	Ingestion (Oral)	Aldrin	1.1E-07	4.8E-08	1.5E-02	6.6E-03
		Dieldrin	2.7E-07	1.2E-07	2.3E-02	1.0E-02
		Arsenic	7.8E-07	3.4E-07	1.2E-01	5.3E-02
		Cadmium	--	--	1.2E-01	5.4E-02
		Chromium**	--	--	8.9E-02	3.9E-02
	<b>Total Across Pathway:</b>		<b>1.2E-06</b>	<b>5.1E-07</b>	<b>3.7E-01</b>	<b>1.6E-01</b>
	Inhalation	Aldrin	2.4E-12	1.6E-12	--	--
Dieldrin		5.7E-12	3.8E-12	--	--	
Arsenic		1.7E-10	1.1E-10	--	--	
Cadmium		2.4E-10	1.6E-10	4.7E-05	3.1E-05	
Chromium**		1.9E-08	1.2E-08	1.9E-04	1.3E-04	
<b>Total Across Pathway:</b>		<b>1.9E-08</b>	<b>1.3E-08</b>	<b>2.4E-04</b>	<b>1.6E-04</b>	
<b>Total Across Subsurface Soil and All Exposure Routes:</b>			<b>1.7E-06</b>	<b>5.9E-07</b>	<b>7.6E-01</b>	<b>2.2E-01</b>
<b>Total Across Surface and Subsurface Soil and All Exposure Routes:</b>			<b>8.2E-06</b>	<b>2.8E-06</b>	<b>1.5E+00</b>	<b>6.0E-01</b>
Future Construction Worker - Groundwater	Ingestion (Oral)	1,2-Dichloroethene (Total)	--	--	6.5E-03	--
		Benzene	8.1E-09	--	6.5E-03	--
		Tetrachloroethene	2.3E-08	--	3.1E-03	--
		Naphthalene	--	--	5.9E-03	--
		Total Arsenic	7.1E-07	--	1.1E-01	--
		Total Cadmium	--	--	4.1E-02	--
		Total Iron	--	--	1.3E-01	--
		Total Manganese	--	--	9.3E-02	--
		Total Nickel	--	--	8.2E-02	--
		Total Thallium	--	--	1.3E-01	--
	<b>Total Across Pathway:</b>		<b>7.4E-07</b>	--	<b>6.1E-01</b>	--
	Dermal Absorption	1,2-Dichloroethene (Total)	--	--	8.6E-03	--
		Benzene	1.4E-08	--	1.1E-02	--
		Tetrachloroethene	9.2E-08	--	1.2E-02	--
		Naphthalene	--	--	4.2E-02	--
Total Arsenic		6.2E-08	--	9.6E-03	--	
Total Cadmium		--	--	6.8E-02	--	
Total Iron		--	--	5.5E-02	--	
Total Manganese		--	--	1.5E-01	--	
Total Nickel	--	--	6.7E-02	--		
Total Thallium	--	--	1.0E-02	--		
<b>Total Across Pathway:</b>		<b>1.7E-07</b>	--	<b>4.4E-01</b>	--	
<b>Total Across Groundwater and All Exposure Routes:</b>			<b>9.1E-07</b>	--	<b>1.0E+00</b>	--
<b>Total All Media and All Exposure Routes:</b>			<b>9.1E-06</b>	<b>2.8E-06</b>	<b>2.5E+00</b>	<b>6.0E-01</b>

-- not applicable

RME- Reasonable Maximum Exposure

CTE- Central Tendency Exposure

\* Dataset does not include the outlier.

\*\* Based on hexavalent chromium analytical results (not total chromium).

