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FINAL SITE 7 OLD DUPONT DISPOSAL AREA REMEDIAL INVESTIGATION REPORT NWS YORKTOWN CHEATHAM ANNEX FISC WILLIAMSBURG VA

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CH2M HILL

Final

Site 7 – Old DuPont Disposal Area
Remedial Investigation Report

Naval Weapons Station Yorktown Cheatham Annex
Williamsburg, Virginia

Contract Task Order WE66

June 2015

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Executive Summary

This report presents the findings of the remedial investigation (RI) at Site 7, Naval Weapons Station (WPNSTA) Yorktown, Cheatham Annex (CAX), in Williamsburg, Virginia. Based on the results from previous investigations, the RI was conducted to further characterize the nature and extent of contamination within groundwater and sediment at Site 7, and to assess the potential risks to human health and ecological receptors posed by exposure to contamination in potentially impacted media at Site 7, which consist of soil, groundwater, and sediment.

Site 7, the old DuPont Disposal Area, is approximately 1 acre in size and is located along the York River, northeast of Chase Road in the north-central part of CAX. According to the *Initial Assessment Study of Naval Supply Center (Norfolk) Cheatham Annex and Yorktown Fuels Division* (C. C. Johnson & Associates Inc. and CH2M HILL, 1984), Site 7 was used as a disposal area for nonhazardous, inert wastes from the former City of Penniman and the former DuPont Company Penniman facility during the early 1900s. The presence of ash, melted bottles, and charred metal indicate some of the waste may have been incinerated before disposal (Baker, 2004).

The RI activities were conducted in accordance with the Uniform Federal Policy (UFP) – Sampling and Analysis Plan (SAP) titled *Tier II Sampling and Analysis Plan, Site 7 – Old DuPont Disposal Area Remedial Investigation, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia* (Site 7 SAP) (CH2M HILL, 2014).

Based on the results of the Site 7 site investigation (SI) (CH2M HILL, 2012), it was determined that the nature and extent of contamination in soil had been completely delineated and no additional soil sampling was warranted. The SI also concluded that surface water sampling was unwarranted because of the earlier removal of the source, the nature and age of the release, and the lack of feasibility for surface water at Site 7 to be impacted. Therefore, no action is required for the surface water medium at Site 7. Consequently, the RI field activities were limited to further investigation of groundwater and sediment, and specifically consisted of:

- Installing two new monitoring wells
- Collecting groundwater samples from five existing monitoring wells and the two new monitoring wells
- Collecting 18 five-point composite York River sediment samples from near-shore and offshore locations adjacent to Site 7 and at near-shore and offshore locations north and south (that is, upstream and downstream) of Site 7

Following the field investigation, human health risk and ecological risk assessments were performed using new and existing data collected at Site 7. No constituents of concern (COCs) and no potential unacceptable risks for ecological receptors were identified in the ecological risk assessment for soil, sediment, or groundwater at Site 7. No potentially unacceptable human health risks were identified from exposure to soil or sediment at Site 7 under current or future exposure scenarios. However, potentially unacceptable risks were identified for groundwater, but only for hypothetical future industrial and residential exposure scenarios (that is, there was no potentially unacceptable risk under current exposure scenarios). These potentially unacceptable risks in groundwater are because of the presence of trichloroethene (TCE), chloroform, 2,4-dinitrotoluene (2,4-DNT), 2,6-DNT, arsenic, and chromium. However, the evaluation of the detected arsenic and chromium concentrations relative to base background levels indicates the detected concentrations of these constituents in groundwater likely represent naturally occurring conditions rather than a site-related release.

A focused feasibility study is recommended to develop and evaluate remedial alternatives to address potentially unacceptable human health risks associated with site-related COCs: 2,4-DNT, 2,6-DNT, TCE, and chloroform in groundwater at Site 7.

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Acronyms and Abbreviations

°C	degree Celsius
°F	degree Fahrenheit
µg/kg	microgram per kilogram
µg/L	microgram per liter
amsl	above mean sea level
AOC	area of concern
ATSDR	Agency for Toxic Substances and Disease Registry
AVS	acid-volatile sulfide
BERA	baseline ecological risk assessment
bgs	below ground surface
bss	below sediment surface
BTAG	Biological Technical Assistance Group
CAX	Cheatham Annex
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
CNO	Chief of Naval Operations
COC	constituent of concern
COPC	constituent of potential concern
CSM	conceptual site model
CTE	central tendency exposure
DCE	dichloroethene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DHC	dehalococcoides
DI	deionized
DNT	dinitrotoluene
DO	dissolved oxygen
DoD	Department of Defense
EODMUTWO	Naval Weapons Station Yorktown Explosive Ordnance Disposal Mobile Unit Two
ER	environmental restoration
ERA	ecological risk assessment
ERP	Environmental Restoration Program
ESV	ecological screening value
ft/day	foot per day
GPS	global positioning system
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
HSA	hollow-stem auger
I	horizontal hydraulic gradient
ID	inside diameter
IDW	investigation-derived waste
K	hydraulic conductivity

MCL	maximum contaminant level
MEC	munitions and explosives of concern
mg/kg	milligram per kilogram
mg/L	milligram per liter
MNA	monitored natural attenuation
MS	matrix spike
mS/cm	milliSiemen per centimeter
MSD	matrix spike duplicate
mV	millivolt
n	effective porosity
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
ORP	oxidation-reduction potential
PCB	polychlorinated biphenyl
pg/g	picogram per gram
ppt	part per thousand
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RDX	Research Department explosive
RI	remedial investigation
RME	reasonable maximum exposure
RSL	regional screening level
SAP	Sampling and Analysis Plan
SEM	simultaneously extracted metals
SERA	screening-level ecological risk assessment
SI	site inspection
Site 7 SAP	*Uniform Federal Policy - Sampling and Analysis Plan, Site 7 – Old DuPont Disposal Area Remedial Investigation, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*
SOP	standard operating procedure
SU	standard unit
SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzo-p-dioxin
TCE	trichloroethene
TCRA	time-critical removal action
TEQ	toxic equivalent
TOC	total organic carbon
TRV	toxicity reference value
UFP	Uniform Federal Policy
USDASCS	United States Department of Agriculture Soil Conservation Services
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
VDEQ	Virginia Department of Environmental Quality
VI	vapor intrusion
VISL	vapor intrusion screening level

VOC	volatile organic compound
WCSD	Watershed Contaminated Source Document
WPNSTA	Naval Weapons Station

SECTION 1

Introduction

This remedial investigation (RI) report presents the data and findings obtained from the field activities conducted to characterize the nature and extent of contamination and to assess potential risks to human health and the environment at Naval Environmental Restoration Program (ERP) Site 7, Naval Weapons Station (WPNSTA) Yorktown, Cheatham Annex (CAX), in Williamsburg, Virginia. This report was prepared under the Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Atlantic Division, Comprehensive Long-term Environmental Action—Navy (CLEAN) 8012, Contract N62470-11-D-8012, Contract Task Order WE66, for submittal to NAVFAC, the United States Environmental Protection Agency (USEPA) Region III, and the Virginia Department of Environmental Quality (VDEQ). The Navy, USEPA, and VDEQ work jointly as the CAX Tier I Partnering Team.

The RI field activities discussed in this report were conducted in March and April 2014. The purpose of the RI is to further characterize the nature and extent of groundwater and sediment contamination at the site and to conduct assessments of potential human health and ecological risks posed by contaminants in the potentially impacted environmental media at Site 7 (soil, groundwater, and sediment). Based on the conclusions of the earlier Site 7 site inspection (SI) (CH2M HILL, 2012), no action is warranted for surface water at Site 7. Site 7 field activities were conducted in accordance with the Uniform Federal Policy (UFP) – Sampling and Analysis Plan (SAP) titled *Tier II Sampling and Analysis Plan, Site 7 – Old DuPont Disposal Area Remedial Investigation, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia* (Site 7 SAP) (CH2M HILL, 2014).

1.1 Objectives and Approach

The objectives of the RI are to characterize the nature and extent of potential contamination in soil, groundwater, and sediment, and to assess the potential risks posed by this potential contamination to human health and the environment. The activities completed to support the objectives of the RI activities were as follows:

- Installed and surveyed two shallow monitoring wells at Site 7
- Collected groundwater samples from the two new monitoring wells and five existing monitoring wells at Site 7
- Collected sediment samples from the York River, from north of the site (upriver), adjacent to the site, and south of the site (downriver)
- Conducted quantitative assessments of the potential human health and ecological risks associated with exposure to site soil, groundwater, and sediment

1.2 Site Background

1.2.1 CAX

CAX consists of 2,300 acres of land on the York-James Peninsula, northwest of WPNSTA Yorktown (**Figure 1-1**). CAX was the location of the former Penniman Shell Loading Plant, a large powder and shell loading facility operated by E.I. DuPont de Nemours & Company during World War I. The facility closed in 1918, and the property was used for farming or remained idle until CAX was commissioned in 1943 as a satellite unit of the Naval Supply Depot to provide bulk storage facilities and serve as an assembly and overseas shipping point throughout World War II. In 1987, CAX was designated the Hampton Roads Navy Recreational Complex. Today, the mission of CAX includes supplying Atlantic Fleet ships and providing recreational opportunities to military and civilian personnel, with outdoor recreational facilities including cabins, campsites, an 18-hole golf course, a swimming pool, baseball fields, freshwater fishing areas, boating, wildlife watching, and hunting.

CAX is bordered by Queen Creek to the north, the Colonial National Historical Park to the south, the York River to the east, King Creek to the southeast, and the Queens Lake subdivision to the west; the City of Williamsburg is southwest of CAX. The majority of CAX is undeveloped and heavily wooded. Major surface water features within

CAX are Youth Pond, Cheatham Pond, Jones Pond, and Penniman Lake. Newport News Waterworks provides potable water supply at CAX (Agency for Toxic Substances and Disease Registry [ATSDR], 2004).

In October 1998, control of CAX was transferred from the Fleet and Industrial Supply Center to WPNSTA Yorktown. Comprehensive environmental restoration (ER) activities at CAX began in 1984 under the Navy Assessment and Control of Installation Pollutants program and the ERP. On January 2, 2001, CAX was added to the National Priorities List, which required all subsequent ER activities to be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Navy, Commonwealth of Virginia (through VDEQ), and USEPA executed a Federal Facilities Agreement in March 2005, which identified 12 sites and 7 areas of concern (AOCs) to be addressed under CERCLA (USEPA et al., 2005).

1.2.2 Site 7

Site 7, the Old DuPont Disposal Area, covers approximately 1 acre along the York River, northeast of Chase Road in the north-central portion of CAX (**Figures 1-1** and **1-2**). Two recreational cabins, former Buildings 169 and 170, were located within the boundary of Site 7.

According to the initial assessment study, wastes from the City of Penniman and the former DuPont Penniman facility were disposed on property along the York River during the early 1900s (C. C. Johnson & Associates, Inc. and CH2M HILL, 1984). Information on the types and quantities of wastes is not available; however, the presence of ash, melted bottles, and charred metal indicate some of the waste may have been incinerated before disposal (Baker, 2004). Currently, Site 7 is vacant and surrounded by a fence to prevent trespassers from entering the site. There are no future anticipated land uses for Site 7; however, because of its location, the site eventually may be used as a recreational area.

In September 2003, Hurricane Isabel eroded approximately 15 to 20 feet of the Site 7 York River shoreline, exposing debris (mostly dinnerware, incinerated bottles, and metal) and ash. The conceptual site model (CSM) for Site 7 is presented on **Figure 1-3**.

1.3 Summary of Previous Investigations and Response Actions

The following subsections summarize previous investigations that helped characterize potential contamination and contaminant sources at Site 7 as well as historical response actions.

1.3.1 2004 Trenching and Limited Field Investigation

In February 2004, soil trenching and sampling were conducted to determine the extent of debris and potential soil contamination in preparation for a time-critical removal action (TCRA) to address shoreline erosion and exposure of debris (Baker, 2004). Potential soil contamination surrounding the footprints of former cabin Buildings 169 and 170 was identified (Baker, 2004). In addition, an area of ash and debris was identified in the southeastern portion of the site where erosion of the slope had occurred.

1.3.2 2006 Shoreline Stabilization and Munitions and Explosives of Concern Removal

During April through May 2004, beach cleanup activities were conducted in an area approximately 150 feet by 200 feet along the shore of the York River at Site 7. The area was hand-cleared of debris consisting of glass, plastic, metal, and ceramic material (Bhate, 2007b). On June 9, 2004, a 3-inch-diameter projectile was found on the beach of the York River, below Site 7. The Naval Weapons Station Yorktown Explosive Ordnance Disposal Mobile Unit Two (EODMUTWO) removed the projectile from the site and disposed of it. The projectile was severely corroded and appeared to be unfired and unfuzed. Evidence following disposal procedures was inconclusive as to whether the projectile was potentially explosive or inert and the origin of this single munitions item is unknown (Bhate, 2007b). The Navy Remedial Project Manager and officials from the Naval Ordnance Safety and Security Activity concluded that munitions and explosives of concern (MEC) screening and removal should be part of the TCRA to protect the shoreline from future erosion by installing geotextile tubes. The Navy directed Bhate to prepare an Explosives Safety Submission that was submitted to the Naval Ordnance Safety and Security Activity for approval (Bhate, 2005).

The TCRA was performed in July and August 2006 to clean up and stabilize the shoreline to prevent further erosion of waste into the York River (Bhate, 2007a). The TCRA consisted of placing sand-filled geotubes against the toe of approximately 240 feet of eroding shoreline (Figure 3 in the Site 7 SAP [CH2M HILL, 2014]). In addition, Buildings 169 and 170 were demolished. No ordnance was found during the MEC screening.

1.3.3 2008 Soil and Debris Removal

Based on the results of the 2004 soil trenching and sampling, an additional removal action was completed between December 2007 and April 2008 to remove waste and waste-contaminated soil (Shaw, 2009). Following the 2008 removal activities, the slope along the shoreline was graded from a near-vertical slope to a less severe, approximately 1:1 slope, and the excavated area was backfilled with clean clay backfill, followed by 6 inches of topsoil, and seeded.

1.3.4 2011 Site 7 Site Investigation

An SI was conducted at Site 7 in January and February 2011 to investigate whether a CERCLA-regulated release to groundwater had occurred from waste or waste-contaminated soil, assess site-specific hydrogeologic conditions, and assess whether there were associated risks to human health and the environment from exposure to soil and groundwater. Results of the SI human health risk screening indicated the potential for unacceptable risks associated with exposure to thallium in soil and exposure to bromodichloromethane, chloroform, dibromochloromethane, tetrachloroethene, trichloroethene (TCE), vinyl chloride, 2,4-dinitrotoluene (2,4-DNT), Research Department explosive (RDX), and arsenic in groundwater. No unacceptable ecological risks associated with exposure to soil or groundwater were identified.

Based on the results of the SI, an RI was recommended to further characterize site-related contamination and evaluate potential risks to human health and ecological receptors from exposure to site-related contamination in soil and groundwater, and possibly in adjacent sediment in the York River. Because there is no ongoing source/release at the site and the most recent release related to impacts of Hurricane Isabel occurred more than 10 years ago, the Navy, USEPA, and VDEQ agreed during the December 2012 RI SAP scoping session that surface water was not a medium of concern at Site 7 (CH2M HILL, 2014).

1.3.5 2013 Watershed Contaminated Source Document for the Lower York River Watershed

If there is a potential for a water body to be affected by contaminants originating from both Navy and non-Navy sources, Navy policy (Chief of Naval Operations [CNO], 2002) requires preparation of a Watershed Contaminated Source Document (WCSD). The WCSD was prepared to summarize existing information and document the existence of Navy and non-Navy sources that may have or continue to affect the sediments in the vicinity of WPNSTA Yorktown and CAX, including the sediments found in the Lower York River and adjacent water bodies.

The 2013 WCSD concluded that there are numerous historical and ongoing inputs of contaminants to the York River watershed, and that these contaminants may be transported into the York River watershed through a number of pathways, including air deposition, stormwater runoff, and direct discharge, where they can settle into the sediments. The sources for the inputs, both Navy and non-Navy, include impacted urban stormwater runoff, Resource Conservation and Recovery Act (RCRA) sites, above and underground fuel storage tanks, documented spills and leaks, and industrial sources (NAVFAC, 2013). The numerous sources indicate the potential for a myriad of non-site-related contaminant sources to affect the York River sediment adjacent to Site 7.

1.4 Report Organization

The RI Report is organized as follows:

- **Section 1** – Introduction
- **Section 2** – Field Investigation Methods
- **Section 3** – Physical Characteristics
- **Section 4** – Nature and Extent of Contamination
- **Section 5** – Human Health Risk Assessment

- **Section 6** – Ecological Risk Assessment
- **Section 7** – Chemical Fate and Transport
- **Section 8** – Conclusions and Recommendations
- **Section 9** – References

Tables and figures are provided at the end of each respective section. Appendixes are included at the end of the report.

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436972_SITE7_RI_UFPSAP\FIGURE 1-1 - CAX LOCATION MAP.MXD JCLEMENTS 6/19/2015 9:33:01 AM

Legend

- Cheatham Annex Boundary
- Site Boundary

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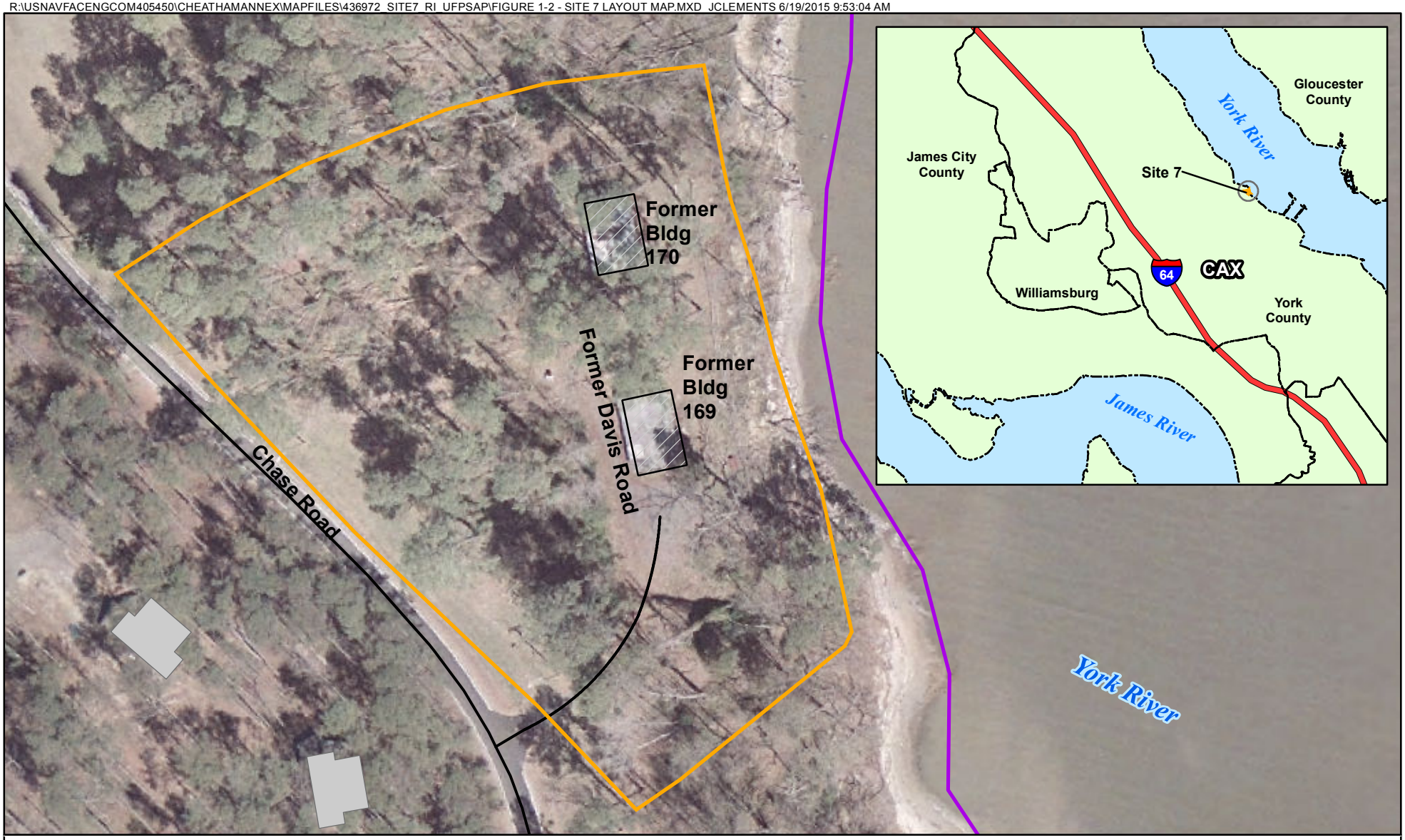
W E
S

0 1,000 2,000 Feet

Figure 1-1
CAX Location Map
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, VA

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436972_SITE7_RI_UFPSAP\FIGURE 1-2 - SITE 7 LAYOUT MAP.MXD JCLEMENTS 6/19/2015 9:53:04 AM



Legend

- Site Boundary
- Cheatham Annex Boundary
- Buildings
- Former Buildings
- Roads

N
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0 40 80
Feet

Figure 1-2
Site 7 Layout Map
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

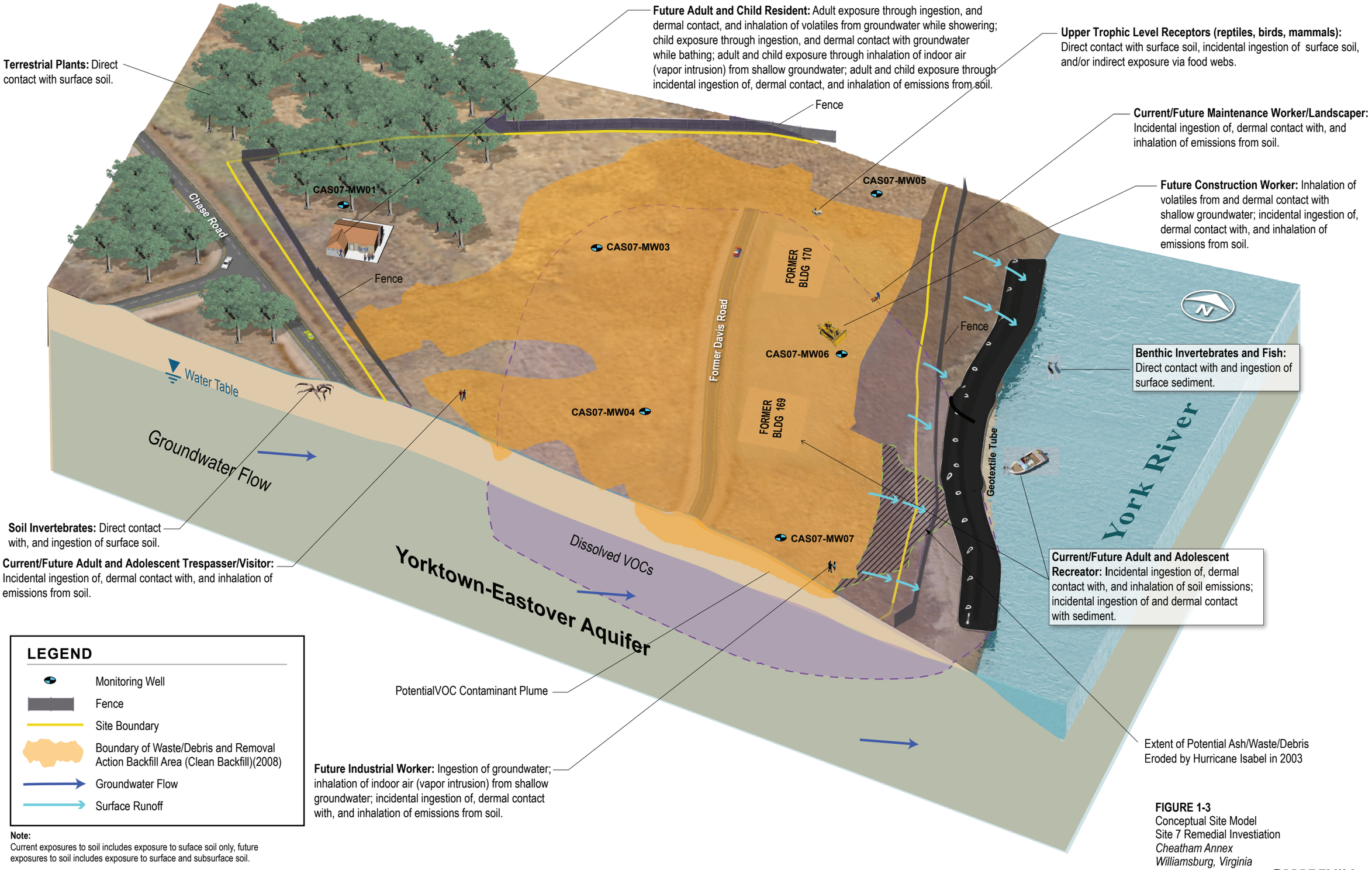

FIGURE 1-3
Conceptual Site Model
Site 7 Remedial Investiation
Cheatham Annex
Williamsburg, Virginia

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SECTION 2

Field Investigation Methods

This section describes the approach and methodology for the field activities conducted as part of the RI at Site 7. The RI field activities consisted of monitoring well installation, groundwater sampling, and sediment sampling. Specific details of the sampling rationale and objectives for the Site 7 RI field activities are provided in the Site 7 SAP (CH2M HILL, 2014). The results of sampling activities conducted during the earlier SI are described in the SI report (CH2M HILL, 2012).

Table 2-1 summarizes the environmental data that were evaluated during the RI, including the numbers of samples collected, sample nomenclature, media sampled, sample collection methods, and analyses performed. **Figure 2-1** depicts the RI groundwater sampling locations as well as the locations of the earlier SI groundwater samples evaluated in the risk assessment portions of this RI (**Sections 5** and **6**). **Figure 2-2** depicts the RI sediment sampling locations discussed in detail in this section. **Figure 2-3** depicts the earlier SI soil sampling locations discussed in detail in the SI report (CH2M HILL, 2012); these previously collected soil data were evaluated in the risk assessment portions of this RI (**Section 5** and **6**).

This field investigation was conducted in support of the Site 7 RI to characterize the nature and extent of potential contamination in soil, groundwater, and sediment, and to assess the potential risks posed by contamination to human health and the environment.

2.1 Pre-Investigation Activities

Utility clearances at Site 7 were performed before starting investigation activities. Miss Utility of Virginia and a third-party utility clearance subcontractor (ECLS, Inc. of Angier, North Carolina) provided underground utility clearance.

2.2 Vegetation Clearance

Site 7 is mostly an open, grass-covered area; however, young (5 years old or younger) volunteer trees (mostly pine) and underbrush are along the shoreline. Where required, vegetation was cleared before sampling activities began to minimally affect the site. Trees smaller than 3 inches in diameter were cut down, if necessary, and/or low-hanging tree limbs were removed. Vegetation debris remained onsite. Cutting was accomplished using a brush hog and manual methods.

2.3 Groundwater Sampling

2.3.1 Monitoring Well Installation

Two new shallow monitoring wells (CAS07-MW08 and CAS07-MW09) were installed within the Yorktown-Eastover aquifer to depths of 30 feet below ground surface (bgs) (**Figure 2-1**). Each monitoring well was installed in accordance with the standard operating procedure (SOP) entitled *General Guidance for Monitoring Well Installation* (CH2M HILL, 2014). The monitoring well construction details are summarized in **Appendix A**.

Parratt-Wolff, Inc. of Hillsborough, North Carolina, provided hollow-stem auger (HSA) well drilling and installation services, using a 4.25-inch-inside-diameter (ID) HSA to advance the borings for well installation. During the lithologic logging of soil cores (collected within 4-foot-long acetate sleeves), soil descriptions were recorded that included grain size, color, moisture content, relative density, consistency, soil structure, mineralogy, and other relevant information, such as possible evidence of contamination. Soil boring logs are included in **Appendix A**.

New monitoring wells were constructed with flush-threaded, 2-inch-ID Schedule 40 polyvinyl chloride (PVC) casing and well screen (**Appendix A**). In accordance with the SOP entitled *Monitoring Well Installation* (CH2M HILL, 2014), the well screens were 10 feet long with 0.010-inch slot sizes. A silica sand filter pack was placed around the annular space of the well screen from the bottom of the boring and well screen to a depth of approximately 2 feet above the top of the screen. A bentonite layer (approximately 2 to 3 feet) was placed at the top of the sand pack.

After the bentonite was hydrated and allowed to set for at least 24 hours, a cement-bentonite grout was placed in the remaining annular space to ground surface. The monitoring wells were completed with steel stick-up protective casings and surrounded by four protective bollards. A locking, watertight cap was placed on the top of each casing, and the well identification numbers were clearly marked on the well with etched well identification tags.

2.3.2 Monitoring Well Development

Before sampling, the monitoring wells were developed to restore the permeability of the aquifer material surrounding the well, which may have been reduced by the drilling operations, and to remove fine-grained materials that may have settled in the well during installation. Monitoring well development was performed after the grout used to construct the new monitoring well was allowed to adequately set (at least 24 hours or more) to prevent grout contamination of the screened interval. Monitoring wells were developed using a submersible pump and a combination of surging and pumping throughout the well screen.

A total of 68 gallons of water were purged from CAS07-MW08, and 48 gallons of water were purged from CAS07-MW09. During monitoring well development, in accordance with the SOP entitled *Installation of Shallow Monitoring Wells* (CH2M HILL, 2014), water quality parameters (pH, oxidation-reduction potential [ORP], temperature, conductivity, turbidity, and dissolved oxygen [DO]) were recorded approximately every 5 minutes using a YSI water-quality meter. The YSI instrument was calibrated daily, and calibration results were recorded on the field forms.

Generally, development continued until at least three well volumes were removed and the water produced was free of turbidity, sand, and silt (to the maximum extent practicable). A YSI water-quality meter was used to determine when the turbidity was low (preferably less than 20 nephelometric turbidity units). If turbidity continued to decrease after removing three well volumes, development was continued until turbidity readings stabilized (that is, until turbidity readings were within 10 percent for three consecutive readings). In addition, development typically ended once three successive measurements of pH, specific conductivity, and temperature within 10 percent of each other were achieved.

2.3.3 Groundwater Elevation Measurement

A groundwater elevation survey was conducted at nine monitoring wells on April 9, 2014, before sampling. **Table 2-2** summarizes the water-level measurements from each well. An electronic water-level meter was used to measure the depth to water from the marking on the top of casing to the nearest 0.01 foot.

2.3.4 Groundwater Sampling

Groundwater samples were collected from five existing monitoring wells (CAS07-MW03 through CAS07-MW07) and the two newly installed monitoring wells (CAS07-MW08 and CAS07-MW09) (**Figure 2-1**), in accordance with the SOP entitled *Low-Flow Groundwater Sampling from Monitoring Wells* (CH2M HILL, 2014). Low-flow sampling techniques were employed to minimize drawdown and obtain samples representative of groundwater conditions in the surrounding geologic formation. Before collecting groundwater samples, monitoring wells were purged to remove stagnant water that may have accumulated within the well. Groundwater samples were collected from monitoring wells using a peristaltic pump and disposable tubing. Groundwater quality parameters comprising pH, conductivity, turbidity, DO, temperature, and ORP were measured during the purging of each well, using a YSI water-quality meter and a flow-through cell to prevent the purged groundwater from contacting the atmosphere before the parameter measurement point.

Purging continued until water quality readings collected 5 minutes apart stabilized to within 10 percent of one another. Following parameter stabilization, a CHEMet test kit was used to confirm DO readings measured by the YSI water-quality meter, and a HACH test kit was used to test for ferrous iron. The final groundwater quality measurements recorded before sample collection for each monitoring well are presented in **Table 2-3**.

Groundwater for laboratory analysis was pumped through the tubing directly into the appropriate laboratory-provided bottleware. Sample containers were packed in ice and shipped via overnight service to the laboratory for analysis in accordance with the SOP entitled *Sample Preservation* (CH2M HILL, 2014). Groundwater samples were

analyzed for volatile organic compounds (VOCs) and monitored natural attenuation (MNA) parameters (ferrous iron, methane, ethane, ethene, sulfate, sulfide, nitrate, nitrite, dissolved manganese, alkalinity, total organic carbon [TOC], chloride, dehalococcoides [DHC], and the functional genes BAV1 vinyl chloride-reductase and TCE-reductase).

2.4 Surface Sediment Sampling

Composite surface sediment samples were collected from 18 locations (CAS04-SD01 through CAS04-SD18) within the York River, divided among locations upstream from Site 7, adjacent to Site 7, and downstream from Site 7 (**Figure 2-2**). The sampling strategy and general sampling locations were jointly selected by representatives from the Navy and the USEPA Biological Technical Assistance Group (BTAG) and subsequently agreed to by the CAX Partnering Team; the precise sampling locations were field-determined based on site conditions. Depositional areas were selected as sampling locations to reflect areas where potential contaminant impacts to the York River were most likely to be present. Sediment samples adjacent to Site 7 were collected first followed by samples at southern background reference locations approximately 4 miles downstream, then northern background reference locations approximately 5 miles upstream.

The sediment sampling activities were conducted in accordance with the SOP entitled *Sediment Sampling* (CH2M HILL, 2014). Surface sediment samples, collected from a boat with a ponar dredge or hand auger, were obtained from a depth of 0 to 6 inches below sediment surface (bss) in accordance with the approved Site 7 SAP (CH2M HILL, 2014).

Eighteen five-point composite surface sediment samples (0 to 6 inches bgs) were collected from 300-foot transects parallel to the shoreline. At each location (site-adjacent, downstream, and upstream), a total of six transects were sampled, with the first transect located midway between the estimated mean low water and mean high water marks (approximately 50 feet apart). The second transect was located 50 feet offshore from the first transect, and the third transect was located 50 feet offshore of the second transect. Transects four through six were placed further offshore where sediments became soft and mucky. Five sediment subsamples were collected from each transect, then homogenized and composited to collect one sample representative of each transect. A portion of one sediment subsample, randomly selected from each transect, was placed directly into sample containers for acid-volatile sulfide (AVS)/simultaneously extracted metals (SEM) analysis without homogenization to minimize exposure to air. Following collection of the AVS/SEM sample, equal volumes for each of the five sediment subsamples within the transect were homogenized in stainless-steel bowls before being placed in laboratory-prepared sample containers. The sediment sample containers were packed in ice and shipped via overnight service to the laboratory in accordance with the SOP entitled *Sample Preservation* (CH2M HILL, 2014). In accordance with the approved Site 7 SAP (CH2M HILL, 2014), the sediment samples were analyzed for select semivolatile organic compounds (SVOCs), dioxins/furans, select inorganic constituents and mercury, pH, TOC, AVS/SEM, and grain size.

2.5 Surveying

A Trimble global positioning system (GPS) unit was used to record the horizontal coordinates of sample locations for groundwater and sediment.

The surveyor, ECLS, Inc. of Richmond, Virginia (a Virginia-licensed and registered surveyor), conducted a survey of the new monitoring wells. Each new monitoring well was surveyed for vertical and horizontal control to an accuracy of ±0.01 foot and ±0.1 foot, respectively (**Appendix B**). Monitoring wells were surveyed at the top of the PVC casing (where marked) and at the ground surface. The vertical elevations were referenced to National Geodetic Vertical Datum of 1988 to remain consistent with the existing WPNSTA Yorktown vertical datum. Horizontal coordinates conformed to North American Datum of 1983 with ties to the Virginia State Plane Coordinate System.

2.6 Quality Assurance and Quality Control

Samples collected for this RI were analyzed using SW-846 Program methods with Level IV quality assurance (QA)/quality control (QC), as identified in the Site 7 SAP (CH2M HILL, 2014). For definitive data, sample results were reported by the laboratory with the equivalent of USEPA Contract Laboratory Program Level IV QA/QC.

Field QA/QC samples were collected during the sampling program. These samples were obtained to:

- Ensure disposable and reusable sampling equipment were free of contaminants
- Evaluate field methodology
- Establish ambient field background conditions
- Evaluate whether cross-contamination occurred during sampling and/or shipping

Several types of field QA/QC samples were collected and analyzed in accordance with the Site 7 SAP (CH2M HILL, 2014). They are defined as follows:

- **Equipment Rinsate Blank (decontaminated equipment):** Equipment blanks were collected at the frequency noted in Section 2.4 or Worksheet #12 of the Site 7 SAP (one per medium per day of sampling). These samples were obtained by running laboratory-grade deionized (DI) water over or through sample collection equipment after the equipment was decontaminated. These samples were used to determine if decontamination procedures for reusable equipment were adequate.
- **Equipment Rinsate Blank (disposable equipment):** Equipment blanks were collected at the frequency noted in Worksheet #12 of the Site 7 SAP (once per lot). These samples were obtained by running laboratory-grade DI water over or through sample collection equipment before using the equipment. These samples were used to determine if disposable, one-time-use equipment was contaminant-free before use.
- **Duplicate Sample:** Duplicate samples were collected at the same time and under identical conditions as their respective associated sample at the frequency noted in Section 2.4 or Worksheet #12 of the Site 7 SAP (one per 10 field samples of similar matrix). These samples were collected to evaluate the field and laboratory reproducibility of sample results, and are one way to evaluate field methodology.
- **Trip Blank:** Trip blanks were prepared at the laboratory, shipped with the sample containers, and stored onsite near the empty sample containers. Any time VOC samples were packed and shipped to the laboratory, a trip blank sample was included inside the shipping cooler. The trip blanks were analyzed for VOCs along with the other VOC samples. These samples were used to evaluate whether cross-contamination of VOCs between sampling containers may have occurred during shipping.

In addition to samples collected to monitor field QC, samples also were collected to monitor quality within the laboratory. These included the following:

- **Matrix Spike (MS):** An aliquot of a matrix (that is, soil, surface sediment, subsurface sediment, surface water, groundwater, and so forth) was spiked with known quantities of analytes of interest and subjected to the entire analytical procedure. By measuring the recovery of these spiked quantities, the appropriateness of the method for the matrix was demonstrated.
- **Matrix Spike Duplicate (MSD):** These samples were collected as second aliquots of the same matrix as the MS to determine the precision of the method.

One MS sample and one MSD sample were collected for every 20 environmental samples collected (or ≥5 percent of the samples collected) per medium, per site.

2.7 Decontamination Procedures

Decontamination activities were conducted in accordance with the SOPs entitled *Decontamination of Drilling Rigs and Equipment* and *Decontamination of Personnel and Equipment*, as applicable (CH2M HILL, 2014). Disposable sampling equipment and personal protective equipment, such as Masterflex tubing and nitrile gloves, were not decontaminated after use and instead were disposed as nonhazardous solid waste. After use, disposable

equipment was placed in plastic contractor bags and disposed in an onsite trash dumpster. Non-disposable sampling equipment, such as hand augers, were decontaminated before each use.

Reusable, heavy equipment, such as drilling rods and augers, was decontaminated before and between locations using a high-pressure steam cleaner with potable-grade water. Pressure washing was conducted at the temporary decontamination pad, which had been constructed before starting drilling activities. The decontamination pad consisted of a raised wood frame lined with a high-density polyethylene tarp, which acted as a basin to collect fluids. These fluids were then pumped into approved 55-gallon drums to await characterization and disposal. Heavy equipment decontamination procedures were conducted in accordance with the SOP entitled *Decontamination of Drilling Rigs and Equipment* (CH2M HILL, 2014).

Water generated during decontamination of sampling equipment was collected and transferred to an approved 55-gallon drum to await characterization and disposal.

2.8 Investigation-Derived Waste Management

Investigation-derived waste (IDW) generated during the Site 7 RI included soil cuttings, well development groundwater, groundwater sampling purge water, as well as decontamination rinse water from non-disposable sampling equipment and heavy equipment. The IDW was containerized in approved 55-gallon drums that were properly labeled and stored on secondary containment at Site 7. Eleven drums of solid and aqueous IDW were generated during the Site 7 RI field activities.

Before disposal, CH2M HILL field staff collected one composite sample from the aqueous IDW drums and one composite sample from the solid IDW drums. The IDW samples were analyzed for full toxicity characteristic leaching procedure analyses (VOCs, SVOCs, pesticides, and inorganic constituents), ignitability, reactive cyanide, reactive sulfide, and corrosivity. Based on the analytical results, the IDW was identified as nonhazardous and disposed by Clearfield, MMG at the company's approved disposal facility in Chesapeake, Virginia, within 90 days of generation.

IDW management activities were conducted in accordance with the IDW Management Plan (Baker, 2005a). An analytical summary for the IDW samples is provided in **Table 2-4**. Laboratory analytical data for the IDW samples are presented in **Appendix C**. IDW handling and disposal information is included in **Appendix D.**

2.9 Data Quality Evaluation

The data quality evaluation and validation is a multi-tiered approach. The process begins with an internal laboratory review, continues with an independent review by a data validator, and ends with an overall review by the CH2M HILL project chemistry team. The results of data quality evaluation are included as **Appendix E**.

TABLE 2-1

Comprehensive Sample Summary Table

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	Sample ID	Corresponding Transect	Investigation	Matrix	VOC	Methane, Ethane, Ethene	SVOCs	Select SVOCs	Pesticides	PCBs	Dioxin/ Furans	Explosives	Total Metals	Dissolved Metals	Select Metals	Filtered Manganese	Alkalinity	pH	Chloride, Nitrate, Nitrite, Sulfate	Sulfide	TOC	DHC and Functional Genes	Ferrous Iron and DO by field test kit	AVS/ SEM	Grainsize	Collection Method	Data used in HHRA or BERA?
					SW846 8260B	RSK-175	SW846 8270C	SW846-8270D	SW846 8081A	SW846 8082	SW-846 8290A	8330	SW846 6020/ 7470A/ 7471A/ 9012	SW846 6020/ 7470A/ 9012	SW-846 3050B/ 6010C	SW-846 6010B	SM2320B	9045C	EPA 300.0	SW-846 9034	SW-846 9060	qPCR with DNA extract	Field Test Kits	EPA821 R91-100	ASTM D422		
CAS07-SO001	NWSY-90-7-SC-PER-132		Shaw 2008 Removal Action	Soil	x		x		x	x	x	x	x													Hand Auger	HHRA, BERA
CAS07-SO002	NWSY-90-7-SC-PER-183				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO002	NWSY-90-7-SC-PER-135				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO005	NWSY-90-7-SC-FLR-138				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO006	NWSY-90-7-SC-FLR-139				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO007	NWSY-90-7-SC-FLR-140				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO008	NWSY-90-7-SC-PER-184				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO008	NWSY-90-7-SC-PER-185[1]				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO008	NWSY-90-7-SC-PER-143				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO009	NWSY-90-7-SC-FLR-144				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO010	NWSY-90-7-SC-FLR-145				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO011	NWSY-90-7-SC-FLR-146				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO012	NWSY-90-7-SC-FLR-147				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO013	NWSY-90-7-SC-PER-148				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO013	NWSY-90-7-SC-PER-149				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO014	NWSY-90-7-SC-PER-150				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO014	NWSY-90-7-SC-PER-151				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO014	NWSY-90-7-SC-PER-152[2]				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO015	NWSY-90-7-SC-PER-153				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO015	NWSY-90-7-SC-PER-154				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO016	NWSY-90-7-SC-PER-159				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO016	NWSY-90-7-SC-PER-186				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO018	NWSY-90-7-SC-PER-161				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO018	NWSY-90-7-SC-PER-162				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO019	NWSY-90-7-SC-PER-163				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO019	NWSY-90-7-SC-PER-164				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO021	NWSY-90-7-SC-FLR-166				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO022	NWSY-90-7-SC-FLR-167				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO023	NWSY-90-7-SC-PER-187				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO023	NWSY-90-7-SC-PER-169				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO023	NWSY-90-7-SC-PER-170[3]				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO024	NWSY-90-7-SC-PER-172				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO024	NWSY-90-7-SC-PER-188				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO024	NWSY-90-7-SC-PER-193[4]				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO025	NWSY-90-7-SC-FLR-173				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO026	NWSY-90-7-SC-FLR-174				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO027	NWSY-90-7-SC-PER-175				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO027	NWSY-90-7-SC-PER-176				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO028	NWSY-90-7-SC-PER-177				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO028	NWSY-90-7-SC-PER-178				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO028	NWSY-90-7-SC-PER-179[5]				x		x		x	x	x	x	x														HHRA, BERA
CAS07-SO001	NWSY-90-7-SC-PER-133		Shaw 2008 Field Investigation	Soil	x		x		x	x	x	x	x													Hand Auger	HHRA[7]
CAS07-SO003	NWSY-90-7-SC-FLR-136				x		x		x	x	x	x	x														HHRA[7]
CAS07-SO004	NWSY-90-7-SC-FLR-137				x		x		x	x	x	x	x														HHRA[7]
CAS07-SO017	NWSY-90-7-SC-FLR-160				x		x		x	x	x	x	x														HHRA[7]
CAS07-SO020	NWSY-90-7-SC-FLR-165				x		x		x	x	x	x	x														HHRA[7]
CAS07-SS01	CAS07-SS01-0024-0111		2011 SI Field Activities	Surface Soil														x								Hand Auger	BERA
CAS07-SS02	CAS07-SS02-0024-0111																	x									BERA
CAS07-SS03	CAS07-SS03-0024-0111																	x									BERA
CAS07-SS04	CAS07-SS04-0024-0111																	x									BERA
CAS07-SS05	CAS07-SS05-0024-0111																	x									BERA
CAS07-SS05	CAS07-SS05P-0024-0111[6]																	x									BERA
CAS07-MW01	CAS07-MW01-0111		2011 SI Field Activities	Groundwater	x		x		x	x	x	x	x	x												Monsoon Pump and Tubing	BERA[8]
CAS07-MW02	CAS07-MW02-0111				x		x		x	x	x	x	x	x													BERA[8]
CAS07-MW03	CAS07-MW03-0111				x		x		x	x	x	x	x	x													HHRA, BERA
CAS07-MW04	CAS07-MW04-0111				x		x		x	x	x	x	x	x													HHRA, BERA
CAS07-MW05	CAS07-MW05-0111				x		x		x	x	x	x	x	x													HHRA, BERA
CAS07-MW06	CAS07-MW06-0111				x		x		x	x	x	x	x	x													HHRA, BERA
CAS07-MW06	CAS07-MW06P-0111[6]																										HHRA, BERA
CAS07-MW07	CAS07-MW07-0111				x		x		x	x	x	x	x	x													HHRA, BERA

TABLE 2-1

Comprehensive Sample Summary Table

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	Sample ID	Corresponding Transect	Investigation	Matrix	VOC	Methane, Ethane, Ethene	SVOCs	Select SVOCs	Pesticides	PCBs	Dioxin/ Furans	Explosives	Total Metals	Dissolved Metals	Select Metals	Filtered Manganese	Alkalinity	pH	Chloride, Nitrate, Nitrite, Sulfate	Sulfide	TOC	DHC and Functional Genes	Ferrous Iron and DO by field test kit	AVS/ SEM	Grainsize	Collection Method	Data used in HHRA or BERA?
					SW846 8260B	RSK-175	SW846 8270C	SW846-8270D	SW846 8081A	SW846 8082	SW-846 8290A	8330	SW846 6020/ 7470A/ 7471A/ 9012	SW846 6020/ 7470A/ 9012	SW-846 3050B/ 6010C	SW-846 6010B	SM2320B	9045C	EPA 300.0	SW-846 9034	SW-846 9060	qPCR with DNA extract	Field Test Kits	EPA821 R91-100	ASTM D422		
CAS07-MW03	CAS07-GW03-0414		2014 RI Field Activities	Groundwater	x	x										x	x		x	x	x	x	x			Peristaltic Pump and Tubing	HHRA, BERA
CAS07-MW03	CAS07-GW03P-0414[5]				x	x										x	x		x	x	x	x	x				HHRA, BERA
CAS07-MW04	CAS07-GW04-0414				x	x										x	x		x	x	x	x	x				HHRA, BERA
CAS07-MW05	CAS07-GW05-0414				x	x										x	x		x	x	x	x	x				HHRA, BERA
CAS07-MW06	CAS07-GW06-0414				x	x										x	x		x	x	x	x	x				HHRA, BERA
CAS07-MW07	CAS07-GW07-0414				x	x										x	x		x	x	x	x	x				HHRA, BERA
CAS07-MW08	CAS07-GW08-0414				x	x										x	x		x	x	x	x	x				HHRA, BERA
CAS07-MW09	CAS07-GW09-0414				x	x										x	x		x	x	x	x	x				HHRA, BERA
CAS07-SD01	CAS07-SD01-0414	T1 (adjacent to Site 7; near-shore)	2014 RI Field Activities	Sediment				x			x		Mercury Only		x			x			x			x	x	Ponar Dredge or Hand Auger	HHRA, BERA
CAS07-SD02	CAS07-SD02-0414	T2 (adjacent to Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD02	CAS07-SD02P-0414[6]	T2 (adjacent to Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD03	CAS07-SD03-0414	T3 (adjacent to Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD04	CAS07-SD04-0414	T4 (adjacent to Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]
CAS07-SD05	CAS07-SD05-0414	T5 (adjacent to Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]
CAS07-SD06	CAS07-SD06-0414	T6 (adjacent to Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]
CAS07-SD07	CAS07-SD07-0414	UT7 (upstream of Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD08	CAS07-SD08-0414	UT8 (upstream of Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD09	CAS07-SD09-0414	UT9 (upstream of Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD10	CAS07-SD10-0414	UT10 (upstream of Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]
CAS07-SD11	CAS07-SD11-0414	UT11 (upstream of Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]
CAS07-SD12	CAS07-SD12-0414	UT12 (upstream of Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]
CAS07-SD13	CAS07-SD13-0414	DT13 (downstream of Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD13	CAS07-SD13P-0414[6]	DT13 (downstream of Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD14	CAS07-SD14-0414	DT14 (downstream of Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD15	CAS07-SD15-0414	DT15 (downstream of Site 7; near-shore)						x			x		Mercury Only		x			x			x			x	x		HHRA, BERA
CAS07-SD16	CAS07-SD16-0414	DT16 (downstream of Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]
CAS07-SD17	CAS07-SD17-0414	DT17 (downstream of Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]
CAS07-SD18	CAS07-SD18-0414	DT18 (downstream of Site 7; deeper water)						x			x		Mercury Only		x			x			x			x	x		BERA[9]

Notes:

HHRA - human health risk assessment

BERA - baseline ecoloical risk assessment

[1]Duplicate of sample NWSY-90-7-SC-PER-184

[2]Duplicate of sample NWSY-90-7-SC-PER-151

[3]Duplicate of sample NWSY-90-7-SC-PER-169

[4]Duplicate of sample NWSY-90-7-SC-PER-188

[5]Duplicate of sample NWSY-90-7-SC-PER-178

[6]Duplicate sample

[7]Samples NWSY-90-7-SC-PER-133, NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-165 were not screened against the ESVs since these samples were collected either below 24 inches from the current ground surface or where more than 24 inches of backfill was placec

[8]Upgradient sample not evaluated as part of the HHRA

[9]Samples collected at CAS07-SD04, CAS07-SD05, CAS07-SD06, CAS07-SD10, CAS07-SD11, CAS07-SD12, CAS07-SD16, CAS07-SD17, CAS07-SD18 were not evaluated as part of the HHRA since the sample location was either too far from the shore or under deep surface wate

TABLE 2-2

Groundwater Elevations

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Monitoring Well ID	Top of Casing Elevation (feet amsl)	April 9, 2014	
		Depth to Water (feet below TOC)	Groundwater Elevation (feet amsl)
CAS07-MW01	23.87	19.83	4.04
CAS07-MW02	21.11	16.47	4.64
CAS07-MW03	23.96	20.59	3.37
CAS07-MW04	23.38	20.20	3.18
CAS07-MW05	24.59	22.44	2.15
CAS07-MW06	23.75	21.40	2.35
CAS07-MW07	24.11	21.40	2.71
CAS07-MW08	23.59	20.89	2.70
CAS07-MW09	23.33	20.07	3.26

Notes:
bgs - below ground surface
amsl - above mean sea level
TOC - top of casing

TABLE 2-3

Groundwater Field Parameter Results - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW01	CAS07-MW02	CAS07-MW03		CAS07-MW04		CAS07-MW05		CAS07-MW06	
Sample ID	CAS07-MW01-0111	CAS07-MW02-0111	CAS07-MW03-0111	CAS07-GW03-0414	CAS07-MW04-0111	CAS07-GW04-0414	CAS07-MW05-0111	CAS07-GW05-0414	CAS07-MW06-0111	CAS07-GW06-0414
Sample Date	1/28/11	1/28/11	1/25/11	4/9/14	1/28/11	4/9/14	1/25/11	4/9/14	1/24/11	4/9/14
Water Quality Parameters										
Dissolved Oxygen (MG/L)	0	0	0	0.48	0	0.54	1.16	2.37	0	0.93
Dissolved Oxygen (Test Kit) (MG/L)	1.5	3	1.5	1	1.5	1	4	2	1	1.5
Depth to Water (FT)	20.79	17.73	21.47	20.70	21.04	21.00	23.21	22.65	22.15	21.66
Oxidation Reduction Potential (MV)	115	110	125	100.5	10	38.6	127	279.9	110	292.3
Ferrous Iron (MG/L)	NS	NS	NS	0.1	NS	0.4	NS	0	NS	0
Flow (GAL/MIN)	NS	NS	NS	0.079	NS	0.079	NS	0.079	NS	0.11
Gallons Purged (GAL)	2.9	1.78	3.17	2.22	2.31	3.8	2.37	2.3	3.03	2.85
pH (pH units)	6.86	6.9	7.22	6.51	7.73	6.67	7.66	6.72	7.02	6.22
Salinity (PCT)	NS	NS	NS	0.066	NS	0.066	NS	0.084	NS	0.056
Specific Conductance (MS/CM)	0.45	0.36	0.55	1.054	0.63	1.1	0.88	1.338	0.59	0.916
Temperature (DEG/C)	13.07	11.30	15.08	14.59	11.92	15.60	15.36	15.19	12.17	15.52
Turbidity (NTU)	11.3	10.45	14.5	0	16.7	1.7	12.3	0.2	13.8	0

Notes:
DEG/C - Degrees centigrade
FT - Feet
GAL - Gallons
GAL/MIN - Gallons per minute
MG/L - Milligrams per liter
MS/CM - Milliseimens per centimeter
MV - Millivolts
NS - Not sampled
NTU - Nephelometric turbidity unit
PCT - Percent

TABLE 2-3

Groundwater Field Parameter Results - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW07		CAS07-MW08	CAS07-MW09
Sample ID	CAS07-MW07-0111	CAS07-GW07-0414	CAS07-GW08-0414	CAS07-GW09-0414
Sample Date	1/24/11	4/9/14	4/10/14	4/10/14
Water Quality Parameters				
Dissolved Oxygen (MG/L)	1.17	0.65	0.72	2.66
Dissolved Oxygen (Test Kit) (MG/L)	1.5	0.8	1	1.5
Depth to Water (FT)	22.12	21.58	21.21	20.23
Oxidation Reduction Potential (MV)	123	280.4	272.2	248.3
Ferrous Iron (MG/L)	NS	0	0	0
Flow (GAL/MIN)	NS	0.079	0.11	0.079
Gallons Purged (GAL)	3.36	2.54	3.06	2.5
pH (pH units)	7.35	6.74	6.65	6.8
Salinity (PCT)	NS	0.06	0.058	0.058
Specific Conductance (MS/CM)	0.69	0.98	0.958	0.936
Temperature (DEG/C)	12.99	15.44	15.63	15.22
Turbidity (NTU)	15	0	1	3.9

Notes:
DEG/C - Degrees centigrade
FT - Feet
GAL - Gallons
GAL/MIN - Gallons per minute
MG/L - Milligrams per liter
MS/CM - Milliseimens per centimeter
MV - Millivolts
NS - Not sampled
NTU - Nephelometric turbidity unit
PCT - Percent

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436972_SITE7_RI_UFPSAP\FIGURE 2-1 - GROUNDWATER SAMPLES MAP.MXD JCLEMENTS 6/19/2015 10:14:08 AM

Legend

- Site Boundary
- Cheatham Annex Boundary
- Buildings
- Former Buildings
- Roads
- Existing Monitoring Well
- Existing Monitoring Well - RI Groundwater Sample Location

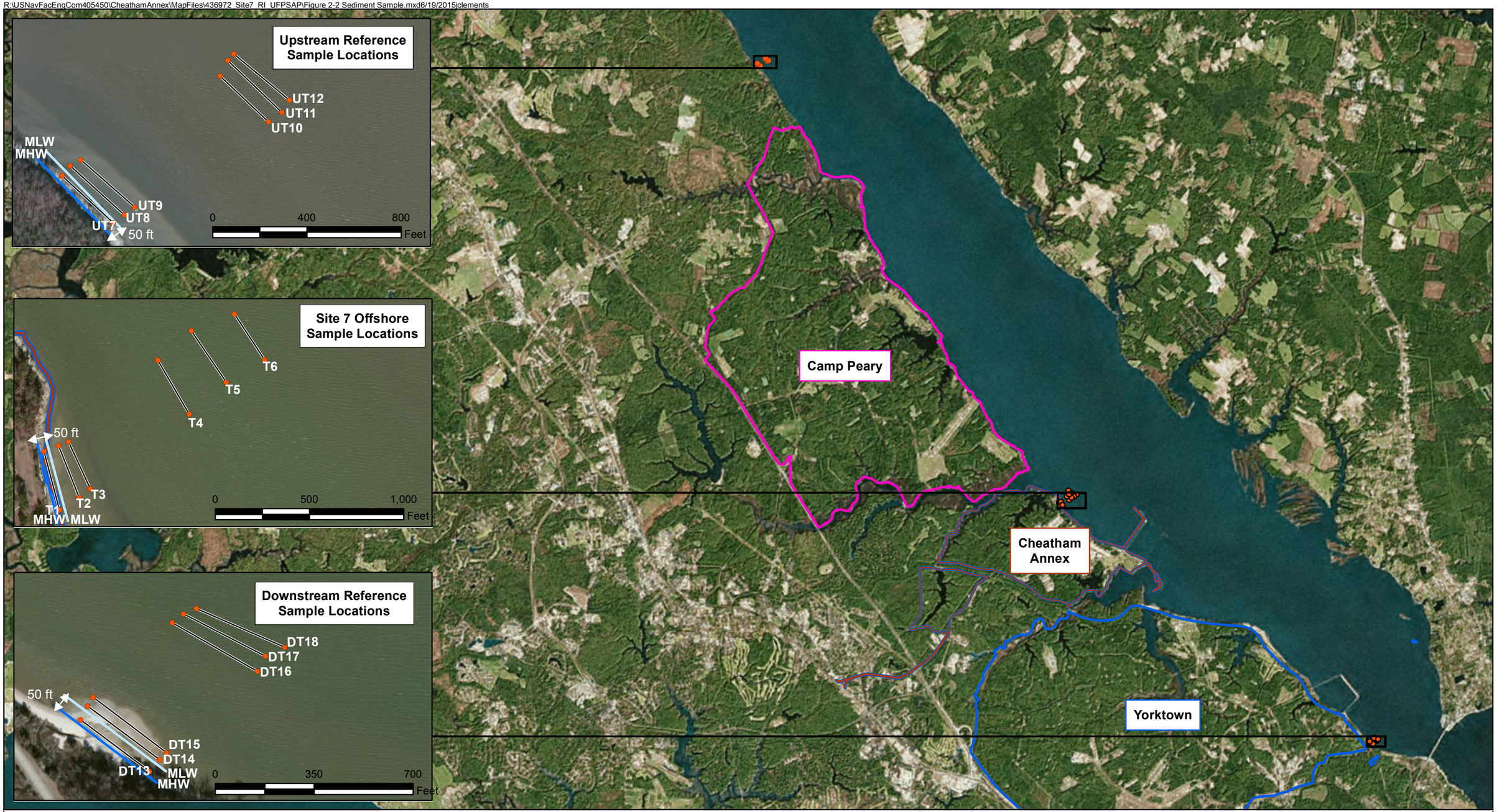
N
W E
S

0 40 80
Feet

Figure 2-1
Groundwater Sample Locations
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, VA

CH2MHILL

R:\USNavFacEngCom405450\CheathamAnnex\MapFiles\436972_Site7_RI_UFPSAP\Figure 2-2 Sediment Sample.mxd6/19/2015jclements



Legend

- Transect Locations
- Camp Peary Installation Boundary
- Cheatham Annex Installation Boundary
- Yorktown Installation Boundary
- Site 7 Boundary

Notes:
MHW – mean high water
MLW – mean low water

N
W E
S

0 1 2
Miles

Nautical Chart Source: ESRI

Figure 2-2
Sediment Sample Locations
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

CH2MHILL®

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436972_SITE7_RI_UFPSAP\FIGURE 2-3 - SOIL SAMPLE LOCATIONS.MXD JCLEMENTS 6/19/2015 10:32:45 AM

Legend

Soil Sample Type

- 2011 SI Field Activities
- Shaw 2008 Field Investigation
- Shaw 2008 Removal Action

- Excavation Boundary
- Site Boundary

N
W E
S

0 30 60 120 Feet

Figure 2-3
Soil Sample Locations
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

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SECTION 3

Physical Characteristics

This section presents an evaluation of the Site 7 physical characteristics and summarizes the physical settings of CAX and Site 7, including meteorology, topography, land and groundwater use, hydrogeology, and ecological resources. This information provides the basis for the hydrologic and hydrogeologic conceptual model of Site 7, which in turn is a foundational element of the overall site CSM. The information concerning the physical characteristics also supports the human health risk assessment (HHRA) and ecological risk assessment (ERA).

3.1 Climate

The moderating effects of the Atlantic Ocean influence the climate of the Virginia Peninsula, resulting in mild winters and long, warm summers. High humidity occurs frequently along the coast and less frequently inland. The average relative humidity in mid-afternoon is approximately 60 percent. Humidity is higher at night, and the average humidity at dawn is approximately 80 percent. Ground fog is a frequent weather occurrence in late summer, especially during early morning hours.

Freezing temperatures occur intermittently from October through March. The average monthly temperatures in the area range from approximately 38.8 degrees Fahrenheit (°F) in January to 77.4°F in July (Baker, 2003).

Because of its location near the coastline, York County, where Williamsburg is located, is subject to easterly storms throughout late summer and early fall, which cause high tides and coastal flooding. Intense tropical hurricanes occasionally sweep the coast. Winter storms that move along the eastern seaboard are often associated with high winds and precipitation, occasionally in the form of snow, ice pellets, or rain; however, the snow is seldom prolonged or heavy. The average annual precipitation is approximately 44 inches, with the summer months being the wettest and the winter months being the driest (Baker, 2003).

Spring is a period of contrasting weather, particularly during March. Spring and autumn are periods of occasional frost. Summer is warm and humid with occasional showers and afternoon thunderstorms. Autumn is a season of comfortable temperatures (average temperature 60˚F to 81˚F) and generally pleasant weather (Baker, 2003).

Winds are highly variable in the area of CAX. Prevailing winds are usually from the south-southwest, but north-northeasterly winds are common in some months. Onshore winds predominate during the spring and summer (Baker, 2003).

3.2 Topography and Surface Water Features

The topography at CAX is characterized by gently rolling terrain dissected by ravines and stream valleys trending predominantly northeastward toward the York River. Ground elevations at CAX vary from sea level along the eastern boundary, which borders the York River, to a maximum elevation of approximately 50 feet above mean sea level (amsl) on a few scattered hills in the western portion of the base. Valleys consisting of deep ravines with steep slopes (slopes exceeding 1:1) occur along the major creeks draining CAX (Baker, 2003).

CAX is bordered on the west by Cheatham Pond, on the north by the mouth of Queen's Creek, on the east by the York River, and on the south by King Creek. In 1943, dams were constructed to create the 108-acre Cheatham Pond from a tributary of Queen's Creek, as well as the 43-acre Penniman Lake from a tributary of King Creek. Both creeks are tidally influenced; however, Cheatham Pond and Penniman Lake are not. Damming a portion of the Cub Creek watershed formed Jones Pond, a 69-acre freshwater, non-tidally influenced pond enclosed by several wooded ravines and located in the southwestern section of CAX. Numerous small creeks flow through wooded ravines throughout CAX and drain into tidal creeks that join the York River. In most areas, forests extend to the marsh and lake margins. The tributaries of CAX drain into the York River (Baker, 2003).

The ground surface at Site 7 is fairly flat and mainly covered with grasses. Mature trees stand outside the limits of the 2008 removal action. However, since the removal action, volunteer pine trees and underbrush have started to

fill in the open areas of the site. Before 2006, the upland area of the site was flat, and there was a steep, near-vertical slope to the York River, where the shoreline was highly vulnerable to erosion caused by surface water runoff and wave action. In 2006, shoreline stabilization activities were conducted, and geotextile tubes were installed to prevent further erosion of the shoreline. The grading following the removal action in 2008 led to the current site conditions that include a more gently sloping grade along the eastern site boundary to the York River shoreline. Surface water from the site runs off to the York River or infiltrates into the ground. Other than the York River, no wetlands or water bodies are on or immediately adjacent to Site 7.

The York River is a partially mixed, micro-tidal estuary that extends 40 miles from the confluence of the Mattaponi and Pamunkey rivers at West Point, Virginia to the Chesapeake Bay. It drains into the Chesapeake Bay approximately 5 miles east of Site 7. It ranges in width from 1 mile at its head to 2.5 miles near its mouth, and is approximately 2 miles wide adjacent to Site 7. Main channel depths near CAX range between 45 and 55 feet, though the river depth is often less than 20 feet up to 300 feet from the shoreline. The York River is a highly energetic environment. The tide cycles move large amounts of sediment upstream and downstream within the estuary even during non-storm conditions (Center for Coastal Resources Management, 2010).

3.3 Land Use

CAX is a secure military installation that occupies 2,300 acres. Site 7 is within the confines of CAX and public access is restricted. The portions of the site surrounding the removal area are forested, with the removal area consisting of successional old field habitat.

Navy and the Department of Defense (DoD) personnel do have access to the area; however, the site itself is surrounded by a fence to deter trespassers. At this time, the future land use of this site is not expected to change; however, because of its location, the site eventually may be used as a recreational area.

3.4 Water Use

Between approximately 1943 and October 2002, Jones Pond was the drinking water source for CAX (ATSDR, 2004). In addition, groundwater from the Yorktown-Eastover aquifer historically was the drinking water source for older homes within the vicinity of CAX and was used as a backup water supply for CAX. However, groundwater at CAX is not a current or anticipated future source of drinking water at CAX, as the City of Newport News Waterworks supplies drinking water to CAX. In addition, drinking water is publically available, through the City of Newport News Waterworks, to domestic homes located within the vicinity of CAX. The Commonwealth of Virginia does not employ groundwater use classifications; therefore, groundwater at CAX is considered to be of potential beneficial use. No fresh surface water bodies are within the vicinity of Site 7 that could feasibly be used as a potable water supply.

3.5 Hydrogeology

3.5.1 Geology

CAX is in the Atlantic Coastal Plain Physiographic Province, which is underlain by multiple layers of unconsolidated sediment of Quaternary, Tertiary, and Cretaceous ages (**Figure 3-1**). The granite rock formations of the Appalachian Mountains to the west were eroded over millennia, and sediment was transported from the mountains by rivers and streams to the coast, building up layers of sediment that fanned out onto the Atlantic continental shelf. Successive sea level rises deposited fluvial estuarine and marine sediment further, building the Coastal Plain. Widely fluctuating sea levels sculpted the Coastal Plain into river terraces of different elevations bounded by scarp features that resulted from shoreline erosion. The Coastal Plain near CAX includes four terraces: Lackey Plain, Croaker Flat, Huntington Flat, and Grafton Plain (from highest to lowest), and three scarps: Kingsmill, Lee Hall, and Camp Peary. As shown on **Figure 3-2**, CAX is located within the Lackey Plain and Croaker Flat terraces, separated by the Camp Peary scarp located along the York River (Brockman et al., 1997).

Ten geologic formations have been identified beneath CAX (Brockman et al., 1997). The uppermost geologic formations consists of alluvial, colluvial, and marsh deposits composed of silt, sand, and pebbles with some clay. In terms of the overlying soils, Site 7 is located within Soil Association Group 2, one of the four soil association

groups identified at CAX during a 1985 soil survey report for CAX prepared by the United States Department of Agriculture Soil Conservation Service (USDASCS, 1985). Soils in Soil Association Group 2, the Dogue, Pamunkey, and Uchee Association (**Figure 3-3**), were formed on river terraces and are deep, well- to poorly drained soils with clayey and loamy subsoils (Baker, 2003). A more detailed description of the soils within Soil Association Group 2 is in the 2003 CAX background investigation report (Baker, 2003).

Based on soil boring logs from the 2011 SI and the RI field activities, geology at Site 7 consists of yellow and brown sand with varying degrees of silt and clay, overlain by fill dirt brought in during excavation activities. Soil boring logs from the RI field activities presenting descriptions of the soil and general subsurface geology are provided in **Appendix A**.

3.5.2 Hydrostratigraphy

Each geologic unit was grouped into hydrostratigraphic units based upon hydrologic characteristics (Lazniak and Meng, 1988; Brockman et al., 1997). Based upon the hydraulic characteristics of the geologic units present, the uppermost eight (Cobham Bay Member of the Eastover formation through the Tabb formation) of the ten geologic formations have been identified as the York County Shallow Aquifer System. As shown on **Figure 3-1**, the following five hydrogeologic units make up the York County Shallow Aquifer System at CAX (in descending order):

- Columbia Aquifer (consisting of the Windsor through Tabb formations)
- Cornwallis Cave Confining Unit (consisting of the Bacons Castle formation)
- Cornwallis Cave Aquifer (consisting of the upper Moore House Member of the Yorktown formation and the Sedley formation)
- Yorktown Confining Unit (consisting of the upper Morgarts Beach and lower Moore House Members of the Yorktown formation)
- Yorktown-Eastover Aquifer (consisting of the Cobham Bay through Rushmere Members of the Yorktown formation)

Site 7 is located on the Croaker Flat. Hydrogeologic units typically noted within the Croaker Flat include the Columbia Aquifer, Yorktown Confining Unit, and Yorktown-Eastover Aquifer. In the Site 7 area of the Croaker Flat, the Columbia Aquifer and/or Yorktown Confining Unit are absent.

3.5.3 Aquifer Properties

Aquifer testing was performed at AOC 8, which is just south of Site 7 and shares geologic and hydrogeologic features with Site 7 in terms of the same surficial aquifer (Yorktown-Eastover Aquifer) and a location within the same soil zone (Soil Association Group 2). The aquifer properties at AOC 8 were assumed to be reasonably comparable to those of Site 7 because of their similarities and close spatial proximity (**Figure 3-3**). Hydraulic conductivity (K) “slug” tests were performed at each of the six AOC 8 monitoring wells in October 2014 to collect rising-head and falling-head test data to estimate the hydraulic conductivity of the Yorktown-Eastover Aquifer near these wells.

The AOC 8 slug test data were analyzed using both the Hvorslev Method (Hvorslev, 1951) and the Bouwer and Rice Method (Bouwer and Rice, 1976). The K values were reported for both rising- and falling-head methods when the static water level occurred within the riser pipe portion of the monitoring well (that is, above the screen interval). **Table 3-1** summarizes the testing results. The slug test data analyses were performed using AQTESOLV software, and the average calculated K value of 1.12 foot per day (ft/day) is reported in **Table 3-1**. While the Hvorslev solution is generally intended for nonleaky, confined aquifers and the Bouwer-Rice solution is intended for confined and unconfined aquifers, a study by Brown et al. (1995) determined that the Hvorslev and Bouwer-Rice solutions are applicable to unconfined and confined aquifers in many cases. Therefore, although the Yorktown-Eastover Aquifer is unconfined at AOC 8 (and Site 7), the overall maximum and minimum K values calculated from the falling- and rising-head test data were chosen independent of the method used to calculate the K value.

The K values in the Yorktown-Eastover Aquifer were estimated to be between 0.188 and 4.24 ft/day. These values fall within or near the reported range of 0.004 to 3 ft/day for this aquifer (Brockman et. al., 1997). Slug test results, by their nature, are limited in their ability to accurately estimate the K of an aquifer, in part because of impacts from the filter pack placed around the well during installation. They are generally considered to represent an "order-of-magnitude" level of precision and accuracy in estimating K.

3.5.4 Groundwater Flow

The first encountered groundwater at Site 7 is within the Yorktown-Eastover Aquifer, and the groundwater elevations on April 9, 2014, ranged from 2.15 feet amsl at CAS07-MW05 to 4.64 feet amsl at CAS07-MW02 (**Table 2-2**). The groundwater elevation data indicate the primary groundwater flow direction at Site 7 is east-northeast, toward the York River (**Figure 3-4**). Groundwater elevations are not expected to be significantly affected by the tide cycles in the York River.

The average horizontal hydraulic gradient (I) along the flow path from CAS07-MW09 to CAS07-MW08 is 0.009[1]. Based on the average calculated K value of 1.12 ft/day within the Yorktown-Eastover Aquifer from nearby AOC 8 (**Table 3-1**), an assumed effective porosity (n) of 0.3[2], and the average horizontal hydraulic gradient calculated from the groundwater contour map (0.009), the average groundwater velocity[3] at Site 7 is estimated to be 0.034 ft/day.

3.6 Ecological Resources

Terrestrial flora at CAX consists predominantly of woodland species (Baker, 2005b). The following three types of forest are present:

- Pine stands composed primarily of loblolly and Virginia pines
- Mixed pine and hardwood stands
- Hardwood stands

Elevated areas are the predominant locations of pine stands, while hardwood stands are found on slopes and in ravines. Native tree species found at CAX include beech, black cherry, red maple, sweet gum, various pines, white ash, and white oak. The woodland's understory is composed of various seedling trees and vine species, such as Virginia creeper, briars, and honeysuckle. Ferns are found in many moist, shaded areas. Ornamental trees and shrubs have been planted in the improved areas and along major roadways. None of the plant species that occur at CAX is listed on the federal or commonwealth endangered species lists.

Small, undeveloped tracts of land at CAX support a variety of indigenous wildlife species. Whitetail deer, beaver, skunk, bobcat, red and gray fox, squirrel, raccoon, opossum, and rabbit are present. Game birds, such as wild turkey, quail, duck, and pheasant, also are resident. Songbirds common to the eastern Virginia area are in abundance at CAX, along with a raptor population consisting of small hawks, owls, and osprey. Carrion-feeding birds such as crows and turkey vultures also are common. The southern bald eagle (federally and state protected) is known to nest nearby at WPNSTA Yorktown. Suitable habitat exists for roosting and perching at CAX, but only occasional sightings of eagles have been made there.

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1 Average horizontal hydraulic gradient was calculated between monitoring wells CAS07-MW08 and CAS07-MW09, whereby I (average horizontal hydraulic gradient) = (3.26-2.7 feet)/62 feet = 0.009.

2 Effective porosity of 0.30 used based on analyses of Cenomanian and Albian Age sands (Upper and Middle Potomac aquifer) in the Norfolk, Virginia, area (Brown and Silvey, 1997).

3 Average groundwater velocity (ft/day) = (K x I)/n.

Wetlands are mainly found along principal tributaries to the York River and along the York River shoreline at CAX. The following four major marsh types exist along these margins:

- Saltmarsh cordgrass communities
- Big cordgrass communities
- Cattail communities
- Brackish water mixed communities

Freshwater wetlands also are present within the interior, non-tidal areas of the installation. Salinities in the York River estuary bordering CAX can be characterized as mesohaline (from 15 to 20 parts per thousand [ppt]), and can fluctuate depending on seasonal impacts, runoff, and rainfall. Of the 295 fish species known from the Chesapeake Bay, only 32 are year-round residents. Nursery areas, foraging areas, and spawning ground attract the remaining species from the Atlantic Ocean and freshwater tributaries each year. In the York River, resident fish include hogchoker, weakfish, and oyster toadfish. Spot and croaker are common in nursery and foraging areas in the summer, and numerous anadromous and catadromous fish use the area during migration, including the alewife, American eel, American shad, blueback herring, striped bass, and white perch. Commercially and recreationally important species from the York River include American shad, bay anchovy, blue crab, bluefish, croaker, spot, striped bass, summer flounder, and weakfish. The York River near CAX is a designated crab pot fishery each year from March through November; immediately north of CAX is a spawning and nursery ground for blue crabs. Several species of endangered sea turtles (namely the green, hawksbill, leatherback, loggerhead, and Kemp's Ridley) are known to feed in the Chesapeake Bay and occasionally forage in the York River, including near CAX, during the summer.

The York River is designated as Essential Fish Habitat for three species of fish managed by the Mid-Atlantic Fishery Management Council—summer flounder, bluefish, and butterfish. Though bluefish and butterfish use the more open, pelagic waters characteristic of the river, juvenile summer flounder often use unvegetated, nearshore sandy bottoms and salt marsh creeks as nursery areas. Other species likely to use salt marsh creeks include anchovies, blue crabs, juveniles of migratory species, hard- and soft-shell clams, killifish, minnows, mummichogs, oysters, silversides, and weakfish.

No known federally or state-listed endangered or threatened species use CAX habitats. Suitable habitat exists at CAX for both the red-cockaded woodpecker (federally endangered) and the bald eagle (formerly federally threatened and still protected by the Bald and Golden Eagle Protection Act and state threatened/endangered). Bordering the CAX property is the York River, which provides seasonal habitat for federally and state endangered Kemp's Ridley sea turtles and federally threatened loggerhead sea turtles. The shoreline along the York River may also provide habitat for federally threatened piping plovers. Rare resources and communities identified at CAX in the Virginia Department of Conservation and Recreation Natural Heritage Program database and the CAX Natural Heritage Inventory include a significant great blue heron colony, low salt marsh and salt scrub habitats, coastal plain depression ponds, non-riverine wet hardwood forests, and coastal plain calcareous seepage swamps.

TABLE 3-1

K_h Values from Slug Tests Conducted at CAX AOC 8

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Monitoring Well	CAA08-MW01				CAA08-MW02				CAA08-MW03			
Falling/Rising Head Test	MW01 FH1	MW01 FH2	MW01 RH1	MW01 RH2	MW02 FH1	MW02 FH2	MW02 RH1	MW02 RH2	MW03 FH1	MW03 FH2	MW03 RH1	MW03 RH2
BR K (ft/s)	7.17E-06	7.82E-06	7.29E-06	8.03E-06	5.16E-06	4.99E-06	6.08E-06	5.24E-06	1.14E-05	1.06E-05	7.07E-06	1.05E-05
BR y (ft)	1.424	1.22	2.129	2.024	1.768	1.778	2.544	2.121	1.674	1.928	2.133	2.064
HV K (ft/s)	1.07E-05	1.16E-05	9.97E-06	1.25E-05	6.32E-06	6.98E-06	8.16E-06	7.26E-06	1.61E-05	1.59E-05	1.01E-05	1.55E-05
HV y (ft)	1.48	1.224	1.967	2.203	1.518	1.852	2.356	2.203	1.683	2.116	2.166	2.132

MW01	Min	7.17E-06	MW02	Min	4.99E-06	MW03	Min	7.07E-06
	Max	1.25E-05		Max	8.16E-06		Max	1.61E-05
	Average	9.38E-06		Average	6.27E-06		Average	1.21E-05

Minimum K (at CAA08-MW05)(ft/day) = 1.88E-01
Maximum K (at CAA08-MW04)(ft/day) = 4.24E+00
Average K_h (ft/day) of all 6 wells = 1.12

Notes:
Shading indicates minimum or maximum K value

TABLE 3-1

K_h Values from Slug Tests Conducted at CAX AOC 8

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Monitoring Well	CAA08-MW04				CAA08-MW05				CAA08-MW06			
Falling/Rising Head Test	MW04 FH1	MW04 FH2	MW04 RH1	MW04 RH2	MW05 FH1	MW05 FH2	MW05 RH1	MW05 RH2	MW06 FH1	MW06 FH2	MW06 RH1	MW06 RH2
BR K (ft/s)	4.91E-05	4.06E-05	4.60E-05	4.80E-05	7.10E-06	6.68E-06	3.21E-06	2.18E-06	1.22E-05	1.17E-05	1.17E-05	1.44E-05
BR y (ft)	1.534	1.414	1.912	2.021	0.5216	0.3989	0.3028	0.2369	1.7	1.629	2.171	2.161
HV K (ft/s)	1.26E-05	1.05E-05	1.24E-05	1.19E-05	9.83E-06	9.86E-06	4.29E-06	3.53E-06	1.78E-05	1.69E-05	1.54E-05	2.10E-05
HV y (ft)	1.563	1.503	2.098	1.99	0.4848	0.4044	0.3087	0.2632	1.746	1.621	2.067	2.231

MW04	Min	1.05E-05	MW05	Min	2.18E-06	MW06	Min	1.17E-05
	Max	4.91E-05		Max	9.86E-06		Max	2.10E-05
	Average	2.89E-05		Average	5.83E-06		Average	1.52E-05

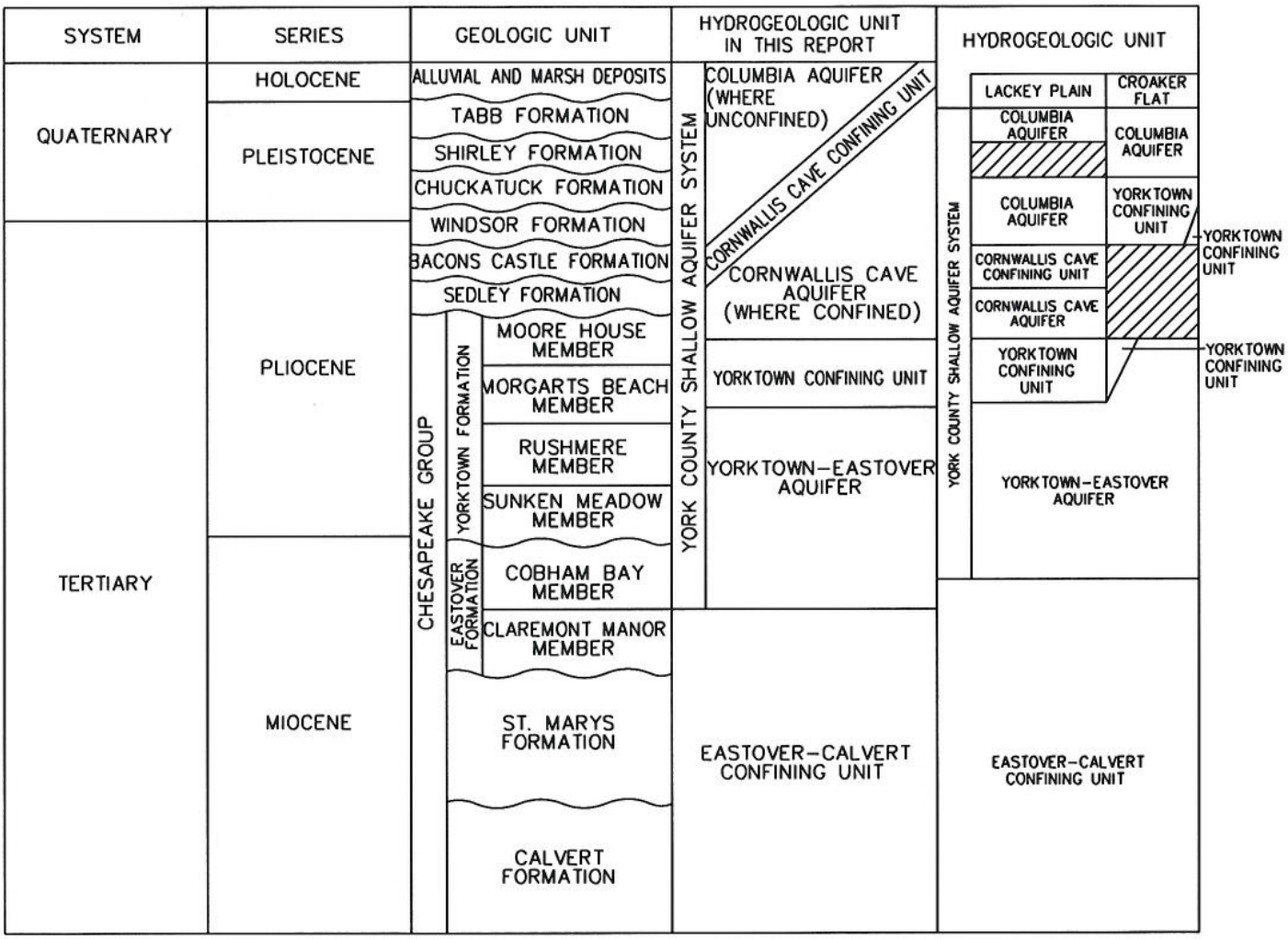
Minimum K (at CAA08-MW05)(ft/day) = 1.88E-01

Maximum K (at CAA08-MW04)(ft/day) = 4.24E+00

Average K_h (ft/day) of all 6 wells = 1.12

Notes:

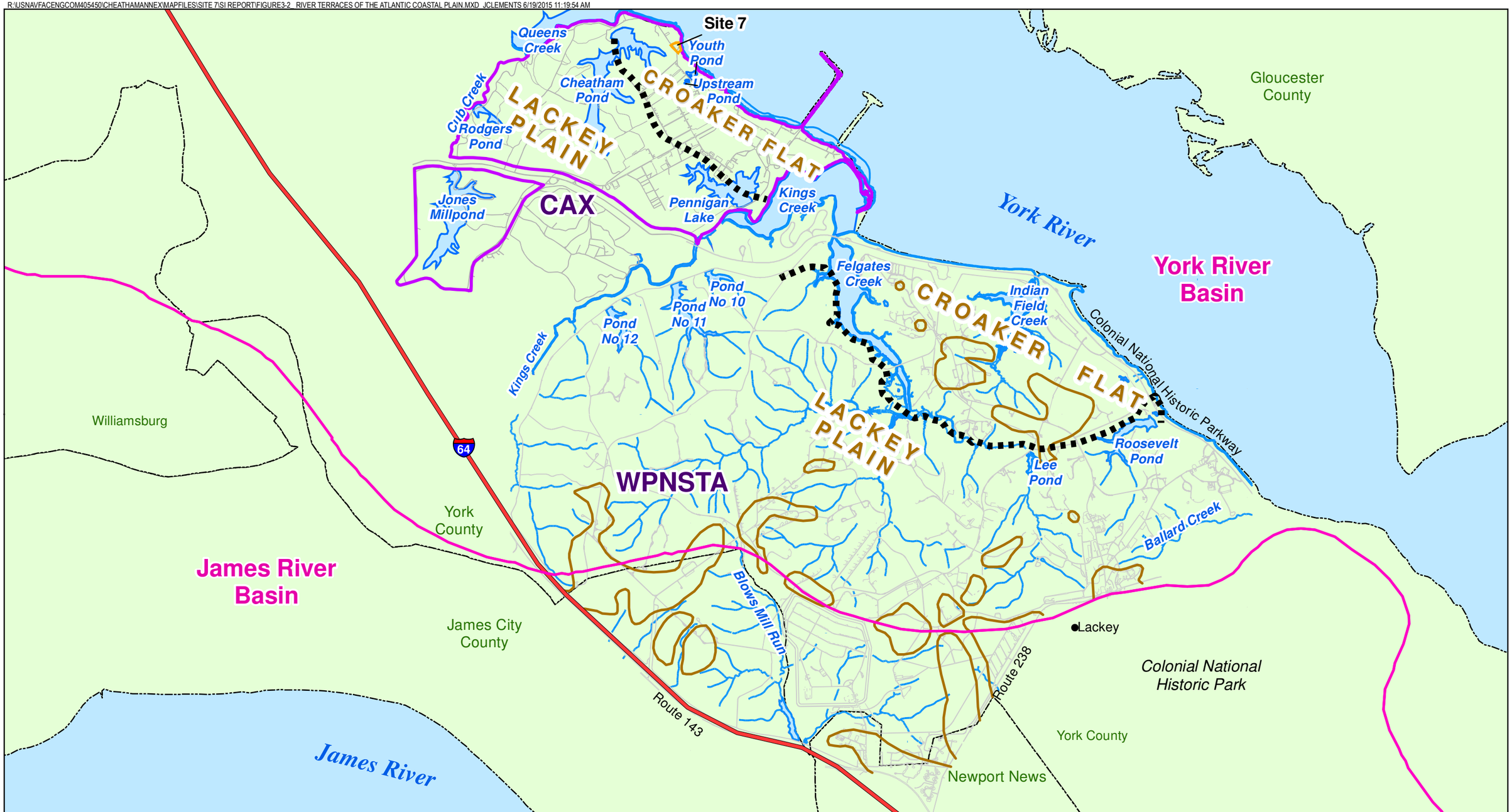
Shading indicates minimum or maximum K value



Source: Brockman, ET AL 1997 GEOHYDROLOGY OF THE SHALLOW AQUIFER SYSTEM, NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Figure 3-1
Geologic Units in York County
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\SITE 7\SI REPORT\FIGURE3-2_ RIVER TERRACES OF THE ATLANTIC COASTAL PLAIN.MXD JCLEMENTS 6/19/2015 11:19:54 AM



Legend

- Activity Boundaries
- Watershed Boundaries
- Site Boundary
- Camp Peary Scarp
- Interstate 64
- Approximate Boundary of Columbia Aquifer, February 3, 1997
- Roads
- Shoreline and Water Bodies
- City / County Boundaries

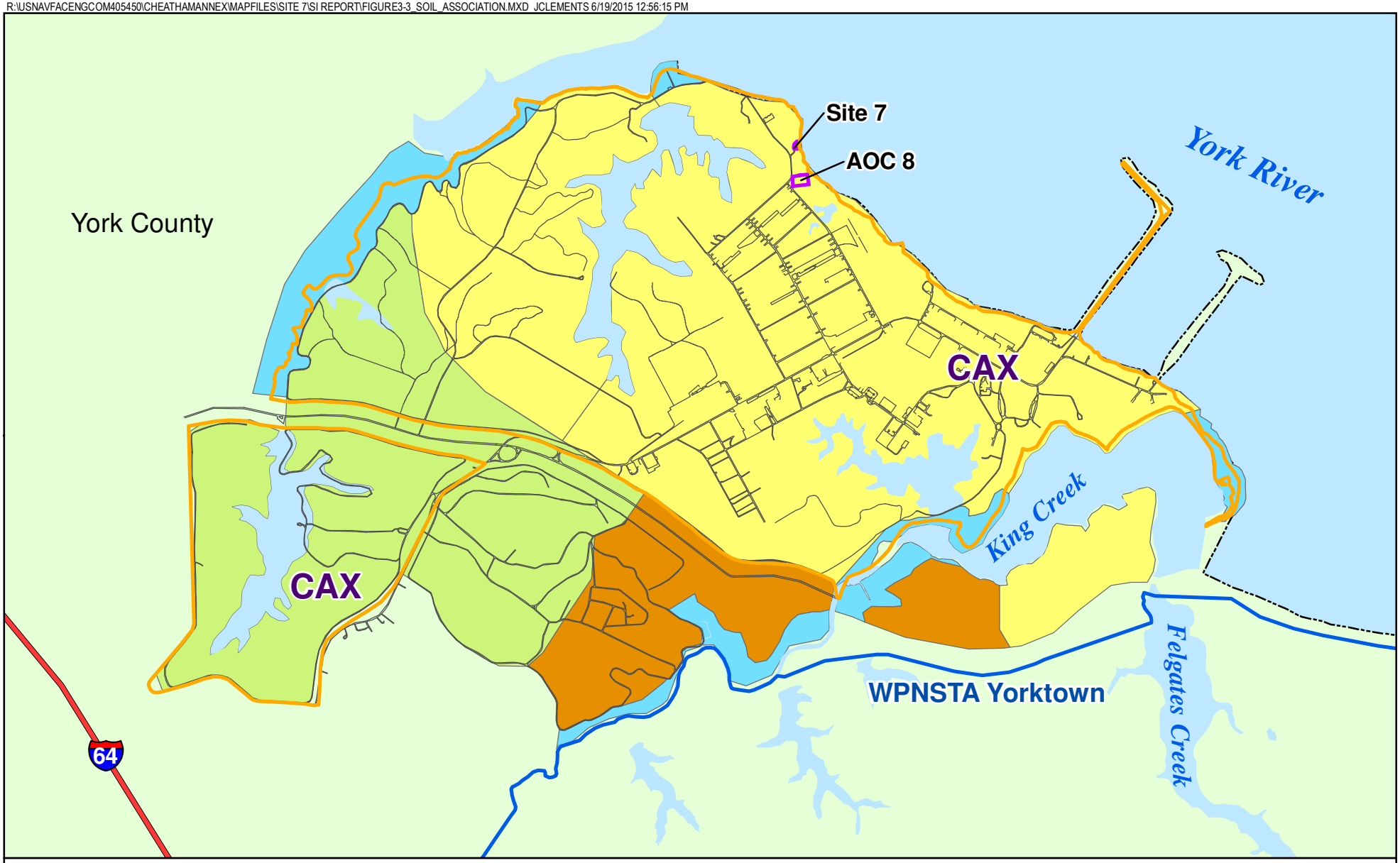
N W E S

0 2,000 4,000 8,000 Feet

Figure 3-2
River Terraces of the Atlantic Coastal Plain
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\SITE 7\SI REPORT\FIGURE3-3_SOIL_ASSOCIATION.MXD JCLEMENTS 6/19/2015 12:56:15 PM



Legend

Cheatham Annex Soil Associations

- Bohicket, Johnson, and Axis (1)
- Dogue, Pamunkey, and Uchee (2)
- Slagle, Emporia, and Craven-Uchee Complex (3)
- Emporia, Emporia Complex, Kempsville, and Craven-Uchee Complex (4)

- Site Boundaries
- CAX Boundary
- WPNSTA Yorktown Boundary

N W E S

0 1,250 2,500 Feet

Figure 3-3
General Soil Association Map
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436972_SITE7_RI_UFPSAP\FIGURE 3-4 - POTENTIOMETRIC SURFACE MAP.MXD JCLEMENTS 6/23/2015 2:24:50 PM

Legend

- Site Boundary
- Cheatham Annex Boundary
- Buildings
- Former Buildings
- Roads
- Existing Monitoring Well Locations
- Potentiometric Surface Contour (Inferred where dashed)
- Approximate Direction of Groundwater Flow
- (2.15) - Groundwater Elevation (feet amsl)

Note: amsl - above mean sea level

N
W E
S

0 40 80
Feet

Figure 3-4
Potentiometric Surface Map
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

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SECTION 4

Nature and Extent of Contamination

This section presents an evaluation of the nature and extent of contamination within soil, sediment, and groundwater at Site 7, based on sampling activities and data analyses from the SI, RI, and earlier field activities. Environmental samples were collected to characterize the vertical and horizontal extents of contamination and to support risk assessments to determine whether further investigation or remedial action are warranted at Site 7.