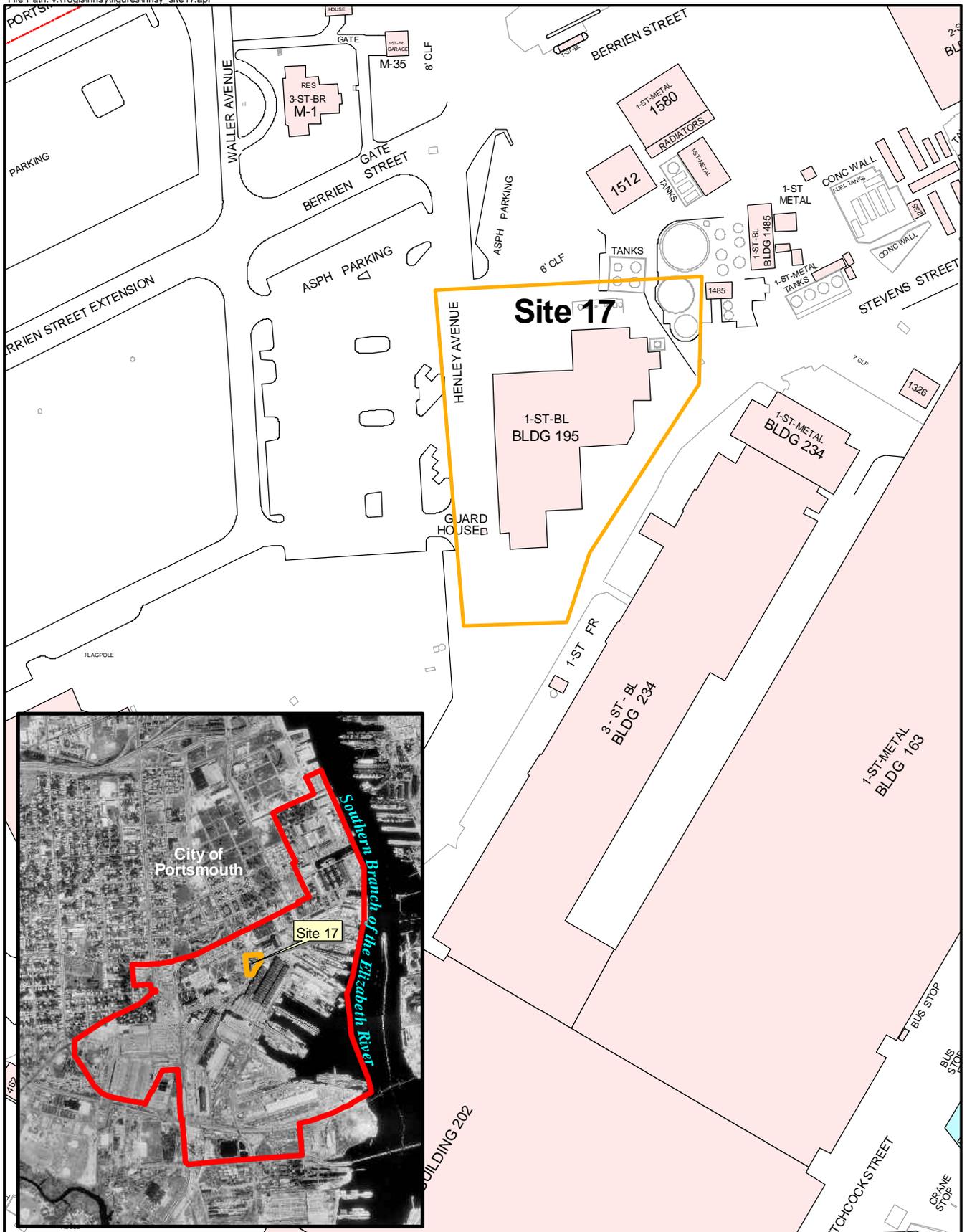
**TABLE 6**  
**Risk Summary for Future Residents Exposed to Arsenic in Shallow Groundwater**  
**Site 17 Record of Decision**  
**Norfolk Naval Shipyard**  
**Portsmouth, Virginia**

Arsenic Concentration (ug/L)	Description	ILCR		HI	
		Adult	Young Child	Adult	Young Child
20.8	Maximum Detected Concentration in Site groundwater	RME = 2.94E-04	RME = 1.72E-04	RME = 1.91	RME = 4.45
		CT = 1.93E-05	CT = 1.83E-05	CT = 0.43	CT = 1.43
12.1	Maximum detected concentration in background groundwater	RME = 1.70E-04	RME = 9.90E-05	RME = 1.10	RME = 2.57
		CT = 2.31E-05	CT = 2.20E-05	CT = 0.51	CT = 1.71
10	MCL	RME = 1.41E-04	RME = 8.25E-05	RME = 0.92	RME = 2.14
		CT = 1.93E-05	CT = 1.83E-05	CT = 0.43	CT = 1.43

Shading indicates exceedances of USEPA acceptable risk criteria.