Environmental sampling results used in this evaluation were collected during the 2008 removal action, 2011 SI (CH2M HILL, 2012), and 2014 RI. Collectively, these samples included 46 soil samples and 14 groundwater samples collected from within Site 7 and 18 sediment samples collected from the adjacent York River (**Table 2-1**).

In the initial step of this evaluation, site-specific data were compared to conservative screening values, as follows:

- Soil – USEPA residential soil regional screening levels (RSLs)[4] (USEPA, 2014) and site-specific, literature-based ecological screening values (ESVs) for plants and soil invertebrates (if the soil sample was within the first 2 feet of ground surface)
- Groundwater – USEPA tap water RSLs[4](USEPA, 2014) and the federal maximum contaminant levels (MCLs)
- Sediment – USEPA residential soil RSLs[4](USEPA, 2014) multiplied by 10 (to adjust the soil RSL to sediment), USEPA Region III BTAG freshwater sediment screening values, and site-specific, literature-based freshwater ESVs
  - Since there are no screening criteria for most dioxin/furan congeners, the detected congener concentrations were used to calculate 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxic equivalent (TEQ) concentrations for each sample used in the human health risk calculations; the TEQ concentrations were then used in the comparison to screening criteria for 2,3,7,8-TCDD.

Summaries of the detected constituents exceeding one or more screening criteria in soil, groundwater, and sediment are provided in **Tables 4-1, 4-2,** and **4-3**, respectively. The complete set of laboratory analytical results used in this evaluation for Site 7 also are presented in **Appendix D**. The constituents exceeding the screening criteria are discussed in the following subsections in terms of nature and extent of contamination, historic site use, and concentration relative to base-wide or site background concentrations.

4.1 Soil

Soil samples evaluated during the RI included 41 soil samples (plus 5 duplicate samples) collected during the 2008 removal action and analyzed for VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), explosives, and inorganics, as identified in **Table 2-1**. An additional five soil samples (plus one duplicate sample) were collected in 2011 and analyzed solely for pH measurement to aid in the ERA.

4.1.1 Organic Constituents

- No VOCs, SVOCs, PCBs, dioxins/furans, or explosives constituents were detected in any soil samples above their respective screening criteria.
- One pesticide, endrin, was detected slightly above the ESV (1.95 micrograms per kilogram [µg/kg]) in one soil sample (NWSY-90-7-SC-PER-132 at 2.4 J µg/kg) (**Figure 4-1**). There is no evidence to suggest pesticides were disposed at Site 7. The low concentration of the detected pesticide suggests it is likely attributable to routine pesticide applications at DoD facilities to control pests and weeds. The legal application of pesticides is not a CERCLA-regulated release.

4 RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic endpoints are based on carcinogenic risk of 1 x 10^{-6}.

4.1.2 Inorganic Constituents

Ten inorganic constituents in soil were detected at concentrations exceeding the residential RSL and/or ESV (**Figure 4-1)**.

- Cobalt was detected in 20 of the 46 samples at concentrations exceeding the residential RSL (2.3 milligrams per kilogram [mg/kg]). However, the maximum cobalt detected concentration (5.8 J mg/kg) is below the Base background 95 percent upper tolerance limit (UTL) (9.93 mg/kg), indicating the cobalt concentrations are representative of naturally occurring conditions.
- Arsenic, lead, manganese, and vanadium were detected in at least one soil sample at concentrations exceeding at least one screening criterion. Specifically:
  - Arsenic was detected in all 46 soil samples (maximum concentration of 24.3 mg/kg) at concentrations exceeding the residential RSL (0.67 mg/kg) and/or ESV (18.0 mg/kg).
  - Lead was only detected in one surface soil sample (NWSY-90-7-SC-FLR-144 at 204 J mg/kg) at a concentration exceeding the ESV (120 mg/kg).
  - Manganese was detected in 8 of the 46 soil samples (maximum concentration of 466 J mg/kg) at concentrations exceeding the residential RSL (180 mg/kg) and/or ESV (220 mg/kg).
  - Vanadium was detected in 2 of the 46 soil samples (maximum concentration of 63.1 J mg/kg) at concentrations exceeding the residential RSL (39 mg/kg).

  However, a maximum of two detections for each of these inorganics exceeded its respective Base background 95 percent UTL out of 46 results. The locations of individual constituent exceedances of Base background 95 percent UTLs do not appear to be correlated, as would be expected in the case of a site-related release. Overall, the concentrations of arsenic, lead, manganese, and vanadium in soil appear to be likely attributable to naturally occurring conditions.
- Aluminum, chromium, iron, and selenium were detected in at least four soil samples at concentrations exceeding at least one screening criterion and the Base background 95 percent UTL. Specifically:
  - Aluminum was detected in 23 of the 46 soil samples at concentrations exceeding the residential RSL (7,700 mg/kg). With the exception of five soil samples (NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-138, NWSY-90-7-SC-FLR-173, and NWSY-90-7-SX-PER-175), the detected concentrations were consistent with the Base background 95 percent UTL (12,200 mg/kg).
  - Chromium was detected in all 46 soil samples at concentrations exceeding the residential RSL (0.3 mg/kg). With the exception of four soil samples (NWSY-90-7-SC-PER-132, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-173, and NWSY-90-7-SC-PER-175), the detected concentrations were consistent with the Base background 95 percent UTL (18.2 mg/kg).
  - Iron was detected in 25 of the 46 soil samples at concentrations exceeding the residential RSL (5,500 mg/kg). With the exception of four samples (NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-SLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-173), the detected concentrations were consistent with the Base background 95 percent UTL (19,900 mg/kg).
- Selenium was detected in 20 of the 46 soil samples at concentrations exceeding the ESV (0.52 mg/kg) and the Base background 95 percent UTL (0.51 mg/kg).
- Thallium was detected in 13 of the 46 soil samples at concentrations exceeding the residential RSL (0.078 mg/kg) and/or ESV (1 mg/kg). There is no Base background 95 percent UTL for thallium.

4.2 Groundwater

Seven groundwater samples were collected from Site 7 during the SI (CAS07-MW01 through CAS07-MW07) and analyzed for VOCs, SVOCs, pesticides, PCBs, dioxins/furans, explosives, and total and dissolved inorganics. Based on the SI groundwater analytical results, an additional seven groundwater samples were collected during the RI (CAS07-MW03 through CAS07-MW09) and analyzed for VOCs and MNA parameters (ferrous iron, methane, ethane, ethane, sulfate, sulfide, nitrate, nitrite, dissolved manganese, alkalinity, TOC, chloride, DHC, and functional genes BAV1 vinyl chloride-reductase and TCE-reductase) to assist in assessing the degradation potential and mobility of VOCs (**Figure 4-2**).

A discussion of the groundwater sampling results is presented below. An evaluation of the results and significance of each natural attenuation parameter and more details regarding aquifer geochemical conditions within groundwater are presented in **Section 7**.

4.2.1 General Groundwater Geochemistry

Measurements of DO, ORP, pH, temperature, conductivity, and turbidity were collected at each monitoring well following purging and immediately before sampling (**Table 2-3**). The DO readings collected during purging activities, which provide an indication of the potential for aerobic or anaerobic biodegradation, ranged between 0.0 milligram per liter (mg/L) and 2.66 mg/L. Temperature readings ranged between 11.30 degrees Celsius (°C) and 15.63°C. The ORP values, which indicate the potential for redox conditions in groundwater, ranged between 10 millivolts (mV) and 292.3 mV, and pH values were generally close to neutral, ranging between 6.22 and 7.73 standard units (SU). Conductivity values, which provide an indication of the concentration of total dissolved solids within groundwater, ranged between 0.36 milliSiemen per centimeter (mS/cm) and 1.338 mS/cm, which are indicative of freshwater conditions. Further details regarding groundwater geochemistry and its applicability to contaminant fate and transport are discussed in **Section 7.1.2.**

4.2.2 Organic Constituents

Six VOCs, two SVOCs, two pesticides, and three explosive constituents were detected at concentrations exceeding either the tap water RSL or federal MCL (**Figure 4-2**). No PCBs or dioxins/furans were detected at concentrations exceeding screening criteria.

- Six VOCs (bromodichloromethane, chloroform, cis-1,2-dichloroethene [cis-1,2-DCE], dibromochloromethane, TCE, and vinyl chloride) were detected at concentrations exceeding tap water RSLs or federal MCLs at five monitoring wells. However, TCE is the primary constituent contributing to the total VOC concentrations in groundwater at Site 7. Consequently, monitoring wells CAS07-MW08 and CAS07-MW09 were installed during the RI to more fully delineate the extent of TCE in groundwater. The maximum concentration of TCE during the RI field investigation (53.8 micrograms per liter [µg/L]) was detected at monitoring well CAS07-MW07, with lower concentrations (1.7 µg/L, 1.1 µg/L, and 0.33 J µg/L) detected at CAS07-MW03, CAS07-MW08, and CAS07-MW09, respectively. The concentrations of TCE in these four wells exceeded the tap water RSL (0.28 µg/L), and the concentrations of TCE in samples collected from CAS07-MW07 in 2011 and 2014 (86.4 and 53.8 µg/L, respectively) also exceeded the MCL (5 µg/L). The concentration of cis-1,2-DCE (a so-called “daughter” product from the biodegradation of TCE) at CAS07-MW07 (7.26 µg/L) also exceeded the tap water RSL (3.6 µg/L) but did not exceed the MCL (70 µg/L). In general, the concentrations of TCE in groundwater during the RI sampling event in 2014 were less than the concentrations detected during the SI sampling event in 2011 in applicable monitoring wells, with the exception of CAS07-MW03. TCE was not detected in the Site 7 soil samples.
- Two SVOCs (2,4-DNT and 2,6-DNT) were detected in groundwater at concentrations exceeding the tap water RSLs at monitoring wells CAS07-MW03, CAS07-MW04, and CAS07-MW06. The maximum concentrations of 2,4-DNT (1.09 µg/L) and 2,6-DNT (0.39 µg/L) were detected in groundwater at CAS07-MW04. Neither of these SVOC constituents was detected in the Site 7 soil samples.
- Two pesticides (4,4’-dichlorodiphenyldichloroethane [4,4’-DDD] and gamma-chlordane) were detected at concentrations exceeding the tap water RSL and/or ESVs at monitoring wells CAS07-MW02 (designated a

background monitoring well), CAS07-MW04, and CAS07-MW07. The maximum concentrations of 4,4'-DDD (0.0396 J µg/L) and gamma-chlordane (0.0251 J µg/L) were detected in groundwater at CAS07-MW04. As discussed in **Section 4.1.1**, the low levels of pesticides detected in soil at Site 7 are likely attributable to normal pesticide use at DoD facilities; 4,4'-DDD and gamma-chlordane were not detected in Site 7 soil samples and likely are not the result of a site-related CERCLA release to groundwater.

- Three explosive constituents (1,3-dinitrobenzene, nitroglycerin, and RDX) were detected at concentrations exceeding tap water RSLs at monitoring wells CAS07-MW02 and CAS07-MW04. The maximum concentrations of 1,3-DNT and RDX (1.46 µg/L and 0.721 µg/L, respectively) were detected in background monitoring well CAS07-MW02; the maximum concentration of nitroglycerin (0.231 J µg/L) was detected in monitoring well CAS07-MW04. No explosives were detected in the Site 7 soil samples.

4.2.3 Inorganic Constituents

Six total inorganic constituents and five dissolved inorganic constituents were detected at concentrations exceeding either tap water RSLs or ESVs; no concentrations of inorganic constituents exceeded federal MCLs.

- While total aluminum was detected at concentrations exceeding the ESV, these concentrations likely represent elevated suspended solids within the sample since this constituent was not detected at concentrations exceeding the screening criteria within the corresponding dissolved fraction samples.
- Total and dissolved chromium concentrations exceeded the tap water RSL (0.035 µg/L) in several groundwater samples, with maximum total and dissolved concentrations (2.49 J µg/L and 2.52 µg/L, respectively) detected in monitoring well CAS07-MW05. However, these concentrations did not exceed the MCL (100 µg/L) or the total and dissolved background 95 percent UTLs (15.1 µg/L and 6.04 µg/L, respectively). Chromium concentrations in groundwater at Site 7 are likely attributable to naturally occurring, background conditions.
- While total cobalt concentrations exceeded the tap water RSL (0.6 µg/L) in several groundwater samples, with a maximum concentration of 4.28 µg/L (CAS07-MW03), this concentration is well below the Base background 95 percent UTL (20.6 µg/L). Dissolved cobalt concentrations exceeded the tap water RSL in several groundwater samples, with a maximum concentration of 4.59 µg/L (CAS07-MW03). The results indicate cobalt concentrations are likely attributable to naturally occurring, background conditions.
- Maximum concentrations of total arsenic, cadmium, and manganese (4.26 µg/L, 1.17 J µg/L, and 216 µg/L) exceeded their respective tap water RSLs (0.052 µg/L, 0.92 µg/L, and 43 µg/L), ESV (100 µg/L; for manganese only), and respective background 95 percent UTLs (2.28 µg/L, 0.605 µg/L, and 57.9 µg/L) in several groundwater samples. In addition, these inorganic constituents also were detected above their respective tap water RSLs, ESV (for manganese only), and background 95 percent UTLs (1.37 µg/L, 0.177 µg/L, and 49.5 µg/L) in the dissolved fraction.

  Arsenic and manganese groundwater concentrations are typically elevated in the shallow coastal plain of southeast Virginia because of the aquifer composition and geochemical conditions. Arsenic and manganese concentrations in soil samples collected within Site 7 appeared to be consistent with naturally occurring, background conditions. And similar to the detections of these inorganics in soil, the locations of individual constituent exceedances of Base background 95 percent UTLs do not appear to be correlated, as would be expected in the case of a site-related release. For cadmium, several concentrations exceeded the total and dissolved background 95 percent UTLs (0.605 µg/L and 0.177 µg/L, respectively). However, the total cadmium concentration of 0.932 µg/L detected in upgradient monitoring well CAS07-MW01 is essentially consistent with the maximum total cadmium concentration (1.17 J µg/L) at Site 7. In addition, no concentrations of cadmium in soil at Site 7 exceeded screening criteria. Overall, the results for these inorganics appear to represent naturally occurring, background conditions rather than a site-related release.

4.3 Sediment

During the RI, 18 five-point composite surface sediment samples were collected from the York River to evaluate whether contaminant transport from Site 7 has affected river sediments. Samples were collected along transects located near-shore and within deeper water adjacent to Site 7 (transects T1 through T6) as well as 5 miles upstream (transects UT7 through UT12) and 4 miles downstream (transects DT13 through DT18) of Site 7 (**Figures 2-2** and **4-3**). The upstream and downstream samples were intended to serve as reference samples for comparison to the samples adjacent to the site, since the 2013 WCSD (NAVFAC, 2013) concluded there are numerous historical and ongoing inputs of contaminants to the York River watershed originating from non-Navy sources in addition to potential Navy sources.

4.3.1 Organic Constituents

Sixteen individual dioxin/furan congeners were detected in the sediment samples. Constituents present in the samples collected adjacent to the site (transects T1 through T6) also were detected in the samples collected at the upstream (transects UT7 through UT12) and downstream (transects DT13 through DT18) locations at similar or greater concentrations, indicating the detected constituents are not likely attributable to a release from Site 7 (**Figure 4-3**). None of the detected constituent concentrations in sediment exceeded human health screening criteria; ecological screening criteria were not available. Detected dioxin and furan congeners in near-shore samples collected adjacent to Site 7 had a maximum total TEQ concentration of 1.2 picogram per gram (pg/g) (transect T2). By comparison, near-shore samples collected upstream and downstream of Site 7 in the York River had a maximum total TEQ concentration of 2.5 pg/g (transect UT9) upstream and total TEQ of 1 pg/g (transect DT13) downstream.

4.3.2 Inorganic Constituents

Only one inorganic constituent, manganese, was detected at concentrations exceeding the ESV; no inorganic constituent concentrations exceeded residential soil RSLs (**Figure 4-3**).

- Manganese concentrations exceeded the ESV (260 mg/kg) and sediment background concentration in four samples. The three highest concentrations were detected in samples CAS07-SD10, CAS07-SD11, and CAS07-SD 12 collected at the deep water transects UT10, UT11, and UT12 located upstream of Site 7. The fourth highest concentration was detected in sample CAS07-SD06, collected adjacent to Site 7 at deep water transect T7. Since the highest manganese concentrations were detected upstream of Site 7, these results indicate the manganese concentrations are likely attributable to background conditions.

TABLE 4-1

Soil Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS***	**Residential Soil RSLs (May 2014)**	**ESV**	CAS07-SO001		CAS07-SO002		CAS07-SO003	CAS07-SO004	CAS07-SO005
Sample ID				NWSY-90-7-SC-PER-132	NWSY-90-7-SC-PER-133	NWSY-90-7-SC-PER-135	NWSY-90-7-SC-PER-183	NWSY-90-7-SC-FLR-136	NWSY-90-7-SC-FLR-137	NWSY-90-7-SC-FLR-138
Sample Date				02/28/08	02/28/08	02/28/08	04/09/08	02/28/08	02/28/08	02/28/08
Chemical Name										
Pesticide/Polychlorinated Biphenyls (µg/kg)										
Endrin	--	1,800	1.95	2.4 J	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U
Total Metals (mg/kg)										
Aluminum	12,200	7,700	pH < 5.5	11,200	3,530	6,710	9,730	**12,600**	**20,300**	**14,100**
Arsenic	6.36	0.67	18.0	4.3 L	1.4	1.5	2.6	1.9	1.3	2
Barium	52.9	1,500	330	24.2 J	19.6 J	**57.7 J**	**90.4**	48.8 J	35.7 J	51.7 J
Beryllium	0.587	16	40.0	0.47	0.33	**0.97**	**1.3**	0.4	**0.6**	**0.6**
Calcium	2,290	--	--	1,480 L	407	458	770 J	1,150	2,070	1,090
Chromium	18.2	0.3	64.0	**23.3 J**	10.9 J	5.1 J	7.4	16.8 J	**41.1 J**	16.3 J
Cobalt	9.93	2.3	13.0	1.1 J	3.4	3.3	5.1 J	1.5 J	2.3 J	1.9 J
Copper	4.25	310	70.0	**7.5 J**	**4.6 J**	3.3 J	2.9 J	2 J	2.7 J	3.5 J
Cyanide	--	2.1	15.8	0.14 U	0.13 U	0.13 U	0.14 U	0.13 U	0.16 U	0.14 U
Iron	19,900	5,500	5 < pH > 8	11,100	4,530	4,050	5,750	**20,300**	**64,000**	15,400
Lead	17.4	400	120	**20.2 J**	16.4 J	6.9 J	10 J	1.1 J	26 U	6.6 J
Magnesium	1,070	--	--	957	661	429	610 J	779	**1,390**	916
Manganese	324	180	220	16.1 J	49.4 J	126 J	258	9.1 J	15.6 J	20.1 J
Mercury	0.111	2.3	0.10	0.044 K	0.032 K	0.021 K	0.025 J	0.05 K	**0.18 K**	0.036 K
Nickel	9.52	150	38.0	2.5	4.2	3.7	6 J	2.7	4.1	3.7
Selenium	0.51	39	0.52	**1 L**	0.41 J	0.47 J	22 U	**1.6 J**	**3.5 J**	**1.2 J**
Thallium	--	0.078	1	0.38 J	0.54 U	0.57 U	2.2 U	1.3	2.4	0.87
Vanadium	27.9	39	130	**34.3 J**	12.7 J	8.1 J	10.5 J	**30.7 J**	**53.8 J**	**28.5 J**
Zinc	26.5	2,300	120	22.9 J	**41.7 J**	14.2 J	15.3	9.2 J	14.5 J	11.3 J
Wet Chemistry										
pH (ph)	--	--	--	NA	NA	NA	NA	NA	NA	NA

Notes:

Bold text indicates exceedance of CLEAN CAX 95% UTL BKG SS

Shading indicates exceedance of Residential Soil RSLs

Underlined text indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

*Samples NWSY-90-7-SC-PER-133, NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-165 were not screened against the ESVs since these samples were collected either below 24 inches from the current ground surface or where more than 24 inches of

TABLE 4-1

Soil Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS***	**Residential Soil RSLs (May 2014)**	**ESV**	CAS07-SO006	CAS07-SO007	CAS07-SO008			CAS07-SO009	CAS07-SO010
Sample ID				NWSY-90-7-SC-FLR-139	NWSY-90-7-SC-FLR-140	NWSY-90-7-SC-PER-143	NWSY-90-7-SC-PER-184	NWSY-90-7-SC-PER-185	NWSY-90-7-SC-FLR-144	NWSY-90-7-SC-FLR-145
Sample Date				02/28/08	02/28/08	02/28/08	04/09/08	04/09/08	02/28/08	02/28/08
Chemical Name										
Pesticide/Polychlorinated Biphenyls (µg/kg)										
Endrin	--	1,800	1.95	3.8 U	3.9 U	3.8 U	3.9 U	3.8 U	3.9 U	3.8 U
Total Metals (mg/kg)										
Aluminum	12,200	7,700	pH < 5.5	6,880	11,000	7,400	7,350	8,900	7,220	6,370
Arsenic	6.36	0.67	18.0	1.5	1.2	1.4	1.8	1.9	1.8	1.1
Barium	52.9	1,500	330	**101 J**	42.2 J	**69.1 J**	**57.6**	**53.7**	**90.1 J**	44.5 J
Beryllium	0.587	16	40.0	**1.1**	0.39	**0.91**	0.39	0.41	**0.85**	0.52
Calcium	2,290	--	--	883	1,200	781	556	1,000	873	483
Chromium	18.2	0.3	64.0	7.6 J	15.3 J	7.6 J	7.4	10	11.6 J	5.3 J
Cobalt	9.93	2.3	13.0	2.8 J	2 J	2.9	2.1 J	2.3 J	2.4 J	2.3 J
Copper	4.25	310	70.0	**12.9 J**	3.7 J	**5.2 J**	2.9	**7**	**39.6 J**	2.4 J
Cyanide	--	2.1	15.8	0.14 U	0.13 U	0.14 U	0.13 U	0.13 U	0.14 U	0.14 U
Iron	19,900	5,500	5 < pH > 8	3,640	17,000	3,680	6,200	7,850	7,120	4,450
Lead	17.4	400	120	**84.3 J**	2.2 J	**81.9 J**	13.6	**37.3**	**204 J**	8 J
Magnesium	1,070	--	--	454	715	429	481	563	427	395
Manganese	324	180	220	169 J	15 J	114 J	30.4	69.2	184 J	50.3 J
Mercury	0.111	2.3	0.10	0.043 K	0.047 K	0.031 K	0.025 J	0.08 J	0.043 K	0.019 K
Nickel	9.52	150	38.0	4.9	2.5	3.9	3.5	3.9	4.6	3.2
Selenium	0.51	39	0.52	0.37 J	**1.2 J**	0.26 J	5.6 U	5.5 U	**0.58 J**	0.41 J
Thallium	--	0.078	1	0.57 U	1	0.58 U	2.2 U	2.2 U	0.56 U	0.57 U
Vanadium	27.9	39	130	7.2 J	26.1 J	7.5 J	12.7	15.7	10.2 J	9.5 J
Zinc	26.5	2,300	120	**51.2 J**	12.5 J	23.2 J	13.2	**26.6**	**79.4 J**	10.2 J
Wet Chemistry										
pH (ph)	--	--	--	NA	NA	NA	NA	NA	NA	NA

Notes:

Bold text indicates exceedance of CLEAN CAX 95% UTL BKG SS

Shading indicates exceedance of Residential Soil RSLs

Underlined text indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

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U - The material was analyzed for, but not detected

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UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

*Samples NWSY-90-7-SC-PER-133, NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-165 were not screened against the ESVs since these samples were collected either below 24 inches from the current ground surface or where more than 24 inches of

TABLE 4-1

Soil Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS***	**Residential Soil RSLs (May 2014)**	**ESV**	CAS07-SO011	CAS07-SO012	CAS07-SO013		CAS07-SO014		
Sample ID				NWSY-90-7-SC-FLR-146	NWSY-90-7-SC-FLR-147	NWSY-90-7-SC-PER-148	NWSY-90-7-SC-PER-149	NWSY-90-7-SC-PER-150	NWSY-90-7-SC-PER-151	NWSY-90-7-SC-PER-152
Sample Date				02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08
Chemical Name										
Pesticide/Polychlorinated Biphenyls (µg/kg)										
Endrin	--	1,800	1.95	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U
Total Metals (mg/kg)										
Aluminum	12,200	7,700	pH < 5.5	7,140	8,830 J	6,990 J	7,630 J	7,760 J	7,190 J	7,300 J
Arsenic	6.36	0.67	18.0	2.1	1.8 L	**24.3**	1.9	2	1.5	1.4
Barium	52.9	1,500	330	**57.5 J**	48.3 J	**250 J**	**56.8 J**	42 J	**54 J**	**54.3 J**
Beryllium	0.587	16	40.0	**0.75**	0.57	**0.94**	**0.7**	0.5	**0.69**	**0.61**
Calcium	2,290	--	--	576	1,060 J	**24,800 J**	1,250 J	1,640 J	988 J	907 J
Chromium	18.2	0.3	64.0	6.8 J	8.7 J	18 J	6.3 J	7.7 J	5 J	5.6 J
Cobalt	9.93	2.3	13.0	2.2 J	2.2 L	2 J	2.1 J	1.9 J	2.1 J	1.8 J
Copper	4.25	310	70.0	**9.8 J**	2.6	**42.7**	3.6	**4.9**	3	2.7
Cyanide	--	2.1	15.8	0.13 U	0.13 U	0.33	0.15 U	0.24	0.13 U	0.14 U
Iron	19,900	5,500	5 < pH > 8	4,690	8,060 J	4,240 J	4,730 J	6,760 J	4,010 J	4,410 J
Lead	17.4	400	120	**41.5 J**	6.4 J	**42.1 J**	11.5 J	15.6 J	10.3 J	8.1 J
Magnesium	1,070	--	--	412	493 J	**1,320 J**	505 J	605 J	366 J	399 J
Manganese	324	180	220	122 J	92.9 J	**466 J**	89.4 J	102 J	204 J	110 J
Mercury	0.111	2.3	0.10	0.037 K	0.027 K	0.048 K	0.026 K	0.058 K	0.03 K	0.019 K
Nickel	9.52	150	38.0	4.1	3.2 J	6.6 J	3.7 J	3.9 J	3.4 J	3.2 J
Selenium	0.51	39	0.52	**0.63 J**	**0.77 L**	0.33 J	**0.52 J**	**0.82 J**	**0.63 J**	0.48 J
Thallium	--	0.078	1	0.56 U	0.53 UL	2.7 U	0.59 U	0.71 U	0.57 U	0.58 U
Vanadium	27.9	39	130	10 J	15.5 J	16.3 J	11.2 J	18.4 J	9.3 J	10.2 J
Zinc	26.5	2,300	120	**29 J**	9.8 L	**119**	20.3	23.3	13.7	11.6
Wet Chemistry										
pH (ph)	--	--	--	NA	NA	NA	NA	NA	NA	NA

Notes:

Bold text indicates exceedance of CLEAN CAX 95% UTL BKG SS

Shading indicates exceedance of Residential Soil RSLs

Underlined text indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic

NA - Not analyzed

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U - The material was analyzed for, but not detected

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UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

*Samples NWSY-90-7-SC-PER-133, NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-165 were not screened against the ESVs since these samples were collected either below 24 inches from the current ground surface or where more than 24 inches of

TABLE 4-1

Soil Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS***	**Residential Soil RSLs (May 2014)**	**ESV**	CAS07-SO015		CAS07-SO016		CAS07-SO017	CAS07-SO018	
Sample ID				NWSY-90-7-SC-PER-153	NWSY-90-7-SC-PER-154	NWSY-90-7-SC-PER-159	NWSY-90-7-SC-PER-186	NWSY-90-7-SC-FLR-160	NWSY-90-7-SC-PER-161	NWSY-90-7-SC-PER-162
Sample Date				02/28/08	02/28/08	02/29/08	04/09/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Pesticide/Polychlorinated Biphenyls (µg/kg)										
Endrin	--	1,800	1.95	4.1 U	3.6 U	3.6 U	4 U	3.8 U	3.7 U	3.8 U
Total Metals (mg/kg)										
Aluminum	12,200	7,700	pH < 5.5	7,150 J	4,010 J	6,220 J	6,060	12,100 J	7,500 J	8,460 J
Arsenic	6.36	0.67	18.0	1.6	3.5	1.4	1.2	1.7	1.4	1.4
Barium	52.9	1,500	330	**54.6 J**	17.8 J	42.6 J	44.9	48.3 J	**69.1 J**	51.4 J
Beryllium	0.587	16	40.0	**0.74**	**1.6**	0.39	0.39	0.43	**0.89**	0.48
Calcium	2,290	--	--	1,180 J	485 J	594 J	418	1,210 J	875 J	762 J
Chromium	18.2	0.3	64.0	5.9 J	16.2 J	7 J	5.5	16.5 J	5.4 J	8.3 J
Cobalt	9.93	2.3	13.0	2.1 J	4	1.6 J	2.1 J	1.6 J	2.6 J	1.9 J
Copper	4.25	310	70.0	3.8	**4.8**	3.4 J	1.3 J	**6.1 J**	3.5 J	2.5 J
Cyanide	--	2.1	15.8	0.15 U	0.13 U	0.12 U	0.13 U	0.14 U	0.13 U	0.14 U
Iron	19,900	5,500	5 < pH > 8	5,150 J	19,800 J	6,480 J	4,280	**20,000 J**	4,360 J	8,230 J
Lead	17.4	400	120	11.8 J	1.8 J	10.8 J	6.6 K	**23.2 J**	14.7 J	9.2 J
Magnesium	1,070	--	--	442 J	170 J	450 J	420	723 J	459 J	560 J
Manganese	324	180	220	125 J	100 J	31.6 J	50.9	15.3 J	149 J	37.4 J
Mercury	0.111	2.3	0.10	0.1 K	0.092 U	0.015 K	0.023 J	0.033 K	0.019 K	0.085 U
Nickel	9.52	150	38.0	3.4 J	2.8 J	2.2 J	3	2.9 J	3.8 J	3 J
Selenium	0.51	39	0.52	0.47 J	**1.7 J**	0.51 J	6 U	**1.5 J**	0.41 J	**0.78 J**
Thallium	--	0.078	1	0.6 U	1.4	0.37 J	2.4 U	1.2	0.54 U	0.55 U
Vanadium	27.9	39	130	10.6 J	18.6 J	12.4 J	8.9	**30.2 J**	9.1 J	15.9 J
Zinc	26.5	2,300	120	18.5	16.4	8.3 J	8.3	**34.3 J**	13.9 J	9.2 J
Wet Chemistry										
pH (ph)	--	--	--	NA	NA	NA	NA	NA	NA	NA

Notes:

Bold text indicates exceedance of CLEAN CAX 95% UTL BKG SS

Shading indicates exceedance of Residential Soil RSLs

Underlined text indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic

NA - Not analyzed

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mg/kg - Milligrams per kilogram

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*Samples NWSY-90-7-SC-PER-133, NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-165 were not screened against the ESVs since these samples were collected either below 24 inches from the current ground surface or where more than 24 inches of

TABLE 4-1

Soil Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS***	**Residential Soil RSLs (May 2014)**	**ESV**	CAS07-SO019		CAS07-SO020	CAS07-SO021	CAS07-SO022
Sample ID				NWSY-90-7-SC-PER-163	NWSY-90-7-SC-PER-164	NWSY-90-7-SC-FLR-165	NWSY-90-7-SC-FLR-166	NWSY-90-7-SC-FLR-167
Sample Date				02/29/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name								
Pesticide/Polychlorinated Biphenyls (µg/kg)								
Endrin	--	1,800	1.95	3.8 U	3.9 U	3.8 U	4 U	3.7 U
Total Metals (mg/kg)								
Aluminum	12,200	7,700	pH < 5.5	5,550 J	7,000 J	6,850 J	7,140 J	8,190 J
Arsenic	6.36	0.67	18.0	1.3	1.4	1.5	1.6	2.1
Barium	52.9	1,500	330	**54 J**	50.4 J	**54.2 J**	**64.8 J**	**64.9 J**
Beryllium	0.587	16	40.0	**0.66**	**0.73**	**0.91**	**0.93**	0.53
Calcium	2,290	--	--	1,790 J	449 J	518 J	1,010 J	1,020 J
Chromium	18.2	0.3	64.0	5.5 J	6.2 J	4.8 J	5.9 J	10.1 J
Cobalt	9.93	2.3	13.0	2.5 J	2.3 J	3.1	2.9	2.6 J
Copper	4.25	310	70.0	**6 J**	1.5 J	2.5 J	**14.3 J**	3.7 J
Cyanide	--	2.1	15.8	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U
Iron	19,900	5,500	5 < pH > 8	4,050 J	5,550 J	3,890 J	3,900 J	10,200 J
Lead	17.4	400	120	**34.4 J**	4.8 J	7.3 J	**58.5 J**	4 J
Magnesium	1,070	--	--	466 J	439 J	406 J	434 J	574 J
Manganese	324	180	220	143 J	63.5 J	124 J	196 J	33.2 J
Mercury	0.111	2.3	0.10	0.046 K	0.019 K	0.019 K	0.042 K	0.088 U
Nickel	9.52	150	38.0	3.6 J	3.2 J	3.9 J	4.6 J	3.1 J
Selenium	0.51	39	0.52	**0.62 J**	**0.59 J**	0.36 J	0.51 J	**0.67 J**
Thallium	--	0.078	1	1.1 U	0.56 U	0.57 U	0.58 U	0.55 U
Vanadium	27.9	39	130	9.4 J	11 J	8.2 J	9.5 J	18.7 J
Zinc	26.5	2,300	120	**31.7 J**	8.2 J	11.3 J	**39.3 J**	9.4 J
Wet Chemistry								
pH (ph)	--	--	--	NA	NA	NA	NA	NA

Notes:

Bold text indicates exceedance of CLEAN CAX 95% UTL BKG SS

Shading indicates exceedance of Residential Soil RSLs

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TABLE 4-1

Soil Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS***	**Residential Soil RSLs (May 2014)**	**ESV**	CAS07-SO023			CAS07-SO024		
Sample ID				NWSY-90-7-SC-PER-169	NWSY-90-7-SC-PER-170	NWSY-90-7-SC-PER-187	NWSY-90-7-SC-PER-172	NWSY-90-7-SC-PER-188	NWSY-90-7-SC-PER-193
Sample Date				02/29/08	02/29/08	04/09/08	02/29/08	04/09/08	04/09/08
Chemical Name									
Pesticide/Polychlorinated Biphenyls (µg/kg)									
Endrin	--	1,800	1.95	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U
Total Metals (mg/kg)									
Aluminum	12,200	7,700	pH < 5.5	9,100 J	8,610 J	8,390	7,080 J	9,730	11,900
Arsenic	6.36	0.67	18.0	1.4	1.5	1.8 J	1.4	2.3	2.9
Barium	52.9	1,500	330	47.2 J	47.7 J	**80.3**	**60.8 J**	**83.4**	**98.5**
Beryllium	0.587	16	40.0	**0.61**	0.58	**1 J**	**0.98**	**1.2**	**1.3**
Calcium	2,290	--	--	902 J	980 J	999 J	685 J	758 J	976 J
Chromium	18.2	0.3	64.0	9.6 J	9.5 J	6.8	5.2 J	6.3	8.1
Cobalt	9.93	2.3	13.0	2.2 J	2 J	4.1 J	4.1	5 J	5.8 J
Copper	4.25	310	70.0	2.1 J	2.2 J	**5.1 J**	**6.5 J**	**5.5 J**	**6.4**
Cyanide	--	2.1	15.8	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U	0.14 U
Iron	19,900	5,500	5 < pH > 8	8,820 J	8,750 J	5,070	3,800 J	4,820	5,820
Lead	17.4	400	120	6.3 J	8 J	**18.9 J**	**20.4 J**	12.8 J	13.9 J
Magnesium	1,070	--	--	577 J	562 J	526 J	394 J	520 J	679 J
Manganese	324	180	220	27.7 J	29 J	241	157 J	225	270
Mercury	0.111	2.3	0.10	0.031 K	0.043 K	0.088 U	0.025 K	0.027 J	0.027 J
Nickel	9.52	150	38.0	3.7 J	3.4 J	5.2 J	4 J	5.6 J	7 J
Selenium	0.51	39	0.52	**0.73 J**	**0.63 J**	24 U	0.36 J	23 U	24 U
Thallium	--	0.078	1	0.33 J	0.41 J	2.4 U	0.57 U	2.3 U	2.4 U
Vanadium	27.9	39	130	17.4 J	16.9 J	9.6 J	7.8 J	9.2 J	11.8 J
Zinc	26.5	2,300	120	9.4 J	9.9 J	21.2	17.4 J	14.9	19.6
Wet Chemistry									
pH (ph)	--	--	--	NA	NA	NA	NA	NA	NA

Notes:

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TABLE 4-1

Soil Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS***	**Residential Soil RSLs (May 2014)**	**ESV**	CAS07-SO025	CAS07-SO026	CAS07-SO027		CAS07-SO028		
Sample ID				NWSY-90-7-SC-FLR-173	NWSY-90-7-SC-FLR-174	NWSY-90-7-SC-PER-175	NWSY-90-7-SC-PER-176	NWSY-90-7-SC-PER-177	NWSY-90-7-SC-PER-178	NWSY-90-7-SC-PER-179
Sample Date				02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Pesticide/Polychlorinated Biphenyls (µg/kg)										
Endrin	--	1,800	1.95	4 U	3.8 U	3.9 U	3.8 U	4.6 U	3.9 U	3.9 U
Total Metals (mg/kg)										
Aluminum	12,200	7,700	pH < 5.5	**17,300 J**	10,600 J	**13,500 J**	9,590	6,810	7,910	7,840
Arsenic	6.36	0.67	18.0	2.6	1.8	1.1	1.5	2	1.3	1.1
Barium	52.9	1,500	330	25.5 J	49.9 J	33.2 J	52.6	**76**	**54.6**	**53.1**
Beryllium	0.587	16	40.0	**0.67**	0.57	0.43	**0.69**	**0.9**	**0.75**	**0.77**
Calcium	2,290	--	--	2,050 J	867 J	1,490 J	744	2,190	546	555
Chromium	18.2	0.3	64.0	**39 J**	11.8 J	**19 J**	10	6.7	6.7	6.6
Cobalt	9.93	2.3	13.0	2 J	2.1 J	2 J	2.4 J	2.8 J	2.9	2.9
Copper	4.25	310	70.0	2.9 J	3.4 J	2.6 J	3.4	**8.9**	2.5	2.7
Cyanide	--	2.1	15.8	0.14 U	0.13 U	0.14 U	0.14 U	0.16 U	0.14 U	0.14 U
Iron	19,900	5,500	5 < pH > 8	**57,800 J**	10,700 J	18,000 J	8,480	4,240	5,300	5,230
Lead	17.4	400	120	5.8 U	7.5 J	3.1 J	7.2 J	**62.9 J**	6.5 J	7 J
Magnesium	1,070	--	--	889 J	676 J	877 J	615	573	522	513
Manganese	324	180	220	17 J	22.1 J	14.4 J	36.2	166	56.7	57.3
Mercury	0.111	2.3	0.10	0.014 K	0.026 K	0.041 K	0.013 K	0.071 K	0.022 K	0.023 K
Nickel	9.52	150	38.0	3.2 J	3.7 J	3.3 J	4	4.2	4.1	4
Selenium	0.51	39	0.52	**2.9 J**	**0.81 J**	**1.5 J**	**0.7 J**	**0.66 J**	0.42 J	0.38 J
Thallium	--	0.078	1	1.6	0.57	0.44 J	0.55 U	0.68 U	0.58 U	0.55 U
Vanadium	27.9	39	130	**63.1 J**	21 J	**29 J**	17.9	9.6	11.6	11.2
Zinc	26.5	2,300	120	15.3 J	20.2 J	11.3 J	13.5 J	**35.5 J**	9.6 J	9.7 J
Wet Chemistry										
pH (ph)	--	--	--	NA	NA	NA	NA	NA	NA	NA

Notes:

Bold text indicates exceedance of CLEAN CAX 95% UTL BKG SS

Shading indicates exceedance of Residential Soil RSLs

Underlined text indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

*Samples NWSY-90-7-SC-PER-133, NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-165 were not screened against the ESVs since these samples were collected either below 24 inches from the current ground surface or where more than 24 inches of

TABLE 4-1

Soil Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CLEAN CAX 95% UTL BKG SS***	**Residential Soil RSLs (May 2014)**	**ESV**	CAS07-SO035	CAS07-SO036	CAS07-SO037	CAS07-SO038	CAS07-SO039	
Sample ID				CAS07-SS01-0024-0111	CAS07-SS02-0024-0111	CAS07-SS03-0024-0111	CAS07-SS04-0024-0111	CAS07-SS05-0024-0111	CAS07-SS05P-0024-0111
Sample Date				01/25/11	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11
Chemical Name									
Pesticide/Polychlorinated Biphenyls (µg/kg)									
Endrin	--	1,800	1.95	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)									
Aluminum	12,200	7,700	pH < 5.5	NA	NA	NA	NA	NA	NA
Arsenic	6.36	0.67	18.0	NA	NA	NA	NA	NA	NA
Barium	52.9	1,500	330	NA	NA	NA	NA	NA	NA
Beryllium	0.587	16	40.0	NA	NA	NA	NA	NA	NA
Calcium	2,290	--	--	NA	NA	NA	NA	NA	NA
Chromium	18.2	0.3	64.0	NA	NA	NA	NA	NA	NA
Cobalt	9.93	2.3	13.0	NA	NA	NA	NA	NA	NA
Copper	4.25	310	70.0	NA	NA	NA	NA	NA	NA
Cyanide	--	2.1	15.8	NA	NA	NA	NA	NA	NA
Iron	19,900	5,500	5 < pH > 8	NA	NA	NA	NA	NA	NA
Lead	17.4	400	120	NA	NA	NA	NA	NA	NA
Magnesium	1,070	--	--	NA	NA	NA	NA	NA	NA
Manganese	324	180	220	NA	NA	NA	NA	NA	NA
Mercury	0.111	2.3	0.10	NA	NA	NA	NA	NA	NA
Nickel	9.52	150	38.0	NA	NA	NA	NA	NA	NA
Selenium	0.51	39	0.52	NA	NA	NA	NA	NA	NA
Thallium	--	0.078	1	NA	NA	NA	NA	NA	NA
Vanadium	27.9	39	130	NA	NA	NA	NA	NA	NA
Zinc	26.5	2,300	120	NA	NA	NA	NA	NA	NA
Wet Chemistry									
pH (ph)	--	--	--	6.11 H3	5.27 H3	4.85 H3	5.62 H3	6.3 H3	6.36 H3

Notes:

Bold text indicates exceedance of CLEAN CAX 95% UTL BKG SS

Shading indicates exceedance of Residential Soil RSLs

Underlined text indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

*Samples NWSY-90-7-SC-PER-133, NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-165 were not screened against the ESVs since these samples were collected either below 24 inches from the current ground surface or where more than 24 inches of

TABLE 4-2

Groundwater Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAX 95% UTL Yorktown-Eastover Aquifer GW Background	MCL	Tap Water RSLs (May 2014)	ESVs	CAS07-MW01*	CAS07-MW02*	CAS07-MW03			CAS07-MW04	
Sample ID					CAS07-MW01-0111	CAS07-MW02-0111	CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414
Sample Date					01/28/11	01/28/11	01/25/11	04/09/14	04/09/14	01/28/11	04/09/14
Chemical Name											
Volatile Organic Compounds (µg/l)											
Acetone	--	--	1,400	564,000	5 U	5 U	5 U	1 U	1 U	4.73 J	1 U
Bromodichloromethane	--	80	0.13	--	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U
Chloroform	--	80	0.22	815	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.614 J	0.2 U
cis-1,2-Dichloroethene	--	70	3.6	680	0.5 U	0.5 U	2.27 J	1.9	1.9	0.5 U	0.2 U
Dibromochloromethane	--	80	0.17	--	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U
Tetrachloroethene	--	5	4.1	45.0	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U
Toluene	--	1,000	110	215	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.28 J	0.2 U
trans-1,2-Dichloroethene	--	100	36	680	0.5 U	0.5 U	0.444 J	0.2 U	0.2 U	0.5 U	0.2 U
Trichloroethene	--	5	0.28	1,940	0.5 U	0.5 U	1.27 J	1.7	1.6	0.5 U	0.2 U
Vinyl chloride	--	2	0.019	930	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U
Semivolatile Organic Compounds (µg/l)											
2,4-Dinitrotoluene	--	--	0.24	480	0.163 U	0.0961 B	0.582 J	NA	NA	1.09	NA
2,6-Dinitrotoluene	--	--	0.048	1,000	0.163 U	0.154 U	0.154 U	NA	NA	0.39	NA
Pesticide/Polychlorinated Biphenyls (µg/l)											
4,4'-DDD	--	--	0.031	0.025	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.0398 J	NA
alpha-BHC	--	--	0.0071	25.0	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00531 J	NA
delta-BHC	--	--	0.025	25.0	0.0102 U	0.00962 U	0.00558 J	NA	NA	0.00943 UJ	NA
Endosulfan II	--	--	10	0.0087	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA
gamma-Chlordane	--	--	0.22	0.004	0.0102 U	0.00921 J	0.00943 U	NA	NA	0.0251 J	NA
Dioxin/Furans (ng/l)											
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	3	0.06	--	9.95E-04 U	8.10E-04 J	8.36E-04 U	NA	NA	0.00136 J	NA
1,2,3,4,7,8-Hexachlorodibenzofuran	--	0.3	0.006	--	3.84E-04 U	3.94E-04 U	5.96E-04 J	NA	NA	3.31E-04 U	NA
2,3,4,7,8-Pentachlorodibenzofuran	--	0.06	0.002	--	3.65E-04 U	3.07E-04 U	4.25E-04 J	NA	NA	3.14E-04 U	NA
Octachlorodibenzo-p-dioxin	--	--	2	--	0.00111 J	0.0129 J	0.00817 J	NA	NA	0.0606 J	NA
Total heptachlorodibenzo-p-dioxin	--	--	--	--	9.95E-04 U	8.10E-04 U	8.36E-04 U	NA	NA	0.0044 J	NA
Total hexachlorodibenzofuran	--	--	--	--	3.29E-04 U	3.39E-04 U	5.96E-04 J	NA	NA	2.83E-04 U	NA
Toxic Equivalents (Total TEQ) - HHRA	--	--	--	0.002	3.3E-07	8.10E-06	1.90E-04	NA	NA	3.2E-05	NA
Toxic Equivalents (Total TEQ) - Eco, Fish	--	--	--	0.002	8.89E-04 J	9.29E-04 J	1.24E-03 J	NA	NA	1.01E-03 J	NA
Explosives (µg/l)											
1,3,5-Trinitrobenzene	--	--	59	15.0	0.163 U	0.129 B	0.154 U	NA	NA	0.132 J	NA
1,3-Dinitrobenzene	--	--	0.2	180	0.163 U	1.46	0.328 B	NA	NA	0.522 B	NA
2,4,6-Trinitrotoluene	--	--	0.98	100	0.163 U	0.154 U	0.154 U	NA	NA	0.157 U	NA
2-Amino-4,6-dinitrotoluene	--	--	3.9	19.0	0.163 U	0.154 U	0.154 U	NA	NA	0.157 U	NA
3-Nitrotoluene	--	--	0.17	750	0.163 U	0.22 B	0.138 B	NA	NA	0.125 B	NA
4-Amino-2,6-dinitrotoluene	--	--	3.9	19.0	0.163 U	0.154 U	0.154 U	NA	NA	0.157 U	NA
HMX	--	--	100	330	0.163 U	0.64	0.122 J	NA	NA	0.532 J	NA
Nitroglycerin	--	--	0.2	138	0.408 U	0.385 U	0.385 U	NA	NA	0.231 J	NA
PETN	--	--	3.9	85,000	0.408 U	0.385 U	0.251 J	NA	NA	0.463 J	NA
RDX	--	--	0.7	5,000	0.163 U	0.721	0.133 J	NA	NA	0.651 J	NA
Total Metals (µg/l)											
Aluminum	2,230	--	2,000	87.0	203	149	24.7 B	NA	NA	262	NA
Arsenic	2.28	10	0.052	36.0	1.5 U	1.5 U	1.5 U	NA	NA	**3.15**	NA
Barium	118	2,000	380	200	17.2	16.6	28.6	NA	NA	22.3	NA
Cadmium	0.605	5	0.92	8.85	**0.932 J**	0.597 J	**1.1 J**	NA	NA	**1.05 J**	NA
Calcium	169,000	--	--	--	50,600	39,600	84,700	NA	NA	105,000	NA
Chromium	15.1	100	0.035	50.4	1.57 J	1.49 J	1 U	NA	NA	2.45 J	NA
Cobalt	20.6	--	0.6	23.0	1.29 J	2.35 J	4.28	NA	NA	3.84	NA
Copper	--	1,300	80	3.73	2 U	2 U	2 U	NA	NA	1.12 J	NA
Iron	894	--	1,400	1,000	389	113	15 U	NA	NA	333	NA
Magnesium	11,500	--	--	--	1,990	2,020	3,290	NA	NA	2,080	NA
Manganese	57.9	--	43	100	42.9	**135**	57.1	NA	NA	**216**	NA
Nickel	11.4	--	39	8.28	2.44 J	2.06 J	3.94	NA	NA	2.7	NA
Potassium	12,700	--	--	--	854 J	1,010 J	1,130 J	NA	NA	1,760	NA
Selenium	--	50	10	71.1	1.25 U	1.25 U	1.25 U	NA	NA	1.25 U	NA

TABLE 4-2

Groundwater Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CAX 95% UTL Yorktown-Eastover Aquifer GW Background**	**MCL**	**Tap Water RSLs (May 2014)**	**ESVs**	CAS07-MW01*	CAS07-MW02*	CAS07-MW03			CAS07-MW04	
Sample ID					CAS07-MW01-0111	CAS07-MW02-0111	CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414
Sample Date					01/28/11	01/28/11	01/25/11	04/09/14	04/09/14	01/28/11	04/09/14
Sodium	64,500	--	--	--	16,400	13,000	15,700	NA	NA	9,090	NA
Vanadium	26.2	--	8.6	50.0	2.5 U	2.5 U	2.5 U	NA	NA	2.5 U	NA
Zinc	4.52	--	600	85.6	2.37 J	1.84 J	**9.91**	NA	NA	2.13 J	NA
Dissolved Metals (µg/l)											
Aluminum, Dissolved	--	--	2,000	87.0	43.5 J	40.3 J	161 B	NA	NA	16.9 J	NA
Arsenic, Dissolved	1.37	10	0.052	36.0	1.5 U	1.5 U	1.5 U	NA	NA	**2.56**	NA
Barium, Dissolved	127	2,000	380	200	17.1	15.9	29.1	NA	NA	20.7	NA
Cadmium, Dissolved	0.177	5	0.92	8.80	**0.893 J**	**0.591 J**	**1.12 J**	NA	NA	**0.949 J**	NA
Calcium, Dissolved	113,000	--	--	--	52,100	39,800	85,900	NA	NA	101,000	NA
Chromium, Dissolved	6.04	100	0.035	50.0	1 U	1 U	0.818 J	NA	NA	1 U	NA
Cobalt, Dissolved	--	--	0.6	23.0	2.5 U	2.22 J	4.59	NA	NA	3.53	NA
Iron, Dissolved	275	--	1,400	1,000	23.7 J	7.6 J	**338**	NA	NA	8.22 J	NA
Magnesium, Dissolved	11,200	--	--	--	1,950	1,990	3,340	NA	NA	1,970	NA
Manganese, Dissolved	49.5	--	43	100	46.3	**137**	**58.5**	19	NA	**208**	40.6
Nickel, Dissolved	--	--	39	8.20	2.11 J	1.71 J	4.58	NA	NA	1.8 J	NA
Potassium, Dissolved	12,600	--	--	--	807 J	979 J	1,170 J	NA	NA	1,620	NA
Selenium, Dissolved	--	50	10	71.0	1.25 U	1.25 U	1.25 U	NA	NA	1.25 U	NA
Sodium, Dissolved	62,800	--	--	--	16,800	12,900	15,700	NA	NA	8,670	NA
Zinc, Dissolved	--	--	600	81.0	1.53 J	1.59 J	12	NA	NA	2.5 U	NA
Wet Chemistry (mg/l)											
Alkalinity	--	--	--	--	NA	NA	NA	257	NA	NA	257
Chloride	--	--	--	--	NA	NA	NA	24.8 D	NA	NA	18.2 D
Methane	--	--	--	--	NA	NA	NA	0.0759 D	NA	NA	0.0534 D
Nitrate	--	10	3.2	--	NA	NA	NA	0.05 U	NA	NA	0.05 U
Sulfate	--	--	--	--	NA	NA	NA	5.38	NA	NA	12.2
Sulfide	--	--	--	--	NA	NA	NA	0.16 J	NA	NA	0.5 U
Total organic carbon (TOC)	--	--	--	--	NA	NA	NA	1.46	NA	NA	1.94
Dechlorinating Bacteria (cells/ml)											
Dehalococcoides	--	--	--	--	NA	NA	NA	0.4 J	NA	NA	0.5 U
Functioning Genes (cells/ml)											
VC R-Dase	--	--	--	--	NA	NA	NA	0.5 U	NA	NA	0.5 U

Notes:

Bold test indicates exceedance of CAX 95% UTL Yorktown-Eastover Aquifer GW Background

Italicized text indicates exceedance of MCLs

Shading indicates exceedance of Tap Water RSLs

Underline indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic endpoints are based on carcinogenic risk of 1×10^{-6}.

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

D - Compound identified in an analysis at a secondary dilution factor

H - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

cells/ml - Cells per milliliter

mg/l - Milligrams per liter

ng/l - Nanograms per liter

µg/l - Micrograms per liter

*CAS07-MW01 and CAS07-MW02 are upgradient of Site 7 and included as background wells

TABLE 4-2

Groundwater Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAX 95% UTL Yorktown-Eastover Aquifer GW Background	MCL	Tap Water RSLs (May 2014)	ESVs	CAS07-MW05		CAS07-MW06			CAS07-MW07		CAS07-MW08	CAS07-MW09
Sample ID					CAS07-MW05-0111	CAS07-GW05-0414	CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414	CAS07-GW08-0414	CAS07-GW09-0414
Sample Date					01/25/11	04/09/14	01/24/11	01/24/11	04/09/14	01/24/11	04/09/14	04/10/14	04/10/14
Chemical Name													
Volatile Organic Compounds (µg/l)													
Acetone	--	--	1,400	564,000	5 U	1 U	5 U	5 U	1 U	5 U	1 U	1 U	1 U
Bromodichloromethane	--	80	0.13	--	0.5 U	0.2 U	0.46 J	0.528 J	0.2 U	0.5 U	0.2 U	0.2 U	0.2 U
Chloroform	--	80	0.22	815	0.5 U	0.2 U	0.757 J	0.628 J	0.2 U	0.5 U	0.2 U	0.2 U	1.6
cis-1,2-Dichloroethene	--	70	3.6	680	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	7.26	6.2	0.48 J	0.2 U
Dibromochloromethane	--	80	0.17	--	0.5 U	0.2 U	0.609 J	0.555 J	0.2 U	0.345 J	0.2 U	0.2 U	0.2 U
Tetrachloroethene	--	5	4.1	45.0	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.474 J	0.2 U	0.2 U	0.2 U
Toluene	--	1,000	110	215	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U	0.2 U	0.2 U
trans-1,2-Dichloroethene	--	100	36	680	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U	0.2 U	0.2 U
Trichloroethene	--	5	0.28	1,940	0.5 U	0.2 U	0.274 J	0.518 J	0.2 U	*86.4*	*53.8*	1.1	0.33 J
Vinyl chloride	--	2	0.019	930	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 J	0.2 U	0.2 U	0.2 U
Semivolatile Organic Compounds (µg/l)													
2,4-Dinitrotoluene	--	--	0.24	480	0.154 U	NA	0.412 J	0.481 J	NA	0.0987 J	NA	NA	NA
2,6-Dinitrotoluene	--	--	0.048	1,000	0.154 U	NA	0.151 U	0.154 U	NA	0.162 U	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (µg/l)													
4,4'-DDD	--	--	0.031	0.025	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00992 J	NA	NA	NA
alpha-BHC	--	--	0.0071	25.0	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA	NA	NA
delta-BHC	--	--	0.025	25.0	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA	NA	NA
Endosulfan II	--	--	10	0.0087	0.0102 U	NA	0.0098 UJ	0.00575 J	NA	0.00714 J	NA	NA	NA
gamma-Chlordane	--	--	0.22	0.004	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00646 J	NA	NA	NA
Dioxin/Furans (ng/l)													
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	3	0.06	--	6.89E-04 U	NA	7.90E-04 U	8.81E-04 U	NA	8.33E-04 U	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzofuran	--	0.3	0.006	--	3.90E-04 U	NA	4.61E-04 U	4.55E-04 U	NA	4.60E-04 U	NA	NA	NA
2,3,4,7,8-Pentachlorodibenzofuran	--	0.06	0.002	--	4.00E-04 U	NA	4.96E-04 U	6.40E-04 U	NA	4.99E-04 U	NA	NA	NA
Octachlorodibenzo-p-dioxin	--	--	2	--	7.90E-04 U	NA	0.00204 J	0.00311 J	NA	0.0101 J	NA	NA	NA
Total heptachlorodibenzo-p-dioxin	--	--	--	--	6.89E-04 U	NA	7.90E-04 U	8.81E-04 U	NA	8.33E-04 U	NA	NA	NA
Total hexachlorodibenzofuran	--	--	--	--	3.34E-04 U	NA	3.98E-04 U	3.92E-04 U	NA	3.94E-04 U	NA	NA	NA
Toxic Equivalents (Total TEQ) - HHRA	--	--	--	0.002	0	NA	6.1E-07	9.3E-07	NA	3.0E-06	NA	NA	NA
Toxic Equivalents (Total TEQ) - Eco, Fish	--	--	--	0.002	1.01E-03 U	NA	1.17E-03 J	1.24E-03 J	NA	1.21E-03 J	NA	NA	NA
Explosives (µg/l)													
1,3,5-Trinitrobenzene	--	--	59	15.0	0.154 U	NA	0.151 U	0.154 U	NA	0.162 U	NA	NA	NA
1,3-Dinitrobenzene	--	--	0.2	180	0.154 U	NA	0.151 U	0.154 U	NA	0.162 U	NA	NA	NA
2,4,6-Trinitrotoluene	--	--	0.98	100	0.154 U	NA	0.151 U	0.214 J	NA	0.162 U	NA	NA	NA
2-Amino-4,6-dinitrotoluene	--	--	3.9	19.0	0.154 U	NA	0.0796 J	0.118 J	NA	0.162 U	NA	NA	NA
3-Nitrotoluene	--	--	0.17	750	0.154 U	NA	0.138 J	0.154 U	NA	0.143 J	NA	NA	NA
4-Amino-2,6-dinitrotoluene	--	--	3.9	19.0	0.154 U	NA	0.188 J	0.204 J	NA	0.162 U	NA	NA	NA
HMX	--	--	100	330	0.154 U	NA	0.114 J	0.109 J	NA	0.162 U	NA	NA	NA
Nitroglycerin	--	--	0.2	138	0.385 U	NA	0.377 U	0.385 U	NA	0.404 U	NA	NA	NA
PETN	--	--	3.9	85,000	0.385 U	NA	0.288 J	0.269 J	NA	0.404 U	NA	NA	NA
RDX	--	--	0.7	5,000	0.263 J	NA	0.151 U	0.154 U	NA	0.282 J	NA	NA	NA
Total Metals (µg/l)													
Aluminum	2,230	--	2,000	87.0	158 B	NA	59.9	60.3	NA	298	NA	NA	NA
Arsenic	2.28	10	0.052	36.0	1.5 U	NA	1.5 U	1.5 U	NA	**4.26**	NA	NA	NA
Barium	118	2,000	380	200	41.5	NA	28.3	29.4	NA	31.1	NA	NA	NA
Cadmium	0.605	5	0.92	8.85	**0.861 J**	NA	**1.14 J**	**1.17 J**	NA	**0.716 J**	NA	NA	NA
Calcium	169,000	--	--	--	140,000	NA	91,600	92,200	NA	104,000	NA	NA	NA
Chromium	15.1	100	0.035	50.4	2.49 J	NA	1 U	1 U	NA	1.67 J	NA	NA	NA
Cobalt	20.6	--	0.6	23.0	2.5 U	NA	1.84 J	2 J	NA	1.43 J	NA	NA	NA
Copper	--	1,300	80	3.73	2 U	NA	2.04 J	2 U	NA	2 U	NA	NA	NA
Iron	894	--	1,400	1,000	28.5 B	NA	89.2	104	NA	603	NA	NA	NA
Magnesium	11,500	--	--	--	6,490	NA	2,080	2,160	NA	2,310	NA	NA	NA
Manganese	57.9	--	43	100	18.5	NA	56.9	55.9	NA	**67.7**	NA	NA	NA
Nickel	11.4	--	39	8.28	2.63	NA	2.48 J	2.61	NA	2.76	NA	NA	NA
Potassium	12,700	--	--	--	2,260	NA	1,360	1,390	NA	1,440	NA	NA	NA
Selenium	--	50	10	71.1	2.4 J	NA	0.878 J	1.25 U	NA	1.25 U	NA	NA	NA

TABLE 4-2

Groundwater Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	**CAX 95% UTL Yorktown-Eastover Aquifer GW Background**	**MCL**	**Tap Water RSLs (May 2014)**	**ESVs**	CAS07-MW05		CAS07-MW06			CAS07-MW07		CAS07-MW08	CAS07-MW09
Sample ID					CAS07-MW05-0111	CAS07-GW05-0414	CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414	CAS07-GW08-0414	CAS07-GW09-0414
Sample Date					01/25/11	04/09/14	01/24/11	01/24/11	04/09/14	01/24/11	04/09/14	04/10/14	04/10/14
Sodium	64,500	--	--	--	21,100	NA	7,360	7,580	NA	7,270	NA	NA	NA
Vanadium	26.2	--	8.6	50.0	2.5 U	NA	2.5 U	2.5 U	NA	1.46 J	NA	NA	NA
Zinc	4.52	--	600	85.6	12.5 U	NA	1.98 J	2.17 J	NA	3.11 J	NA	NA	NA
Dissolved Metals (µg/l)													
Aluminum, Dissolved	--	--	2,000	87.0	160 B	NA	14.9 J	15.4 J	NA	25 U	NA	NA	NA
Arsenic, Dissolved	1.37	10	0.052	36.0	1.5 U	NA	1.5 U	1.5 U	NA	**3.55**	NA	NA	NA
Barium, Dissolved	127	2,000	380	200	41.3	NA	28.2	27.7	NA	30.4	NA	NA	NA
Cadmium, Dissolved	0.177	5	0.92	8.80	**0.896 J**	NA	**1.12 J**	**1.12 J**	NA	**0.652 J**	NA	NA	NA
Calcium, Dissolved	113,000	--	--	--	**141,000**	NA	90,500	87,900	NA	104,000	NA	NA	NA
Chromium, Dissolved	6.04	100	0.035	50.0	2.52	NA	1 U	1 U	NA	1 U	NA	NA	NA
Cobalt, Dissolved	--	--	0.6	23.0	2.5 U	NA	1.84 J	1.84 J	NA	2.5 U	NA	NA	NA
Iron, Dissolved	275	--	1,400	1,000	30.2 B	NA	15 U	15 U	NA	15 U	NA	NA	NA
Magnesium, Dissolved	11,200	--	--	--	6,520	NA	2,030	2,000	NA	2,270	NA	NA	NA
Manganese, Dissolved	49.5	--	43	100	18.3	3.31 J	**55**	**53.9**	4.5 J	**70.4**	9 J	12.3	32.4
Nickel, Dissolved	--	--	39	8.20	2.65	NA	2.25 J	2.27 J	NA	1.89 J	NA	NA	NA
Potassium, Dissolved	12,600	--	--	--	2,240	NA	1,340	1,320	NA	1,310	NA	NA	NA
Selenium, Dissolved	--	50	10	71.0	2.29 J	NA	1.25 U	1.25 U	NA	1.25 U	NA	NA	NA
Sodium, Dissolved	62,800	--	--	--	21,000	NA	7,390	7,240	NA	7,370	NA	NA	NA
Zinc, Dissolved	--	--	600	81.0	12.5 U	NA	1.83 J	1.54 J	NA	2.5 U	NA	NA	NA
Wet Chemistry (mg/l)													
Alkalinity	--	--	--	--	NA	315	NA	NA	234	NA	249	296	292
Chloride	--	--	--	--	NA	26.7 D	NA	NA	9.97	NA	8.04	10	10.2
Methane	--	--	--	--	NA	0.0034 U	NA	NA	0.0034 U	NA	0.0034 U	0.0027 J	0.0057
Nitrate	--	10	3.2	--	NA	0.349	NA	NA	0.284	NA	0.302	0.357 H	0.314 H
Sulfate	--	--	--	--	NA	25.1	NA	NA	11	NA	14.5	14.8	16.8
Sulfide	--	--	--	--	NA	2.08	NA	NA	0.64 J	NA	0.8 J	0.32 J	0.32 J
Total organic carbon (TOC)	--	--	--	--	NA	1.3	NA	NA	0.872	NA	0.998	1.56	1.51
Dechlorinating Bacteria (cells/ml)													
Dehalococcoides	--	--	--	--	NA	0.5 U	NA	NA	0.5 U	NA	1	1.15	2.4
Functioning Genes (cells/ml)													
VC R-Dase	--	--	--	--	NA	0.5 U	NA	NA	0.5 U	NA	0.5 U	0.1 J	0.5 U

Notes:

Bold test indicates exceedance of CAX 95% UTL Yorktown-Eastover Aquifer GW Background

Italicized text indicates exceedance of MCLs

Shading indicates exceedance of Tap Water RSLs

Underline indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic endpoints are based on carcinogenic risk of 1×10^{-6}.

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

D - Compound identified in an analysis at a secondary dilution factor

H - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

cells/ml - Cells per milliliter

mg/l - Milligrams per liter

ng/l - Nanograms per liter

µg/l - Micrograms per liter

*CAS07-MW01 and CAS07-MW02 are upgradient of Site 7 and included as background wells

TABLE 4-3

Sediment Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Transect ID	**Residential Soil RSLs X 10 for SD (May 2014)**	**Sediment Background****	**ESV**	T1	T2		T3	T4	T5	T6	UT7	UT8	UT9
Station ID				CAS07-SD01	CAS07-SD02		CAS07-SD03	CAS07-SD04*	CAS07-SD05*	CAS07-SD06*	CAS07-SD07	CAS07-SD08	CAS07-SD09
Sample ID				CAS07-SD01-0414	CAS07-SD02-0414	CAS07-SD02P-0414	CAS07-SD03-0414	CAS07-SD04-0414	CAS07-SD05-0414	CAS07-SD06-0414	CAS07-SD07-0414	CAS07-SD08-0414	CAS07-SD09-0414
Sample Date				04/14/14	04/14/14	04/14/14	04/14/14	04/18/14	04/18/14	04/18/14	04/22/14	04/22/14	04/22/14
Chemical Name													
Semivolatile Organic Compounds (µg/kg)													
No Detections													
Dioxin/Furans (pg/g)													
1,2,3,4,6,7,8-Heptachlorodibenzofuran	4,900	--	--	0.784 J	0.318 J	0.242 X	0.269 X	5.24	6.12	10.4	5.4	5.78	5.8
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	4,900	--	--	18.2	6.05 J	7.51 J	7.01	39.6	63.8	144	40.1	43.4	60.7
1,2,3,4,7,8,9-Heptachlorodibenzofuran	4,900	--	--	0.995 U	1 U	0.915 U	0.972 U	0.742 B	0.626 B	1.25 X	0.655 J	0.784 J	0.487 J
1,2,3,4,7,8-Hexachlorodibenzofuran	490	--	--	0.197 B	0.0877 B	0.915 U	0.0863 B	0.834 X	0.82 X	1.51 J	0.66 J	0.615 J	0.79 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	490	--	--	0.409 J	0.183 X	0.228 J	0.247 J	0.412 B	0.863 X	2.25 J	0.449 X	0.41 X	0.81 J
1,2,3,6,7,8-Hexachlorodibenzofuran	490	--	--	0.158 B	0.0727 B	0.915 U	0.972 U	0.251 J	0.295 X	0.537 J	0.192 B	0.154 B	0.225 B
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	490	--	--	0.694 X	0.268 X	0.291 X	0.341 X	1.9 J	2.38 J	5.76	1.68 J	1.85 J	2.21 J
1,2,3,7,8,9-Hexachlorodibenzofuran	490	--	--	0.138 B	0.134 B	0.915 U	0.972 U	0.229 B	1.06 U	0.415 B	0.921 U	1.04 U	1.04 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	490	--	--	1.26 J	0.359 X	0.476 J	0.456 J	1.06 J	2.2 J	6.58	0.951 J	1.19 J	1.82 J
1,2,3,7,8-Pentachlorodibenzofuran	1,600	--	--	0.995 U	1 U	0.915 U	0.972 U	0.226 X	1.06 U	1.53 U	0.921 U	1.04 U	1.04 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	49	--	--	0.279 X	1 U	0.15 X	0.972 U	0.249 X	0.523 J	0.865 J	0.151 J	0.169 X	0.271 X
2,3,4,6,7,8-Hexachlorodibenzofuran	490	--	--	0.22 B	0.0826 B	0.107 B	0.106 B	0.391 X	0.456 J	0.988 J	0.284 X	0.327 X	0.312 J
2,3,4,7,8-Pentachlorodibenzofuran	160	--	--	0.995 U	1 U	0.915 U	0.972 U	0.297 X	1.06 U	0.662 X	0.212 X	0.181 X	1.04 U
2,3,7,8-Tetrachlorodibenzofuran	490	--	--	0.248 U	0.249 U	0.194 U	0.199 U	0.192 U	0.239 J	0.502 J	0.114 X	0.207 U	0.209 U
Octachlorodibenzofuran	160,000	--	--	0.903 J	2 U	0.332 J	0.251 J	18.4	18.3	31.8	18.9	21.5	19.7
Octachlorodibenzo-p-dioxin	160,000	--	--	619 L	154 J	195 J	167	356 K	798 K	2,090 K	748 K	420	734
Total heptachlorodibenzofuran	--	--	--	0.784 J	0.318 J	0.185 J	0.972 U	32.1 J	33.9 J	51.9	30.8	33.4	31.4
Total heptachlorodibenzo-p-dioxin	--	--	--	73.7	24.1	27.7	28.2	90.9	178	431	71.1	103	164
Total hexachlorodibenzofuran	--	--	--	1.15 J	0.286 J	0.127 J	0.972 U	6.5 J	7.53	16.9 J	6.67 J	7.79 J	8 J
Total hexachlorodibenzo-p-dioxin	--	--	--	29.2	7.19	10.9	2.88 J	25 J	55.4	151	19.9	27.9	49.5
Total pentachlorodibenzofuran	--	--	--	0.995 U	1 U	0.915 U	0.972 U	0.406 J	0.342 J	0.675 J	0.619 J	0.412 J	0.26 J
Total pentachlorodibenzo-p-dioxin	--	--	--	0.793 J	1 U	0.426 J	0.352 J	1.37 J	3.94	15.2	2.48 J	0.84 J	3.29 J
Total tetrachlorodibenzofuran	--	--	--	0.248 U	0.249 U	0.194 U	0.199 U	0.192 U	0.467 J	1.4	0.184 U	0.207 U	0.209 U
Total tetrachlorodibenzo-p-dioxin	--	--	--	1.07	0.35 U	0.349 U	0.32 U	0.489 J	0.368 J	3.12	0.184 U	0.207 U	0.981
Toxic Equivalents (Total TEQ) - HHRA	--	--	0.85	0.89	1.2	0.39	0.23	1.35	2.19	5.06	1.3	1.3	2.5
Toxic Equivalents (Total TEQ) - Eco, Fish	--	--	0.85	1.05	1.1	0.879	1.19	0.934	1.83	3.46	0.956	0.937	1.48
Total Metals (mg/kg)													
Barium	15,000	7.47	48.0	7.17	5.14 J	**7.56**	**8.62**	3.4 J	**8.38**	**23.3**	6.99	6.26	7.47
Beryllium	160	0.616	--	**1.05**	0.402	0.402	0.422	0.155 U	0.167 U	0.257 U	0.538	0.545	0.616
Copper	3,100	2.71	34.0	**3.61**	1.52	1.31	1.46	0.516 U	0.558 U	0.856 U	1.62	2.13	2.71
Lead	4,000	4.79	46.7	**12.7**	**6.46**	**6.98**	**5.18**	2.83	**5.02**	**16.8**	4.79	4.18	4.68
Manganese	1,800	70.9	260	44 K	20.3	21.1	22.3	47.2	**92.2**	**286**	56.1 K	61.9	70.9
Mercury	23	0.014	0.15	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 J	**0.036**	0.007 J	0.014	0.011 J
Zinc	23,000	22.3	150	**30.1 K**	14	14	14.8	10.8	**24.6**	**82.1**	12.7 K	18	22.3
Acid Volatile Sulfide/Simultaneously Extractable Metals (µmol/g)													
Zinc, SEM	--	--	--	0.28	0.11	NA	0.11	0.18	0.25	0.44	0.023	0.062	0.13
Acid volatile sulfide, SEM	--	--	--	1.59	0.81	NA	2.59	4.05	3.43	6.86	1.25	1.72	1.87
Cadmium, SEM	--	--	--	2.00E-04 J	4.00E-04 J	NA	4.00E-04 U	4.00E-04 U	1.00E-03	7.00E-04 U	0.0012	4.00E-04 J	4.00E-04 U
Copper, SEM	--	--	--	0.013	0.016	NA	0.011	0.012	0.1	0.033	0.0073	0.013	0.011
Lead, SEM	--	--	--	0.033	0.016	NA	0.014	0.012	0.024	0.026	0.0034	0.0053	0.0081
Nickel, SEM	--	--	--	0.0087 J	0.0072 J	NA	0.0046 J	0.0081 J	0.089	0.019	0.0059 U	0.0032 J	0.0046 J
Silver, SEM	--	--	--	8.00E-04 U	8.00E-04 U	NA	7.00E-04 U	7.00E-04 U	8.00E-04 U	0.0012 U	8.00E-04 U	8.00E-04 U	8.00E-04 U
Wet Chemistry													
% Solids (pct)	--	--	--	74.8	74.4	81.3	75.2	74.2	67	47	79.6	71.9	68.5
pH (pH units)	--	--	--	8.84 H	8.45 H	NA	8.55 H	7.99 H	8.17 H	8.56 H	8.84 H	8.73 H	8.61 H
Total organic carbon (TOC) (mg/kg)	--	--	--	2,070 D	874	NA	954	888	2,780 D	12,300 E	1,610	2,240 D	2,760 D
Grain Size (pct)													
Cobbles (%)	--	--	--	0	0	NA	0	0	0	0	0	0	0
Fines (%)	--	--	--	8.8	4.6	NA	4	3	10.5	55	8.7	7.1	9.6

TABLE 4-3

Sediment Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Transect ID	**Residential Soil RSLs X 10 for SD (May 2014)**	**Sediment Background****	**ESV**	T1	T2		T3	T4	T5	T6	UT7	UT8	UT9
Station ID				CAS07-SD01	CAS07-SD02		CAS07-SD03	CAS07-SD04*	CAS07-SD05*	CAS07-SD06*	CAS07-SD07	CAS07-SD08	CAS07-SD09
Sample ID				CAS07-SD01-0414	CAS07-SD02-0414	CAS07-SD02P-0414	CAS07-SD03-0414	CAS07-SD04-0414	CAS07-SD05-0414	CAS07-SD06-0414	CAS07-SD07-0414	CAS07-SD08-0414	CAS07-SD09-0414
Sample Date				04/14/14	04/14/14	04/14/14	04/14/14	04/18/14	04/18/14	04/18/14	04/22/14	04/22/14	04/22/14
Gravel (%)	--	--	--	2	0	NA	0	0	0	0	2.2	0	0
Sand (%)	--	--	--	89.2	95.4	NA	96	97	89.5	45	89.1	92.9	90.4
Grain Size (pct/p)													
GS03 Sieve 3" (75 mm)	--	--	--	100	100	NA	100	100	100	100	100	100	100
GS05 Sieve 2" (50 mm)	--	--	--	100	100	NA	100	100	100	100	100	100	100
GS06 Sieve 1.5" (37.5 mm)	--	--	--	100	100	NA	100	100	100	100	100	100	100
GS07 Sieve 1" (25.0 mm)	--	--	--	100	100	NA	100	100	100	100	100	100	100
GS08 Sieve 0.75" (19.0 mm)	--	--	--	100	100	NA	100	100	100	100	100	100	100
GS09 Sieve 0.5" (12.5 mm)	--	--	--	100	100	NA	100	100	100	100	100	100	100
GS10 Sieve 0.375" (9.5 mm)	--	--	--	100	100	NA	100	100	100	100	98.5	100	100
GS11 Sieve 0.25" (6.35 mm)	--	--	--	98.8	100	NA	100	100	100	100	98.4	100	100
Sieve No. 004 (4.75 mm)	--	--	--	98.8	100	NA	100	100	100	100	97.8	100	100
Sieve No. 010 (2.00 mm)	--	--	--	92.5	100	NA	100	100	100	99.6	92.8	100	100
Sieve No. 020 (850 um)	--	--	--	87.3	99.9	NA	100	99.9	99.7	99.1	87.3	99.9	99.9
Sieve No. 040 (425 um)	--	--	--	79.7	99.6	NA	99.8	99.5	98.6	98.6	79.5	99.3	99.6
Sieve No. 060 (250 um)	--	--	--	62.8	90.4	NA	92.4	81.4	56.4	92.6	63.3	88.5	92.8
Sieve No. 140 (106 um)	--	--	--	24.9	19.5	NA	16.8	4.4	11.9	59.8	18.2	18	19.9
Sieve No. 200 (75 um)	--	--	--	8.8	4.6	NA	4	3	10.5	55	8.7	7.1	9.6

Notes:

Shading indicates exceedance of Residential Soil RSLs X 10 for SD

Bold text indicates exceedance of Sediment Background

Underlined text indicates exceedance of ESVs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

D - Compound identified in an analysis at a secondary dilution factor

E - Estimated; concentration exceeds calibration range

H - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UL - Analyte not detected, quantitation limit is probably higher

X - Dioxins only: Estimated Maximum Possible Concentration (EMPC)

mg/kg - Milligrams per kilogram

pct - Percent

pct/p - Percent Passed

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

µmol/g - Micromoles per gram

*Samples collected at CAS07-SD04, CAS07-SD05, CAS07-SD06, CAS07-SD10, CAS07-SD11, CAS07-SD12, CAS07-SD16, CAS07-SD17, CAS07-SD18 were not evaluated as part of the HHRA since the sample location was either too far from the shore or under deep surface water

**Sediment background is the maximum concentration among the upstream sediment locations (CAS07-SD07, CAS07-SD08, CAS07-SD09)