ILCR - Incremental Lifetime Cancer Risk (USEPA acceptable risk range 1.0E-06 to 1.0E-04)

HI - Hazard Index (USEPA acceptable HI <= 1)



**LEGEND**

- Site 17 Boundary
- NNSY Boundary
- Buildings

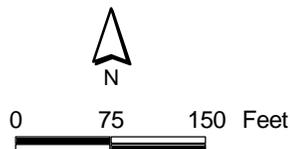
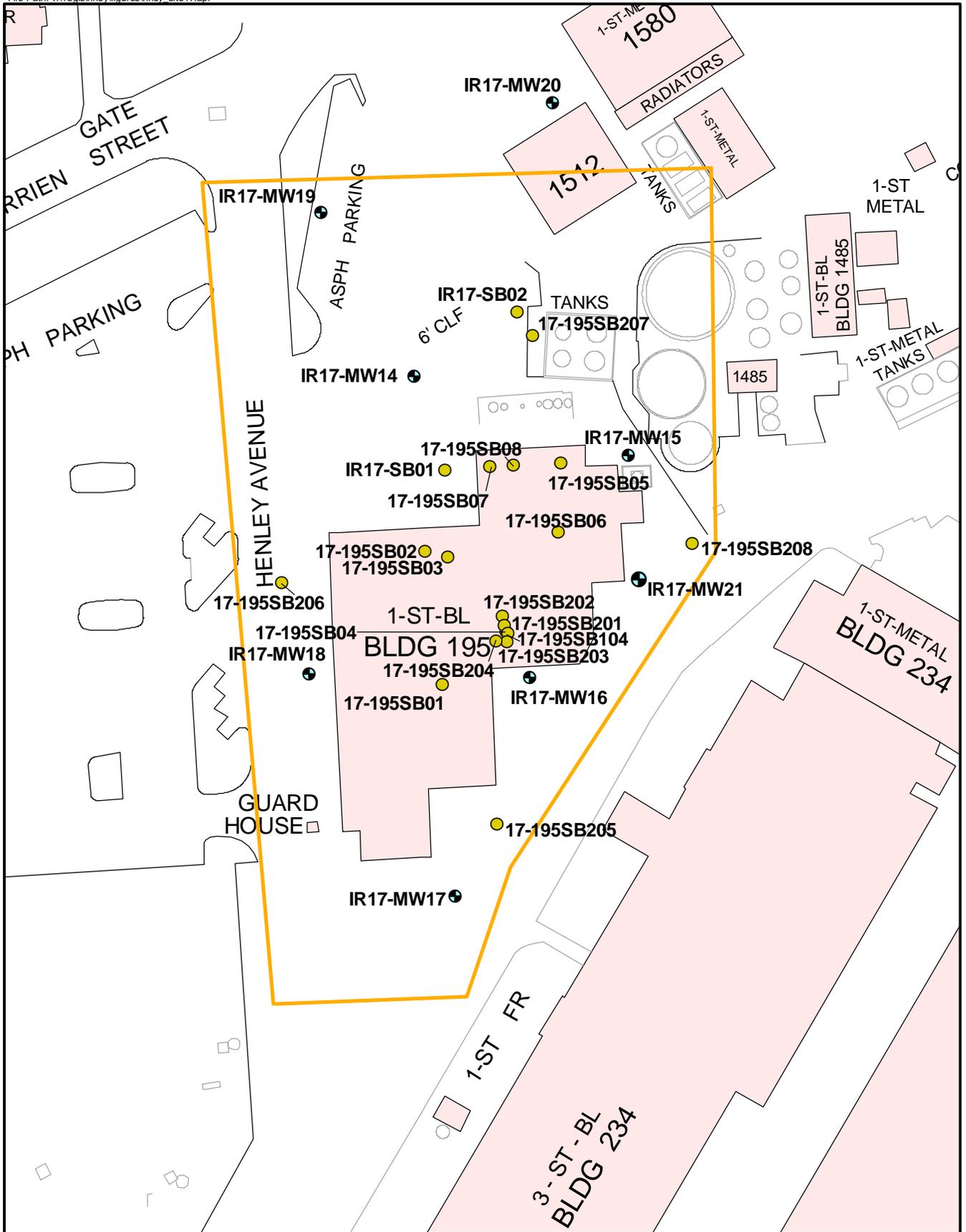


Figure 1  
 Site 17 Location Map  
 Record of Decision  
 Norfolk Naval Shipyard  
 Portsmouth, Virginia