TABLE 4-3

Sediment Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Transect ID	**Residential Soil RSLs X 10 for SD (May 2014)**	**Sediment Background****	**ESV**	UT10	UT11	UT12	DT13		DT14	DT15	DT16	DT17	DT18
Station ID				CAS07-SD10*	CAS07-SD11*	CAS07-SD12*	CAS07-SD13		CAS07-SD14	CAS07-SD15	CAS07-SD16*	CAS07-SD17*	CAS07-SD18*
Sample ID				CAS07-SD10-0414	CAS07-SD11-0414	CAS07-SD12-0414	CAS07-SD13-0414	CAS07-SD13P-0414	CAS07-SD14-0414	CAS07-SD15-0414	CAS07-SD16-0414	CAS07-SD17-0414	CAS07-SD18-0414
Sample Date				04/22/14	04/22/14	04/22/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14
Chemical Name													
Semivolatile Organic Compounds (µg/kg)													
No Detections													
Dioxin/Furans (pg/g)													
1,2,3,4,6,7,8-Heptachlorodibenzofuran	4,900	--	--	11.6	12.3	12.7	4.48	5.71	5.17	4.43	4.55	5.5	5.82
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	4,900	--	--	162	212	203	22.6	27.3	25.7	24.7	26	38.5	51.6
1,2,3,4,7,8,9-Heptachlorodibenzofuran	4,900	--	--	1.34 J	1.28 X	1.13 J	0.51 B	0.604 B	0.683 B	0.526 B	0.628 B	0.529 B	0.325 B
1,2,3,4,7,8-Hexachlorodibenzofuran	490	--	--	1.6 J	1.69 J	1.55 X	0.767 J	0.796 X	0.744 J	0.768 J	0.78 J	0.832 X	0.867 X
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	490	--	--	2.18 J	3.06 X	2.77 X	0.361 B	0.314 B	0.248 B	0.243 B	0.176 B	0.548 J	0.51 J
1,2,3,6,7,8-Hexachlorodibenzofuran	490	--	--	0.481 B	0.413 B	0.645 J	0.205 J	0.356 J	0.277 X	0.289 X	0.162 J	0.203 J	0.206 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	490	--	--	5.67 J	7.62	6.78 J	1.25 J	1.36 J	1.39 X	1.29 X	1.27 J	2.1 J	2.04 X
1,2,3,7,8,9-Hexachlorodibenzofuran	490	--	--	1.82 U	0.295 B	0.362 X	0.187 B	0.201 B	0.289 B	0.222 B	0.119 B	1.03 U	0.166 B
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	490	--	--	5.72 J	8.66	7.05	0.449 X	0.615 J	0.529 J	0.562 X	0.452 J	1.2 J	1.9 J
1,2,3,7,8-Pentachlorodibenzofuran	1,600	--	--	1.82 U	2.04 U	0.443 X	0.907 U	0.175 J	0.146 X	0.925 U	0.96 U	1.03 U	0.177 X
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	49	--	--	0.818 J	1.22 J	1.05 X	0.155 X	0.162 X	0.202 X	0.126 J	0.0836 X	0.182 J	0.331 X
2,3,4,6,7,8-Hexachlorodibenzofuran	490	--	--	0.646 J	0.919 X	0.928 J	0.34 X	0.401 J	0.337 J	0.292 J	0.254 J	0.401 J	0.39 J
2,3,4,7,8-Pentachlorodibenzofuran	160	--	--	0.513 X	0.644 X	0.364 X	0.304 J	0.378 X	0.257 X	0.191 J	0.96 U	0.185 X	0.217 J
2,3,7,8-Tetrachlorodibenzofuran	490	--	--	0.439 J	0.848 X	0.534 J	0.181 U	0.18 U	0.181 U	0.185 U	0.192 U	0.205 U	0.226 J
Octachlorodibenzofuran	160,000	--	--	36.6	38.9	39.6	15.6 J	20.2 J	18.7	15.1	15.4	17.5	17.8
Octachlorodibenzo-p-dioxin	160,000	--	--	2,450	3,370	3,410	82.7 J	121 J	111 K	112 K	118 K	334 K	594 K
Total heptachlorodibenzofuran	--	--	--	61.2	62.8	66.2	25.3 J	31.2 J	29.1 J	24.9 J	26.6 J	30.7 J	32.8 J
Total heptachlorodibenzo-p-dioxin	--	--	--	486	662	634	37.7	49.2	43.8	43.1	46.1	88.5	135
Total hexachlorodibenzofuran	--	--	--	15.9 J	17.7 J	17.5	6.61 J	6.9 J	7.71 J	5.37 J	6.99 J	7.23	7.96 J
Total hexachlorodibenzo-p-dioxin	--	--	--	164	224	214	3.34 J	5.94 J	3.49 J	5.3 J	8.43 J	24.7	37.9
Total pentachlorodibenzofuran	--	--	--	0.716 J	2.76 J	2.79 J	0.776 J	0.446 J	0.199 J	0.185 J	0.96 U	0.162 J	0.349 J
Total pentachlorodibenzo-p-dioxin	--	--	--	15.3	24.4	20.7	0.0826 J	0.0949 J	0.907 U	0.325 J	0.34 J	2.4 J	2.74 J
Total tetrachlorodibenzofuran	--	--	--	0.439 J	2.65	1.32 J	0.181 U	0.18 U	0.181 U	0.185 U	0.192 U	0.205 U	0.226 J
Total tetrachlorodibenzo-p-dioxin	--	--	--	3.54	6.77	3.85	0.181 U	0.18 U	0.181 U	0.185 U	0.192 U	0.205 U	0.216 U
Toxic Equivalents (Total TEQ) - HHRA	--	--	0.85	5.09	6.97	6.44	0.85	1	0.96	0.83	0.721	1.31	1.77
Toxic Equivalents (Total TEQ) - Eco, Fish	--	--	0.85	3.41	4.53	4.05	0.752	0.819	0.758	0.651	0.723	1.04	1.19
Total Metals (mg/kg)													
Barium	15,000	7.47	48.0	**34.2**	**37.4**	**39.6**	4.25 J	2.84 J	5.19	**9.91**	1.88 J	4.36 J	5.61
Beryllium	160	0.616	--	**2.66**	**2.81**	**2.82**	0.157 U	0.154 U	0.151 U	0.148 U	0.159 U	0.159 U	0.157 U
Copper	3,100	2.71	34.0	**13.2**	**14.6**	**14.8**	0.523 UL	0.514 U	0.607 J	0.493 U	0.531 U	0.53 U	0.522 U
Lead	4,000	4.79	46.7	**21.9**	**23.8**	**23.2**	2.44	2.13	2.18	3.57	1.35	2.87	3.96
Manganese	1,800	70.9	260	**471**	**518**	**514**	31.3 K	21 J	39.3	31.5	26.5	40.8	59.4
Mercury	23	0.014	0.15	**0.051**	**0.055**	**0.055**	0.006 U	0.006 U	**0.017**	0.006 U	0.006 U	0.006 U	0.006 U
Zinc	23,000	22.3	150	**124**	**132**	**130**	8.61 J	**22.5 J**	21.3	16.7	4.45 B	12.3	18.7
Acid Volatile Sulfide/Simultaneously Extractable Metals (µmol/g)													
Zinc, SEM	--	--	--	0.53	0.84	1	0.03	NA	0.052	0.06	0.048	0.074	0.17
Acid volatile sulfide, SEM	--	--	--	8.42	10.3	10.3	1.75	NA	2.06	3.12	4.05	4.05	4.37
Cadmium, SEM	--	--	--	9.00E-04 U	1.00E-03 U	9.00E-04 U	2.00E-04 J	NA	3.00E-04 J	5.00E-04 J	4.00E-04 U	4.00E-04 U	4.00E-04 U
Copper, SEM	--	--	--	0.026	0.026	0.05	0.19	NA	0.014	0.01	0.0071	0.047	0.015
Lead, SEM	--	--	--	0.028	0.049	0.06	0.0045	NA	0.0049	0.0041	0.0033	0.0046	0.0097
Nickel, SEM	--	--	--	0.018 J	0.025	0.048	0.0026 J	NA	0.0092 J	0.0045 J	0.0054 U	0.0035 J	0.0071 J
Silver, SEM	--	--	--	0.0011 J	0.0021 J	0.0029 J	7.00E-04 U	NA	7.00E-04 U	7.00E-04 U	8.00E-04 U	7.00E-04 U	8.00E-04 U
Wet Chemistry													
% Solids (pct)	--	--	--	39.6	36.3	35.4	82.4	81.7	80.2	80.3	77.2	72.2	68.9
pH (pH units)	--	--	--	8.56 H	8.39 H	8.49 H	8.64 H	NA	8.85 H	8.79 H	7.74 H	8.33 H	8.22 H
Total organic carbon (TOC) (mg/kg)	--	--	--	9,320 E	11,900 E	9,080 E	3,870 D	NA	2,020 D	13,700 E	788	1,400 D	2,920 D
Grain Size (pct)													
Cobbles (%)	--	--	--	0	0	0	0	NA	0	0	0	0	0
Fines (%)	--	--	--	67.5	71	73.8	0.5	NA	0.7	0.8	1.2	4.6	7.8

TABLE 4-3

Sediment Data Exceedance Results

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Transect ID	**Residential Soil RSLs X 10 for SD (May 2014)**	**Sediment Background****	**ESV**	UT10	UT11	UT12	DT13		DT14	DT15	DT16	DT17	DT18
Station ID				CAS07-SD10*	CAS07-SD11*	CAS07-SD12*	CAS07-SD13		CAS07-SD14	CAS07-SD15	CAS07-SD16*	CAS07-SD17*	CAS07-SD18*
Sample ID				CAS07-SD10-0414	CAS07-SD11-0414	CAS07-SD12-0414	CAS07-SD13-0414	CAS07-SD13P-0414	CAS07-SD14-0414	CAS07-SD15-0414	CAS07-SD16-0414	CAS07-SD17-0414	CAS07-SD18-0414
Sample Date				04/22/14	04/22/14	04/22/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14
Gravel (%)	--	--	--	0	0	0	2.6	NA	5.6	7.1	0	0	0.1
Sand (%)	--	--	--	32.5	29	26.2	96.9	NA	93.8	92.1	98.8	95.4	92.1
Grain Size (pct/p)													
GS03 Sieve 3" (75 mm)	--	--	--	100	100	100	100	NA	100	100	100	100	100
GS05 Sieve 2" (50 mm)	--	--	--	100	100	100	100	NA	100	100	100	100	100
GS06 Sieve 1.5" (37.5 mm)	--	--	--	100	100	100	100	NA	100	100	100	100	100
GS07 Sieve 1" (25.0 mm)	--	--	--	100	100	100	100	NA	100	100	100	100	100
GS08 Sieve 0.75" (19.0 mm)	--	--	--	100	100	100	100	NA	100	100	100	100	100
GS09 Sieve 0.5" (12.5 mm)	--	--	--	100	100	100	100	NA	100	100	100	100	100
GS10 Sieve 0.375" (9.5 mm)	--	--	--	100	100	100	99.2	NA	99.9	98.2	100	100	100
GS11 Sieve 0.25" (6.35 mm)	--	--	--	100	100	100	98.8	NA	96.1	96.1	100	100	100
Sieve No. 004 (4.75 mm)	--	--	--	100	100	100	97.4	NA	94.4	92.9	100	100	99.9
Sieve No. 010 (2.00 mm)	--	--	--	100	100	100	89.9	NA	85.4	81.6	100	99.8	99.5
Sieve No. 020 (850 um)	--	--	--	99.8	99.6	99.8	79.6	NA	71.8	69.5	99.2	98.7	98.2
Sieve No. 040 (425 um)	--	--	--	99.5	98.8	99.4	39.3	NA	37.2	36	87.5	87.3	83
Sieve No. 060 (250 um)	--	--	--	99	97.6	98.8	5.4	NA	8	9.6	54.7	59.2	55.6
Sieve No. 140 (106 um)	--	--	--	80.6	82.9	85.2	0.7	NA	1.4	1.5	2.2	6.2	9.9
Sieve No. 200 (75 um)	--	--	--	67.5	71	73.8	0.5	NA	0.7	0.8	1.2	4.6	7.8

Notes:

Shading indicates exceedance of Residential Soil RSLs X 10 for SD

Bold text indicates exceedance of Sediment Background

Underlined text indicates exceedance of ESVs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

D - Compound identified in an analysis at a secondary dilution factor

E - Estimated; concentration exceeds calibration range

H - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UL - Analyte not detected, quantitation limit is probably higher

X - Dioxins only: Estimated Maximum Possible Concentration (EMPC)

mg/kg - Milligrams per kilogram

pct - Percent

pct/p - Percent Passed

pg/g - Picograms per gram

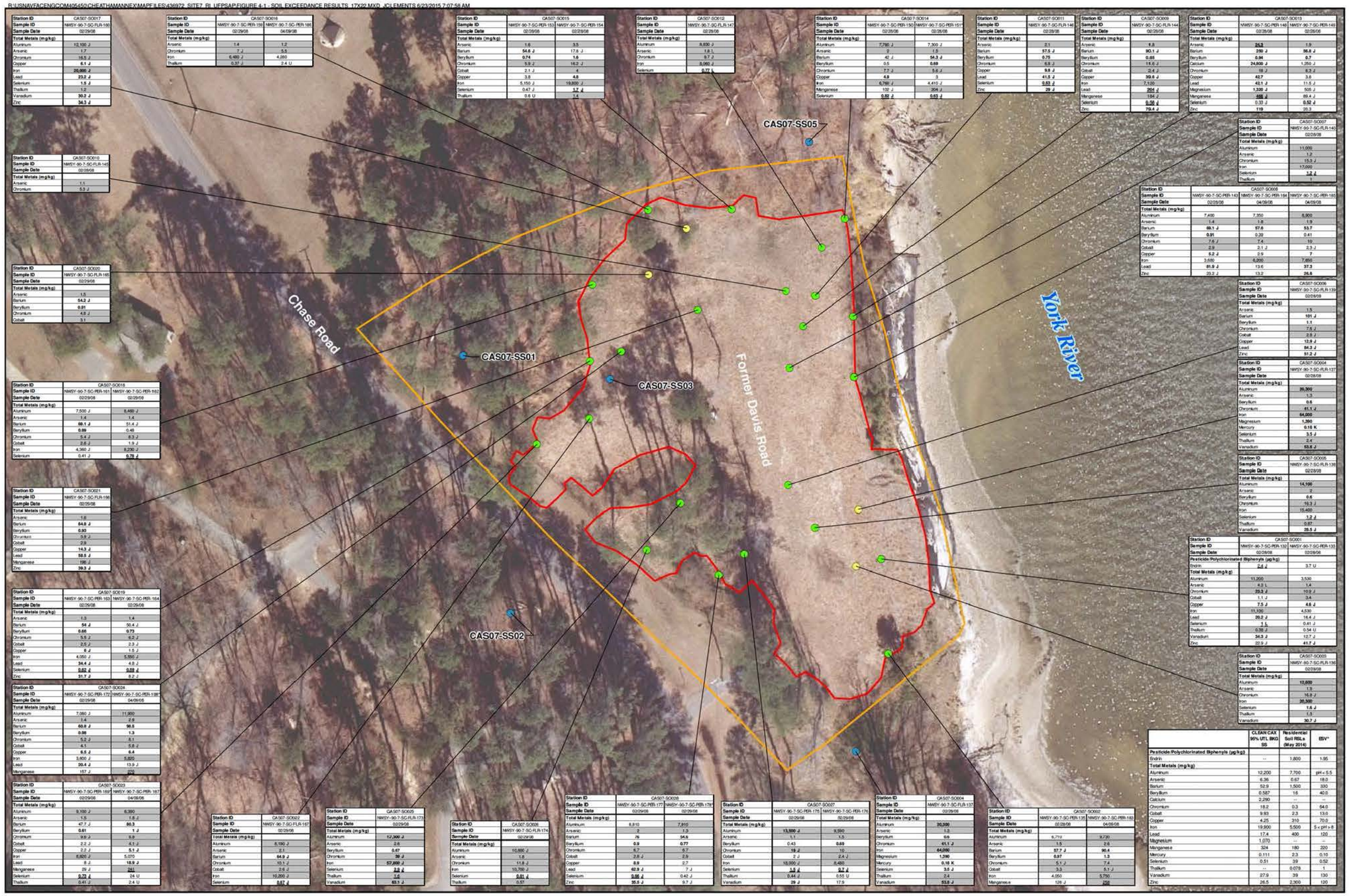
µg/kg - Micrograms per kilogram

µmol/g - Micromoles per gram

*Samples collected at CAS07-SD04, CAS07-SD05, CAS07-SD06, CAS07-SD10, CAS07-SD11, CAS07-SD12, CAS07-SD16, CAS07-SD17, CAS07-SD18 were not evaluated as part of the HHRA since the sample location was either too far from the shore or under deep surface water

**Sediment background is the maximum concentration among the upstream sediment locations (CAS07-SD07, CAS07-SD08, CAS07-SD09)

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436972_SITE7_RI_UFPSAP\FIGURE 4-1 - SOIL EXCEEDANCE RESULTS_17X22.MXD JCLEMENTS 6/23/2015 7:07:58 AM



Station ID	CAS07-SO017
Sample ID	NWSY-90-7-SC-FLR-160
Sample Date	02/29/08
Total Metals (mg/kg)	
Aluminum	12,100 J
Arsenic	1.7
Chromium	16.5 J
Copper	5.1 J
Iron	**20,000 J**
Lead	**23.2 J**
Selenium	1.5 J
Thallium	1.2
Vanadium	**30.2 J**
Zinc	**34.3 J**

Station ID	CAS07-SO016	
Sample ID	NWSY-90-7-SC-PER-159	NWSY-90-7-SC-PER-186
Sample Date	02/29/08	04/09/08
Total Metals (mg/kg)		
Arsenic	1.4	1.2
Chromium	7.J	5.5
Iron	6,480 J	4,280
Thallium	0.37 J	2.4 U

Station ID	CAS07-SO015	
Sample ID	NWSY-90-7-SC-PER-153	NWSY-90-7-SC-PER-154
Sample Date	02/29/08	02/29/08
Total Metals (mg/kg)		
Arsenic	1.6	3.5
Barium	**54.6 J**	17.8 J
Beryllium	**0.74**	**1.6**
Chromium	5.9 J	16.2 J
Cobalt	2.1 J	4
Copper	3.8	**4.8**
Iron	5,150 J	19,900 J
Selenium	0.47 J	**1.7 J**
Thallium	0.6 U	1.4

Station ID	CAS07-SO012
Sample ID	NWSY-90-7-SC-FLR-147
Sample Date	02/29/08
Total Metals (mg/kg)	
Aluminum	8,800 J
Arsenic	1.8 L
Chromium	9.7 J
Iron	8,060 J
Selenium	**0.77 L**

Station ID	CAS07-SO014	
Sample ID	NWSY-90-7-SC-PER-150	NWSY-90-7-SC-PER-151*
Sample Date	02/28/08	02/28/08
Total Metals (mg/kg)		
Aluminum	7,790 J	7,300 J
Arsenic	2	1.5
Barium	42 J	**54.3 J**
Beryllium	0.5	**0.69**
Chromium	7.7 J	5.6 J
Copper	**4.9**	3
Iron	6,790 J	4,410 J
Manganese	150 J	204 J
Selenium	**0.82 J**	**0.63 J**

Station ID	CAS07-SO011
Sample ID	NWSY-90-7-SC-FLR-146
Sample Date	02/29/08
Total Metals (mg/kg)	
Arsenic	2.1
Barium	57.5 J
Beryllium	**0.75**
Chromium	6.8 J
Copper	**9.8 J**
Lead	**41.5 J**
Selenium	**0.83 J**
Zinc	**29 J**

Station ID	CAS07-SO009
Sample ID	NWSY-90-7-SC-FLR-144
Sample Date	02/28/08
Total Metals (mg/kg)	
Arsenic	**1.8**
Barium	90.1 J
Beryllium	**0.65**
Chromium	15.6 J
Cobalt	2.4 J
Copper	**39.6 J**
Iron	7,130
Lead	**204 J**
Manganese	184 J
Selenium	**0.56 J**
Zinc	**79.4 J**

Station ID	CAS07-SO013	
Sample ID	NWSY-90-7-SC-PER-148	NWSY-90-7-SC-PER-149
Sample Date	02/28/08	02/28/08
Total Metals (mg/kg)		
Arsenic	**25.3**	1.9
Barium	**250 J**	**56.8 J**
Beryllium	**0.94**	**0.7**
Calcium	**24,000 J**	1,250 J
Chromium	18 J	6.3 J
Copper	**42.7**	3.6
Lead	**43.1 J**	11.5 J
Magnesium	**1,300 J**	505 J
Manganese	**466 J**	89.4 J
Selenium	0.33 J	**0.52 J**
Zinc	**119**	35.3

Station ID	CAS07-SO007
Sample ID	NWSY-90-7-SC-FLR-140
Sample Date	02/28/08
Total Metals (mg/kg)	
Aluminum	11,000
Arsenic	1.2
Chromium	15.3 J
Iron	17,000
Selenium	**3.2 J**
Thallium	1

Station ID	CAS07-SO010
Sample ID	NWSY-90-7-SC-FLR-145
Sample Date	02/28/08
Total Metals (mg/kg)	
Arsenic	1.1
Chromium	5.3 J

Station ID	CAS07-SO008		
Sample ID	NWSY-90-7-SC-PER-143	NWSY-90-7-SC-PER-184	NWSY-90-7-SC-PER-185
Sample Date	02/28/08	04/09/08	04/09/08
Total Metals (mg/kg)			
Aluminum	7,400	7,350	8,900
Arsenic	1.4	1.8	1.9
Barium	**69.1 J**	**57.6**	**53.7**
Beryllium	**0.91**	0.39	0.41
Chromium	7.6 J	7.4	19
Cobalt	2.9	2.1 J	2.3 J
Copper	**5.2 J**	2.9	**7**
Iron	3,680	6,200	7,860
Lead	**81.9 J**	13.6	**37.3**
Zinc	23.2 J	13.2	**26.6**

Station ID	CAS07-SO020
Sample ID	NWSY-90-7-SC-FLR-165
Sample Date	02/29/08
Total Metals (mg/kg)	
Arsenic	1.5
Barium	**54.2 J**
Beryllium	**0.81**
Chromium	4.8 J
Cobalt	3.1

Station ID	CAS07-SO006
Sample ID	NWSY-90-7-SC-FLR-139
Sample Date	02/28/08
Total Metals (mg/kg)	
Arsenic	1.5
Barium	**101 J**
Beryllium	1.1
Chromium	7.6 J
Cobalt	2.8 J
Copper	**12.8 J**
Lead	**84.3 J**
Zinc	**51.2 J**

Station ID	CAS07-SO018	
Sample ID	NWSY-90-7-SC-PER-161	NWSY-90-7-SC-PER-162
Sample Date	02/29/08	02/29/08
Total Metals (mg/kg)		
Aluminum	7,500 J	8,460 J
Arsenic	1.4	1.4
Barium	**68.1 J**	51.4 J
Beryllium	**0.89**	0.48
Chromium	5.4 J	8.3 J
Cobalt	2.6 J	1.9 J
Iron	4,360 J	8,230 J
Selenium	0.41 J	**0.78 J**

Station ID	CAS07-SO004
Sample ID	NWSY-90-7-SC-FLR-137
Sample Date	02/28/08
Total Metals (mg/kg)	
Aluminum	**20,300**
Arsenic	1.3
Beryllium	**0.6**
Chromium	**41.1 J**
Iron	**64,000**
Magnesium	**1,390**
Mercury	**0.16 K**
Selenium	**3.5 J**
Thallium	2.4
Vanadium	**53.8 J**

Station ID	CAS07-SO005
Sample ID	NWSY-90-7-SC-FLR-138
Sample Date	02/28/08
Total Metals (mg/kg)	
Aluminum	**14,100**
Arsenic	2
Beryllium	**0.6**
Chromium	19.3 J
Iron	15,400
Selenium	**1.2 J**
Thallium	0.87
Vanadium	**35.5 J**

Station ID	CAS07-SO021
Sample ID	NWSY-90-7-SC-FLR-166
Sample Date	02/29/08
Total Metals (mg/kg)	
Arsenic	1.8
Barium	**64.8 J**
Beryllium	**0.93**
Chromium	3.9 J
Cobalt	2.9
Copper	**14.3 J**
Lead	**58.5 J**
Manganese	196 J
Zinc	**39.3 J**

Station ID	CAS07-SO001	
Sample ID	NWSY-90-7-SC-PER-132	NWSY-90-7-SC-PER-133
Sample Date	02/28/08	02/28/08
Pesticide/Polychlorinated Biphenyls (µg/kg)		
Endrin	**2.4 J**	3.7 U
Total Metals (mg/kg)		
Aluminum	11,200	3,530
Arsenic	4.3 L	1.4
Chromium	**23.3 J**	10.9 J
Cobalt	1.1 J	3.4
Copper	**7.5 J**	**4.8 J**
Iron	11,100	4,530
Lead	**20.2 J**	16.4 J
Selenium	1 L	0.41 J
Thallium	0.39 J	0.54 U
Vanadium	**34.3 J**	12.7 J
Zinc	22.9 J	**41.7 J**

Station ID	CAS07-SO019	
Sample ID	NWSY-90-7-SC-PER-163	NWSY-90-7-SC-PER-164
Sample Date	02/29/08	02/29/08
Total Metals (mg/kg)		
Arsenic	1.3	1.4
Barium	**54 J**	50.4 J
Beryllium	**0.66**	**0.73**
Chromium	5.5 J	6.2 J
Cobalt	2.5 J	2.3 J
Copper	**6 J**	1.5 J
Iron	4,050 J	5,850 J
Lead	**34.4 J**	4.8 J
Selenium	**0.62 J**	**0.59 J**
Zinc	**31.7 J**	8.2 J

Station ID	CAS07-SO003
Sample ID	NWSY-90-7-SC-FLR-136
Sample Date	02/28/08
Total Metals (mg/kg)	
Aluminum	**12,600**
Arsenic	1.9
Chromium	16.9 J
Iron	**20,300**
Selenium	**1.6 J**
Thallium	1.3
Vanadium	**30.7 J**

Station ID	CAS07-SO024	
Sample ID	NWSY-90-7-SC-PER-172	NWSY-90-7-SC-PER-186*
Sample Date	02/29/08	04/09/08
Total Metals (mg/kg)		
Aluminum	7,090 J	11,900
Arsenic	1.4	2.6
Barium	**60.8 J**	**98.5**
Beryllium	**0.88**	**1.3**
Chromium	5.2 J	8.1
Cobalt	4.1	5.8 J
Copper	**6.5 J**	**6.4**
Iron	3,800 J	5,820
Lead	**20.4 J**	13.9 J
Manganese	157 J	273

Station ID	CAS07-SO023	
Sample ID	NWSY-90-7-SC-PER-169*	NWSY-90-7-SC-PER-187
Sample Date	02/29/08	04/09/08
Total Metals (mg/kg)		
Aluminum	9,100 J	6,390
Arsenic	1.5	1.8 J
Barium	47.7 J	**80.3**
Beryllium	**0.81**	**1 J**
Chromium	9.9 J	5.9
Cobalt	2.2 J	4.1 J
Copper	2.2 J	**5.1 J**
Iron	6,820 J	5,070
Lead	8 J	**18.9 J**
Manganese	29 J	241
Selenium	**0.73 J**	24 U
Thallium	0.41 J	2.4 U

Station ID	CAS07-SO022
Sample ID	NWSY-90-7-SC-FLR-167
Sample Date	02/29/08
Total Metals (mg/kg)	
Aluminum	8,190 J
Arsenic	2.1
Barium	**64.9 J**
Chromium	15.1 J
Cobalt	2.6 J
Iron	10,200 J
Selenium	**0.87 J**

Station ID	CAS07-SO025
Sample ID	NWSY-90-7-SC-FLR-173
Sample Date	02/29/08
Total Metals (mg/kg)	
Aluminum	**12,300 J**
Arsenic	2.6
Beryllium	**0.67**
Chromium	**30 J**
Iron	**57,800 J**
Selenium	**2.2 J**
Thallium	**1.6**
Vanadium	**63.1 J**

Station ID	CAS07-SO026
Sample ID	NWSY-90-7-SC-FLR-174
Sample Date	02/29/08
Total Metals (mg/kg)	
Aluminum	10,600 J
Arsenic	1.8
Chromium	11.8 J
Iron	10,700 J
Selenium	**0.61 J**
Thallium	0.57

Station ID	CAS07-SO028	
Sample ID	NWSY-90-7-SC-PER-177	NWSY-90-7-SC-PER-178*
Sample Date	02/29/08	02/29/08
Total Metals (mg/kg)		
Aluminum	8,810	7,910
Arsenic	2	1.3
Barium	76	**54.6**
Beryllium	**0.9**	**0.77**
Chromium	6.7	6.7
Cobalt	2.8 J	2.9
Copper	**8.9**	2.7
Lead	**62.9 J**	7.1
Selenium	**0.66 J**	0.42 J
Zinc	**35.5 J**	9.7 J

Station ID	CAS07-SO027	
Sample ID	NWSY-90-7-SC-PER-175	NWSY-90-7-SC-PER-176
Sample Date	02/29/08	02/29/08
Total Metals (mg/kg)		
Aluminum	**13,800 J**	9,590
Arsenic	1.1	1.5
Beryllium	0.43	**0.60**
Chromium	**19 J**	16
Cobalt	2 J	2.4 J
Iron	10,000 J	8,480
Selenium	**1.8 J**	**0.7 J**
Thallium	0.44 J	0.55 U
Vanadium	**29 J**	17.9

Station ID	CAS07-SO002	
Sample ID	NWSY-90-7-SC-PER-135	NWSY-90-7-SC-PER-180
Sample Date	02/28/08	04/09/08
Total Metals (mg/kg)		
Aluminum	6,710	9,730
Arsenic	1.5	2.6
Barium	57.7 J	**90.4**
Beryllium	**0.87**	**1.3**
Chromium	5.1 J	7.4
Cobalt	3.3	5.1 J
Iron	4,050	5,750
Manganese	126 J	258

	CLEAN CAX 95% UTL BKG SS	Residential Soil RSLs (May 2014)	ESV*
Pesticide/Polychlorinated Biphenyls (µg/kg)			
Endrin	--	1,800	1.95
Total Metals (mg/kg)			
Aluminum	12,200	7,700	pH < 5.5
Arsenic	6.36	0.67	18.0
Barium	52.9	1,500	330
Beryllium	0.587	16	40.0
Calcium	2,290	--	--
Chromium	18.2	0.3	64.0
Cobalt	9.93	2.3	13.0
Copper	4.25	310	70.0
Iron	19,900	5,500	5 < pH > 8
Lead	17.4	400	120
Magnesium	1,070	--	--
Manganese	324	180	220
Mercury	0.111	2.3	0.10
Selenium	0.51	39	0.52
Thallium	--	0.078	1
Vanadium	27.9	39	130
Zinc	26.5	2,300	120

Legend

- 2011 SI Field Activities
- Shaw 2008 Field Investigation
- Shaw 2008 Removal Action
- Excavation Boundary
- Site Boundary

Notes:

Bold text indicates exceedance of CLEAN CAX 95% UTL BKG SS

Shading indicates exceedance of Residential Soil RSLs

Underlined text indicates exceedance of ESVs

RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic endpoints are based on carcinogenic risk of 1 x 10-6.

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

**Samples NWSY-90-7-SC-PER-133, NWSY-90-7-SC-FLR-136, NWSY-90-7-SC-FLR-137, NWSY-90-7-SC-FLR-160, and NWSY-90-7-SC-FLR-165 were not screened against the ESVs since these samples were collected either below 24 inches from the current ground surface or where more than 24 inches of backfill was placed

**Field duplicate collected at this location; the greater of the results is shown

0 50 100 Feet

N W E S

Figure 4-1
Soil Exceedance Results
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, VA

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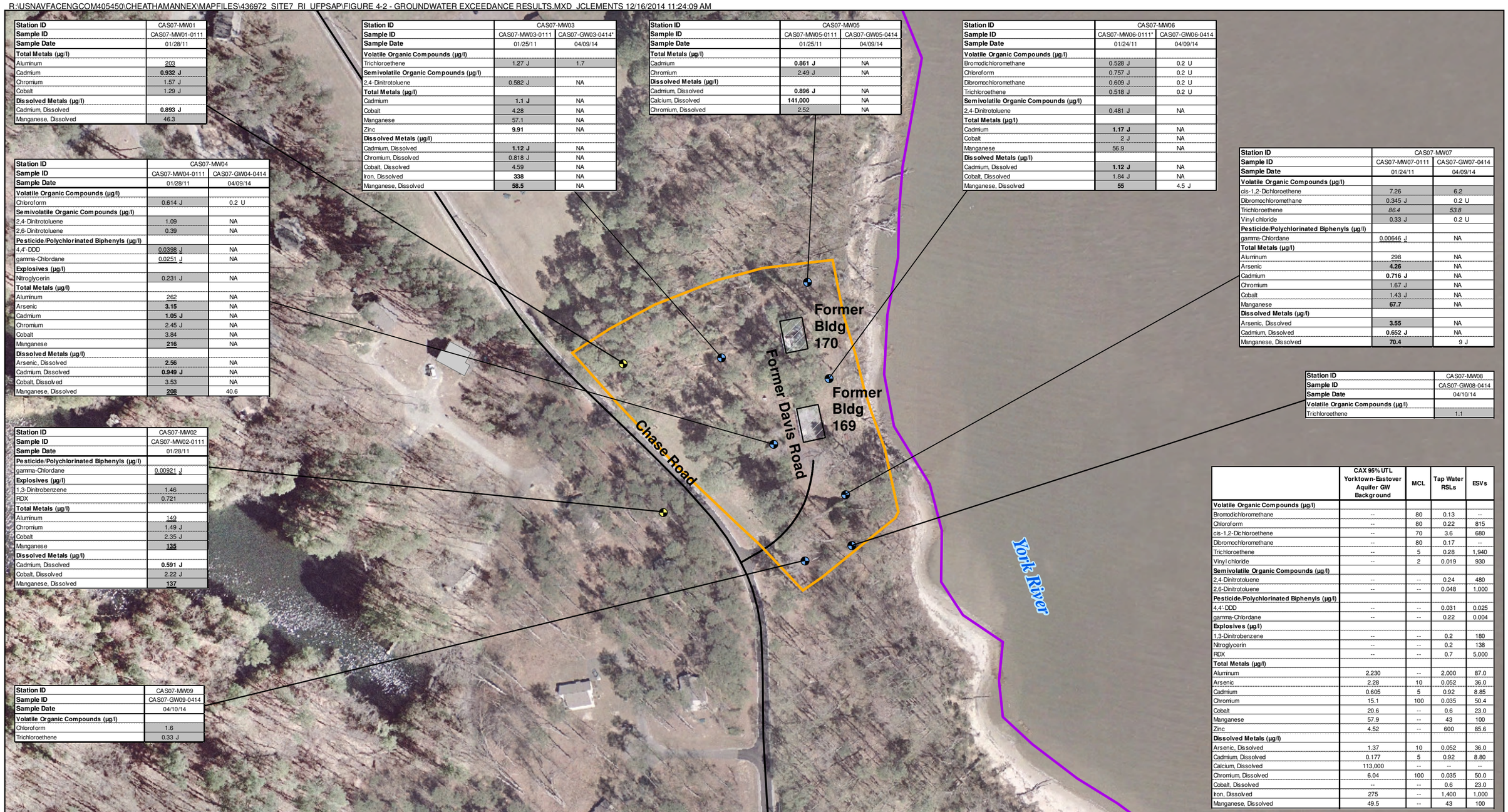
R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436972_SITE7_RI_UFPSAP\FIGURE 4-2 - GROUNDWATER EXCEEDANCE RESULTS.MXD JCLEMENTS 12/16/2014 11:24:09 AM



Station ID	CAS07-MW01
Sample ID	CAS07-MW01-0111
Sample Date	01/28/11
Total Metals (µg/l)	
Aluminum	203
Cadmium	**0.932 J**
Chromium	1.57 J
Cobalt	1.29 J
Dissolved Metals (µg/l)	
Cadmium, Dissolved	**0.893 J**
Manganese, Dissolved	46.3

Station ID	CAS07-MW03	
Sample ID	CAS07-MW03-0111	CAS07-GW03-0414*
Sample Date	01/25/11	04/09/14
Volatile Organic Compounds (µg/l)		
Trichloroethene	1.27 J	1.7
Semivolatile Organic Compounds (µg/l)		
2,4-Dinitrotoluene	0.582 J	NA
Total Metals (µg/l)		
Cadmium	**1.1 J**	NA
Cobalt	4.28	NA
Manganese	57.1	NA
Zinc	**9.91**	NA
Dissolved Metals (µg/l)		
Cadmium, Dissolved	**1.12 J**	NA
Chromium, Dissolved	0.818 J	NA
Cobalt, Dissolved	4.59	NA
Iron, Dissolved	**338**	NA
Manganese, Dissolved	**58.5**	NA

Station ID	CAS07-MW05	
Sample ID	CAS07-MW05-0111	CAS07-GW05-0414
Sample Date	01/25/11	04/09/14
Total Metals (µg/l)		
Cadmium	**0.861 J**	NA
Chromium	2.49 J	NA
Dissolved Metals (µg/l)		
Cadmium, Dissolved	**0.896 J**	NA
Calcium, Dissolved	**141,000**	NA
Chromium, Dissolved	2.52	NA

Station ID	CAS07-MW06	
Sample ID	CAS07-MW06-0111*	CAS07-GW06-0414
Sample Date	01/24/11	04/09/14
Volatile Organic Compounds (µg/l)		
Bromodichloromethane	0.528 J	0.2 U
Chloroform	0.757 J	0.2 U
Dibromochloromethane	0.609 J	0.2 U
Trichloroethene	0.518 J	0.2 U
Semivolatile Organic Compounds (µg/l)		
2,4-Dinitrotoluene	0.481 J	NA
Total Metals (µg/l)		
Cadmium	**1.17 J**	NA
Cobalt	2 J	NA
Manganese	56.9	NA
Dissolved Metals (µg/l)		
Cadmium, Dissolved	**1.12 J**	NA
Cobalt, Dissolved	1.84 J	NA
Manganese, Dissolved	**55**	4.5 J

Station ID	CAS07-MW04	
Sample ID	CAS07-MW04-0111	CAS07-GW04-0414
Sample Date	01/28/11	04/09/14
Volatile Organic Compounds (µg/l)		
Chloroform	0.614 J	0.2 U
Semivolatile Organic Compounds (µg/l)		
2,4-Dinitrotoluene	1.09	NA
2,6-Dinitrotoluene	0.39	NA
Pesticide/Polychlorinated Biphenyls (µg/l)		
4,4'-DDD	0.0398 J	NA
gamma-Chlordane	0.0251 J	NA
Explosives (µg/l)		
Nitroglycerin	0.231 J	NA
Total Metals (µg/l)		
Aluminum	262	NA
Arsenic	**3.15**	NA
Cadmium	**1.05 J**	NA
Chromium	2.45 J	NA
Cobalt	3.84	NA
Manganese	**216**	NA
Dissolved Metals (µg/l)		
Arsenic, Dissolved	**2.56**	NA
Cadmium, Dissolved	**0.949 J**	NA
Cobalt, Dissolved	3.53	NA
Manganese, Dissolved	**208**	40.6

Station ID	CAS07-MW07	
Sample ID	CAS07-MW07-0111	CAS07-GW07-0414
Sample Date	01/24/11	04/09/14
Volatile Organic Compounds (µg/l)		
cis-1,2-Dichloroethene	7.26	6.2
Dibromochloromethane	0.345 J	0.2 U
Trichloroethene	*86.4*	*53.8*
Vinyl chloride	0.33 J	0.2 U
Pesticide/Polychlorinated Biphenyls (µg/l)		
gamma-Chlordane	0.00646 J	NA
Total Metals (µg/l)		
Aluminum	298	NA
Arsenic	**4.26**	NA
Cadmium	**0.716 J**	NA
Chromium	1.67 J	NA
Cobalt	1.43 J	NA
Manganese	**67.7**	NA
Dissolved Metals (µg/l)		
Arsenic, Dissolved	**3.55**	NA
Cadmium, Dissolved	**0.652 J**	NA
Manganese, Dissolved	**70.4**	9 J

Station ID	CAS07-MW08
Sample ID	CAS07-GW08-0414
Sample Date	04/10/14
Volatile Organic Compounds (µg/l)	
Trichloroethene	1.1

Station ID	CAS07-MW02
Sample ID	CAS07-MW02-0111
Sample Date	01/28/11
Pesticide/Polychlorinated Biphenyls (µg/l)	
gamma-Chlordane	0.00921 J
Explosives (µg/l)	
1,3-Dinitrobenzene	1.46
RDX	0.721
Total Metals (µg/l)	
Aluminum	149
Chromium	1.49 J
Cobalt	2.35 J
Manganese	135
Dissolved Metals (µg/l)	
Cadmium, Dissolved	**0.591 J**
Cobalt, Dissolved	2.22 J
Manganese, Dissolved	**137**

Station ID	CAS07-MW09
Sample ID	CAS07-GW09-0414
Sample Date	04/10/14
Volatile Organic Compounds (µg/l)	
Chloroform	1.6
Trichloroethene	0.33 J

	CAX 95% UTL Yorktown-Eastover Aquifer GW Background	MCL	Tap Water RSLs	ESVs
Volatile Organic Compounds (µg/l)				
Bromodichloromethane	--	80	0.13	--
Chloroform	--	80	0.22	815
cis-1,2-Dichloroethene	--	70	3.6	680
Dibromochloromethane	--	80	0.17	--
Trichloroethene	--	5	0.28	1,940
Vinyl chloride	--	2	0.019	930
Semivolatile Organic Compounds (µg/l)				
2,4-Dinitrotoluene	--	--	0.24	480
2,6-Dinitrotoluene	--	--	0.048	1,000
Pesticide/Polychlorinated Biphenyls (µg/l)				
4,4'-DDD	--	--	0.031	0.025
gamma-Chlordane	--	--	0.22	0.004
Explosives (µg/l)				
1,3-Dinitrobenzene	--	--	0.2	180
Nitroglycerin	--	--	0.2	138
RDX	--	--	0.7	5,000
Total Metals (µg/l)				
Aluminum	2,230	--	2,000	87.0
Arsenic	2.28	10	0.052	36.0
Cadmium	0.605	5	0.92	8.85
Chromium	15.1	100	0.035	50.4
Cobalt	20.6	--	0.6	23.0
Manganese	57.9	--	43	100
Zinc	4.52	--	600	85.6
Dissolved Metals (µg/l)				
Arsenic, Dissolved	1.37	10	0.052	36.0
Cadmium, Dissolved	0.177	5	0.92	8.80
Calcium, Dissolved	113,000	--	--	--
Chromium, Dissolved	6.04	100	0.035	50.0
Cobalt, Dissolved	--	--	0.6	23.0
Iron, Dissolved	275	--	1,400	1,000
Manganese, Dissolved	49.5	--	43	100

Legend
- Site Boundary
- Cheatham Annex Boundary
- Buildings
- Former Buildings
- Roads
- Existing Monitoring Well
- Existing Monitoring Well - RI Groundwater Sample Location

Notes:
Bold text indicates exceedance of CAX 95% UTL Yorktown-Eastover Aquifer GW Background
Italicized text indicates exceedance of the MCL
Shading indicates exceedance of Tap Water RSLs
Underline indicates exceedance of the ESV
RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic endpoints are based on carcinogenic risk of 1 x 10-6.
NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
µg/l - Micrograms per liter
*Field duplicate collected at this location; the greater of the results is shown

N W E S

0 150 300 Feet

Figure 4-2
Groundwater Exceedance Results
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, VA

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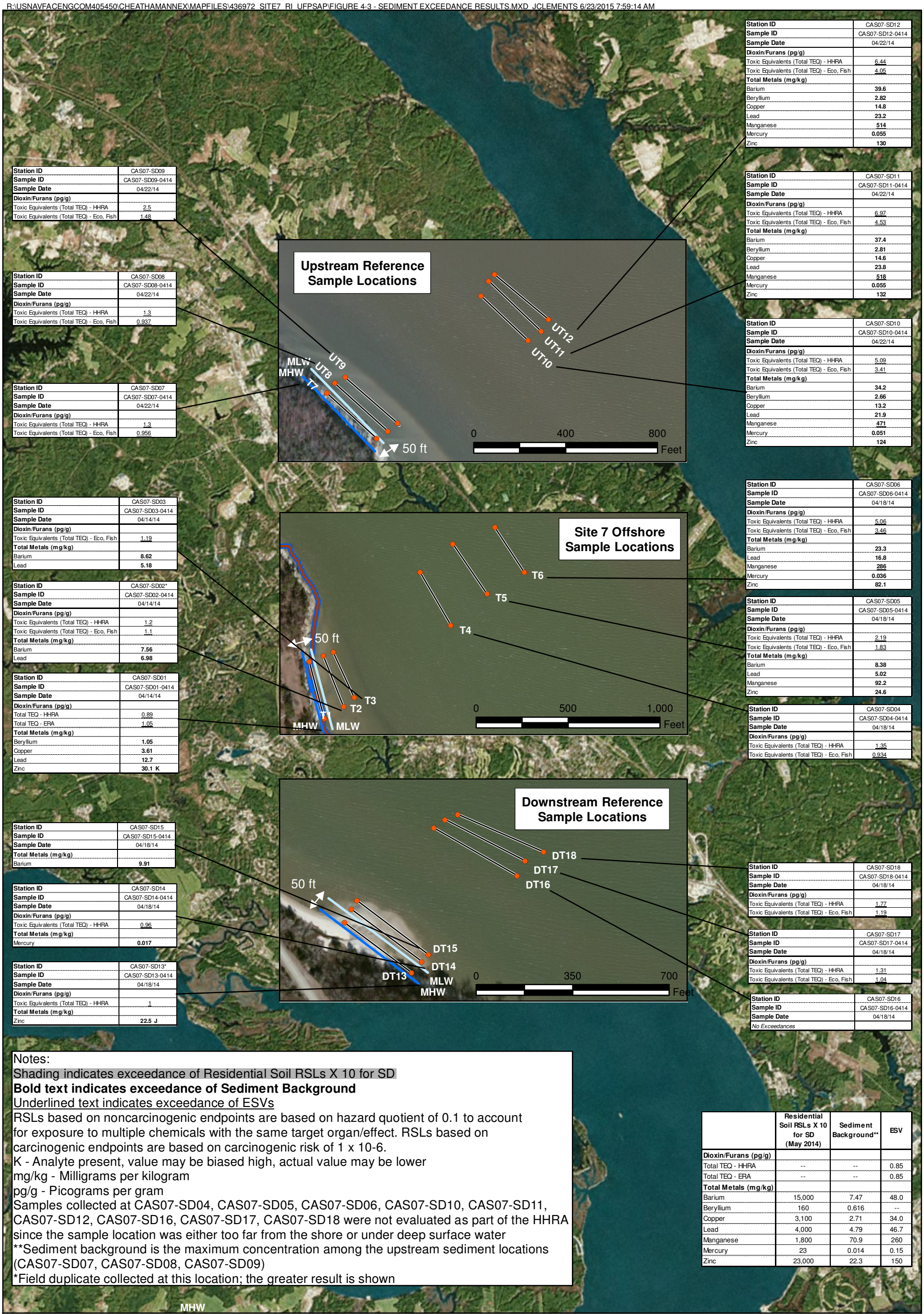
R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436972_SITE7_RI_UFPSAP\FIGURE 4-3 - SEDIMENT EXCEEDANCE RESULTS.MXD JCLEMENTS 6/23/2015 7:59:14 AM



Station ID	CAS07-SD09
Sample ID	CAS07-SD09-0414
Sample Date	04/22/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	2.5
Toxic Equivalents (Total TEQ) - Eco, Fish	1.48

Station ID	CAS07-SD08
Sample ID	CAS07-SD08-0414
Sample Date	04/22/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	1.3
Toxic Equivalents (Total TEQ) - Eco, Fish	0.937

Station ID	CAS07-SD07
Sample ID	CAS07-SD07-0414
Sample Date	04/22/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	1.3
Toxic Equivalents (Total TEQ) - Eco, Fish	0.956

Station ID	CAS07-SD03
Sample ID	CAS07-SD03-0414
Sample Date	04/14/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - Eco, Fish	1.19
Total Metals (mg/kg)	
Barium	**8.62**
Lead	**5.18**

Station ID	CAS07-SD02*
Sample ID	CAS07-SD02-0414
Sample Date	04/14/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	1.2
Toxic Equivalents (Total TEQ) - Eco, Fish	1.1
Total Metals (mg/kg)	
Barium	**7.56**
Lead	**6.98**

Station ID	CAS07-SD01
Sample ID	CAS07-SD01-0414
Sample Date	04/14/14
Dioxin/Furans (pg/g)	
Total TEQ - HHRA	0.89
Total TEQ - ERA	1.05
Total Metals (mg/kg)	
Beryllium	**1.05**
Copper	**3.61**
Lead	**12.7**
Zinc	**30.1 K**

Station ID	CAS07-SD15
Sample ID	CAS07-SD15-0414
Sample Date	04/18/14
Total Metals (mg/kg)	
Barium	**9.91**

Station ID	CAS07-SD14
Sample ID	CAS07-SD14-0414
Sample Date	04/18/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	0.96
Total Metals (mg/kg)	
Mercury	**0.017**

Station ID	CAS07-SD13*
Sample ID	CAS07-SD13-0414
Sample Date	04/18/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	1
Total Metals (mg/kg)	
Zinc	**22.5 J**

Station ID	CAS07-SD12
Sample ID	CAS07-SD12-0414
Sample Date	04/22/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	6.44
Toxic Equivalents (Total TEQ) - Eco, Fish	4.05
Total Metals (mg/kg)	
Barium	**39.6**
Beryllium	**2.82**
Copper	**14.8**
Lead	**23.2**
Manganese	**514**
Mercury	**0.055**
Zinc	**130**

Station ID	CAS07-SD11
Sample ID	CAS07-SD11-0414
Sample Date	04/22/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	6.97
Toxic Equivalents (Total TEQ) - Eco, Fish	4.53
Total Metals (mg/kg)	
Barium	**37.4**
Beryllium	**2.81**
Copper	**14.6**
Lead	**23.8**
Manganese	**518**
Mercury	**0.055**
Zinc	**132**

Station ID	CAS07-SD10
Sample ID	CAS07-SD10-0414
Sample Date	04/22/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	5.09
Toxic Equivalents (Total TEQ) - Eco, Fish	3.41
Total Metals (mg/kg)	
Barium	**34.2**
Beryllium	**2.66**
Copper	**13.2**
Lead	**21.9**
Manganese	**471**
Mercury	**0.051**
Zinc	**124**

Station ID	CAS07-SD06
Sample ID	CAS07-SD06-0414
Sample Date	04/18/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	5.06
Toxic Equivalents (Total TEQ) - Eco, Fish	3.46
Total Metals (mg/kg)	
Barium	**23.3**
Lead	**16.8**
Manganese	**286**
Mercury	**0.036**
Zinc	**82.1**

Station ID	CAS07-SD05
Sample ID	CAS07-SD05-0414
Sample Date	04/18/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	2.19
Toxic Equivalents (Total TEQ) - Eco, Fish	1.83
Total Metals (mg/kg)	
Barium	**8.38**
Lead	**5.02**
Manganese	**92.2**
Zinc	**24.6**

Station ID	CAS07-SD04
Sample ID	CAS07-SD04-0414
Sample Date	04/18/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	1.35
Toxic Equivalents (Total TEQ) - Eco, Fish	0.934

Station ID	CAS07-SD18
Sample ID	CAS07-SD18-0414
Sample Date	04/18/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	1.77
Toxic Equivalents (Total TEQ) - Eco, Fish	1.19

Station ID	CAS07-SD17
Sample ID	CAS07-SD17-0414
Sample Date	04/18/14
Dioxin/Furans (pg/g)	
Toxic Equivalents (Total TEQ) - HHRA	1.31
Toxic Equivalents (Total TEQ) - Eco, Fish	1.04

Station ID	CAS07-SD16
Sample ID	CAS07-SD16-0414
Sample Date	04/18/14
No Exceedances	

Notes:
Shading indicates exceedance of Residential Soil RSLs X 10 for SD
Bold text indicates exceedance of Sediment Background
Underlined text indicates exceedance of ESVs
RSLs based on noncarcinogenic endpoints are based on hazard quotient of 0.1 to account for exposure to multiple chemicals with the same target organ/effect. RSLs based on carcinogenic endpoints are based on carcinogenic risk of 1 x 10-6.
K - Analyte present, value may be biased high, actual value may be lower
mg/kg - Milligrams per kilogram
pg/g - Picograms per gram
Samples collected at CAS07-SD04, CAS07-SD05, CAS07-SD06, CAS07-SD10, CAS07-SD11, CAS07-SD12, CAS07-SD16, CAS07-SD17, CAS07-SD18 were not evaluated as part of the HHRA since the sample location was either too far from the shore or under deep surface water
**Sediment background is the maximum concentration among the upstream sediment locations (CAS07-SD07, CAS07-SD08, CAS07-SD09)
*Field duplicate collected at this location; the greater result is shown

	Residential Soil RSLs X 10 for SD (May 2014)	Sediment Background**	ESV
Dioxin/Furans (pg/g)			
Total TEQ - HHRA	--	--	0.85
Total TEQ - ERA	--	--	0.85
Total Metals (mg/kg)			
Barium	15,000	7.47	48.0
Beryllium	160	0.616	--
Copper	3,100	2.71	34.0
Lead	4,000	4.79	46.7
Manganese	1,800	70.9	260
Mercury	23	0.014	0.15
Zinc	23,000	22.3	150

Legend

- Mean high water line (MHW)
- Mean low water line (MLW)
- Transect location

N
W E
S

0 1 2 Miles

Figure 4-3
Sediment Exceedance Results
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

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SECTION 5

Human Health Risk Assessment

5.1 Human Health Risk Assessment Overview

This section summarizes the baseline HHRA for Site 7. The primary objective of the HHRA is to assess the potential current and future health risks from exposure to chemicals of potential concern (COPCs) associated with sediment, soil, and groundwater (see **Appendix F** for the complete HHRA text and summary tables and **Appendix G** for the risk calculation tables).

The analytical data used in the HHRA were validated, are considered representative of current conditions, and were determined to be useable for the HHRA. **Table F-1** in **Appendix F** identifies the sample results evaluated in the HHRA. These include the laboratory analytical results from:

- Sediment samples collected from the York River adjacent to Site 7 in April 2014.
- Soil samples collected at the site in February and April 2008.
- Groundwater samples collected from Site 7 monitoring wells in January 2011 and analyzed for SVOCs, pesticides, PCBs, explosives, and inorganic constituents.
- Groundwater samples collected from Site 7 monitoring wells in April 2014 and analyzed for VOCs. The 2011 groundwater data for VOCs evaluated as part of the 2012 SI were not evaluated in this HHRA because of the more recent VOC data from 2014.

The analytical data are provided in **Appendix D**.

The HHRA evaluated the carcinogenic risks and noncarcinogenic hazards to potential receptors at Site 7 under a reasonable maximum exposure (RME) scenario, which is consistent with the methodologies described in USEPA Superfund risk assessment guidance documents (USEPA 1989, 1993, 2001, 2004, 2009). The RME scenario is the maximum exposure that is reasonably expected to occur at a site (USEPA, 1989). When the RME risk exceeded regulatory target risk levels, the central tendency exposure (CTE) scenario was evaluated. The CTE risk is the risk to individuals who have average or typical exposure to the environmental media.

5.2 Identification of Human Health COPCs

The identified human health COPCs, as discussed below, were determined based on a quantitative evaluation in the risk assessment. The maximum detected concentration of each constituent for each medium was compared to the criteria listed below to determine the COPCs for further quantitative evaluation in the HHRA. Analytes with maximum concentrations greater than the screening criteria were identified as COPCs. Analytes not detected in any sample or detected at concentrations less than the criteria were not identified as COPCs. The screening criteria, by medium, consisted of:

- Soil – USEPA RSLs for residential soil (May 2014 RSL Table)
- Ambient air concentrations because of particulate and volatile emissions from soil– USEPA RSLs for residential air (May 2014 RSL Table)
- Sediment – USEPA RSLs for residential soil (May 2014) x 10
- Groundwater – USEPA RSLs for tap water (May 2014 RSL Table)
- Vapor intrusion from groundwater into indoor air – screening levels calculated using USEPA vapor intrusion screening level (VISL) calculator (May 2014)

The COPCs for each medium are shown in **Table F-2**, **Appendix F**. No human health COPCs were identified for sediment; therefore, exposure to sediment would not result in unacceptable risks, and risks associated with sediment were not calculated.

5.3 Potential and Exposure Scenarios

Site 7 covers approximately 1 acre along the York River in the north-central portion of CAX. Site 7 is restricted to the general public by a locked chain-link fence; however, it is unrestricted to Navy and DoD personnel whom perform landscaping or maintenance activities at the site or use the area for access to the York River. Potential current receptors that may be exposed to site soil include adult/adolescent trespassers (although unlikely because of site fencing) and maintenance workers (Navy and DoD personnel performing landscaping or maintenance activities at the site). Although current recreational users could be exposed to sediment, no COPCs were identified for sediment.

Although there are no plans for future site development and future site use will likely remain the same, future site use is unknown. Because of the location of the site adjacent to the York River, the site eventually may be used as a recreational area. Additionally, as future site use is unknown, the investigation area could be developed, and future receptors could include future industrial workers, residents, or construction workers, in addition to adult/adolescent/child recreational users, adult/adolescent trespassers, and/or maintenance workers.

Although groundwater beneath the site currently is not used as a potable water supply, it was conservatively assumed that shallow groundwater could be used as a future residential or industrial potable water supply. Because of the depth of shallow groundwater (greater than 20 feet below ground surface), construction workers would not contact groundwater during construction and excavation activities.

There is the potential for vapor intrusion (VI) of volatile constituents in groundwater into future buildings if constructed at the site. Future residents and industrial workers could be exposed to groundwater through VI into a building, and subsequent inhalation of indoor air.

The current receptors and exposure pathways quantitatively evaluated in the HHRA are:

- **Maintenance worker/landscaper:** Incidental ingestion of and dermal contact with soil, and inhalation of particulate emissions from soil.
- **Trespasser (adult and adolescent):** Incidental ingestion of and dermal contact with soil and inhalation of particulate emissions from soil.

Future receptors and exposure pathways quantitatively evaluated in the HHRA include the following:

- **Recreator (adult, adolescent, and child):** Incidental ingestion of and dermal contact with soil and inhalation of particulate emissions from soil.
- **Resident (adult and child):** Incidental ingestion of and dermal contact with soil. Ingestion of shallow groundwater, dermal contact with shallow groundwater while bathing/showering, inhalation of volatile COPCs from shallow groundwater while showering (adult exposure), and inhalation of volatile COPCs in indoor air from vapor intrusion from groundwater to indoor air.
- **Industrial worker:** Incidental ingestion of and dermal contact with soil, and inhalation of particulate emissions from soil. Ingestion of shallow groundwater, and inhalation of volatile COPCs in indoor air from vapor intrusion from groundwater to indoor air.
- **Construction worker:** Incidental ingestion of and dermal contact with soil, and inhalation of particulate emissions from soil.

5.4 HHRA Findings

The RME noncarcinogenic hazards and carcinogenic risks are presented by receptor in **Appendix F**, **Table F-3**, and the CTE results are summarized in **Appendix F**, **Table F-4**. The risk calculations are presented in **Appendix G, Tables 7.1.RME** through **7.11.RME**, and **7.1.CTE** through **7.4.CTE**. The CTE risks were calculated only when the RME hazards exceeded the noncarcinogenic target hazard index (HI) of 1, or the RME carcinogenic risks exceeded the target risk range of 1×10^{-6} to 1×10^{-4} (USEPA, 1994). **Appendix G, Tables 9.1.RME** through **9.11.RME** and **9.1.CTE** through **9.4.CTE** summarize the hazards and risks to each receptor.

Human health consituents of concern (COCs) are identified for the scenarios with potentially unacceptable risks. The COCs are those COPCs that contribute an HI greater than 0.1 to a cumulative target organ HI that exceeds 1 or a carcinogenic risk greater than 1×10^{-6} to a cumulative carcinogenic risk that exceeds 1×10^{-4}. No potential unacceptable noncarcinogenic hazards or carcinogenic risks were identified for exposure to soil or sediment. Potential unacceptable noncarcinogenic hazards or carcinogenic risks associated with exposure to groundwater were identified for the following scenarios:

- Future adult and child resident scenario from potable use of groundwater associated with TCE, chloroform, 2,4-DNT, 2,6-DNT, arsenic, and chromium, and the potential for vapor intrusion into indoor air from TCE
- Future industrial worker from the potential for vapor intrusion into indoor air from TCE

A comparison of site concentrations to background concentrations was not used to select the COPCs. Therefore, it is possible that the inorganic constituents identified as COPCs and COCs for groundwater (arsenic and chromium) may be associated with background conditions.

Chromium was identified as a COC in groundwater; however, detected concentrations of chromium were below the chromium groundwater background 95 percent UTL concentration for CAX/Yorktown from the Cornwallis Cave/Yorktown Eastover Aquifer (CH2M HILL, 2012). Therefore, the risk associated with exposure to chromium in groundwater is likely the result of naturally occurring background conditions. It also is noted that the risks calculated for chromium assume that all of the detected chromium is in the more toxic, hexavalent form of chromium rather than the more common, trivalent form. Additionally, the detected concentrations of arsenic, chromium, and chloroform in groundwater were below their respective MCLs.

The future residential land use scenario evaluated in this assessment is conservative because it is unlikely that land use for Site 7 will change to residential development in the future. Additionally, even if the site is used for future residential development, it is unlikely that shallow groundwater would be used as a potable water supply.

SECTION 6

Ecological Risk Assessment

This section summarizes the results of the ERA that was conducted for Site 7. The complete ERA is contained in **Appendix H**.

6.1 Introduction

This ERA was conducted in accordance with the *Navy Policy for Conducting Ecological Risk Assessments* (CNO, 1999) and the Navy guidance for implementing this ERA policy (NAVFAC, 2003 and 2012). It considers data collected as part of previous evaluations of Site 7 and data collected specifically for this RI. This ERA is completed through Step 3A of the eight-step ERA process (USEPA, 1997).

The most recent previous ERA for Site 7 was conducted as part of the SI report (CH2M HILL, 2012) and consisted of an ecological risk screening, constituting a screening-level ecological risk assessment (SERA), and an abbreviated version of a baseline ecological risk assessment (BERA) Step 3A. The results of the 2012 SI were used to develop the Site 7 SAP for this RI (CH2M HILL, 2014). Additional groundwater data, as well as sediment data from the York River adjacent to the site (as well as upstream and downstream of the site), were collected in 2014 to support this RI. The 2008 (post-removal) and 2011 soil data used in the 2012 SI also are included in this ERA. However, the 2011 groundwater data for VOCs evaluated as part of the 2012 SI are not included in this ERA, since more recent VOC data were collected in 2014.

6.2 Environmental Setting

Site 7 is approximately 1 acre in size and is located immediately adjacent to the York River, a tidal estuarine water body (**Figure 1-2**). Site 7 was forested before the 2007-2008 removal action. However, as part of the removal action, the excavation area was cleared of trees and brush. Currently, the portions of the site surrounding the removal area are forested, with the removal area consisting of successional old field habitat. Surface water from the site runs off to the York River or infiltrates the ground. Other than the York River, no wetlands or water bodies are on or immediately adjacent to Site 7. During the 2011 SI, groundwater underlying Site 7 was encountered within the Yorktown-Eastover Aquifer between 15 and 25 feet bgs. Based on water level measurements collected during the SI, groundwater flows east-northeast toward the York River (CH2M HILL, 2012).

Soils on the site are somewhat acidic, with an average pH of 5.64 SU (range of 4.85 to 6.36 SU). The substrate along the shoreline of the York River is very coarse, consisting mostly of shell fragments and sand; there is very little organic matter present. TOC levels generally increase further from the shoreline, and the substrates become less sandy, with higher percentages of fines. Sediment conditions were generally comparable between site samples and upstream and downstream samples. The salinity of the York River near Site 7 is in the marine range, averaging 26.2 ppt. The salinity is lower in upstream areas, averaging 17.3 ppt, and higher in downstream areas, averaging 34.3 ppt.

Currently, Site 7 is vacant and is surrounded by a fence to prevent trespassers from entering the site. There are no future anticipated uses for Site 7; however, because of its location, the site eventually may be used as a recreational area.

6.3 Analytical Data Used in the Ecological Risk Assessment

The soil data used in this ERA included 36 of the 41 post-removal (2008) samples, which represent the post-removal samples that are within the 0- to 24-inch depth range relative to the current (backfilled) site elevation; samples of the backfill material, however, were not included in the evaluation. This depth range was selected since ecological exposures are generally considered to be confined to the top 2 feet of the soil column. The soil samples used in the ERA were within 24 inches (the depth of potential ecological exposures) of the current ground elevation (following backfill activities) and were below the backfill material (that is, represented soils in areas where less than 24 inches of backfill were placed). Thus, the use of these data is conservative since

the samples are covered by backfill, but less than 24 inches of backfill is present, which means that some ecological exposures to these samples are still possible. Five soil samples collected in 2011 and analyzed for pH also were used in this ERA.

Surface (0 to 6 inches) sediment samples collected from the York River upstream, adjacent to, and downstream of Site 7 were quantitatively evaluated in this ERA. The upstream and downstream samples were used to represent background conditions. Sediment samples were five-point composites collected along 300-foot transects located parallel to the shoreline. At each location (site, upstream, and downstream), a total of six transects were sampled, with the first transect placed midway between the estimated mean low water and mean high water marks (which were approximately 50 feet from each other), the second transect placed 50 feet offshore from the first transect, and the third transect placed 50 feet offshore of the second transect. Transects 4 through 6 were placed further offshore where sediments began to be more soft and mucky (representing likely depositional areas). **Section 2.4** provides a more detailed description of the sediment sampling conducted for this RI.

Although ecological receptors do not have direct exposure to groundwater, groundwater data collected in 2014 as part of this RI were quantitatively evaluated in this ERA, as were groundwater data collected in 2011 for the SI (except for the 2011 VOC data, which were replaced with the VOC data collected in 2014). This evaluation was done to provide a conservative measure of the potential for significant contaminant transport via groundwater to downgradient receiving water bodies (York River) and the subsequent potential exposure of ecological receptors in this water body.

Background soil and groundwater (Yorktown-Eastover Aquifer) UTLs from the Yorktown-CAX background study (CH2M HILL, 2011) also were considered in this ERA. The higher of the surface and subsurface soil UTLs was used, because the site soil samples encompassed the total depth range of both sets of background samples (0 to 24 inches).

6.4 Conceptual Site Model

The CSM relates potentially exposed receptor populations with potential source areas based on physical site characteristics and complete exposure pathways. Important components of the CSM are the identification of potential source areas, transport pathways, exposure media, exposure pathways and routes, and receptors. **Appendix H, Figure H-1** illustrates a diagrammatic CSM for Site 7. Key components of this CSM are discussed in **Appendix H**. **Table 6-1** shows the assessment endpoints, risk hypotheses, and measurement endpoints used in the ERA and the receptors associated with each of these endpoints.

6.5 Results

6.5.1 Terrestrial Habitats

Ten assessment endpoints were developed for terrestrial habitats on the site (**Table 6-1**). Lines of evidence for terrestrial habitats included:

- Comparison of soil concentrations with ESVs
- Comparison of modeled dietary doses with ingestion toxicity reference values (TRVs)
- Comparison of site soil concentrations with background concentrations

In soil, one inorganic constituent (selenium) and one pesticide (endrin) were identified as COPCs for further risk evaluation. No COPCs for further risk evaluation were identified for terrestrial food web exposures.

The 95 percent upper confidence level hazard quotient (HQ) for selenium (2.24) exceeded 1. However, this constituent is not likely to be site-related since it was not detected in 2004 (pre-removal) surface and subsurface soil samples (all samples were flagged U or B). In addition, the ESV used is based on potential impacts to plants. Soil ESVs for other receptors (for example, 4.10 mg/kg for soil invertebrates) were not exceeded (maximum selenium concentrations in soil were 2.90 mg/kg). Furthermore, selenium concentrations of up to 2.70 mg/kg have been detected in facility-specific background soil samples. Thus, selenium is not likely to constitute a risk to

ecological receptors at the site above naturally occurring levels, and this constituent was not identified as a final COPC.

Endrin was detected in 1 of 36 soil samples at a maximum concentration of 2.40 µg/kg. This concentration was less than concentrations that were detected in background surface soil samples (3.50 µg/kg) collected during the background study (CH2M HILL, 2011). Thus, endrin was not identified as a final COPC.

No final COPCs were identified for Site 7 soil. Thus, no unacceptable ecological risks are associated with this medium.

6.5.2 Aquatic Habitats

Twelve assessment endpoints were developed for aquatic habitats associated with Site 7 (**Table 6-1**). Lines of evidence for aquatic habitats included:

- Comparison of surface sediment and groundwater concentrations with ESVs
- Comparison of modeled dietary doses (based on sediment) with ingestion TRVs
- Bioavailability measures
- Comparison of site surface sediment and groundwater concentrations with background concentrations

In sediment, no chemicals were identified as COPCs for further risk evaluation. No COPCs for further risk evaluation were identified for aquatic food web exposures. Thus, no unacceptable ecological risks are associated with this medium or associated pathways.

In site groundwater, gamma-chlordane was identified as a COPC for further risk evaluation. Based on the mean concentration, gamma-chlordane exceeded its ESV by a factor of 2.31. Thus, the mean HQ would be below 1 assuming a dilution factor of 10. Gamma-chlordane was detected in samples from upgradient wells at generally similar concentrations found in site wells (the mean ratio between site and upgradient samples was 1.29). Furthermore, gamma-chlordane was not detected in soil samples collected at the site (including 2004 pre-removal samples). Thus, this chemical does not appear to be site-related and was not identified as a final COPC. Based on the results of this evaluation, groundwater is not a significant transport medium for site-related constituents to the York River, and site-related constituents that might reach this water body via groundwater would not pose an unacceptable risk to aquatic biota.

6.6 ERA Summary and Conclusions

6.6.1 Terrestrial Habitats

In summary, no final COPCs were identified for Site 7 soil or for terrestrial food web exposures. Thus, no unacceptable ecological risks are associated with this medium or associated pathways.

6.6.2 Aquatic Habitats

In summary, no final COPCs were identified for sediment or aquatic food web exposures. Based on the results of this evaluation, groundwater is not a significant transport medium for site-related constituents to the York River, and site-related constituents that might reach this water body via groundwater would not pose an unacceptable risk to aquatic biota.

TABLE 6-1

Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities	Are site-related chemical concentrations in surface soil sufficient to adversely affect soil invertebrate communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil ESVs	Soil invertebrates
Survival, growth, and reproduction of terrestrial plant communities	Are site-related chemical concentrations in surface soil sufficient to adversely affect terrestrial plant communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil ESVs	Terrestrial plants
Survival, growth, and reproduction of terrestrial reptile populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial reptile populations?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil ESVs Evidence of potential risk to other upper trophic level terrestrial receptors evaluated in the ERA (birds and mammals used as surrogates)	Reptiles
Survival, growth, and reproduction of avian terrestrial herbivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants (seeds) from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Mourning dove
Survival, growth, and reproduction of avian terrestrial invertivore/omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	American robin
Survival, growth, and reproduction of avian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume small mammals from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Red-tailed hawk
Survival, growth, and reproduction of mammalian terrestrial herbivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume terrestrial plants from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Meadow vole

TABLE 6-1

Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of mammalian terrestrial invertivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Short-tailed shrew
Survival, growth, and reproduction of mammalian terrestrial omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	White-footed mouse
Survival, growth, and reproduction of mammalian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume small mammals from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Red fox
Aquatic Habitats			
Survival, growth, and reproduction of aquatic plant communities	Are site-related chemical concentrations in surface sediment sufficient to adversely affect aquatic plant communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface sediment with sediment ESVs	Aquatic plants
Survival, growth, and reproduction of benthic invertebrate communities	Are site-related chemical concentrations in surface sediment sufficient to adversely affect benthic invertebrate communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface sediment with sediment ESVs	Benthic invertebrates
Survival, growth, and reproduction of fish communities	Are site-related chemical concentrations in surface sediment sufficient to adversely affect fish communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface sediment with sediment ESVs	Fish
Survival, growth, and reproduction of aquatic reptile populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to aquatic reptile populations?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface sediment with sediment ESVs Evidence of potential risk to other upper trophic level aquatic receptors evaluated in the ERA (birds and mammals used as surrogates)	Reptiles
Survival, growth, and reproduction of avian aquatic omnivore populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume aquatic prey from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface sediment concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Mallard

TABLE 6-1

Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of avian aquatic piscivore populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume fish from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface sediment concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Belted kingfisher Great blue heron Osprey
Survival, growth, and reproduction of mammalian aquatic omnivore populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume aquatic prey from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface sediment concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Raccoon
Survival, growth, and reproduction of mammalian piscivore populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume fish from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface sediment concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Mink
Survival, growth, and reproduction of aquatic plant communities	Are site-related chemical concentrations in groundwater sufficient to adversely affect aquatic plant communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in groundwater with surface water ESVs	Aquatic plants
Survival, growth, and reproduction of aquatic and benthic invertebrate communities	Are site-related chemical concentrations in groundwater sufficient to adversely affect aquatic and benthic invertebrate communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in groundwater with surface water ESVs	Aquatic and benthic invertebrates
Survival, growth, and reproduction of fish communities	Are site-related chemical concentrations in groundwater sufficient to adversely affect fish communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in groundwater with surface water ESVs	Fish
Survival, growth, and reproduction of aquatic reptile populations	Are site-related chemical concentrations in groundwater sufficient to adversely affect aquatic reptile populations?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in groundwater with surface water ESVs	Reptiles

SECTION 7

Chemical Fate and Transport

This section discusses the fate and transport of potentially site-related COCs identified from the HHRA and ERA (Sections 5 and 6, respectively) for Site 7. Evaluating chemical fate and transport consists of identifying theoretical chemical phases and migration and degradation pathways. An understanding of the mobility and persistence of a constituent in the subsurface is part of the overall assessment of the potential for that constituent to cause an adverse human health or environmental effect.

No COCs were identified for any media in ecological exposure scenarios, nor for soil or sediment in human exposure scenarios. The COCs identified for human exposure to groundwater include VOCs, explosives constituents, and total and/or dissolved inorganic constituents; however, as discussed in Section 4.2, the detected pesticides and inorganic constituents at concentrations above screening criteria were determined to be either not the result of a CERCLA release or likely representative of naturally occurring conditions. This section discusses the fate and transport of the primary site-related COCs, which are limited to several VOCs in groundwater.

This section also presents and summarizes the overall CSM for Site 7, which was developed using the compendium of information and data presented in this RI report.

7.1 Fate and Transport of Volatile Organic Compounds

Many basic physical and chemical processes potentially affect the fate and transport of VOCs in the environment. Volatilization and degradation are the chemical processes likely to be the most important for controlling the fate and transport of VOCs in groundwater at Site 7. Based on the hydrogeologic conceptual model for Site 7, advection, dispersion, and dilution are the three primary physical processes that influence the contaminant distribution within Site 7 groundwater. The following subsections discuss each of these processes.

7.1.1 Volatilization

Volatilization is the tendency for some constituents, particularly VOCs, to change from a liquid or adsorbed state to a gas state. Volatilization to the atmosphere is the dominant process for removing VOCs from shallow, unsaturated soil. In addition, VOCs in shallow groundwater may volatilize into soil gas that overlies the water table. However, in groundwater, volatilization can occur only at the air/water interface between the saturated and unsaturated zones, and movement of aqueous-phase contaminants from bulk groundwater to the air/water interface is largely diffusion-limited.

7.1.2 Degradation

Degradation is the transformation of one chemical to another by such processes as hydrolysis, photolysis, and biodegradation. At Site 7, biodegradation, which is an important mechanism for removing chlorinated VOCs from groundwater, is likely operating to some degree in the subsurface (ATSDR, 2013). The general requirements for biodegradation and the effects of biodegradation on chlorinated VOCs are discussed below.

7.1.2.1. Biodegradation of Chlorinated Hydrocarbons

The biodegradation process uses soil organisms to degrade chlorinated hydrocarbons to innocuous byproducts, such as carbon dioxide and water. Not all contaminants are biodegradable, and chlorinated hydrocarbons, such as those detected in groundwater at Site 7, are only completely degraded under certain conditions. If these conditions do not exist, or if one of the necessary requirements is limiting, the contaminant will not completely degrade.

Three processes govern the biodegradation of chlorinated hydrocarbons: reductive dechlorination, oxidation, and cometabolism. In general, a chlorinated hydrocarbon contaminant must first be dechlorinated before complete degradation can occur. This process is called reductive dechlorination, where the contaminant acts as the terminal

electron acceptor and hydrogen is the electron donor (Wiedemeier et al., 1999). The following trends occur in environments that are undergoing reductive dechlorination through biodegradation:

- Reduction in parent chemical concentrations (such as TCE)
- Increase in daughter product concentrations (for example, cis-1,2 DCE, trans-1,2-DCE, and vinyl chloride)
- Increase in ethene and ethane concentrations
- Elevated chloride concentrations
- Methane production
- Low redox conditions
- Production of iron (II)

These trends may be monitored to provide evidence for degradation via reductive dechlorination. The availability of data at Site 7 allows for a qualitative assessment of whether the reductive dechlorination process is occurring. Parameters such as chloride and methane have been analyzed only during one sampling event, so trends cannot be evaluated. The results are provided in **Tables 2-3** and **4-2.** With regard to reducing versus oxidizing conditions, the ORP measurements in monitoring wells at Site 7 suggest slightly oxidizing conditions exist. Reductive dechlorination is more likely to occur in reducing conditions (that is, with lower ORP measurements). The concentrations of TCE and its degradation products (cis-1,2 DCE and vinyl chloride) that were detected in samples from CAS07-MW07 have decreased since the 2011 SI, suggesting reductive dechlorination, possibly coupled with some additional degradation processes (such as oxidation and/or cometabolism), may be acting to reduce the concentrations of TCE in groundwater at Site 7.

7.1.3 Advection

Advection is defined as the transport of dissolved constituents by the motion of flowing groundwater. Advection causes the dissolved contaminant plume to migrate parallel to the groundwater flow direction. The rate at which advective transport operates is determined by the average linear velocity of flowing groundwater, which is subject to the effective porosity and horizontal hydraulic conductivity of the porous medium and the hydraulic gradient along the flow path. The migration rates of dissolved contaminants range widely for different constituents because of their degree of adsorption. Compounds that do not tend to partition onto soil from water (such as VOCs) will tend to move by advection at a velocity that is comparable to the groundwater flow velocity.

7.1.4 Dilution and Dispersion

Dilution and dispersion are considered together because both processes act to effectively reduce the observed concentrations of groundwater contaminants. Dispersion is the spreading of dissolved contaminants from the path they would be expected to follow during advection. It results from the spatial variation in hydraulic conductivity, fluid mixing, and molecular diffusion. Dilution can reduce contaminant concentrations by adding “clean” water to the contaminant plume. Here, “clean” is defined as water with lower or no concentrations of contaminants. This process typically occurs when water infiltrates the subsurface during a precipitation event and mixes with shallow groundwater. Dilution also occurs as areas of higher contaminant concentrations diffuse into areas of lower contaminant concentrations.

7.2 Conceptual Site Model Summary

A graphical depiction of the CSM for Site 7 was developed to present a three-dimensional representation of the waste material (that is, source area), potential migration pathways, exposure routes, and receptors (**Figure 1-3**). The source of groundwater contamination at the site is the buried waste and debris that were removed from Site 7. Based on the investigations conducted at Site 7, non-CERCLA-regulated sources of contamination that also may have affected the site include routine pest and weed management via the normal use of pesticides around buildings and/or roads. Finally, the concentrations of inorganic constituents in Site 7 groundwater are likely naturally occurring in the environment.

The primary migration pathways of COCs in groundwater are dissolved contaminant migration in the Yorktown-Eastover Aquifer with groundwater flow (via advection and dispersion) and, to a lesser extent, volatilization of

groundwater contaminants into soil gas, and discharge of groundwater contaminants through sediment and into surface water.

The future use of Site 7 is not expected to change; however, because of its location, the site eventually may be used as a recreational area. Groundwater at CAX is not a current or anticipated source of potable drinking water. However, the Commonwealth of Virginia does not employ groundwater use classifications; therefore, groundwater at CAX is considered to be of potential beneficial.

The only potential current receptors at the site are visitors/trespassers, maintenance/landscape workers, and ecological receptors. No potentially unacceptable risks are associated with exposure to site media for these current human or ecological receptors; however, there are potentially unacceptable risks to future human receptors (industrial workers and residents) associated with potential exposure to contaminants in groundwater.

SECTION 8

Conclusions and Recommendations

This section summarizes the major conclusions of the RI for Site 7 that have been drawn from the findings and results presented and evaluated in earlier sections of this report. It also presents a recommended path forward to address potentially unacceptable risks to human health from site-related COCs at Site 7 in groundwater. The recommended path forward is based on the Site 7 RI decision tree (**Figure 8-1**) that was developed to document the criteria for determining if additional investigation and/or remedial action are warranted.

8.1 Conclusions

8.1.1 Site Characterization

Through contaminant characterization and sampling activities performed at the site during the SI and RI, the nature and extent of contamination in soil, sediment, and groundwater have been adequately characterized, and human health and ecological risk assessments have been performed with the site data.

In Site 7 soil, no VOCs, SVOCs, PCBs, dioxins/furans, or explosives constituents were detected above screening criteria. None of the explosives constituents detected in soil was found in Site 7 groundwater. One or more of several pesticides were detected in 3 of the 41 samples at concentrations below screening criteria or below Base-wide background concentrations, and are attributed to normal pesticide use at DoD facilities to control pests. The dioxin congener 2,3,7,8-TCDD was detected in 6 of 411 soil samples; however, the concentrations were well below the human health and ecological risk-based exposure criteria. Ten inorganic constituents (aluminum, arsenic, chromium, cobalt, iron, lead, manganese, selenium, thallium, and vanadium) exceeded human health and/or ecological risk screening criteria in at least one sample. There was no discernible pattern to the distribution of inorganic constituents exceeding screening criteria in soil at Site 7, and exceedances of base background UTLs were infrequent.

In groundwater, three VOCs (chloroform, cis-1,2-DCE, and TCE) were identified as COPCs based on exceedances of screening criteria. None of these VOCs was detected in the Site 7 soil samples. One pesticide (4,4'-DDD) was detected in two monitoring wells at concentrations that slightly exceeded the USEPA tap water RSL; however, 4,4'-DDD was not detected in Site 7 soil samples and is not likely indicative of a site-related CERCLA release. The low levels of pesticides detected in soil at Site 7 are attributed to normal pesticide use at DoD facilities to control pests. Three explosives constituents (2,4-DNT, 2,6-DNT, and nitroglycerin) were identified as groundwater COPCs based on detected concentrations that slightly exceeded USEPA tap water RSLs in at least one well sample. None of these explosives constituents was detected in Site 7 soil samples. Six inorganic constituents exceeded screening criteria in one or more groundwater samples (aluminum, arsenic, cadmium, chromium, cobalt, and manganese), but results for these inorganic constituents were well below their respective MCL, where applicable. A comparison of the detected inorganic constituent concentrations to Base background levels indicates the detected concentrations likely represent naturally occurring conditions rather than a site-related release.

Sediment samples were collected from the York River to evaluate whether contaminant transport from Site 7 has affected river sediments, including at locations adjacent to Site 7 as well as 5 miles upstream and 4 miles downstream of Site 7. The upstream and downstream samples were intended to serve as reference samples for comparison to the samples adjacent to the site, since the 2013 WCSD (NAVFAC, 2013) concluded there are numerous historical and ongoing inputs of contaminants to the York River watershed originating from non-Navy sources in addition to potential Navy sources. In total, 16 individual dioxin/furan congeners and 7 inorganic constituents were detected in the sediment samples. Constituents present in the samples collected adjacent to the site also were detected in the samples collected at the upstream and downstream locations at similar or greater concentrations, indicating the detected constituents are unlikely to be related to a release from Site 7. None of the detected constituent concentrations in sediment samples exceeded human health; while the concentration of manganese detected in one sediment sample collected adjacent to Site 7 within deep water

exceeded ecological screening criteria and the near-shore, upstream background concentration, this concentration was below the highest manganese concentrations detected in deeper water upstream of Site 7.

8.1.2 Human Health Risk

The HHRA was conducted to evaluate the potential human health risks associated with the presence of site-related contaminants in soil, groundwater, and sediment at Site 7. Potential risks were calculated for a current/future maintenance worker/landscaper, current/future trespasser, future recreator, future adult and child resident, future industrial worker, and future construction worker.

The assessment determined no risks or hazards are associated with soil, sediment, or groundwater that exceed acceptable risk levels for the current/future maintenance worker/landscaper, current/future trespasser, future recreator, and future construction worker.

Future industrial use of the site could result in potential unacceptable, noncarcinogenic hazards for exposure to indoor air associated with VI of TCE from groundwater. Potential unacceptable, noncarcinogenic hazards and carcinogenic risks to future adult and child residents from exposure to groundwater were identified for potable use of groundwater because of the concentrations of TCE, chloroform, 2,4-DNT, 2,6-DNT, arsenic, and chromium, and for VI from TCE in groundwater to indoor air.

None of the evaluated residential or industrial exposure scenarios is currently present at the site, nor are they expected to be present at the site in the future. It is also unlikely that surficial aquifer groundwater at Site 7 would be used as a future source of potable water.

8.1.3 Ecological Risk

The ERA was conducted to evaluate the potential ecological risks associated with the presence of site-related contaminants in soil, sediment, and groundwater at Site 7, using the three-tiered Navy ERA process. Soil and terrestrial food web exposures and sediment and aquatic food web exposures were evaluated in the ERA. Groundwater was not evaluated, as it was not identified as a significant transport medium for site-related constituents to the York River, and site-related constituents that might reach the York River via groundwater would not pose potential unacceptable risk.

No COPCs or potential unacceptable risks were identified that are associated with site media at Site 7 for ecological receptors.

8.1.4 Remedial Investigation Summary

No potentially unacceptable risks to human or ecological receptors were identified from the HHRA and ERA for soil and sediment. Therefore, no additional investigation or action is warranted for these media. Based on the earlier SI for Site 7, no action is warranted for surface water at Site 7.

Site 7 groundwater was found to pose potentially unacceptable risk only to human receptors in hypothetical future residential or industrial worker scenarios. There was no potentially unacceptable risk from the evaluated current exposure scenarios. The COCs identified from the HHRA that are associated with Site 7 groundwater are TCE, chloroform, 2,4-DNT, 2,6-DNT, arsenic, and chromium.

In addition, although arsenic and chromium were identified as HHRA COCs in groundwater, detected concentrations for these constituents appear to be from naturally occurring conditions rather than site-related impacts. The concentrations of arsenic and chromium concentrations in groundwater were well below their respective MCLs. Therefore, no additional investigation or action is recommended for arsenic, chromium, or other inorganic constituents at Site 7.

TCE was detected at low levels in groundwater across the site. The TCE concentration in one well exceeded the MCL, and TCE was found to present potentially unacceptable risks to future human receptors exposed to groundwater at Site 7. Based on the Site 7 RI decision tree developed to determine the path forward for Site 7 (**Figure 8-1**), an evaluation of remedial alternatives for TCE in groundwater is warranted.

8.2 Recommendations

Based on the results and evaluations presented in this RI, and in particular the findings of the HHRA and ERA, a focused feasibility study is recommended to evaluate potential remedial alternatives to address 2,4-DNT, 2,6-DNT, TCE, and chloroform in groundwater at Site 7. No further action or investigation is recommended for soil, surface water, or sediment at Site 7.