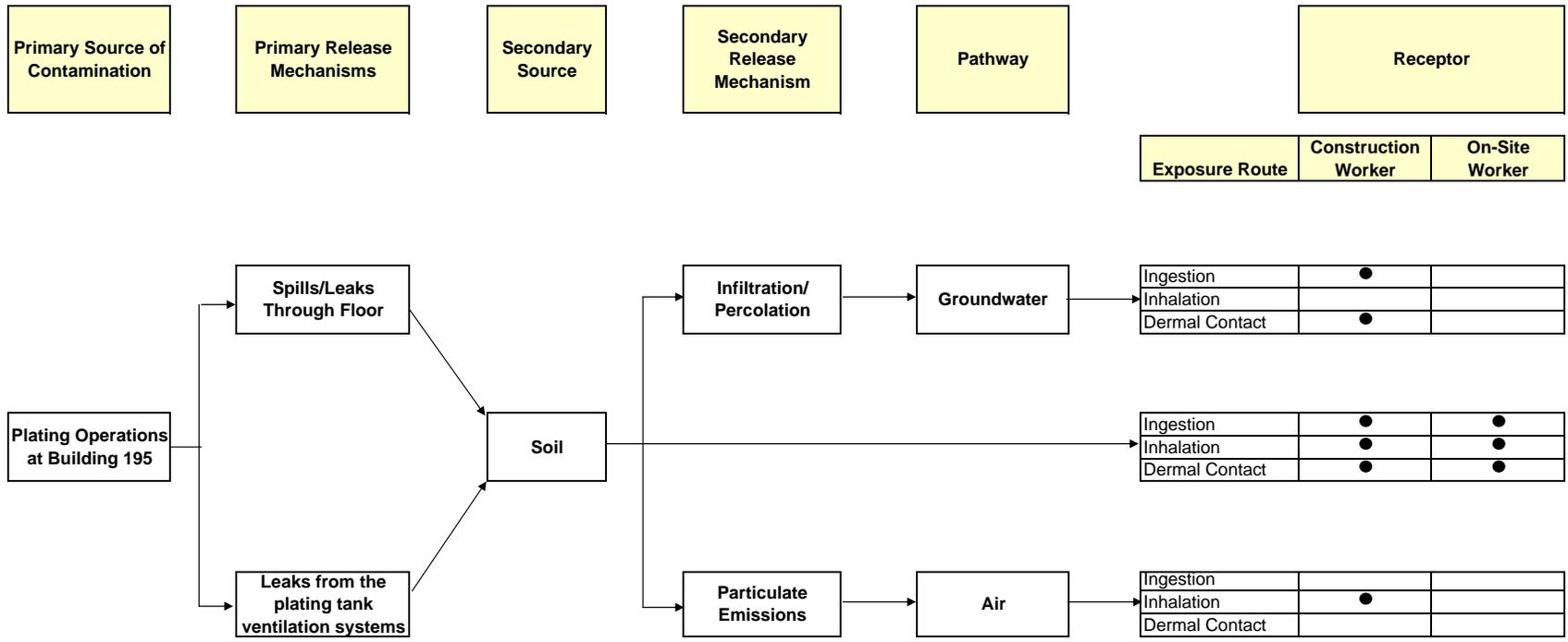
**LEGEND**

- Monitoring Well Locations
- Soil Sample Locations
- ▭ Site 17 / Land Use Control Boundary
- ▭ Buildings



Figure 2  
 Site 17 Sample Locations  
 Record of Decision  
 Norfolk Naval Shipyard  
 Portsmouth, Virginia

**Figure 3**  
**Conceptual Site Model for Potential Human Exposures at Site 17**  
**Norfolk Naval Shipyard Portsmouth, Virginia**