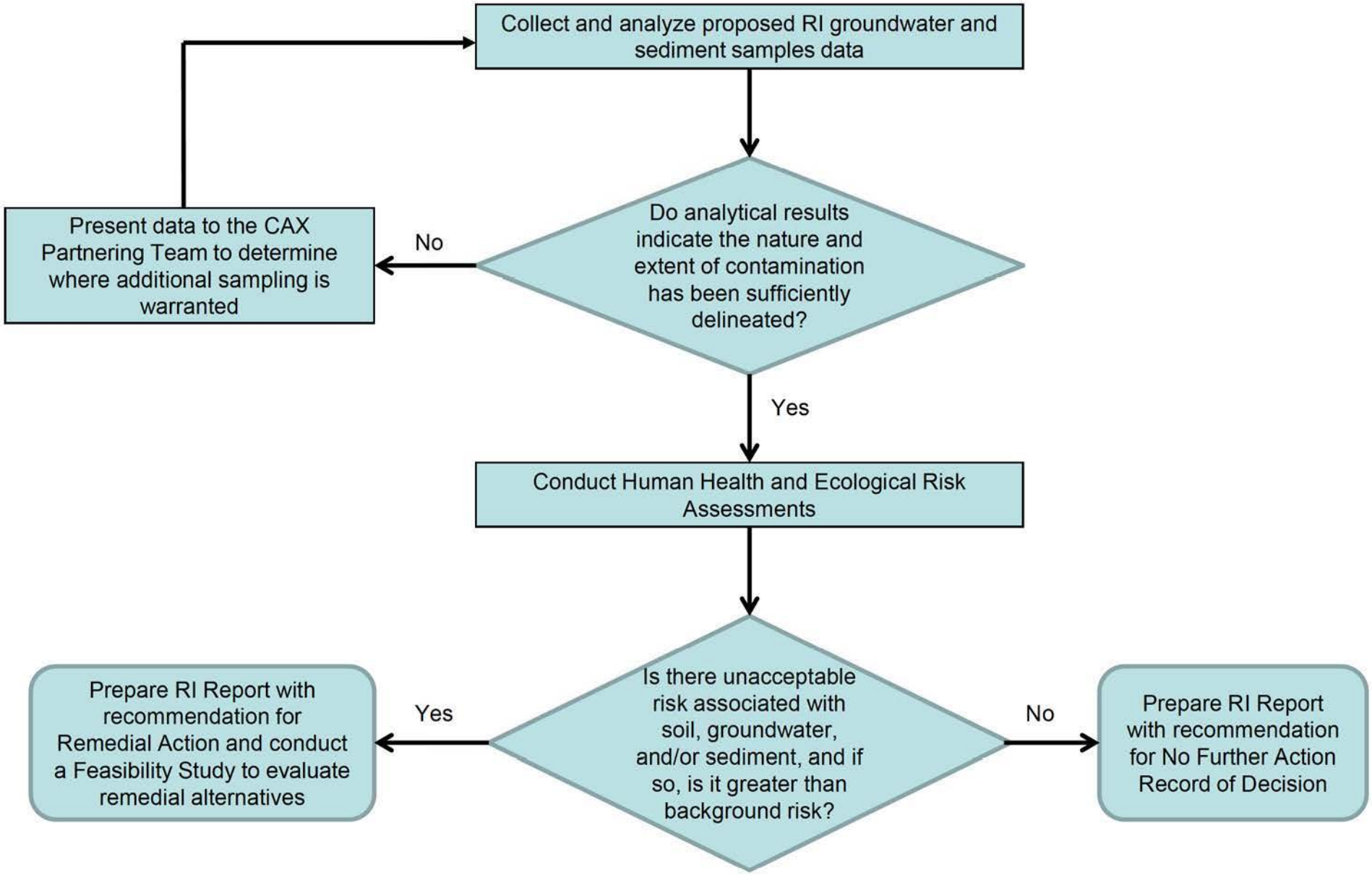

Figure 8-1
Decision Tree
Site 7 Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

SECTION 9

References

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Appendix A
Soil Boring and Monitoring Well Construction Logs

PROJECT NUMBER:	BORING NUMBER:	
436972.FI.FK	CAS07-MW08	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Site 07 Old DuPont Disposal Area - Remedial Investigation LOCATION : *Cheatham Annex (CAX) Williamsburg, VA (3636713.3 N, 12033110.5 E)

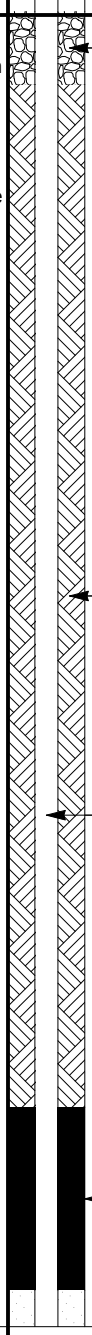
ELEVATION : 20.3 ft NAVD88 (natural ground elevation) DRILLING CONTRACTOR : Parratt-Wolff Drilling, Inc.\J. Ellingworth

DRILLING METHOD AND EQUIPMENT : IR300A Truck Rig, 4 ¼ ID 8 ¾ O.D. HSA, 4 ft Macro Core Sampler

WATER LEVELS : 16.2 ft bgs START : 4/1/2014 END : 4/1/2014 LOGGER : T. Stewart\VBO

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE ID (TIME)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
20.3	0.0	1.2	S-1	**CLAY WITH SILT (CL)** 0.0-0.6'- strong brown and light gray mottled, (10YR 5/6 and 7.5YR 5/6), moist, stiff, medium to high plasticity, 3-7% rootlets **CLAY AND SILTY SAND (SM)** 0.6-1.2'- dark grayish brown, (2.5Y 4/2), wet, loose, fine to medium grained, mottled **NO RECOVERY (NR)** 1.2-3.0'		0.4	Stick-up style surface completion, with a water-tight expansion cap and a lockable, protective steel cover set in 2ft-square concrete pad
	3.0			**CLAY WITH SILT (CL)** 3.0-3.8'- Same as 0.0-0.6 **NO RECOVERY (NR)** 3.8-7.0'			
5 15.3		0.8	S-2			0.4	Driller uses 3ft initial run due to rig stroke length. Top of Well Casing (Sch.40 PVC) Elevation: 23.59 ft msl
	7.0			**CLAY (CL)** 7.0-9.0'- greenish gray, (5G 6/1), moist to dry, very stiff, high plasticity, mottled light gray (5Y 7/1) to 30%, with trace silt and medium sand, trace rootlets			Total Measured Depth (BTOC): 33.05 ft
		4.0	S-3	**CLAY (CL)** 9.0-10.8'- light gray, (5Y 7/1), moist to dry, stiff, medium to high plasticity, mottled strong brown to 20%		0.4	
10 10.3	11.0			**SILTY SAND (SM)** 10.8-11.0'- strong brown, (7.5YR 5/8), dry, dense, very fine grained, laminated sand 11.0-13.0'- pale brown, (2.5Y 8/2), dry, very loose, medium grained, 15% mottled with pockets of brownish yellow sands			
		2.0	S-4	**NO RECOVERY (NR)** 13.0-15.0'		0.4	
15 5.3	15.0			**SILTY SAND (SM)** 15.0-17.0'- light gray, (5Y 7/1), wet, loose, fine to medium grained, wet at 16.2ft below ground surface (bgs), strong brown (7.5YR 5/5) below 6.2ft bgs			Inverted blue triangle indicates top of saturated zone as observed during drilling operations.
		2.0	S-5	**NO RECOVERY (NR)** 17.0-19.0'		1.6	

WELL DIAGRAM



PROJECT NUMBER: 436972.FI.FK	BORING NUMBER: CAS07-MW08	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Site 07 Old DuPont Disposal Area - Remedial Investigation LOCATION : *Cheatham Annex (CAX) Williamsburg, VA (3636713.3 N, 12033110.5 E)

ELEVATION : 20.3 ft NAVD88 (natural ground elevation) DRILLING CONTRACTOR : Parratt-Wolff Drilling, Inc.\J. Ellingworth

DRILLING METHOD AND EQUIPMENT : IR300A Truck Rig, 4 ¼ ID 8 ¾ O.D. HSA, 4 ft Macro Core Sampler

WATER LEVELS : 16.2 ft bgs START : 4/1/2014 END : 4/1/2014 LOGGER : T. Stewart\VBO

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE ID (TIME)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
	19.0							
20 0.3		1.0	S-6	**SILTY SAND (SM)** 19.0-20.0'- wet, very loose, fine to medium grained, strong brown discoloration **NO RECOVERY (NR)** 20.0-23.0'		0		Sand Pack (5.5-50lb bags Southern Products GP#1) starting 2ft above top of screen
	23.0							
25 -4.7		2.6	S-7	**SILTY SAND (SM)** 23.0-25.6'- grayish brown to light olive brown, (2.5Y 5/2-3), wet, loose, medium grained, trace strong brown discoloration **NO RECOVERY (NR)** 25.6-27.0'		0.2	BTOC - Below Top of Casing *Top of PVC well casing elevations and coordinates (NAD83) as surveyed by ECLS, Inc. on April 9th, 2014.	One 10-foot 0.01 slotted screen 2-inch diameter PVC
	27.0							
30 -9.7		4.0	S-8	**SILTY SAND (SM)** 27.0-31.0'- light olive brown, (2.5Y 5/4), wet, loose, medium grained, 15% coarse white shell fragments starting below 28.3ft bgs, trace strong brown mottling at 30-31ft bgs		0	Soil samples were only collected for the physical and lithological characterization of the boring location.	approximately 8.25" diameter borehole
	31.0							
				Bottom of Boring at 31.0 ft bgs on 4/1/2014				

PROJECT NUMBER: 436972.FI.FK	BORING NUMBER: CAS07-MW09	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Site 07 Old DuPont Disposal Area - Remedial Investigation LOCATION : *Cheatham Annex (CAX) Williamsburg, VA (3636693.0 N, 12033048.8 E)

ELEVATION : 20.0 ft NAVD88 (natural ground elevation) DRILLING CONTRACTOR : Parratt-Wolff Drilling, Inc.\J. Ellingworth

DRILLING METHOD AND EQUIPMENT : IR300A Truck Rig, 4 ¼ ID 8 ¾ O.D. HSA, 4 ft Macro Core Sampler

WATER LEVELS : 16.0 ft bgs START : 4/1/2014 END : 4/1/2014 LOGGER : T. Stewart\VBO

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE ID (TIME)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
20.0	0.0	0.8	S-1	**SILTY SAND (SM)** 0.0-0.8'- very dark gray, (7.5YR 3/1), moist, loose to medium dense, medium grained, roots **NO RECOVERY (NR)** 0.8-4.0'		6.7	Stick-up style surface completion, with a water-tight expansion cap and a lockable, protective steel cover set in 2ft-square concrete pad	Concrete collar
5 15.0	4.0	4.0	S-2	**CLAY (CL)** 4.0-8.0'- light gray, (2.5Y 7/1), dry, very stiff, high plasticity, 15% marbling of yellowish brown medium silty sand seams, trace roots, marbled 20% strong brown, trace silt throughout		0.1	Top of Well Casing (Sch.40 PVC) Elevation: 23.33 ft msl Total Measured Depth (BTOC): 33.09 ft	
10 10.0	8.0	2.6	S-3	**SILTY SAND (SM)** 8.0-10.6'- pale brown, (2.5Y 8/2), dry, loose, medium grained, nonplastic, white poorly graded silty sand lense at 8.3ft bgs, laminated brownish yellow (10YR 6/8) from 8.4-9.1ft bgs **NO RECOVERY (NR)** 10.6-12.0'		6.9		Grout Seal - Sakrete Portland Type I/II (approx. 40 gallons) Two 10ft sections of Sch.40 PVC riser, 2-inch diameter, to surface
15 5.0 ▽	12.0 16.0	2.6	S-4	**CLAY (CL)** 12.0-13.1'- light gray, (2.5Y 7/1), dry, stiff to very stiff, high plasticity, mottled 20% strong brown, trace roots, laminated/fissile from 12.9-13.1ft bgs, grades to soil below **SILTY SAND (SM)** 13.1-14.3'- light gray, (2.5Y 7/1), dense, medium grained, low plasticity, mottled 20% strong brown **POOR GRADED SAND/SILTY SAND (SP-SM)** 14.3-14.6'- white, (5Y 8/2), moist, medium grained, nonplastic **NO RECOVERY (NR)** 14.6-16.0' **SILTY SAND (SM)** 16.0-16.8'- light gray, (5Y 7/1), wet, loose, medium grained, nonplastic, wet at 16.0ft bgs, trace yellowish brown mottling 16.7-16.8ft bgs **IRON NODULES (GW)** 16.8-16.9'- with light greenish gray (5GY 6/2) sands		6.7	Inverted blue triangle indicates top of saturated zone as observed during drilling operations.	Bentonite Seal - Medium Chip (1-50lb bag)

PROJECT NUMBER: 436972.FI.FK	BORING NUMBER: CAS07-MW09	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Site 07 Old DuPont Disposal Area - Remedial Investigation LOCATION : *Cheatham Annex (CAX) Williamsburg, VA (3636693.0 N, 12033048.8 E)

ELEVATION : 20.0 ft NAVD88 (natural ground elevation) DRILLING CONTRACTOR : Parratt-Wolff Drilling, Inc.\J. Ellingworth

DRILLING METHOD AND EQUIPMENT : IR300A Truck Rig, 4 ¼ ID 8 ¾ O.D. HSA, 4 ft Macro Core Sampler

WATER LEVELS : 16.0 ft bgs START : 4/1/2014 END : 4/1/2014 LOGGER : T. Stewart\VBO

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE ID (TIME)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS	WELL DIAGRAM
		2.8	S-5	**SILTY SAND (SM)** 16.9-28.0'- pale olive, (5Y 6/4), wet, loose to very loose, medium grained, nonplastic, high silt content 16.9-20ft bgs, discolored strong brown from 16.9-21.3ft bgs		7		Sand Pack (6-50lb bags Southern Products GP#1) starting 2ft above top of screen
20 0.0	20.0							
		4.0	S-6			7.1		
	24.0							
25 -5.0		4.0	S-7			7.1	BTOC - Below Top of Casing *Top of PVC well casing elevations and coordinates (NAD83) as surveyed by ECLS, Inc. on April 9th, 2014. Soil samples were only collected for the physical and lithological characterization of the boring location.	One 10-foot 0.01 slotted screen, 2-inch diameter Sch.40 PVC
	28.0			28.0-32.0'- light olive brown, (2.5Y 5/3-4), wet, loose, medium grained, nonplastic				approximately 8.25" diameter borehole
30 -10.0		4.0	S-8			7		
	32.0			Bottom of Boring at 32.0 ft bgs on 4/1/2014				

Appendix B
Survey Report

227 Fish Dr., Angier, NC 27501
A Veteran Owned Company

ECLS
•Engineering
•Construction Staking
•Land Surveying
•Subsurface Utility Locating

CH2MHILL SURVEYOR REPORT

Surveying of Monitoring Well Locations at Site 7

Remedial Investigation at Naval Weapons Station Yorktown; Cheatham Annex

Williamsburg, Virginia

Navy CLEAN 8012

CONTRACT N62470-11-D-8012

CTO-WE66

Page	1	Survey Control Stations
Page	2	Monitoring Wells

COMMONWEALTH OF VIRGINIA
G. DARRELL TAYLOR
Lic. No. 2985
LAND SURVEYOR

5-2-14

Date of Survey: 04-09-2014

Name(s) of crew: Don Williams and Robert Rose

Temperature: 64°F

Barometric Pressure: 29.7

Survey Control Stations:

The Horizontal values shown in this report are Virginia South Coordinates System (VACS) of 1983 (NAD 83) current adjustment. The Vertical values shown in this report are in NAVD 88 Datum current adjustment.

All coordinates shown in U.S. Survey Foot.

CONTROL USED	ELEV.	NORTHING	EASTING
	(ft mls)	(ft mls)	(ft mls)
PT1: MAG NAIL	20.59	3,636,714.72	12,033,008.12
PT2: EIR	22.76	3,636,214.28	12,032,969.89

Control Points 1 and 2 were supplied by CH2MHILL and were checked using Topcon Hyperlite Plus GPS, Glonass, L1-L2 receiver collecting data every five seconds for 30 minutes plus. Data then submitted to the OPUS online website using the Rapid Static selection to generate GPS reports. GPS reports were then used to check Virginia South State Plane coordinates that were supplied by CH2MHILL. A Topcon 9003A instrument was used to establish the monitoring wells using control points 1 and 2. The elevations between the control points and the monitoring wells were established using a AT-F2 Topcon Auto Level and a closed loop bench circuit was ran between the control points using the GPS elevations that were established from OPUS for site control. The following checks were made throughout the survey.

CONTROL CHECKS	ELEV.	NORTHING	EASTING
	(ft mls)	(ft mls)	(ft mls)
PT2 CHECK	22.72	3,636,214.27	12,032,969.89

Upon review of field control data, the accuracies obtained on horizontal control work complied with Third Order Class II (1:10,000) or better, as outlined in the FGDC Geospatial Positioning Accuracy Standards. The accuracies obtained on vertical control work complied with the Third Order (0.05 √M [M in miles]) or better, as outlined in the FGDC Geospatial Positioning Accuracy Standards.

227 Fish Dr., Angier, NC 27501
A Veteran Owned Company

Monitoring Well Locations:

WELL NUMBER	TOP OF RIM	TOP OF CASING	GROUND	NORTHING	EASTING
	(ft mls)	(ft mls)	(ft mls)	(ft mls)	(ft mls)
MW-08	23.58	23.59	20.31	3,636,713.31	12,033,110.46
MW-09	23.30	23.33	20.03	3,636,693.04	12,033,048.79

Appendix C
IDW Analytical Data, Profiles, and Disposal Manifest

TABLE C-1

Investigation-Derived Waste Laboratory Analytical Results (Aqueous) - April 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Sample ID	CAS07-IDW042714-AQ
Sample Date	4/27/14
Chemical Name	
TCLP Volatile Organic Compounds (UG/L)	
Chloroform	8.7
TCLP Semivolatile Organic Compounds (UG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (UG/L)	
No Detections	
TCLP Herbicides (UG/L)	
No Detections	
TCLP Metals (UG/L)	
Barium	211 J
Chromium	69.8
Ignitability (DEG/F)	
No Detections	
Reactivity (MG/L)	
No Detections	
Corrosivity (PH)	
Corrosivity (pH Units)	7.23

Notes:

> - Sample did not flash at temperature reported

DEG/F - Degrees Fahrenheit

J - Analyte present. Value may or may not be accurate or precise

MG/L - Milligrams per liter

NS - Not sampled

PH - pH units

U - The material was analyzed for, but not detected

UG/L - Micrograms per liter

Shading indicates detection

TABLE C-2

Investigation-Derived Waste Laboratory Analytical Results (Solids) - April 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Sample ID	CAS07-IDW042714-SO
Sample Date	4/27/14
Chemical Name	
TCLP Volatile Organic Compounds (UG/L)	
No Detections	
TCLP Semivolatile Organic Compounds (UG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (UG/L)	
No Detections	
TCLP Herbicides (UG/L)	
No Detections	
TCLP Metals (UG/L)	
Barium	974
Corrosivity (pH Units)	
Corrosivity (pH Units)	6.17
Reactivity (MG/KG)	
Reactive sulfide	11
Ignitability (DEG/C)	
No Detections	

Notes:

DEG/C - Degrees centigrade

MG/KG - Milligrams per kilogram

NS - Not sampled

PH - pH units

U - The material was analyzed for, but not detected

UG/L - Micrograms per liter

Shading indicates detection

Clearfield MMG
resourceful waste management

Material Characterization Form

Applicant Information

Company Name:	CH2M HILL, Inc.
Address:	5701 Cleveland Street
City / State / Zip:	Virginia Beach, VA 23462
Contact:	Jennifer Myers
Phone:	757-671-6215
Fax:	703-376-5703
e-mail:	jennifer.myers@ch2m.com

Generator Information

Company Name:	NAVFAC MID ATLANTIC
Address:	9742 Maryland Ave. Bldg. N-26
City / State / Zip:	Norfolk, VA 23511
Contact:	Scott Park
Phone:	757-341-0481
Fax:	
e-mail:	scott.park@navy.mil

Project Description

Site Name:	Cheatham Annex, Site 7
Site Address:	NWSY, Cheatham Annex, Williamsburg, VA
Source of Contamination:	
Waste Generating Activity:	Monitoring Well Installation, Development, Purging, & Decontamination Activities

Waste Description

Applicant must complete the following information and attach all laboratory analyses and / or MSDS utilized to characterize the material as non-hazardous and acceptable for receipt by Clearfield MMG.

General Description: IDW Groundwater

Matrix: [ ] Soil [ ] Sludge [X] Water [ ] Debris / Absorbents

Petroleum Type: *(Check all that apply)*
[ ] Virgin (un-used) [ ] Non-Virgin (used) [X] None
[ ] Gas [ ] Diesel / # 2 [ ] Motor / Hydraulic Oil [ ] # 4, 5, or 6 Oil

Other Contaminants: See Analysis

Volume: (6) 55 Gallon Drums **Lab Analysis Completed:** [X] YES [ ] NO

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed M*aterial Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

PARK.SCOTT.R.1229816159 Digitally signed by PARK.SCOTT.R.1229816159
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=PARK.SCOTT.R.1229816159
Date: 2014.06.05 12:32:39 -04'00'

Scott R. Park

Generator or Agent Signature / Date ***Generator or Agent Printed Name***

If I am an agent signing on behalf of the generator, I have confirmed with the generator that the information contained in this profile is accurate and complete.

For Facility Use Only

Approved By: _____ Approval Code: _____

Approval Date: _____ Comments: _____

All Deliveries Must be Accompanied by an Approved MCF or Reference Approval Code on Manifest

Clearfield MMG
resourceful waste management

Material Characterization Form

Applicant Information

Company Name:	CH2M HILL, Inc.
Address:	5701 Cleveland Street
City / State / Zip:	Virginia Beach, VA 23462
Contact:	Jennifer Myers
Phone:	757-671-6215
Fax:	703-376-5703
e-mail:	jennifer.myers@ch2m.com

Generator Information

Company Name:	NAVFAC MID ATLANTIC
Address:	9742 Maryland Ave. Bldg. N-26
City / State / Zip:	Norfolk, VA 23511
Contact:	Scott Park
Phone:	757-341-0481
Fax:	
e-mail:	scott.park@navy.mil

Project Description

Site Name:	Cheatham Annex, Site 7
Site Address:	NWSY, Cheatham Annex, Williamsburg, VA
Source of Contamination:	
Waste Generating Activity:	Monitoring Well Installation, Development, Purging, & Decontamination Activities

Waste Description

Applicant must complete the following information and attach all laboratory analyses and / or MSDS utilized to characterize the material as non-hazardous and acceptable for receipt by Clearfield MMG.

General Description: IDW Soil

Matrix: [X] Soil [ ] Sludge [ ] Water [ ] Debris / Absorbents

Petroleum Type: [ ] Virgin (un-used) [ ] Non-Virgin (used) [X] None
(Check all that apply) [ ] Gas [ ] Diesel / # 2 [ ] Motor / Hydraulic Oil [ ] # 4, 5, or 6 Oil

Other Contaminants: See Analysis

Volume: (5) 55 Gallon Drums **Lab Analysis Completed:** [X] YES [ ] NO

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed M*aterial Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

PARK.SCOTT.R.1229816159 Digitally signed by PARK.SCOTT.R.1229816159 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=PARK.SCOTT.R.1229816159 Date: 2014.06.06 12:56:42 -04'00'

Scott R. Park

Generator or Agent Signature / Date ***Generator or Agent Printed Name***

If I am an agent signing on behalf of the generator, I have confirmed with the generator that the information contained in this profile is accurate and complete.

For Facility Use Only

Approved By: _____ Approval Code: _____

Approval Date: _____ Comments: _____

All Deliveries Must be Accompanied by an Approved MCF or Reference Approval Code on Manifest

Clearfield MMG
resourceful waste management

PROJECT DOCUMENTS

TO: Ms. Jennifer Myers

PROJECT: NWSY, Cheatham Annex, Site 7
Williamsburg, VA

DATE: June 30, 2014

Please find enclosed all project documentation pertaining to the disposal of waste materials from the above location. This material has been deemed acceptable for disposal and conforms to Clearfield MMG permits and all applicable environmental regulations.

We suggest that you or your customers retain this information indefinitely.

Should you have any questions or require additional copies, please contact our office.

Thank you again for the opportunity to be of service.

Enclosure

P.O. Box 1444 • Chesapeake, VA 23327
p: 757-549-8448 • f: 757-549-6668 • www.clearfieldmmg.com

Clearfield MMG

Post Office Box 1444
Chesapeake, VA 23327
(757) 549-8448
FAX: (757) 549-6668

NON-HAZARDOUS SHIPPING MANIFEST

MANIFEST NO._____

GENERATOR

NAME NAVFAC Mid-Atlantic TELEPHONE 757-341-0481

ADDRESS 9742 Maryland Ave. Bldg. N-26 CITY Norfolk STATE VA

SHIPMENT ORIGIN NWSY, Cheatham Annex, Site 7 CITY Williamsburg STATE VA

AUTHORIZED AGENT c/o CH2M HILL FIRM

ADDRESS OTHER CTO - WE66
CH2M HILL Project # 436972

MATERIAL CHARACTERIZATION

ACTIVITY GENERATING THIS MATERIAL: UST/AST REMOVAL _____ OTHER Well Installation Activities

PETROLEUM TYPE (S): None VIRGIN PRODUCT_____ NON-VIRGIN PRODUCT_____

PHYSICAL STATE: STOCKPILED _____ EXCAVATING_____ DRUMS 5 (Soil) OTHER _____

HANDLING INSTRUCTIONS: **Transport To Facility Designated Below**

FIRE OR SPILL INSTRCUTIONS: **Non-Flammable / Non-Hazardous**

DESTINATION: Chesapeake Facility

I hereby certify, to the best of my knowledge, the material characterized above is non-hazardous as defined by the Virginia Hazardous Waste Management Regulations, Federal Regulations under Subtitle C - RCRA, U.S. Department of Transportation, or local / state of origin regulations.

Signature of Generator / Agent

Printed Name / Date 6/27/14

TRANSPORTER

TRANSPORTER NAME Clearfield MMG, Inc. TELEPHONE 549-8448 TRUCK NO. 14

I certify that the materials described above were received by me for shipment and delivered to the designated facility.

6-27-14

Transporter Signature / Date

FACILTIY

I certify that the materials described above were delivered to the facility and received by me.

ACCEPTED BY_____ DATE 6-27-14

REASONS FOR REJECTION _____

Gross Weight	
Tare Weight	
Net Weight	
Tons	

GENERATOR

Clearfield MMG
Post Office Box 1444
Chesapeake, VA 23327
(757) 549-8448
FAX: (757) 549-6668

NON-HAZARDOUS SHIPPING MANIFEST

MANIFEST NO._____

GENERATOR

NAME NAVFAC Mid-Atlantic TELEPHONE 757-341-0481

ADDRESS 9742 Maryland Ave. Bldg. N-26 CITY Norfolk STATE VA

SHIPMENT ORIGIN NWSY, Cheatham Annex, Site 7 CITY Williamsburg STATE VA

AUTHORIZED AGENT c/o CH2M HILL FIRM

ADDRESS OTHER CTO - WE66
CH2M HILL Project # 436972

MATERIAL CHARACTERIZATION

ACTIVITY GENERATING THIS MATERIAL: UST/AST REMOVAL _____ OTHER Well Installation Activities

PETROLEUM TYPE (S): None VIRGIN PRODUCT_____ NON-VIRGIN PRODUCT_____

PHYSICAL STATE: STOCKPILED _____ EXCAVATING_____ DRUMS 6 (Groundwater) OTHER _____

HANDLING INSTRUCTIONS: **Transport To Facility Designated Below**

FIRE OR SPILL INSTRCUTIONS: **Non-Flammable / Non-Hazardous**

DESTINATION: Chesapeake Facility

I hereby certify, to the best of my knowledge, the material characterized above is non-hazardous as defined by the Virginia Hazardous Waste Management Regulations, Federal Regulations under Subtitle C - RCRA, U.S. Department of Transportation, or local / state of origin regulations.

Signature of Generator / Agent

Scott R. Park / 6/26/14
Printed Name / Date

TRANSPORTER

TRANSPORTER NAME Clearfield MMG, Inc. TELEPHONE 549-8448 TRUCK NO. 14

I certify that the materials described above were received by me for shipment and delivered to the designated facility.

6-27-14
Transporter Signature / Date

FACILTIY

I certify that the materials described above were delivered to the facility and received by me.

ACCEPTED BY_____ DATE 6-27-14

REASONS FOR REJECTION _____

Gross Weight	
Tare Weight	
Net Weight	
Tons	

GENERATOR

Appendix D
Laboratory Analytical Data

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO001		CAS07-SO002		CAS07-SO003	CAS07-SO004	CAS07-SO005	CAS07-SO006	CAS07-SO007	CAS07-SO008		
Sample ID	NWSY-90-7-SC-PER-132	NWSY-90-7-SC-PER-133	NWSY-90-7-SC-PER-135	NWSY-90-7-SC-PER-183	NWSY-90-7-SC-FLR-136	NWSY-90-7-SC-FLR-137	NWSY-90-7-SC-FLR-138	NWSY-90-7-SC-FLR-139	NWSY-90-7-SC-FLR-140	NWSY-90-7-SC-PER-143	NWSY-90-7-SC-PER-184	NWSY-90-7-SC-PER-185
Sample Date	02/28/08	02/28/08	02/28/08	04/09/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	04/09/08	04/09/08
Chemical Name												
Volatile Organic Compounds (µg/kg)												
1,1,1-Trichloroethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,1,2,2-Tetrachloroethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,1,2-Trichloroethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,1-Dichloroethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,1-Dichloroethene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,2,3-Trichlorobenzene	4.7 U	7.7 U	7.4 U	7.7 UL	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,2,4-Trichlorobenzene	4.7 U	7.7 U	7.4 U	7.7 UL	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,2-Dibromo-3-chloropropane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,2-Dibromoethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,2-Dichlorobenzene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,2-Dichloroethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,2-Dichloropropane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,3-Dichlorobenzene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
1,4-Dichlorobenzene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
2-Butanone	23 UL	38 U	37 U	38 U	32 U	42 U	40 U	35 U	32 U	43 U	39 U	42 U
2-Hexanone	23 U	38 U	37 U	38 U	32 U	42 U	40 U	35 U	32 U	43 U	39 U	42 U
4-Methyl-2-pentanone	23 U	38 U	37 U	38 U	32 U	42 U	40 U	35 U	32 U	43 U	39 U	42 U
Acetone	47 U	77 U	74 U	77 U	65 U	84 U	81 U	69 U	63 U	86 U	78 U	84 U
Benzene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Bromochloromethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Bromodichloromethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Bromoform	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Bromomethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Carbon disulfide	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Carbon tetrachloride	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Chlorobenzene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Chloroethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Chloroform	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Chloromethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
cis-1,2-Dichloroethene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
cis-1,3-Dichloropropene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Cyclohexane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Dibromochloromethane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Dichlorodifluoromethane (Freon-12)	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Ethylbenzene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Isopropylbenzene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
m- and p-Xylene	9.4 U	15 U	15 U	15 U	13 U	17 U	16 U	14 U	13 U	17 U	16 U	17 U
Methyl acetate	23 U	38 U	37 U	38 U	32 U	42 U	40 U	35 U	32 U	43 U	39 U	42 U
Methylcyclohexane	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Methylene chloride	25.6 B	40.3 B	69.2 B	69.4 B	72.1 B	89.8 B	70.7 B	51.1 B	36 B	43.3 B	60.2 B	50 B
Methyl-tert-butyl ether (MTBE)	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
o-Xylene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Styrene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Tetrachloroethene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Toluene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
trans-1,2-Dichloroethene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
trans-1,3-Dichloropropene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Trichloroethene	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Trichlorofluoromethane (Freon-11)	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U
Vinyl chloride	4.7 U	7.7 U	7.4 U	7.7 U	6.5 U	8.4 U	8.1 U	6.9 U	6.3 U	8.6 U	7.8 U	8.4 U

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO001		CAS07-SO002		CAS07-SO003	CAS07-SO004	CAS07-SO005	CAS07-SO006	CAS07-SO007	CAS07-SO008		
Sample ID	NWSY-90-7-SC-PER-132	NWSY-90-7-SC-PER-133	NWSY-90-7-SC-PER-135	NWSY-90-7-SC-PER-183	NWSY-90-7-SC-FLR-136	NWSY-90-7-SC-FLR-137	NWSY-90-7-SC-FLR-138	NWSY-90-7-SC-FLR-139	NWSY-90-7-SC-FLR-140	NWSY-90-7-SC-PER-143	NWSY-90-7-SC-PER-184	NWSY-90-7-SC-PER-185
Sample Date	02/28/08	02/28/08	02/28/08	04/09/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	04/09/08	04/09/08
Chemical Name												
Semivolatile Organic Compounds (µg/kg)												
1,1-Biphenyl	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
1,2,4,5-Tetrachlorobenzene	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
1,4-Dioxane	230 UJ	380 UJ	370 UJ	380 U	320 UJ	420 UJ	400 UJ	350 UJ	320 UJ	430 UJ	390 U	420 U
1-Methylnaphthalene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
2,2'-Oxybis(1-chloropropane)	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2,3,4,6-Tetrachlorophenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2,4,5-Trichlorophenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2,4,6-Trichlorophenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2,4-Dichlorophenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2,4-Dimethylphenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2,4-Dinitrophenol	1,000 U	910 U	950 U	980 U	930 U	1,100 U	980 U	960 U	960 U	980 U	960 U	970 U
2,4-Dinitrotoluene	220 U	210 U	200 U	200 U	190 U	220 R	200 R	220 U	200 U	200 R	200 U	200 U
2,6-Dinitrotoluene	220 U	210 U	200 U	200 U	190 U	220 U	200 U	220 U	200 U	200 U	200 U	200 UL
2-Chloronaphthalene	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2-Chlorophenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2-Methylnaphthalene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
2-Methylphenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
2-Nitroaniline	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
2-Nitrophenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
3- and 4-Methylphenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
3,3'-Dichlorobenzidine	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
3-Nitroaniline	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
4,6-Dinitro-2-methylphenol	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
4-Bromophenyl-phenylether	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
4-Chloro-3-methylphenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
4-Chloroaniline	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
4-Chlorophenyl-phenylether	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
4-Nitroaniline	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
4-Nitrophenol	1,000 U	910 U	950 U	980 U	930 U	1,100 U	980 U	960 U	960 U	980 U	960 U	970 U
Acenaphthene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
Acenaphthylene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
Acetophenone	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Anthracene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
Atrazine	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Benzaldehyde	1,000 U	910 U	950 U	980 U	930 U	1,100 U	980 U	960 U	960 U	980 U	960 U	970 U
Benzo(a)anthracene	67 U	58 U	61 U	63 U	59 U	71 U	63 U	62 U	62 U	63 U	62 U	62 U
Benzo(a)pyrene	67 U	58 U	61 U	63 U	59 U	71 U	63 U	62 U	62 U	63 U	62 U	62 U
Benzo(b)fluoranthene	67 U	58 U	61 U	63 U	59 U	71 U	63 U	62 U	62 U	63 U	62 U	62 U
Benzo(g,h,i)perylene	67 U	58 U	61 U	63 U	59 U	71 U	63 U	62 U	62 U	63 U	62 U	62 U
Benzo(k)fluoranthene	67 U	58 U	61 U	63 U	59 U	71 U	63 U	62 U	62 U	63 U	62 U	62 U
bis(2-Chloroethoxy)methane	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
bis(2-Chloroethyl)ether	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
bis(2-Ethylhexyl)phthalate	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
Butylbenzylphthalate	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
Caprolactam	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Carbazole	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Chrysene	67 U	58 U	61 U	63 U	59 U	71 U	63 U	62 U	62 U	63 U	62 U	62 U
Dibenz(a,h)anthracene	67 U	58 U	61 U	63 U	59 U	71 U	63 U	62 U	62 U	63 U	62 U	62 U
Dibenzofuran	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Diethylphthalate	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
Dimethyl phthalate	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
Di-n-butylphthalate	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
Di-n-octylphthalate	420 U	370 U	380 U	390 U	370 U	440 U	390 U	380 U	380 U	390 U	380 U	390 U
Fluoranthene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
Fluorene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
Hexachlorobenzene	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Hexachlorobutadiene	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Hexachlorocyclopentadiene	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Hexachloroethane	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Indeno(1,2,3-cd)pyrene	67 U	58 U	61 U	63 U	59 U	71 U	63 U	62 U	62 U	63 U	62 U	62 U
Isophorone	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Naphthalene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
n-Nitroso-di-n-propylamine	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
n-Nitrosodiphenylamine	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Nitrobenzene	220 U	210 U	200 U	200 U	190 U	220 U	200 U	220 U	200 U	200 U	200 U	200 U

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO001		CAS07-SO002		CAS07-SO003	CAS07-SO004	CAS07-SO005	CAS07-SO006	CAS07-SO007	CAS07-SO008		
Sample ID	NWSY-90-7-SC-PER-132	NWSY-90-7-SC-PER-133	NWSY-90-7-SC-PER-135	NWSY-90-7-SC-PER-183	NWSY-90-7-SC-FLR-136	NWSY-90-7-SC-FLR-137	NWSY-90-7-SC-FLR-138	NWSY-90-7-SC-FLR-139	NWSY-90-7-SC-FLR-140	NWSY-90-7-SC-PER-143	NWSY-90-7-SC-PER-184	NWSY-90-7-SC-PER-185
Sample Date	02/28/08	02/28/08	02/28/08	04/09/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	04/09/08	04/09/08
Chemical Name												
Pentachlorophenol	1,000 U	910 U	950 U	980 U	930 U	1,100 U	980 U	960 U	960 U	980 U	960 U	970 U
Phenanthrene	340 U	290 U	310 U	310 U	300 U	350 U	310 U	310 U	310 U	310 U	310 U	310 U
Phenol	210 U	180 U	190 U	200 U	190 U	220 U	200 U	190 U	190 U	200 U	190 U	190 U
Pyrene	340 UJ	290 UJ	310 UJ	310 U	300 UJ	350 UJ	310 UJ	310 UJ	310 UJ	310 U	310 U	310 U
Pesticide/Polychlorinated Biphenyls (µg/kg)												
4,4'-DDD	4.2 U	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	3.8 U	3.9 U	3.8 U
4,4'-DDE	4.2 U	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	3.8 U	3.9 U	3.8 U
4,4'-DDT	4.2 U	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	38 U	3.9 U	3.8 U
Aldrin	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
alpha-BHC	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
alpha-Chlordane	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
Aroclor-1016	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
Aroclor-1221	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
Aroclor-1232	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
Aroclor-1242	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
Aroclor-1248	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
Aroclor-1254	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
Aroclor-1260	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
Aroclor-1262	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
Aroclor-1268	21 U	19 U	19 U	20 U	19 U	22 U	19 U	19 U	20 U	19 U	19 U	19 U
beta-BHC	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
delta-BHC	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
Dieldrin	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
Endosulfan I	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
Endosulfan II	4.2 U	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	3.8 U	3.9 U	3.8 U
Endosulfan sulfate	4.2 U	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	3.8 U	3.9 U	3.8 U
Endrin	2.4 J	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	3.8 U	3.9 U	3.8 U
Endrin aldehyde	4.2 U	3.7 U	3.8 U	3.9 UJ	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	3.8 U	3.9 UJ	3.8 UJ
Endrin ketone	4.2 U	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	3.8 U	3.9 U	3.8 U
gamma-BHC (Lindane)	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
gamma-Chlordane	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
Heptachlor	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
Heptachlor epoxide	2.1 U	1.9 U	1.9 U	2 U	1.9 U	2.2 U	1.9 U	1.9 U	2 U	1.9 U	1.9 U	1.9 U
Methoxychlor	4.2 U	3.7 U	3.8 U	3.9 U	3.8 U	4.5 U	3.9 U	3.8 U	3.9 U	38 U	3.9 U	3.8 U
Polychlorinated biphenyls (PCBs)	42 U	37 U	38 U	39 U	38 U	45 U	39 U	38 U	39 U	38 U	39 U	38 U
Toxaphene	100 U	93 U	96 U	98 U	94 U	110 U	97 U	96 U	98 U	96 U	97 U	96 U
Dioxin/Furans (pg/g)												
2,3,7,8-TCDD (dioxin)	0.248 U	0.19 U	0.138 U	0.119 J	0.177 U	0.199 U	0.19 U	0.267 J	0.182 U	0.201 U	0.109 U	0.135 J
Explosives (µg/kg)												
1,3,5-Trinitrobenzene	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
1,3-Dinitrobenzene	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
2,4,6-Trinitrotoluene	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
2-Amino-4,6-dinitrotoluene	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
2-Nitrotoluene	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
3-Nitrotoluene	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
4-Amino-2,6-dinitrotoluene	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
4-Nitrotoluene	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
HMX	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
RDX	220 U	210 U	200 U	200 U	190 U	190 U	180 U	220 U	200 U	190 U	200 U	200 U
Tetryl	440 U	420 U	390 U	400 U	370 U	380 U	370 U	430 U	410 U	370 U	400 U	400 U
Total Metals (mg/kg)												
Aluminum	11,200	3,530	6,710	9,730	12,600	20,300	14,100	6,880	11,000	7,400	7,350	8,900
Antimony	3.7 UL	3.3 UL	3.4 UL	13 UL	0.3 B	0.6 B	0.54 B	3.4 UL	3.3 UL	3.5 UL	3.4 UL	0.23 L
Arsenic	4.3 L	1.4	1.5	2.6	1.9	1.3	2	1.5	1.2	1.4	1.8	1.9
Barium	24.2 J	19.6 J	57.7 J	90.4	48.8 J	35.7 J	51.7 J	101 J	42.2 J	69.1 J	57.6	53.7
Beryllium	0.47	0.33	0.97	1.3	0.4	0.6	0.6	1.1	0.39	0.91	0.39	0.41
Cadmium	0.25 UL	0.22 U	0.23 U	0.9 U	0.84 U	2.6 U	1.2 U	0.23 U	1.1 U	0.23 U	0.22 U	0.22 U
Calcium	1,480 L	407	458	770 J	1,150	2,070	1,090	883	1,200	781	556	1,000
Chromium	23.3 J	10.9 J	5.1 J	7.4	16.8 J	41.1 J	16.3 J	7.6 J	15.3 J	7.6 J	7.4	10
Cobalt	1.1 J	3.4	3.3	5.1 J	1.5 J	2.3 J	1.9 J	2.8 J	2 J	2.9	2.1 J	2.3 J
Copper	7.5 J	4.6 J	3.3 J	2.9 J	2 J	2.7 J	3.5 J	12.9 J	3.7 J	5.2 J	2.9	7
Cyanide	0.14 U	0.13 U	0.13 U	0.14 U	0.13 U	0.16 U	0.14 U	0.14 U	0.13 U	0.14 U	0.13 U	0.13 U
Iron	11,100	4,530	4,050	5,750	20,300	64,000	15,400	3,640	17,000	3,680	6,200	7,850

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO001		CAS07-SO002		CAS07-SO003	CAS07-SO004	CAS07-SO005	CAS07-SO006	CAS07-SO007	CAS07-SO008		
Sample ID	NWSY-90-7-SC-PER-132	NWSY-90-7-SC-PER-133	NWSY-90-7-SC-PER-135	NWSY-90-7-SC-PER-183	NWSY-90-7-SC-FLR-136	NWSY-90-7-SC-FLR-137	NWSY-90-7-SC-FLR-138	NWSY-90-7-SC-FLR-139	NWSY-90-7-SC-FLR-140	NWSY-90-7-SC-PER-143	NWSY-90-7-SC-PER-184	NWSY-90-7-SC-PER-185
Sample Date	02/28/08	02/28/08	02/28/08	04/09/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	04/09/08	04/09/08
Chemical Name												
Lead	20.2 J	16.4 J	6.9 J	10 J	1.1 J	26 U	6.6 J	84.3 J	2.2 J	81.9 J	13.6	37.3
Magnesium	957	661	429	610 J	779	1,390	916	454	715	429	481	563
Manganese	16.1 J	49.4 J	126 J	258	9.1 J	15.6 J	20.1 J	169 J	15 J	114 J	30.4	69.2
Mercury	0.044 K	0.032 K	0.021 K	0.025 J	0.05 K	0.18 K	0.036 K	0.043 K	0.047 K	0.031 K	0.025 J	0.08 J
Nickel	2.5	4.2	3.7	6 J	2.7	4.1	3.7	4.9	2.5	3.9	3.5	3.9
Potassium	982 B	636 B	342 B	752 B	702 B	1,320 B	685 B	359 B	589 B	339 B	394 B	486 B
Selenium	1 L	0.41 J	0.47 J	22 U	1.6 J	3.5 J	1.2 J	0.37 J	1.2 J	0.26 J	5.6 U	5.5 U
Silver	0.62 U	0.54 U	0.57 U	2.2 U	0.53 U	0.64 U	0.59 U	0.57 U	0.56 U	0.58 U	0.56 U	0.55 U
Sodium	276 B	307 B	184 B	266 B	268 B	459 B	227 B	174 B	257 B	173 B	72.6 B	81 B
Thallium	0.38 J	0.54 U	0.57 U	2.2 U	1.3	2.4	0.87	0.57 U	1	0.58 U	2.2 U	2.2 U
Vanadium	34.3 J	12.7 J	8.1 J	10.5 J	30.7 J	53.8 J	28.5 J	7.2 J	26.1 J	7.5 J	12.7	15.7
Zinc	22.9 J	41.7 J	14.2 J	15.3	9.2 J	14.5 J	11.3 J	51.2 J	12.5 J	23.2 J	13.2	26.6
Wet Chemistry												
pH (pH units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

R - Rejected Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO009	CAS07-SO010	CAS07-SO011	CAS07-SO012	CAS07-SO013		CAS07-SO014			CAS07-SO015	
Sample ID	NWSY-90-7-SC-FLR-144	NWSY-90-7-SC-FLR-145	NWSY-90-7-SC-FLR-146	NWSY-90-7-SC-FLR-147	NWSY-90-7-SC-PER-148	NWSY-90-7-SC-PER-149	NWSY-90-7-SC-PER-150	NWSY-90-7-SC-PER-151	NWSY-90-7-SC-PER-152	NWSY-90-7-SC-PER-153	NWSY-90-7-SC-PER-154
Sample Date	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08
Chemical Name											
Volatile Organic Compounds (µg/kg)											
1,1,1-Trichloroethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
1,1,2,2-Tetrachloroethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 UJ	6.9 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
1,1,2-Trichloroethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
1,1-Dichloroethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
1,1-Dichloroethene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
1,2,3-Trichlorobenzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 UJ	6.9 UL
1,2,4-Trichlorobenzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 UJ	6.9 UL
1,2-Dibromo-3-chloropropane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 UJ	6.9 UL
1,2-Dibromoethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
1,2-Dichlorobenzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 UJ	6.9 U
1,2-Dichloroethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
1,2-Dichloropropane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
1,3-Dichlorobenzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 UJ	6.9 U
1,4-Dichlorobenzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 UJ	6.9 U
2-Butanone	41 U	29 U	42 U	40 U	64 UJ	33 U	65 U	32 U	35 U	34 U	35 UL
2-Hexanone	41 U	29 U	42 U	40 U	64 UJ	33 U	65 U	32 U	35 U	34 U	35 UL
4-Methyl-2-pentanone	41 U	29 U	42 U	40 U	64 UJ	33 U	65 U	32 U	35 U	34 U	35 UL
Acetone	81 U	57 U	84 U	80 U	130 UJ	65 U	130 U	64 U	69 U	68 U	69 U
Benzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Bromochloromethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Bromodichloromethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Bromoform	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Bromomethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Carbon disulfide	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Carbon tetrachloride	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Chlorobenzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Chloroethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Chloroform	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Chloromethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
cis-1,2-Dichloroethene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
cis-1,3-Dichloropropene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 UL
Cyclohexane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Dibromochloromethane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Dichlorodifluoromethane (Freon-12)	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Ethylbenzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Isopropylbenzene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
m- and p-Xylene	16 U	11 U	17 U	16 U	25 UJ	13 U	26 U	13 U	14 U	14 U	14 U
Methyl acetate	41 U	29 U	42 U	40 U	64 UJ	33 U	65 U	32 U	35 U	34 U	35 U
Methylcyclohexane	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Methylene chloride	56.3 B	57.3 B	77.9 B	87.9 B	123 B	13.1 B	14.8 B	11 B	9.8 B	13.5 B	14.8 B
Methyl-tert-butyl ether (MTBE)	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
o-Xylene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Styrene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Tetrachloroethene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Toluene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
trans-1,2-Dichloroethene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
trans-1,3-Dichloropropene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Trichloroethene	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Trichlorofluoromethane (Freon-11)	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U
Vinyl chloride	8.1 U	5.7 U	8.4 U	8 U	13 UJ	6.5 U	13 U	6.4 U	6.9 U	6.8 U	6.9 U

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO009	CAS07-SO010	CAS07-SO011	CAS07-SO012	CAS07-SO013		CAS07-SO014			CAS07-SO015	
Sample ID	NWSY-90-7-SC-FLR-144	NWSY-90-7-SC-FLR-145	NWSY-90-7-SC-FLR-146	NWSY-90-7-SC-FLR-147	NWSY-90-7-SC-PER-148	NWSY-90-7-SC-PER-149	NWSY-90-7-SC-PER-150	NWSY-90-7-SC-PER-151	NWSY-90-7-SC-PER-152	NWSY-90-7-SC-PER-153	NWSY-90-7-SC-PER-154
Sample Date	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08
Chemical Name											
Semivolatile Organic Compounds (µg/kg)											
1,1-Biphenyl	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
1,2,4,5-Tetrachlorobenzene	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
1,4-Dioxane	410 UJ	290 UJ	420 UJ	400 UJ	640 UJ	330 UJ	650 UJ	320 UJ	350 UJ	340 U	350 U
1-Methylnaphthalene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
2,2'-Oxybis(1-chloropropane)	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2,3,4,6-Tetrachlorophenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2,4,5-Trichlorophenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2,4,6-Trichlorophenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2,4-Dichlorophenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2,4-Dimethylphenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2,4-Dinitrophenol	960 U	950 U	940 U	920 U	1,200 U	1,000 U	1,200 U	990 U	980 U	1,000 U	920 U
2,4-Dinitrotoluene	200 U	220 U	210 U	220 U	240 R	210 R	240 R	200 U	240 U	250 U	250 U
2,6-Dinitrotoluene	200 U	220 U	210 U	220 U	240 U	210 U	240 U	200 U	240 U	250 U	250 U
2-Chloronaphthalene	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2-Chlorophenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2-Methylnaphthalene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
2-Methylphenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
2-Nitroaniline	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
2-Nitrophenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
3- and 4-Methylphenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
3,3'-Dichlorobenzidine	380 U	380 U	380 UL	370 U	480 U	410 U	480 U	400 U	390 U	410 UL	370 U
3-Nitroaniline	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
4,6-Dinitro-2-methylphenol	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
4-Bromophenyl-phenylether	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
4-Chloro-3-methylphenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
4-Chloroaniline	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
4-Chlorophenyl-phenylether	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
4-Nitroaniline	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
4-Nitrophenol	960 U	950 U	940 U	920 U	1,200 U	1,000 U	1,200 U	990 U	980 U	1,000 U	920 U
Acenaphthene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
Acenaphthylene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
Acetophenone	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Anthracene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
Atrazine	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 UL	180 U
Benzaldehyde	960 U	950 U	940 U	920 U	1,200 U	1,000 U	1,200 U	990 U	980 U	1,000 U	920 U
Benzo(a)anthracene	18.4 J	61 U	60 U	59 U	76 U	66 U	76 U	63 U	63 U	66 U	59 U
Benzo(a)pyrene	61 U	61 U	60 U	59 U	76 U	66 U	76 U	63 U	63 U	66 U	59 U
Benzo(b)fluoranthene	16.6 J	61 U	60 U	59 U	76 U	66 U	76 U	63 U	63 U	66 U	59 U
Benzo(g,h,i)perylene	61 U	61 U	60 U	59 U	76 U	66 U	76 U	63 U	63 U	66 U	59 U
Benzo(k)fluoranthene	61 U	61 U	60 U	59 U	76 U	66 U	76 U	63 U	63 U	66 U	59 U
bis(2-Chloroethoxy)methane	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
bis(2-Chloroethyl)ether	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
bis(2-Ethylhexyl)phthalate	380 U	380 U	256 J	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
Butylbenzylphthalate	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
Caprolactam	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Carbazole	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Chrysene	22.5 J	61 U	60 U	59 U	76 U	66 U	76 U	63 U	63 U	66 U	59 U
Dibenz(a,h)anthracene	61 U	61 U	60 U	59 U	76 U	66 U	76 U	63 U	63 U	66 U	59 U
Dibenzofuran	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Diethylphthalate	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
Dimethyl phthalate	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
Di-n-butylphthalate	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
Di-n-octylphthalate	380 U	380 U	380 U	370 U	480 U	410 U	480 U	400 U	390 U	410 U	370 U
Fluoranthene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
Fluorene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
Hexachlorobenzene	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Hexachlorobutadiene	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Hexachlorocyclopentadiene	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 UL	180 U
Hexachloroethane	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 UL	180 U
Indeno(1,2,3-cd)pyrene	61 U	61 U	60 U	59 U	76 U	66 U	76 U	63 U	63 U	66 U	59 U
Isophorone	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Naphthalene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
n-Nitroso-di-n-propylamine	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
n-Nitrosodiphenylamine	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Nitrobenzene	200 U	220 U	210 U	220 U	240 U	210 U	240 U	200 U	240 U	250 U	250 U

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO009	CAS07-SO010	CAS07-SO011	CAS07-SO012	CAS07-SO013		CAS07-SO014			CAS07-SO015	
Sample ID	NWSY-90-7-SC-FLR-144	NWSY-90-7-SC-FLR-145	NWSY-90-7-SC-FLR-146	NWSY-90-7-SC-FLR-147	NWSY-90-7-SC-PER-148	NWSY-90-7-SC-PER-149	NWSY-90-7-SC-PER-150	NWSY-90-7-SC-PER-151	NWSY-90-7-SC-PER-152	NWSY-90-7-SC-PER-153	NWSY-90-7-SC-PER-154
Sample Date	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08
Chemical Name											
Pentachlorophenol	960 U	950 U	940 U	920 U	1,200 U	1,000 U	1,200 U	990 U	980 U	1,000 U	920 U
Phenanthrene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
Phenol	190 U	190 U	190 U	180 U	240 U	210 U	240 U	200 U	200 U	210 U	180 U
Pyrene	310 U	310 U	300 U	290 U	380 U	330 U	380 U	320 U	310 U	330 U	290 U
Pesticide/Polychlorinated Biphenyls (µg/kg)											
4,4'-DDD	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U	4.1 U	3.6 U
4,4'-DDE	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U	4.1 U	3.6 U
4,4'-DDT	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U	4.1 U	3.6 U
Aldrin	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
alpha-BHC	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
alpha-Chlordane	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
Aroclor-1016	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
Aroclor-1221	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
Aroclor-1232	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
Aroclor-1242	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
Aroclor-1248	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
Aroclor-1254	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
Aroclor-1260	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
Aroclor-1262	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
Aroclor-1268	19 U	19 U	19 U	18 U	23 U	21 U	23 U	20 U	19 U	21 U	18 U
beta-BHC	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
delta-BHC	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
Dieldrin	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
Endosulfan I	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
Endosulfan II	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U	4.1 U	3.6 U
Endosulfan sulfate	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U	4.1 U	3.6 U
Endrin	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U	4.1 U	3.6 U
Endrin aldehyde	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U	4.1 U	3.6 U
Endrin ketone	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 U	4.1 U	3.6 U
gamma-BHC (Lindane)	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
gamma-Chlordane	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
Heptachlor	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
Heptachlor epoxide	1.9 U	1.9 U	1.9 U	1.8 U	2.3 U	2.1 U	2.3 U	2 U	1.9 U	2.1 U	1.8 U
Methoxychlor	3.9 U	3.8 U	3.8 U	3.6 U	4.7 U	4.1 U	4.6 U	4 U	3.9 UL	4.1 U	3.6 U
Polychlorinated biphenyls (PCBs)	39 U	38 U	38 U	36 U	47 U	41 U	46 U	40 U	39 U	41 U	36 U
Toxaphene	97 U	94 U	95 U	91 U	120 U	100 U	120 U	99 U	96 U	100 U	91 U
Dioxin/Furans (pg/g)											
2,3,7,8-TCDD (dioxin)	0.189 U	0.175 U	0.104 J	0.102 J	0.289 U	0.104 U	0.217 J	0.088 U	0.15 U	0.272 U	0.457 U
Explosives (µg/kg)											
1,3,5-Trinitrobenzene	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
1,3-Dinitrobenzene	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
2,4,6-Trinitrotoluene	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
2-Amino-4,6-dinitrotoluene	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
2-Nitrotoluene	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
3-Nitrotoluene	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
4-Amino-2,6-dinitrotoluene	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
4-Nitrotoluene	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
HMX	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
RDX	200 U	220 U	210 U	220 U	220 U	200 U	220 U	200 U	240 U	250 U	250 U
Tetryl	390 U	430 U	420 U	430 U	450 U	400 U	430 U	390 U	490 U	500 U	500 U
Total Metals (mg/kg)											
Aluminum	7,220	6,370	7,140	8,830 J	6,990 J	7,630 J	7,760 J	7,190 J	7,300 J	7,150 J	4,010 J
Antimony	3.3 UL	3.4 UL	3.3 UL	3.2 UL	4.1 UL	3.5 UL	4.2 UL	3.4 UL	3.5 UL	3.6 UL	3.2 UL
Arsenic	1.8	1.1	2.1	1.8 L	24.3	1.9	2	1.5	1.4	1.6	3.5
Barium	90.1 J	44.5 J	57.5 J	48.3 J	250 J	56.8 J	42 J	54 J	54.3 J	54.6 J	17.8 J
Beryllium	0.85	0.52	0.75	0.57	0.94	0.7	0.5	0.69	0.61	0.74	1.6
Cadmium	0.22 U	0.23 U	0.22 U	0.21 UL	0.12 J	0.24 U	0.28 U	0.23 U	0.23 U	0.24 U	1.1 U
Calcium	873	483	576	1,060 J	24,800 J	1,250 J	1,640 J	988 J	907 J	1,180 J	485 J
Chromium	11.6 J	5.3 J	6.8 J	8.7 J	18 J	6.3 J	7.7 J	5 J	5.6 J	5.9 J	16.2 J
Cobalt	2.4 J	2.3 J	2.2 J	2.2 L	2 J	2.1 J	1.9 J	2.1 J	1.8 J	2.1 J	4
Copper	39.6 J	2.4 J	9.8 J	2.6	42.7	3.6	4.9	3	2.7	3.8	4.8
Cyanide	0.14 U	0.14 U	0.13 U	0.13 U	0.33	0.15 U	0.24	0.13 U	0.14 U	0.15 U	0.13 U
Iron	7,120	4,450	4,690	8,060 J	4,240 J	4,730 J	6,760 J	4,010 J	4,410 J	5,150 J	19,800 J

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO009	CAS07-SO010	CAS07-SO011	CAS07-SO012	CAS07-SO013		CAS07-SO014			CAS07-SO015	
Sample ID	NWSY-90-7-SC-FLR-144	NWSY-90-7-SC-FLR-145	NWSY-90-7-SC-FLR-146	NWSY-90-7-SC-FLR-147	NWSY-90-7-SC-PER-148	NWSY-90-7-SC-PER-149	NWSY-90-7-SC-PER-150	NWSY-90-7-SC-PER-151	NWSY-90-7-SC-PER-152	NWSY-90-7-SC-PER-153	NWSY-90-7-SC-PER-154
Sample Date	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08
Chemical Name											
Lead	204 J	8 J	41.5 J	6.4 J	42.1 J	11.5 J	15.6 J	10.3 J	8.1 J	11.8 J	1.8 J
Magnesium	427	395	412	493 J	1,320 J	505 J	605 J	366 J	399 J	442 J	170 J
Manganese	184 J	50.3 J	122 J	92.9 J	466 J	89.4 J	102 J	204 J	110 J	125 J	100 J
Mercury	0.043 K	0.019 K	0.037 K	0.027 K	0.048 K	0.026 K	0.058 K	0.03 K	0.019 K	0.1 K	0.092 U
Nickel	4.6	3.2	4.1	3.2 J	6.6 J	3.7 J	3.9 J	3.4 J	3.2 J	3.4 J	2.8 J
Potassium	369 B	356 B	337 B	430 B	610 B	401 B	575 B	337 B	362 B	416 B	335 B
Selenium	0.58 J	0.41 J	0.63 J	0.77 L	0.33 J	0.52 J	0.82 J	0.63 J	0.48 J	0.47 J	1.7 J
Silver	0.56 U	0.57 U	0.56 U	0.53 UL	0.68 U	0.59 U	0.71 U	0.57 U	0.58 U	0.6 U	0.54 U
Sodium	200 B	173 B	194 B	209 B	345 B	166 B	246 B	176 B	185 B	194 B	227 B
Thallium	0.56 U	0.57 U	0.56 U	0.53 UL	2.7 U	0.59 U	0.71 U	0.57 U	0.58 U	0.6 U	1.4
Vanadium	10.2 J	9.5 J	10 J	15.5 J	16.3 J	11.2 J	18.4 J	9.3 J	10.2 J	10.6 J	18.6 J
Zinc	79.4 J	10.2 J	29 J	9.8 L	119	20.3	23.3	13.7	11.6	18.5	16.4
Wet Chemistry											
pH (pH units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

R - Rejected Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO016		CAS07-SO017	CAS07-SO018		CAS07-SO019		CAS07-SO020	CAS07-SO021	CAS07-SO022
Sample ID	NWSY-90-7-SC-PER-159	NWSY-90-7-SC-PER-186	NWSY-90-7-SC-FLR-160	NWSY-90-7-SC-PER-161	NWSY-90-7-SC-PER-162	NWSY-90-7-SC-PER-163	NWSY-90-7-SC-PER-164	NWSY-90-7-SC-FLR-165	NWSY-90-7-SC-FLR-166	NWSY-90-7-SC-FLR-167
Sample Date	02/29/08	04/09/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Volatile Organic Compounds (µg/kg)										
1,1,1-Trichloroethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
1,1,2,2-Tetrachloroethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 UJ	7.5 U	6.5 U	7.6 UJ	6.1 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
1,1,2-Trichloroethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
1,1-Dichloroethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
1,1-Dichloroethene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
1,2,3-Trichlorobenzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 UJ	7.5 U	6.5 U	7.6 UJ	6.1 U
1,2,4-Trichlorobenzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 UJ	7.5 U	6.5 U	7.6 UJ	6.1 U
1,2-Dibromo-3-chloropropane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 UJ	7.5 U	6.5 U	7.6 UJ	6.1 U
1,2-Dibromoethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
1,2-Dichlorobenzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 UJ	7.5 U	6.5 U	7.6 UJ	6.1 U
1,2-Dichloroethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
1,2-Dichloropropane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
1,3-Dichlorobenzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 UJ	7.5 U	6.5 U	7.6 UJ	6.1 U
1,4-Dichlorobenzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 UJ	7.5 U	6.5 U	7.6 UJ	6.1 U
2-Butanone	33 U	32 UJ	38 U	33 U	32 U	40 U	38 U	33 U	38 U	31 U
2-Hexanone	33 U	32 U	38 U	33 U	32 U	40 U	38 U	33 U	38 U	31 U
4-Methyl-2-pentanone	33 U	32 U	38 U	33 U	32 U	40 U	38 U	33 U	38 U	31 U
Acetone	67 U	64 UJ	77 U	65 U	63 U	83.7 B	75 U	65 U	76 U	61 U
Benzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Bromochloromethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Bromodichloromethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Bromoform	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Bromomethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Carbon disulfide	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Carbon tetrachloride	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Chlorobenzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Chloroethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Chloroform	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Chloromethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
cis-1,2-Dichloroethene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
cis-1,3-Dichloropropene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Cyclohexane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Dibromochloromethane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Dichlorodifluoromethane (Freon-12)	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Ethylbenzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Isopropylbenzene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
m- and p-Xylene	13 U	13 U	15 U	13 U	13 U	16 U	15 U	13 U	15 U	12 U
Methyl acetate	33 U	32 U	38 U	33 U	32 U	40 U	38 U	33 U	38 U	31 U
Methylcyclohexane	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Methylene chloride	33.1 B	42.2	36.9 B	37.7 B	25 B	42.7 B	15.2 B	23 B	11 B	25.7 B
Methyl-tert-butyl ether (MTBE)	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
o-Xylene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Styrene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Tetrachloroethene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Toluene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
trans-1,2-Dichloroethene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
trans-1,3-Dichloropropene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Trichloroethene	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Trichlorofluoromethane (Freon-11)	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U
Vinyl chloride	6.7 U	6.4 U	7.7 U	6.5 U	6.3 U	8.1 U	7.5 U	6.5 U	7.6 U	6.1 U

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO016		CAS07-SO017	CAS07-SO018		CAS07-SO019		CAS07-SO020	CAS07-SO021	CAS07-SO022
Sample ID	NWSY-90-7-SC-PER-159	NWSY-90-7-SC-PER-186	NWSY-90-7-SC-FLR-160	NWSY-90-7-SC-PER-161	NWSY-90-7-SC-PER-162	NWSY-90-7-SC-PER-163	NWSY-90-7-SC-PER-164	NWSY-90-7-SC-FLR-165	NWSY-90-7-SC-FLR-166	NWSY-90-7-SC-FLR-167
Sample Date	02/29/08	04/09/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Semivolatile Organic Compounds (µg/kg)										
1,1-Biphenyl	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
1,2,4,5-Tetrachlorobenzene	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
1,4-Dioxane	330 U	320 U	380 UJ	330 U	320 UJ	400 U	380 U	330 UJ	380 UJ	310 UJ
1-Methylnaphthalene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
2,2'-Oxybis(1-chloropropane)	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2,3,4,6-Tetrachlorophenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2,4,5-Trichlorophenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2,4,6-Trichlorophenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2,4-Dichlorophenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2,4-Dimethylphenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2,4-Dinitrophenol	890 U	1,000 U	950 U	940 U	950 U	940 U	960 U	960 U	1,000 U	920 U
2,4-Dinitrotoluene	240 U	200 R	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
2,6-Dinitrotoluene	240 U	200 R	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
2-Chloronaphthalene	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2-Chlorophenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2-Methylnaphthalene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
2-Methylphenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
2-Nitroaniline	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
2-Nitrophenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
3- and 4-Methylphenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
3,3'-Dichlorobenzidine	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
3-Nitroaniline	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
4,6-Dinitro-2-methylphenol	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
4-Bromophenyl-phenylether	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
4-Chloro-3-methylphenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
4-Chloroaniline	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
4-Chlorophenyl-phenylether	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
4-Nitroaniline	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
4-Nitrophenol	890 U	1,000 U	950 U	940 U	950 U	940 U	960 U	960 U	1,000 U	920 U
Acenaphthene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
Acenaphthylene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
Acetophenone	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Anthracene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
Atrazine	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Benzaldehyde	890 U	1,000 U	950 U	940 U	950 U	940 U	960 U	960 U	1,000 U	920 U
Benzo(a)anthracene	57 U	65 U	61 U	60 U	61 U	60 U	62 U	61 U	64 U	59 U
Benzo(a)pyrene	57 U	65 U	61 U	60 U	61 U	60 U	62 U	61 U	64 U	59 U
Benzo(b)fluoranthene	57 U	65 U	61 U	60 U	61 U	60 U	62 U	61 U	64 U	59 U
Benzo(g,h,i)perylene	57 U	65 U	61 U	60 U	61 U	60 U	62 U	61 U	64 U	59 U
Benzo(k)fluoranthene	57 U	65 U	61 U	60 U	61 U	60 U	62 U	61 U	64 U	59 U
bis(2-Chloroethoxy)methane	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
bis(2-Chloroethyl)ether	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
bis(2-Ethylhexyl)phthalate	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
Butylbenzylphthalate	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
Caprolactam	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Carbazole	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Chrysene	57 U	65 U	61 U	60 U	61 U	60 U	62 U	61 U	64 U	59 U
Dibenz(a,h)anthracene	57 U	65 U	61 U	60 U	61 U	60 U	62 U	61 U	64 U	59 U
Dibenzofuran	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Diethylphthalate	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
Dimethyl phthalate	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
Di-n-butylphthalate	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
Di-n-octylphthalate	360 U	400 U	380 U	380 U	380 U	380 U	390 U	380 U	400 U	370 U
Fluoranthene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
Fluorene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
Hexachlorobenzene	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Hexachlorobutadiene	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Hexachlorocyclopentadiene	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Hexachloroethane	180 UL	200 U	190 UL	190 UL	190 UL	190 UL	190 UL	190 UL	200 UL	180 UL
Indeno(1,2,3-cd)pyrene	57 U	65 U	61 U	60 U	61 U	60 U	62 U	61 U	64 U	59 U
Isophorone	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Naphthalene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
n-Nitroso-di-n-propylamine	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
n-Nitrosodiphenylamine	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Nitrobenzene	240 U	200 R	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO016		CAS07-SO017	CAS07-SO018		CAS07-SO019		CAS07-SO020	CAS07-SO021	CAS07-SO022
Sample ID	NWSY-90-7-SC-PER-159	NWSY-90-7-SC-PER-186	NWSY-90-7-SC-FLR-160	NWSY-90-7-SC-PER-161	NWSY-90-7-SC-PER-162	NWSY-90-7-SC-PER-163	NWSY-90-7-SC-PER-164	NWSY-90-7-SC-FLR-165	NWSY-90-7-SC-FLR-166	NWSY-90-7-SC-FLR-167
Sample Date	02/29/08	04/09/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Pentachlorophenol	890 U	1,000 U	950 U	940 U	950 U	940 U	960 U	960 U	1,000 U	920 U
Phenanthrene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
Phenol	180 U	200 U	190 U	190 U	190 U	190 U	190 U	190 U	200 U	180 U
Pyrene	280 U	320 U	310 U	300 U	300 U	300 U	310 U	310 U	320 U	290 U
Pesticide/Polychlorinated Biphenyls (µg/kg)										
4,4'-DDD	3.6 U	4 U	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
4,4'-DDE	3.6 U	4 U	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
4,4'-DDT	3.6 U	4 U	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
Aldrin	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
alpha-BHC	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
alpha-Chlordane	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
Aroclor-1016	18 U	20 U	19 U	19 U	19 U	19 UL	19 U	19 U	20 U	19 U
Aroclor-1221	18 U	20 U	19 U	19 U	19 U	19 U	19 U	19 U	20 U	19 U
Aroclor-1232	18 U	20 U	19 U	19 U	19 U	19 U	19 U	19 U	20 U	19 U
Aroclor-1242	18 U	20 U	19 U	19 U	19 U	19 U	19 U	19 U	20 U	19 U
Aroclor-1248	18 U	20 U	19 U	19 U	19 U	19 U	19 U	19 U	20 U	19 U
Aroclor-1254	18 U	20 U	19 U	19 U	19 U	19 U	19 U	19 U	20 U	19 U
Aroclor-1260	18 U	20 U	19 U	19 U	19 U	19 UL	19 U	19 U	20 U	19 U
Aroclor-1262	18 U	20 U	19 U	19 U	19 U	19 U	19 U	19 U	20 U	19 U
Aroclor-1268	18 U	20 U	19 U	19 U	19 U	19 U	19 U	19 U	20 U	19 U
beta-BHC	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
delta-BHC	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
Dieldrin	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
Endosulfan I	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
Endosulfan II	3.6 U	4 U	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
Endosulfan sulfate	3.6 U	4 U	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
Endrin	3.6 U	4 U	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
Endrin aldehyde	3.6 U	4 UJ	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
Endrin ketone	3.6 U	4 U	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
gamma-BHC (Lindane)	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
gamma-Chlordane	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
Heptachlor	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
Heptachlor epoxide	1.8 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	2 U	1.9 U
Methoxychlor	3.6 U	4 U	3.8 U	3.7 U	3.8 U	3.8 U	3.9 U	3.8 U	4 U	3.7 U
Polychlorinated biphenyls (PCBs)	36 U	40 U	38 U	37 U	38 U	38 U	39 U	38 U	40 U	37 U
Toxaphene	89 U	99 U	94 U	93 U	95 U	94 U	96 U	96 U	100 U	93 U
Dioxin/Furans (pg/g)										
2,3,7,8-TCDD (dioxin)	0.0712 U	0.113 U	0.361 U	0.623 U	0.187 U	1.13 U	0.127 U	0.181 U	0.506 U	0.348 U
Explosives (µg/kg)										
1,3,5-Trinitrobenzene	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
1,3-Dinitrobenzene	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
2,4,6-Trinitrotoluene	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
2-Amino-4,6-dinitrotoluene	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
2-Nitrotoluene	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
3-Nitrotoluene	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
4-Amino-2,6-dinitrotoluene	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
4-Nitrotoluene	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
HMX	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
RDX	240 U	190 U	240 U	250 U	240 U	240 U	250 U	250 U	250 U	250 U
Tetryl	490 U	380 U	480 U	500 U	480 U	490 U	500 U	500 U	500 U	500 U
Total Metals (mg/kg)										
Aluminum	6,220 J	6,060	12,100 J	7,500 J	8,460 J	5,550 J	7,000 J	6,850 J	7,140 J	8,190 J
Antimony	3.2 UL	3.6 UL	3.4 UL	3.2 UL	3.3 UL	3.3 UL	3.4 UL	3.4 UL	3.5 UL	3.3 UL
Arsenic	1.4	1.2	1.7	1.4	1.4	1.3	1.4	1.5	1.6	2.1
Barium	42.6 J	44.9	48.3 J	69.1 J	51.4 J	54 J	50.4 J	54.2 J	64.8 J	64.9 J
Beryllium	0.39	0.39	0.43	0.89	0.48	0.66	0.73	0.91	0.93	0.53
Cadmium	0.21 U	0.24 U	1.2 U	0.22 U	0.22 U	0.22 U	0.22 U	0.23 U	0.23 U	0.22 U
Calcium	594 J	418	1,210 J	875 J	762 J	1,790 J	449 J	518 J	1,010 J	1,020 J
Chromium	7 J	5.5	16.5 J	5.4 J	8.3 J	5.5 J	6.2 J	4.8 J	5.9 J	10.1 J
Cobalt	1.6 J	2.1 J	1.6 J	2.6 J	1.9 J	2.5 J	2.3 J	3.1	2.9	2.6 J
Copper	3.4 J	1.3 J	6.1 J	3.5 J	2.5 J	6 J	1.5 J	2.5 J	14.3 J	3.7 J
Cyanide	0.12 U	0.13 U	0.14 U	0.13 U	0.14 U	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U
Iron	6,480 J	4,280	20,000 J	4,360 J	8,230 J	4,050 J	5,550 J	3,890 J	3,900 J	10,200 J

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO016		CAS07-SO017	CAS07-SO018		CAS07-SO019		CAS07-SO020	CAS07-SO021	CAS07-SO022
Sample ID	NWSY-90-7-SC-PER-159	NWSY-90-7-SC-PER-186	NWSY-90-7-SC-FLR-160	NWSY-90-7-SC-PER-161	NWSY-90-7-SC-PER-162	NWSY-90-7-SC-PER-163	NWSY-90-7-SC-PER-164	NWSY-90-7-SC-FLR-165	NWSY-90-7-SC-FLR-166	NWSY-90-7-SC-FLR-167
Sample Date	02/29/08	04/09/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Lead	10.8 J	6.6 K	23.2 J	14.7 J	9.2 J	34.4 J	4.8 J	7.3 J	58.5 J	4 J
Magnesium	450 J	420	723 J	459 J	560 J	466 J	439 J	406 J	434 J	574 J
Manganese	31.6 J	50.9	15.3 J	149 J	37.4 J	143 J	63.5 J	124 J	196 J	33.2 J
Mercury	0.015 K	0.023 J	0.033 K	0.019 K	0.085 U	0.046 K	0.019 K	0.019 K	0.042 K	0.088 U
Nickel	2.2 J	3	2.9 J	3.8 J	3 J	3.6 J	3.2 J	3.9 J	4.6 J	3.1 J
Potassium	432 B	361 B	700 B	379 B	475 B	389 B	371 B	359 B	381 B	563 B
Selenium	0.51 J	6 U	1.5 J	0.41 J	0.78 J	0.62 J	0.59 J	0.36 J	0.51 J	0.67 J
Silver	0.53 U	0.6 U	0.57 U	0.54 U	0.55 U	0.55 U	0.56 U	0.57 U	0.58 U	0.55 U
Sodium	185 B	54.8 B	247 B	172 B	220 B	196 B	178 B	170 B	184 B	240 B
Thallium	0.37 J	2.4 U	1.2	0.54 U	0.55 U	1.1 U	0.56 U	0.57 U	0.58 U	0.55 U
Vanadium	12.4 J	8.9	30.2 J	9.1 J	15.9 J	9.4 J	11 J	8.2 J	9.5 J	18.7 J
Zinc	8.3 J	8.3	34.3 J	13.9 J	9.2 J	31.7 J	8.2 J	11.3 J	39.3 J	9.4 J
Wet Chemistry										
pH (pH units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

R - Rejected Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO023			CAS07-SO024			CAS07-SO025	CAS07-SO026	CAS07-SO027	
Sample ID	NWSY-90-7-SC-PER-169	NWSY-90-7-SC-PER-170	NWSY-90-7-SC-PER-187	NWSY-90-7-SC-PER-172	NWSY-90-7-SC-PER-188	NWSY-90-7-SC-PER-193	NWSY-90-7-SC-FLR-173	NWSY-90-7-SC-FLR-174	NWSY-90-7-SC-PER-175	NWSY-90-7-SC-PER-176
Sample Date	02/29/08	02/29/08	04/09/08	02/29/08	04/09/08	04/09/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Volatile Organic Compounds (µg/kg)										
1,1,1-Trichloroethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,1,2,2-Tetrachloroethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,1,2-Trichloroethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,1-Dichloroethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,1-Dichloroethene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,2,3-Trichlorobenzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,2,4-Trichlorobenzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,2-Dibromo-3-chloropropane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,2-Dibromoethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,2-Dichlorobenzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,2-Dichloroethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,2-Dichloropropane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,3-Dichlorobenzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
1,4-Dichlorobenzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
2-Butanone	31 U	34 U	34 U	32 U	41 U	44 U	43 U	32 U	28 U	30 U
2-Hexanone	31 U	34 U	34 U	32 U	41 U	44 U	43 U	32 U	28 U	30 U
4-Methyl-2-pentanone	31 U	34 U	34 U	32 U	41 U	44 U	43 U	32 U	28 U	30 U
Acetone	63 U	68 U	69 U	65 U	83 U	88 UJ	85 U	65 U	55 U	60 U
Benzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Bromochloromethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Bromodichloromethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Bromoform	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Bromomethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Carbon disulfide	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Carbon tetrachloride	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Chlorobenzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Chloroethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Chloroform	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Chloromethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
cis-1,2-Dichloroethene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
cis-1,3-Dichloropropene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Cyclohexane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Dibromochloromethane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Dichlorodifluoromethane (Freon-12)	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Ethylbenzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Isopropylbenzene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
m- and p-Xylene	13 U	14 U	14 U	13 U	17 U	18 U	17 U	13 U	11 U	12 U
Methyl acetate	31 U	34 U	34 U	32 U	41 U	44 U	43 U	32 U	28 U	30 U
Methylcyclohexane	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Methylene chloride	21.8 B	12.1 B	29.7 B	13.3 B	25.5 B	24.6 B	15.4 B	17.9 B	11.2 B	16.5 B
Methyl-tert-butyl ether (MTBE)	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
o-Xylene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Styrene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Tetrachloroethene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Toluene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
trans-1,2-Dichloroethene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
trans-1,3-Dichloropropene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Trichloroethene	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Trichlorofluoromethane (Freon-11)	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U
Vinyl chloride	6.3 U	6.8 U	6.9 U	6.5 U	8.3 U	8.8 U	8.5 U	6.5 U	5.5 U	6 U

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO023			CAS07-SO024			CAS07-SO025	CAS07-SO026	CAS07-SO027	
Sample ID	NWSY-90-7-SC-PER-169	NWSY-90-7-SC-PER-170	NWSY-90-7-SC-PER-187	NWSY-90-7-SC-PER-172	NWSY-90-7-SC-PER-188	NWSY-90-7-SC-PER-193	NWSY-90-7-SC-FLR-173	NWSY-90-7-SC-FLR-174	NWSY-90-7-SC-PER-175	NWSY-90-7-SC-PER-176
Sample Date	02/29/08	02/29/08	04/09/08	02/29/08	04/09/08	04/09/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Semivolatile Organic Compounds (µg/kg)										
1,1-Biphenyl	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
1,2,4,5-Tetrachlorobenzene	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
1,4-Dioxane	310 UJ	340 U	340 U	320 UJ	410 U	440 U	430 U	320 U	280 UJ	300 U
1-Methylnaphthalene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
2,2'-Oxybis(1-chloropropane)	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2,3,4,6-Tetrachlorophenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2,4,5-Trichlorophenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2,4,6-Trichlorophenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2,4-Dichlorophenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2,4-Dimethylphenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2,4-Dinitrophenol	950 U	970 U	1,000 U	970 U	1,000 U	990 U	980 U	930 U	970 U	960 U
2,4-Dinitrotoluene	240 U	240 U	200 R	250 U	200 R	200 U	240 U	250 U	240 U	240 U
2,6-Dinitrotoluene	240 U	240 U	200 R	250 U	200 R	200 U	240 U	250 U	240 U	240 U
2-Chloronaphthalene	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2-Chlorophenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2-Methylnaphthalene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
2-Methylphenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
2-Nitroaniline	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
2-Nitrophenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
3- and 4-Methylphenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
3,3'-Dichlorobenzidine	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
3-Nitroaniline	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
4,6-Dinitro-2-methylphenol	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
4-Bromophenyl-phenylether	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
4-Chloro-3-methylphenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
4-Chloroaniline	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
4-Chlorophenyl-phenylether	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
4-Nitroaniline	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
4-Nitrophenol	950 U	970 U	1,000 U	970 U	1,000 U	990 U	980 U	930 U	970 U	960 U
Acenaphthene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
Acenaphthylene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
Acetophenone	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Anthracene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
Atrazine	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Benzaldehyde	950 U	970 U	1,000 U	970 U	1,000 U	990 U	980 U	930 U	970 U	960 U
Benzo(a)anthracene	61 U	62 U	64 U	62 U	64 U	63 U	63 U	59 U	62 U	61 U
Benzo(a)pyrene	61 U	62 U	64 U	62 U	64 U	63 U	63 U	59 U	62 U	61 U
Benzo(b)fluoranthene	61 U	62 U	64 U	62 U	64 U	63 U	63 U	59 U	62 U	61 U
Benzo(g,h,i)perylene	61 U	62 U	64 U	62 U	64 U	63 U	63 U	59 U	62 U	61 U
Benzo(k)fluoranthene	61 U	62 U	64 U	62 U	64 U	63 U	63 U	59 U	62 U	61 U
bis(2-Chloroethoxy)methane	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
bis(2-Chloroethyl)ether	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
bis(2-Ethylhexyl)phthalate	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
Butylbenzylphthalate	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
Caprolactam	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Carbazole	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Chrysene	61 U	62 U	64 U	62 U	64 U	63 U	63 U	59 U	62 U	61 U
Dibenz(a,h)anthracene	61 U	62 U	64 U	62 U	64 U	63 U	63 U	59 U	62 U	61 U
Dibenzofuran	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Diethylphthalate	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
Dimethyl phthalate	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
Di-n-butylphthalate	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
Di-n-octylphthalate	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
Fluoranthene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
Fluorene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
Hexachlorobenzene	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Hexachlorobutadiene	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Hexachlorocyclopentadiene	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Hexachloroethane	190 UL	190 UL	200 U	190 UL	200 U	200 U	200 UL	190 UL	190 UL	190 UL
Indeno(1,2,3-cd)pyrene	61 U	62 U	64 U	62 U	64 U	63 U	63 U	59 U	62 U	61 U
Isophorone	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Naphthalene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
n-Nitroso-di-n-propylamine	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
n-Nitrosodiphenylamine	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Nitrobenzene	240 U	240 U	200 R	250 U	200 R	200 U	240 U	250 U	240 U	240 U

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO023			CAS07-SO024			CAS07-SO025	CAS07-SO026	CAS07-SO027	
Sample ID	NWSY-90-7-SC-PER-169	NWSY-90-7-SC-PER-170	NWSY-90-7-SC-PER-187	NWSY-90-7-SC-PER-172	NWSY-90-7-SC-PER-188	NWSY-90-7-SC-PER-193	NWSY-90-7-SC-FLR-173	NWSY-90-7-SC-FLR-174	NWSY-90-7-SC-PER-175	NWSY-90-7-SC-PER-176
Sample Date	02/29/08	02/29/08	04/09/08	02/29/08	04/09/08	04/09/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Pentachlorophenol	950 U	970 U	1,000 U	970 U	1,000 U	990 U	980 U	930 U	970 U	960 U
Phenanthrene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
Phenol	190 U	190 U	200 U	190 U	200 U	200 U	200 U	190 U	190 U	190 U
Pyrene	300 U	310 U	320 U	310 U	320 U	320 U	310 U	300 U	310 U	310 U
Pesticide/Polychlorinated Biphenyls (µg/kg)										
4,4'-DDD	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U	4 U	3.8 U	3.9 U	3.8 U
4,4'-DDE	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U	4 U	3.8 U	3.9 U	3.8 U
4,4'-DDT	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U	4 U	3.8 U	3.9 U	3.8 U
Aldrin	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
alpha-BHC	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
alpha-Chlordane	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
Aroclor-1016	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
Aroclor-1221	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
Aroclor-1232	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
Aroclor-1242	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
Aroclor-1248	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
Aroclor-1254	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
Aroclor-1260	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
Aroclor-1262	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
Aroclor-1268	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	19 U
beta-BHC	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
delta-BHC	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
Dieldrin	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
Endosulfan I	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
Endosulfan II	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U	4 U	3.8 U	3.9 U	3.8 U
Endosulfan sulfate	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U	4 U	3.8 U	3.9 U	3.8 U
Endrin	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U	4 U	3.8 U	3.9 U	3.8 U
Endrin aldehyde	3.8 U	3.9 U	4.1 UJ	3.9 U	4 UJ	4.1 UJ	4 U	3.8 U	3.9 U	3.8 U
Endrin ketone	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U	4 U	3.8 U	3.9 U	3.8 U
gamma-BHC (Lindane)	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
gamma-Chlordane	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
Heptachlor	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
Heptachlor epoxide	1.9 U	1.9 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U
Methoxychlor	3.8 U	3.9 U	4.1 U	3.9 U	4 U	4.1 U	4 U	3.8 U	3.9 U	3.8 U
Polychlorinated biphenyls (PCBs)	38 U	39 U	41 U	39 U	40 U	41 U	40 U	38 U	39 U	38 U
Toxaphene	95 U	97 U	100 U	99 U	100 U	100 U	99 U	94 U	97 U	94 U
Dioxin/Furans (pg/g)										
2,3,7,8-TCDD (dioxin)	0.176 U	0.163 U	0.205 U	0.188 U	0.233 U	0.187 U	0.174 U	0.121 U	0.132 U	0.153 U
Explosives (µg/kg)										
1,3,5-Trinitrobenzene	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
1,3-Dinitrobenzene	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
2,4,6-Trinitrotoluene	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
2-Amino-4,6-dinitrotoluene	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
2-Nitrotoluene	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
3-Nitrotoluene	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
4-Amino-2,6-dinitrotoluene	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
4-Nitrotoluene	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
HMX	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
RDX	240 U	240 U	190 U	250 U	190 U	200 U	240 U	250 U	240 U	240 U
Tetryl	480 U	490 U	370 U	500 U	380 U	400 U	480 U	500 U	490 U	490 U
Total Metals (mg/kg)										
Aluminum	9,100 J	8,610 J	8,390	7,080 J	9,730	11,900	17,300 J	10,600 J	13,500 J	9,590
Antimony	3.3 UL	3.4 UL	14 UL	3.4 UL	14 UL	14 UL	0.29 L	3.4 UL	3.3 UL	3.3 UL
Arsenic	1.4	1.5	1.8 J	1.4	2.3	2.9	2.6	1.8	1.1	1.5
Barium	47.2 J	47.7 J	80.3	60.8 J	83.4	98.5	25.5 J	49.9 J	33.2 J	52.6
Beryllium	0.61	0.58	1 J	0.98	1.2	1.3	0.67	0.57	0.43	0.69
Cadmium	0.88 U	0.92 U	0.95 U	0.23 U	0.91 U	0.96 U	2.3 U	0.23 U	0.88 U	0.22 U
Calcium	902 J	980 J	999 J	685 J	758 J	976 J	2,050 J	867 J	1,490 J	744
Chromium	9.6 J	9.5 J	6.8	5.2 J	6.3	8.1	39 J	11.8 J	19 J	10
Cobalt	2.2 J	2 J	4.1 J	4.1	5 J	5.8 J	2 J	2.1 J	2 J	2.4 J
Copper	2.1 J	2.2 J	5.1 J	6.5 J	5.5 J	6.4	2.9 J	3.4 J	2.6 J	3.4
Cyanide	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U	0.14 U	0.14 U	0.13 U	0.14 U	0.14 U
Iron	8,820 J	8,750 J	5,070	3,800 J	4,820	5,820	57,800 J	10,700 J	18,000 J	8,480

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO023			CAS07-SO024			CAS07-SO025	CAS07-SO026	CAS07-SO027	
Sample ID	NWSY-90-7-SC-PER-169	NWSY-90-7-SC-PER-170	NWSY-90-7-SC-PER-187	NWSY-90-7-SC-PER-172	NWSY-90-7-SC-PER-188	NWSY-90-7-SC-PER-193	NWSY-90-7-SC-FLR-173	NWSY-90-7-SC-FLR-174	NWSY-90-7-SC-PER-175	NWSY-90-7-SC-PER-176
Sample Date	02/29/08	02/29/08	04/09/08	02/29/08	04/09/08	04/09/08	02/29/08	02/29/08	02/29/08	02/29/08
Chemical Name										
Lead	6.3 J	8 J	18.9 J	20.4 J	12.8 J	13.9 J	5.8 U	7.5 J	3.1 J	7.2 J
Magnesium	577 J	562 J	526 J	394 J	520 J	679 J	889 J	676 J	877 J	615
Manganese	27.7 J	29 J	241	157 J	225	270	17 J	22.1 J	14.4 J	36.2
Mercury	0.031 K	0.043 K	0.088 U	0.025 K	0.027 J	0.027 J	0.014 K	0.026 K	0.041 K	0.013 K
Nickel	3.7 J	3.4 J	5.2 J	4 J	5.6 J	7 J	3.2 J	3.7 J	3.3 J	4
Potassium	493 B	489 B	750 B	367 B	722 B	815 B	1,030 B	590 B	810 B	499 B
Selenium	0.73 J	0.63 J	24 U	0.36 J	23 U	24 U	2.9 J	0.81 J	1.5 J	0.7 J
Silver	0.55 U	0.57 U	2.4 U	0.57 U	2.3 U	2.4 U	0.58 U	0.56 U	0.56 U	0.55 U
Sodium	211 B	210 B	265 B	202 B	244 B	273 B	408 B	237 B	279 B	223 B
Thallium	0.33 J	0.41 J	2.4 U	0.57 U	2.3 U	2.4 U	1.6	0.57	0.44 J	0.55 U
Vanadium	17.4 J	16.9 J	9.6 J	7.8 J	9.2 J	11.8 J	63.1 J	21 J	29 J	17.9
Zinc	9.4 J	9.9 J	21.2	17.4 J	14.9	19.6	15.3 J	20.2 J	11.3 J	13.5 J
Wet Chemistry										
pH (pH units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

R - Rejected Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO028			CAS07-SO035	CAS07-SO036	CAS07-SO037	CAS07-SO038	CAS07-SO039	
Sample ID	NWSY-90-7-SC-PER-177	NWSY-90-7-SC-PER-178	NWSY-90-7-SC-PER-179	CAS07-SS01-0024-0111	CAS07-SS02-0024-0111	CAS07-SS03-0024-0111	CAS07-SS04-0024-0111	CAS07-SS05-0024-0111	CAS07-SS05P-0024-0111
Sample Date	02/29/08	02/29/08	02/29/08	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11
Chemical Name									
Volatile Organic Compounds (µg/kg)									
1,1,1-Trichloroethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	6.4 UJ	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,2,3-Trichlorobenzene	6.4 UJ	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	6.4 UJ	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	6.4 UJ	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	6.4 UJ	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	6.4 UJ	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	6.4 UJ	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
2-Butanone	32 U	34 U	30 U	NA	NA	NA	NA	NA	NA
2-Hexanone	32 U	34 U	30 U	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone	32 U	34 U	30 U	NA	NA	NA	NA	NA	NA
Acetone	64 U	68 U	61 U	NA	NA	NA	NA	NA	NA
Benzene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Bromochloromethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Bromodichloromethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Bromoform	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Bromomethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Carbon disulfide	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Chlorobenzene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Chloroethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Chloroform	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Chloromethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Cyclohexane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Dibromochloromethane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane (Freon-12)	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Ethylbenzene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Isopropylbenzene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
m- and p-Xylene	13 U	14 U	12 U	NA	NA	NA	NA	NA	NA
Methyl acetate	32 U	34 U	30 U	NA	NA	NA	NA	NA	NA
Methylcyclohexane	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Methylene chloride	13.5 B	16.7 B	15.3 B	NA	NA	NA	NA	NA	NA
Methyl-tert-butyl ether (MTBE)	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
o-Xylene	6.4 U	7.3 J	6.1 UJ	NA	NA	NA	NA	NA	NA
Styrene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Tetrachloroethene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Toluene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Trichloroethene	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane (Freon-11)	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA
Vinyl chloride	6.4 U	6.8 U	6.1 U	NA	NA	NA	NA	NA	NA

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO028			CAS07-SO035	CAS07-SO036	CAS07-SO037	CAS07-SO038	CAS07-SO039	
Sample ID	NWSY-90-7-SC-PER-177	NWSY-90-7-SC-PER-178	NWSY-90-7-SC-PER-179	CAS07-SS01-0024-0111	CAS07-SS02-0024-0111	CAS07-SS03-0024-0111	CAS07-SS04-0024-0111	CAS07-SS05-0024-0111	CAS07-SS05P-0024-0111
Sample Date	02/29/08	02/29/08	02/29/08	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11
Chemical Name									
Semivolatile Organic Compounds (µg/kg)									
1,1-Biphenyl	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
1,4-Dioxane	320 U	340 U	300 U	NA	NA	NA	NA	NA	NA
1-Methylnaphthalene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2,3,4,6-Tetrachlorophenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	1,100 U	970 U	960 U	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2-Chlorophenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
2-Methylphenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
2-Nitroaniline	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
2-Nitrophenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
3- and 4-Methylphenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
3-Nitroaniline	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
4-Chloroaniline	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
4-Nitroaniline	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
4-Nitrophenol	1,100 U	970 U	960 U	NA	NA	NA	NA	NA	NA
Acenaphthene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
Acenaphthylene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
Acetophenone	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Anthracene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
Atrazine	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Benzaldehyde	1,100 U	970 U	960 U	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	73 U	62 U	62 U	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	73 U	62 U	62 U	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	73 U	62 U	62 U	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	73 U	62 U	62 U	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	73 U	62 U	62 U	NA	NA	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
Caprolactam	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Carbazole	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Chrysene	73 U	62 U	62 U	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	73 U	62 U	62 U	NA	NA	NA	NA	NA	NA
Dibenzofuran	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Diethylphthalate	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
Dimethyl phthalate	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
Di-n-octylphthalate	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
Fluoranthene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
Fluorene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Hexachloroethane	230 UL	190 U	190 U	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	73 U	62 U	62 U	NA	NA	NA	NA	NA	NA
Isophorone	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Naphthalene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
n-Nitroso-di-n-propylamine	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Nitrobenzene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO028			CAS07-SO035	CAS07-SO036	CAS07-SO037	CAS07-SO038	CAS07-SO039	
Sample ID	NWSY-90-7-SC-PER-177	NWSY-90-7-SC-PER-178	NWSY-90-7-SC-PER-179	CAS07-SS01-0024-0111	CAS07-SS02-0024-0111	CAS07-SS03-0024-0111	CAS07-SS04-0024-0111	CAS07-SS05-0024-0111	CAS07-SS05P-0024-0111
Sample Date	02/29/08	02/29/08	02/29/08	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11
Chemical Name									
Pentachlorophenol	1,100 U	970 U	960 U	NA	NA	NA	NA	NA	NA
Phenanthrene	370 U	310 U	310 U	NA	NA	NA	NA	NA	NA
Phenol	230 U	190 U	190 U	NA	NA	NA	NA	NA	NA
Pyrene	370 U	310 UJ	310 UJ	NA	NA	NA	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (µg/kg)									
4,4'-DDD	4.6 U	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
4,4'-DDE	4.6 UL	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
4,4'-DDT	46 UL	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
Aldrin	2.3 U	2 U	1.9 U	NA	NA	NA	NA	NA	NA
alpha-BHC	2.3 U	2 U	1.9 U	NA	NA	NA	NA	NA	NA
alpha-Chlordane	2.3 UL	2 U	1.9 U	NA	NA	NA	NA	NA	NA
Aroclor-1016	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
Aroclor-1221	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
Aroclor-1232	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
Aroclor-1242	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
Aroclor-1248	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
Aroclor-1254	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
Aroclor-1260	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
Aroclor-1262	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
Aroclor-1268	23 U	20 U	19 U	NA	NA	NA	NA	NA	NA
beta-BHC	2.3 U	2 U	1.9 U	NA	NA	NA	NA	NA	NA
delta-BHC	2.3 U	2 U	1.9 U	NA	NA	NA	NA	NA	NA
Dieldrin	2.3 UL	2 U	1.9 U	NA	NA	NA	NA	NA	NA
Endosulfan I	2.3 U	2 U	1.9 U	NA	NA	NA	NA	NA	NA
Endosulfan II	4.6 UL	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
Endosulfan sulfate	4.6 UL	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
Endrin	4.6 U	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
Endrin aldehyde	4.6 UL	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
Endrin ketone	4.6 U	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	2.3 U	2 U	1.9 U	NA	NA	NA	NA	NA	NA
gamma-Chlordane	2.3 UL	2 U	1.9 U	NA	NA	NA	NA	NA	NA
Heptachlor	23 UL	2 U	1.9 U	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	2.3 UL	2 U	1.9 U	NA	NA	NA	NA	NA	NA
Methoxychlor	46 U	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA
Polychlorinated biphenyls (PCBs)	46 U	39 U	39 U	NA	NA	NA	NA	NA	NA
Toxaphene	110 U	98 U	96 U	NA	NA	NA	NA	NA	NA
Dioxin/Furans (pg/g)									
2,3,7,8-TCDD (dioxin)	0.19 U	0.136 U	0.181 U	NA	NA	NA	NA	NA	NA
Explosives (µg/kg)									
1,3,5-Trinitrobenzene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
2,4,6-Trinitrotoluene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
2-Amino-4,6-dinitrotoluene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
2-Nitrotoluene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
3-Nitrotoluene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
4-Amino-2,6-dinitrotoluene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
4-Nitrotoluene	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
HMX	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
RDX	250 U	240 U	240 U	NA	NA	NA	NA	NA	NA
Tetryl	500 U	480 U	490 U	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)									
Aluminum	6,810	7,910	7,840	NA	NA	NA	NA	NA	NA
Antimony	4.1 UL	3.5 UL	3.3 UL	NA	NA	NA	NA	NA	NA
Arsenic	2	1.3	1.1	NA	NA	NA	NA	NA	NA
Barium	76	54.6	53.1	NA	NA	NA	NA	NA	NA
Beryllium	0.9	0.75	0.77	NA	NA	NA	NA	NA	NA
Cadmium	0.27 U	0.23 U	0.22 U	NA	NA	NA	NA	NA	NA
Calcium	2,190	546	555	NA	NA	NA	NA	NA	NA
Chromium	6.7	6.7	6.6	NA	NA	NA	NA	NA	NA
Cobalt	2.8 J	2.9	2.9	NA	NA	NA	NA	NA	NA
Copper	8.9	2.5	2.7	NA	NA	NA	NA	NA	NA
Cyanide	0.16 U	0.14 U	0.14 U	NA	NA	NA	NA	NA	NA
Iron	4,240	5,300	5,230	NA	NA	NA	NA	NA	NA

TABLE D-1

Raw Soil Analytical Data - 2008 and 2011

Site 7 Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SO028			CAS07-SO035	CAS07-SO036	CAS07-SO037	CAS07-SO038	CAS07-SO039	
Sample ID	NWSY-90-7-SC-PER-177	NWSY-90-7-SC-PER-178	NWSY-90-7-SC-PER-179	CAS07-SS01-0024-0111	CAS07-SS02-0024-0111	CAS07-SS03-0024-0111	CAS07-SS04-0024-0111	CAS07-SS05-0024-0111	CAS07-SS05P-0024-0111
Sample Date	02/29/08	02/29/08	02/29/08	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11	01/25/11
Chemical Name									
Lead	62.9 J	6.5 J	7 J	NA	NA	NA	NA	NA	NA
Magnesium	573	522	513	NA	NA	NA	NA	NA	NA
Manganese	166	56.7	57.3	NA	NA	NA	NA	NA	NA
Mercury	0.071 K	0.022 K	0.023 K	NA	NA	NA	NA	NA	NA
Nickel	4.2	4.1	4	NA	NA	NA	NA	NA	NA
Potassium	639 B	421 B	406 B	NA	NA	NA	NA	NA	NA
Selenium	0.66 J	0.42 J	0.38 J	NA	NA	NA	NA	NA	NA
Silver	0.68 U	0.58 U	0.55 U	NA	NA	NA	NA	NA	NA
Sodium	158 B	194 B	188 B	NA	NA	NA	NA	NA	NA
Thallium	0.68 U	0.58 U	0.55 U	NA	NA	NA	NA	NA	NA
Vanadium	9.6	11.6	11.2	NA	NA	NA	NA	NA	NA
Zinc	35.5 J	9.6 J	9.7 J	NA	NA	NA	NA	NA	NA
Wet Chemistry									
pH (pH units)	NA	NA	NA	6.11 H3	5.27 H3	4.85 H3	5.62 H3	6.3 H3	6.36 H3

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

H3 - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

R - Rejected Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

mg/kg - Milligrams per kilogram

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW01*	CAS07-MW02*	CAS07-MW03			CAS07-MW04		CAS07-MW05		CAS07-MW06			CAS07-MW07	
Sample ID	CAS07-MW01-0111	CAS07-MW02-0111	CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414	CAS07-MW05-0111	CAS07-GW05-0414	CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414
Sample Date	01/28/11	01/28/11	01/25/11	04/09/14	04/09/14	01/28/11	04/09/14	01/25/11	04/09/14	01/24/11	01/24/11	04/09/14	01/24/11	04/09/14
Chemical Name														
Volatile Organic Compounds (µg/l)														
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	1 U	1 U	1 U	0.2 U	0.2 U	1 U	0.2 U	1 U	0.2 U	1 U	1 U	0.2 U	1 U	0.2 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,2,3-Trichlorobenzene	NA	NA	NA	0.2 U	0.2 U	NA	0.2 U	NA	0.2 U	NA	NA	0.2 U	NA	0.2 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,2-Dibromo-3-chloropropane	1 U	1 U	1 U	0.2 U	0.2 U	1 U	0.2 U	1 U	0.2 U	1 U	1 U	0.2 U	1 U	0.2 U
1,2-Dibromoethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
2-Butanone	5 U	5 U	5 U	2.5 U	2.5 U	5 U	2.5 U	5 U	2.5 U	5 U	5 U	2.5 U	5 U	2.5 U
2-Hexanone	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
4-Methyl-2-pentanone	2.5 U	2.5 U	2.5 U	1 U	1 U	2.5 U	1 U	2.5 U	1 U	2.5 U	2.5 U	1 U	2.5 U	1 U
Acetone	5 U	5 U	5 U	1 U	1 U	4.73 J	1 U	5 U	1 U	5 U	5 U	1 U	5 U	1 U
Benzene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Bromochloromethane	NA	NA	NA	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA	NA	0.5 U	NA	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.46 J	0.528 J	0.2 U	0.5 U	0.2 U
Bromoform	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Bromomethane	1 U	1 U	1 U	0.2 U	0.2 U	1 U	0.2 U	1 U	0.2 U	1 U	1 U	0.2 U	1 U	0.2 U
Carbon disulfide	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Chloroethane	1 U	1 U	1 U	0.5 U	0.5 U	1 U	0.5 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.614 J	0.2 U	0.5 U	0.2 U	0.757 J	0.628 J	0.2 U	0.5 U	0.2 U
Chloromethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
cis-1,2-Dichloroethene	0.5 U	0.5 U	2.27 J	1.9	1.9	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	7.26	6.2
cis-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Cyclohexane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.609 J	0.555 J	0.2 U	0.345 J	0.2 U
Dichlorodifluoromethane (Freon-12)	1 U	1 U	1 U	0.2 U	0.2 U	1 U	0.2 U	1 U	0.2 U	1 U	1 U	0.2 U	1 U	0.2 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Isopropylbenzene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
m- and p-Xylene	1 U	1 U	1 U	0.4 U	0.4 U	1 U	0.4 U	1 U	0.4 U	1 U	1 U	0.4 U	1 U	0.4 U
Methyl acetate	1 U	1 U	1 U	0.5 U	0.5 U	1 U	0.5 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Methylene chloride	1 U	1 U	1 U	0.2 U	0.2 U	1 U	0.2 U	1 U	0.2 U	1 U	1 U	0.2 U	1 U	0.2 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
o-Xylene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Styrene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.474 J	0.2 U
Toluene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.28 J	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
trans-1,2-Dichloroethene	0.5 U	0.5 U	0.444 J	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
trans-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.5 U	0.2 U
Trichloroethene	0.5 U	0.5 U	1.27 J	1.7	1.6	0.5 U	0.2 U	0.5 U	0.2 U	0.274 J	0.518 J	0.2 U	86.4	53.8
Trichlorofluoromethane (Freon-11)	1 U	1 U	1 U	0.2 U	0.2 U	1 U	0.2 U	1 U	0.2 U	1 U	1 U	0.2 U	1 U	0.2 U
Vinyl chloride	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 J	0.2 U
Xylene, total	1.5 U	1.5 U	1.5 U	NA	NA	1.5 U	NA	1.5 U	NA	1.5 U	1.5 U	NA	1.5 U	NA

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW01*	CAS07-MW02*	CAS07-MW03			CAS07-MW04		CAS07-MW05		CAS07-MW06			CAS07-MW07	
Sample ID	CAS07-MW01-0111	CAS07-MW02-0111	CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414	CAS07-MW05-0111	CAS07-GW05-0414	CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414
Sample Date	01/28/11	01/28/11	01/25/11	04/09/14	04/09/14	01/28/11	04/09/14	01/25/11	04/09/14	01/24/11	01/24/11	04/09/14	01/24/11	04/09/14
Chemical Name														
Semivolatile Organic Compounds (µg/l)														
1,1-Biphenyl	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2,2'-Oxybis(1-chloropropane)	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2,4,5-Trichlorophenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2,4,6-Trichlorophenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2,4-Dichlorophenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2,4-Dimethylphenol	10.4 U	9.43 U	9.43 U	NA	NA	9.62 U	NA	9.26 U	NA	9.26 U	9.43 U	NA	10.2 U	NA
2,4-Dinitrophenol	26 U	23.6 U	23.6 U	NA	NA	24 U	NA	23.1 U	NA	23.1 U	23.6 U	NA	25.5 U	NA
2,4-Dinitrotoluene	0.163 U	0.0961 B	0.582 J	NA	NA	1.09	NA	0.154 U	NA	0.412 J	0.481 J	NA	0.0987 J	NA
2,6-Dinitrotoluene	0.163 U	0.154 U	0.154 U	NA	NA	0.39	NA	0.154 U	NA	0.151 U	0.154 U	NA	0.162 U	NA
2-Chloronaphthalene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2-Chlorophenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2-Methylnaphthalene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2-Methylphenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
2-Nitroaniline	10.4 U	9.43 U	9.43 U	NA	NA	9.62 U	NA	9.26 U	NA	9.26 U	9.43 U	NA	10.2 U	NA
2-Nitrophenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
3,3'-Dichlorobenzidine	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 UJ	2.36 UJ	NA	2.55 UJ	NA
3-Nitroaniline	10.4 U	9.43 U	9.43 U	NA	NA	9.62 U	NA	9.26 U	NA	9.26 U	9.43 U	NA	10.2 U	NA
4,6-Dinitro-2-methylphenol	10.4 U	9.43 U	9.43 U	NA	NA	9.62 U	NA	9.26 U	NA	9.26 U	9.43 U	NA	10.2 U	NA
4-Bromophenyl-phenylether	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
4-Chloro-3-methylphenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
4-Chloroaniline	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
4-Chlorophenyl-phenylether	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
4-Methylphenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
4-Nitroaniline	10.4 U	9.43 U	9.43 U	NA	NA	9.62 U	NA	9.26 U	NA	9.26 U	9.43 U	NA	10.2 U	NA
4-Nitrophenol	10.4 U	9.43 U	9.43 U	NA	NA	9.62 U	NA	9.26 U	NA	9.26 U	9.43 U	NA	10.2 U	NA
Acenaphthene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Acenaphthylene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Acetophenone	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Anthracene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Atrazine	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Benzaldehyde	2.6 UJ	2.36 UJ	2.36 UJ	NA	NA	2.4 UJ	NA	2.31 UJ	NA	2.31 UJ	2.36 UJ	NA	2.55 UJ	NA
Benzo(a)anthracene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Benzo(a)pyrene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Benzo(b)fluoranthene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Benzo(g,h,i)perylene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Benzo(k)fluoranthene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
bis(2-Chloroethoxy)methane	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
bis(2-Chloroethyl)ether	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
bis(2-Ethylhexyl)phthalate	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Butylbenzylphthalate	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Caprolactam	2.6 UL	2.36 UL	2.36 UL	NA	NA	2.4 UL	NA	2.31 UL	NA	2.31 UL	2.36 UL	NA	2.55 UL	NA
Carbazole	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Chrysene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Dibenz(a,h)anthracene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Dibenzofuran	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Diethylphthalate	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Dimethyl phthalate	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Di-n-butylphthalate	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Di-n-octylphthalate	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Fluoranthene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Fluorene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Hexachlorobenzene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Hexachlorobutadiene	2.6 UL	2.36 UL	2.36 U	NA	NA	2.4 UL	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Hexachlorocyclopentadiene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Hexachloroethane	2.6 UL	2.36 UL	2.36 U	NA	NA	2.4 UL	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Indeno(1,2,3-cd)pyrene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Isophorone	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Naphthalene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
n-Nitroso-di-n-propylamine	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
n-Nitrosodiphenylamine	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Nitrobenzene	0.163 U	0.156 B	0.154 U	NA	NA	0.292 B	NA	0.154 U	NA	0.0934 B	0.154 U	NA	0.259 B	NA
Pentachlorophenol	10.4 U	9.43 U	9.43 U	NA	NA	9.62 U	NA	9.26 U	NA	9.26 U	9.43 U	NA	10.2 U	NA
Phenanthrene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Phenol	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA
Pyrene	2.6 U	2.36 U	2.36 U	NA	NA	2.4 U	NA	2.31 U	NA	2.31 U	2.36 U	NA	2.55 U	NA

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW01*	CAS07-MW02*	CAS07-MW03			CAS07-MW04		CAS07-MW05		CAS07-MW06			CAS07-MW07	
Sample ID	CAS07-MW01-0111	CAS07-MW02-0111	CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414	CAS07-MW05-0111	CAS07-GW05-0414	CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414
Sample Date	01/28/11	01/28/11	01/25/11	04/09/14	04/09/14	01/28/11	04/09/14	01/25/11	04/09/14	01/24/11	01/24/11	04/09/14	01/24/11	04/09/14
Chemical Name														
Pesticide/Polychlorinated Biphenyls (µg/l)														
4,4'-DDD	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.0398 J	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00992 J	NA
4,4'-DDE	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
4,4'-DDT	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Aldrin	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
alpha-BHC	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00531 J	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
alpha-Chlordane	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Aroclor-1016	0.255 U	0.24 U	0.236 UJ	NA	NA	0.236 UJ	NA	0.255 U	NA	0.231 UJ	0.24 UJ	NA	0.255 UJ	NA
Aroclor-1221	0.255 U	0.24 U	0.236 UJ	NA	NA	0.236 UJ	NA	0.255 U	NA	0.231 UJ	0.24 UJ	NA	0.255 UJ	NA
Aroclor-1232	0.255 U	0.24 U	0.236 UJ	NA	NA	0.236 UJ	NA	0.255 U	NA	0.231 UJ	0.24 UJ	NA	0.255 UJ	NA
Aroclor-1242	0.255 U	0.24 U	0.236 UJ	NA	NA	0.236 UJ	NA	0.255 U	NA	0.231 UJ	0.24 UJ	NA	0.255 UJ	NA
Aroclor-1248	0.255 U	0.24 U	0.236 UJ	NA	NA	0.236 UJ	NA	0.255 U	NA	0.231 UJ	0.24 UJ	NA	0.255 UJ	NA
Aroclor-1254	0.255 U	0.24 U	0.236 UJ	NA	NA	0.236 UJ	NA	0.255 U	NA	0.231 UJ	0.24 UJ	NA	0.255 UJ	NA
Aroclor-1260	0.255 U	0.24 U	0.236 UJ	NA	NA	0.236 UJ	NA	0.255 U	NA	0.231 UJ	0.24 UJ	NA	0.255 UJ	NA
beta-BHC	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
delta-BHC	0.0102 U	0.00962 U	0.00558 J	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Dieldrin	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Endosulfan I	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Endosulfan II	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00575 J	NA	0.00714 J	NA
Endosulfan sulfate	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Endrin	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Endrin aldehyde	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Endrin ketone	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
gamma-BHC (Lindane)	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
gamma-Chlordane	0.0102 U	0.00921 J	0.00943 U	NA	NA	0.0251 J	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00646 J	NA
Heptachlor	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Heptachlor epoxide	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Methoxychlor	0.0102 U	0.00962 U	0.00943 U	NA	NA	0.00943 UJ	NA	0.0102 U	NA	0.0098 UJ	0.00926 UJ	NA	0.00926 U	NA
Toxaphene	0.681 U	0.641 U	0.629 U	NA	NA	0.629 UJ	NA	0.681 U	NA	0.654 UJ	0.618 UJ	NA	0.618 U	NA
Dioxin/Furans (ng/l)														
1,2,3,4,6,7,8-Heptachlorodibenzofuran	3.03E-04 U	3.39E-04 U	4.74E-04 U	NA	NA	4.09E-04 U	NA	3.98E-04 U	NA	4.51E-04 U	4.98E-04 U	NA	4.56E-04 U	NA
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	9.95E-04 U	8.10E-04 J	8.36E-04 U	NA	NA	0.00136 J	NA	6.89E-04 U	NA	7.90E-04 U	8.81E-04 U	NA	8.33E-04 U	NA
1,2,3,4,7,8,9-Heptachlorodibenzofuran	4.16E-04 U	4.66E-04 U	6.53E-04 U	NA	NA	5.63E-04 U	NA	5.46E-04 U	NA	6.21E-04 U	6.82E-04 U	NA	6.27E-04 U	NA
1,2,3,4,7,8-Hexachlorodibenzofuran	3.84E-04 U	3.94E-04 U	5.96E-04 J	NA	NA	3.31E-04 U	NA	3.90E-04 U	NA	4.61E-04 U	4.55E-04 U	NA	4.60E-04 U	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	5.05E-04 U	4.79E-04 U	5.64E-04 U	NA	NA	7.26E-04 U	NA	6.04E-04 U	NA	7.15E-04 U	7.45E-04 U	NA	7.47E-04 U	NA
1,2,3,6,7,8-Hexachlorodibenzofuran	3.29E-04 U	3.39E-04 U	5.06E-04 U	NA	NA	2.83E-04 U	NA	3.34E-04 U	NA	3.98E-04 U	3.92E-04 U	NA	3.94E-04 U	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	4.69E-04 U	4.44E-04 U	5.21E-04 U	NA	NA	6.74E-04 U	NA	5.58E-04 U	NA	6.64E-04 U	6.90E-04 U	NA	6.91E-04 U	NA
1,2,3,7,8,9-Hexachlorodibenzofuran	4.39E-04 U	4.54E-04 U	6.76E-04 U	NA	NA	3.78E-04 U	NA	4.47E-04 U	NA	5.31E-04 U	5.22E-04 U	NA	5.28E-04 U	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	5.24E-04 U	4.97E-04 U	5.83E-04 U	NA	NA	7.53E-04 U	NA	6.25E-04 U	NA	7.41E-04 U	7.72E-04 U	NA	7.73E-04 U	NA
1,2,3,7,8-Pentachlorodibenzofuran	3.57E-04 U	2.99E-04 U	3.87E-04 U	NA	NA	3.08E-04 U	NA	3.92E-04 U	NA	4.86E-04 U	6.25E-04 U	NA	4.89E-04 U	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	4.92E-04 U	6.72E-04 U	6.93E-04 U	NA	NA	5.77E-04 U	NA	6.04E-04 U	NA	5.88E-04 U	7.27E-04 U	NA	7.67E-04 U	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	3.65E-04 U	3.76E-04 U	5.62E-04 U	NA	NA	3.14E-04 U	NA	3.70E-04 U	NA	4.39E-04 U	4.33E-04 U	NA	4.37E-04 U	NA
2,3,4,7,8-Pentachlorodibenzofuran	3.65E-04 U	3.07E-04 U	4.25E-04 J	NA	NA	3.14E-04 U	NA	4.00E-04 U	NA	4.96E-04 U	6.40E-04 U	NA	4.99E-04 U	NA
2,3,7,8-TCDD (dioxin)	6.41E-04 U	5.77E-04 U	7.23E-04 U	NA	NA	7.20E-04 U	NA	7.05E-04 U	NA	8.92E-04 U	8.00E-04 U	NA	7.73E-04 U	NA
2,3,7,8-Tetrachlorodibenzofuran	4.58E-04 U	4.44E-04 U	5.51E-04 U	NA	NA	5.46E-04 U	NA	4.29E-04 U	NA	5.92E-04 U	6.05E-04 U	NA	5.55E-04 U	NA
Octachlorodibenzofuran	8.74E-04 U	7.29E-04 U	8.81E-04 U	NA	NA	8.77E-04 U	NA	8.23E-04 U	NA	0.00112 U	0.00115 U	NA	0.00115 U	NA
Octachlorodibenzo-p-dioxin	0.00111 J	0.0129 J	0.00817 J	NA	NA	0.0606 J	NA	7.90E-04 U	NA	0.00204 J	0.00311 J	NA	0.0101 J	NA
Total heptachlorodibenzofuran	3.03E-04 U	3.39E-04 U	4.74E-04 U	NA	NA	4.09E-04 U	NA	3.98E-04 U	NA	4.51E-04 U	4.98E-04 U	NA	4.56E-04 U	NA
Total heptachlorodibenzo-p-dioxin	9.95E-04 U	8.10E-04 U	8.36E-04 U	NA	NA	0.0044 J	NA	6.89E-04 U	NA	7.90E-04 U	8.81E-04 U	NA	8.33E-04 U	NA
Total hexachlorodibenzofuran	3.29E-04 U	3.39E-04 U	5.96E-04 J	NA	NA	2.83E-04 U	NA	3.34E-04 U	NA	3.98E-04 U	3.92E-04 U	NA	3.94E-04 U	NA
Total hexachlorodibenzo-p-dioxin	4.69E-04 U	4.44E-04 U	5.21E-04 U	NA	NA	6.74E-04 U	NA	5.58E-04 U	NA	6.64E-04 U	6.90E-04 U	NA	6.91E-04 U	NA
Total pentachlorodibenzofuran	3.57E-04 U	2.99E-04 U	3.87E-04 U	NA	NA	3.08E-04 U	NA	3.92E-04 U	NA	4.86E-04 U	6.25E-04 U	NA	4.89E-04 U	NA
Total pentachlorodibenzo-p-dioxin	4.92E-04 U	6.72E-04 U	6.93E-04 U	NA	NA	5.77E-04 U	NA	6.04E-04 U	NA	5.88E-04 U	7.27E-04 U	NA	7.67E-04 U	NA
Total tetrachlorodibenzofuran	4.58E-04 U	4.44E-04 U	5.51E-04 U	NA	NA	5.46E-04 U	NA	4.29E-04 U	NA	5.92E-04 U	6.05E-04 U	NA	5.55E-04 U	NA
Total tetrachlorodibenzo-p-dioxin	6.41E-04 U	5.77E-04 U	7.23E-04 U	NA	NA	7.20E-04 U	NA	7.05E-04 U	NA	8.92E-04 U	8.00E-04 U	NA	7.73E-04 U	NA
Toxic Equivalents (Total TEQ) - HHRA	3.3E-07	8.10E-06	1.90E-04	NA	NA	3.2E-05	NA	0	NA	6.1E-07	9.3E-07	NA	3.0E-06	NA
Toxic Equivalents (Total TEQ) - Eco, Fish	8.89E-04 J	9.29E-04 J	1.24E-03 J	NA	NA	1.01E-03 J	NA	1.01E-03 U	NA	1.17E-03 J	1.24E-03 J	NA	1.21E-03 J	NA

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW01*	CAS07-MW02*	CAS07-MW03			CAS07-MW04		CAS07-MW05		CAS07-MW06			CAS07-MW07	
Sample ID	CAS07-MW01-0111	CAS07-MW02-0111	CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414	CAS07-MW05-0111	CAS07-GW05-0414	CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414
Sample Date	01/28/11	01/28/11	01/25/11	04/09/14	04/09/14	01/28/11	04/09/14	01/25/11	04/09/14	01/24/11	01/24/11	04/09/14	01/24/11	04/09/14
Chemical Name														
Explosives (µg/l)														
1,3,5-Trinitrobenzene	0.163 U	0.129 B	0.154 U	NA	NA	0.132 J	NA	0.154 U	NA	0.151 U	0.154 U	NA	0.162 U	NA
1,3-Dinitrobenzene	0.163 U	1.46	0.328 B	NA	NA	0.522 B	NA	0.154 U	NA	0.151 U	0.154 U	NA	0.162 U	NA
2,4,6-Trinitrotoluene	0.163 U	0.154 U	0.154 U	NA	NA	0.157 U	NA	0.154 U	NA	0.151 U	0.214 J	NA	0.162 U	NA
2-Amino-4,6-dinitrotoluene	0.163 U	0.154 U	0.154 U	NA	NA	0.157 U	NA	0.154 U	NA	0.0796 J	0.118 J	NA	0.162 U	NA
2-Nitrotoluene	0.163 U	0.154 U	0.22 B	NA	NA	0.636 B	NA	0.176 B	NA	0.151 U	0.154 U	NA	0.0953 B	NA
3-Nitrotoluene	0.163 U	0.22 B	0.138 B	NA	NA	0.125 B	NA	0.154 U	NA	0.138 J	0.154 U	NA	0.143 J	NA
4-Amino-2,6-dinitrotoluene	0.163 U	0.154 U	0.154 U	NA	NA	0.157 U	NA	0.154 U	NA	0.188 J	0.204 J	NA	0.162 U	NA
4-Nitrotoluene	0.163 U	0.154 U	0.154 U	NA	NA	0.157 U	NA	0.154 U	NA	0.151 U	0.154 U	NA	0.162 U	NA
HMX	0.163 U	0.64	0.122 J	NA	NA	0.532 J	NA	0.154 U	NA	0.114 J	0.109 J	NA	0.162 U	NA
Nitroglycerin	0.408 U	0.385 U	0.385 U	NA	NA	0.231 J	NA	0.385 U	NA	0.377 U	0.385 U	NA	0.404 U	NA
PETN	0.408 U	0.385 U	0.251 J	NA	NA	0.463 J	NA	0.385 U	NA	0.288 J	0.269 J	NA	0.404 U	NA
RDX	0.163 U	0.721	0.133 J	NA	NA	0.651 J	NA	0.263 J	NA	0.151 U	0.154 U	NA	0.282 J	NA
Tetryl	0.163 U	0.791 B	0.154 U	NA	NA	0.364 B	NA	0.154 U	NA	0.151 U	0.154 U	NA	0.162 U	NA
Total Metals (µg/l)														
Aluminum	203	149	24.7 B	NA	NA	262	NA	158 B	NA	59.9	60.3	NA	298	NA
Antimony	2 U	2 U	2 U	NA	NA	2 U	NA	2 U	NA	2 U	2 U	NA	2 U	NA
Arsenic	1.5 U	1.5 U	1.5 U	NA	NA	3.15	NA	1.5 U	NA	1.5 U	1.5 U	NA	4.26	NA
Barium	17.2	16.6	28.6	NA	NA	22.3	NA	41.5	NA	28.3	29.4	NA	31.1	NA
Beryllium	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA
Cadmium	0.932 J	0.597 J	1.1 J	NA	NA	1.05 J	NA	0.861 J	NA	1.14 J	1.17 J	NA	0.716 J	NA
Calcium	50,600	39,600	84,700	NA	NA	105,000	NA	140,000	NA	91,600	92,200	NA	104,000	NA
Chromium	1.57 J	1.49 J	1 U	NA	NA	2.45 J	NA	2.49 J	NA	1 U	1 U	NA	1.67 J	NA
Cobalt	1.29 J	2.35 J	4.28	NA	NA	3.84	NA	2.5 U	NA	1.84 J	2 J	NA	1.43 J	NA
Copper	2 U	2 U	2 U	NA	NA	1.12 J	NA	2 U	NA	2.04 J	2 U	NA	2 U	NA
Cyanide	10 U	10 U	10 U	NA	NA	10 U	NA	10 U	NA	10 U	10 U	NA	10 U	NA
Iron	389	113	15 U	NA	NA	333	NA	28.5 B	NA	89.2	104	NA	603	NA
Lead	0.75 U	0.75 U	0.75 U	NA	NA	0.75 U	NA	3.75 U	NA	0.75 U	0.75 U	NA	0.75 U	NA
Magnesium	1,990	2,020	3,290	NA	NA	2,080	NA	6,490	NA	2,080	2,160	NA	2,310	NA
Manganese	42.9	135	57.1	NA	NA	216	NA	18.5	NA	56.9	55.9	NA	67.7	NA
Mercury	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	NA	0.2 U	NA	0.2 U	0.2 U	NA	0.2 U	NA
Nickel	2.44 J	2.06 J	3.94	NA	NA	2.7	NA	2.63	NA	2.48 J	2.61	NA	2.76	NA
Potassium	854 J	1,010 J	1,130 J	NA	NA	1,760	NA	2,260	NA	1,360	1,390	NA	1,440	NA
Selenium	1.25 U	1.25 U	1.25 U	NA	NA	1.25 U	NA	2.4 J	NA	0.878 J	1.25 U	NA	1.25 U	NA
Silver	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA
Sodium	16,400	13,000	15,700	NA	NA	9,090	NA	21,100	NA	7,360	7,580	NA	7,270	NA
Thallium	1 U	1 U	1 U	NA	NA	1 U	NA	1 U	NA	1 U	1 U	NA	1 U	NA
Vanadium	2.5 U	2.5 U	2.5 U	NA	NA	2.5 U	NA	2.5 U	NA	2.5 U	2.5 U	NA	1.46 J	NA
Zinc	2.37 J	1.84 J	9.91	NA	NA	2.13 J	NA	12.5 U	NA	1.98 J	2.17 J	NA	3.11 J	NA
Dissolved Metals (µg/l)														
Aluminum, Dissolved	43.5 J	40.3 J	161 B	NA	NA	16.9 J	NA	160 B	NA	14.9 J	15.4 J	NA	25 U	NA
Antimony, Dissolved	2 U	2 U	2 U	NA	NA	2 U	NA	2 U	NA	2 U	2 U	NA	2 U	NA
Arsenic, Dissolved	1.5 U	1.5 U	1.5 U	NA	NA	2.56	NA	1.5 U	NA	1.5 U	1.5 U	NA	3.55	NA
Barium, Dissolved	17.1	15.9	29.1	NA	NA	20.7	NA	41.3	NA	28.2	27.7	NA	30.4	NA
Beryllium, Dissolved	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA
Cadmium, Dissolved	0.893 J	0.591 J	1.12 J	NA	NA	0.949 J	NA	0.896 J	NA	1.12 J	1.12 J	NA	0.652 J	NA
Calcium, Dissolved	52,100	39,800	85,900	NA	NA	101,000	NA	141,000	NA	90,500	87,900	NA	104,000	NA
Chromium, Dissolved	1 U	1 U	0.818 J	NA	NA	1 U	NA	2.52	NA	1 U	1 U	NA	1 U	NA
Cobalt, Dissolved	2.5 U	2.22 J	4.59	NA	NA	3.53	NA	2.5 U	NA	1.84 J	1.84 J	NA	2.5 U	NA
Copper, Dissolved	2 U	2 U	2 U	NA	NA	2 U	NA	2 U	NA	2 U	2 U	NA	2 U	NA
Iron, Dissolved	23.7 J	7.6 J	338	NA	NA	8.22 J	NA	30.2 B	NA	15 U	15 U	NA	15 U	NA
Lead, Dissolved	0.75 U	0.75 U	0.75 U	NA	NA	0.75 U	NA	3.75 U	NA	0.75 U	0.75 U	NA	0.75 U	NA
Magnesium, Dissolved	1,950	1,990	3,340	NA	NA	1,970	NA	6,520	NA	2,030	2,000	NA	2,270	NA
Manganese, Dissolved	46.3	137	58.5	19	NA	208	40.6	18.3	3.31 J	55	53.9	4.5 J	70.4	9 J
Mercury, Dissolved	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	NA	0.2 U	NA	0.2 U	0.2 U	NA	0.2 U	NA
Nickel, Dissolved	2.11 J	1.71 J	4.58	NA	NA	1.8 J	NA	2.65	NA	2.25 J	2.27 J	NA	1.89 J	NA
Potassium, Dissolved	807 J	979 J	1,170 J	NA	NA	1,620	NA	2,240	NA	1,340	1,320	NA	1,310	NA
Selenium, Dissolved	1.25 U	1.25 U	1.25 U	NA	NA	1.25 U	NA	2.29 J	NA	1.25 U	1.25 U	NA	1.25 U	NA
Silver, Dissolved	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	NA
Sodium, Dissolved	16,800	12,900	15,700	NA	NA	8,670	NA	21,000	NA	7,390	7,240	NA	7,370	NA
Thallium, Dissolved	1 U	1 U	1 U	NA	NA	1 U	NA	1 U	NA	1 U	1 U	NA	1 U	NA
Vanadium, Dissolved	2.5 U	2.5 U	2.5 U	NA	NA	2.5 U	NA	2.5 U	NA	2.5 U	2.5 U	NA	2.5 U	NA
Zinc, Dissolved	1.53 J	1.59 J	12	NA	NA	2.5 U	NA	12.5 U	NA	1.83 J	1.54 J	NA	2.5 U	NA

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW01*	CAS07-MW02*	CAS07-MW03			CAS07-MW04		CAS07-MW05		CAS07-MW06			CAS07-MW07	
Sample ID	CAS07-MW01-0111	CAS07-MW02-0111	CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414	CAS07-MW05-0111	CAS07-GW05-0414	CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414
Sample Date	01/28/11	01/28/11	01/25/11	04/09/14	04/09/14	01/28/11	04/09/14	01/25/11	04/09/14	01/24/11	01/24/11	04/09/14	01/24/11	04/09/14
Chemical Name														
Wet Chemistry (mg/l)														
Alkalinity	NA	NA	NA	257	NA	NA	257	NA	315	NA	NA	234	NA	249
Chloride	NA	NA	NA	24.8 D	NA	NA	18.2 D	NA	26.7 D	NA	NA	9.97	NA	8.04
Ethane	NA	NA	NA	0.0034 U	NA	NA	0.0034 U	NA	0.0034 U	NA	NA	0.0034 U	NA	0.0034 U
Ethene	NA	NA	NA	0.0034 U	NA	NA	0.0034 U	NA	0.0034 U	NA	NA	0.0034 U	NA	0.0034 U
Methane	NA	NA	NA	0.0759 D	NA	NA	0.0534 D	NA	0.0034 U	NA	NA	0.0034 U	NA	0.0034 U
Nitrate	NA	NA	NA	0.05 U	NA	NA	0.05 U	NA	0.349	NA	NA	0.284	NA	0.302
Nitrite	NA	NA	NA	0.075 U	NA	NA	0.075 U	NA	0.075 U	NA	NA	0.075 U	NA	0.075 U
Sulfate	NA	NA	NA	5.38	NA	NA	12.2	NA	25.1	NA	NA	11	NA	14.5
Sulfide	NA	NA	NA	0.16 J	NA	NA	0.5 U	NA	2.08	NA	NA	0.64 J	NA	0.8 J
Total organic carbon (TOC)	NA	NA	NA	1.46	NA	NA	1.94	NA	1.3	NA	NA	0.872	NA	0.998
Dechlorinating Bacteria (cells/ml)														
Dehalococcoides	NA	NA	NA	0.4 J	NA	NA	0.5 U	NA	0.5 U	NA	NA	0.5 U	NA	1
Functioning Genes (cells/ml)														
BAV1 R-Dase	NA	NA	NA	0.5 U	NA	NA	0.5 U	NA	0.5 U	NA	NA	0.5 U	NA	0.5 U
TCE R-Dase	NA	NA	NA	0.5 U	NA	NA	0.5 U	NA	0.5 U	NA	NA	0.5 U	NA	0.5 U
VC R-Dase	NA	NA	NA	0.5 U	NA	NA	0.5 U	NA	0.5 U	NA	NA	0.5 U	NA	0.5 U

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

D - Compound identified in an analysis at a secondary dilution factor

H - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

cells/ml - Cells per milliliter

mg/l - Milligrams per liter

ng/l - Nanograms per liter

µg/l - Micrograms per liter

*CAS07-MW01 and CAS07-MW02 are upgradient of Site 7 and included as background wells

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW08	CAS07-MW09
Sample ID	CAS07-GW08-0414	CAS07-GW09-0414
Sample Date	04/10/14	04/10/14
Chemical Name		
Volatile Organic Compounds (µg/l)		
1,1,1-Trichloroethane	0.2 U	0.2 U
1,1,2,2-Tetrachloroethane	0.2 U	0.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	0.2 U	0.2 U
1,1,2-Trichloroethane	0.2 U	0.2 U
1,1-Dichloroethane	0.2 U	0.2 U
1,1-Dichloroethene	0.2 U	0.2 U
1,2,3-Trichlorobenzene	0.2 U	0.2 U
1,2,4-Trichlorobenzene	0.2 U	0.2 U
1,2-Dibromo-3-chloropropane	0.2 U	0.2 U
1,2-Dibromoethane	0.2 U	0.2 U
1,2-Dichlorobenzene	0.2 U	0.2 U
1,2-Dichloroethane	0.2 U	0.2 U
1,2-Dichloropropane	0.2 U	0.2 U
1,3-Dichlorobenzene	0.2 U	0.2 U
1,4-Dichlorobenzene	0.2 U	0.2 U
2-Butanone	2.5 U	2.5 U
2-Hexanone	2.5 U	2.5 U
4-Methyl-2-pentanone	1 U	1 U
Acetone	1 U	1 U
Benzene	0.2 U	0.2 U
Bromochloromethane	0.5 U	0.5 U
Bromodichloromethane	0.2 U	0.2 U
Bromoform	0.2 U	0.2 U
Bromomethane	0.2 U	0.2 U
Carbon disulfide	0.2 U	0.2 U
Carbon tetrachloride	0.2 U	0.2 U
Chlorobenzene	0.2 U	0.2 U
Chloroethane	0.5 U	0.5 U
Chloroform	0.2 U	1.6
Chloromethane	0.2 U	0.2 U
cis-1,2-Dichloroethene	0.48 J	0.2 U
cis-1,3-Dichloropropene	0.2 U	0.2 U
Cyclohexane	0.2 U	0.2 U
Dibromochloromethane	0.2 U	0.2 U
Dichlorodifluoromethane (Freon-12)	0.2 U	0.2 U
Ethylbenzene	0.2 U	0.2 U
Isopropylbenzene	0.2 U	0.2 U
m- and p-Xylene	0.4 U	0.4 U
Methyl acetate	0.5 U	0.5 U
Methylcyclohexane	0.2 U	0.2 U
Methylene chloride	0.2 U	0.2 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U
o-Xylene	0.2 U	0.2 U
Styrene	0.2 U	0.2 U
Tetrachloroethene	0.2 U	0.2 U
Toluene	0.2 U	0.2 U
trans-1,2-Dichloroethene	0.2 U	0.2 U
trans-1,3-Dichloropropene	0.2 U	0.2 U
Trichloroethene	1.1	0.33 J
Trichlorofluoromethane (Freon-11)	0.2 U	0.2 U
Vinyl chloride	0.2 U	0.2 U
Xylene, total	NA	NA

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW08	CAS07-MW09
Sample ID	CAS07-GW08-0414	CAS07-GW09-0414
Sample Date	04/10/14	04/10/14
Chemical Name		
Semivolatile Organic Compounds (µg/l)		
1,1-Biphenyl	NA	NA
2,2'-Oxybis(1-chloropropane)	NA	NA
2,4,5-Trichlorophenol	NA	NA
2,4,6-Trichlorophenol	NA	NA
2,4-Dichlorophenol	NA	NA
2,4-Dimethylphenol	NA	NA
2,4-Dinitrophenol	NA	NA
2,4-Dinitrotoluene	NA	NA
2,6-Dinitrotoluene	NA	NA
2-Chloronaphthalene	NA	NA
2-Chlorophenol	NA	NA
2-Methylnaphthalene	NA	NA
2-Methylphenol	NA	NA
2-Nitroaniline	NA	NA
2-Nitrophenol	NA	NA
3,3'-Dichlorobenzidine	NA	NA
3-Nitroaniline	NA	NA
4,6-Dinitro-2-methylphenol	NA	NA
4-Bromophenyl-phenylether	NA	NA
4-Chloro-3-methylphenol	NA	NA
4-Chloroaniline	NA	NA
4-Chlorophenyl-phenylether	NA	NA
4-Methylphenol	NA	NA
4-Nitroaniline	NA	NA
4-Nitrophenol	NA	NA
Acenaphthene	NA	NA
Acenaphthylene	NA	NA
Acetophenone	NA	NA
Anthracene	NA	NA
Atrazine	NA	NA
Benzaldehyde	NA	NA
Benzo(a)anthracene	NA	NA
Benzo(a)pyrene	NA	NA
Benzo(b)fluoranthene	NA	NA
Benzo(g,h,i)perylene	NA	NA
Benzo(k)fluoranthene	NA	NA
bis(2-Chloroethoxy)methane	NA	NA
bis(2-Chloroethyl)ether	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA
Butylbenzylphthalate	NA	NA
Caprolactam	NA	NA
Carbazole	NA	NA
Chrysene	NA	NA
Dibenz(a,h)anthracene	NA	NA
Dibenzofuran	NA	NA
Diethylphthalate	NA	NA
Dimethyl phthalate	NA	NA
Di-n-butylphthalate	NA	NA
Di-n-octylphthalate	NA	NA
Fluoranthene	NA	NA
Fluorene	NA	NA
Hexachlorobenzene	NA	NA
Hexachlorobutadiene	NA	NA
Hexachlorocyclopentadiene	NA	NA
Hexachloroethane	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA
Isophorone	NA	NA
Naphthalene	NA	NA
n-Nitroso-di-n-propylamine	NA	NA
n-Nitrosodiphenylamine	NA	NA
Nitrobenzene	NA	NA
Pentachlorophenol	NA	NA
Phenanthrene	NA	NA
Phenol	NA	NA
Pyrene	NA	NA

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW08	CAS07-MW09
Sample ID	CAS07-GW08-0414	CAS07-GW09-0414
Sample Date	04/10/14	04/10/14
Chemical Name		
Pesticide/Polychlorinated Biphenyls (µg/l)		
4,4'-DDD	NA	NA
4,4'-DDE	NA	NA
4,4'-DDT	NA	NA
Aldrin	NA	NA
alpha-BHC	NA	NA
alpha-Chlordane	NA	NA
Aroclor-1016	NA	NA
Aroclor-1221	NA	NA
Aroclor-1232	NA	NA
Aroclor-1242	NA	NA
Aroclor-1248	NA	NA
Aroclor-1254	NA	NA
Aroclor-1260	NA	NA
beta-BHC	NA	NA
delta-BHC	NA	NA
Dieldrin	NA	NA
Endosulfan I	NA	NA
Endosulfan II	NA	NA
Endosulfan sulfate	NA	NA
Endrin	NA	NA
Endrin aldehyde	NA	NA
Endrin ketone	NA	NA
gamma-BHC (Lindane)	NA	NA
gamma-Chlordane	NA	NA
Heptachlor	NA	NA
Heptachlor epoxide	NA	NA
Methoxychlor	NA	NA
Toxaphene	NA	NA
Dioxin/Furans (ng/l)		
1,2,3,4,6,7,8-Heptachlorodibenzofuran	NA	NA
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	NA	NA
1,2,3,4,7,8,9-Heptachlorodibenzofuran	NA	NA
1,2,3,4,7,8-Hexachlorodibenzofuran	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	NA	NA
1,2,3,6,7,8-Hexachlorodibenzofuran	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	NA	NA
1,2,3,7,8,9-Hexachlorodibenzofuran	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	NA	NA
1,2,3,7,8-Pentachlorodibenzofuran	NA	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	NA	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	NA	NA
2,3,4,7,8-Pentachlorodibenzofuran	NA	NA
2,3,7,8-TCDD (dioxin)	NA	NA
2,3,7,8-Tetrachlorodibenzofuran	NA	NA
Octachlorodibenzofuran	NA	NA
Octachlorodibenzo-p-dioxin	NA	NA
Total heptachlorodibenzofuran	NA	NA
Total heptachlorodibenzo-p-dioxin	NA	NA
Total hexachlorodibenzofuran	NA	NA
Total hexachlorodibenzo-p-dioxin	NA	NA
Total pentachlorodibenzofuran	NA	NA
Total pentachlorodibenzo-p-dioxin	NA	NA
Total tetrachlorodibenzofuran	NA	NA
Total tetrachlorodibenzo-p-dioxin	NA	NA
Toxic Equivalents (Total TEQ) - HHRA	NA	NA
Toxic Equivalents (Total TEQ) - Eco, Fish	NA	NA

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW08	CAS07-MW09
Sample ID	CAS07-GW08-0414	CAS07-GW09-0414
Sample Date	04/10/14	04/10/14
Chemical Name		
Explosives (µg/l)		
1,3,5-Trinitrobenzene	NA	NA
1,3-Dinitrobenzene	NA	NA
2,4,6-Trinitrotoluene	NA	NA
2-Amino-4,6-dinitrotoluene	NA	NA
2-Nitrotoluene	NA	NA
3-Nitrotoluene	NA	NA
4-Amino-2,6-dinitrotoluene	NA	NA
4-Nitrotoluene	NA	NA
HMX	NA	NA
Nitroglycerin	NA	NA
PETN	NA	NA
RDX	NA	NA
Tetryl	NA	NA
Total Metals (µg/l)		
Aluminum	NA	NA
Antimony	NA	NA
Arsenic	NA	NA
Barium	NA	NA
Beryllium	NA	NA
Cadmium	NA	NA
Calcium	NA	NA
Chromium	NA	NA
Cobalt	NA	NA
Copper	NA	NA
Cyanide	NA	NA
Iron	NA	NA
Lead	NA	NA
Magnesium	NA	NA
Manganese	NA	NA
Mercury	NA	NA
Nickel	NA	NA
Potassium	NA	NA
Selenium	NA	NA
Silver	NA	NA
Sodium	NA	NA
Thallium	NA	NA
Vanadium	NA	NA
Zinc	NA	NA
Dissolved Metals (µg/l)		
Aluminum, Dissolved	NA	NA
Antimony, Dissolved	NA	NA
Arsenic, Dissolved	NA	NA
Barium, Dissolved	NA	NA
Beryllium, Dissolved	NA	NA
Cadmium, Dissolved	NA	NA
Calcium, Dissolved	NA	NA
Chromium, Dissolved	NA	NA
Cobalt, Dissolved	NA	NA
Copper, Dissolved	NA	NA
Iron, Dissolved	NA	NA
Lead, Dissolved	NA	NA
Magnesium, Dissolved	NA	NA
Manganese, Dissolved	12.3	32.4
Mercury, Dissolved	NA	NA
Nickel, Dissolved	NA	NA
Potassium, Dissolved	NA	NA
Selenium, Dissolved	NA	NA
Silver, Dissolved	NA	NA
Sodium, Dissolved	NA	NA
Thallium, Dissolved	NA	NA
Vanadium, Dissolved	NA	NA
Zinc, Dissolved	NA	NA

TABLE D-2

Raw Groundwater Analytical Data - 2011 and 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-MW08	CAS07-MW09
Sample ID	CAS07-GW08-0414	CAS07-GW09-0414
Sample Date	04/10/14	04/10/14
Chemical Name		
Wet Chemistry (mg/l)		
Alkalinity	296	292
Chloride	10	10.2
Ethane	0.0034 U	0.0034 U
Ethene	0.0034 U	0.0034 U
Methane	0.0027 J	0.0057
Nitrate	0.357 H	0.314 H
Nitrite	0.075 HU	0.075 HU
Sulfate	14.8	16.8
Sulfide	0.32 J	0.32 J
Total organic carbon (TOC)	1.56	1.51
Dechlorinating Bacteria (cells/ml)		
Dehalococcoides	1.15	2.4
Functioning Genes (cells/ml)		
BAV1 R-Dase	0.5 U	0.5 U
TCE R-Dase	0.5 U	0.5 U
VC R-Dase	0.1 J	0.5 U

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

D - Compound identified in an analysis at a secondary dilution factor

H - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UL - Analyte not detected, quantitation limit is probably higher

cells/ml - Cells per milliliter

mg/l - Milligrams per liter

ng/l - Nanograms per liter

µg/l - Micrograms per liter

*CAS07-MW01 and CAS07-MW02 are upgradient of Site 7 and included as background wells

TABLE D-3

Raw Sediment Analytical Data - 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SD01	CAS07-SD02		CAS07-SD03	CAS07-SD04*	CAS07-SD05*	CAS07-SD06*	CAS07-SD07	CAS07-SD08	CAS07-SD09
Sample ID	CAS07-SD01-0414	CAS07-SD02-0414	CAS07-SD02P-0414	CAS07-SD03-0414	CAS07-SD04-0414	CAS07-SD05-0414	CAS07-SD06-0414	CAS07-SD07-0414	CAS07-SD08-0414	CAS07-SD09-0414
Sample Date	04/14/14	04/14/14	04/14/14	04/14/14	04/18/14	04/18/14	04/18/14	04/22/14	04/22/14	04/22/14
Chemical Name										
Semivolatile Organic Compounds (µg/kg)										
bis(2-Ethylhexyl)phthalate	44.3 U	41.6 U	41.8 U	41.5 U	41.7 U	43.4 U	68.4 U	42.7 U	42.3 U	45.2 U
Di-n-octylphthalate	2.2 U	2.1 U	2.1 U	2 U	2.1 U	2.1 U	3.4 U	2.1 U	2.1 U	2.2 U
Dioxin/Furans (pg/g)										
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.784 J	0.318 J	0.242 X	0.269 X	5.24	6.12	10.4	5.4	5.78	5.8
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	18.2	6.05 J	7.51 J	7.01	39.6	63.8	144	40.1	43.4	60.7
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.995 U	1 U	0.915 U	0.972 U	0.742 B	0.626 B	1.25 X	0.655 J	0.784 J	0.487 J
1,2,3,4,7,8-Hexachlorodibenzofuran	0.197 B	0.0877 B	0.915 U	0.0863 B	0.834 X	0.82 X	1.51 J	0.66 J	0.615 J	0.79 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.409 J	0.183 X	0.228 J	0.247 J	0.412 B	0.863 X	2.25 J	0.449 X	0.41 X	0.81 J
1,2,3,6,7,8-Hexachlorodibenzofuran	0.158 B	0.0727 B	0.915 U	0.972 U	0.251 J	0.295 X	0.537 J	0.192 B	0.154 B	0.225 B
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.694 X	0.268 X	0.291 X	0.341 X	1.9 J	2.38 J	5.76	1.68 J	1.85 J	2.21 J
1,2,3,7,8,9-Hexachlorodibenzofuran	0.138 B	0.134 B	0.915 U	0.972 U	0.229 B	1.06 U	0.415 B	0.921 U	1.04 U	1.04 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.26 J	0.359 X	0.476 J	0.456 J	1.06 J	2.2 J	6.58	0.951 J	1.19 J	1.82 J
1,2,3,7,8-Pentachlorodibenzofuran	0.995 U	1 U	0.915 U	0.972 U	0.226 X	1.06 U	1.53 U	0.921 U	1.04 U	1.04 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.279 X	1 U	0.15 X	0.972 U	0.249 X	0.523 J	0.865 J	0.151 J	0.169 X	0.271 X
2,3,4,6,7,8-Hexachlorodibenzofuran	0.22 B	0.0826 B	0.107 B	0.106 B	0.391 X	0.456 J	0.988 J	0.284 X	0.327 X	0.312 J
2,3,4,7,8-Pentachlorodibenzofuran	0.995 U	1 U	0.915 U	0.972 U	0.297 X	1.06 U	0.662 X	0.212 X	0.181 X	1.04 U
2,3,7,8-TCDD (dioxin)	0.271 U	0.35 U	0.349 U	0.32 U	0.192 U	0.213 U	0.305 U	0.184 U	0.207 U	0.209 U
2,3,7,8-Tetrachlorodibenzofuran	0.248 U	0.249 U	0.194 U	0.199 U	0.192 U	0.239 J	0.502 J	0.114 X	0.207 U	0.209 U
Octachlorodibenzofuran	0.903 J	2 U	0.332 J	0.251 J	18.4	18.3	31.8	18.9	21.5	19.7
Octachlorodibenzo-p-dioxin	619 L	154 J	195 J	167	356 K	798 K	2,090 K	748 K	420	734
Total heptachlorodibenzofuran	0.784 J	0.318 J	0.185 J	0.972 U	32.1 J	33.9 J	51.9	30.8	33.4	31.4
Total heptachlorodibenzo-p-dioxin	73.7	24.1	27.7	28.2	90.9	178	431	71.1	103	164
Total hexachlorodibenzofuran	1.15 J	0.286 J	0.127 J	0.972 U	6.5 J	7.53	16.9 J	6.67 J	7.79 J	8 J
Total hexachlorodibenzo-p-dioxin	29.2	7.19	10.9	2.88 J	25 J	55.4	151	19.9	27.9	49.5
Total pentachlorodibenzofuran	0.995 U	1 U	0.915 U	0.972 U	0.406 J	0.342 J	0.675 J	0.619 J	0.412 J	0.26 J
Total pentachlorodibenzo-p-dioxin	0.793 J	1 U	0.426 J	0.352 J	1.37 J	3.94	15.2	2.48 J	0.84 J	3.29 J
Total tetrachlorodibenzofuran	0.248 U	0.249 U	0.194 U	0.199 U	0.192 U	0.467 J	1.4	0.184 U	0.207 U	0.209 U
Total tetrachlorodibenzo-p-dioxin	1.07	0.35 U	0.349 U	0.32 U	0.489 J	0.368 J	3.12	0.184 U	0.207 U	0.981
Toxic Equivalents (Total TEQ) - HHRA	0.89	1.2	0.39	0.23	1.3	2.2	5.1	1.3	1.3	2.5
Toxic Equivalents (Total TEQ) - Eco, Fish	1.05	1.10	0.879	1.19	0.934	1.83	3.46	0.956	0.937	1.48
Total Metals (mg/kg)										
Barium	7.17	5.14 J	7.56	8.62	3.4 J	8.38	23.3	6.99	6.26	7.47
Beryllium	1.05	0.402	0.402	0.422	0.155 U	0.167 U	0.257 U	0.538	0.545	0.616
Copper	3.61	1.52	1.31	1.46	0.516 U	0.558 U	0.856 U	1.62	2.13	2.71
Lead	12.7	6.46	6.98	5.18	2.83	5.02	16.8	4.79	4.18	4.68
Manganese	44 K	20.3	21.1	22.3	47.2	92.2	286	56.1 K	61.9	70.9
Mercury	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 J	0.036	0.007 J	0.014	0.011 J
Zinc	30.1 K	14	14	14.8	10.8	24.6	82.1	12.7 K	18	22.3
Acid Volatile Sulfide/Simultaneously Extractable Metals (µmol/g)										
Zinc, SEM	0.28	0.11	NA	0.11	0.18	0.25	0.44	0.023	0.062	0.13
Acid volatile sulfide, SEM	1.59	0.81	NA	2.59	4.05	3.43	6.86	1.25	1.72	1.87
Cadmium, SEM	2.00E-04 J	4.00E-04 J	NA	4.00E-04 U	4.00E-04 U	1.00E-03	7.00E-04 U	0.0012	4.00E-04 J	4.00E-04 U
Copper, SEM	0.013	0.016	NA	0.011	0.012	0.1	0.033	0.0073	0.013	0.011
Lead, SEM	0.033	0.016	NA	0.014	0.012	0.024	0.026	0.0034	0.0053	0.0081
Mercury, SEM	2.00E-05 U	2.00E-05 U	NA	2.00E-05 U	2.00E-04 U	2.00E-04 U	3.00E-04 U	2.00E-05 U	2.00E-05 U	2.00E-05 U
Nickel, SEM	0.0087 J	0.0072 J	NA	0.0046 J	0.0081 J	0.089	0.019	0.0059 U	0.0032 J	0.0046 J
Silver, SEM	8.00E-04 U	8.00E-04 U	NA	7.00E-04 U	7.00E-04 U	8.00E-04 U	0.0012 U	8.00E-04 U	8.00E-04 U	8.00E-04 U
Wet Chemistry										
% Solids (pct)	74.8	74.4	81.3	75.2	74.2	67	47	79.6	71.9	68.5
pH (pH units)	8.84 H	8.45 H	NA	8.55 H	7.99 H	8.17 H	8.56 H	8.84 H	8.73 H	8.61 H
Total organic carbon (TOC) (mg/kg)	2,070 D	874	NA	954	888	2,780 D	12,300 E	1,610	2,240 D	2,760 D

TABLE D-3

Raw Sediment Analytical Data - 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SD01	CAS07-SD02		CAS07-SD03	CAS07-SD04*	CAS07-SD05*	CAS07-SD06*	CAS07-SD07	CAS07-SD08	CAS07-SD09
Sample ID	CAS07-SD01-0414	CAS07-SD02-0414	CAS07-SD02P-0414	CAS07-SD03-0414	CAS07-SD04-0414	CAS07-SD05-0414	CAS07-SD06-0414	CAS07-SD07-0414	CAS07-SD08-0414	CAS07-SD09-0414
Sample Date	04/14/14	04/14/14	04/14/14	04/14/14	04/18/14	04/18/14	04/18/14	04/22/14	04/22/14	04/22/14
Chemical Name										
Grain Size (pct)										
Cobbles (%)	0	0	NA	0	0	0	0	0	0	0
Fines (%)	8.8	4.6	NA	4	3	10.5	55	8.7	7.1	9.6
Gravel (%)	2	0	NA	0	0	0	0	2.2	0	0
Sand (%)	89.2	95.4	NA	96	97	89.5	45	89.1	92.9	90.4
Grain Size (pct/p)										
GS03 Sieve 3" (75 mm)	100	100	NA	100	100	100	100	100	100	100
GS05 Sieve 2" (50 mm)	100	100	NA	100	100	100	100	100	100	100
GS06 Sieve 1.5" (37.5 mm)	100	100	NA	100	100	100	100	100	100	100
GS07 Sieve 1" (25.0 mm)	100	100	NA	100	100	100	100	100	100	100
GS08 Sieve 0.75" (19.0 mm)	100	100	NA	100	100	100	100	100	100	100
GS09 Sieve 0.5" (12.5 mm)	100	100	NA	100	100	100	100	100	100	100
GS10 Sieve 0.375" (9.5 mm)	100	100	NA	100	100	100	100	98.5	100	100
GS11 Sieve 0.25" (6.35 mm)	98.8	100	NA	100	100	100	100	98.4	100	100
Sieve No. 004 (4.75 mm)	98.8	100	NA	100	100	100	100	97.8	100	100
Sieve No. 010 (2.00 mm)	92.5	100	NA	100	100	100	99.6	92.8	100	100
Sieve No. 020 (850 um)	87.3	99.9	NA	100	99.9	99.7	99.1	87.3	99.9	99.9
Sieve No. 040 (425 um)	79.7	99.6	NA	99.8	99.5	98.6	98.6	79.5	99.3	99.6
Sieve No. 060 (250 um)	62.8	90.4	NA	92.4	81.4	56.4	92.6	63.3	88.5	92.8
Sieve No. 140 (106 um)	24.9	19.5	NA	16.8	4.4	11.9	59.8	18.2	18	19.9
Sieve No. 200 (75 um)	8.8	4.6	NA	4	3	10.5	55	8.7	7.1	9.6

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

D - Compound identified in an analysis at a secondary dilution factor

E - Estimated; concentration exceeds calibration range

H - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UL - Analyte not detected, quantitation limit is probably higher

X - Dioxins only: Estimated Maximum Possible Concentration (EMPC)

mg/kg - Milligrams per kilogram

pct - Percent

pct/p - Percent Passed

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

µmol/g - Micromoles per gram

*Samples collected at CAS07-SD04, CAS07-SD05, CAS07-SD06, CAS07-SD10, CAS07-SD11, CAS07-SD12, CAS07-SD16, CAS07-SD17, CAS07-SD18 were not evaluated as part of the HHRA since the sample location was either too far from the shore or under deep surface water

TABLE D-3

Raw Sediment Analytical Data - 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SD10*	CAS07-SD11*	CAS07-SD12*	CAS07-SD13		CAS07-SD14	CAS07-SD15	CAS07-SD16*	CAS07-SD17*	CAS07-SD18*
Sample ID	CAS07-SD10-0414	CAS07-SD11-0414	CAS07-SD12-0414	CAS07-SD13-0414	CAS07-SD13P-0414	CAS07-SD14-0414	CAS07-SD15-0414	CAS07-SD16-0414	CAS07-SD17-0414	CAS07-SD18-0414
Sample Date	04/22/14	04/22/14	04/22/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14
Chemical Name										
Semivolatile Organic Compounds (µg/kg)										
bis(2-Ethylhexyl)phthalate	85.3 U	93 U	92.2 U	40.6 U	41.6 U	40.5 U	40.2 U	42 U	41.1 U	42.7 U
Di-n-octylphthalate	4.2 U	4.6 U	4.6 U	2 U	2.1 U	2 U	2 U	2.1 U	2 U	2.1 U
Dioxin/Furans (pg/g)										
1,2,3,4,6,7,8-Heptachlorodibenzofuran	11.6	12.3	12.7	4.48	5.71	5.17	4.43	4.55	5.5	5.82
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	162	212	203	22.6	27.3	25.7	24.7	26	38.5	51.6
1,2,3,4,7,8,9-Heptachlorodibenzofuran	1.34 J	1.28 X	1.13 J	0.51 B	0.604 B	0.683 B	0.526 B	0.628 B	0.529 B	0.325 B
1,2,3,4,7,8-Hexachlorodibenzofuran	1.6 J	1.69 J	1.55 X	0.767 J	0.796 X	0.744 J	0.768 J	0.78 J	0.832 X	0.867 X
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.18 J	3.06 X	2.77 X	0.361 B	0.314 B	0.248 B	0.243 B	0.176 B	0.548 J	0.51 J
1,2,3,6,7,8-Hexachlorodibenzofuran	0.481 B	0.413 B	0.645 J	0.205 J	0.356 J	0.277 X	0.289 X	0.162 J	0.203 J	0.206 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	5.67 J	7.62	6.78 J	1.25 J	1.36 J	1.39 X	1.29 X	1.27 J	2.1 J	2.04 X
1,2,3,7,8,9-Hexachlorodibenzofuran	1.82 U	0.295 B	0.362 X	0.187 B	0.201 B	0.289 B	0.222 B	0.119 B	1.03 U	0.166 B
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	5.72 J	8.66	7.05	0.449 X	0.615 J	0.529 J	0.562 X	0.452 J	1.2 J	1.9 J
1,2,3,7,8-Pentachlorodibenzofuran	1.82 U	2.04 U	0.443 X	0.907 U	0.175 J	0.146 X	0.925 U	0.96 U	1.03 U	0.177 X
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.818 J	1.22 J	1.05 X	0.155 X	0.162 X	0.202 X	0.126 J	0.0836 X	0.182 J	0.331 X
2,3,4,6,7,8-Hexachlorodibenzofuran	0.646 J	0.919 X	0.928 J	0.34 X	0.401 J	0.337 J	0.292 J	0.254 J	0.401 J	0.39 J
2,3,4,7,8-Pentachlorodibenzofuran	0.513 X	0.644 X	0.364 X	0.304 J	0.378 X	0.257 X	0.191 J	0.96 U	0.185 X	0.217 J
2,3,7,8-TCDD (dioxin)	0.364 U	0.441 U	0.422 U	0.181 U	0.18 U	0.181 U	0.185 U	0.192 U	0.205 U	0.216 U
2,3,7,8-Tetrachlorodibenzofuran	0.439 J	0.848 X	0.534 J	0.181 U	0.18 U	0.181 U	0.185 U	0.192 U	0.205 U	0.226 J
Octachlorodibenzofuran	36.6	38.9	39.6	15.6 J	20.2 J	18.7	15.1	15.4	17.5	17.8
Octachlorodibenzo-p-dioxin	2,450	3,370	3,410	82.7 J	121 J	111 K	112 K	118 K	334 K	594 K
Total heptachlorodibenzofuran	61.2	62.8	66.2	25.3 J	31.2 J	29.1 J	24.9 J	26.6 J	30.7 J	32.8 J
Total heptachlorodibenzo-p-dioxin	486	662	634	37.7	49.2	43.8	43.1	46.1	88.5	135
Total hexachlorodibenzofuran	15.9 J	17.7 J	17.5	6.61 J	6.9 J	7.71 J	5.37 J	6.99 J	7.23	7.96 J
Total hexachlorodibenzo-p-dioxin	164	224	214	3.34 J	5.94 J	3.49 J	5.3 J	8.43 J	24.7	37.9
Total pentachlorodibenzofuran	0.716 J	2.76 J	2.79 J	0.776 J	0.446 J	0.199 J	0.185 J	0.96 U	0.162 J	0.349 J
Total pentachlorodibenzo-p-dioxin	15.3	24.4	20.7	0.0826 J	0.0949 J	0.907 U	0.325 J	0.34 J	2.4 J	2.74 J
Total tetrachlorodibenzofuran	0.439 J	2.65	1.32 J	0.181 U	0.18 U	0.181 U	0.185 U	0.192 U	0.205 U	0.226 J
Total tetrachlorodibenzo-p-dioxin	3.54	6.77	3.85	0.181 U	0.18 U	0.181 U	0.185 U	0.192 U	0.205 U	0.216 U
Toxic Equivalents (Total TEQ) - HHRA	5.1	7.0	6.4	0.85	1.0	0.96	0.83	0.72	1.3	1.8
Toxic Equivalents (Total TEQ) - Eco, Fish	3.41	4.53	4.05	0.752	0.819	0.758	0.651	0.723	1.04	1.19
Total Metals (mg/kg)										
Barium	34.2	37.4	39.6	4.25 J	2.84 J	5.19	9.91	1.88 J	4.36 J	5.61
Beryllium	2.66	2.81	2.82	0.157 U	0.154 U	0.151 U	0.148 U	0.159 U	0.159 U	0.157 U
Copper	13.2	14.6	14.8	0.523 UL	0.514 U	0.607 J	0.493 U	0.531 U	0.53 U	0.522 U
Lead	21.9	23.8	23.2	2.44	2.13	2.18	3.57	1.35	2.87	3.96
Manganese	471	518	514	31.3 K	21 J	39.3	31.5	26.5	40.8	59.4
Mercury	0.051	0.055	0.055	0.006 U	0.006 U	0.017	0.006 U	0.006 U	0.006 U	0.006 U
Zinc	124	132	130	8.61 J	22.5 J	21.3	16.7	4.45 B	12.3	18.7
Acid Volatile Sulfide/Simultaneously Extractable Metals (µmol/g)										
Zinc, SEM	0.53	0.84	1	0.03	NA	0.052	0.06	0.048	0.074	0.17
Acid volatile sulfide, SEM	8.42	10.3	10.3	1.75	NA	2.06	3.12	4.05	4.05	4.37
Cadmium, SEM	9.00E-04 U	1.00E-03 U	9.00E-04 U	2.00E-04 J	NA	3.00E-04 J	5.00E-04 J	4.00E-04 U	4.00E-04 U	4.00E-04 U
Copper, SEM	0.026	0.026	0.05	0.19	NA	0.014	0.01	0.0071	0.047	0.015
Lead, SEM	0.028	0.049	0.06	0.0045	NA	0.0049	0.0041	0.0033	0.0046	0.0097
Mercury, SEM	3.00E-05 U	4.00E-05 U	4.00E-05 U	2.00E-04 U	NA	2.00E-04 U	2.00E-04 U	2.00E-04 U	2.00E-04 U	2.00E-04 U
Nickel, SEM	0.018 J	0.025	0.048	0.0026 J	NA	0.0092 J	0.0045 J	0.0054 U	0.0035 J	0.0071 J
Silver, SEM	0.0011 J	0.0021 J	0.0029 J	7.00E-04 U	NA	7.00E-04 U	7.00E-04 U	8.00E-04 U	7.00E-04 U	8.00E-04 U
Wet Chemistry										
% Solids (pct)	39.6	36.3	35.4	82.4	81.7	80.2	80.3	77.2	72.2	68.9
pH (pH units)	8.56 H	8.39 H	8.49 H	8.64 H	NA	8.85 H	8.79 H	7.74 H	8.33 H	8.22 H
Total organic carbon (TOC) (mg/kg)	9,320 E	11,900 E	9,080 E	3,870 D	NA	2,020 D	13,700 E	788	1,400 D	2,920 D

TABLE D-3

Raw Sediment Analytical Data - 2014

Site 7 Remedial Investigation

Cheatham Annex, Williamsburg, Virginia

Station ID	CAS07-SD10*	CAS07-SD11*	CAS07-SD12*	CAS07-SD13		CAS07-SD14	CAS07-SD15	CAS07-SD16*	CAS07-SD17*	CAS07-SD18*
Sample ID	CAS07-SD10-0414	CAS07-SD11-0414	CAS07-SD12-0414	CAS07-SD13-0414	CAS07-SD13P-0414	CAS07-SD14-0414	CAS07-SD15-0414	CAS07-SD16-0414	CAS07-SD17-0414	CAS07-SD18-0414
Sample Date	04/22/14	04/22/14	04/22/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14
Chemical Name										
Grain Size (pct)										
Cobbles (%)	0	0	0	0	NA	0	0	0	0	0
Fines (%)	67.5	71	73.8	0.5	NA	0.7	0.8	1.2	4.6	7.8
Gravel (%)	0	0	0	2.6	NA	5.6	7.1	0	0	0.1
Sand (%)	32.5	29	26.2	96.9	NA	93.8	92.1	98.8	95.4	92.1
Grain Size (pct/p)										
GS03 Sieve 3" (75 mm)	100	100	100	100	NA	100	100	100	100	100
GS05 Sieve 2" (50 mm)	100	100	100	100	NA	100	100	100	100	100
GS06 Sieve 1.5" (37.5 mm)	100	100	100	100	NA	100	100	100	100	100
GS07 Sieve 1" (25.0 mm)	100	100	100	100	NA	100	100	100	100	100
GS08 Sieve 0.75" (19.0 mm)	100	100	100	100	NA	100	100	100	100	100
GS09 Sieve 0.5" (12.5 mm)	100	100	100	100	NA	100	100	100	100	100
GS10 Sieve 0.375" (9.5 mm)	100	100	100	99.2	NA	99.9	98.2	100	100	100
GS11 Sieve 0.25" (6.35 mm)	100	100	100	98.8	NA	96.1	96.1	100	100	100
Sieve No. 004 (4.75 mm)	100	100	100	97.4	NA	94.4	92.9	100	100	99.9
Sieve No. 010 (2.00 mm)	100	100	100	89.9	NA	85.4	81.6	100	99.8	99.5
Sieve No. 020 (850 um)	99.8	99.6	99.8	79.6	NA	71.8	69.5	99.2	98.7	98.2
Sieve No. 040 (425 um)	99.5	98.8	99.4	39.3	NA	37.2	36	87.5	87.3	83
Sieve No. 060 (250 um)	99	97.6	98.8	5.4	NA	8	9.6	54.7	59.2	55.6
Sieve No. 140 (106 um)	80.6	82.9	85.2	0.7	NA	1.4	1.5	2.2	6.2	9.9
Sieve No. 200 (75 um)	67.5	71	73.8	0.5	NA	0.7	0.8	1.2	4.6	7.8

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected significantly above the level reported in an associated blank

D - Compound identified in an analysis at a secondary dilution factor

E - Estimated; concentration exceeds calibration range

H - Analyzed outside of holding time

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UL - Analyte not detected, quantitation limit is probably higher

X - Dioxins only: Estimated Maximum Possible Concentration (EMPC)

mg/kg - Milligrams per kilogram

pct - Percent

pct/p - Percent Passed

pg/g - Picograms per gram

µg/kg - Micrograms per kilogram

µmol/g - Micromoles per gram

*Samples collected at CAS07-SD04, CAS07-SD05, CAS07-SD06, CAS07-SD10, CAS07-SD11, CAS07-SD12, CAS07-SD16, CAS07-SD17, CAS07-SD18 were not evaluated as part of the HHRA since the sample location was either too far from the shore or under deep surface water

Appendix E
Data Quality Evaluation

Appendix E
Data Quality Report for Cheatham Annex Site 7, Remedial Investigation

Naval Weapons Station Yorktown, Cheatham Annex
Williamsburg, Virginia

Contract Task Order WE66

December 2014

Prepared for

Department of the Navy
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CH2MHILL

Virginia Beach, Virginia

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SECTION 1

Data Quality Evaluation Process

This data quality evaluation assesses the effect of the overall analytical process on the availability of the analytical data. “Availability” in this context refers to whether results can be used by the project team, and is based on the analytical soundness of the results, as determined in the evaluation process. If a result is analytically sound, it is available for use in evaluating the potential release, nature, and extent of contamination, and estimating potentially associated human health and ecological risks. Though results are available, the data user may consider a particular result or group of results to be not usable for one or more purposes if other conditions apply. In order to avoid confusion of terms, this data quality evaluation differentiates the “availability” of results from “usability” of results.

Three major categories of data evaluation are considered: laboratory performance, field collection performance, and matrix interference. Evaluation of laboratory performance is a check of the laboratory’s compliance with the method and client-specified requirements. Evaluation of field collection performance is a review of field quality control (QC) samples such as equipment blanks and field duplicates. Evaluation of potential matrix interference involves the review of supporting data such as surrogate recoveries and matrix spike (MS) recoveries.

Data evaluation is a multi-tiered approach, as outlined in Worksheet #34-36 of the *Sampling and Analysis Plan Site 7 – Old Dupont Disposal Area Remedial Investigation* (CH2M HILL, 2014). The process begins with an internal review by the laboratory, continues with validation, and ends with an overall review by the CH2M HILL project chemistry team and the production of this report. While only the data validator applies final qualifiers to the data, the tiered-approach allows for data quality to be evaluated thoroughly and provides a medium for essential communication among the laboratory, validator, and project team.

1.1 Laboratory Internal Quality Control Review

During analysis and prior to releasing the analytical data, the laboratory reviewed both the client sample and laboratory QC sample data to verify sample identity, instrument calibration, quantitation limits, dilution factors, numerical computations, transcription accuracy, and chemical identification. The QC data were tabulated and the results reviewed to determine whether they were within the limits for accuracy and precision. Corrective action was taken and any non-conforming data was discussed in the data package cover letter and case narrative.

To identify the need for corrective action, the laboratory referred to their in-house Standard Operating Procedures (SOPs) and the specifications of the Sampling and Analysis Plan(s) (SAPs) specific to this project. Laboratory SOPs were based on the analytical method, Department of Defense requirements, and accumulated laboratory experience; the SAP was Cheatham Annex the *Sampling and Analysis Plan Site 7 – Old Dupont Disposal Area Remedial Investigation* (CH2M HILL, 2014).

1.2 Data Validation

Validation was performed by CH2M HILL. The validator reviewed all definitive data packages, qualified data, and reduced the dataset to present only one result per analyte, per sample. For each sample, and each analyte, the validator retained the result with the highest data quality and excluded any other results (from re-extraction, re-analysis, or multiple dilutions) to avoid redundancy.

During this review and determination of the need for qualification, the validator evaluated analytical results against the quality assurance (QA)/QC criteria of the SAP, analytical methods, and laboratory SOPs, respectively. The data qualifiers applied are those presented in *Region III Modifications to the National Functional Guidelines for Organic Data Review (September 1994)* and *Region III Modifications to National Functional Guidelines for Inorganic Data Review (April 1993)*. National Functional Guidelines may have also been used during validation if criteria did not contradict criteria in the SAPs.

The data validation was focused on the laboratory’s performance and the sample matrix and their effects on the analytical results. Areas of review consisted of holding time compliance, surrogate recovery accuracy, blank

contamination (trip, equipment, and method blanks), initial and continuing calibration accuracy and precision, laboratory control sample (LCS) accuracy, internal standard response and retention time accuracy, instrument tune criteria accuracy, matrix spike and matrix spike duplicate (MS/MSD) recovery and duplicate sample precision (laboratory and field duplicates). Additionally, the analytical spectrum and raw data output were reviewed and 10% of the laboratory results were recalculated from the raw data to verify final laboratory identification and quantitation.

1.3 Precision, Accuracy, Representativeness, Completeness, Comparability (PARCC)

Throughout the data evaluation process, data quality is evaluated by the precision, accuracy, representativeness, completeness, and comparability (PARCC) of the data. For reference, PARCC is defined as:

1.3.1 Precision

Precision is defined as the agreement between duplicate results, and was characterized by comparing the relative percent differences (RPDs) of MS/MSD, laboratory control sample (LCS) and its duplicate, serial dilutions, laboratory replicates, and/or field duplicate sample results. Although results may have been qualified due to QC exceedances that may suggest an impact on precision, there is no actual significant negative impact on precision unless a data point is deemed unavailable (rejected) due to precision exceedances.

1.3.2 Accuracy/Bias

Accuracy/bias is a measure of the agreement between an analytical determination and the true value of the parameter being measured. For organic analyses, each sample was spiked with surrogate compounds; and for both organic and inorganic analyses, an MS/MSD and LCS were spiked with a known analyte concentration before preparation. Internal standards, surrogates and MS/MSDs provide a measure of the matrix effects on the analytical accuracy. The LCS demonstrates accuracy of the method and the laboratory's ability to meet the method criteria. Accuracy/bias is also assessed by calibration recoveries. Although results may have been qualified due to QC exceedances which may suggest an impact on accuracy/bias, there is no actual significant negative impact on accuracy unless a data point is deemed unusable (rejected) due to accuracy exceedances.

1.3.3 Representativeness

Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition (in this case, the nature and extent of contamination). Representativeness is a subjective parameter and is used to evaluate the efficacy of the sample planning design. In terms of data quality, representativeness is assured by the sampling team by following approved standard operating procedures (SOPs) for sample collection and handling, and the laboratory following approved SOPs for sample handling, preparation, and analysis.

1.3.4 Completeness

Completeness is calculated as the number of analytically-sound results that are available for use compared to the total number of measurements made. All results except those R-qualified as "rejected" are available for use as analytically-sound results. The R-qualifier is the only qualifier that negatively affects a data point's availability. The completeness of the dataset will be compared to a completeness goal of 95%, as identified in Worksheet #37 of the UFP-SAP (CH2M HILL, 2014).

1.3.5 Comparability

Comparability is a qualitative measure designed to express the confidence with which one data set may be compared to another. Factors that affect comparability are sample collection and handling techniques, sample matrix, and analytical methods. If SOPs are followed, then with the exception of data that has been rejected due to quality exceedances, precision and accuracy are said to be acceptable and the data user may be confident that this data set is comparable to others of high data quality.

SECTION 2

Qualifiers and Reasons

2.1 Availability of Qualified Data

The qualifiers applied during validation affect the availability of the results and may affect their usability for certain purposes. The qualifiers in **Table 2-1** were applied to the Site 7 dataset during the data validation process. For definitive data (organics and inorganics), final qualifiers are issued by the validator; for screening data, the laboratory qualifiers are considered final qualifiers. Qualifiers are discussed in greater detail in **Sections 2.1.1 through 2.1.7**, and reasons for applying these qualifiers are discussed in **Section 2.2**.

TABLE 2-1
Final Qualifiers Applied to Cheatham Annex Site 7 Data

Qualifier	Meaning	Percent of Data Qualified	Count
[NONE]	Detected	40.12%	696
U	Nondetect at the reported concentration	38.50%	668
J	Detected, concentration estimated	12.22%	212
X	Tentatively detected, estimated concentration; specific to dioxin/furan data	3.57%	62
B	Attributed to blank contamination	2.36%	41
H	Detected, concentration estimated; specific to screening data	1.15%	20
K	Detected, concentration biased high	0.81%	14
D	Detected, concentration estimated; specific to screening data	0.75%	13
E	Detected, concentration estimated; specific to screening data	0.29%	5
HU	Non-detect, quantitation limit estimated; specific to screening data	0.12%	2
L	Detected, concentration biased low	0.06%	1
UL	Nondetect, quantitation limit biased low	0.06%	1
Totals:		100.00%	1,735

100.00% not R-flagged and available for use

2.1.1 R-Qualified Results

In certain cases, a result is rejected and deemed to be unavailable. “Unavailable” in this instance is defined as a result that is not analytically sound and is not considered available for use by the project team. The R-qualifier is the only qualifier that may have an adverse effect on the availability of data. There are no rejected data points in this data set.

2.1.2 Results with No Qualification

The absence of a qualifier indicates that the analyte was detected at the reported concentration and no qualification was warranted.

2.1.3 J-, UJ-, and U-Qualified Results

The J-qualification, UJ-qualification, and U-qualification of results are common occurrences and have no adverse effect on the availability of that result to the project team for making decisions. J-qualified results are available for use as detects at the reported result as long as they are considered “estimated” by the project team. Human health risk assessment guidance suggests that these qualifiers “indicate uncertainty in the reported concentration of the chemical, but not in its assigned identity. Therefore, these data can be used just as positive data with no qualifiers or codes.” In addition, one is to use “J-qualified concentrations the same way as positive data that do not have this qualifier” (*Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual.*

(Part A) EPA/540/1-89/002. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. 1989). U-qualified and UJ-qualified results are available for use as nondetects at the reported quantitation limit as long as they are considered “nondetect,” or “nondetect, estimated quantitation limit,” as appropriate.

2.1.4 B-Qualified Results

The B-qualification indicates that the results may be attributable to field or laboratory blank contamination, and that the analyte was detected in an associated blank as well as in the sample. If the B-qualifier is applied to definitive data, the results are usable as nondetects as long as they are considered “not detected at significantly greater concentration than that in an associated blank.” If the B-qualifier is applied to screening data, the results are usable as detects as qualified.

2.1.5 K-, L-, and UL-Qualified Results

The K-qualification, L-qualification, and UL-qualification indicate the data is affected by an undeterminable degree of positive or negative bias. This may indicate the presence of a QC problem, but not a problem severe enough to warrant rejection of data. K-qualified results are usable as detects as long as they are considered “estimated and biased high.” L-qualified results are available for use as detects and UL-qualified results are usable as nondetects as long as L- and UL-qualified results are considered “estimated and biased low.”

2.1.6 X-Qualified Results

The X-qualification indicates uncertainty in the reported concentration of the analyte, as well as its assigned identity. This qualification is applied when there is a response similar to that of the target analyte is detected, but not all of the identification criteria are met. It is a qualification unique to high resolution methods such as those used for dioxins/furans and PCB congeners. X-qualified results are tentative detections and can be treated as detects or nondetects at the reported concentration, as long as they are treated as “estimated maximum possible concentrations.” For this RI report, X-qualified data have been treated as detections.

2.1.7 H-, D- and E-Qualified Results

The H-, D- and E-qualifications were made at the laboratory and are associated with screening data, not definitive data. H-qualified results are reported from an analysis that was performed outside of the holding time but within twice the holding time. D-qualified results were analyzed at a dilution. E-qualified results are detections above the calibration range. H-, D- and E-qualified results are available for use as detects at the reported result as long as they are considered “estimated” by the project team.

2.2 Reasons for Data Qualification

When qualifying data the validator associates a reason code to explain why the qualification was made. Examining reasons for qualifying data provides insight into whether QC issues were encountered due to laboratory performance, field collection performance, or matrix interference. **Table 2-2** provides a list of the combinations of qualifiers and reason codes applied to the Site 7 dataset, explains them, and identifies the impact of these qualifications on data quality. Whenever data is available for use as reported or as qualified, there is no impact on the availability of data for use by the project team.