● Evaluated as a Complete Pathway in the Human Health Risk Assessment

**Table A.1  
Federal Location-Specific ARARs, Site 17  
NNSY**

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
<b>Resource Conservation and Recovery Act</b>					
Within 100-year Floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout.	RCRA hazardous waste; treatment, storage, or disposal.	40 CFR 264.18(b)	Relevant and Appropriate	Site 17 is within the 100 yr floodplain, however this ARAR is not applicable because the remedial action is LUCs and does not require facility construction nor the treatment storage or disposal of hazardous waste within the 100-year floodplain.
<b>Clean Water Act as Amended by the Chesapeake Bay Restoration Act of 2000</b>					
Chesapeake Bay watershed	Actions taken should expand and strengthen cooperative efforts to restore and protect the Chesapeake Bay and to achieve the goals established in the Chesapeake Bay Agreement.	Located within the Chesapeake Bay watershed.	<i>Chesapeake Restoration Act of 2000</i>	Relevant and Appropriate	Site 17 is located within the Chesapeake Bay watershed, however this ARAR is not applicable because the remedial action is LUCs and does not involve nor impact the Chesapeake Bay
<b>National Historic Preservation Act</b>					
Historic district, site, building, structure, or object	Avoid impacts on cultural resources; recover and preserve artifacts and historic properties. Where impacts are unavoidable, mitigate through design and data recovery. Plan action to minimize harm to National Historic Landmarks.	Properties listed in the National Register of Historic Places, or eligible for such listing. Alteration of terrain that threatens significant scientific, prehistorical, historical or archaeological data.	<i>National Historic Preservation Act</i> , 16 USC 469 to 470; 36 CFR 65; 36 CFR 800	Relevant and Appropriate	While historical structures/buildings/artifacts have been identified at NNSY, this ARAR is not applicable because Site 17 is not located in historic district or in vicinity of historical structures, known artifacts, or historic landmarks
<b>Coastal Zone Management Act</b>					
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with, to the area that will affect maximum extent practicable, State coastal zone management programs. Federal agencies must supply the State with a consistency determination.	Wetland, flood plain, estuary, beach, dune, barrier island, coral reef, and fish and wildlife and their habitat, within the coastal zone.	<i>Coastal Zone Management Act</i> , 16 USC 1451 et. seq.; 15 CFR 930.30; 15 CFR 930.34	Relevant and Appropriate	Site 17 is located within the Coastal Zone, however this ARAR is not applicable because the remedial action is LUCs and does not involve nor impact the coastal zone
<b>Migratory Bird Treaty Act</b>					
Migratory Bird Area	Protects almost all species of native birds in the U.S. from unregulated taking which can include poisoning at hazardous waste sites.	Presence of migratory birds.	16 USC 703	Relevant and Appropriate	This ARAR is not applicable because Site 17 remedial actions involve LUCs and will not impact potential migratory birds

**Table A.2  
Federal Action-Specific ARARs Site 17  
NNSY**

<b>Media</b>	<b>Requirement</b>	<b>Prerequisite</b>	<b>Citation</b>	<b>ARAR Determination</b>	<b>Comment</b>
<b>There are no identified Federal Action-Specific ARARs</b>					

**Table A.3  
Federal Chemical-Specific ARARs Site 17  
NNSY**

<b>Media</b>	<b>Requirement</b>	<b>Prerequisite</b>	<b>Citation</b>	<b>ARAR Determination</b>	<b>Comment</b>
<b>EPA Region III RBC Tables</b>					
Water, air, fish tissue, soil	Chemical concentrations corresponding to fixed levels of human health risk (i.e., a hazard quotient of 1, or lifetime cancer risk of $10^{-6}$ , whichever occurs at a lower concentration).	Assessment of potential human health risks.	EPA Region III RBC Tables	TBC	Residential risk is assumed therefore remedial action clean up goals are not established. Residential RBCs for soil will be considered should the Navy consider use of the property for any unrestricted use or unlimited exposure

**Table A.4  
Virginia Location-Specific ARARs, Site 17  
NNSY**

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
<b>Chesapeake Bay Preservation Act [VA Code Ann. §§ 10.1-2100 to 2116]</b>					
Chesapeake Bay and its tributaries	Criteria that provide for the protection of water quality of the Chesapeake Bay and its tributaries, that will also accommodate economic development in Tidewater Virginia. 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.	Location is within a Chesapeake Bay Preservation Area.	<i>Chesapeake Bay Preservation Area Designation and Management Regulations</i> , 9 VAC 10-20-10 to 260	Relevant and Appropriate	Site 17 is located within the Chesapeake Bay watershed, however this ARAR is not applicable because the remedial action is LUCs and does not involve nor impact the Chesapeake Bay
<b>Groundwater Management Act of 1992 [VA Code Ann. §§ 62.1-254 to 62.1-279]</b>					
Groundwater management area	Regulates groundwater withdrawals in Ground Water Management Areas. Any person or entity wishing to withdraw 300,000 gallons per month or more in a declared management area must obtain a permit.	Location is in a Groundwater Management Area. Currently (June 2005), there are two Ground Water Management Areas in the state. The Eastern Virginia Ground Water Management Area comprises an area east of Interstate 95 and south of the Mattaponi and York rivers. The Eastern Shore Ground Water Management Area includes Accomack and Northampton counties.	<i>Groundwater Management Act of 1992</i> , VA Code Ann. §§ 62.1-254 to 62.1-279	Relevant and Appropriate	While the Site is located in a groundwater management area, this ARAR is not applicable because the remedial action will not require the withdrawal of groundwater in excess of 300,000 gallons per month

Note: There are no identified Virginia Action-Specific or Chemical-Specific ARARs

**Table A.5**  
**Virginia Action-Specific ARARs, Site 17**  
**NNSY**

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
<b>There are no identified Virginia Action-Specific ARARs</b>					

**Table A.6**  
**Virginia Chemical-Specific ARARs, Site 17**  
**NNSY**

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
<b>There are no identified Virginia Chemical-Specific ARARs</b>					