TABLE 2-2
Reasons for Data Qualification

Qualifier	Reason Code	Count	Percent	Explanation	Impact on PARCC
				Data Available as Reported	
[NONE]	[NONE]	696	40.12%	Constituent was detected and further qualification was not necessary as there were no QA/QC exceedances. The result is available as a detect as reported.	none
U	[NONE]	668	38.50%	Constituent was analyzed for but not detected. Further qualification was not necessary as there were no QA/QC exceedances. The result is available as a nondetect at the reported quantitation limit.	none
J	[NONE]	170	9.80%	Constituent was detected at a concentration less than the quantitation limit and was thus qualified as estimated by the laboratory. Further qualification was not necessary as there were no QA/QC exceedances. The result is available as a detect as reported.	none
H	[NONE]	20	1.15%	Specific to screening data. Constituent was detected. The result is H-qualified due to exceeding the analysis holding time. The result is available as a detect as qualified.	none
D	[NONE]	13	0.75%	Specific to screening data. Constituent was detected. The result is D-qualified due to the sample being analyzed at a dilution. The result is available as a detect as qualified.	none
E	[NONE]	5	0.29%	Specific to screening data. Constituent was detected. The result is E-qualified due to exceeding the calibration range. The result is available as a detect as qualified.	none
HU	[NONE]	2	0.12%	Specific to screening data. Constituent was not detected. The result is H-qualified due to exceeding the analysis holding time. The result is available as a nondetect as qualified.	none
				Data Available as Qualified	
X	EMPC	62	3.57%	Specific to dioxin/furan data. Constituent was tentatively detected. This is an estimated maximum possible concentration because one of the criteria required for positive identification (ion abundance ratio) was not met; therefore the identity of the detection is not certain. The result is available as a detect as qualified; for some data users, X-qualified data may not be considered a detection. For this RI report, X-qualified data have been treated as detections.	none
B	MBL	34	1.96%	Constituent was detected. The result is B-qualified due to method blank contamination. The result is available as a nondetect as qualified.	none
J	OT	31	1.79%	Constituent was detected. Result is J-qualified for a reason specified in the DV report. In these instances, the qualifier is unique to dioxin/furan data. The total congener series were J-flagged if an associated single congener was B-flagged. The result is available as a detect as qualified.	none
J	FD	11	0.63%	Constituent was detected. Result is J-qualified due to poor reproducibility between the parent and field duplicate. The QA/QC exceedance (potential precision issue) was not severe enough to warrant rejection. The result is available as a detect as qualified, the greater of the parent and duplicate results should be used.	none
K	BSH	8	0.46%	Constituent was detected. The result is K-qualified due to high recovery in the LCS. The QA/QC exceedance (potential high bias) was not severe enough to warrant rejection. The result is available as a detect as qualified.	none

TABLE 2-2
Reasons for Data Qualification

Qualifier	Reason Code	Count	Percent	Explanation	Impact on PARCC
				Data Available as Qualified	
B	EBL	7	0.40%	Constituent was detected. The result was B-qualified due to equipment blank contamination. The result is available as a nondetect as qualified.	none
K	MSH	6	0.35%	Constituent was detected. The result was K-qualified due to high recovery in the matrix spike and/or matrix spike duplicate. The QA/QC exceedance (potential high bias) was not severe enough to warrant rejection. The result is available as a detect as qualified.	none
L	MSL	1	0.06%	Constituent was detected. The result was L-qualified due to low recovery in a matrix spike and/or matrix spike duplicate. The QA/QC exceedance (potential low bias) was not severe enough to warrant rejection. The result is available as a detect as qualified.	none
UL	MSL	1	0.06%	Constituent was analyzed for but not detected. The result was UL-qualified due to low recovery in the matrix spike and/or matrix spike duplicate. The QA/QC exceedance (potential low bias) was not severe enough to warrant rejection. The result is available as a nondetect as qualified.	none
Totals:		1735	100.00%		

100.00% not R-flagged and available for use

SECTION 3

Evaluation of Data against Project Action Limits

When nondetect results are reported at a value greater than project action limits (PALs), the results are available for use as nondetects, but their use may add uncertainty to the conclusions drawn. This is a relatively common occurrence, and there are a variety of potentially unavoidable reasons why the value at which nondetects are reported nondetect may exceed PALs, but the following two are the most common:

- Current technology may not be able to achieve an LOD or DL less than the PAL, in such cases the PAL is considered unreasonably low
- Soil and sediment samples may be too wet to achieve the PAL; samples are reported on a dry-weight basis, so if a soil sample is characterized by high percent moisture, then the reporting limits will be elevated

When drafting the UFP-SAP for Site 7, it was anticipated that some PALs would not be met. This is detailed in the Reference Limits and Evaluation Tables with shading of the PALs that would not be met.

As part of the data quality evaluation, nondetected results, their associated nondetect value (the LOD), and the detection limit (DL) are compared to the minimum PAL (or to the background value if one exists). Such a comparison identifies instances where there is uncertainty regarding whether the analyte is present above the PAL (or background) due to the detection limits of the method and instrument. Since any concentration greater than the DL would be reported as a detection, uncertainty only exists when the DL is greater than the PAL. The different permutations for the PAL, LOD, and DL are summarized in **Table 3-1**, along with their impact on certainty of absence.

TABLE 3-1
Possible Arrangements for PAL, LOD, and DL, and Impact on Certainty of Absence

PAL relative to limits	Impact on Certainty of Absence
PAL > LOD > DL	baring other qualifications, there is certainty that the analyte is not present above the PAL, this is apparent on data tables
LOD > PAL > DL	baring other qualifications, there is certainty that the analyte is not present above the PAL, however this may not be apparent from data tables
LOD > DL > PAL	though the data is qualified as nondetect, there is uncertainty regarding whether the analyte is present at a concentration exceeding the PAL; this may not be apparent from data tables

PAL (project action limit) – the comparison criteria

LOD (limit of detection) – the value at which nondetects are reported in data tables

DL (detection limit) – the lowest concentration the instrument can detect; any response greater than this is reported as a detection

Lists of all data for which the PAL is lower than the LOD or the DL is are included in tables **Tables 3-2 through 3-3**. Data for which PAL is lower than the DL is discussed in Section 4 for each site, media, and analytical group as appropriate.

Comparison Criteria

The comparison criteria considered in **Tables 3-2 through 3-3** were as follows:

- Groundwater: Federal Maximum Contaminant Levels (MCLs), Adjusted USEPA Regional Screening Levels (RSLs) for Tapwater from May 2014, and Ecological Screening Values (ESVs) for Water
- Sediment: Adjusted USEPA RSLs for Residential Soil from May 2014 times 10 for comparison to sediment and ESVs for Marine Sediment.

TABLE 3-2

Nondetect Results Reported at Value Greater than the Comparison Criteria

Organics in Groundwater

DL meets Action Limit?	Sample Name	Analysis Group	Analyte Name	CAS Number	Analytical Result	Units	Validator Qualifier	Qualifier Reason Code	DL	LOD	LOQ	Minimum PAL
No	CAS07-GW03-0414	VOA	1,1,2,2-Tetrachloroethane	79-34-5	0.2	UG_L	U		0.2	0.2	1	0.076
No	CAS07-GW03P-0414	VOA	1,1,2,2-Tetrachloroethane	79-34-5	0.2	UG_L	U		0.2	0.2	1	0.076
No	CAS07-GW04-0414	VOA	1,1,2,2-Tetrachloroethane	79-34-5	0.2	UG_L	U		0.2	0.2	1	0.076
No	CAS07-GW05-0414	VOA	1,1,2,2-Tetrachloroethane	79-34-5	0.2	UG_L	U		0.2	0.2	1	0.076
No	CAS07-GW06-0414	VOA	1,1,2,2-Tetrachloroethane	79-34-5	0.2	UG_L	U		0.2	0.2	1	0.076
No	CAS07-GW07-0414	VOA	1,1,2,2-Tetrachloroethane	79-34-5	0.2	UG_L	U		0.2	0.2	1	0.076
No	CAS07-GW08-0414	VOA	1,1,2,2-Tetrachloroethane	79-34-5	0.2	UG_L	U		0.2	0.2	1	0.076
No	CAS07-GW09-0414	VOA	1,1,2,2-Tetrachloroethane	79-34-5	0.2	UG_L	U		0.2	0.2	1	0.076
No	CAS07-GW03-0414	VOA	1,1,2-Trichloroethane	79-00-5	0.2	UG_L	U		0.2	0.2	1	0.041
No	CAS07-GW03P-0414	VOA	1,1,2-Trichloroethane	79-00-5	0.2	UG_L	U		0.2	0.2	1	0.041
No	CAS07-GW04-0414	VOA	1,1,2-Trichloroethane	79-00-5	0.2	UG_L	U		0.2	0.2	1	0.041
No	CAS07-GW05-0414	VOA	1,1,2-Trichloroethane	79-00-5	0.2	UG_L	U		0.2	0.2	1	0.041
No	CAS07-GW06-0414	VOA	1,1,2-Trichloroethane	79-00-5	0.2	UG_L	U		0.2	0.2	1	0.041
No	CAS07-GW07-0414	VOA	1,1,2-Trichloroethane	79-00-5	0.2	UG_L	U		0.2	0.2	1	0.041
No	CAS07-GW08-0414	VOA	1,1,2-Trichloroethane	79-00-5	0.2	UG_L	U		0.2	0.2	1	0.041
No	CAS07-GW09-0414	VOA	1,1,2-Trichloroethane	79-00-5	0.2	UG_L	U		0.2	0.2	1	0.041
No	CAS07-GW03-0414	VOA	1,2-Dibromo-3-chloropropane	96-12-8	0.2	UG_L	U		0.2	0.2	1	0.00033
No	CAS07-GW03P-0414	VOA	1,2-Dibromo-3-chloropropane	96-12-8	0.2	UG_L	U		0.2	0.2	1	0.00033
No	CAS07-GW04-0414	VOA	1,2-Dibromo-3-chloropropane	96-12-8	0.2	UG_L	U		0.2	0.2	1	0.00033
No	CAS07-GW05-0414	VOA	1,2-Dibromo-3-chloropropane	96-12-8	0.2	UG_L	U		0.2	0.2	1	0.00033
No	CAS07-GW06-0414	VOA	1,2-Dibromo-3-chloropropane	96-12-8	0.2	UG_L	U		0.2	0.2	1	0.00033
No	CAS07-GW07-0414	VOA	1,2-Dibromo-3-chloropropane	96-12-8	0.2	UG_L	U		0.2	0.2	1	0.00033
No	CAS07-GW08-0414	VOA	1,2-Dibromo-3-chloropropane	96-12-8	0.2	UG_L	U		0.2	0.2	1	0.00033
No	CAS07-GW09-0414	VOA	1,2-Dibromo-3-chloropropane	96-12-8	0.2	UG_L	U		0.2	0.2	1	0.00033
No	CAS07-GW03-0414	VOA	1,2-Dibromoethane	106-93-4	0.2	UG_L	U		0.2	0.2	1	0.0075
No	CAS07-GW03P-0414	VOA	1,2-Dibromoethane	106-93-4	0.2	UG_L	U		0.2	0.2	1	0.0075
No	CAS07-GW04-0414	VOA	1,2-Dibromoethane	106-93-4	0.2	UG_L	U		0.2	0.2	1	0.0075
No	CAS07-GW05-0414	VOA	1,2-Dibromoethane	106-93-4	0.2	UG_L	U		0.2	0.2	1	0.0075
No	CAS07-GW06-0414	VOA	1,2-Dibromoethane	106-93-4	0.2	UG_L	U		0.2	0.2	1	0.0075
No	CAS07-GW07-0414	VOA	1,2-Dibromoethane	106-93-4	0.2	UG_L	U		0.2	0.2	1	0.0075
No	CAS07-GW08-0414	VOA	1,2-Dibromoethane	106-93-4	0.2	UG_L	U		0.2	0.2	1	0.0075
No	CAS07-GW09-0414	VOA	1,2-Dibromoethane	106-93-4	0.2	UG_L	U		0.2	0.2	1	0.0075
No	CAS07-GW03-0414	VOA	1,2-Dichloroethane	107-06-2	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW03P-0414	VOA	1,2-Dichloroethane	107-06-2	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW04-0414	VOA	1,2-Dichloroethane	107-06-2	0.2	UG_L	U		0.2	0.2	1	0.17

TABLE 3-2

Nondetect Results Reported at Value Greater than the Comparison Criteria

Organics in Groundwater

DL meets Action Limit?	Sample Name	Analysis Group	Analyte Name	CAS Number	Analytical Result	Units	Validator Qualifier	Qualifier Reason Code	DL	LOD	LOQ	Minimum PAL
No	CAS07-GW05-0414	VOA	1,2-Dichloroethane	107-06-2	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW06-0414	VOA	1,2-Dichloroethane	107-06-2	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW07-0414	VOA	1,2-Dichloroethane	107-06-2	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW08-0414	VOA	1,2-Dichloroethane	107-06-2	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW09-0414	VOA	1,2-Dichloroethane	107-06-2	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW03-0414	VOA	Bromodichloromethane	75-27-4	0.2	UG_L	U		0.2	0.2	1	0.13
No	CAS07-GW03P-0414	VOA	Bromodichloromethane	75-27-4	0.2	UG_L	U		0.2	0.2	1	0.13
No	CAS07-GW04-0414	VOA	Bromodichloromethane	75-27-4	0.2	UG_L	U		0.2	0.2	1	0.13
No	CAS07-GW05-0414	VOA	Bromodichloromethane	75-27-4	0.2	UG_L	U		0.2	0.2	1	0.13
No	CAS07-GW06-0414	VOA	Bromodichloromethane	75-27-4	0.2	UG_L	U		0.2	0.2	1	0.13
No	CAS07-GW07-0414	VOA	Bromodichloromethane	75-27-4	0.2	UG_L	U		0.2	0.2	1	0.13
No	CAS07-GW08-0414	VOA	Bromodichloromethane	75-27-4	0.2	UG_L	U		0.2	0.2	1	0.13
No	CAS07-GW09-0414	VOA	Bromodichloromethane	75-27-4	0.2	UG_L	U		0.2	0.2	1	0.13
No	CAS07-GW03-0414	VOA	Dibromochloromethane	124-48-1	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW03P-0414	VOA	Dibromochloromethane	124-48-1	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW04-0414	VOA	Dibromochloromethane	124-48-1	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW05-0414	VOA	Dibromochloromethane	124-48-1	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW06-0414	VOA	Dibromochloromethane	124-48-1	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW07-0414	VOA	Dibromochloromethane	124-48-1	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW08-0414	VOA	Dibromochloromethane	124-48-1	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW09-0414	VOA	Dibromochloromethane	124-48-1	0.2	UG_L	U		0.2	0.2	1	0.17
No	CAS07-GW03-0414	VOA	Vinyl chloride	75-01-4	0.2	UG_L	U		0.2	0.2	1	0.019
No	CAS07-GW03P-0414	VOA	Vinyl chloride	75-01-4	0.2	UG_L	U		0.2	0.2	1	0.019
No	CAS07-GW04-0414	VOA	Vinyl chloride	75-01-4	0.2	UG_L	U		0.2	0.2	1	0.019
No	CAS07-GW05-0414	VOA	Vinyl chloride	75-01-4	0.2	UG_L	U		0.2	0.2	1	0.019
No	CAS07-GW06-0414	VOA	Vinyl chloride	75-01-4	0.2	UG_L	U		0.2	0.2	1	0.019
No	CAS07-GW07-0414	VOA	Vinyl chloride	75-01-4	0.2	UG_L	U		0.2	0.2	1	0.019
No	CAS07-GW08-0414	VOA	Vinyl chloride	75-01-4	0.2	UG_L	U		0.2	0.2	1	0.019
No	CAS07-GW09-0414	VOA	Vinyl chloride	75-01-4	0.2	UG_L	U		0.2	0.2	1	0.019

TABLE 3-3

Nondetect Results Reported at Value Greater than the Comparison Criteria

Organics in Sediment

DL meets Action Limit?	Sample Name	Analysis Group	Analyte Name	CAS Number	Analytical Result	Units	Validator Qualifier	Qualifier Reason Code	DL	LOD	LOQ	Minimum PAL
No	CAS07-SD01-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	44.3	UG_KG	U		15.7	44.3	440	0.38
No	CAS07-SD02-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	41.6	UG_KG	U		14.7	41.6	410	0.38
No	CAS07-SD02P-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	41.8	UG_KG	U		14.8	41.8	410	0.38
No	CAS07-SD03-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	41.5	UG_KG	U		14.7	41.5	410	0.38
No	CAS07-SD04-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	41.7	UG_KG	U		14.8	41.7	410	0.38
No	CAS07-SD05-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	43.4	UG_KG	U		15.4	43.4	430	0.38
No	CAS07-SD06-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	68.4	UG_KG	U		24.2	68.4	680	0.38
No	CAS07-SD07-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	42.7	UG_KG	U		15.1	42.7	420	0.38
No	CAS07-SD08-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	42.3	UG_KG	U		15	42.3	420	0.38
No	CAS07-SD09-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	45.2	UG_KG	U		16	45.2	450	0.38
No	CAS07-SD10-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	85.3	UG_KG	U		30.2	85.3	840	0.38
No	CAS07-SD11-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	93	UG_KG	U		32.9	93	920	0.38
No	CAS07-SD12-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	92.2	UG_KG	U		32.6	92.2	910	0.38
No	CAS07-SD13-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	40.6	UG_KG	U		14.4	40.6	400	0.38
No	CAS07-SD13P-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	41.6	UG_KG	U		14.7	41.6	410	0.38
No	CAS07-SD14-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	40.5	UG_KG	U		14.3	40.5	400	0.38
No	CAS07-SD15-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	40.2	UG_KG	U		14.2	40.2	400	0.38
No	CAS07-SD16-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	42	UG_KG	U		14.9	42	420	0.38
No	CAS07-SD17-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	41.1	UG_KG	U		14.5	41.1	410	0.38
No	CAS07-SD18-0414	SVOA	bis(2-Ethylhexyl)phthalate	117-81-7	42.7	UG_KG	U		15.1	42.7	420	0.38
Yes	CAS07-SD01-0414	SVOA	Di-n-octylphthalate	117-84-0	2.2	UG_KG	U		0.53	2.2	4.4	0.62
Yes	CAS07-SD02-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.5	2.1	4.1	0.62
Yes	CAS07-SD02P-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.5	2.1	4.2	0.62
Yes	CAS07-SD03-0414	SVOA	Di-n-octylphthalate	117-84-0	2	UG_KG	U		0.5	2	4.1	0.62
Yes	CAS07-SD04-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.5	2.1	4.1	0.62
Yes	CAS07-SD05-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.52	2.1	4.3	0.62
No	CAS07-SD06-0414	SVOA	Di-n-octylphthalate	117-84-0	3.4	UG_KG	U		0.82	3.4	6.8	0.62
Yes	CAS07-SD07-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.51	2.1	4.2	0.62
Yes	CAS07-SD08-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.51	2.1	4.2	0.62
Yes	CAS07-SD09-0414	SVOA	Di-n-octylphthalate	117-84-0	2.2	UG_KG	U		0.54	2.2	4.5	0.62
No	CAS07-SD10-0414	SVOA	Di-n-octylphthalate	117-84-0	4.2	UG_KG	U		1	4.2	8.4	0.62
No	CAS07-SD11-0414	SVOA	Di-n-octylphthalate	117-84-0	4.6	UG_KG	U		1.1	4.6	9.2	0.62
No	CAS07-SD12-0414	SVOA	Di-n-octylphthalate	117-84-0	4.6	UG_KG	U		1.1	4.6	9.1	0.62
Yes	CAS07-SD13-0414	SVOA	Di-n-octylphthalate	117-84-0	2	UG_KG	U		0.49	2	4	0.62

TABLE 3-3

Nondetect Results Reported at Value Greater than the Comparison Criteria

Organics in Sediment

DL meets Action Limit?	Sample Name	Analysis Group	Analyte Name	CAS Number	Analytical Result	Units	Validator Qualifier	Qualifier Reason Code	DL	LOD	LOQ	Minimum PAL
Yes	CAS07-SD13P-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.5	2.1	4.1	0.62
Yes	CAS07-SD14-0414	SVOA	Di-n-octylphthalate	117-84-0	2	UG_KG	U		0.49	2	4	0.62
Yes	CAS07-SD15-0414	SVOA	Di-n-octylphthalate	117-84-0	2	UG_KG	U		0.48	2	4	0.62
Yes	CAS07-SD16-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.5	2.1	4.2	0.62
Yes	CAS07-SD17-0414	SVOA	Di-n-octylphthalate	117-84-0	2	UG_KG	U		0.49	2	4.1	0.62
Yes	CAS07-SD18-0414	SVOA	Di-n-octylphthalate	117-84-0	2.1	UG_KG	U		0.51	2.1	4.2	0.62

SECTION 4

Data Quality Evaluation

In this section data qualifiers and the reason for their use are presented by site, media, and analytical grouping. Qualifiers and the reason codes are defined in **Section 2**.

Each subsection by media and analytical grouping includes a summary table of qualifications. The table shows the qualifiers and the reason for their use in order of decreasing frequency, and each qualifier is identified as being either available as reported by the laboratory, available as qualified by the validator, or not available. The impact on Precision, Accuracy, Representativeness, Completeness and Comparability (PARCC) is identified. Statistics are also included: a count and percentage of the number of instances of each type of qualification is shown. Note that the statistics in these tables consider only parent and field duplicate results; data for quality control samples such as MS/MSD and blanks are not counted. The last row of the table shows the statistics totals.

A discussion is included if data that was deemed unusable or if there are other quality issues that should be considered during data use. In many cases the data is 100% usable and the need for qualification was sporadic and unremarkable; therefore the table is presented with no discussion, which implies that the data is of excellent quality.

4.1 Site 7 Groundwater

Groundwater samples were collected from Site 7 on April 9-10, 2014. Analysis was performed by Chemtech with select analyses by Microbial Insights.

Organics Data

VOCs were analyzed by the methods specified in the UFP-SAP (SW-846 8260B). The validation process issued the qualifiers shown in the following table.

Qualifier	Reason Code	Count	Percent	Available as Reported	Available as Qualified	Impact on PARCC
U	[NONE]	398	97.55%	X		none
[NONE]	[NONE]	8	1.96%	X		none
J	[NONE]	2	0.49%	X		none
		408	100.00%	100.00%		

100.00% not R-flagged and available for use

All data is of sufficient quality to evaluate whether action limits were met, with the exception of data for which the DL was greater than the comparison criteria. Affected nondetect data are listed in **Table 3-2**, and include data for eight VOCs: 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, 1,2-dichloroethane, bromodichloromethane, dibromochloromethane, and vinyl chloride. These results are available for use as nondetects, but their use may add uncertainty to the conclusions drawn.

Screening Data

Natural attenuation indicator parameters (NAIPs) (alkalinity, dissolved manganese, sulfate, sulfide, chloride, nitrite, nitrate, methane, ethane, ethene, total organic carbon, dehalococcoides [DHC] and functional genes BAV1 VC-reductase and TCE-reductase) were analyzed by the methods specified in the UFP-SAP. The data review process issued the qualifiers shown in the following table. The NAIP data is 100% complete and available for use as screening data.

Qualifier	Reason Code	Count	Percent	Available as Reported	Impact on PARCC
U	[NONE]	48	45.71%	X	none
[NONE]	[NONE]	37	35.24%	X	none
J	[NONE]	11	10.48%	X	none
D	[NONE]	5	4.76%	X	none
H	[NONE]	2	1.90%	X	none
HU	[NONE]	2	1.90%	X	none
		105	100.00%	100.00%	

100.00% not R-flagged and available for use

4.2 Site 7 Sediment

Sediment samples were collected from Site 7 on April 14-22, 2014. Analysis was performed by Chemtech with select analyses by ALS Environmental-Houston and GeoStructures, Inc.

Organics Data

Select SVOCs were analyzed by the methods specified in the UFP-SAP (SW-846 8270D) with the exception of di-n-octylphthalate which was analyzed by SW-846 8270D_SIM to achieve lower reporting limits. The validation process issued the qualifiers shown in the following table.

Qualifier	Reason Code	Count	Percent	Available as Reported	Available as Qualified	Impact on PARCC
U	[NONE]	40	100.00%	X		none
		40	100.00%	100.00%		

100.00% not R-flagged and available for use

All data is of sufficient quality to evaluate whether action limits were met, with the exception of data for which the DL was greater than the comparison criteria. Affected nondetect data are listed in **Table 3-3**, and include 20 results for bis(2-ethylhexyl)phthalate and four results for di-n-octylphthalate. These results are available for use as nondetects, but their use may add uncertainty to the conclusions drawn.

Dioxins/Furans Data

Dioxins/furans were analyzed by the method specified in the UFP-SAP (SW-846 8290A). The validation process issued the qualifiers shown in the following table.

Qualifier	Reason Code	Count	Percent	Available as Reported	Available as Qualified	Impact on PARCC
J	[NONE]	126	25.20%	X		none
[NONE]	[NONE]	115	23.00%	X		none
U	[NONE]	108	21.60%	X		none
X	EMPC	62	12.40%		X	none
B	MBL	34	6.80%		X	none
J	OT	31	6.20%		X	none
J	FD	8	1.60%		X	none
K	BSH	8	1.60%		X	none
B	EBL	6	1.20%		X	none
L	MSL	1	0.20%		X	none

Qualifier	Reason Code	Count	Percent	Available as Reported	Available as Qualified	Impact on PARCC
K	MSH	1	0.20%		X	none
		500	100.00%	69.80%	30.20%	

100.00% not R-flagged and available for use

All data is of sufficient quality to evaluate whether action limits were met.

One result for SD01 (Octachlorodibenzo-p-dioxin) was detected below the PAL, but was qualified as biased low (L-qualified). The true concentration may be higher, and the possibility that the concentration exceeds the PAL should be taken into consideration when using the data.

Inorganics Data

Metals including mercury were analyzed by the methods specified in the UFP- SAP (SW-846 6010C and 7471A, respectively). The validation process issued the qualifiers shown in the following table.

Qualifier	Reason Code	Count	Percent	Available as Reported	Available as Qualified	Impact on PARCC
[NONE]	[NONE]	91	65.00%	X		none
U	[NONE]	29	20.71%	X		none
J	[NONE]	10	7.14%	X		none
K	MSH	5	3.57%		X	none
J	FD	3	2.14%		X	none
UL	MSL	1	0.71%		X	none
B	EBL	1	0.71%		X	none
		140	100.00%	92.86%	7.14%	

100.00% not R-flagged and available for use

All data is of sufficient quality to evaluate whether action limits were met.

Screening Data

Grain-size, total organic carbon, pH, and AVS/SEM were measured in all sediment samples by the methods specified in the UFP- SAP (ASTM D422, Lloyd Kahn, SW-846 9045D, and EPA 821_R-91-100 respectively). The data review process issued the qualifiers shown in the following table. The screening data is 100% complete and available for use as screening data.

Qualifier	Reason Code	Count	Percent	Available as Reported	Impact on PARCC
[NONE]	[NONE]	445	82.10%	X	none
U	[NONE]	45	8.30%	X	none
J	[NONE]	21	3.87%	X	none
H	[NONE]	18	3.32%	X	none
D	[NONE]	8	1.48%	X	none
E	[NONE]	5	0.92%	X	none
		542	100.00%	100.00%	

100.00% not R-flagged and available for use

SECTION 5

Conclusions

The data user may express confidence in the fact that the data for Cheatham Annex Site 7 Remedial Investigation is comparable to others of acceptable data quality because approved SOPs were used for sample collection and handling, common sample matrices were evaluated, and EPA methods were utilized.

Precision, accuracy, representativeness, and completeness were demonstrated to be acceptable and the data user may be confident that this data set is comparable to others of high data quality. The Site 7 dataset is 100% complete. This far exceeds the typical 95% completeness goal.

SECTION 6

References

CH2M HILL. 2014. *Uniform Federal Policy – Sampling and Analysis Plan Site 7 – Old Dupont Disposal Area Remedial Investigation*. March.

USEPA. 1989. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual.* EPA/540/1-89/002, Part A, October.

USEPA. 1993. *USEPA Contract Laboratory Program Region III Modification to National Functional Guidelines for Inorganic Data Review, Multi Media Multi Concentration.* April.

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Appendix F
Human Health Risk Assessment

APPENDIX F

Baseline Human Health Risk Assessment

F.1 Introduction

Appendix F is the baseline human health risk assessment (HHRA) for Cheatham Annex (CAX) Site 7, Old DuPont Disposal Area. The baseline HHRA was conducted to assess the nature, magnitude, and probability of potential harm to public health posed by exposure to site-related constituents in soil, sediment, and groundwater. The data evaluated in the HHRA are presented in **Appendix E** of the Remedial Investigation (RI) Report and discussed in Section 5 of the RI Report. The HHRA incorporates the general methodology described in the following documents:

- *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A* (USEPA, 1989)
- *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part D* (USEPA, 2001)
- *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (USEPA, 2004)
- *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)* (USEPA, 2009a)
- *USEPA Region III Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening* (USEPA, 1993)
- *World Health Organization (WHO) toxicity equivalency factor (TEF) approach* (Van den Berg et al., 2006)
- *Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds* (USEPA, 2010)

The HHRA consists of the following components:

- Human Health Conceptual Site Model (CSM)
- Identification of Chemicals of Potential Concern (COPCs)
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization
- Uncertainty Assessment

Risk calculation spreadsheets for Site 7 were prepared in accordance with *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part D* (USEPA, 2001) to screen for COPCs and to calculate risks estimates associated with the COPCs. These spreadsheets are presented in **Appendix G**.

F.2 Human Health Conceptual Site Model

The human health CSM showing potential human health exposure scenarios for current and potential future site use is provided in **Table 1, Appendix G** of this appendix and graphically on **Figure F-1**. The CSM provides a current understanding of the source(s) of contamination, release and transport mechanisms, current and potential future land use, and identifies potentially complete human exposure pathways for Site 7.

Site 7, the Old DuPont Disposal Area, covers approximately 1 acre along the York River, northeast of Chase Road in the north central portion of CAX. The source of contamination at Site 7 is non-hazardous and/or inert wastes from the City of Penniman and the DuPont Company Penniman facility that were reported to be disposed in what was thought to be a topographic depression along the York River in the early 1900s. As the shoreline along the York River eroded, site wastes (dinner ware, incinerated bottles, and metal, etc.) were exposed. Ash and debris from historical incinerations activities were also identified in the southwestern portion of the site where erosion of the slope has occurred. A Time Critical Removal Action consisting of beach cleanup and shore stabilization activities,

including removal of about 86 pounds of munition debris and installation of geotextile tubes at the base of the slope, was completed in 2006.

The primary release mechanisms transporting the potential contamination from the source, through environmental media, and to potential receptors are:

- Direct releases from debris materials, incinerated ash, and waste to soil and groundwater
- Leaching of chemicals or metals from soil to groundwater via infiltrating precipitation
- Surface runoff of chemicals or metals from surface soil to sediment
- Future household use of groundwater from wells, including volatilization of chemicals in groundwater from showering or household activities (groundwater is not currently used as a potable water supply)
- Volatilizing chemicals emanating from groundwater and soil to indoor air in potential future buildings constructed at the site

Site 7 is currently restricted to the general public by a locked chain-link fence; however, it is unrestricted to Navy and DoD personnel who perform landscaping or maintenance activities at the site or use the area for recreational activities such as boating, swimming, and wading in the York River. Potential current receptors who may be exposed to site soil include adult/adolescent trespassers (although unlikely due to site fencing) and maintenance workers (Navy and DOD personnel performing landscaping or maintenance activities at the site). Although current recreational users could be exposed to sediment (but are assumed not to be exposed to soil due to the fencing), there were no COPCs identified for sediment (see **Section F.3** for identification and discussion of COPCs).Although there are no plans for future site development and future site use will likely remain the same as current site use, future site use is unknown. Due to the location of the site adjacent to the York River, the site may eventually be used as a recreational area. Additionally, as future site use is unknown, the investigation area could be developed, and future receptors could also include industrial workers, residents, or construction workers, in addition to adult/adolescent/child recreational users, adult/adolescent trespassers, and/or maintenance workers.

Although groundwater beneath the site is not currently used as a potable water supply, it was conservatively assumed that groundwater could be used as a future residential or industrial potable water supply. Due to the depth to groundwater (about 20 feet below ground surface and deeper), construction workers would not be exposed to groundwater during future excavation and construction activities.

There is the potential for vapor intrusion (VI) of volatile constituents from groundwater into future buildings if constructed at the site. Future residents and industrial workers could be exposed to volatile constituents from groundwater through VI into a future building.

F.3 Data Evaluation and Identification of COPCs

The identification of COPCs includes data collection, evaluation, and screening to identify those chemicals which contribute the most to the total risk estimates associated with the site. The data collection and evaluation involve gathering and reviewing the available site data and identifying a set of data for the risk assessment that meets project-specific data quality objectives. This data set is then screened against concentrations that are protective of human health to focus the risk assessment efforts on the constituents and media of potential concern for human receptors.

F.3.1 Data Summary

Soil, sediment, and groundwater data were evaluated in the HHRA. The analytical data used in the risk assessment were all validated and are provided in **Appendix E**. **Table F-1** lists the soil, sediment, and groundwater samples evaluated in the HHRA. Analytical results from soil samples collected in February and April 2008, sediment samples collected in April 2014, and groundwater samples collected from Site 7 monitoring wells in January 2011 and April 2014 were included in the risk assessment. Analytical results for SVOC, pesticides, PCBs, explosives, and metals from the January 2011 groundwater samples, and analytical results for VOCs from the April 2014 groundwater samples were evaluated in the HHRA. Due to the various depths of backfill used after the visible

debris removal during the 2008 removal action, all soil samples were evaluated as one exposure group (surface and subsurface soil samples were not evaluated separately). Groundwater samples were analyzed for both total and dissolved metals. The total and dissolved concentrations of aluminum, iron, and manganese were compared for each monitoring well to note if there were significant differences (over an order of magnitude) between the two in any of the wells, following United States Environmental Protection Agency (USEPA) guidance (USEPA, 1992). Because no significant differences were noted between total and dissolved concentrations of these indicator metals in any of the wells, the total metals data were used to evaluate risks associated with potable use of groundwater. The use of total (unfiltered) metals concentrations is also consistent with the USEPA's February 2014 Memorandum, *Determining Groundwater Exposure Point Concentrations* (USEPA, 2014a).

All of the data used in the risk assessment were fully validated and are assumed to represent current conditions. The data collected during the site investigations were evaluated to assess their reliability for use in the quantitative risk assessments. The following criteria were used to assess data usability based on past discussions with USEPA and the Navy:

- Estimated values flagged with a J, K, or L were treated as unqualified detected concentrations.
- Data qualified with an R (rejected) were not used in the risk assessment.
- Data qualified with a B (blank contamination) were used in the risk assessment as if the results were non-detects, with the blank-related concentrations of each constituent used as the sample detection limit.
- For duplicate samples, the maximum concentration between the two samples was used as the sample concentration. If the analyte was only detected in one of the samples, the detected concentration was used as the sample concentration. If the analyte was not detected in either of the samples, the higher detection limit was used as the sample detection limit.
- Non-detected values were included in the risk assessment and exposure point concentration (EPC) calculations at the detection limit using ProUCL (USEPA, 2013a).
- For dioxin/furan congeners (which were analyzed in sediment samples), only the detected congeners were used to calculate the 2,3,7,8-TCDD toxicity equivalent (TEQ) concentrations for each sample used in the risk calculations. Undetected congeners were not included in the calculations (see **Section F.4.2**). The uncertainty associated with not including the non-detected congeners in the risk calculations is discussed in the uncertainty assessment (**Section F.7.2**).

Detailed results for sampling that was performed at Site 7 are presented in Section 5 of the RI report.

F.3.2 Selection of COPCs

The selection of COPCs was based on the criteria presented in the USEPA Region III technical guidance manual (USEPA, 1993) and *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part D* (USEPA, 2001). The maximum detected concentration of each constituent for each medium was compared to the criteria discussed below to select the COPCs. If the maximum concentration exceeded the criteria, the constituent was selected as a COPC. Constituents that were not detected in any of the samples or were detected at concentrations less than the criteria were not identified as COPCs. The following screening criteria were used in the HHRA, as presented in Tables 2.1 through 2.7 in **Appendix G**:

- **Comparison with Health-based Criteria for Sediment:** Sediment data were compared to 10 times the USEPA residential soil regional screening levels (RSLs) (USEPA, 2014b). This was done following USEPA Region III guidance because exposure to sediment is expected to be significantly less than exposure to soil, and there are no human health screening levels for sediment. RSLs based on noncarcinogenic effects were based on a hazard quotient of 0.1 to account for exposure to multiple constituents with the same target organ or target effect. RSLs based on carcinogenic effects were based on a $1x10^{-6}$ carcinogenic risk. Therefore, the lower of the residential soil RSL based on a noncarcinogenic hazard index of 1 and ten times the residential soil RSL based on a carcinogenic risk of $1x10^{-6}$ was used as the sediment screening level for each constituent. Screening for dioxin/furan congeners was performed using the 2,3,7,8-TCDD TEQ concentration, calculated as discussed in

Section F.4.2. Lead concentrations in sediment were compared to the USEPA residential child soil screening value of 400 milligrams per kilogram (mg/kg) (USEPA, 2014b; USEPA, 1994a).

- **Comparison with Health-based Criteria for Soil:** Soil data were compared to the USEPA residential soil RSLs (USEPA, 2014b). RSLs based on noncarcinogenic effects were based on a hazard quotient of 0.1 to account for exposure to multiple constituents with the same target organ or target effect. RSLs based on carcinogenic effects were based on a $1x10^{-6}$ carcinogenic risk. Lead concentrations were compared to the USEPA residential child soil screening value of 400 mg/kg (USEPA, 1994a). Soil data were also compared to the USEPA risk-based soil screening levels (SSLs) for protection of groundwater (noncarcinogenic effects based on a hazard quotient of 0.1 and carcinogenic endpoints based on a carcinogenic risk of $1x10^{-6}$, as was done for RSLs) included on the RSL Table (USEPA, 2014b). SSLs were not used to identify COPCs but are discussed in **Section F.3.3.1** as an indication of potential leaching of constituents from soil to groundwater at levels of potential concern for human receptors.
- **Comparison with Health-based Criteria for Soil–to-air Pathway:** The maximum detected concentrations in soil were used to estimate the maximum ambient air concentrations. Volatile and fugitive emissions from soil were estimated using the volatilization factor (VF) and particulate emission factor (PEF) approach presented in USEPA's soil screening guidance (USEPA, 1996). The modeled air concentrations were compared to USEPA RSLs for ambient air (USEPA, 2014b). RSLs based on noncarcinogenic effects were based on a hazard quotient of 0.1 to account for exposure to multiple constituents. RSLs based on carcinogenic effects were based on a carcinogenic risk of $1x10^{-6}$.
- **Comparison with Health-based Criteria for Groundwater:** Groundwater data were compared to the USEPA RSLs for tap water (USEPA, 2014b). RSLs that are based on noncarcinogenic effects were based on a hazard quotient of 0.1 to account for exposure to multiple constituents. RSLs based on carcinogenic effects were based on a carcinogenic risk of $1x10^{-6}$ as presented in the RSL table. Lead concentrations in groundwater were compared to the federal action level of 15 micrograms per liter (μg/L) (USEPA, 2009b). The Safe Drinking Water Act Maximum Contaminant Levels (MCLs) are also included on the groundwater COPC screening table, however, they were not used to identify COPCs, but are used in risk management discussions, if applicable.
- **Comparison with Health-based Criteria for Vapor Intrusion from Groundwater to Indoor Air:** Groundwater data from the shallow aquifer were compared to residential and industrial screening levels for protection of indoor air based on vapor intrusion from groundwater, calculated using the USEPA's Vapor Intrusion Screening Level (VISL) Calculator (USEPA, 2014c). VISLs based on noncarcinogenic effects were based on a target hazard quotient of 0.1 to account for exposure to multiple constituents. VISLs based on carcinogenic effects are based on a target carcinogenic risk of $1x10^{-6}$. A site-specific groundwater temperature of 15.3 degrees Celsius was used to calculate the VISLs.
- **Essential Human Nutrients:** Constituents that are considered essential nutrients and are toxic only at very high doses were eliminated from the quantitative risk analysis. These constituents are calcium, magnesium, potassium, and sodium. Although iron and manganese are also considered essential nutrients and are only toxic at very high doses, they were included in the HHRA because toxicity values are available for these two nutrients.
- **Comparison to Background Concentrations**: Background concentrations were not used to identify/eliminate COPCs. However, background concentrations are included in the screening tables, if available, and are discussed in the risk characterization, if applicable (i.e, constituents resulting in risks above target risk levels may be associated with background conditions). Background concentrations for surface soil are the 95 percent upper tolerance level (95% UTL) from the CAX/Yorktown background surface soil samples (CH2M HILL, 2012). The range of background values from upstream and downstream background sediment sample locations collected at the same time the site-related sediment samples were collected were used for sediment. Background concentrations for groundwater are the CAX/Yorktown background 95% UTL concentrations from the Cornwallis Cave/Yorktown Eastover aquifer (CH2M HILL, 2012).

Some of the constituents detected in the site media are not included on the USEPA RSL table because toxicity values are not available. When possible, appropriate surrogate constituents were selected and their RSLs were used as the screening values, as noted in **Appendix G**, Tables 2.1 through 2.7.

F.3.3 COPCs

Table F-2, presented at the end of this HHRA Appendix, lists the constituents identified as COPCs for each medium, as summarized below.

Sediment

- None

Soil

- Eight metals: aluminum, arsenic, chromium, cobalt, iron, manganese, thallium, and vanadium
- Chromium was identified as a COPC for particulate emissions from soil to air

Groundwater

- Three volatile organic constituents (VOCs): chloroform, cis-1,2-dichloroethene, and trichloroethene
- Three explosives: 2,4-dinitrotoluene, 2,6-dinitrotoluene, and nitroglycerin
- One pesticide: 4,4'-DDD
- Five metals: arsenic, cadmium, chromium, cobalt, and manganese

Groundwater to Indoor Air (Vapor intrusion)

- Two VOCs (chloroform and trichloroethene) for the residential scenario and one VOC (trichloroethene) for the industrial scenario

F.3.3.1 Comparison to SSLs

Soil data were compared to SSLs from the RSL table to identify if potential leaching from soil to groundwater could result in concentrations in groundwater at levels of potential concern to human health. Table 2.2 in **Appendix G** presents SSLs; SSLs based on noncarcinogenic effects are based on a hazard quotient of 0.1 and SSLs based on carcinogenic effects are based on a $1x10^{-6}$ carcinogenic risk. More than half of the constituents detected in soil had maximum concentrations exceeding their applicable SSLs. This indicates that these constituents may be leaching to groundwater at concentrations of potential concern to human health if the groundwater is used as a potable water supply. However, the SSLs from the RSL table are extremely conservative, do not account for dilution or attenuation (are calculated using a dilution and attenuation factor of 1), and are only an estimate for the migration to groundwater pathway. However, the one VOC and one SVOC detected in soil at concentrations above the SSLs were not detected in groundwater, and of the metals detected in soil at concentrations above the SSLs, only two (arsenic and chromium) were detected in groundwater at concentrations that contribute to potential unacceptable risks. Since groundwater data is available for Site 7, the actual groundwater concentrations were used to evaluate risks from exposure to groundwater.

F.4 Exposure Assessment

Exposure refers to the potential contact of an individual with a constituent. The exposure assessment identifies pathways and routes by which an individual may be exposed to the COPCs, and estimates the magnitude, frequency, and duration of potential exposure. Constituent intakes and associated health risks are only quantified for complete exposure pathways.

The components of exposure assessment include the following:

- Development of the CSM for human health
- Calculation of EPCs
- Development of exposure assumptions for potentially complete exposure pathways
- Calculation of intake for COPCs using calculated EPCs and exposure assumptions

F.4.1 Conceptual Site Model for Human Health

The CSM for human health is presented in **Section F.2** and **Figure F-1**. The potentially exposed populations evaluated in the risk assessment are shown in **Figure F-1** and **Table 1, Appendix G**.

Potential current receptors are maintenance workers/landscapers and adult and adolescent trespassers who may come in contact with soil. Future site use and future receptors will most likely remain the same as the current site use and receptors. However, although there are no plans for future site development, future site use is unknown. Due to the location of the site adjacent to the York River, the site may eventually be used as a recreational area. Additionally, as future site use is unknown, the investigation area could be developed, and future receptors could also include future industrial workers, residents, or construction workers, in addition to adult/adolescent/child recreational users, adult/adolescent trespassers, and/or maintenance workers. Although groundwater beneath the site is not currently used as a potable water supply, it was conservatively assumed that shallow groundwater could be used as a future residential or industrial potable water supply. Due to the depth of the shallow groundwater (greater than 20 feet below ground surface), construction workers would not contact groundwater during construction and excavation activities.

There is the potential for vapor intrusion (VI) of volatile constituents in groundwater into future buildings that could be constructed at the site. Future residents and industrial workers could be exposed to the groundwater through VI into a building, and subsequent inhalation of indoor air.

In summary, current receptors and exposure pathways quantitatively evaluated in the HHRA are:

- **Maintenance worker/Landscaper:** Incidental ingestion of and dermal contact with soil, and inhalation of particulate emissions from soil.
- **Trespasser (adult, and adolescent):** Incidental ingestion of and dermal contact with soil and inhalation of particulate emissions from soil.

Future receptors and exposure pathways quantitatively evaluated in the HHRA include the following:

- **Recreator (adult, adolescent, and child):** Incidental ingestion of and dermal contact with soil, and inhalation of particulate emissions from soil.
- **Resident (adult and child):** Incidental ingestion of and dermal contact with soil. Ingestion of shallow groundwater, dermal contact with shallow groundwater while bathing/showering, and inhalation of volatile COPCs from shallow groundwater while showering (adult exposure). Inhalation of volatile COPCs in indoor air from vapor intrusion from groundwater to indoor air.
- **Industrial worker:** Incidental ingestion of and dermal contact with soil, and inhalation of particulate emissions from soil. Ingestion of shallow groundwater, and inhalation of volatile COPCs in indoor air from vapor intrusion from groundwater to indoor air.
- **Construction worker:** Incidental ingestion of and dermal contact with soil, and inhalation of particulate emissions from soil.

F.4.2 Calculation of Exposure Point Concentrations

Exposure is quantified by estimating the EPCs for COPCs and intake (ingestion, dermal absorption, and inhalation) of the COPCs by the receptor. EPCs are the estimated concentrations that a receptor may contact and are specific to each exposure medium. The EPCs for Site 7 are provided in Tables 3.1 through 3.6 of **Appendix G**.

EPCs may be directly monitored or estimated using environmental models. Constituent concentrations in soil and groundwater were measured for this assessment. Fate and transport modeling was used to estimate constituent concentrations in volatile and particulate emissions from soil, in vapors from groundwater while showering, and in vapors migrating from groundwater into indoor air.

The methodologies used in the fate and transport modeling for each medium are discussed below:

- Soil (Particulate and Volatile Emissions from Soil): Concentrations in volatile and particulate emissions from soil were estimated using the VF and PEF approach presented in *Supplemental Guidance for Developing Soil Levels for Superfund Sites* (USEPA, 2002). For volatile constituents, VFs and PEFs were used to estimate potential ambient air concentrations. For non-volatile constituents, PEFs were used to estimate potential ambient air concentrations. VFs were calculated using site-specific input parameters and default values and are provided in **Appendix G**, Table 2.3 Supplement A. The calculated air concentrations are shown in **Appendix G**, Table 2.3.
- Groundwater (Water Vapors at Showerhead): Concentrations of VOCs in water vapors while showering were estimated using the Foster and Chrostowski shower model (Foster and Chrostowski, 1987), as provided in **Appendix G**, Table 7.7.RME Supplement C.
- Groundwater (Vapor Intrusion to Indoor Air): Concentrations of VOCs in indoor air associated with vapor intrusion from groundwater were calculated using an empirical attenuation factor of $1x10^{-3}$ and the chemical specific Henry's Law Constant adjusted to the site groundwater temperature, as shown in **Appendix G**, Table 3.5 Supplement A. The maximum detected concentration of the VOC in groundwater was used as the groundwater concentration as it was assumed a future building could be constructed anywhere on the site.

ProUCL software Version 5.0 (USEPA, 2013a) was used to calculate the EPCs. The recommendations outlined in the ProUCL software documentation (USEPA, 2013a) were followed to select the appropriate 95 percent upper confidence levels (95 percent UCLs) used as the EPCs. The maximum detected concentration was used as the EPC where the estimated 95 percent UCL was greater than the maximum detected concentration or the COPC was only detected in one sample in a specific medium. The EPCs for groundwater were calculated using all of the groundwater samples because there is no groundwater plume identified at the site.

Dioxin/furan Congeners

The 2,3,7,8-TCDD TEQ concentration for dioxin and furan congeners were calculated for each sample according to the WHO TEF approach (Van den Berg et al., 2006; USEPA, 2010). The purpose of using the WHO TEF approach is to adjust the relative carcinogenic potency of specific dioxin and furan congeners relative to 2,3,7,8-TCDD, the most potent dioxin congener. TEFs are published by WHO for mammals, fish, and wildlife. 2,3,6,8-TCDD TEQ concentrations for this HHRA were calculated using the mammal TEFs. Using the measured concentration values for each congener and the TEF for that congener, the 2,3,7,8-TCDD TEQ concentration for a mixture of dioxin and furan congeners in a specific sample is calculated as follows:

$$\text{2,3,7,8-TCDD TEQ Concentration} = \Sigma\ (TEF_i \times C_i)$$

Where

2,3,7,8 TEQ	=	2,3,7,8-TCDD toxicity equivalent concentration (mg/kg)
TEF_i	=	Toxicity equivalency factor for congener *i* (unitless)
C_i	=	Concentration of congener *i* (mg/kg)

Identification of the 2,3,7,8-TCDD TEQ concentration as a COPC was based on comparison to the RSLs for 2,3,7,8-TCDD. Risks were not calculated using the 2,3,7,8-TCDD TEQ concentration (it was not identified as a COPC for sediment, the only media analyzed for dioxin and furan congeners). The TEFs used to calculate the 2,3,7,8-TCDD TEQ concentrations are shown in Table 2.1 Supplement A in **Appendix G**.

Non-detected congeners were not included in the 2,3,7,8-TCDD TEQ concentration calculation. However, if non-detected congeners were included in the calculation, the 2,3,7,8-TCDD TEQ concentration would still be below the 2,3,7,8-TCDD RSL, and therefore, 2,3,7,8-TCDD would not be a COPC.

F.4.3 Estimation of Chemical Intakes for Individual Pathways

Chemical intake is the amount of the chemical constituent entering the receptor's body. The quantification of exposure is based on an estimate of the chronic daily intake (CDI), the average amount of the COPC entering the receptor's body per day. Chemical intake estimates for the ingestion and dermal exposure pathways are generally expressed as follows:

$$\mathrm{CDI} = \frac{\mathrm{C} \times \mathrm{CR} \times \mathrm{EF} \times \mathrm{ED}}{\mathrm{BW} \times \mathrm{AT}}$$

Where

CDI	=	chronic daily intake (mg/kg-day)
C	=	chemical concentration (mg/L, mg/kg)
CR	=	contact rate (L/day, mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)

For the dermal pathway, the contact rate incorporates the skin surface area in contact with the exposure medium (soil or groundwater) and an absorption (soil) or permeability (groundwater) factor.

For soil, the contact rate is calculated as follows:

$$\mathrm{CR} = \mathrm{SA} \times \mathrm{SSAF} \times \mathrm{DABS}$$

Where

SA	=	Skin surface area in contact with soil (cm^2)
SSAF	=	soil to skin adherence factor (mg/cm^2-day)
DABS	=	dermal absorption factor, chemical specific (unitless)

Chemical-specific dermal absorption fractions for soil were obtained from USEPA's Dermal Exposure Assessment Guidance (USEPA, 2004) and the USEPA RSL table (2014b), which recommends, 3 percent for arsenic, and 1 percent for all other inorganics.

For groundwater, the contact rate is calculated as follows:

$$\mathrm{CR} = \mathrm{DAevent} \times \mathrm{SA}$$

Where

DAevent	=	dermally absorbed dose per event (mg/cm^2-event)
SA	=	Skin surface area in contact with water (cm^2)

The dermally absorbed dose per event is calculated using chemical-specific permeability constants and additional chemical specific parameters which are shown in supplemental tables to the Table 7 series in **Appendix G** (Table 7.7.RME Supplement A, Table 7.8.RME Supplement A, Table 7.1.CTE Supplement A, and Table 7.2.CTE Supplement A).

Chemical exposure estimates for the inhalation pathway are generally expressed as follows:

$$EC = \frac{Ca \times ET \times EF \times ED \times CF}{AT}$$

Where

EC = exposure concentration (mg/m3)

Ca = chemical concentration in air (mg/m3)

ET = exposure time (hours/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

CF = conversion factor (day/24 hours)

AT = averaging time (days)

The intake and exposure equations require exposure parameters that are specific to each exposure pathway. Many of the exposure parameters have default values, which were used for this assessment. These assumptions, based on estimates of body weights, media intake levels, and exposure frequencies and duration, are provided in USEPA guidance (USEPA, 1989; 1991; 2002; 2004; 2011; 2014d), and Virginia Department of Environmental Quality (VDEQ) guidance (2003). Other assumptions (for example, for the maintenance worker/landscaper, recreational user, and construction worker scenarios) require consideration of location-specific information and were made using professional judgment. Tables 4.1.RME through 4.7.RME and Tables 4.1.CTE through 4.5.CTE of **Appendix G** present the exposure parameters that were used for the exposure scenarios evaluated in the risk assessment. RME scenario exposure parameters were compiled for all scenarios; CTE parameters were compiled only for scenarios where the RME noncarcinogenic hazard or carcinogenic risk for an environmental medium was greater than the noncarcinogenic hazard or carcinogenic risk target levels (cumulative noncarcinogenic hazard index (HI) >1, and carcinogenic risk $>1 \times 10^{-4}$).

F.5 Toxicity Assessment

Toxicity assessment defines the relationship between the magnitude of exposure and possible severity of adverse effects, and weighs the quality of available toxicological evidence. Toxicity assessment generally consists of two steps: hazard identification and dose-response assessment. Hazard identification is the process of characterizing the potential adverse effects from exposure to the chemical and the type of health effect involved. Dose-response assessment is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the constituent administered or received and the incidence of adverse health effects in the exposed population. Toxicity criteria (e.g., reference doses [RfDs], inhalation reference concentrations [RfCs], cancer slope factors [CSFs], and inhalation unit risk factors [IURs]) are derived from the dose-response relationship.

USEPA recommends that a tiered approach be used to obtain the toxicity values (RfDs, RfCs, CSFs, and IURs) that are used to estimate noncarcinogenic hazards and carcinogenic risks (USEPA, 2003). The hierarchy of toxicity value sources is the following:

1. Integrated Risk Information System (IRIS) (USEPA, 2014e)
2. Provisional Peer-Reviewed Toxicity Values (PPRTV)
3. Other peer-reviewed USEPA and non-USEPA sources (USEPA, 2013b), including the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997), USEPA's National Center for Environmental Assessment (NCEA), New Jersey Department of Environmental Protection chromium work group (NJDEP, 2009), Cal/EPA Toxicity Criteria Database (Cal/EPA, 2014), and Agency for Toxic Substances and Disease Registry (2014)

The use of toxicity values from sources other than IRIS increases the uncertainty of the quantitative risk estimates. Some of the COPCs elicit both systemic (noncarcinogenic) toxic effects and cancer (carcinogenic) effects. Because

of this, these constituents are evaluated as both noncarcinogens and carcinogens. The health risks for carcinogenic and noncarcinogenic effects were estimated separately based on different toxicity values. The non-carcinogenic toxicity values are provided in Tables 5.1 and 5.2 of **Appendix G** and the carcinogenic toxicity values are provided in Tables 6.1 and 6.2 of **Appendix G**.

Chromium was identified as a COPC in soil and groundwater, based on the assumption that all of the detected chromium is hexavalent chromium. The risks associated with exposure to chromium were calculated assuming all of the detected chromium is hexavalent chromium. Hexavalent chromium is unstable in the body (in biological tissues) and is ultimately reduced to trivalent chromium by a variety of reducing agents, including ascorbate and glutathione (ATSDR, 2014; USEPA, 2014e). Hexavalent chromium exerts toxicity through direct contact mechanisms rather than bioaccumulation to a critical concentration in tissue. However, the hexavalent chromium toxicity values were used to evaluate the risks associated with chromium in groundwater. An RfD for hexavalent chromium is available in IRIS; however, IRIS does not include a CSF for hexavalent chromium. The CSF for hexavalent chromium used in the HHRA is the same one included on the RSL Table (USEPA, 2014b) from NJDEP.

F.5.1 Toxicity Information for Noncarcinogenic Effects

Noncarcinogenic health effects include a variety of toxic effects on body systems, ranging from toxicity to the kidneys to central nervous system disorders. The toxicity of a chemical is assessed through a review of toxic effects noted in short-term (acute) animal studies, long-term (chronic) animal studies, and epidemiological investigations.

USEPA (1989) defines the chronic RfD (and RfC) as a dose that is likely to be without appreciable risk of deleterious effects during a lifetime of exposure. Chronic RfDs and RfCs are specifically developed to be protective for long-term exposure to a compound (for example, 7 years to a lifetime), and consider uncertainty in the toxicological database and sensitive receptors. Subchronic RfDs and RfCs (applicable for exposures less than 7 years), which are all provisional values (that is, not verified by USEPA), were used for the construction worker scenario, if available. Chronic RfDs and RfCs were used to evaluate noncarcinogenic hazards to all other receptors included in the HHRA. In the development of RfDs and RfCs, all available studies examining the toxicity of a chemical following exposure are considered on the basis of scientific merit. The lowest dose level at which an observed toxic effect occurs is identified as the lowest observed adverse effect level (LOAEL), and the dose at which no effect is observed is identified as the no observed adverse effect level (NOAEL). Several uncertainty factors (UFs) may be applied to the LOAEL or NOAEL to account for uncertainties such as limited data, extrapolation of data from animal studies to human exposures, or the use of subchronic studies to develop the RfD or RfC. These UFs range from 10 to 10,000, and are based on professional judgment. Consequently, there are varying degrees of uncertainty in the toxicity criteria, which range from 1 to 10,000 for the COPCs identified for this site.

In accordance with USEPA guidance, oral RfDs were adjusted from administered dose (oral) to absorbed dose (dermal) to evaluate dermal toxicity. When appropriate, the RfDs were adjusted using oral absorption factors (USEPA, 2004). This adjustment is shown in Table 5.1 in **Appendix G**.

F.5.2 Toxicity Information for Carcinogenic Effects

Potential carcinogenic effects are quantified as CSFs or IURs that convert estimated exposures directly to incremental lifetime carcinogenic risks.

CSFs and IURs may be derived from the results of chronic animal bioassays, human epidemiological studies, or both. Animal bioassays are usually conducted at dose levels that are much higher than are likely to be encountered in the environment. This design detects possible adverse effects in the relatively small test populations used in the studies. The actual risks from exposure to a potential carcinogen are not likely to exceed the estimated risks and are probably much lower or even zero.

As was done for oral RfDs, oral CSFs were adjusted from administered dose (oral) to absorbed dose (dermal) to evaluate dermal toxicity. When appropriate, the CSFs were adjusted using oral absorption factors (USEPA, 2004). This adjustment is shown in Table 6.1 in **Appendix G**.

F.5.3 Approach for Potential Mutagenic Effects

Consistent with the cancer guidelines and supplemental guidance (USEPA, 2005a and 2005b), cancer risks were estimated using age-dependent adjustment factors (ADAFs) for COPCs which act via a mutagenic mode of action (MMOA). Trichloroethene and chromium (assuming it is hexavalent chromium) were the only COPCs categorized as chemicals with a MMOA. Trichloroethene is carcinogenic by a MMOA for induction of kidney tumors (USEPA, 2014e). Therefore, ADAFs were used to estimate carcinogenic risks for the kidney component of trichloroethene. Modes of action have not been established for trichloroethene-induced non-Hodgkin lumphoma and liver cancer; therefore, ADAFs were not used to estimate risks for these types of cancer.

The calculation of cancer risk using ADAFs is presented in the Table 7 series in **Appendix G**. Because chemical-specific data are not available for trichloroethene or hexavalent chromium, default ADAFs, as included in *Derivation of RBCs for Carcinogens that Act Via a Mutagenic Mode of Action and Incorporate Default ADAFs* (USEPA, 2006), were used for the MMOA evaluation. The default ADAFs used to adjust the CSF and IUR are 10 for 0 to 2-year-olds, 3 for 2- to 6-year-olds, 3 for 6- to 12-year-olds, and 1 for 16- to 26-year-olds. The CSF and IUR were multiplied by the appropriate ADAF to derive the age-specific CSF and IUR for a receptor to calculate the total carcinogenic risk. Additionally, the exposure factors for children 0 to 2 years old and 2 to 6 years old were assumed to be the same as the parameters for a child 0 to 6 years old, except for the exposure duration, which was 2 years and 4 years, respectively. The exposure factors for the adult receptor were used for 6 to 16 year olds and 16 to 26 year olds, with the exception of the exposure durations, which were 10 years for each age-range. For the adolescent receptors, the CSF and IUR were multiplied by an ADAF of 3, and the exposure factors used for these were receptors were the same as used for the COPCs that do not act via a MMOA.

F.5.4 Constituents for Which USEPA Toxicity Values Are Not Available

Most of the constituents detected at Site 7 have toxicity factors and USEPA RSLs. Detected constituents that did not have RSLs were compared to RSLs for appropriate surrogate constituents during the COPC selection process. Surrogates were selected based on previous recommendations from USEPA Region III. The surrogates are identified in the Table 2 series in **Appendix G**.

Quantitative oral toxicity criteria are not available for lead. As a screening tool, lead is screened against 400 mg/kg in soil and sediment and 15 μg/L in groundwater, based on residential exposure. Lead concentrations were below these screening levels, therefore, no further evaluation of lead was necessary.

F.6 Risk Characterization

Risk characterization combines the results of the previous elements of the risk assessment to evaluate the potential health risks associated with exposure to the COPCs. The risk characterization is then used as an integral component in remedial decision making and selection of potential remedies or actions, as necessary.

F.6.1 Methods for Estimating Risks

Potential human health risks are discussed independently for carcinogenic and noncarcinogenic constituents because of the different toxicological endpoints, relevant exposure duration, and methods used to characterize risk. Exposure to some constituents may result in both noncarcinogenic and carcinogenic effects (i.e., arsenic), and therefore, these constituents were evaluated in both groups. The methodology used to estimate noncarcinogenic hazards and carcinogenic risks are described below.

F.6.1.1 Noncarcinogenic Hazard Estimation

Noncarcinogenic health risks are estimated by comparing the calculated exposures to RfDs or the exposure concentrations to RfCs. The calculated intake divided by the RfD, or exposure concentration divided by the RfC, is equal to the hazard quotient (HQ):

$$HQ = \text{Intake} / \text{RfD or Exposure Concentration} / \text{RfC}$$

The intake and RfD, or exposure concentration and RfC, represent the same exposure route (i.e., oral intakes are divided by oral RfDs, inhalation exposure concentrations are divided by inhalation RfCs). An HQ that exceeds 1

(i.e., intake exceeds the RfD) indicates that there is a potential for adverse health effects associated with exposure to that constituent.

To assess the potential for noncarcinogenic health effects posed by exposure to multiple constituents, an HI approach is used (USEPA, 1986). This approach assumes that noncarcinogenic hazards associated with exposure to more than one constituent are additive (HI = sum of the HQs). Synergistic or antagonistic interactions between constituents are not considered. The HI may exceed 1 even if all of the individual HQs are less than 1. HIs may be added across exposure routes and media to estimate the total noncarcinogenic health effects to a receptor posed by exposure through multiple routes and media. If the HI is greater than 1, separate HIs are estimated for each target organ to assess whether the HI for a specific target organ is greater than 1. A target organ-specific HI greater than 1 indicates there is some potential for adverse noncarcinogenic health effects associated with exposure to the COPCs. If the HI for each target organ does not exceed 1, noncarcinogenic hazards are not expected.

F.6.1.2 Carcinogenic Risk Estimation

The potential for carcinogenic effects due to exposure to site-related constituents is evaluated by estimating the excess lifetime carcinogenic risk (ELCR). ELCR is the incremental increase in the probability of developing cancer during one's lifetime in addition to the probability to developing cancer associated with exposure to all non-site related sources of carcinogens.

Carcinogenic risk is calculated by multiplying the intake by the CSF, or multiplying the exposure concentration by the IUR.

$$\text{ELCR} = \text{Intake} \times \text{CSF or Exposure Concentration x IUR}$$

The combined risk from exposure to multiple constituents was evaluated by adding the risks from individual constituents. Risks were also added across the exposure routes and media if an individual would be exposed through multiple routes and to multiple media.

As required under the *National Oil and Hazardous Substances Contingency Plan* (USEPA, 1994b) "[f]or known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6} using information on the relationship between dose and response." When a cumulative carcinogenic risk to a receptor under the assumed RME exposure conditions exceeds 1 in 10 thousand (10^{-4} ELCR), CERCLA generally requires remedial action to reduce risks at the site.

F.6.2 Risk Assessment Results

The results of risk estimates for Site 7 are summarized below by receptor. The RME results are summarized in **Table F-3**, and the CTE results are summarized in **Table F-4**, presented at the end of this HHRA. The risk calculations are presented in Tables 7.1.RME through 7.11.RME, and 7.1.CTE through 7.4.CTE in **Appendix G**. CTE hazards and risks were calculated only when the RME hazards exceeded the noncarcinogenic target HI of 1, or the RME carcinogenic risks exceeded the acceptable risk range of 1×10^{-6} to 1×10^{-4}. Tables 9.1.RME through 9.11.RME and 9.1.CTE through 9.4.CTE in **Appendix G** summarize the hazards and risks to each receptor. The constituents of concern (COCs) are identified below for each receptor. The COCs are those COPCs that contribute an HI greater than 0.1 to a cumulative target organ HI that exceeds 1, or a carcinogenic risk greater than 1×10^{-6} to a cumulative carcinogenic risk that exceeds 1×10^{-4}.

F.6.2.1 Current/Future Maintenance Worker/Landscaper (Table 9.1.RME, Appendix G)

The risk assessment assumed that a current maintenance worker/landscaper could be exposed to soil through incidental ingestion, dermal contact, and inhalation of particulate emissions.

- Cumulative HI (RME) = 0.03, is less than the target HI of 1.
- Cumulative ELCR (RME) = 2×10^{-6}, within the target risk range of 1×10^{-6} to 1×10^{-4}.

F.6.2.2 Current/Future Adult Trespasser (Table 9.2.RME, Appendix G)

The risk assessment assumed that a future adult trespasser could be exposed to soil through incidental ingestion, dermal contact, and inhalation of particulate emissions.

- Cumulative HI (RME) = 0.03, is less than the target HI of 1.
- Cumulative ELCR (RME) = 2×10^{-6}, within the target risk range of 1×10^{-6} to 1×10^{-4}.

F.6.2.3 Current/Future Adolescent Trespasser (Table 9.3.RME, Appendix G)

The risk assessment assumed that a future adult trespasser could be exposed to soil through incidental ingestion, dermal contact, and inhalation of particulate emissions.

- Cumulative HI (RME) = 0.06, is less than the target HI of 1.
- Cumulative ELCR (RME) = 5×10^{-6}, within the target risk range of 1×10^{-6} to 1×10^{-4}.

F.6.2.4 Future Adult Recreator (Table 9.4.RME, Appendix G)

The risk assessment assumed that a future adult recreator could be exposed to soil through incidental ingestion, dermal contact, and inhalation of particulate emissions.

- Cumulative HI (RME) = 0.03, is less than the target HI of 1.
- Cumulative ELCR (RME) = 2×10^{-6}, within the target risk range of 1×10^{-6} to 1×10^{-4}.
- Recreators could also be exposed to sediment, however, no COPCs were identified for sediment. Therefore noncarcinogenic hazards and carcinogenic risks associated with exposure to site-related sediment are within acceptable levels.

F.6.2.5 Future Adolescent Recreator (Table 9.5.RME, Appendix G)

The risk assessment assumed that a future adolescent recreator could be exposed to soil through incidental ingestion, dermal contact, and inhalation of particulate emissions.

- Cumulative HI (RME) = 0.06, is less than the target HI of 1.
- Cumulative ELCR (RME) = 5×10^{-6}, within the target risk range of 1×10^{-6} to 1×10^{-4}.
- Recreators could also be exposed to sediment, however, no COPCs were identified for sediment. Therefore noncarcinogenic hazards and carcinogenic risks associated with exposure to site-related sediment are within acceptable levels.

F.6.2.6 Future Child Recreator (Table 9.6.RME, Appendix G)

The risk assessment assumed that a future child recreator could be exposed to soil through incidental ingestion, dermal contact, and inhalation of particulate emissions.

- Cumulative HI (RME) = 0.3, is less than the target HI of 1.
- Cumulative ELCR (RME) = 2×10^{-5}, within the target risk range of 1×10^{-6} to 1×10^{-4}.
- Recreators could also be exposed to sediment, however, no COPCs were identified for sediment. Therefore noncarcinogenic hazards and carcinogenic risks associated with exposure to site-related sediment are within acceptable levels.

F.6.2.7 Future Adult Resident (Noncarcinogenic Hazard, Tables 9.7.RME and 9.1.CTE, Appendix G)

The risk assessment assumed that a future adult resident could be exposed to soil through incidental ingestion, dermal contact, and inhalation of particulate emissions, and to groundwater through potable use (ingestion, dermal contact while bathing/showering, and inhalation of volatile COPCs from shallow groundwater while showering), and through VI pathway into indoor air (inhalation of volatile COPCs from groundwater in indoor air). Carcinogenic risks were not calculated for an adult resident, but rather for a lifetime child/adult resident, following USEPA guidance.

- Cumulative HI (RME) = 11, exceeds target HI of 1.
  - Cumulative HI (RME) for soil = 0.2, is below the target HI.
  - Cumulative HI (RME) for groundwater = 10, exceeds target HI.
    - HI (RME) associated with potable use = 4, associated with trichloroethene, which contributes to target organ HIs above 1.
    - HI (RME) associated with VI pathway = 6, associated with trichloroethene, resulting in target organ HIs above 1.
- Cumulative HI (CTE) = 8, exceeds target HI.
  - Cumulative HI (CTE) for soil = 0.04, is below the target HI.
  - Cumulative HI (CTE) for groundwater = 8, exceeds target HI.
    - HI (CTE) associated with potable use = 2, no target organ HIs associated with potable use only exceed 1.
    - HI (CTE) associated with VI pathway = 6, associated with trichloroethene, resulting in target organ HIs above 1.

COC for groundwater: trichloroethene (for both potable use and VI pathway).

F.6.2.8 Future Child Resident (Noncarcinogenic Hazard, Tables 9.8.RME and 9.2.CTE, Appendix G)

The risk assessment assumed that a future child resident could be exposed to soil through incidental ingestion, dermal contact, inhalation of particulate emissions, to groundwater through potable use (ingestion of shallow groundwater and dermal contact with shallow groundwater while bathing/showering), and to groundwater through VI pathway (inhalation of volatile COPCs from groundwater to indoor air). Carcinogenic risks were not calculated for a child resident, but rather for a lifetime child/adult resident, following USEPA guidance.

- Cumulative HI (RME) = 13, exceeds target HI of 1.
  - Cumulative HI (RME) for soil = 2, however, no target organ HIs for soil exposure alone exceed the target HI.
  - Cumulative HI (RME) for groundwater = 11, exceeds target HI
    - HI (RME) associated with potable use = 5, associated with trichloroethene, which contributes to target organ HIs above 1.
    - HI (RME) associated with VI pathway = 6, associated with trichloroethene associated trichloroethene, which results in target organ HIs above 1.
- Cumulative HI (CTE) = 9, exceeds target HI of 1.
  - Cumulative HI (CTE) for soil = 0.5, is below the target HI.
  - Cumulative HI (CTE) for groundwater = 9, exceeds target HI.
    - HI (CTE) associated with potable use = 2, no target organ HIs associated with potable use only exceed 1.
    - HI (CTE) associated with VI pathway = 6, associated with trichloroethene, resulting in target organ HIs above 1.
- COCs for groundwater: trichloroethene (for both potable use and VI pathway).

F.6.2.9 Future Lifetime Resident (Carcinogenic Risk, Tables 9.9.RME and 9.3.CTE, Appendix G)

The risk assessment assumed that a future lifetime child/adult resident could be exposed to soil through incidental ingestion, dermal contact, inhalation of particulate emissions, to groundwater through potable use (ingestion, dermal contact while bathing/showering, inhalation of volatile COPCs while showering[adult only]), and to groundwater through VI pathway (inhalation of volatile COPCs from groundwater to indoor air).

- Cumulative ELCR (RME) = 3x10-4, exceeds target risk range.
  - Cumulative ELCR (RME) for soil = $1x10^{-4}$, does not exceed the target risk range. This ELCR is primarily associated with chromium, and based on assumption all chromium is hexavalent chromium.
  - Cumulative ELCR (RME) for groundwater = $2x10^{-4}$, exceeds target risk range,
    - ELCR (RME) associated with potable use of groundwater = $2x10^{-4}$, exceeds target risk range associated with trichloroethene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, arsenic, chromium (assuming all detected chromium is hexavalent chromium).
    - ELCR (RME) associated with VI pathway = $3x10^{-5}$, alone does not exceed target risk range. ELCR primarily associated with Trichloroethene.
- Cumulative ELCR (CTE) = $1x10^{-4}$, does not exceed the target risk range.
- COCs for groundwater for potable use: trichloroethene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, arsenic, and chromium (assuming all detected chromium is hexavalent chromium). When considering both potable use and VI pathway, chloroform would also be a COC. No COCs for VI pathway alone.
- COC for soil assuming future resident exposed to both soil and groundwater used as a potable water supply: chromium (assuming all detected chromium is hexavalent chromium).

F.6.2.10 Future Industrial Worker (Table 9.10.RME, Appendix G)

The risk assessment assumed that a future industrial worker could be exposed to soil through incidental ingestion, dermal contact, inhalation of particulate emissions, to groundwater used as a potable water supply through ingestion, and inhalation of volatile COPCs from VI from groundwater to indoor air.

- Cumulative HI (RME) = 3, exceeds the target HI of 1.
  - Cumulative HI (RME) for soil = 0.09, does not exceed the target HI of 1.
  - Cumulative HI (RME) for groundwater = 3, exceeds target HI
    - HI (RME) associated with potable use = 1, alone does not exceed target HI
    - HI (RME) associated with VI = 2, associated with trichloroethene, resulting in target organ HIs above 1.
- Cumulative HI (CTE) = 2, exceeds the target HI of 1.
- Cumulative ELCR (RME) = $5x10^{-5}$, is within target risk range.
- COC for groundwater: trichloroethene (for VI pathway). When considering exposure through both the VI pathway and potable use, trichloroethene would also be a COC for the potable use pathway.

F.6.2.11 Future Construction Worker (Table 9.11.RME, Appendix G)

The risk assessment assumed that a future construction worker could be exposed to soil through incidental ingestion, dermal contact, and inhalation of particulate emissions.

- Cumulative HI (RME) = 0.1, does not exceed the target HI of 1.
- Cumulative ELCR (RME) = $4x10^{-7}$, is below target risk range.

F.7 Uncertainty Associated with Human Health Assessment

The risk measures used in site risk assessments are not fully probabilistic estimates of risk, but are conditional estimates given that a set of assumptions about exposure and toxicity are realized. Thus, it is important to specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective.

F.7.1 Uncertainty in Data Evaluation and COPC Selection

The sampling of site media focused on areas that were most likely affected by past site activities. Therefore, the uncertainty associated with missing a contaminated location is expected to be minimal because the investigation was focused to find the most likely and potentially highest areas of contamination. The uncertainty associated with the data analysis is minimal; all of the data were validated before being used in the HHRA. A data quality evaluation was performed on all analytical data evaluated in the HHRA, as discussed in Section 5 of the RI.

The general assumptions used in the COPC selection process were conservative to ensure that true COPCs were not eliminated from the quantitative risk assessment and that the reasonable maximum risk was estimated. RSLs based on residential assumptions were used to select the COPCs for all exposure scenarios, including non-residential scenarios.

A comparison of site concentrations to background concentrations was not used to select the COPCs. Therefore, it is possible that any of the metals identified as COPCs and COCs may be associated with background conditions. The chromium concentrations in groundwater are below the 95% UTLs from the Cornwalis Cave/Yorktown Eastover Aquifer background groundwater samples (CH2M HILL, 2012) therefore, the risks associated with exposure to chromium in the groundwater are likely associated with background conditions and not site related.Constituents that were not detected in any of the samples within an environmental medium were not selected as COPCs. Reporting limits for constituents that were not detected were compared to the screening levels. Many constituents were not detected but had reporting limits greater than the screening limits. This may result in underestimating risk associated with exposure to site media, if any of these constituents are present at concentrations below the reporting limit but above the screening level. However, based on the detected compounds and historic site use, it is not likely this would result in any significant changes to the results of the HHRA.

Currently, there are no buildings located at Site 7. Therefore, vapor intrusion is not considered a complete pathway for current exposures. Results of the COPC selection indicated chloroform and trichloroethene are present in groundwater at concentrations that exceed VISLs for the vapor intrusion pathway for future residential scenario and trichloroethene is preset in groundwater at concentrations that the exceed VISL for industrial scenarios. Therefore, exposure to COPCs in indoor is considered a potentially complete exposure pathway under future site conditions. However, the attenuation factor (AF) used to estimate the VISLs is a generic AF and is not based on site-specific subsurface data; therefore, the VISLs used in the screening of groundwater may underestimate or overestimate the potential for vapor intrusion.

F.7.2 Uncertainty Associated with Exposure Assessment

Uncertainty in the exposure assessment was generally treated with conservative decision rules and assumptions, and therefore the uncertainty likely overestimates actual exposure to COPCs. Several exposure pathways evaluated by the HHRA, such as residential land use, are hypothetical and are not likely to occur in the future at Site 7. It is also not likely that shallow groundwater would be used as a potable or industrial water supply because of the availability of better water supplies with respect to both water quality and quantity. Most of the exposure factors used for quantitation of exposure are generally conservative and reflect worst-case, or upper-bound, assumptions for the exposure.

Site-related contamination is expected to decrease with time due to naturally occurring attenuation processes such as degradation due to weathering, volatilization, advection, dispersion, and leaching due to infiltrating precipitation. The risk assessment assumed that concentrations would remain constant throughout the exposure period and that these concentrations occur everywhere throughout the site. This assumption likely results in an over-estimation of risk.

The percent of a constituent absorbed through the skin is another source of uncertainty and is likely to be affected by many parameters, including soil loading, moisture content, organic content, pH, and presence of other constituents. The availability of a constituent for absorption through the skin depends on site-specific fate and transport properties of the chemical species available for eventual absorption. Constituent concentrations, specific properties of the constituent, and the kinetics of constituents being released all affect the amount of a constituent that is absorbed. These factors contribute to the uncertainty associated with dermal absorption estimates, and make it difficult to quantify the amount of certain constituents absorbed through the skin from soil.

A site-specific attenuation factor for VI from groundwater into indoor has not been calculated for Site 7 as there are no current buildings on site; therefore, it is uncertain whether the attenuation factor of 0.001, calculated for other Department of Defense facilities is applicable. Additionally, the maximum detected concentrations of trichloroethene and chloroform, the two COPCs for the VI pathway, were used to estimate risks associated with VI to indoor air.

Chloroform and 2,6-dinitrotoluene were identified as COCs in groundwater. Chloroform was detected in only 1 of 7 samples, while 2,6-dinitrotoluene was detected in 1 of 5 samples; therefore the maximum detected concentration of chloroform and 2,6-dinitrotoluene was used to calculate risk.

F.7.3 Uncertainty Associated with Toxicity Assessment

Uncertainty associated with the noncarcinogenic toxicity factors (RfDs and RfCs) is included in the toxicity tables (Tables 5.1 and 5.2) in **Appendix G**. Several UFs were applied to extrapolate dose points from animal studies to humans. These UFs range between 1 and 10,000. Therefore, there is a high degree of uncertainty in the noncarcinogenic toxicity criteria based on the available scientific data for each constituent.

The uncertainty associated with CSFs and IURs is mostly due to the low dose extrapolation where carcinogenicity at low doses is assumed to be a linear response. This is a conservative assumption, which introduces a high uncertainty into slope factors that are extrapolated from this area of the dose-response curve. The CSFs are based on the assumption that there is no threshold level for carcinogenicity. Therefore, CSFs and IURs developed by USEPA represent upper-bound estimates. Carcinogenic risks generated in this assessment should be regarded as an upper-bound estimate on potential carcinogenic risks, rather than an accurate representation of carcinogenic risk. The true carcinogenic risk is likely to be less than the predicted value (USEPA, 1989).

Uncertainty is also associated with the application of the MMOA for trichloroethene and chromium (assuming all chromium is hexavalent chromium); this may overestimate or underestimate risks. Additionally, generic ADAFs were used in the MMOA calculations because no chemical specific ADAFs are available for the COPCs that act via a MMOA.

Total chromium was identified as a COC in soil and groundwater based on a comparison of the total chromium concentrations to hexavalent chromium screening values. The toxicity values for hexavalent chromium were conservatively used to estimate potential noncarcinogenic hazards and carcinogenic risks associated with exposures to total chromium. It is not likely all of the chromium detected is in the hexavalent form; therefore, the hazards and risks are likely overestimated for potential exposures to chromium in soil and groundwater.

Use of provisional toxicity factors from sources other than IRIS increases the uncertainty of the quantitative hazard and risk estimates. These provisional values were used to provide a quantitative estimate rather than a merely qualitative risk discussion.

Additional uncertainty lies in the prediction of relative sensitivities of different species of animals and the applicability of animal data to humans. This uncertainty is conservatively accounted for in the use of the UFs used to adjust the toxicity values.

A large degree of uncertainty is associated with the oral-to-dermal adjustment factors (based on constituent-specific gastrointestinal absorption factors) used to transform the oral RfDs based on administered doses to dermal RfDs based on absorbed doses. It is not known if the adjustment factor results in an underestimate or overestimate of the actual toxicity associated with dermal exposure.

The TEFs used to adjust the concentrations of the dioxin and furan congeners to the 2,3,7,8-TCDD TEQ concentration for the sediment also result in uncertainty in the risk assessment. However, based on a comparison of the 2,3,7,8-TCDD TEQ concentration to the 2,3,7,8-TCDD RSL, dioxins were not identified as a COPC for sediment.

F.7.4 Uncertainty in Risk Characterization

The uncertainties identified in each component of risk assessment ultimately contribute to uncertainty in risk characterization. The addition of risks and HIs across pathways and constituents contributes to uncertainty based on chemical interactions such as additivity, synergism, potentiation, and susceptibility of exposed receptors.

F.8 Human Health Risk Summary

The HHRA was conducted to evaluate the potential human health risks associated with exposure to sediment, soil, and groundwater at Site 7.

Tables F-3 and F-4, and Tables 9.1.RME through 9.11.RME and 9.1.CTE through 9.4.CTE in **Appendix G** summarize the RME and CTE potential hazards and risks to each receptor. Tables 10.1.RME through 10.4.RME and 10.1.CTE through 10.4.CTE, **Appendix G**, show the receptor scenarios with cumulative target organ HIs greater than 1, or total carcinogenic risks greater than 1×10^{-4}. The COCs are included in the tables. COCs are identified for the scenarios with potentially unacceptable risks. The COCs are those COPCs that contribute an HI greater than 0.1 to a cumulative target organ HI that exceeds 1 or a carcinogenic risk greater than 1×10^{-6} to a cumulative carcinogenic risk that exceeds 1×10^{-4}. Risk estimates and COCs are summarized below.

Maintenance Worker/Landscaper

- Exposure to soil under current and future scenarios
- HIs and ELCRs are within USEPA acceptable levels

Trespasser (Adult and Adolescent)

- Exposure to soil under current and future scenarios
- HIs and ELCRs are within USEPA acceptable levels

Recreator (Adult, Adolescent, and Child)

- Exposure to soil under future scenario
- HIs and ELCRs are within USEPA acceptable levels
- No COPCs identified for sediment, therefore, exposure to sediment within USEPA acceptable level

Future Resident (Adult and Child)

- Exposure to soil and groundwater under future scenarios
- HIs and ELCRs associated with exposure to soil alone within target USEPA risk levels
- HIs associated with potable use of groundwater exceed target HI, associated trichloroethene, which contributes to target organ HIs above 1.
- HIs associated with VI from groundwater to indoor air exceed target HI, associated with trichloroethene, which contributes to target organ HIs above 1.
- ELCR associated with potable use of groundwater exceeds target risk range, associated with trichloroethene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, arsenic, chromium (assuming all detected chromium is hexavalent chromium).
- ELCR associated with VI from groundwater to indoor air within acceptable risk levels.
- COCs for groundwater are trichloroethene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, arsenic, chromium (assuming all detected chromium is hexavalent chromium). Chloroform would also be considered a COC if resident exposed to groundwater both through potable use and VI.

- Concentrations of chromium were below background. Therefore, it is possible some of the risk associated with exposure to chromium in groundwater is from background conditions.
- The detected concentrations of arsenic and chromium are below the chromium MCL.
- Chloroform and 2,6-dinitrotoluene were identified as COCs in groundwater. Chloroform was detected in only 1 of 7 samples, while 2,6-dinitrotoluene was detected in 1 of 5 samples; therefore the maximum detected concentration of chloroform and 2,6-dinitrotoluene was used to calculate risk.
- The hazard and risk associated with trichloroethene is primarily associated with the trichloroethene detected in one monitoring well, MW-07, the only detected concentration of trichloroethene that exceeds the MCL.
- COC for soil assuming future resident exposed to both soil and groundwater used as a potable water supply is chromium (assuming all detected chromium is hexavalent chromium

Industrial Worker

- Exposure to soil and groundwater under future scenarios
- HIs and ELCRs for exposure to soil are within USEPA acceptable levels
- ELCRs for exposure to groundwater (through both potable use and VI) are within USEPA acceptable levels.
- HI for potable use of groundwater alone does not exceed USEPA target risk levels.
- HI for VI from groundwater to indoor air exceeds USEPA target risk levels, associated with trichloroethene.
- COC for groundwater is trichloroethene. When considering exposure through both the VI pathway and potable use, trichloroethene would also be a COC for the potable use pathway.

Construction Worker

- Exposure to soil under future scenario
- HIs and ELCRs are within USEPA acceptable levels

In summary, exposure to soil alone would not result in any risks above regulatory target levels to the receptors evaluated in the HHRA.

The COCs identified for groundwater based on potable use under an unrestricted use scenario (residential scenario) are:

- Trichloroethene
- Chloroform (assuming also exposed via the VI pathway)
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- Arsenic
- Chromium (assuming all chromium is hexavalent chromium)

The COC identified for groundwater based on potable use under an industrial scenario is:

- Trichloroethene

The COC identified for groundwater based on VI to indoor air for both a residential and industrial scenario is:

- Trichloroethene

The COC identified for soil assuming residential exposure to soil and potable use of groundwater is:

- Chromium (assuming all chromium is hexavalent chromium)

F.9 References

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Tables

TABLE F-1

Summary of Data Used in Baseline Human Health Risk Assessment

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Medium/ Sample ID	Date of Sampling	Sample Locations	Parameters
Sediment			
CAS07-SD01-0414	4/14/2014	CAS07-SD01	Bis(2-Ethylhexyl)phthalate, Di-n-octylphthalate, Dioxins/Furans, Metals[3]
CAS07-SD02-0414	4/14/2014	CAS07-SD02	
CAS07-SD02P-0414[2]	4/14/2014	CAS07-SD02	
CAS07-SD03-0414	4/14/2014	CAS07-SD03	
CAS07-SD07-0414[1]	4/22/2014	CAS07-SD07	
CAS07-SD08-0414[1]	4/22/2014	CAS07-SD08	
CAS07-SD09-0414[1]	4/22/2014	CAS07-SD09	
CAS07-SD13-0414[1]	4/18/2014	CAS07-SD13	
CAS07-SD13P-0414[1, 2]	4/18/2014	CAS07-SD13	
CAS07-SD14-0414[1]	4/18/2014	CAS07-SD14	
CAS07-SD15-0414[1]	4/18/2014	CAS07-SD15	
Soil			
NWSY-90-7-SC-PER-132	2/28/2008	CAS07-SO001	VOCs, SVOCs, PAHs, Pesticides/PCBs, Explosives, Metals[3]
NWSY-90-7-SC-PER-133	2/28/2008	CAS07-SO001	
NWSY-90-7-SC-PER-135	2/28/2008	CAS07-SO002	
NWSY-90-7-SC-PER-183	4/9/2008	CAS07-SO002	
NWSY-90-7-SC-FLR-136	2/28/2008	CAS07-SO003	
NWSY-90-7-SC-FLR-137	2/28/2008	CAS07-SO004	
NWSY-90-7-SC-FLR-138	2/28/2008	CAS07-SO005	
NWSY-90-7-SC-FLR-139	2/28/2008	CAS07-SO006	
NWSY-90-7-SC-FLR-140	2/28/2008	CAS07-SO007	
NWSY-90-7-SC-PER-143	2/28/2008	CAS07-SO008	
NWSY-90-7-SC-PER-184	4/9/2008	CAS07-SO008	
NWSY-90-7-SC-PER-185[2]	4/9/2008	CAS07-SO008	
NWSY-90-7-SC-PER-186	4/9/2008	CAS07-SO016	
NWSY-90-7-SC-FLR-144	2/28/2008	CAS07-SO009	
NWSY-90-7-SC-FLR-145	2/28/2008	CAS07-SO010	
NWSY-90-7-SC-FLR-146	2/28/2008	CAS07-SO011	
NWSY-90-7-SC-FLR-147	2/28/2008	CAS07-SO012	
NWSY-90-7-SC-PER-148	2/28/2008	CAS07-SO013	
NWSY-90-7-SC-PER-149	2/28/2008	CAS07-SO013	
NWSY-90-7-SC-PER-150	2/28/2008	CAS07-SO014	
NWSY-90-7-SC-PER-151	2/28/2008	CAS07-SO014	
NWSY-90-7-SC-PER-152[2]	2/28/2008	CAS07-SO014	
NWSY-90-7-SC-PER-153	2/28/2008	CAS07-SO015	
NWSY-90-7-SC-PER-154	2/28/2008	CAS07-SO015	
NWSY-90-7-SC-PER-159	2/29/2008	CAS07-SO016	
NWSY-90-7-SC-FLR-160	2/29/2008	CAS07-SO017	
NWSY-90-7-SC-PER-161	2/29/2008	CAS07-SO018	
NWSY-90-7-SC-PER-162	2/29/2008	CAS07-SO018	

TABLE F-1

Summary of Data Used in Baseline Human Health Risk Assessment

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Medium/ Sample ID	Date of Sampling	Sample Locations	Parameters
NWSY-90-7-SC-PER-163	2/29/2008	CAS07-SO019	VOCs, SVOCs, PAHs, Pesticides/PCBs, Explosives, Metals[3] (cont.)
NWSY-90-7-SC-PER-164	2/29/2008	CAS07-SO019	
NWSY-90-7-SC-FLR-165	2/29/2008	CAS07-SO020	
NWSY-90-7-SC-FLR-166	2/29/2008	CAS07-SO021	
NWSY-90-7-SC-FLR-167	2/29/2008	CAS07-SO022	
NWSY-90-7-SC-PER-169	2/29/2008	CAS07-SO023	
NWSY-90-7-SC-PER-170[2]	2/29/2008	CAS07-SO023	
NWSY-90-7-SC-PER-187	4/9/2008	CAS07-SO023	
NWSY-90-7-SC-PER-172	2/29/2008	CAS07-SO024	
NWSY-90-7-SC-PER-188	4/9/2008	CAS07-SO024	
NWSY-90-7-SC-PER-193[2]	4/9/2008	CAS07-SO024	
NWSY-90-7-SC-FLR-173	2/29/2008	CAS07-SO025	
NWSY-90-7-SC-FLR-174	2/29/2008	CAS07-SO026	
NWSY-90-7-SC-PER-175	2/29/2008	CAS07-SO027	
NWSY-90-7-SC-PER-176	2/29/2008	CAS07-SO027	
NWSY-90-7-SC-PER-177	2/29/2008	CAS07-SO028	
NWSY-90-7-SC-PER-178	2/29/2008	CAS07-SO028	
NWSY-90-7-SC-PER-179[2]	2/29/2008	CAS07-SO028	
Groundwater			
CAS07-GW03-0414	4/9/2014	CAS07-MW03	VOCs
CAS07-GW03P-0414[2]	4/9/2014	CAS07-MW03	
CAS07-GW04-0414	4/9/2014	CAS07-MW04	
CAS07-GW05-0414	4/9/2014	CAS07-MW05	
CAS07-GW06-0414	4/9/2014	CAS07-MW06	
CAS07-GW07-0414	4/9/2014	CAS07-MW07	
CAS07-GW08-0414	4/10/2014	CAS07-MW08	
CAS07-GW09-0414	4/10/2014	CAS07-MW09	
CAS07-MW03-0111	1/25/2011	CAS07-MW03	SVOCs, PAHs, Pesticides/PCBs, Dioxins/Furans, Explosives, Total Metals, Dissolved Metals
CAS07-MW04-0111	1/28/2011	CAS07-MW04	
CAS07-MW05-0111	1/25/2011	CAS07-MW05	
CAS07-MW06-0111	1/24/2011	CAS07-MW06	
CAS07-MW06P-0111[2]	1/24/2011	CAS07-MW06	
CAS07-MW07-0111	1/24/2011	CAS07-MW07	

Notes:

PAHs = polycyclic aromatic hydrocarbons

PCBs = polychlorinated biphenyls

SVOCs = semi-volatile organic compounds

VOCs = volatile organic compounds

[1] Background sample.

[2] Duplicate of previous sample.

[3] Metals include barium, beryllium, copper, lead, manganese, mercury, and zinc.

TABLE F-2

Summary of COPCs

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Soil
Aluminum
Arsenic
Chromium
Cobalt
Iron
Manganese
Thallium
Vanadium
Air - Emissions from Soil
Chromium
Groundwater
Chloroform
cis-1,2-Dichloroethene
Trichloroethene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
4,4'-DDD
Nitroglycerin
Arsenic
Cadmium
Chromium
Cobalt
Manganese
Air (Groundwater) - Water Vapors at Showerhead
Chloroform
cis-1,2-Dichloroethene
Trichloroethene
Air (Groundwater) - Vapor Intrusion to Indoor Air
Chloroform[1]
Trichloroethene

[1] Residential exposure only

TABLE F-3

Summary of RME Cancer Risks and Hazard Indices

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1	COCs[1]
Current/Future Maintenance Worker/ Landscaper Adult	Soil	Ingestion	9E-07				0.03		None
		Dermal Contact	9E-07				0.005		
		Inhalation	2E-08				0.000006		
		Total	2E-06				0.03		
	All Media	Total	2E-06				0.03		
Current/Future Trespasser Adult	Soil	Ingestion	8E-07				0.03		None
		Dermal Contact	8E-07				0.005		
		Inhalation	7E-09				0.000003		
		Total	2E-06				0.03		
	All Media	Total	2E-06				0.03		
Current/Future Trespasser Adolescent	Soil	Ingestion	1E-06				0.04		None
		Dermal Contact	4E-06			Chromium	0.02		
		Inhalation	9E-09				0.000003		
		Total	5E-06			Chromium	0.06		
	All Media	Total	5E-06				0.06		
Future Recreator Adult	Soil	Ingestion	8E-07				0.03		None
		Dermal Contact	8E-07				0.005		
		Inhalation	7E-09				0.000003		
		Total	2E-06				0.03		
	All Media	Total	2E-06				0.03		
Future Recreator Adolescent	Soil	Ingestion	1E-06				0.04		None
		Dermal Contact	4E-06			Chromium	0.02		
		Inhalation	9E-09				0.000003		
		Total	5E-06			Chromium	0.06		
	All Media	Total	5E-06				0.06		
Future Recreator Child	Soil	Ingestion	8E-06			Chromium	0.3		None
		Dermal Contact	8E-06			Chromium	0.04		
		Inhalation	1E-08				0.000003		
		Total	2E-05			Chromium	0.3		
	All Media	Total	2E-05				0.3		
Future Adult Resident	Soil	Ingestion	N/A				0.2		None
		Dermal Contact	N/A				0.04		
		Inhalation	N/A				0.0001		
		Total	N/A				0.2		
	Groundwater	Ingestion	N/A				3		Trichloroethene
		Dermal Contact	N/A				0.3		
		Inhalation (shower)	N/A				0.9		
		Inhalation (indoor air)	N/A				6	Trichloroethene	
		Total	N/A				10		
	All Media	Total	N/A				11		

TABLE F-3

Summary of RME Cancer Risks and Hazard Indices

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1	COCs[1]
Future Child Resident	Soil	Ingestion	N/A				2		None
		Dermal Contact	N/A				0.2		
		Inhalation	N/A				0.0001		
		Total	N/A				2		
	Groundwater	Ingestion	N/A				4	Trichloroethene	Trichloroethene
		Dermal Contact	N/A				0.4		
		Inhalation (indoor air)	N/A				6	Trichloroethene	
		Total	N/A				11	Trichloroethene	
	All Media	Total	N/A				13		
Future Child/Adult Resident	Soil	Ingestion	6E-05		Chromium	Arsenic	N/A		None
		Dermal Contact	6E-05		Chromium		N/A		
		Inhalation	1E-06				N/A		
		Total	1E-04		Chromium	Arsenic	N/A		
	Groundwater	Ingestion	2E-04		Trichloroethene, Arsenic, Chromium	2,4-Dinitrotoluene, 2,6-Dinitrotoluene	N/A		Trichloroethene, Chloroform, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, Arsenic, Chromium
		Dermal Contact	2E-05			Trichloroethene, Chromium	N/A		
		Inhalation (shower)	3E-06			Trichloroethene	N/A		
		Inhalation (indoor air)	3E-05		Trichloroethene		N/A		
		Total	2E-04		Trichloroethene, Arsenic, Chromium	Chloroform, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene	N/A		
	All Media	Total	3E-04				N/A		
Future Industrial Worker	Soil	Ingestion	2E-06				0.06		None
		Dermal Contact	4E-06		Chromium		0.03		
		Inhalation	8E-08				0.00003		
		Total	7E-06		Chromium		0.09		
	Groundwater	Ingestion	3E-05		Arsenic	Trichloroethene, 2,6-Dinitrotoluene, Chromium	1		Trichloroethene
		Dermal Contact	N/A				N/A		
		Inhalation (indoor air)	4E-06			Trichloroethene	2	Trichloroethene	
		Total	4E-05		Arsenic	Trichloroethene, 2,6-Dinitrotoluene, Chromium	2		
	All Media	Total	5E-05				3		
Future Construction Worker	Soil	Ingestion	3E-07				0.1		None
		Dermal Contact	9E-08				0.007		
		Inhalation	2E-09				0.000005		
		Total	4E-07				0.1		
	All Media	Total	4E-07				0.1		

[1] Includes analytes with an ELCR greater than 1E-06 that contribute to a total risk greater than 1E-04 and/or analytes with an HI greater than 0.1 that contribute to a target organ HI greater than 1.

COC = Contaminants of concern

ELCR = Excess Lifetime Cancer Risk

HI = Hazard Index

N/A = Not available/not applicable

TABLE F-4

Summary of CTE Cancer Risks and Hazard Indices

Site 7 – Old DuPont Disposal Area Remedial Investigatior

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginic

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1	COCs[1]
Future Adult Resident	Soil	Ingestion	N/A				0.04		None
		Dermal Contact	N/A				0.005		
		Inhalation	N/A				0.0001		
		Total	N/A				0.04		
	Groundwater	Ingestion	N/A				1		Trichloroethene
		Dermal Contact	N/A				0.2		
		Inhalation (shower)	N/A				0.4		
		Inhalation (indoor air)	N/A				6	Trichlorothene	
		Total	N/A				8		
	All Media	Total	N/A				8		
Future Child Resident	Soil	Ingestion	N/A				0.5		None
		Dermal Contact	N/A				0.05		
		Inhalation	N/A				0.0001		
		Total	N/A				0.5		
	Groundwater	Ingestion	N/A				2		Trichloroethene
		Dermal Contact	N/A				0.3		
		Inhalation (indoor air)	N/A				6	Trichloroethene	
		Total	N/A				9		
	All Media	Total	N/A				9		
Future Child/Adult Resident	Soil	Ingestion	1E-05			Arsenic, Chromium	N/A		None
		Dermal Contact	1E-05			Chromium	N/A		
		Inhalation	8E-07				N/A		
		Total	3E-05		Chromium	Arsenic	N/A		
	Groundwater	Ingestion	5E-05		Arsenic, Chromium	Trichloroethene, 2,6-Dinitrotoluene	N/A		None
		Dermal Contact	7E-06			Trichloroethene, Chromium	N/A		
		Inhalation (shower)	2E-06				N/A		
		Inhalation (indoor air)	2E-05		Trichloroethene		N/A		
		Total	7E-05		Trichloroethene, Arsenic, Chromium	2,6-Dinitrotoluene,	N/A		
	All Media	Total	1E-04				N/A		
Future Industrial Worker	Soil	Ingestion	7E-07				0.06		None
		Dermal Contact	2E-07				0.004		
		Inhalation	3E-08				0.000002		
		Total	1E-06				0.06		
	Groundwater	Ingestion	4E-06			Arsenic	0.3		Trichloroethene
		Dermal Contact	N/A				N/A		
		Inhalation (indoor air)	1E-06				1		
		Total	6E-06			Arsenic	2		
	All Media	Total	7E-06			Arsenic	2		

[1] Includes analytes with an ELCR greater than 1E-06 that contribute to a total risk greater than 1E-04 and/or analytes with an HI greater than 0.1 that contribute to a target organ HI greater than 1.

COC = Contaminants of concern

ELCR = Excess Lifetime Cancer Risk

HI = Hazard Index

N/A = Not available/not applicable

Figure

Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Exposure Media	Exposure Route	Current/Future						Future			
							Recreator			Trespasser			Resident		
						Maintenance Worker/ Landscaper	Adult	Adolescent	Child	Adult	Child	Industrial Worker	Adult	Child	Construction Worker
Debris, Incinerated Waste, and Ash	Leaching and shoreline erosion	Soil		Soil	Ingestion	X	X[1]	X[1]	X[1]	X	X	X	X	X	X
					Dermal Contact	X	X[1]	X[1]	X[1]	X	X	X	X	X	X
					Inhalation	X	X[1]	X[1]	X[1]	X	X	X	X	X	X
			Leaching	Groundwater	Ingestion	NA	NA	NA	NA	NA	NA	X	X	X	NA
					Dermal Contact	NA	NA	NA	NA	NA	NA	NA	X	X	NA
					Inhalation	NA	NA	NA	NA	NA	NA	NA	X	X	NA
				Vapor Intrusion through Building Foundation	Inhalation	NA	NA	NA	NA	NA	NA	X	X	X	NA
			Erosion and Surface Runoff	Sediment	Ingestion	NA	X[2]	X[2]	X[2]	NA	NA	NA	NA	NA	NA
					Dermal Contact	NA	X[2]	X[2]	X[2]	NA	NA	NA	NA	NA	NA
					Inhalation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA - Not Applicable or pathway is incomplete
X - Potentially complete exposure pathway
[1] - Future exposure only
[2] - No COPCs identified for sediment; therefore, risks associated with this pathway not quantified

FIGURE F-1
Conceptual Site Model for HHRA
Site 7 – Old DuPont Disposal Area Remedial Investigation
Cheatham Annex Areas of Concern, Williamsburg, Virginia

Appendix G
Human Health Risk Assessment Tables

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Sediment	Sediment	Near-shore Sediment	Recreator	Adult	Dermal Absorption	On-site	Quant	People using York River for recreational activities such as boating, swimming, and wading may contact near-shore sediment along the Site 7 shoreline.
						Ingestion	On-site	Quant	
					Adolescent	Dermal Absorption	On-site	Quant	
						Ingestion	On-site	Quant	
					Child	Dermal Absorption	On-site	Quant	
						Ingestion	On-site	Quant	
	Soil	Soil	Site 7	Maintenance Worker/Landscaper	Adult	Dermal	On-site	Quant	Current and future maintenance workers/landscapers could contact soil while performing activities at the site
						Ingestion	On-site	Quant	
				Trespasser	Adult	Dermal	On-site	Quant	Access to site is restricted and site is fenced. However, trespassers may access site and contact soil.
						Ingestion	On-site	Quant	
					Adolescent	Dermal	On-site	Quant	
						Ingestion	On-site	Quant	
		Air	Emissions from Site Soil	Maintenance Worker/Landscaper	Adult	Inhalation	On-site	Quant	Maintenance workers/landscapers may inhale vapors and dust from areas of site disturbed during activities at the site.
				Trespasser	Adult	Inhalation	On-site	Quant	Access to site is restricted and site is fenced. However, trespassers may access site and inhale vapors and dust from soil while on the site.
					Adolescent	Inhalation	On-site	Quant	
Future	Soil	Soil	Site 7	Recreator	Adult	Dermal	On-site	Quant	Site access is restricted for the general public. However, due to its location, the site may eventually be used as a recreational area. Future recreators may contact soil while at site.
						Ingestion	On-site	Quant	
					Adolescent	Dermal	On-site	Quant	
						Ingestion	On-site	Quant	
					Child	Dermal	On-site	Quant	
						Ingestion	On-site	Quant	
				Resident*	Adult	Dermal	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is included for a conservative evaluation of unrestricted land use. It was assumed residents could contact soil while on the site.
						Ingestion	On-site	Quant	
					Child	Dermal	On-site	Quant	
						Ingestion	On-site	Quant	
					Child/Adult	Dermal	On-site	Quant	
						Ingestion	On-site	Quant	
				Industrial Worker	Adult	Dermal	On-site	Quant	It is not likely the site will be developed for future industrial use, however if it is developed for industrial use, industrial workers could contact soil at the site.
						Ingestion	On-site	Quant	
				Construction Worker	Adult	Dermal	On-site	Quant	Construction workers could contact soil while performing intrusive activities on the site.
						Ingestion	On-site	Quant	

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil	Air	Emissions from Site 7 Soil	Recreator	Adult	Inhalation	On-site	Quant	Recreators/visitors may inhale vapors and dust from soil while on the site.
					Child	Inhalation	On-site	Quant	
				Resident*	Adult	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is included for a conservative evaluation of unrestricted land use. Future residents could inhale dust and vapors from soil at site.
					Child	Inhalation	On-site	Quant	
					Child/Adult	Inhalation	On-site	Quant	
				Industrial Worker	Adult	Inhalation	On-site	Quant	It is not likely the site will be developed for future industrial use, however if it is developed for industrial use, industrial workers could inhale dust and vapors from soil while on site.
				Construction Worker	Adult	Inhalation	On-site	Quant	Construction workers may inhale vapors and dust emanating from soil while on the site.
	Groundwater	Groundwater	Tap Water	Resident*	Adult	Dermal Absorption	On-site	Quant	Groundwater is not currently used on-site as a water supply and the site is not expected to be developed for residential use; however, the residential scenario is included for a conservative evaluation of unrestricted land use.
						Ingestion	On-site	Quant	
					Child	Dermal Absorption	On-site	Quant	
						Ingestion	On-site	Quant	
					Child/Adult	Dermal Absorption	On-site	Quant	
						Ingestion	On-site	Quant	
				Industrial Worker	Adult	Dermal	On-site	None	Industrial workers assumed not to shower/bath at work.
						Ingestion	On-site	Quant	Groundwater is not currently used on-site as a water supply; however, although unlikely, future industrial potable use of the groundwater is possible.
			Water in Excavation Trench	Construction Worker	Adult	Dermal	On-site	None	Depth to groundwater sixteen to twenty feet below ground surface. Construction worker exposure to groundwater is not expected.
						Ingestion	On-site	None	
		Air	Water Vapors at Showerhead	Resident*	Adult	Inhalation	On-site	Quant	Groundwater not currently used on-site as a water supply and the site is not expected to be developed for residential use; however, the residential scenario is included for a conservative evaluation of unrestricted land use, and future adult residents could inhale VOCs from groundwater while showering.
					Child	Inhalation	On-site	None	Children not expected to shower, inhalation of VOCs from groundwater while bathing considered minimal.
					Child/Adult	Inhalation	On-site	None	
				Industrial Worker	Adult	Inhalation	On-site	None	Industrial worker not expected to shower while at work.
			Water Vapors in Excavation Trench	Construction Worker	Adult	Inhalation	On-site	None	Depth to groundwater sixteen to twenty feet below ground surface. Construction worker exposure to groundwater is not expected.

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Indoor Air	Vapor Intrusion to Indoor Air	Resident*	Adult	Inhalation	On-site	Quant	The site is not expected to be developed for residential use, however, the residential scenario, including vapor intrusion from groundwater into indoor air, and inhalation of indoor air by future residents, is included as a conservative evaluation of unrestricted land use.
					Child	Inhalation	On-site	Quant	
					Child/Adult	Inhalation	On-site	Quant	
				Industrial Worker	Adult	Inhalation	On-site	Quant	It is not likely the site will be developed for future industrial use, however vapor intrusion from groundwater to indoor air, and inhalation of indoor air by future industrial workers was evaluated as a potential future exposure pathway.

* Noncarcinogenic hazard evaluated separately for adult and child residential receptors, combined lifetime carcinogenic risk evaluated on an age-adjusted basis for residential scenario.

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe:Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Range of [3] Background Values	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Near-shore Sediment	1746-01-6	2,3,7,8-TCDD TEQ (dioxin)[6]	2.3E-07	1.2E-06	MG/KG	CAS07-SD02-0414	N/A	N/A	1.2E-06	8.3E-07 - 2.5E-06	4.9E-05 C	N/A		NO	BSL
	7440-39-3	Barium	7.2E+00	8.6E+00	MG/KG	CAS07-SD03-0414	3/3	5.0E+00 - 5.6E+00	8.6E+00	4.3E+00 - 9.9E+00	1.5E+04 N	N/A		NO	BSL
	7440-41-7	Beryllium	4.0E-01	1.1E+00	MG/KG	CAS07-SD01-0414	3/3	3.0E-01 - 3.3E-01	1.1E+00	ND - 6.2E-01	1.6E+02 N	N/A		NO	BSL
	7440-50-8	Copper	1.5E+00	3.6E+00	MG/KG	CAS07-SD01-0414	3/3	1.0E+00 - 1.1E+00	3.6E+00	ND - 2.7E+00	3.1E+03 N	N/A		NO	BSL
	7439-92-1	Lead	5.2E+00	1.3E+01	MG/KG	CAS07-SD01-0414	3/3	6.0E-01 - 6.7E-01	1.3E+01	2.2E+00 - 4.8E+00	4.0E+02 NL	N/A		NO	BSL
	7439-96-5	Manganese	2.1E+01	4.4E+01 K	MG/KG	CAS07-SD01-0414	3/3	1.0E+00 - 1.1E+00	4.4E+01	3.1E+01 - 7.1E+01	1.8E+03 N	N/A		NO	BSL
	7440-66-6	Zinc	1.4E+01	3.0E+01 K	MG/KG	CAS07-SD01-0414	3/3	2.0E+00 - 2.2E+00	3.0E+01	1.3E+01 - 2.3E+01	2.3E+04 N	N/A		NO	BSL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background samples from upstream and downstream locations (CAS07-SD07 through -09 and CAS07-SD13 through -15).

[4] Oak Ridge National Laboratory (ORNL). May, 2014. Regional Screening Levels for Chemical Contaminants at Superfund Sites. [Online].
Available: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
Residential soil RSL x 10. RSL based on noncarcinogenic endpoints based on hazard quotient of 0.1. RSL based on carcinogenic endpoints based on cancer risk of 10^{-6}.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Below Screening Level (BSL)

[6] 2,3,7,8-TCDD TEQ site concentration calculated on Table 2.1 Supplement A. 2,3,7,8-TCDD TEQ background concentration calculated on Table 2.1 Supplement B.

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
K = Biased High
C = Carcinogenic
N = Noncarcinogenic
N/A = Not available
ND = Not detected
NL = Noncarcinogenic lead residential soil RSL based on IEUBK model.
MG/KG = Milligram per kilogram

Table 2.1 Supplement A

Calculation of 2,3,7,8-TCDD Equivalent Concentrations - Near-shore Sediment

Site 7 – Old DuPont Disposal Area Remedial Investigatio

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

StationID		**CAS07-SD01**			**CAS07-SD02**			**CAS07-SD02**			**CAS07-SD03**		
SampleID		**CAS07-SD01-0414**			**CAS07-SD02-0414**			**CAS07-SD02P-0414**			**CAS07-SD03-0414**		
SampleDate		**4/14/2014**			**4/14/2014**			**4/14/2014**			**4/1/42014**		
Analyte (pg/g)	**TEF[1]**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	7.8E-01	J	7.8E-03	3.2E-01	J	3.2E-03	2.4E-01	X	2.4E-03	2.7E-01	X	2.7E-03
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	1.8E+01		1.8E-01	6.1E+00	J	6.1E-02	7.5E+00	J	7.5E-02	7.0E+00		7.0E-02
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	1.0E+00	U		1.0E+00	U		9.2E-01	U		9.7E-01	U	
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	2.0E-01	B		8.8E-02	B		9.2E-01	U		8.6E-02	B	
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	4.1E-01	J	4.1E-02	1.8E-01	X	1.8E-02	2.3E-01	J	2.3E-02	2.5E-01	J	2.5E-02
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	1.6E-01	B		7.3E-02	B		9.2E-01	U		9.7E-01	U	
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	6.9E-01	X	6.9E-02	2.7E-01	X	2.7E-02	2.9E-01	X	2.9E-02	3.4E-01	X	3.4E-02
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	1.4E-01	B		1.3E-01	B		9.2E-01	U		9.7E-01	U	
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	1.3E+00	J	1.3E-01	3.6E-01	X	3.6E-02	4.8E-01	J	4.8E-02	4.6E-01	J	4.6E-02
1,2,3,7,8-Pentachlorodibenzofuran	0.03	1.0E+00	U		1.0E+00	U		9.2E-01	U		9.7E-01	U	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	2.8E-01	X	2.8E-01	1.0E+00	U	1.0E+00	1.5E-01	X	1.5E-01	9.7E-01	U	
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	2.2E-01	B		8.3E-02	B		1.1E-01	B		1.1E-01	B	
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1.0E+00	U		1.0E+00	U		9.2E-01	U		9.7E-01	U	
2,3,7,8-TCDD (dioxin)	1	2.7E-01	U		3.5E-01	U		3.5E-01	U		3.2E-01	U	
2,3,7,8-Tetrachlorodibenzofuran	0.1	2.5E-01	U		2.5E-01	U		1.9E-01	U		2.0E-01	U	
Octachlorodibenzofuran	0.0003	9.0E-01	J	2.7E-04	2.0E+00	U	6.0E-04	3.3E-01	J	1.0E-04	2.5E-01	J	7.5E-05
Octachlorodibenzo-p-dioxin	0.0003	6.2E+02	L	1.9E-01	1.5E+02	J	4.6E-02	2.0E+02	J	5.9E-02	1.7E+02		5.0E-02
Total 2,3,7,8-TCDD TEQ (pg/g)				8.9E-01			1.2E+00			3.9E-01			2.3E-01
Sample 2,3,7,8-TCDD TEQ Concentration (mg/kg)				8.9E-07			1.2E-06			3.9E-07			2.3E-07

Minimum equivalent concentration = 2.3E-07

Maximum equivalent concentration = 1.2E-06

Notes:

B - Analyte also detected in an associated blank

pg/g = picograms per gram

mg/kg = milligrams per kilogram

J = Estimated Value

L = Biased Low

TEF = Toxicity Equivalent Factor

TEQ = Toxicity Equivalent

U - The material was analyzed for, but not detected

X = Estimated Maximum Possible Concentration

[1] TEF from *Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds.* Risk Assessment Forum, Washington, DC. EPA/100/R-10/005.

Table 2.1 Supplement B

Calculation of 2,3,7,8-TCDD Equivalent Concentrations - Near-shore Sediment Background Samples

Site 7 – Old DuPont Disposal Area Remedial Investigatio

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

StationID		**CAS07-SD07**			**CAS07-SD08**			**CAS07-SD09**			**CAS07-SD13**			**CAS07-SD13**			**CAS07-SD14**			**CAS07-SD15**		
SampleID		**CAS07-SD07-0414**			**CAS07-SD08-0414**			**CAS07-SD09-0414**			**CAS07-SD13-0414**			**CAS07-SD13P-0414**			**CAS07-SD14-0414**			**CAS07-SD15-0414**		
SampleDate		**4/22/2014**			**4/22/2014**			**4/22/2014**			**4/18/2014**			**4/18/2014**			**4/18/2014**			**4/18/2014**		
Analyte (pg/g)	**TEF[1]**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Conc. (pg/g)**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	5.4E+00		5.4E-02	5.8E+00		5.8E-02	5.8E+00		5.8E-02	4.5E+00		4.5E-02	5.7E+00		5.7E-02	5.2E+00		5.2E-02	4.4E+00		4.4E-02
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	4.0E+01		4.0E-01	4.3E+01		4.3E-01	6.1E+01		6.1E-01	2.3E+01		2.3E-01	2.7E+01		2.7E-01	2.6E+01		2.6E-01	2.5E+01		2.5E-01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	6.6E-01	J	6.6E-03	7.8E-01	J	7.8E-03	4.9E-01		4.9E-03	5.1E-01	B		6.0E-01	B		6.8E-01	B		5.3E-01	B	
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	6.6E-01	J	6.6E-02	6.2E-01	J	6.2E-02	7.9E-01		7.9E-02	7.7E-01	J	7.7E-02	8.0E-01	X	8.0E-02	7.4E-01	J	7.4E-02	7.7E-01	J	7.7E-02
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	4.5E-01	X	4.5E-02	4.1E-01	X	4.1E-02	8.1E-01		8.1E-02	3.6E-01	B		3.1E-01	B		2.5E-01	B		2.4E-01	B	
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	1.9E-01	B		1.5E-01	B		2.3E-01		2.3E-02	2.1E-01	J	2.1E-02	3.6E-01	J	3.6E-02	2.8E-01	X	2.8E-02	2.9E-01	X	2.9E-02
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	1.7E+00	J	1.7E-01	1.9E+00	J	1.9E-01	2.2E+00		2.2E-01	1.3E+00	J	1.3E-01	1.4E+00	J	1.4E-01	1.4E+00	X	1.4E-01	1.3E+00	X	1.3E-01
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	9.2E-01	U		1.0E+00	U		1.0E+00		1.0E-01	1.9E-01	B		2.0E-01	B		2.9E-01	B		2.2E-01	B	
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	9.5E-01	J	9.5E-02	1.2E+00	J	1.2E-01	1.8E+00		1.8E-01	4.5E-01	X	4.5E-02	6.2E-01	J	6.2E-02	5.3E-01	J	5.3E-02	5.6E-01	X	5.6E-02
1,2,3,7,8-Pentachlorodibenzofuran	0.03	9.2E-01	U		1.0E+00	U		1.0E+00		3.1E-02	9.1E-01	U		1.8E-01	J	5.3E-03	1.5E-01	X	4.4E-03	9.3E-01	U	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	1.5E-01	J	1.5E-01	1.7E-01	X	1.7E-01	2.7E-01		2.7E-01	1.6E-01	X	1.6E-01	1.6E-01	X	1.6E-01	2.0E-01	X	2.0E-01	1.3E-01	J	1.3E-01
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	2.8E-01	X	2.8E-02	3.3E-01	X	3.3E-02	3.1E-01		3.1E-02	3.4E-01	X	3.4E-02	4.0E-01	J	4.0E-02	3.4E-01	J	3.4E-02	2.9E-01	J	2.9E-02
2,3,4,7,8-Pentachlorodibenzofuran	0.3	2.1E-01	X	6.4E-02	1.8E-01	X	5.4E-02	1.0E+00		3.1E-01	3.0E-01	J	9.1E-02	3.8E-01	X	1.1E-01	2.6E-01	X	7.7E-02	1.9E-01	J	5.7E-02
2,3,7,8-TCDD (dioxin)	1	1.8E-01	U		2.1E-01	U		2.1E-01		2.1E-01	1.8E-01	U		1.8E-01	U		1.8E-01	U		1.9E-01	U	
2,3,7,8-Tetrachlorodibenzofuran	0.1	1.1E-01	X	1.1E-02	2.1E-01	U		2.1E-01		2.1E-02	1.8E-01	U		1.8E-01	U		1.8E-01	U		1.9E-01	U	
Octachlorodibenzofuran	0.0003	1.9E+01		5.7E-03	2.2E+01		6.5E-03	2.0E+01		5.9E-03	1.6E+01	J	4.7E-03	2.0E+01	J	6.1E-03	1.9E+01		5.6E-03	1.5E+01		4.5E-03
Octachlorodibenzo-p-dioxin	0.0003	7.5E+02	K	2.2E-01	4.2E+02		1.3E-01	7.3E+02		2.2E-01	8.3E+01	J	2.5E-02	1.2E+02	J	3.6E-02	1.1E+02	K	3.3E-02	1.1E+02	K	3.4E-02
Total 2,3,7,8-TCDD TEQ (pg/g)				1.3E+00			1.3E+00			2.5E+00			8.5E-01			1.0E+00			9.6E-01			8.3E-01
Sample 2,3,7,8-TCDD TEQ Concentration (mg/kg)				1.3E-06			1.3E-06			2.5E-06			8.5E-07			1.0E-06			9.6E-07			8.3E-07

Minimum equivalent concentration = 8.3E-07

Maximum equivalent concentration = 2.5E-06

Notes:

B - Analyte also detected in an associated blank

pg/g = picograms per gram

mg/kg = milligrams per kilogram

J = Estimated Value

L = Biased Low

TEF = Toxicity Equivalent Factor

TEQ = Toxicity Equivalent

U - The material was analyzed for, but not detected

X = Estimated Maximum Possible Concentration

[1] TEF from *Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds.* Risk Assessment Forum,

Table 2.2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future, Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Site 7	75-09-2	Methylene chloride	4.2E-02	4.2E-02	MG/KG	NWSY-90-7-SC-PER-186	1/41	9.4E-03 - 2.6E-01	4.2E-02	N/A	3.5E+01 N	2.7E-03	SSL	NO	BSL
	95-47-6	o-Xylene	7.3E-03 J	7.3E-03 J	MG/KG	NWSY-90-7-SC-PER-178	1/41	4.7E-03 - 1.3E-02	7.3E-03	N/A	6.5E+01 N	1.9E-02	SSL	NO	BSL
	56-55-3	Benzo(a)anthracene	1.8E-02 J	1.8E-02 J	MG/KG	NWSY-90-7-SC-FLR-144	1/41	5.7E-02 - 7.6E-02	1.8E-02	N/A	1.5E-01 C	1.2E-02	SSL	NO	BSL
	205-99-2	Benzo(b)fluoranthene	1.7E-02 J	1.7E-02 J	MG/KG	NWSY-90-7-SC-FLR-144	1/41	5.7E-02 - 7.6E-02	1.7E-02	N/A	1.5E-01 C	4.1E-02	SSL	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	2.6E-01 J	2.6E-01 J	MG/KG	NWSY-90-7-SC-FLR-146	1/41	3.6E-01 - 4.8E-01	2.6E-01	N/A	3.8E+01 C	1.3E+00	SSL	NO	BSL
	218-01-9	Chrysene	2.3E-02 J	2.3E-02 J	MG/KG	NWSY-90-7-SC-FLR-144	1/41	5.7E-02 - 7.6E-02	2.3E-02	N/A	1.5E+01 C	1.2E+00	SSL	NO	BSL
	72-20-8	Endrin	2.4E-03 J	2.4E-03 J	MG/KG	NWSY-90-7-SC-PER-132	1/41	3.6E-03 - 4.7E-03	2.4E-03	N/A	1.8E+00 N	9.2E-03	SSL	NO	BSL
	1746-01-6	2,3,7,8-TCDD (dioxin)	1.0E-07 J	2.7E-07 J	MG/KG	NWSY-90-7-SC-FLR-139	6/41	7.1E-08 - 5.1E-07	2.7E-07	N/A	4.9E-06 C	3.0E-07	SSL	NO	BSL
	7429-90-5	**Aluminum**	**3.5E+03**	**2.0E+04**	**MG/KG**	**NWSY-90-7-SC-FLR-137**	**41/41**	**1.1E+01 - 4.8E+01**	**2.0E+04**	**1.2E+04**	**7.7E+03 N**	**3.0E+03**	**SSL**	**YES**	**ASL**
	7440-36-0	Antimony	2.3E-01 L	2.9E-01 L	MG/KG	NWSY-90-7-SC-FLR-173	2/41	3.2E+00 - 1.4E+01	2.9E-01	1.1E+01	3.1E+00 N	3.5E-02	SSL	NO	BSL
	7440-38-2	**Arsenic**	**1.1E+00**	**2.4E+01**	**MG/KG**	**NWSY-90-7-SC-PER-148**	**41/41**	**4.2E-01 - 1.9E+00**	**2.4E+01**	**6.4E+00**	**6.7E-01 C**	**1.5E-03**	**SSL**	**YES**	**ASL**
	7440-39-3	Barium	1.8E+01 J	2.5E+02 J	MG/KG	NWSY-90-7-SC-PER-148	41/41	1.1E+01 - 4.8E+01	2.5E+02	5.3E+01	1.5E+03 N	1.6E+01	SSL	NO	BSL
	7440-41-7	Beryllium	3.3E-01	1.6E+00	MG/KG	NWSY-90-7-SC-PER-154	41/41	2.6E-01 - 1.2E+00	1.6E+00	5.9E-01	1.6E+01 N	1.9E+00	SSL	NO	BSL
	7440-43-9	Cadmium	1.2E-01 J	1.2E-01 J	MG/KG	NWSY-90-7-SC-PER-148	1/41	2.1E-01 - 2.6E+00	1.2E-01	1.5E+00	7.0E+00 N	6.9E-02	SSL	NO	BSL
	7440-70-2	Calcium	4.1E+02	2.5E+04 J	MG/KG	NWSY-90-7-SC-PER-148	41/41	2.6E+02 - 1.2E+03	2.5E+04	2.3E+03	N/A	N/A		NO	NUT
	7440-47-3	**Chromium**	**4.8E+00 J**	**4.1E+01 J**	**MG/KG**	**NWSY-90-7-SC-FLR-137**	**41/41**	**5.3E-01 - 2.4E+00**	**4.1E+01**	**1.8E+01**	**3.0E-01 C**	**6.7E-04**	**SSL**	**YES**	**ASL**
	7440-48-4	**Cobalt**	**1.1E+00 J**	**5.8E+00 J**	**MG/KG**	**NWSY-90-7-SC-PER-193**	**41/41**	**2.6E+00 - 1.2E+01**	**5.8E+00**	**9.9E+00**	**2.3E+00 N**	**2.7E-02**	**SSL**	**YES**	**ASL**
	7440-50-8	Copper	1.3E+00 J	4.3E+01	MG/KG	NWSY-90-7-SC-PER-148	41/41	1.3E+00 - 6.0E+00	4.3E+01	4.3E+00	3.1E+02 N	1.5E-03	SSL	NO	BSL
	57-12-5	Cyanide	2.4E-01	3.3E-01	MG/KG	NWSY-90-7-SC-PER-148	2/41	1.2E-01 - 1.7E-01	3.3E-01	N/A	2.1E+00 N	**3.5E+01**	**SSL**	NO	BSL
	7439-89-6	**Iron**	**3.6E+03**	**6.4E+04**	**MG/KG**	**NWSY-90-7-SC-FLR-137**	**41/41**	**5.3E+00 - 1.3E+02**	**6.4E+04**	**2.0E+04**	**5.5E+03 N**	**N/A**		**YES**	**ASL**
	7439-92-1	Lead	1.1E+00 J	2.0E+02 J	MG/KG	NWSY-90-7-SC-FLR-144	39/41	5.3E+00 - 2.6E+01	2.0E+02	1.7E+01	4.0E+02 N	N/A		NO	BSL
	7439-95-4	Magnesium	1.7E+02 J	1.4E+03	MG/KG	NWSY-90-7-SC-FLR-137	41/41	2.6E+02 - 1.2E+03	1.4E+03	1.1E+03	N/A	N/A		NO	NUT
	7439-96-5	**Manganese**	**9.1E+00 J**	**4.7E+02 J**	**MG/KG**	**NWSY-90-7-SC-PER-148**	**41/41**	**7.9E-01 - 4.1E+00**	**4.7E+02**	**3.2E+02**	**1.8E+02 N**	**2.8E+00**	**SSL**	**YES**	**ASL**
	7439-97-6	Mercury	1.3E-02 K	1.8E-01 K	MG/KG	NWSY-90-7-SC-FLR-137	37/41	8.2E-02 - 1.2E-01	1.8E-01	1.1E-01	2.3E+00 N	N/A		NO	BSL
	7440-02-0	Nickel	2.2E+00 J	7.0E+00 J	MG/KG	NWSY-90-7-SC-PER-193	41/41	2.1E+00 - 9.6E+00	7.0E+00	9.5E+00	1.5E+02 N	2.6E+00	SSL	NO	BSL
	7782-49-2	Selenium	2.6E-01 J	3.5E+00 J	MG/KG	NWSY-90-7-SC-FLR-137	36/41	5.3E+00 - 2.4E+01	3.5E+00	5.1E-01	3.9E+01 N	**5.2E-02**	**SSL**	NO	BSL
	7440-28-0	**Thallium**	**3.7E-01 J**	**2.4E+00**	**MG/KG**	**NWSY-90-7-SC-FLR-137**	**12/41**	**5.3E-01 - 2.7E+00**	**2.4E+00**	**ND**	**7.8E-02 N**	**1.4E-03**	**SSL**	**YES**	**ASL**
	7440-62-2	**Vanadium**	**7.2E+00 J**	**6.3E+01 J**	**MG/KG**	**NWSY-90-7-SC-FLR-173**	**41/41**	**2.6E+00 - 1.2E+01**	**6.3E+01**	**2.8E+01**	**3.9E+01 N**	**8.6E+00**	**SSL**	**YES**	**ASL**
	7440-66-6	Zinc	8.2E+00 J	1.2E+02	MG/KG	NWSY-90-7-SC-PER-148	41/41	1.1E+00 - 4.8E+00	1.2E+02	2.7E+01	2.3E+03 N	3.7E+01	SSL	NO	BSL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are 95% UTL from Cheatham Annex/Yorktown background surface soil samples, June 2012.

[4] Oak Ridge National Laboratory (ORNL). May, 2014. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. Residential soil RSLs. [Online]. Available: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

RSL based on noncarcinogenic endpoints based on hazard quotient of 0.1. RSL based on carcinogenic endpoints based on cancer risk of 10^{-6}.

RSL value for chromium (VI) used as surrogate for chromium.

RSL value for mercuric chloride (and other mercury salts) used for mercury.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

K = Biased High

L = Biased Low

C = Carcinogenic

N = Noncarcinogenic

MG/KG = milligrams per kilogram

N/A = Not available

ND = Not detected

SSL =Risk-based soil screening level for protection of groundwater from RSL table (noncarcinogenic endpoints based on hazard quotient of 0.1)

NL = Noncarcinogenic lead residential soil RSL based on IEUBK model.

Table 2.3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future, Future
Medium: Soil
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Emissions from Site 7 Soil	75-09-2	Methylene chloride	1.6E-02	1.6E-02	ug/m^3	NWSY-90-7-SC-PER-186	1/41	N/A	1.6E-02	N/A	6.3E+01 N	N/A		NO	BSL
	95-47-6	o-Xylene	9.3E-04 J	9.3E-04 J	ug/m^3	NWSY-90-7-SC-PER-178	1/41	N/A	9.3E-04	N/A	1.0E+01 N	N/A		NO	BSL
	56-55-3	Benzo(a)anthracene	1.4E-08 J	1.4E-08 J	ug/m^3	NWSY-90-7-SC-FLR-144	1/41	N/A	1.4E-08	N/A	9.2E-03 C	N/A		NO	BSL
	205-99-2	Benzo(b)fluoranthene	1.2E-08 J	1.2E-08 J	ug/m^3	NWSY-90-7-SC-FLR-144	1/41	N/A	1.2E-08	N/A	9.2E-03 C	N/A		NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	1.9E-07 J	1.9E-07 J	ug/m^3	NWSY-90-7-SC-FLR-146	1/41	N/A	1.9E-07	N/A	1.2E+00 C	N/A		NO	BSL
	218-01-9	Chrysene	1.7E-08 J	1.7E-08 J	ug/m^3	NWSY-90-7-SC-FLR-144	1/41	N/A	1.7E-08	N/A	9.2E-02 C	N/A		NO	BSL
	72-20-8	Endrin	1.8E-09 J	1.8E-09 J	ug/m^3	NWSY-90-7-SC-PER-132	1/41	N/A	1.8E-09	N/A	N/A	N/A		NO	NTX
	1746-01-6	2,3,7,8-TCDD (dioxin)	7.5E-14 J	2.0E-13 J	ug/m^3	NWSY-90-7-SC-FLR-139	6/41	N/A	2.0E-13	N/A	7.4E-08 C	N/A		NO	BSL
	7429-90-5	Aluminum	2.6E-03	1.5E-02	ug/m^3	NWSY-90-7-SC-FLR-137	41/41	N/A	1.5E-02	N/A	5.2E-01 N	N/A		NO	BSL
	7440-36-0	Antimony	1.7E-07 L	2.1E-07 L	ug/m^3	NWSY-90-7-SC-FLR-173	2/41	N/A	2.1E-07	N/A	N/A	N/A		NO	NTX
	7440-38-2	Arsenic	8.1E-07	1.8E-05	ug/m^3	NWSY-90-7-SC-PER-148	41/41	N/A	1.8E-05	N/A	6.5E-04 C	N/A		NO	BSL
	7440-39-3	Barium	1.3E-05 J	1.8E-04 J	ug/m^3	NWSY-90-7-SC-PER-148	41/41	N/A	1.8E-04	N/A	5.2E-02 N	N/A		NO	BSL
	7440-41-7	Beryllium	2.4E-07 J	1.2E-06	ug/m^3	NWSY-90-7-SC-PER-154	41/41	N/A	1.2E-06	N/A	1.2E-03 C	N/A		NO	BSL
	7440-43-9	Cadmium	8.8E-08 J	8.8E-08 J	ug/m^3	NWSY-90-7-SC-PER-148	1/41	N/A	8.8E-08	N/A	1.0E-03 N	N/A		NO	BSL
	7440-70-2	Calcium	3.0E-04	1.8E-02 J	ug/m^3	NWSY-90-7-SC-PER-148	41/41	N/A	1.8E-02	N/A	N/A	N/A		NO	NUT
	7440-47-3	**Chromium**	**3.5E-06 J**	**3.0E-05 J**	**ug/m^3**	**NWSY-90-7-SC-FLR-137**	**41/41**	**N/A**	**3.0E-05**	**N/A**	**1.2E-05 C**	**N/A**		**YES**	**ASL**
	7440-48-4	Cobalt	8.1E-07 J	4.3E-06 J	ug/m^3	NWSY-90-7-SC-PER-193	41/41	N/A	4.3E-06	N/A	3.1E-04 C	N/A		NO	BSL
	7440-50-8	Copper	9.6E-07 J	3.1E-05	ug/m^3	NWSY-90-7-SC-PER-148	41/41	N/A	3.1E-05	N/A	N/A	N/A		NO	NTX
	57-12-5	Cyanide	1.8E-07	2.4E-07	ug/m^3	NWSY-90-7-SC-PER-148	2/41	N/A	2.4E-07	N/A	8.3E-02 N	N/A		NO	BSL
	7439-89-6	Iron	2.7E-03	4.7E-02	ug/m^3	NWSY-90-7-SC-FLR-137	41/41	N/A	4.7E-02	N/A	N/A	N/A		NO	NTX
	7439-92-1	Lead	8.1E-07 J	1.5E-04 J	ug/m^3	NWSY-90-7-SC-FLR-144	39/41	N/A	1.5E-04	N/A	1.5E-01 NL	N/A		NO	BSL
	7439-95-4	Magnesium	1.3E-04 J	1.0E-03	ug/m^3	NWSY-90-7-SC-FLR-137	41/41	N/A	1.0E-03	N/A	N/A	N/A		NO	NUT
	7439-96-5	Manganese	6.7E-06 J	3.4E-04 J	ug/m^3	NWSY-90-7-SC-PER-148	41/41	N/A	3.4E-04	N/A	5.2E-03 N	N/A		NO	BSL
	7439-97-6	Mercury	9.6E-09 K	1.3E-07 K	ug/m^3	NWSY-90-7-SC-FLR-137	37/41	N/A	1.3E-07	N/A	3.1E-02 N	N/A		NO	BSL
	7440-02-0	Nickel	1.6E-06 J	5.1E-06 J	ug/m^3	NWSY-90-7-SC-PER-193	41/41	N/A	5.1E-06	N/A	9.4E-03 N	N/A		NO	BSL
	7782-49-2	Selenium	1.9E-07 J	2.6E-06 J	ug/m^3	NWSY-90-7-SC-FLR-137	36/41	N/A	2.6E-06	N/A	2.1E+00 N	N/A		NO	BSL
	7440-28-0	Thallium	2.7E-07 J	1.8E-06	ug/m^3	NWSY-90-7-SC-FLR-137	12/41	N/A	1.8E-06	N/A	N/A	N/A		NO	NTX
	7440-62-2	Vanadium	5.3E-06 J	4.6E-05 J	ug/m^3	NWSY-90-7-SC-FLR-173	41/41	N/A	4.6E-05	N/A	1.0E-02 N	N/A		NO	BSL
	7440-66-6	Zinc	6.0E-06 J	8.8E-05	ug/m^3	NWSY-90-7-SC-PER-148	41/41	N/A	8.8E-05	N/A	N/A	N/A		NO	NTX

[1] Minimum/Maximum calculated air concentrations from surface soil concentrations. Air concentrations calculated as Cair = Csoil*1000*(1/PEF + 1/VF).
PEF = 1.36E+09 m^3/kg. VF calculated for volatile constituents only, on Table 2.2A. PEF and equations to calculate VF from USEPA's Supplemental Soil Screening Guidance. (USEPA, 200

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Oak Ridge National Laboratory (ORNL). May, 2014. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. Residential air RSLs.
[Online]. Available: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
RSL based on noncarcinogenic endpoints based on hazard quotient of 0.1. RSL based on carcinogenic endpoints based on cancer risk of 10^{-6}.
RSL value for chromium (VI) used as surrogate for chromium.
RSL value for mercuric chloride (and other mercury salts) used for mercury.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic
ug/m^3 = micrograms per cubic meter
N/A = Not available
NL = Noncarcinogenic lead residential air screening level is National Ambient Air Quality Standard of 0.15 ug/m^3.

Table 2.3 Supplement A

Calculation of Volatilization Factor - Soil

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Diffusivity in Air (D_i) (cm^2/s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D_w) (cm^2/s)	Soil Organic Carbon Partition Coeff. (K_{oc}) (cm^3/g)	Soil Water Partition Coeff. ($K_d = K_{oc} \times F_{oc}$) ($g/cm^3$)	Apparent Diffusivity (D_A) (cm^2/s)	Volatilization Factor (VF) (m^3/kg)
Methylene Chloride	1.0E-01	1.3E-01	1.3E-05	2.2E+01	1.3E-01	2.8E-03	2.7E+03
o-Xylene	6.9E-02	2.1E-01	8.5E-06	3.8E+02	2.3E+00	3.2E-04	7.9E+03

Volatilization factor (VF) = (m^3/kg)

$$\frac{Q/C * (3.14 * D_A * T)^{1/2} * 10^{-4}\ m^2/cm^2}{2 * \rho_b * D_A}$$

Apparent Diffusivity (D_A) = (cm^2/s)

$$\frac{[(\Theta_a^{10/3} * D_i * H' + \Theta_w^{10/3} * D_w)/n^2]}{(\rho_b * K_d + \Theta_w + \Theta_a * H')}$$

Parameters	Values
Q/Cvol - Inverse of the geometric mean air concentration to the volatilization flux at of a 0.5-acre-square source for Raleigh-Durham, NC (g/m2-s per kg/m3)	77.26
T - Exposure interval(s)	9.5E+08
ρ_b - Soil bulk density (g/cm^3)	1.5
Θ_a - Air-filled soil porosity (L_{air}/L_{water}) = n - Θ_w	0.28
n - Total soil porosity (Lpore/Lsoil) = 1 - (r_b/r_s)	0.43
Θ_w - Water-filled soil porosity (Lwater/Lsoil)	0.15
ρ_s - Soil particle density (g/cm^3)	2.65
f_{oc} - fraction organic carbon in soil (g/g)	0.006

Parameters from USEPA, 1996. *Soil Screening Guidance: User's Guide* . EPA/540/R-96/018.

Equations from USEPA, 2002. *Supplemental Soil Screening Guidance: User's Guide.*

Physical/chemical properties from Oak Ridge National Laboratory (ORNL). May 2014. Regional Screening Levels for Chemical Contaminants at Superfund Sites.

Table 2.4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Tap Water	**67-66-3**	**Chloroform**	**1.6E+00**	**1.6E+00**	**UG/L**	**CAS07-GW09-0414**	**1/7**	**1.0E+00 - 1.0E+00**	**1.6E+00**	**N/A**	**2.2E-01 C**	**8.0E+01**	**MCL**	**YES**	**ASL**
	156-59-2	**cis-1,2-Dichloroethene**	**4.8E-01 J**	**6.2E+00**	**UG/L**	**CAS07-MW07-0414**	**3/7**	**1.0E+00 - 1.0E+00**	**6.2E+00**	**N/A**	**3.6E+00 N**	**7.0E+01**	**MCL**	**YES**	**ASL**
	79-01-6	**Trichloroethene**	**3.3E-01 J**	**5.4E+01**	**UG/L**	**CAS07-MW07-0414**	**4/7**	**1.0E+00 - 1.0E+00**	**5.4E+01**	**N/A**	**2.8E-01 N**	**5.0E+00**	**MCL**	**YES**	**ASL**
	121-14-2	**2,4-Dinitrotoluene**	**9.9E-02 J**	**1.1E+00**	**UG/L**	**CAS07-MW04-0111**	**4/5**	**3.0E-01 - 3.2E-01**	**1.1E+00**	**N/A**	**2.4E-01 C**	**N/A**		**YES**	**ASL**
	606-20-2	**2,6-Dinitrotoluene**	**3.9E-01**	**3.9E-01**	**UG/L**	**CAS07-MW04-0111**	**1/5**	**3.0E-01 - 3.2E-01**	**3.9E-01**	**N/A**	**4.8E-02 C**	**N/A**		**YES**	**ASL**
	72-54-8	**4,4'-DDD**	**9.9E-03 J**	**4.0E-02 J**	**UG/L**	**CAS07-MW04-0111**	**2/5**	**1.9E-02 - 2.0E-02**	**4.0E-02**	**N/A**	**3.1E-02 C**	**N/A**		**YES**	**ASL**
	319-84-6	alpha-BHC	5.3E-03 J	5.3E-03 J	UG/L	CAS07-MW04-0111	1/5	1.9E-02 - 2.0E-02	5.3E-03	N/A	7.1E-03 C	N/A		NO	BSL
	319-86-8	delta-BHC	5.6E-03 J	5.6E-03 J	UG/L	CAS07-MW03-0111	1/5	1.9E-02 - 2.0E-02	5.6E-03	N/A	2.5E-02 C	N/A		NO	BSL
	33213-65-9	Endosulfan II	5.8E-03 J	7.1E-03 J	UG/L	CAS07-MW07-0111	2/5	1.9E-02 - 2.0E-02	7.1E-03	N/A	1.0E+01 N	N/A		NO	BSL
	5103-74-2	gamma-Chlordane	6.5E-03 J	2.5E-02 J	UG/L	CAS07-MW04-0111	2/5	1.9E-02 - 2.0E-02	2.5E-02	N/A	2.2E-01 C	2.0E+00	MCL	NO	BSL
	1746-01-6	2,3,7,8-TCDD TEQ (dioxin)[6]	9.3E-10	1.9E-07	UG/L	CAS07-MW03-0111	4/5	N/A	1.9E-07	N/A	6.0E-07 C	3.0E-05	MCL	NO	BSL
	99-35-4	1,3,5-Trinitrobenzene	1.3E-01 J	1.3E-01 J	UG/L	CAS07-MW04-0111	1/5	3.0E-01 - 3.2E-01	1.3E-01	N/A	5.9E+01 N	N/A		NO	BSL
	118-96-7	2,4,6-Trinitrotoluene	2.1E-01 J	2.1E-01 J	UG/L	CAS07-MW06P-0111	1/5	3.0E-01 - 3.2E-01	2.1E-01	N/A	9.8E-01 N	N/A		NO	BSL
	35572-78-2	2-Amino-4,6-dinitrotoluene	1.2E-01 J	1.2E-01 J	UG/L	CAS07-MW06P-0111	1/5	3.0E-01 - 3.2E-01	1.2E-01	N/A	3.9E+00 N	N/A		NO	BSL
	99-08-1	3-Nitrotoluene	1.4E-01 J	1.4E-01 J	UG/L	CAS07-MW07-0111	2/5	3.0E-01 - 3.2E-01	1.4E-01	N/A	1.7E-01 N	N/A		NO	BSL
	19406-51-0	4-Amino-2,6-dinitrotoluene	2.0E-01 J	2.0E-01 J	UG/L	CAS07-MW06P-0111	1/5	3.0E-01 - 3.2E-01	2.0E-01	N/A	3.9E+00 N	N/A		NO	BSL
	2691-41-0	HMX	1.1E-01 J	5.3E-01 J	UG/L	CAS07-MW04-0111	3/5	3.0E-01 - 3.2E-01	5.3E-01	N/A	1.0E+02 N	N/A		NO	BSL
	55-63-0	**Nitroglycerin**	**2.3E-01 J**	**2.3E-01 J**	**UG/L**	**CAS07-MW04-0111**	**1/5**	**7.6E-01 - 8.1E-01**	**2.3E-01**	**N/A**	**2.0E-01 N**	**N/A**		**YES**	**ASL**
	78-11-5	PETN	2.5E-01 J	4.6E-01 J	UG/L	CAS07-MW04-0111	3/5	7.6E-01 - 8.1E-01	4.6E-01	N/A	3.9E+00 N	N/A		NO	BSL
	121-82-4	RDX	1.3E-01 J	6.5E-01 J	UG/L	CAS07-MW04-0111	4/5	3.0E-01 - 3.2E-01	6.5E-01	N/A	7.0E-01 C	N/A		NO	BSL
	7429-90-5	Aluminum	6.0E+01	3.0E+02	UG/L	CAS07-MW07-0111	3/5	5.0E+01 - 2.5E+02	3.0E+02	2.2E+03	2.0E+03 N	50 - 200	SMCL	NO	BSL
	7440-38-2	**Arsenic**	**3.2E+00**	**4.3E+00**	**UG/L**	**CAS07-MW07-0111**	**2/5**	**2.5E+00 - 2.5E+00**	**4.3E+00**	**2.3E+00**	**5.2E-02 C**	**1.0E+01**	**MCL**	**YES**	**ASL**
	7440-39-3	Barium	2.2E+01	4.2E+01	UG/L	CAS07-MW05-0111	5/5	1.0E+01 - 1.0E+01	4.2E+01	1.2E+02	3.8E+02 N	2.0E+03	MCL	NO	BSL
	7440-43-9	**Cadmium**	**7.2E-01 J**	**1.2E+00 J**	**UG/L**	**CAS07-MW06P-0111**	**5/5**	**1.3E+00 - 1.3E+00**	**1.2E+00**	**6.1E-01**	**9.2E-01 N**	**5.0E+00**	**MCL**	**YES**	**ASL**
	7440-70-2	Calcium	8.5E+04	1.4E+05	UG/L	CAS07-MW05-0111	5/5	1.3E+03 - 6.3E+03	1.4E+05	1.6E+05	N/A	N/A		NO	NUT
	7440-47-3	**Chromium**	**1.7E+00 J**	**2.5E+00 J**	**UG/L**	**CAS07-MW05-0111**	**3/5**	**2.5E+00 - 2.5E+00**	**2.5E+00**	**1.5E+01**	**3.5E-02 C**	**1.0E+02**	**MCL**	**YES**	**ASL**
	7440-48-4	**Cobalt**	**1.4E+00 J**	**4.3E+00**	**UG/L**	**CAS07-MW03-0111**	**4/5**	**3.1E+00 - 3.1E+00**	**4.3E+00**	**2.1E+01**	**6.0E-01 N**	**N/A**		**YES**	**ASL**
	7440-50-8	Copper	1.1E+00 J	2.0E+00 J	UG/L	CAS07-MW06-0111	2/5	2.5E+00 - 2.5E+00	2.0E+00	1.2E+01	8.0E+01 N	1.3E+03	MCL	NO	BSL
	7439-89-6	Iron	1.0E+02	6.0E+02	UG/L	CAS07-MW07-0111	3/5	2.5E+01 - 2.5E+01	6.0E+02	3.6E+03	1.4E+03 N	3.0E+02	MCL	NO	BSL
	7439-95-4	Magnesium	2.1E+03	6.5E+03	UG/L	CAS07-MW05-0111	5/5	1.3E+03 - 1.3E+03	6.5E+03	3.6E+03	N/A	N/A		NO	NUT
	7439-96-5	**Manganese**	**1.9E+01**	**2.2E+02**	**UG/L**	**CAS07-MW04-0111**	**5/5**	**3.8E+00 - 3.8E+00**	**2.2E+02**	**5.8E+01**	**4.3E+01 N**	**5.0E+01**	**SMCL**	**YES**	**ASL**
	7440-02-0	Nickel	2.6E+00	3.9E+00	UG/L	CAS07-MW03-0111	5/5	2.5E+00 - 2.5E+00	3.9E+00	1.1E+01	3.9E+01 N	N/A		NO	BSL
	7440-09-7	Potassium	1.1E+03 J	2.3E+03	UG/L	CAS07-MW05-0111	5/5	1.3E+03 - 1.3E+03	2.3E+03	3.5E+03	N/A	N/A		NO	NUT
	7782-49-2	Selenium	8.8E-01 J	2.4E+00 J	UG/L	CAS07-MW05-0111	2/5	2.5E+00 - 2.5E+00	2.4E+00	ND	1.0E+01 N	5.0E+01		NO	BSL
	7440-23-5	Sodium	7.3E+03	2.1E+04	UG/L	CAS07-MW05-0111	5/5	1.3E+03 - 1.3E+03	2.1E+04	9.9E+03	N/A	N/A		NO	NUT
	7440-62-2	Vanadium	1.5E+00 J	1.5E+00 J	UG/L	CAS07-MW07-0111	1/5	3.1E+00 - 3.1E+00	1.5E+00	2.6E+01	8.6E+00 N	N/A		NO	BSL
	7440-66-6	Zinc	2.1E+00 J	9.9E+00	UG/L	CAS07-MW03-0111	4/5	5.0E+00 - 2.5E+01	9.9E+00	4.5E+00	6.0E+02 N	N/A		NO	BSL

[1] Minimum/Maximum detected concentration. Unfiltered results for metals since in general no significant difference between filtered and unfiltered results of aluminum, iron, and manganese in any of the monitoring wells, and consistent with USEPA's February 2014 "Determining Groundwater Exposure Point Concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are Cornwalis Cave/Yorktown Eastover Aquifer or Cornwalis Cave Aquifer, 95% UTL, from Final Background Study Report, Naval Weapons Station

[4] Oak Ridge National Laboratory (ORNL). May, 2014. Regional Screening Levels for Chemical Contaminants at Superfund Sites. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/whatsnew.html. Tap water RSLs.

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A= Not available or not applicable

Table 2.4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection

RSL based on noncarcinogenic endpoints based on hazard quotient of 0.1. RSL based on carcinogenic endpoints based on cancer risk of 10-6.

RSL and MCL value for chlordane used as surrogate for gamma-chlordane.

RSL value for technical HCH used as surrogate for delta-BHC.

RSL value for chromium (VI) used as surrogate for chromium.

RSL value for endosulfan used as surrogate for endosulfan II.

ND = Not detected

UG/L = micrograms per liter

MCL = Maximum Contaminant Level

SMCL = Maximum Contaminant Level, Secondary Drinking Water Standards

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

[6] 2,3,7,8-TCDD TEQ concentration calculated on Table 2.4 Supplement A.

Table 2.4 Supplement A

Calculation of 2,3,7,8-TCDD Equivalent Concentrations - Groundwater

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

StationID		**CAS07-MW03**			**CAS07-MW04**			**CAS07-MW05**			**CAS07-MW06**			**CAS07-MW06**			**CAS07-MW07**		
SampleID		**CAS07-MW03-0111**			**CAS07-MW04-0111**			**CAS07-MW05-0111**			**CAS07-MW06-0111**			**CAS07-MW06P-0111**			**CAS07-MW07-0111**		
SampleDate		**1/25/2011**			**1/28/2011**			**1/25/2011**			**1/24/2011**			**1/24/2011**			**1/24/2011**		
Analyte (NG/L)	**TEF[1]**	**Concentration**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Concentration**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Concentration**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Concentration**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Concentration**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**	**Concentration**	**Data Qualifier**	**2,3,7,8-TCDD TEQ**
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	4.7E-04	U		4.1E-04	U		4.0E-04	U		4.5E-04	U		5.0E-04	U		4.6E-04	U	
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	8.4E-04	U		1.4E-03	J	1.4E-05	6.9E-04	U		7.9E-04	U		8.8E-04	U		8.3E-04	U	
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	6.5E-04	U		5.6E-04	U		5.5E-04	U		6.2E-04	U		6.8E-04	U		6.3E-04	U	
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	6.0E-04	J	6.0E-05	3.3E-04	U		3.9E-04	U		4.6E-04	U		4.6E-04	U		4.6E-04	U	
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	5.6E-04	U		7.3E-04	U		6.0E-04	U		7.2E-04	U		7.5E-04	U		7.5E-04	U	
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	5.1E-04	U		2.8E-04	U		3.3E-04	U		4.0E-04	U		3.9E-04	U		3.9E-04	U	
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	5.2E-04	U		6.7E-04	U		5.6E-04	U		6.6E-04	U		6.9E-04	U		6.9E-04	U	
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	6.8E-04	U		3.8E-04	U		4.5E-04	U		5.3E-04	U		5.2E-04	U		5.3E-04	U	
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	5.8E-04	U		7.5E-04	U		6.3E-04	U		7.4E-04	U		7.7E-04	U		7.7E-04	U	
1,2,3,7,8-Pentachlorodibenzofuran	0.03	3.9E-04	U		3.1E-04	U		3.9E-04	U		4.9E-04	U		6.3E-04	U		4.9E-04	U	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	6.9E-04	U		5.8E-04	U		6.0E-04	U		5.9E-04	U		7.3E-04	U		7.7E-04	U	
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	5.6E-04	U		3.1E-04	U		3.7E-04	U		4.4E-04	U		4.3E-04	U		4.4E-04	U	
2,3,4,7,8-Pentachlorodibenzofuran	0.3	4.3E-04	J	1.3E-04	3.1E-04	U		4.0E-04	U		5.0E-04	U		6.4E-04	U		5.0E-04	U	
2,3,7,8-TCDD (dioxin)	1	7.2E-04	U		7.2E-04	U		7.1E-04	U		8.9E-04	U		8.0E-04	U		7.7E-04	U	
2,3,7,8-Tetrachlorodibenzofuran	0.1	5.5E-04	U		5.5E-04	U		4.3E-04	U		5.9E-04	U		6.1E-04	U		5.6E-04	U	
Octachlorodibenzofuran	0.0003	8.8E-04	U		8.8E-04	U		8.2E-04	U		1.1E-03	U		1.2E-03	U		1.2E-03	U	
Octachlorodibenzo-p-dioxin	0.0003	8.2E-03	J	2.5E-06	6.1E-02	J	1.8E-05	7.9E-04	U		2.0E-03	J	6.1E-07	3.1E-03	J	9.3E-07	1.0E-02	J	3.0E-06
Total 2,3,7,8-TCDD TEQ (NG/L)				1.9E-04			3.2E-05			0.0E+00			6.1E-07			9.3E-07			3.0E-06
Sample 2,3,7,8-TCDD TEQ Concentration (UG/L)				1.9E-07			3.2E-08			0.0E+00			6.1E-10			9.3E-10			3.0E-09

Minimum equivalent concentration = 9.3E-10

Maximum equivalent concentration = 1.9E-07

Notes:

NG/L = nanograms per liter

UG/L = micrograms per liter

J = Estimated Value

U = Not detected

TEF = Toxicity Equivalent Factor

TEQ = Toxicity Equivalent

[1] TEF from *Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds.* Risk Assessment Forum, Washington, DC. EPA/100/R-10/005.

Table 2.5

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Water Vapors at Showerhead	**67-66-3**	**Chloroform**	**1.6E+00**	**1.6E+00**	**UG/L**	**CAS07-GW09-0414**	**1/7**	**1.0E+00 - 1.0E+00**	**1.6E+00**	**N/A**	**2.2E-01 C**	**8.0E+01**	**MCL**	**YES**	**ASL**
	156-59-2	**cis-1,2-Dichloroethene**	**4.8E-01 J**	**6.2E+00**	**UG/L**	**CAS07-MW07-0414**	**3/7**	**1.0E+00 - 1.0E+00**	**6.2E+00**	**N/A**	**3.6E+00 N**	**7.0E+01**	**MCL**	**YES**	**ASL**
	79-01-6	**Trichloroethene**	**3.3E-01 J**	**5.4E+01**	**UG/L**	**CAS07-MW07-0414**	**4/7**	**1.0E+00 - 1.0E+00**	**5.4E+01**	**N/A**	**2.8E-01 N**	**5.0E+00**	**MCL**	**YES**	**ASL**

[1] Minimum/Maximum detected concentration.

[2] Maximum concentration is used for screening.

[3] No background values for VOCs.

[4] Oak Ridge National Laboratory (ORNL). May, 2014. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/whatsnew.html. Tap water RSLs.
RSL based on noncarcinogenic endpoints based on hazard quotient of 0.1. RSL based on carcinogenic endpoints based on cancer risk of 10-6.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Below Screening Level (BSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

C = Carcinogenic

N = Noncarcinogenic

N/A= Not available or not applicable

UG/L = micrograms per liter

MCL = Maximum Contaminant Level

Table 2.6

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air (Residential)

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Vapor Intrusion to Indoor Air	**67-66-3**	**Chloroform**	**1.6E+00**	**1.6E+00**	**UG/L**	**CAS07-GW09-0414**	**1/7**	**1.0E+00 - 1.0E+00**	**1.6E+00**	**N/A**	**1.2E+00 C**	**8.0E+01**	**MCL**	**YES**	**ASL**
	156-59-2	cis-1,2-Dichloroethene	4.8E-01 J	6.2E+00	UG/L	CAS07-MW07-0414	3/7	1.0E+00 - 1.0E+00	6.2E+00	N/A	N/A	7.0E+01	MCL	NO	NTX
	79-01-6	**Trichloroethene**	**3.3E-01 J**	**5.4E+01**	**UG/L**	**CAS07-MW07-0414**	**4/7**	**1.0E+00 - 1.0E+00**	**5.4E+01**	**N/A**	**8.4E-01 N**	**5.0E+00**	**MCL**	**YES**	**ASL**

[1] Minimum/Maximum detected concentration.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] Vapor Intrusion Groundwater Screening Levels. See Table 2.6 Supplement A
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
N = Noncarcinogenic
N/A= Not available or not applicable
UG/L = micrograms per liter
MCL = Maximum Contaminant Level

Table 2.6 Supplement A
OSWER VAPOR INTRUSION ASSESSMENT
Vapor Intrusion Screening Level (VISL) Calculator Version 3.3.1, May 2014 RSLs

Parameter	Symbol	Value	Instructions
Exposure Scenario	Scenario	Residential	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	TCR	1.00E-06	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	THQ	0.1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (ºC)	Tgw	15.3	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations

	CAS	Chemical Name	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 1E-06 or THQ = 0.1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 1E-06 or THQ = 0.1	Target Ground Water Conc. @ TCR = 1E-06 or THQ = 0.1	Is Target Ground Water Conc. < MCL?	Temperature for Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source
			Cvp > Cia,target?	Chc > Cia,target?	MIN(Cia,c;Cia,nc)		Csg	Cgw	Cgw<MCL?	Tgw or 25	LEL	
			Yes/No	Yes/No	(ug/m^3)	C/NC	(ug/m^3)	(ug/L)	Yes/No (MCL ug/L)	C	(% by vol)	
x	67-66-3	Chloroform	Yes	Yes	1.2E-01	C	1.2E+00	1.2E+00	Yes (80)	15.3	0	0
x	79-01-6	Trichloroethylene	Yes	Yes	2.1E-01	NC	2.1E+00	8.4E-01	Yes (5)	15.3	8	N

CAS	Inhalation Unit Risk	IUR Source*	Reference Concentration	RFC Source*	Mutagenic Indicator	Target Indoor Air Conc. for Carcinogens @ TCR = 1E-06	Target Indoor Air Conc. for Non-Carcinogens @ THQ = 0.1
	IUR		RfC		i	Cia,c	Cia,nc
	(ug/m^3)$^{-1}$		(mg/m^3)			(ug/m^3)	(ug/m^3)
67-66-3	2.30E-05	I	9.80E-02	A		1.2E-01	1.0E+01
79-01-6	see note	I	2.00E-03	I	TCE	4.8E-01	2.1E-01

Notes:

(1) **Inhalation Pathway Exposure Parameters (RME):**

Exposure Scenario	Units	Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E6) Symbol	Selected Value
Averaging time for carcinogens	(yrs)	ATc_R	70	ATc_C	70	ATc	70
Averaging time for non-carcinogens	(yrs)	ATnc_R	26	ATnc_C	25	ATnc	26
Exposure duration	(yrs)	ED_R	26	ED_C	25	ED	26
Exposure frequency	(days/yr)	EF_R	350	EF_C	250	EF	350
Exposure time	(hr/day)	ET_R	24	ET_C	8	ET	24

(2) **Generic Attenuation Factors:**

Source Medium of Vapors		Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E6) Symbol	Selected Value
Groundwater	(-)	AFgw_R	0.001	AFgw_C	0.001	AFgw	0.001
Sub-Slab and Exterior Soil Gas	(-)	AFss_R	0.1	AFss_C	0.1	AFss	0.1

(3) **Formulas**

Cia, target = MIN(Cia,c; Cia,nc)
Cia,c (ug/m3) = TCR x ATc x (365 days/yr) x (24 hrs/day) / (ED x EF x ET x IUR)
Cia,nc (ug/m3) = THQ x ATnc x (365 days/yr) x (24 hrs/day) x RfC x (1000 ug/mg) / (ED x EF x ET)

(4) **Special Case Chemicals**

Trichloroethylene	Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E6) Symbol	Selected Value
	mIURTCE_R	1.00E-06	mIURTCE_C	0.00E+00	mIURTCE	1.00E-06
	IURTCE_R	3.10E-06	IURTCE_C	4.10E-06	IURTCE	3.10E-06

Mutagenic Chemicals — The exposure durations and age-dependent adjustment factors for mutagenic-mode-of-action are listed in the table below:

Note: This section applies to trichloroethylene and other mutagenic chemicals, but not to vinyl chloride.

Age Cohort	Exposure Duration (years)	Age-dependent adjustment factor
0 - 2 years	2	10
2 - 6 years	4	3
6 - 16 years	10	3
16 - 26 years	10	1

Mutagenic-mode-of-action (MMOA) adjustment factor 72 This factor is used in the equations for mutagenic chemicals.

Vinyl Chloride — See the Navigation Guide equation for Cia,c for vinyl chloride.

Notation:

NVT = Not sufficiently volatile and/or toxic to pose inhalation risk in selected exposure scenario for the indicated medium
C = Carcinogenic
NC = Non-carcinogenic
I = IRIS: EPA Integrated Risk Information System (IRIS). Available online at: http://www.epa.gov/iris/subst/index.html
P = PPRTV. EPA Provisional Peer Reviewed Toxicity Values (PPRTVs). Available online at: http://hhpprtv.ornl.gov/pprtv.shtml
A = Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRLs). Available online at: http://www.atsdr.cdc.gov/mrls/index.html
CA = California Environmental Protection Agency/Office of Environmental Health Hazard Assessment assessments. Available online at:
H = HEAST. EPA Superfund Health Effects Assessment Summary Tables (HEAST) database. Available online at: http://epa-heast.ornl.gov/heast.shtml
S = See RSL User Guide, Section 5
X = PPRTV Appendix
E = The Engineering ToolBox. Available online at http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html
N = Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. Available online at: http://www.cdc.gov/niosh/npg/default.html
M = Chemical-specific MSDS
Mut = Chemical acts according to the mutagenic-mode-of-action, special exposure parameters apply (see footnote (4) above).
VC = Special exposure equation for vinyl chloride applies (see Navigation Guide for equation).
TCE = Special mutagenic and non-mutagenic IURs for trichloroethylene apply (see footnote (4) above).
Yellow highlighting indicates site-specific parameters that may be edited by the user.
Blue highlighting indicates exposure factors that are based on Risk Assessment Guidance for Superfund (RAGS) or EPA vapor intrusion guidance, which generally should not be changed.
**Lower explosive limit is the minimum concentration of the compound in air (% by volume) that is needed for the gas to ignite and explode.

Table 2.7

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air (Industrial)

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Vapor Intrusion to Indoor Air	67-66-3	Chloroform	1.6E+00	1.6E+00	UG/L	CAS07-GW09-0414	1/7	1.0E+00 - 1.0E+00	1.6E+00	N/A	5.4E+00 C	8.0E+01	MCL	NO	BSL
	156-59-2	cis-1,2-Dichloroethene	4.8E-01 J	6.2E+00	UG/L	CAS07-MW07-0414	3/7	1.0E+00 - 1.0E+00	6.2E+00	N/A	N/A	7.0E+01	MCL	NO	NTX
	79-01-6	**Trichloroethene**	**3.3E-01 J**	**5.4E+01**	**UG/L**	**CAS07-MW07-0414**	**4/7**	**1.0E+00 - 1.0E+00**	**5.4E+01**	**N/A**	**3.5E+00 N**	**5.0E+00**	**MCL**	**YES**	**ASL**

[1] Minimum/Maximum detected concentration.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] Vapor Intrusion Groundwater Screening Levels. See Table 2.7 Supplement A
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
N = Noncarcinogenic
N/A= Not available or not applicable
UG/L = micrograms per liter
MCL = Maximum Contaminant Level

Table 2.7 Supplement A
OSWER VAPOR INTRUSION ASSESSMENT
Vapor Intrusion Screening Level (VISL) Calculator Version 3.3.1, May 2014 RSLs

Parameter	Symbol	Value	Instructions
Exposure Scenario	Scenario	Commercial	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	TCR	1.00E-06	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	THQ	0.1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (ºC)	Tgw	15.3	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations

	CAS	Chemical Name	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 1E-06 or THQ = 0.1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 1E-06 or THQ = 0.1	Target Ground Water Conc. @ TCR = 1E-06 or THQ = 0.1	Is Target Ground Water Conc. < MCL?	Temperature for Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source
			Cvp > Cia,target?	Chc > Cia,target?	MIN(Cia,c;Cia,nc)		Csg	Cgw	Cgw<MCL?	Tgw or 25	LEL	
			Yes/No	Yes/No	(ug/m^3)	C/NC	(ug/m^3)	(ug/L)	Yes/No (MCL ug/L)	C	(% by vol)	
x	67-66-3	Chloroform	Yes	Yes	5.3E-01	C	5.3E+00	5.4E+00	Yes (80)	15.3	0	0
x	79-01-6	Trichloroethylene	Yes	Yes	8.8E-01	NC	8.8E+00	3.5E+00	Yes (5)	15.3	8	N

CAS	Inhalation Unit Risk	IUR Source*	Reference Concentration	RFC Source*	Mutagenic Indicator	Target Indoor Air Conc. for Carcinogens @ TCR = 1E-06	Target Indoor Air Conc. for Non-Carcinogens @ THQ = 0.1
	IUR		RfC		i	Cia,c	Cia,nc
	(ug/m^3)$^{-1}$		(mg/m^3)			(ug/m^3)	(ug/m^3)
67-66-3	2.30E-05	I	9.80E-02	A		5.3E-01	4.3E+01
79-01-6	see note	I	2.00E-03	I	TCE	3.0E+00	8.8E-01

Notes:

(1) **Inhalation Pathway Exposure Parameters (RME):**

Exposure Scenario	Units	Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E6) Symbol	Selected Value
Averaging time for carcinogens	(yrs)	ATc_R	70	ATc_C	70	ATc	70
Averaging time for non-carcinogens	(yrs)	ATnc_R	26	ATnc_C	25	ATnc	25
Exposure duration	(yrs)	ED_R	26	ED_C	25	ED	25
Exposure frequency	(days/yr)	EF_R	350	EF_C	250	EF	250
Exposure time	(hr/day)	ET_R	24	ET_C	8	ET	8

(2) **Generic Attenuation Factors:**

Source Medium of Vapors		Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E6) Symbol	Selected Value
Groundwater	(-)	AFgw_R	0.001	AFgw_C	0.001	AFgw	0.001
Sub-Slab and Exterior Soil Gas	(-)	AFss_R	0.1	AFss_C	0.1	AFss	0.1

(3) **Formulas**

Cia, target = MIN(Cia,c; Cia,nc)
Cia,c (ug/m3) = TCR x ATc x (365 days/yr) x (24 hrs/day) / (ED x EF x ET x IUR)
Cia,nc (ug/m3) = THQ x ATnc x (365 days/yr) x (24 hrs/day) x RfC x (1000 ug/mg) / (ED x EF x ET)

(4) **Special Case Chemicals**

Trichloroethylene

	Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E6) Symbol	Selected Value
	mIURTCE_R	1.00E-06	mIURTCE_C	0.00E+00	mIURTCE	0.00E+00
	IURTCE_R	3.10E-06	IURTCE_C	4.10E-06	IURTCE	4.10E-06

Mutagenic Chemicals — The exposure durations and age-dependent adjustment factors for mutagenic-mode-of-action are listed in the table below:

Note: This section applies to trichloroethylene and other mutagenic chemicals, but not to vinyl chloride.

Age Cohort	Exposure Duration (years)	Age-dependent adjustment factor
0 - 2 years	2	10
2 - 6 years	4	3
6 - 16 years	10	3
16 - 26 years	10	1

Mutagenic-mode-of-action (MMOA) adjustment factor 25 This factor is used in the equations for mutagenic chemicals.

Vinyl Chloride — See the Navigation Guide equation for Cia,c for vinyl chloride.

Notation:

NVT = Not sufficiently volatile and/or toxic to pose inhalation risk in selected exposure scenario for the indicated medium
C = Carcinogenic
NC = Non-carcinogenic
I = IRIS: EPA Integrated Risk Information System (IRIS). Available online at: http://www.epa.gov/iris/subst/index.html
P = PPRTV. EPA Provisional Peer Reviewed Toxicity Values (PPRTVs). Available online at: http://hhpprtv.ornl.gov/pprtv.shtml
A = Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRLs). Available online at: http://www.atsdr.cdc.gov/mrls/index.html
CA = California Environmental Protection Agency/Office of Environmental Health Hazard Assessment assessments. Available online at:
H = HEAST. EPA Superfund Health Effects Assessment Summary Tables (HEAST) database. Available online at: http://epa-heast.ornl.gov/heast.shtml
S = See RSL User Guide, Section 5
X = PPRTV Appendix
E = The Engineering ToolBox. Available online at http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html
N = Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. Available online at: http://www.cdc.gov/niosh/npg/default.html
M = Chemical-specific MSDS
Mut = Chemical acts according to the mutagenic-mode-of-action, special exposure parameters apply (see footnote (4) above).
VC = Special exposure equation for vinyl chloride applies (see Navigation Guide for equation).
TCE = Special mutagenic and non-mutagenic IURs for trichloroethylene apply (see footnote (4) above).
Yellow highlighting indicates site-specific parameters that may be edited by the user.
Blue highlighting indicates exposure factors that are based on Risk Assessment Guidance for Superfund (RAGS) or EPA vapor intrusion guidance, which generally should not be changed.
**Lower explosive limit is the minimum concentration of the compound in air (% by volume) that is needed for the gas to ignite and explode.

Table 3.1

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future, Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Site 7	Aluminum	MG/KG	8.8E+03	9.7E+03	G	2.0E+04		9.7E+03	MG/KG	Adj. Gamma	1, 3
	Arsenic	MG/KG	2.3E+00	4.8E+00	NP	2.4E+01		4.8E+00	MG/KG	95% Cheb-m	4
	Chromium	MG/KG	1.1E+01	1.7E+01	NP	4.1E+01	J	1.7E+01	MG/KG	95% Cheb-m	4
	Cobalt	MG/KG	2.6E+00	2.8E+00	N	5.8E+00	J	2.8E+00	MG/KG	95% Mod-t	1
	Iron	MG/KG	1.0E+04	1.9E+04	NP	6.4E+04		1.9E+04	MG/KG	95% Cheb-m	4
	Manganese	MG/KG	1.0E+02	1.3E+02	G	4.7E+02	J	1.3E+02	MG/KG	Adj. Gamma	1, 3
	Thallium	MG/KG	6.0E-01	7.4E-01	NP	2.4E+00		7.4E-01	MG/KG	95% KM-Boot	1, 2, 3
	Vanadium	MG/KG	1.7E+01	2.5E+01	NP	6.3E+01	J	2.5E+01	MG/KG	95% Cheb-m	4

ProUCL, Version 5.0.00 used to determine distribution of data and calculate 95% UCL, following recommendations in users guide (USEPA. September 2013. Prepared by Lockheed Martin Environmental Services).

Options: 95% Adjusted Gamma UCL (Adj. Gamma); 95% Chebyshev (Mean-Sd) UCL (95% Cheb-m); 95% Modified-t UCL (95% Mod-t); 95% Kaplan-Meier (Percentile Bootstrap) UCL (95% KM-Boot)

UCL Rationale:

(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.

(3) Anderson-Darling and/or Kolmogorov-Smirnov Tests indicate data are gamma distributed.

(4) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).

G = Gamma, NP = Non-Parametric, N = Normal

J = Estimated Value, MG/KG = milligram per kilogram

Table 3.2

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future, Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Emissions from Site 7 Soil	Chromium	µg/m^3	8.1E-06	1.2E-05	NP	3.0E-05	J	1.2E-05	µg/m^3	95% Cheb-m	4

ProUCL, Version 5.0.00 used to determine distribution of data and calculate 95% UCL, following recommendations in users guide (USEPA. September 2013. Prepared by Lockheed Martin Environmental Services).
Options: 95% Chebyshev (Mean-Sd) UCL (95% Cheb-m)

UCL Rationale:
(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
(3) Anderson-Darling and/or Kolmogorov-Smirnov Tests indicate data are gamma distributed.
(4) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).

NP = Non-Parametric
J = Estimated Value, µg/m^3 = micrograms per cubic meter

Table 3.3

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Tap Water	Chloroform	UG/L	N/A	N/A		1.6E+00		1.6E+00	UG/L	Max	5
	cis-1,2-Dichloroethene	UG/L	1.3E+00	3.2E+00	NP	6.2E+00		3.2E+00	UG/L	95% KM-t	1, 2
	Trichloroethene	UG/L	8.2E+00	2.4E+01	NP	5.4E+01		2.4E+01	UG/L	95% KM-t	1, 2, 3
	2,4-Dinitrotoluene	UG/L	4.7E-01	8.7E-01	NP	1.1E+00		8.7E-01	UG/L	95% KM-t	1, 2, 3
	2,6-Dinitrotoluene	UG/L	N/A	N/A		3.9E-01		3.9E-01	UG/L	Max	5
	4,4'-DDD	UG/L	1.6E-02	3.2E-02	NP	4.0E-02	J	3.2E-02	UG/L	95% KM-t	4
	Nitroglycerin	UG/L	N/A	N/A		2.3E-01	J	2.3E-01	UG/L	Max	5
	Arsenic	UG/L	2.4E+00	3.9E+00	NP	4.3E+00		3.9E+00	UG/L	95% KM-t	4
	Cadmium	UG/L	9.8E-01	1.2E+00	N	1.2E+00	J	1.2E+00	UG/L	95% Stud-t	1, 2, 3
	Chromium	UG/L	1.7E+00	2.5E+00	NP	2.5E+00	J	2.5E+00	UG/L	95% KM-t	1, 2
	Cobalt	UG/L	2.7E+00	4.0E+00	NP	4.3E+00		4.0E+00	UG/L	95% KM-t	1, 2, 3
	Manganese	UG/L	8.3E+01	1.6E+02	N	2.2E+02		1.6E+02	UG/L	95% Stud-t	1, 2, 3

ProUCL, Version 5.0.00 used to determine distribution of data and calculate 95% UCL, following recommendations in users guide (USEPA. September 2013. Prepared by Lockheed Martin Environmental Services).
Options: Maximum Detected Value (Max); 95% Kaplan-Meier (t) UCL (95% KM-t); 95% Student's-T test UCL (95% Stud-t)

UCL Rationale:
(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
(3) Anderson-Darling and/or Kolmogorov-Smirnov Tests indicate data are gamma distributed.
(4) Not enough data to perform goodness of fit test.
(5) The maximum detected concentration was used because chemical detected in only one sample.

NP = Non-Parametric, N = Normal
J = Estimated Value, UG/L = micrograms per liter

Table 3.4

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)	Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Water Vapors at Showerhead	Chloroform	UG/L	N/A	N/A		1.6E+00	1.6E+00	UG/L	Max	5
	cis-1,2-Dichloroethene	UG/L	1.3E+00	3.2E+00	NP	6.2E+00	3.2E+00	UG/L	95% KM-t	1, 2
	Trichloroethene	UG/L	8.2E+00	2.4E+01	NP	5.4E+01	2.4E+01	UG/L	95% KM-t	1, 2, 3

ProUCL, Version 5.0.00 used to determine distribution of data and calculate 95% UCL, following recommendations in users guide (USEPA. September 2013. Prepared by Lockheed Martin Environmental Services).
Options: Maximum Detected Value (Max); 95% Kaplan-Meier (t) UCL (95% KM-t)

UCL Rationale:
(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
(3) Anderson-Darling and/or Kolmogorov-Smirnov Tests indicate data are gamma distributed.
(4) Not enough data to perform goodness of fit test.
(5) The maximum detected concentration was used because chemical detected in only one sample.

NP = Non-Parametric
UG/L = micrograms per liter

Table 3.5
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air (Residential)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Vapor Intrusion to Indoor Air	Chloroform	UG/L	N/A	N/A	1.6E+00	1.6E-04	mg/m^3	Max	1
	Trichloroethene	UG/L	8.2E+00	N/A	5.4E+01	1.3E-02	mg/m^3	Max	1

(1) The maximum detected concentration in groundwater will be used to calculate an indoor air concentration. Future on-site structures could be constructed above the contaminant plum
See Table 3.5 Supplement A.

UG/L = micrograms per liter
mg/m^3 = milligrams per cubic meter

TABLE 3.5 Supplement A

Calculation of Indoor Air Concentration from Groundwater

Reasonable Maximum Exposure

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Parameter	Symbol	Value
Henry's Law Constant	H	chem-specific
Empirical Attenuation Factor	alpha	1.0E-03

CAS	Chemical	Concentration in Groundwater (µg/L)	Henry's Law Constant (1)	Indoor Air Concentration (mg/m^3)
67-66-3	Chloroform	1.6E+00	9.8E-02	1.6E-04
79-01-6	Trichloroethene	5.4E+01	2.5E-01	1.3E-02

(1) Dimensionless Henry's Law Constant at System Temperature as shown on Table 3.5 Supplement B

C_{ia} (mg/m^3) = C_{gw} [µg/L] * H'_{TS} * α * 1000 L/m3 * 10 -3 mg/ug

where,

C_{ia} Indoor air concentration,

C_{gw} Groundwater concentration,

α Attenuation factor ([AF] default ratio of indoor air concentration to source vapor concentration; 1 x 10^{-3}), and

H'_{TS} Henry's law constant at system (groundwater) temperature (dimensionless)

Table 3.5 Supplement B
Chemical Properties for Supporting the VISL

CAS	Chemical of Potential Concern	Molecular Weight MW (g/mole)	source	Vapor Pressure VP (mm Hg)	source	Pure Component Water Solubility S (mg/L)	source	MCL (ug/L)	Henry's Law Constant @25°C Hc25 (atm-m^3/mol)	source	Henry's Law Constant @25°C[9] H'25 (unitless)	Henry's Law Constant @ Tgw[9] H'Tgw (unitless)	Henry's Law Constant Used in Calcs HLC (unitless)	Henry's Law Constant @ Tgw_GW[9] H'Tgw_GW (unitless)
67-66-3	Chloroform	119.38	a	1.97E+02	b	7.95E+03	a	80	3.67E-03	a	1.50E-01	9.80E-02	9.80E-02	1.50E-01
79-01-6	Trichloroethylene	131.39	a	6.90E+01	b	1.28E+03	a	5	9.85E-03	a	4.03E-01	2.49E-01	2.49E-01	4.03E-01

NOTE: Values not currently included in the chemical parameter Regional screening table (see footnote a) were derived following the hierarchy outlined in the Regional Screening Tables User's Guide.
Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm

a Based on values reported in the U.S. EPA Regional Screening Tables. May 2014.
Available online at: www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
b Experimental values. USEPA 2009. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.00. United States Environmental Protection Agency, Washington, DC, USA.
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c USEPA 1996. Soil Screening Guidance. Attachment C: Chemical Properties for SSL Development. EPA540/R-96/018. July, 1996.
d USEPA 2001. USEPA WATER9, Version 2.0. United States Environmental Protection Agency, Research Triangle Park, NC, USA.
Available online at: http://www.epa.gov/ttn/chief/software/water/index.html
e Syracuse Research Corporation (SRC). 2005. PHYSPROP Database. SRC. Syracuse, NY
Available online at: http://www.syrres.com/what-we-do/databaseforms.aspx?id=386
f CRC Handbook of Chemistry and Physics, 76th Edition
g National Institute of Standards and Technology (NIST). Chemistry WebBook.
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h USEPA, 2001. FACT SHEET Correcting the Henry's Law Constant for Soil Temperature. Attachment.
j Weast, Robert C. CRC Handbook of Chemistry and Physics 1984-1985, 65th edition. Pages F-62 through F-64.
k McKay, D., et al. Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals. Second Edition.
kk Chemical-specific MSDS
m These properties are not used for any calculations in the spreadsheet, but are included to maintain consistency with other spreadsheet tools that do use these properties
mm The Merck Index, 10th Edition
n United States National Library of Medicine. National Institutes of Health. TOXNET Toxicology Data Network.
Available online at: http://toxnet.nlm.nih.gov/
nn Weiss, G. Hazardous Chemicals Data Book, Second Edition, Noyes Data Corporation, 1986.
p DECHEMA Web Database, March 2003.
q No chemical property information available for this chemical, although toxicity data are available.
r California Environmental Protection Agency. Consumer Products Solvents Database. Entry for "Aromatic 150". 2004.
Available online at: http://www.arb.ca.gov/db/solvents/solvents.htm
s Calculated as average of m-xylene, o-xylene, and p-xylene isomers.
v Approximated using Tcrit = 1.5 x Tboil.

Table 3.6

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air (Industrial)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Vapor Intrusion to Indoor Air	Trichloroethene	UG/L	8.2E+00	N/A	5.4E+01	1.3E-02	mg/m^3	Max	1

(1) The maximum detected concentration in groundwater will be used to calculate an indoor air concentration. Future on-site structures could be constructed above the contaminant plum
See Table 3.5 Supplement A.

UG/L = micrograms per liter

Table 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker/ Landscaper	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	50	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	
		Adolescent	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	9	years	(3)	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	54	kg	EPA, 2011 (4)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
Dermal	Maintenance Worker/ Landscaper	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,470	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.12	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	50	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

Table 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	6,032	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	20	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	
		Adolescent	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,757	cm^2	EPA, 2011 (5)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm^2-day	EPA, 2004 (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	9	years	(3)	
				BW	Body Weight	54	kg	EPA, 2011 (4)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Notes:

(1) Professional judgment assuming 1 day per week throughout the year, with 2 weeks of vacation.

(2) Professional judgment assuming 2 day per week for 26 weeks per year.

(3) Professional judgment assuming adolescents from 9 to 18 years of age.

(4) Body weight is average of the mean values for boys and girls for the ages 9 through 18.

(5) Surface area includes face, forearms, hands, and lower legs for children 9-18 year old.

(6) Soil to skin adherence factor is 95th percentile adherence factor for soccer players #1 (age 13-15 years).

Sources:

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TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Maintenance Worker/ Landscaper	Adult	Emissions from Site 7 Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
				CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	8	hr/day	EPA, 2014	
				EF	Exposure Frequency	50	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser	Adult	Emissions from Site 7 Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
				CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	4	hr/day	(2)	
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	
		Adolescent	Emissions from Site 7 Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
				CA	Chemical Concentration in Air	See Table 3.2	mg/m3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	4	hr/day	(2)	
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	9	years	(3)	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

(1) Professional judgment assuming 1 day per week throughout the year, with 2 weeks of vacation.

(2) Professional judgment assuming 2 day per week for 26 weeks per year, and 4 hours per day.

(3) Professional judgment assuming adolescents from 9 to 18 years of age.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

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EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6.

Table 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreator	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	
		Adolescent	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	54	kg	EPA, 2011 (3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
	Resident	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	

Table 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S-A	Ingestion Rate of Soil, Adult	100	mg/day	EPA, 2014	CS x IR-S-Adj x EF x CF1 x 1/AT
				IR-S-C	Ingestion Rate of Soil, Child	200	mg/day	EPA, 2014	
				IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	105	mg-year/kg-day	Calculated	IR-S-Adj (mg-year/kg-day) =
				EF	Exposure Frequency	350	days/year	EPA, 2014	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
				ED-A	Exposure Duration, Adult	20	years	EPA, 2014	
				ED-C	Exposure Duration, Child	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW-A	Body Weight , Adult	80	kg	EPA, 2014	
				BW-C	Body Weight, Child	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 2014	
				ED	Exposure Duration	25	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Construction Worker	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	330	mg/day	EPA, 2002	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	125	days/year	VDEQ, 2003	
				ED	Exposure Duration	1	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

Table 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreator	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	6,032	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	20	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	
		Adolescent	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,757	cm^2	EPA, 2011 (4)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm^2-day	EPA, 2004 (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				BW	Body Weight	54	kg	EPA, 2011 (3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Site 7	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,690	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 2014	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

Table 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	6,032	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	20	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	
	Resident	Child	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,690	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA-A	Skin Surface Area Available for Contact, Adult	6,032	cm^2	EPA, 2014	CS x DA-Adj x DABS x CF1 x EF x 1/AT
				SA-C	Skin Surface Area Available for Contact, Child	2,690	cm^2	EPA, 2014	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.07	mg/cm^2-day	EPA, 2014	DA-Adj (mg-year/kg-day) =
				SSAF-C	Soil to Skin Adherence Factor, Child	0.2	mg/cm^2-day	EPA, 2014	(ED-C x SA-C x SSAF-C / BW-C)
				DA-Adj	Dermal Absorption, Age-adjusted	321	mg-year/kg-day	Calculated	+ (ED-A x SA-A x SSAF-A / BW-A)
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED-A	Exposure Duration, Adult	20	years	EPA, 2014	
				ED-C	Exposure Duration, Child	6	years	EPA, 2014	
				BW-A	Body Weight , Adult	80	kg	EPA, 2014	
				BW-C	Body Weight, Child	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Table 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Industrial Worker	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,470	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.12	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/year	EPA, 2014	
				ED	Exposure Duration	25	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Construction Worker	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,470	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.12	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	125	days/year	VDEQ, 2003	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

Notes:

(1) Professional judgment assuming 2 day per week for 26 weeks per year.

(2) Professional judgment assuming adolescents from 9 to 18 years of age.

(3) Body weight is average of the mean values for boys and girls for the ages 9 through 18.

(4) Surface area includes face, forearms, hands, and lower legs for children 9-18 year old.

(5) Soil to skin adherence factor is 95th percentile adherence factor for soccer players #1 (age 13-15 years).

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

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VDEQ, 2003: Virginia Department of Environmental Quality, Voluntary Remediation Program Risk Assessment Guidance. December.

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreator	Adult	Emissions from Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
			Soil	CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	4	hr/day	(1)	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	
		Adolescent	Emissions from Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
			Soil	CA	Chemical Concentration in Air	See Table 3.2	mg/m3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	4	hr/day	(1)	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Emissions from Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
			Soil	CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	4	hr/day	(1)	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
	Resident	Adult	Emissions from Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
			Soil	CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	24	hour/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 1989	

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	Emissions from Site 7 Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
				CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF)
				ET	Exposure Time	24	hour/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Emissions from Site 7 Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m3) =
				CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	24	hr/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	26	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Emissions from Site 7 Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
				CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m3) = CS (1/PEF)
				ET	Exposure Time	8	hr/day	EPA, 2014	
				EF	Exposure Frequency	250	days/year	EPA, 2014	
				ED	Exposure Duration	25	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Construction Worker	Adult	Emissions from Site 7 Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
				CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF)
				ET	Exposure Time	8	hr/day	EPA, 2014	
				EF	Exposure Frequency	125	days/year	VDEQ, 2003	
				ED	Exposure Duration	1	years	EPA, 1991	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

(1) Professional judgment assuming 2 day per week for 26 weeks per year, and 4 hours per day.

(2) Professional judgment assuming adolescents from 9 to 18 years of age.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6.

VDEQ, 2003: Virginia Department of Environmental Quality, Voluntary Remediation Program Risk Assessment Guidance. December.

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2.5	liters/day	EPA, 2014	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 2014	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	0.78	liters/day	EPA, 2014	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	2.5	liters/day	EPA, 2014	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	0.78	liters/day	EPA, 2014	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.94	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kg-day) =
				EF	Exposure Frequency	350	days/year	EPA, 2014	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	20	years	EPA, 2014	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	80	kg	EPA, 2014	
				BW-C	Body Weight, Child	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1.25	liters/day	EPA, 2014 (1)	CW x IR-W x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 2014	
				ED	Exposure Duration	25	years	EPA, 2014	
				CF	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical-specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical-specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical-specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1x CF2
				t*	Time to Reach Steady-state	Chemical-specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical-specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.71	hr/event	EPA, 2014	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	20,900	cm^2	EPA, 2014	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	20	years	EPA, 2014	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	80	kg	EPA, 2014	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 2014	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical-specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical-specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical-specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1x CF2
				t*	Time to Reach Steady-state	Chemical-specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical-specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.54	hr/event	EPA, 2014	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,378	cm^2	EPA, 2014	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 2014	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (cont'd)	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	Calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	Calculated	mg/cm^2-event	calculated	DA-Adj = (DAevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	Calculated	mg-year/event-kg	calculated	+ (DAevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	Chemical-specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical-specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical-specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	Chemical-specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical-specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.71	hr/event	EPA, 2014	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.54	hr/event	EPA, 2014	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	20,900	cm^2	EPA, 2014	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,378	cm^2	EPA, 2014	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2014	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	20	years	EPA, 2014	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2014	
				BW-A	Body Weight, Adult	80	kg	EPA, 2014	
				BW-C	Body Weight, Child	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

(1) One-half of residential water ingestion rate, based on USEPA 1991 and water ingestion rate from USEPA 2014.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 2004 . Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6.

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Water Vapors at Showerhead	CW	Chemical Concentration in Water	Table 3.4	µg/l	Table 3.4	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x EF x ED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration , Adult	20	years	EPA, 2014	Use Foster & Chrostowski Shower model to
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	calculate CAa
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 2014	

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6.

TABLE 4.7.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Indoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Vapor Intrusion to Indoor Air	CW	Chemical Concentration in Water	Table 3.5	mg/m^3	Table 3.5	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	24	hr/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hour	- -	CA calculated using an attenuation factor and Henry's Law Constant at site groundwater temperature (refer to Table 3.5 Supplement A).
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	EPA, 2014	
		Child	Vapor Intrusion to Indoor Air	CW	Chemical Concentration in Water	Table 3.5	mg/m^3	Table 3.5	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	24	hr/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hour	- -	CA calculated using an attenuation factor and Henry's Law Constant at site groundwater temperature (refer to Table 3.5 Supplement A).
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 2014	
		Child/Adult	Vapor Intrusion to Indoor Air	CW	Chemical Concentration in Water	Table 3.5	mg/m^3	Table 3.5	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	24	hr/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	26	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hour	- -	CA calculated using an attenuation factor and Henry's Law Constant at site groundwater temperature (refer to Table 3.5 Supplement A).
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Vapor Intrusion to Indoor Air	CW	Chemical Concentration in Water	Table 3.6	mg/m^3	Table 3.6	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	8	hr/day	EPA, 2014	
				EF	Exposure Frequency	250	days/year	EPA, 2014	
				ED	Exposure Duration	25	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hour	- -	CA calculated using an attenuation factor and Henry's Law Constant at site groundwater temperature (refer to Table 3.5 Supplement A).
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 2014	

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6.

Table 4.1.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	20	mg/day	EPA, 2011 (1)	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2011 (2)	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	47	mg/day	EPA, 2011 (3)	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S-A	Ingestion Rate of Soil, Adult	20	mg/day	EPA, 2011 (1)	CS x IR-S-Adj x EF x CF1 x 1/AT
				IR-S-C	Ingestion Rate of Soil, Child	47	mg/day	EPA, 2011 (3)	
				IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	21	mg-year/kg-day	Calculated	IR-S-Adj (mg-year/kg-day) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
				ED-A	Exposure Duration, Adult	9	years	EPA, 2011 (2)	
				ED-C	Exposure Duration, Child	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW-A	Body Weight , Adult	80	kg	EPA, 2014	
				BW-C	Body Weight, Child	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	219	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Table 4.1.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	6,032	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2011 (2)	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,690	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2014	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	CDI (mg/kg-day) =
				SA-A	Skin Surface Area Available for Contact, Adult	6,032	cm^2	EPA, 2014	CS x DA-Adj x DABS x CF1 x EF x 1/AT
				SA-C	Skin Surface Area Available for Contact, Child	2,690	cm^2	EPA, 2014	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.01	mg/cm^2-day	EPA, 2004	DA-Adj (mg-year/kg-day) =
				SSAF-C	Soil to Skin Adherence Factor, Child	0.04	mg/cm^2-day	EPA, 2004	
				DA-Adj	Dermal Absorption, Age-adjusted	50	mg-year/kg-day	Calculated	(ED-C x SA-C x SSAF-C / BW-C) + (ED-A x SA-A x SSAF-A / BW-A)
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED-A	Exposure Duration, Adult	9	years	EPA, 2011 (2)	
				ED-C	Exposure Duration, Child	6	years	EPA, 2014	
				BW-A	Body Weight , Adult	80	kg	EPA, 2014	
				BW-C	Body Weight, Child	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Table 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Industrial Worker	Adult	Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	CDI (mg/kg-day) =
(cont'd)				SA	Skin Surface Area Available for Contact	3,470	cm^2	EPA, 2014	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.02	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	219	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2004	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Notes:

(1) Table 5-1, general population central tendency value for adult.

(2) Table 16-108, 50th percentile value for both sexes.

(3) Table 5-1, calculated using the general population central tendency values for birth to <6 years, based on time-weighted average, as follows: ((11 months x 30 mg/day)+(60 months x 50 mg/day))/71 months

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure, Draft.

EPA, 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July 2004.

EPA, 2011. Exposure Factors Handbook: 2011 Edition. National Center for Environmental Assessment, Washington, DC; EPA/600/R-09/052F.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6, 2014.

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Emissions from Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
			Soil	CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF)
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ET	Exposure Time	24	hour/day	EPA, 2014	
				ED	Exposure Duration	9	years	EPA, 2011 (1)	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Emissions from Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
			Soil	CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF)
				ET	Exposure Time	24	hour/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Emissions from Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m3) =
			Soil	CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF)
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ET	Exposure Time	24	hr/day	EPA, 2014	
				ED	Exposure Duration	15	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Emissions from Site 7	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
			Soil	CA	Chemical Concentration in Air	See Table 3.2	mg/m^3	See Table 3.2	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emissions Factor	1.36E+09	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF)
				ET	Exposure Time	8	hr/day	EPA, 2014	
				EF	Exposure Frequency	219	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2004	
				CF	Conversion Factor	1/24	day/hr	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

(1) Table 16-108, 50th percentile value for both sexes.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

EPA, 2011. Exposure Factors Handbook: 2011 Edition. National Center for Environmental Assessment, Washington, DC; EPA/600/R-09/052F.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6, 2014.

TABLE 4.3.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	0.99	liters/day	EPA, 2011 (1)	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2011 (2)	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 2014	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	0.31	liters/day	EPA, 2011 (3)	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	0.99	liters/day	EPA, 2011 (1)	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	0.31	liters/day	EPA, 2011 (3)	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.24	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	9	years	EPA, 2011 (2)	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 2014	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	80	kg	EPA, 2014	
				BW-C	Body Weight, Child	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	0.5	liters/day	EPA, 2014 (4)	CW x IR-W x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	219	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2004	
				CF	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical-specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical-specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical-specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1x CF2
				t*	Time to Reach Steady-state	Chemical-specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical-specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.28	hr/event	EPA, 2011 (5)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	20,900	cm^2	EPA, 2014	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2011 (2)	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	80	kg	EPA, 2014	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 2014	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical-specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical-specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical-specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	Chemical-specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical-specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.37	hr/event	EPA, 2011 (6)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,378	cm^2	EPA, 2014	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2014	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 2014	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (cont'd)	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.3	µg/l	See Table 3.3	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	Calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	Calculated	mg/cm^2-event	calculated	DA-Adj = (DAevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	Calculated	mg-year/event-kg	calculated	+ (DAevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	Chemical-specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical-specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical-specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	Chemical-specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical-specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.28	hr/event	EPA, 2011 (5)	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.37	hr/event	EPA, 2011 (6)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	20,900	cm^2	EPA, 2014	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,378	cm^2	EPA, 2014	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	9	years	EPA, 2011 (2)	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2014	
				BW-A	Body Weight, Adult	80	kg	EPA, 2014	
				BW-C	Body Weight, Child	15	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

(1) 50th percentile consumer only ingestion value of drinking water from Table 3-33 (> 21 years) from EPA 2011.

(2) Table 16-108 from EPA 2011, 50th percentile value for both sexes.

(3) Weighted average of 50th percentile consumer only ingestion values from Table 3-15 and 3-33 (birth to < 6 years) from EPA 2011.

(4) Assumes half ingestion rate of resident adult.

(5) Table 16-1 from EPA 2011, mean value for time spent bathing/showering (ages 18 years and older). 17 minutes/day divided by 60 minutes/hour.

(6) Table 16-1 from EPA 2011, mean value for time spent bathing (birth to <6 years). 22 minutes/day divided by 60 minutes/hour.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 2004 . Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July.

EPA, 2011. Exposure Factors Handbook: 2011 Edition. National Center for Environmental Assessment, Washington, DC; EPA/600/R-09/052F.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6.

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Water Vapors at Showerhead	CW	Chemical Concentration in Water	Table 3.4	µg/l	Table 3.4	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x EF x ED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration , Adult	9	years	EPA, 2011 (1)	Use Foster & Chrostowski Shower model to
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	calculate CAa
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 2014	

(1) Table 16-108 from EPA 2011, 50th percentile value for both sexes.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 2011. Exposure Factors Handbook: 2011 Edition. National Center for Environmental Assessment, Washington, DC; EPA/600/R-09/052F.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6.

TABLE 4.5.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Indoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Vapor Intrusion to Indoor Air	CW	Chemical Concentration in Water	Table 3.5	mg/m^3	Table 3.5	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	24	hr/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	9	years	EPA, 2011 (1)	
				CF	Conversion Factor	1/24	day/hour	- -	CA calculated using an attenuation factor and Henry's Law Constant at site groundwater temperature (refer to Table 3.5 Supplement A).
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 2014	
		Child	Vapor Intrusion to Indoor Air	CW	Chemical Concentration in Water	Table 3.5	mg/m^3	Table 3.5	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	24	hr/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF	Conversion Factor	1/24	day/hour	- -	CA calculated using an attenuation factor and Henry's Law Constant at site groundwater temperature (refer to Table 3.5 Supplement A).
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 2014	
		Child/Adult	Vapor Intrusion to Indoor Air	CW	Chemical Concentration in Water	Table 3.5	mg/m^3	Table 3.5	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	24	hr/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	9	years	EPA, 2011 (1)	
				CF	Conversion Factor	1/24	day/hour	- -	CA calculated using an attenuation factor and Henry's Law Constant at site groundwater temperature (refer to Table 3.5 Supplement A).
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Vapor Intrusion to Indoor Air	CW	Chemical Concentration in Water	Table 3.6	mg/m^3	Table 3.6	Chronic Daily Intake (CDI) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	Calculated	CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	8	hr/day	EPA, 2014	
				EF	Exposure Frequency	219	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2004	
				CF	Conversion Factor	1/24	day/hour	- -	CA calculated using an attenuation factor and Henry's Law Constant at site groundwater temperature (refer to Table 3.5 Supplement A).
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 2014	

TABLE 4.5.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Indoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

(1) Table 16-108 from EPA 2011, 50th percentile value for both sexes.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 2004 . Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July.

EPA, 2011. Exposure Factors Handbook: 2011 Edition. National Center for Environmental Assessment, Washington, DC; EPA/600/R-09/052F.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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 (MM/DD/YY)
Chloroform	Chronic	1.0E-02	mg/kg-day	>50%	1.0E-02	mg/kg-day	Liver	100	IRIS	8/7/2014
	Subchronic	1.0E-01	mg/kg-day	>50%	1.0E-01	mg/kg-day	Liver	100	ATSDR	9/1997
cis-1,2-Dichloroethene	Chronic	2.0E-03	mg/kg-day	>50%	2.0E-03	mg/kg-day	Kidney	3000	IRIS	08/07/14
	Subchronic	2.0E-02	mg/kg-day	>50%	2.0E-02	mg/kg-day	Kidney	300	PPRTV	2/3/2011
Trichloroethene	Chronic	5.0E-04	mg/kg-day	>50%	5.0E-04	mg/kg-day	Immune System, Developmental, Heart	multiple	IRIS	08/07/14
	Subchronic	N/A			N/A					
2,4-Dinitrotoluene	Chronic	2.0E-03	mg/kg-day	>50%	2.0E-03	mg/kg-day	Neurological, Blood, billiary tract	100	IRIS	8/7/2014
	Subchronic	7.0E-03	mg/kg-day	>50%	7.0E-03	mg/kg-day	Blood	100	ATSDR	4/2013
2,6-Dinitrotoluene	Chronic	3.0E-04	mg/kg-day	>50%	3.0E-04	mg/kg-day	Spleen	10,000	PPRTV	4/10/2103
	Subchronic	3.0E-03	mg/kg-day	>50%	3.0E-03	mg/kg-day	Spleen	1,000	PPRTV	4/10/2103
4,4'-DDD	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Nitroglycerin	Chronic	1.0E-04	mg/kg-day	>50%	1.0E-04	mg/kg-day	Blood	300	PPRTV	8/22/2006
	Subchronic	1.0E-04	mg/kg-day	>50%	1.0E-04	mg/kg-day	Blood	300	PPRTV	8/22/2006
Aluminum	Chronic	1.0E+00	mg/kg-day	N/A	1.0E+00	mg/kg-day	Neurological	100	PPRTV	10/23/2006
	Subchronic	1.0E+00	mg/kg-day	N/A	1.0E+00	mg/kg-day	Neurological	30	ATSDR	9/2008
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3/1	IRIS	8/7/2014
	Subchronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3	HEAST	7/1997
Cadmium (water)	Chronic	5.0E-04	mg/kg-day	5%	2.5E-05	mg/kg-day	Proteinuria (Kidney)	10	IRIS	8/7/2014
	Subchronic	N/A			N/A					
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	NOE	300/1	IRIS	8/7/2014
	Subchronic	5.0E-03	mg/kg-day	2.5%	1.3E-04	mg/kg-day	Blood	100	ATSDR	9/2012
Cobalt	Chronic	3.0E-04	mg/kg-day	N/A	3.0E-04	mg/kg/day	Thyroid	3000	PPRTV	8/25/2008
	Subchronic	3.0E-03	mg/kg-day	N/A	3.0E-03	mg/kg/day	Thyroid	300	PPRTV	8/25/2008
Iron	Chronic	7.0E-01	mg/kg/day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1.5	PPRTV	9/11/2006
	Subchronic	7.0E-01	mg/kg/day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1.5	PPRTV	9/11/2006
Manganese (non-diet)	Chronic	2.4E-02	mg/kg-day	4%	9.6E-04	mg/kg-day	Neurological	1/1	IRIS	8/7/2014
	Subchronic	N/A			N/A					
Thallium	Chronic	1.0E-05	mg/kg-day	100%	1.0E-05	mg/kg-day	Hair	3000	PPRTV	10/25/12
	Subchronic	4.0E-05	mg/kg-day	100%	4.0E-05	mg/kg-day	Hair	1000	PPRTV	10/25/12
Vanadium	Chronic	5.0E-03	mg/kg-day	2.6%	1.3E-04	mg/kg-day	Hair	300	RSL/IRIS	08/07/14
	Subchronic	1.0E-02	mg/kg-day	2.6%	2.6E-04	mg/kg-day	Blood	10	ATSDR	9/2012

Notes:

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table or on the RSL table were assumed to have an oral absorption efficiency of 100%.

(2) Adjusted based on RAGS Part E. (Dermal RfD = Oral RfD x oral absorption efficiency)

Definitions:
ATSDR = Agency for Toxic Substances and Disease Registry
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
N/A = Not Available
NOE = No Observed Effects
PPRTV = Provisional Peer-Reviewed Toxicity Value
RSL = USEPA Regional Screening Level Table

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

AOC 1 South, Scrap Metals Dump - Expanded Site Inspection

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (MM/DD/YY)
Chloroform	Chronic	9.8E-02	mg/m^3	Liver	100	ATSDR	9/1997
	Subchronic	2.4E-01	mg/m^3	Liver	300	ATSDR	9/1997
cis-1,2-Dichloroethene	Chronic	N/A					
	Subchronic	N/A					
Trichloroethene	Chronic	2.0E-03	mg/m^3	Immunotoxicity, Heart	multiple	IRIS	08/07/14
	Subchronic	NA	N/A	N/A	N/A	N/A	N/A
Chromium (hexavalent)	Chronic	1.0E-04	mg/m^3	Respiratory System	300	IRIS	08/07/14
	Subchronic	3.0E-04	mg/m^3	Respiratory System	30	ATSDR	9/2012

Definitions:

ATSDR = Agency for Toxic Substances & Disease Registry Minimal Risk Levels

IRIS = Integrated Risk Information System

N/A = Not Available

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

AOC 1 South, Scrap Metals Dump - Expanded Site Inspection

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	EPA Carcinogen Group	Source	Date (MM/DD/YY)
Chloroform	3.1E-02	>50%	3.1E-02	$(mg/kg\text{-}day)^{-1}$	B2	CalEPA	8/07/2014
cis-1,2-Dichloroethene	N/A		N/A				
Trichloroethene (4)	4.6E-02	>50%	4.6E-02	$(mg/kg\text{-}day)^{-1}$	Carcinogenic	IRIS	8/07/2014
Trichloroethene (Kidney) (3)	9.3E-03	>50%	9.3E-03	$(mg/kg\text{-}day)^{-1}$	Carcinogenic	IRIS	8/07/2014
Trichloroethene (NHL+Liver)	3.7E-02	>50%	3.7E-02	$(mg/kg\text{-}day)^{-1}$	Carcinogenic	IRIS	8/07/2014
2,4-Dinitrotoluene	3.1E-01	>50%	3.1E-01	$(mg/kg\text{-}day)^{-1}$	2B	CalEPA	8/07/2014
2,6-Dinitrotoluene	1.5E+00	>50%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	SU	PPRTV	4/10/2013
4,4'-DDD	2.4E-01	>50%	2.4E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	8/7/2014
Nitroglycerin	1.7E-02	>50%	1.7E-02	$(mg/kg\text{-}day)^{-1}$	LI	PPRTV	8/22/2006
Aluminum	N/A		N/A				
Antimony	N/A		N/A				
Arsenic	1.5E+00	95%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	8/07/2014
Cadmium (water)	N/A		N/A				
Chromium (hexavalent) (3)	5.0E-01	2.5%	2.0E+01	$(mg/kg\text{-}day)^{-1}$	D	NJ DEP	4/8/2009
Cobalt	N/A		N/A				
Copper	N/A		N/A				
Iron	N/A		N/A				
Manganese	N/A		N/A				
Thallium	N/A		N/A				
Vanadium	N/A		N/A				

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Section 4.2 and Exhibit 4-1. USEPA recommends that the oral slope factor should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table or on the RSL table were assumed to have an oral absorption efficiency of 100%.

(2) Adjusted based on RAGS Part E. (Dermal CSF = Oral CSF / oral absorption efficiency)

(3) This chemical operates with a mutagenic mode of action.
Chemical-specific data are not available; therefore, default age-dependent adjustment factors (ADAF) will be applied to the slope factor as follows:

AGE	AGE ADAF	EXPOSURE DURATION
0-<2	10	2
2-<6	3	4
6-<16	3	10
16-<26	1	10

Definitions:
CalEPA = California Environmental Protection Agency
IRIS = Integrated Risk Information System
N/A = Not Available
NCEA = National Center for Environmental Assessment
NJ DEP = New Jersey Department of Environmental Protection
PPRTV = Provisional Peer-Reviewed Toxicity Value

Weight of Evidence definitions:
2B: The agent is possibly carcinogenic to humans
Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.

Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.

Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

SU = suggestive evidence of carcinogenicity in humans.

LI = Likely to be carcinogenic to humans.

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

AOC 1 South, Scrap Metals Dump - Expanded Site Inspection

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Unit Risk	Units	Weight of Evidence/ Cancer Guidance Description	Source	Date (MM/DD/YY)
Chloroform	2.3E-05	$(\mu g/m^3)^{-1}$	B2	IRIS	8/07/2014
cis-1,2-Dichloroethene	N/A				
Trichloroethene (1)	4.1E-06	$(\mu g/m^3)^{-1}$	Carcinogenic	IRIS	8/07/2014
Trichloroethene (Kidney) (2)	1.0E-06	$(\mu g/m^3)^{-1}$	Carcinogenic	IRIS	8/07/2014
Trichloroethene (NHL+Liver)	3.1E-06	$(\mu g/m^3)^{-1}$	Carcinogenic	IRIS	8/07/2014
Chromium (hexavalent) (2)	8.4E-02	$(ug/m^3)^{-1}$	A	IRIS	8/07/2014

Definitions: IRIS = Integrated Risk Information System

(1) EPA has concluded, by a weight of evidence evaluation, that TCE is carcinogenic by a mutagenic mode of action for induction of kidney tumors. As a result, increased early-life susceptibility is assumed for kidney cancer and the age-dependent adjustment factors (ADAFs) were used for the kidney cancer component of the total cancer risk when estimating age-specific cancer risks. Cancer risk estimates will also account for non-Hodgkins Lymphoma (NHL) and liver contribution.

(2) This chemical operates with a mutagenic mode of action (USEPA 2005). Chemical-specific data are not available; therefore, USEPA (2005) default age-dependent adjustment factors (ADAF) will be applied to the slope factor as follows:

AGE	AGE ADAF	EXPOSURE DURATION
0-<2	10	2
2-<6	3	4
2-<16	3	10
16-<26	1	10

Weight of Evidence definitions:

Group A - Human Carcinogen

Group B2 - Probable Human Carcinogen

Carcinogenic : Carcinogenic to human beings

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Receptor Population: Maintenance Worker/Landscaper
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	5.9E-04	mg/kg-day	N/A		N/A	1.7E-03	mg/kg-day	1.0E+00	mg/kg-day	1.7E-03
				Arsenic	4.8E+00	mg/kg	2.9E-07	mg/kg-day	1.5E+00	1/mg/kg-day	4.4E-07	8.2E-07	mg/kg-day	3.0E-04	mg/kg-day	2.7E-03
				Chromium	1.7E+01	mg/kg	1.0E-06	mg/kg-day	5.0E-01	1/mg/kg-day	5.0E-07	2.8E-06	mg/kg-day	3.0E-03	mg/kg-day	9.4E-04
				Cobalt	2.8E+00	mg/kg	1.7E-07	mg/kg-day	N/A		N/A	4.8E-07	mg/kg-day	3.0E-04	mg/kg-day	1.6E-03
				Iron	1.9E+04	mg/kg	1.2E-03	mg/kg-day	N/A		N/A	3.2E-03	mg/kg-day	7.0E-01	mg/kg-day	4.6E-03
				Manganese	1.3E+02	mg/kg	8.2E-06	mg/kg-day	N/A		N/A	2.3E-05	mg/kg-day	2.4E-02	mg/kg-day	9.6E-04
				Thallium	7.4E-01	mg/kg	4.5E-08	mg/kg-day	N/A		N/A	1.3E-07	mg/kg-day	1.0E-05	mg/kg-day	1.3E-02
				Vanadium	2.5E+01	mg/kg	1.5E-06	mg/kg-day	N/A		N/A	4.3E-06	mg/kg-day	5.0E-03	mg/kg-day	8.6E-04
			Exp. Route Total								9.4E-07					2.6E-02
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	2.5E-05	mg/kg-day	N/A		N/A	6.9E-05	mg/kg-day	1.0E+00	mg/kg-day	6.9E-05
				Arsenic	4.8E+00	mg/kg	3.6E-08	mg/kg-day	1.5E+00	1/mg/kg-day	5.5E-08	1.0E-07	mg/kg-day	3.0E-04	mg/kg-day	3.4E-04
				Chromium	1.7E+01	mg/kg	4.2E-08	mg/kg-day	2.0E+01	1/mg/kg-day	8.4E-07	1.2E-07	mg/kg-day	7.5E-05	mg/kg-day	1.6E-03
				Cobalt	2.8E+00	mg/kg	7.2E-09	mg/kg-day	N/A		N/A	2.0E-08	mg/kg-day	3.0E-04	mg/kg-day	6.7E-05
				Iron	1.9E+04	mg/kg	4.8E-05	mg/kg-day	N/A		N/A	1.4E-04	mg/kg-day	7.0E-01	mg/kg-day	1.9E-04
				Manganese	1.3E+02	mg/kg	3.4E-07	mg/kg-day	N/A		N/A	9.6E-07	mg/kg-day	9.6E-04	mg/kg-day	1.0E-03
				Thallium	7.4E-01	mg/kg	1.9E-09	mg/kg-day	N/A		N/A	5.2E-09	mg/kg-day	1.0E-05	mg/kg-day	5.2E-04
				Vanadium	2.5E+01	mg/kg	6.4E-08	mg/kg-day	N/A		N/A	1.8E-07	mg/kg-day	1.3E-04	mg/kg-day	1.4E-03
			Exp. Route Total								9.0E-07					5.1E-03
		Exposure Point Total									1.8E-06					3.1E-02
	Exposure Medium Total										1.8E-06					3.1E-02
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	µg/m^3	2.0E-07	µg/m^3	8.4E-02	(µg/m^3)$^{-1}$	1.7E-08	5.5E-10	mg/m^3	1.0E-04	mg/m^3	5.5E-06
			Exp. Route Total								1.7E-08					5.5E-06
		Exposure Point Total									1.7E-08					5.5E-06
	Exposure Medium Total										1.7E-08					5.5E-06
Soil Total											1.9E-06					3.1E-02
							Total of Receptor Risks Across All Media				1.9E-06	Total of Receptor Hazards Across All Media				3.1E-02

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	4.9E-04	mg/kg-day	N/A		N/A	1.7E-03	mg/kg-day	1.0E+00	mg/kg-day	1.7E-03
				Arsenic	4.8E+00	mg/kg	2.4E-07	mg/kg-day	1.5E+00	1/mg/kg-day	3.6E-07	8.5E-07	mg/kg-day	3.0E-04	mg/kg-day	2.8E-03
				Chromium	1.7E+01	mg/kg	8.4E-07	mg/kg-day	5.0E-01	1/mg/kg-day	4.2E-07	2.9E-06	mg/kg-day	3.0E-03	mg/kg-day	9.8E-04
				Cobalt	2.8E+00	mg/kg	1.4E-07	mg/kg-day	N/A		N/A	5.0E-07	mg/kg-day	3.0E-04	mg/kg-day	1.7E-03
				Iron	1.9E+04	mg/kg	9.6E-04	mg/kg-day	N/A		N/A	3.4E-03	mg/kg-day	7.0E-01	mg/kg-day	4.8E-03
				Manganese	1.3E+02	mg/kg	6.8E-06	mg/kg-day	N/A		N/A	2.4E-05	mg/kg-day	2.4E-02	mg/kg-day	1.0E-03
				Thallium	7.4E-01	mg/kg	3.7E-08	mg/kg-day	N/A		N/A	1.3E-07	mg/kg-day	1.0E-05	mg/kg-day	1.3E-02
				Vanadium	2.5E+01	mg/kg	1.3E-06	mg/kg-day	N/A		N/A	4.5E-06	mg/kg-day	5.0E-03	mg/kg-day	9.0E-04
			Exp. Route Total								7.8E-07					2.7E-02
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	2.1E-05	mg/kg-day	N/A		N/A	7.3E-05	mg/kg-day	1.0E+00	mg/kg-day	7.3E-05
				Arsenic	4.8E+00	mg/kg	3.1E-08	mg/kg-day	1.5E+00	1/mg/kg-day	4.6E-08	1.1E-07	mg/kg-day	3.0E-04	mg/kg-day	3.6E-04
				Chromium	1.7E+01	mg/kg	3.5E-08	mg/kg-day	2.0E+01	1/mg/kg-day	7.1E-07	1.2E-07	mg/kg-day	7.5E-05	mg/kg-day	1.7E-03
				Cobalt	2.8E+00	mg/kg	6.1E-09	mg/kg-day	N/A		N/A	2.1E-08	mg/kg-day	3.0E-04	mg/kg-day	7.1E-05
				Iron	1.9E+04	mg/kg	4.1E-05	mg/kg-day	N/A		N/A	1.4E-04	mg/kg-day	7.0E-01	mg/kg-day	2.0E-04
				Manganese	1.3E+02	mg/kg	2.9E-07	mg/kg-day	N/A		N/A	1.0E-06	mg/kg-day	9.6E-04	mg/kg-day	1.1E-03
				Thallium	7.4E-01	mg/kg	1.6E-09	mg/kg-day	N/A		N/A	5.5E-09	mg/kg-day	1.0E-05	mg/kg-day	5.5E-04
				Vanadium	2.5E+01	mg/kg	5.4E-08	mg/kg-day	N/A		N/A	1.9E-07	mg/kg-day	1.3E-04	mg/kg-day	1.5E-03
			Exp. Route Total								7.6E-07					5.4E-03
		Exposure Point Total									1.5E-06					3.2E-02
	Exposure Medium Total										1.5E-06					3.2E-02
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	$\mu g/m^3$	8.2E-08	$\mu g/m^3$	8.4E-02	$(\mu g/m^3)^{-1}$	6.9E-09	2.9E-10	mg/m^3	1.0E-04	mg/m^3	2.9E-06
			Exp. Route Total								6.9E-09					2.9E-06
		Exposure Point Total									6.9E-09					2.9E-06
	Exposure Medium Total										6.9E-09					2.9E-06
Soil Total											1.5E-06					3.2E-02
							Total of Receptor Risks Across All Media				1.5E-06	Total of Receptor Hazards Across All Media				3.2E-02

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	3.3E-04	mg/kg-day	N/A		N/A	2.6E-03	mg/kg-day	1.0E+00	mg/kg-day	2.6E-03
				Arsenic	4.8E+00	mg/kg	1.6E-07	mg/kg-day	1.5E+00	1/mg/kg-day	2.4E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg-day	4.2E-03
				Chromium[2]	1.7E+01	mg/kg	5.6E-07	mg/kg-day	1.5E+00	1/mg/kg-day	8.4E-07	4.4E-06	mg/kg-day	3.0E-03	mg/kg-day	1.5E-03
				Cobalt	2.8E+00	mg/kg	9.6E-08	mg/kg-day	N/A		N/A	7.5E-07	mg/kg-day	3.0E-04	mg/kg-day	2.5E-03
				Iron	1.9E+04	mg/kg	6.4E-04	mg/kg-day	N/A		N/A	5.0E-03	mg/kg-day	7.0E-01	mg/kg-day	7.1E-03
				Manganese	1.3E+02	mg/kg	4.6E-06	mg/kg-day	N/A		N/A	3.5E-05	mg/kg-day	2.4E-02	mg/kg-day	1.5E-03
				Thallium	7.4E-01	mg/kg	2.5E-08	mg/kg-day	N/A		N/A	1.9E-07	mg/kg-day	1.0E-05	mg/kg-day	1.9E-02
				Vanadium	2.5E+01	mg/kg	8.5E-07	mg/kg-day	N/A		N/A	6.6E-06	mg/kg-day	5.0E-03	mg/kg-day	1.3E-03
			Exp. Route Total								1.1E-06					4.0E-02
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	3.7E-05	mg/kg-day	N/A		N/A	2.9E-04	mg/kg-day	1.0E+00	mg/kg-day	2.9E-04
				Arsenic	4.8E+00	mg/kg	5.5E-08	mg/kg-day	1.5E+00	1/mg/kg-day	8.2E-08	4.2E-07	mg/kg-day	3.0E-04	mg/kg-day	1.4E-03
				Chromium[2]	1.7E+01	mg/kg	6.3E-08	mg/kg-day	6.0E+01	1/mg/kg-day	3.8E-06	4.9E-07	mg/kg-day	7.5E-05	mg/kg-day	6.5E-03
				Cobalt	2.8E+00	mg/kg	1.1E-08	mg/kg-day	N/A		N/A	8.4E-08	mg/kg-day	3.0E-04	mg/kg-day	2.8E-04
				Iron	1.9E+04	mg/kg	7.2E-05	mg/kg-day	N/A		N/A	5.6E-04	mg/kg-day	7.0E-01	mg/kg-day	8.1E-04
				Manganese	1.3E+02	mg/kg	5.1E-07	mg/kg-day	N/A		N/A	4.0E-06	mg/kg-day	9.6E-04	mg/kg-day	4.2E-03
				Thallium	7.4E-01	mg/kg	2.8E-09	mg/kg-day	N/A		N/A	2.2E-08	mg/kg-day	1.0E-05	mg/kg-day	2.2E-03
				Vanadium	2.5E+01	mg/kg	9.6E-08	mg/kg-day	N/A		N/A	7.5E-07	mg/kg-day	1.3E-04	mg/kg-day	5.8E-03
			Exp. Route Total								3.9E-06					2.1E-02
		Exposure Point Total									5.0E-06					6.1E-02
	Exposure Medium Total										5.0E-06					6.1E-02
	Air	Emissions from Site 7 Soil	Inhalation	Chromium[2]	1.2E-05	µg/m^3	3.7E-08	µg/m^3	2.5E-01	(µg/m^3)$^{-1}$	9.3E-09	2.9E-10	mg/m^3	1.0E-04	mg/m^3	2.9E-06
			Exp. Route Total								9.3E-09					2.9E-06
		Exposure Point Total									9.3E-09					2.9E-06
	Exposure Medium Total										9.3E-09					2.9E-06
Soil Total											5.0E-06					6.1E-02
							Total of Receptor Risks Across All Media				5.0E-06	Total of Receptor Hazards Across All Media				6.1E-02

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

[2] Chemical acts via a MMOA. Therefore, CSF and Unit Risk are adjusted by an age-dependent adjustment factor of 3.

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	4.9E-04	mg/kg-day	N/A		N/A	1.7E-03	mg/kg-day	1.0E+00	mg/kg-day	1.7E-03
				Arsenic	4.8E+00	mg/kg	2.4E-07	mg/kg-day	1.5E+00	1/mg/kg-day	3.6E-07	8.5E-07	mg/kg-day	3.0E-04	mg/kg-day	2.8E-03
				Chromium	1.7E+01	mg/kg	8.4E-07	mg/kg-day	5.0E-01	1/mg/kg-day	4.2E-07	2.9E-06	mg/kg-day	3.0E-03	mg/kg-day	9.8E-04
				Cobalt	2.8E+00	mg/kg	1.4E-07	mg/kg-day	N/A		N/A	5.0E-07	mg/kg-day	3.0E-04	mg/kg-day	1.7E-03
				Iron	1.9E+04	mg/kg	9.6E-04	mg/kg-day	N/A		N/A	3.4E-03	mg/kg-day	7.0E-01	mg/kg-day	4.8E-03
				Manganese	1.3E+02	mg/kg	6.8E-06	mg/kg-day	N/A		N/A	2.4E-05	mg/kg-day	2.4E-02	mg/kg-day	1.0E-03
				Thallium	7.4E-01	mg/kg	3.7E-08	mg/kg-day	N/A		N/A	1.3E-07	mg/kg-day	1.0E-05	mg/kg-day	1.3E-02
				Vanadium	2.5E+01	mg/kg	1.3E-06	mg/kg-day	N/A		N/A	4.5E-06	mg/kg-day	5.0E-03	mg/kg-day	9.0E-04
			Exp. Route Total								7.8E-07					2.7E-02
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	2.1E-05	mg/kg-day	N/A		N/A	7.3E-05	mg/kg-day	1.0E+00	mg/kg-day	7.3E-05
				Arsenic	4.8E+00	mg/kg	3.1E-08	mg/kg-day	1.5E+00	1/mg/kg-day	4.6E-08	1.1E-07	mg/kg-day	3.0E-04	mg/kg-day	3.6E-04
				Chromium	1.7E+01	mg/kg	3.5E-08	mg/kg-day	2.0E+01	1/mg/kg-day	7.1E-07	1.2E-07	mg/kg-day	7.5E-05	mg/kg-day	1.7E-03
				Cobalt	2.8E+00	mg/kg	6.1E-09	mg/kg-day	N/A		N/A	2.1E-08	mg/kg-day	3.0E-04	mg/kg-day	7.1E-05
				Iron	1.9E+04	mg/kg	4.1E-05	mg/kg-day	N/A		N/A	1.4E-04	mg/kg-day	7.0E-01	mg/kg-day	2.0E-04
				Manganese	1.3E+02	mg/kg	2.9E-07	mg/kg-day	N/A		N/A	1.0E-06	mg/kg-day	9.6E-04	mg/kg-day	1.1E-03
				Thallium	7.4E-01	mg/kg	1.6E-09	mg/kg-day	N/A		N/A	5.5E-09	mg/kg-day	1.0E-05	mg/kg-day	5.5E-04
				Vanadium	2.5E+01	mg/kg	5.4E-08	mg/kg-day	N/A		N/A	1.9E-07	mg/kg-day	1.3E-04	mg/kg-day	1.5E-03
			Exp. Route Total								7.6E-07					5.4E-03
		Exposure Point Total									1.5E-06					3.2E-02
	Exposure Medium Total										1.5E-06					3.2E-02
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	$\mu g/m^3$	8.2E-08	$\mu g/m^3$	8.4E-02	$(\mu g/m^3)^{-1}$	6.9E-09	2.9E-10	mg/m^3	1.0E-04	mg/m^3	2.9E-06
			Exp. Route Total								6.9E-09					2.9E-06
		Exposure Point Total									6.9E-09					2.9E-06
	Exposure Medium Total										6.9E-09					2.9E-06
Soil Total											1.5E-06					3.2E-02
							Total of Receptor Risks Across All Media				1.5E-06	Total of Receptor Hazards Across All Media				3.2E-02

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

TABLE 7.5.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	3.3E-04	mg/kg-day	N/A		N/A	2.6E-03	mg/kg-day	1.0E+00	mg/kg-day	2.6E-03
				Arsenic	4.8E+00	mg/kg	1.6E-07	mg/kg-day	1.5E+00	1/mg/kg-day	2.4E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg-day	4.2E-03
				Chromium[2]	1.7E+01	mg/kg	5.6E-07	mg/kg-day	1.5E+00	1/mg/kg-day	8.4E-07	4.4E-06	mg/kg-day	3.0E-03	mg/kg-day	1.5E-03
				Cobalt	2.8E+00	mg/kg	9.6E-08	mg/kg-day	N/A		N/A	7.5E-07	mg/kg-day	3.0E-04	mg/kg-day	2.5E-03
				Iron	1.9E+04	mg/kg	6.4E-04	mg/kg-day	N/A		N/A	5.0E-03	mg/kg-day	7.0E-01	mg/kg-day	7.1E-03
				Manganese	1.3E+02	mg/kg	4.6E-06	mg/kg-day	N/A		N/A	3.5E-05	mg/kg-day	2.4E-02	mg/kg-day	1.5E-03
				Thallium	7.4E-01	mg/kg	2.5E-08	mg/kg-day	N/A		N/A	1.9E-07	mg/kg-day	1.0E-05	mg/kg-day	1.9E-02
				Vanadium	2.5E+01	mg/kg	8.5E-07	mg/kg-day	N/A		N/A	6.6E-06	mg/kg-day	5.0E-03	mg/kg-day	1.3E-03
			Exp. Route Total								1.1E-06					4.0E-02
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	3.7E-05	mg/kg-day	N/A		N/A	2.9E-04	mg/kg-day	1.0E+00	mg/kg-day	2.9E-04
				Arsenic	4.8E+00	mg/kg	5.5E-08	mg/kg-day	1.5E+00	1/mg/kg-day	8.2E-08	4.2E-07	mg/kg-day	3.0E-04	mg/kg-day	1.4E-03
				Chromium[2]	1.7E+01	mg/kg	6.3E-08	mg/kg-day	6.0E+01	1/mg/kg-day	3.8E-06	4.9E-07	mg/kg-day	7.5E-05	mg/kg-day	6.5E-03
				Cobalt	2.8E+00	mg/kg	1.1E-08	mg/kg-day	N/A		N/A	8.4E-08	mg/kg-day	3.0E-04	mg/kg-day	2.8E-04
				Iron	1.9E+04	mg/kg	7.2E-05	mg/kg-day	N/A		N/A	5.6E-04	mg/kg-day	7.0E-01	mg/kg-day	8.1E-04
				Manganese	1.3E+02	mg/kg	5.1E-07	mg/kg-day	N/A		N/A	4.0E-06	mg/kg-day	9.6E-04	mg/kg-day	4.2E-03
				Thallium	7.4E-01	mg/kg	2.8E-09	mg/kg-day	N/A		N/A	2.2E-08	mg/kg-day	1.0E-05	mg/kg-day	2.2E-03
				Vanadium	2.5E+01	mg/kg	9.6E-08	mg/kg-day	N/A		N/A	7.5E-07	mg/kg-day	1.3E-04	mg/kg-day	5.8E-03
			Exp. Route Total								3.9E-06					2.1E-02
		Exposure Point Total									5.0E-06					6.1E-02
	Exposure Medium Total										5.0E-06					6.1E-02
	Air	Emissions from Site 7 Soil	Inhalation	Chromium[2]	1.2E-05	µg/m^3	3.7E-08	µg/m^3	2.5E-01	(µg/m^3)$^{-1}$	9.3E-09	2.9E-10	mg/m^3	1.0E-04	mg/m^3	2.9E-06
			Exp. Route Total								9.3E-09					2.9E-06
		Exposure Point Total									9.3E-09					2.9E-06
	Exposure Medium Total										9.3E-09					2.9E-06
Soil Total											5.0E-06					6.1E-02
							Total of Receptor Risks Across All Media				5.0E-06	Total of Receptor Hazards Across All Media				6.1E-02

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

[2] Chemical acts via a MMOA. Therefore, CSF and Unit Risk are adjusted by an age-dependent adjustment factor of 3.

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	1.6E-03	mg/kg-day	N/A		N/A	1.8E-02	mg/kg-day	1.0E+00	mg/kg-day	1.8E-02
				Arsenic	4.8E+00	mg/kg	7.8E-07	mg/kg-day	1.5E+00	1/mg/kg-day	1.2E-06	9.0E-06	mg/kg-day	3.0E-04	mg/kg-day	3.0E-02
				Chromium[2]	1.7E+01	mg/kg			5.0E-01	1/mg/kg-day	7.2E-06	3.1E-05	mg/kg-day	3.0E-03	mg/kg-day	1.0E-02
				Cobalt	2.8E+00	mg/kg	4.6E-07	mg/kg-day	N/A		N/A	5.4E-06	mg/kg-day	3.0E-04	mg/kg-day	1.8E-02
				Iron	1.9E+04	mg/kg	3.1E-03	mg/kg-day	N/A		N/A	3.6E-02	mg/kg-day	7.0E-01	mg/kg-day	5.1E-02
				Manganese	1.3E+02	mg/kg	2.2E-05	mg/kg-day	N/A		N/A	2.5E-04	mg/kg-day	2.4E-02	mg/kg-day	1.1E-02
				Thallium	7.4E-01	mg/kg	1.2E-07	mg/kg-day	N/A		N/A	1.4E-06	mg/kg-day	1.0E-05	mg/kg-day	1.4E-01
				Vanadium	2.5E+01	mg/kg	4.1E-06	mg/kg-day	N/A		N/A	4.8E-05	mg/kg-day	5.0E-03	mg/kg-day	9.6E-03
			Exp. Route Total								8.3E-06					2.9E-01
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	4.2E-05	mg/kg-day	N/A		N/A	4.9E-04	mg/kg-day	1.0E+00	mg/kg-day	4.9E-04
				Arsenic	4.8E+00	mg/kg	6.3E-08	mg/kg-day	1.5E+00	1/mg/kg-day	9.4E-08	7.3E-07	mg/kg-day	3.0E-04	mg/kg-day	2.4E-03
				Chromium[2]	1.7E+01	mg/kg			2.0E+01	1/mg/kg-day	7.7E-06	8.4E-07	mg/kg-day	7.5E-05	mg/kg-day	1.1E-02
				Cobalt	2.8E+00	mg/kg	1.2E-08	mg/kg-day	N/A		N/A	1.4E-07	mg/kg-day	3.0E-04	mg/kg-day	4.8E-04
				Iron	1.9E+04	mg/kg	8.3E-05	mg/kg-day	N/A		N/A	9.7E-04	mg/kg-day	7.0E-01	mg/kg-day	1.4E-03
				Manganese	1.3E+02	mg/kg	5.9E-07	mg/kg-day	N/A		N/A	6.9E-06	mg/kg-day	9.6E-04	mg/kg-day	7.1E-03
				Thallium	7.4E-01	mg/kg	3.2E-09	mg/kg-day	N/A		N/A	3.8E-08	mg/kg-day	1.0E-05	mg/kg-day	3.8E-03
				Vanadium	2.5E+01	mg/kg	1.1E-07	mg/kg-day	N/A		N/A	1.3E-06	mg/kg-day	1.3E-04	mg/kg-day	9.9E-03
			Exp. Route Total								7.8E-06					3.7E-02
		Exposure Point Total									1.6E-05					3.3E-01
	Exposure Medium Total										1.6E-05					3.3E-01
	Air	Emissions from Site 7 Soil	Inhalation	Chromium[2]	1.2E-05	µg/m^3			8.4E-02	(µg/m^3)$^{-1}$	1.1E-08	2.9E-10	mg/m^3	1.0E-04	mg/m^3	2.9E-06
			Exp. Route Total								1.1E-08					2.9E-06
		Exposure Point Total									1.1E-08					2.9E-06
	Exposure Medium Total										1.1E-08					2.9E-06
Soil Total											1.6E-05					3.3E-01
							Total of Receptor Risks Across All Media				1.6E-05	Total of Receptor Hazards Across All Media				3.3E-01

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

[2] See Table 7.6.RME Supplement A for calculation of intake and cancer risk following MMOA method.

TABLE 7.6.RME Supplement A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations						
							Intake			CSF/Unit Risk			Cancer Risk
					Value	Units	Value		Units	Value		Units	
							0-2 yrs	2-6 yrs		0-2 yrs (ADAF=10)	2-6 yrs (ADAF=3)		
Soil	Soil	Site 7	Ingestion	Chromium	1.7E+01	mg/kg	9.0E-07	1.8E-06	mg/kg-day	5.0E+00	1.5E+00	1/(mg/kg-day)	7.2E-06
			Dermal	Chromium	1.7E+01	mg/kg	2.4E-08	4.8E-08	mg/kg-day	2.0E+02	6.0E+01	1/(mg/kg-day)	7.7E-06
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	ug/m^3	8.2E-09	1.6E-08	ug/m^3	8.4E-01	2.5E-01	$1/(ug/m^3)$	1.1E-08

Cancer risk = $(Intake_{0-2} \times CSF_{0-2}) + (Intake_{2-6} \times CSF_{2-6})$

Notes:
ADAF = Age-dependent adjustment factor
CSF = Cancer slope factor
EPC = Exposure point concentration
mg/kg = milligram per kilogram
mg/kg/day = milligram per kilogram per day
ug/m^3 = micrograms per cubic meter

TABLE 7.7.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	N/A		N/A		N/A	1.2E-02	mg/kg/day	1.0E+00	mg/kg/day	1.2E-02
				Arsenic	4.8E+00	mg/kg	N/A		N/A		N/A	5.7E-06	mg/kg/day	3.0E-04	mg/kg/day	1.9E-02
				Chromium	1.7E+01	mg/kg	N/A		N/A		N/A	2.0E-05	mg/kg/day	3.0E-03	mg/kg/day	6.6E-03
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	3.4E-06	mg/kg/day	3.0E-04	mg/kg/day	1.1E-02
				Iron	1.9E+04	mg/kg	N/A		N/A		N/A	2.3E-02	mg/kg/day	7.0E-01	mg/kg/day	3.2E-02
				Manganese	1.3E+02	mg/kg	N/A		N/A		N/A	1.6E-04	mg/kg/day	2.4E-02	mg/kg/day	6.7E-03
				Thallium	7.4E-01	mg/kg	N/A		N/A		N/A	8.8E-07	mg/kg/day	1.0E-05	mg/kg/day	8.8E-02
				Vanadium	2.5E+01	mg/kg	N/A		N/A		N/A	3.0E-05	mg/kg/day	5.0E-03	mg/kg/day	6.0E-03
			Exp. Route Total								N/A					1.8E-01
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	N/A		N/A		N/A	4.9E-04	mg/kg/day	1.0E+00	mg/kg/day	4.9E-04
				Arsenic	4.8E+00	mg/kg	N/A		N/A		N/A	7.2E-07	mg/kg/day	3.0E-04	mg/kg/day	2.4E-03
				Chromium	1.7E+01	mg/kg	N/A		N/A		N/A	8.4E-07	mg/kg/day	7.5E-05	mg/kg/day	1.1E-02
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	1.4E-07	mg/kg/day	3.0E-04	mg/kg/day	4.8E-04
				Iron	1.9E+04	mg/kg	N/A		N/A		N/A	9.6E-04	mg/kg/day	7.0E-01	mg/kg/day	1.4E-03
				Manganese	1.3E+02	mg/kg	N/A		N/A		N/A	6.8E-06	mg/kg/day	9.6E-04	mg/kg/day	7.1E-03
				Thallium	7.4E-01	mg/kg	N/A		N/A		N/A	3.7E-08	mg/kg/day	1.0E-05	mg/kg/day	3.7E-03
				Vanadium	2.5E+01	mg/kg	N/A		N/A		N/A	1.3E-06	mg/kg/day	1.3E-04	mg/kg/day	9.8E-03
			Exp. Route Total								N/A					3.6E-02
		Exposure Point Total									N/A					2.2E-01
	Exposure Medium Total										N/A					2.2E-01
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	µg/m^3	N/A		N/A		N/A	1.2E-08	mg/m^3	1.0E-04	mg/m^3	1.2E-04
			Exp. Route Total								N/A					1.2E-04
		Exposure Point Total									N/A					1.2E-04
	Exposure Medium Total										N/A					1.2E-04
Soil Total											N/A					2.2E-01
Groundwater	Groundwater	Tap Water	Ingestion	Chloroform	1.6E+00	ug/L	N/A		N/A		N/A	4.8E-05	mg/kg/day	1.0E-02	mg/kg/day	4.8E-03
				cis-1,2-Dichloroethene	3.2E+00	ug/L	N/A		N/A		N/A	9.6E-05	mg/kg/day	2.0E-03	mg/kg/day	4.8E-02
				Trichloroethene	2.4E+01	ug/L	N/A		N/A		N/A	7.2E-04	mg/kg/day	5.0E-04	mg/kg/day	1.4E+00
				2,4-Dinitrotoluene	8.7E-01	ug/L	N/A		N/A		N/A	2.6E-05	mg/kg/day	2.0E-03	mg/kg/day	1.3E-02
				2,6-Dinitrotoluene	3.9E-01	ug/L	N/A		N/A		N/A	1.2E-05	mg/kg/day	3.0E-04	mg/kg/day	3.9E-02
				4,4'-DDD	3.2E-02	ug/L	N/A		N/A		N/A	9.6E-07	mg/kg/day	N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	N/A		N/A		N/A	6.9E-06	mg/kg/day	1.0E-04	mg/kg/day	6.9E-02
				Arsenic	3.9E+00	ug/L	N/A		N/A		N/A	1.2E-04	mg/kg/day	3.0E-04	mg/kg/day	3.9E-01
				Cadmium	1.2E+00	ug/L	N/A		N/A		N/A	3.5E-05	mg/kg/day	5.0E-04	mg/kg/day	6.9E-02
				Chromium	2.5E+00	ug/L	N/A		N/A		N/A	7.5E-05	mg/kg/day	3.0E-03	mg/kg/day	2.5E-02
				Cobalt	4.0E+00	ug/L	N/A		N/A		N/A	1.2E-04	mg/kg/day	3.0E-04	mg/kg/day	4.0E-01
				Manganese	1.6E+02	ug/L	N/A		N/A		N/A	4.7E-03	mg/kg/day	2.4E-02	mg/kg/day	2.0E-01
			Exp. Route Total								N/A					2.7E+00
			Dermal Absorption[2]	Chloroform	1.6E+00	ug/L	N/A		N/A		N/A	4.5E-06	mg/kg/day	1.0E-02	mg/kg/day	4.5E-04
				cis-1,2-Dichloroethene	3.2E+00	ug/L	N/A		N/A		N/A	8.7E-06	mg/kg/day	2.0E-03	mg/kg/day	4.3E-03
				Trichloroethene	2.4E+01	ug/L	N/A		N/A		N/A	1.2E-04	mg/kg/day	5.0E-04	mg/kg/day	2.5E-01
				2,4-Dinitrotoluene	8.7E-01	ug/L	N/A		N/A		N/A	1.7E-06	mg/kg/day	2.0E-03	mg/kg/day	8.3E-04
				2,6-Dinitrotoluene	3.9E-01	ug/L	N/A		N/A		N/A	5.1E-07	mg/kg/day	3.0E-04	mg/kg/day	1.7E-03
				4,4'-DDD	3.2E-02	ug/L	N/A		N/A		N/A	6.9E-06	mg/kg/day	N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	N/A		N/A		N/A	1.9E-07	mg/kg/day	1.0E-04	mg/kg/day	1.9E-03
				Arsenic	3.9E+00	ug/L	N/A		N/A		N/A	7.0E-07	mg/kg/day	3.0E-04	mg/kg/day	2.3E-03

TABLE 7.7.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater (cont'd)	Groundwater	Tap Water	Dermal Absorption[2]	Cadmium	1.2E+00	ug/L	N/A		N/A		N/A	2.1E-07	mg/kg/day	2.5E-05	mg/kg/day	8.2E-03
				Chromium	2.5E+00	ug/L	N/A		N/A		N/A	4.4E-07	mg/kg/day	7.5E-05	mg/kg/day	5.9E-03
				Cobalt	4.0E+00	ug/L	N/A		N/A		N/A	2.8E-07	mg/kg/day	3.0E-04	mg/kg/day	9.4E-04
				Manganese	1.6E+02	ug/L	N/A		N/A		N/A	2.8E-05	mg/kg/day	9.6E-04	mg/kg/day	2.9E-02
			Exp. Route Total								N/A					3.0E-01
		Exposure Point Total									N/A					3.0E+00
	Exposure Medium Total										N/A					3.0E+00
	Air	Water Vapors at Showerhead[3]	Inhalation	Chloroform	1.3E-04	mg/m^3	N/A		N/A		N/A	1.3E-04	mg/m^3	9.8E-02	mg/m^3	1.3E-03
				cis-1,2-Dichloroethene	2.9E-04	mg/m^3	N/A		N/A		N/A	2.8E-04	mg/m^3	N/A		N/A
				Trichloroethene	2.0E-03	mg/m^3	N/A		N/A		N/A	1.9E-03	mg/m^3	2.0E-03	mg/m^3	9.4E-01
			Exp. Route Total								N/A					9.4E-01
		Exposure Point Total									N/A					9.4E-01
		Vapor Intrusion into Indoor Air	Inhalation	Chloroform	1.6E-04	mg/m^3	N/A		N/A		N/A	1.5E-04	mg/m^3	9.8E-02	mg/m^3	1.5E-03
				Trichloroethene	1.3E-02	mg/m^3	N/A		N/A		N/A	1.3E-02	mg/m^3	2.0E-03	mg/m^3	6.4E+00
			Exp. Route Total								N/A					6.4E+00
		Exposure Point Total									N/A					6.4E+00
	Exposure Medium Total										N/A					7.4E+00
Groundwater Total											N/A					1.0E+01
										Total of Receptor Risk	N/A				Total of Receptor Hazard	1.1E+01

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABS of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

[2] DAevent for exposure to groundwater calculated on Table 7.7.RME Supplement A.

[3] Inhalation exposure for groundwater while showering calculated on Table 7.7.RME Supplement C.

Table 7.7.RME Supplement A
Calculation of DAevent - Resident Adult
Reasonable Maximum Exposure
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	1.6E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.71	1.8E-08	2
cis-1,2-Dichloroethene[1]	3.2E+00	7.7E-03	2.9E-02	3.7E-01	8.8E-01	1.0E+00	0.71	3.5E-08	2
Trichloroethene	2.4E+01	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	0.71	4.9E-07	2
2,4-Dinitrotoluene	8.7E-01	3.1E-03	1.6E-02	1.1E+00	2.7E+00	1.0E+00	0.71	6.6E-09	2
2,6-Dinitrotoluene	3.9E-01	2.1E-03	1.1E-02	1.1E+00	2.7E+00	1.0E+00	0.71	2.0E-09	2
4,4'-DDD	3.2E-02	1.8E-01	1.2E+00	6.6E+00	2.6E+01	8.0E-01	0.71	2.8E-08	2
Nitroglycerin[1]	2.3E-01	1.0E-03	5.8E-03	2.0E+00	4.7E+00	1.0E+00	0.71	7.5E-10	2
Arsenic	3.9E+00	1.0E-03	N/A	N/A	N/A	N/A	0.71	2.8E-09	1
Cadmium	1.2E+00	1.0E-03	N/A	N/A	N/A	N/A	0.71	8.2E-10	1
Chromium	2.5E+00	1.0E-03	N/A	N/A	N/A	N/A	0.71	1.8E-09	1
Cobalt	4.0E+00	4.0E-04	N/A	N/A	N/A	N/A	0.71	1.1E-09	1
Manganese	1.6E+02	1.0E-03	N/A	N/A	N/A	N/A	0.71	1.1E-07	1

Notes:

[1] Kp, B, lag time and t* values calculated on Table 7.7 Supplement B

N/A - Not applicable

All parameter values except water concentrations and duration of event from EPA 2004,*Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default permeability coefficient value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

Inorganics: DAevent (mg/cm2-event) =

Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Table 7.7.RME Supplement B
Calculation of Permeability Constants
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	MW[a]	log Kow[a]	Kow	log Kp[b]	Kp (cm/hr)	B[b]	log D_{sc}/l_{sc}[b]	D_{sc}/l_{sc}[b]	l_{sc} (cm)	D_{sc} (cm^2/hr)	τ_{event}[b] (hr)	t*[b] (hr)
cis-1,2-Dichloroethene	9.7E+01	1.9E+00	7.2E+01	-2.1E+00	7.7E-03	2.9E-02	-3.3E+00	4.5E-04	1.0E-03	4.5E-07	3.7E-01	8.8E-01
Nitroglycerin	2.3E+02	1.6E+00	4.2E+01	-3.0E+00	1.0E-03	5.8E-03	-4.1E+00	8.5E-05	1.0E-03	8.5E-08	2.0E+00	4.7E+00

[a] Values obtained from the Risk Assessment Information System (RAIS, 2014)

[b] Equations from Risk Assessment Guidance for Superfund Volume 1; Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment, EPA/540/R/99/005. July 2004).

Table 7.7.RME Supplement C

Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model

Adult Resident

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Exposure Point Concentration Cwo (µg/L)	Molecular weight (MW) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl (VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (µg/L)	S (µg/m^3 -min)	Ca (mg/m^3)
Chloroform	1.6E+00	1.2E+02	3.7E-03	1.2E+03	1.2E+01	1.1E+01	1.5E+01	1.9E-01	1.6E-01	1.3E-04
cis-1,2-Dichloroethene	3.2E+00	9.7E+01	4.1E-03	1.3E+03	1.3E+01	1.3E+01	1.7E+01	4.3E-01	3.5E-01	2.9E-04
Trichloroethene	2.4E+01	1.3E+02	9.9E-03	1.1E+03	1.2E+01	1.1E+01	1.5E+01	2.9E+00	2.4E+00	2.0E-03

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	centipoise	1.002
Cwd = conc. leaving droplets after time sdt	µg/l	Solved by Eq 5
sdt = shower droplet drop time	sec	0.5
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	10
SV = shower room air volume	m^3	12
S = indoor VOC generation rate	µg/m^3-min	Solved by Eq 6
Ds = duration of shower	min	42.6
Dt = total duration in shower room	min	60
R = air exchange rate	min^{-1}	0.01667
Ca = indoor air concentration of VOCs	mg/m^3	Solved by Eq 7

Equation 1:	Kg(VOC) =	3000 * (18 / MW)$^{0.5}$
Equation 2:	Kl(VOC) =	20 * (44 / MW)$^{0.5}$
Equation 3:	KL =	((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))$^{-1}$
Equation 4:	Kal =	(KL * (((Tl * Us) / (Ts * Ul))$^{-0.5}$))
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))
Equation 6:	S =	(Cwd * FR / SV)
Equation 7:	Ca =	If t>Ds [(S / R) * (Ds + (EXP(-R * Dt) / R)-(EXP(R *(Ds - Dt)) / R)] * 1/1440 min/day * 1/1000 ug/mg

Notes:

MW and Henry's Law Constant from Oak Ridge National Laboratory (ORNL). May 2014. [Online]. Available: http://epa-prgs.ornl.gov/chemicals/index.shtml

TABLE 7.8.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	N/A		N/A		N/A	1.2E-01	mg/kg/day	1.0E+00	mg/kg/day	1.2E-01
				Arsenic	4.8E+00	mg/kg	N/A		N/A		N/A	6.1E-05	mg/kg/day	3.0E-04	mg/kg/day	2.0E-01
				Chromium	1.7E+01	mg/kg	N/A		N/A		N/A	2.1E-04	mg/kg/day	3.0E-03	mg/kg/day	7.0E-02
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	3.6E-05	mg/kg/day	3.0E-04	mg/kg/day	1.2E-01
				Iron	1.9E+04	mg/kg	N/A		N/A		N/A	2.4E-01	mg/kg/day	7.0E-01	mg/kg/day	3.5E-01
				Manganese	1.3E+02	mg/kg	N/A		N/A		N/A	1.7E-03	mg/kg/day	2.4E-02	mg/kg/day	7.1E-02
				Thallium	7.4E-01	mg/kg	N/A		N/A		N/A	9.4E-06	mg/kg/day	1.0E-05	mg/kg/day	9.4E-01
				Vanadium	2.5E+01	mg/kg	N/A		N/A		N/A	3.2E-04	mg/kg/day	5.0E-03	mg/kg/day	6.4E-02
			Exp. Route Total								N/A					1.9E+00
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	N/A		N/A		N/A	3.3E-03	mg/kg/day	1.0E+00	mg/kg/day	3.3E-03
				Arsenic	4.8E+00	mg/kg	N/A		N/A		N/A	4.9E-06	mg/kg/day	3.0E-04	mg/kg/day	1.6E-02
				Chromium	1.7E+01	mg/kg	N/A		N/A		N/A	5.7E-06	mg/kg/day	7.5E-05	mg/kg/day	7.6E-02
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	9.7E-07	mg/kg/day	3.0E-04	mg/kg/day	3.2E-03
				Iron	1.9E+04	mg/kg	N/A		N/A		N/A	6.5E-03	mg/kg/day	7.0E-01	mg/kg/day	9.3E-03
				Manganese	1.3E+02	mg/kg	N/A		N/A		N/A	4.6E-05	mg/kg/day	9.6E-04	mg/kg/day	4.8E-02
				Thallium	7.4E-01	mg/kg	N/A		N/A		N/A	2.5E-07	mg/kg/day	1.0E-05	mg/kg/day	2.5E-02
				Vanadium	2.5E+01	mg/kg	N/A		N/A		N/A	8.7E-06	mg/kg/day	1.3E-04	mg/kg/day	6.7E-02
			Exp. Route Total								N/A					2.5E-01
		Exposure Point Total									N/A					2.2E+00
	Exposure Medium Total										N/A					2.2E+00
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	µg/m^3	N/A		N/A		N/A	1.2E-08	mg/m^3	1.0E-04	mg/m^3	1.2E-04
			Exp. Route Total								N/A					1.2E-04
		Exposure Point Total									N/A					1.2E-04
	Exposure Medium Total										N/A					1.2E-04
Soil Total											N/A					2.2E+00
Groundwater	Groundwater	Tap Water	Ingestion	Chloroform	1.6E+00	ug/L	N/A		N/A		N/A	8.0E-05	mg/kg/day	1.0E-02	mg/kg/day	8.0E-03
				cis-1,2-Dichloroethene	3.2E+00	ug/L	N/A		N/A		N/A	1.6E-04	mg/kg/day	2.0E-03	mg/kg/day	8.0E-02
				Trichloroethene	2.4E+01	ug/L	N/A		N/A		N/A	1.2E-03	mg/kg/day	5.0E-04	mg/kg/day	2.4E+00
				2,4-Dinitrotoluene	8.7E-01	ug/L	N/A		N/A		N/A	4.4E-05	mg/kg/day	2.0E-03	mg/kg/day	2.2E-02
				2,6-Dinitrotoluene	3.9E-01	ug/L	N/A		N/A		N/A	1.9E-05	mg/kg/day	3.0E-04	mg/kg/day	6.5E-02
				4,4'-DDD	3.2E-02	ug/L	N/A		N/A		N/A	1.6E-06	mg/kg/day	N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	N/A		N/A		N/A	1.2E-05	mg/kg/day	1.0E-04	mg/kg/day	1.2E-01
				Arsenic	3.9E+00	ug/L	N/A		N/A		N/A	2.0E-04	mg/kg/day	3.0E-04	mg/kg/day	6.5E-01
				Cadmium	1.2E+00	ug/L	N/A		N/A		N/A	5.8E-05	mg/kg/day	5.0E-04	mg/kg/day	1.2E-01
				Chromium	2.5E+00	ug/L	N/A		N/A		N/A	1.2E-04	mg/kg/day	3.0E-03	mg/kg/day	4.1E-02
				Cobalt	4.0E+00	ug/L	N/A		N/A		N/A	2.0E-04	mg/kg/day	3.0E-04	mg/kg/day	6.6E-01
				Manganese	1.6E+02	ug/L	N/A		N/A		N/A	7.8E-03	mg/kg/day	2.4E-02	mg/kg/day	3.2E-01
			Exp. Route Total								N/A					4.5E+00
			Dermal Absorption[2]	Chloroform	1.6E+00	ug/L	N/A		N/A		N/A	6.4E-06	mg/kg/day	1.0E-02	mg/kg/day	6.4E-04
				cis-1,2-Dichloroethene	3.2E+00	ug/L	N/A		N/A		N/A	1.2E-05	mg/kg/day	2.0E-03	mg/kg/day	6.2E-03
				Trichloroethene	2.4E+01	ug/L	N/A		N/A		N/A	1.8E-04	mg/kg/day	5.0E-04	mg/kg/day	3.5E-01
				2,4-Dinitrotoluene	8.7E-01	ug/L	N/A		N/A		N/A	2.4E-06	mg/kg/day	2.0E-03	mg/kg/day	1.2E-03
				2,6-Dinitrotoluene	3.9E-01	ug/L	N/A		N/A		N/A	7.2E-07	mg/kg/day	3.0E-04	mg/kg/day	2.4E-03
				4,4'-DDD	3.2E-02	ug/L	N/A		N/A		N/A	9.8E-06	mg/kg/day	N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	N/A		N/A		N/A	2.7E-07	mg/kg/day	1.0E-04	mg/kg/day	2.7E-03
				Arsenic	3.9E+00	ug/L	N/A		N/A		N/A	8.6E-07	mg/kg/day	3.0E-04	mg/kg/day	2.9E-03

TABLE 7.8.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater (cont'd)	Groundwater	Tap Water	Dermal Absorption[2]	Cadmium	1.2E+00	ug/L	N/A		N/A		N/A	2.5E-07	mg/kg/day	2.5E-05	mg/kg/day	1.0E-02
				Chromium	2.5E+00	ug/L	N/A		N/A		N/A	5.5E-07	mg/kg/day	7.5E-05	mg/kg/day	7.3E-03
				Cobalt	4.0E+00	ug/L	N/A		N/A		N/A	3.5E-07	mg/kg/day	3.0E-04	mg/kg/day	1.2E-03
				Manganese	1.6E+02	ug/L	N/A		N/A		N/A	3.4E-05	mg/kg/day	9.6E-04	mg/kg/day	3.6E-02
			Exp. Route Total								N/A					4.2E-01
		Exposure Point Total									N/A					4.9E+00
	Exposure Medium Total										N/A					4.9E+00
	Air	Vapor Intrusion into Indoor Air	Inhalation	Chloroform	1.6E-04	mg/m^3	N/A		N/A		N/A	1.5E-04	mg/m^3	9.8E-02	mg/m^3	1.5E-03
				Trichloroethene	1.3E-02	mg/m^3	N/A		N/A		N/A	1.3E-02	mg/m^3	2.0E-03	mg/m^3	6.4E+00
			Exp. Route Total								N/A					6.4E+00
		Exposure Point Total									N/A					6.4E+00
	Exposure Medium Total										N/A					6.4E+00
Groundwater Total											N/A					1.1E+01
										Total of Receptor Risk	N/A				Total of Receptor Hazard	1.3E+01

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABS of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

[2] DAevent for exposure to groundwater calculated on Table 7.7.RME Supplement A.

Table 7.8.RME Supplement A
Calculation of DAevent - Resident Child
Reasonable Maximum Exposure
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	1.6E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.54	1.6E-08	2
cis-1,2-Dichloroethene[1]	3.2E+00	7.7E-03	2.9E-02	3.7E-01	8.8E-01	1.0E+00	0.54	3.0E-08	2
Trichloroethene	2.4E+01	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	0.54	4.3E-07	2
2,4-Dinitrotoluene	8.7E-01	3.1E-03	1.6E-02	1.1E+00	2.7E+00	1.0E+00	0.54	5.8E-09	2
2,6-Dinitrotoluene	3.9E-01	2.1E-03	1.1E-02	1.1E+00	2.7E+00	1.0E+00	0.54	1.8E-09	2
4,4'-DDD	3.2E-02	1.8E-01	1.2E+00	6.6E+00	2.6E+01	8.0E-01	0.54	2.4E-08	2
Nitroglycerin[1]	2.3E-01	9.9E-04	5.8E-03	2.0E+00	4.7E+00	1.0E+00	0.54	6.5E-10	2
Arsenic	3.9E+00	1.0E-03	N/A	N/A	N/A	N/A	0.54	2.1E-09	1
Cadmium	1.2E+00	1.0E-03	N/A	N/A	N/A	N/A	0.54	6.2E-10	1
Chromium	2.5E+00	1.0E-03	N/A	N/A	N/A	N/A	0.54	1.3E-09	1
Cobalt	4.0E+00	4.0E-04	N/A	N/A	N/A	N/A	0.54	8.6E-10	1
Manganese	1.6E+02	1.0E-03	N/A	N/A	N/A	N/A	0.54	8.4E-08	1

Notes:

[1] Kp, B, lag time and t* values calculated on Table 7.7 Supplement B

N/A - Not applicable

All parameter values except water concentrations and duration of event from EPA 2004,*Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default permeability coefficient value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

Inorganics: DAevent (mg/cm2-event) =

Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

TABLE 7.9.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	1.4E-02	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Arsenic	4.8E+00	mg/kg	6.8E-06	mg/kg-day	1.5E+00	1/mg/kg-day	1.0E-05	N/A		N/A		N/A
				Chromium[4]	1.7E+01	mg/kg			5.0E-01	1/mg/kg-day	5.4E-05	N/A		N/A		N/A
				Cobalt	2.8E+00	mg/kg	4.1E-06	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Iron	1.9E+04	mg/kg	2.7E-02	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.3E+02	mg/kg	1.9E-04	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Thallium	7.4E-01	mg/kg	1.1E-06	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Vanadium	2.5E+01	mg/kg	3.6E-05	mg/kg-day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								6.4E-05					N/A
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	4.3E-04	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Arsenic	4.8E+00	mg/kg	6.3E-07	mg/kg-day	1.5E+00	1/mg/kg-day	9.4E-07	N/A		N/A		N/A
				Chromium[4]	1.7E+01	mg/kg			2.0E+01	1/mg/kg-day	6.1E-05	N/A		N/A		N/A
				Cobalt	2.8E+00	mg/kg	1.2E-07	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Iron	1.9E+04	mg/kg	8.3E-04	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.3E+02	mg/kg	5.9E-06	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Thallium	7.4E-01	mg/kg	3.2E-08	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Vanadium	2.5E+01	mg/kg	1.1E-06	mg/kg-day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								6.2E-05					N/A
		Exposure Point Total									1.3E-04					N/A
	Exposure Medium Total										1.3E-04					N/A
	Air	Emissions from Site 7 Soil	Inhalation	Chromium[4]	1.2E-05	µg/m^3			8.4E-02	(µg/m^3)$^{-1}$	1.0E-06	N/A		N/A		N/A
			Exp. Route Total								1.0E-06					N/A
		Exposure Point Total									1.0E-06					N/A
	Exposure Medium Total										1.0E-06					N/A
Soil Total											1.3E-04					N/A
Groundwater	Groundwater	Tap Water	Ingestion	Chloroform	1.6E+00	ug/L	2.1E-05	mg/kg/day	3.1E-02	mg/kg/day	6.4E-07	N/A		N/A		N/A
				cis-1,2-Dichloroethene	3.2E+00	ug/L	4.1E-05	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Trichloroethene (†)	2.4E+01	ug/L	N/A		N/A		N/A	N/A		N/A		N/A
				Trichloroethene (Kidney)[4]	2.4E+01	ug/L			9.3E-03	mg/kg/day	8.9E-06	N/A		N/A		N/A
				Trichloroethene (NHL + Liver)	2.4E+01	ug/L	3.1E-04	mg/kg/day	3.7E-02	mg/kg/day	1.1E-05	N/A		N/A		N/A
				2,4-Dinitrotoluene	8.7E-01	ug/L	1.1E-05	mg/kg/day	3.1E-01	mg/kg/day	3.5E-06	N/A		N/A		N/A
				2,6-Dinitrotoluene	3.9E-01	ug/L	5.0E-06	mg/kg/day	1.5E+00	mg/kg/day	7.5E-06	N/A		N/A		N/A
				4,4'-DDD	3.2E-02	ug/L	4.1E-07	mg/kg/day	2.4E-01	mg/kg/day	9.9E-08	N/A		N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	3.0E-06	mg/kg/day	1.7E-02	mg/kg/day	5.1E-08	N/A		N/A		N/A
				Arsenic	3.9E+00	ug/L	5.0E-05	mg/kg/day	1.5E+00	mg/kg/day	7.6E-05	N/A		N/A		N/A
				Cadmium	1.2E+00	ug/L	1.5E-05	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Chromium[4]	2.5E+00	ug/L			5.0E-01	mg/kg/day	5.0E-05	N/A		N/A		N/A
				Cobalt	4.0E+00	ug/L	5.1E-05	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.6E+02	ug/L	2.0E-03	mg/kg/day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								1.6E-04					N/A
			Dermal Absorption[2]	Chloroform	1.6E+00	ug/L	1.8E-06	mg/kg/day	3.1E-02	mg/kg/day	5.7E-08	N/A		N/A		N/A
				cis-1,2-Dichloroethene	3.2E+00	ug/L	3.5E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Trichloroethene (†)	2.4E+01	ug/L	N/A		N/A		N/A	N/A		N/A		N/A
				Trichloroethene (Kidney)[4]	2.4E+01	ug/L			9.3E-03	mg/kg/day	1.4E-06	N/A		N/A		N/A
				Trichloroethene (NHL + Liver)	2.4E+01	ug/L	5.0E-05	mg/kg/day	3.7E-02	mg/kg/day	1.9E-06	N/A		N/A		N/A
				2,4-Dinitrotoluene	8.7E-01	ug/L	6.8E-07	mg/kg/day	3.1E-01	mg/kg/day	2.1E-07	N/A		N/A		N/A

TABLE 7.9.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater (cont'd)	Groundwater	Tap Water	Dermal Absorption[2]	2,6-Dinitrotoluene	3.9E-01	ug/L	2.1E-07	mg/kg/day	1.5E+00	mg/kg/day	3.1E-07	N/A		N/A		N/A
				4,4'-DDD	3.2E-02	ug/L	2.8E-06	mg/kg/day	2.4E-01	mg/kg/day	6.8E-07	N/A		N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	7.7E-08	mg/kg/day	1.7E-02	mg/kg/day	1.3E-09	N/A		N/A		N/A
				Arsenic	3.9E+00	ug/L	2.7E-07	mg/kg/day	1.5E+00	mg/kg/day	4.1E-07	N/A		N/A		N/A
				Cadmium	1.2E+00	ug/L	8.1E-08	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Chromium[4]	2.5E+00	ug/L			2.0E+01	mg/kg/day	1.0E-05	N/A		N/A		N/A
				Cobalt	4.0E+00	ug/L	1.1E-07	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.6E+02	ug/L	1.1E-05	mg/kg/day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								1.5E-05					N/A
		Exposure Point Total									1.7E-04					N/A
	Exposure Medium Total										1.7E-04					N/A
	Air	Water Vapors at Showerhead	Inhalation[3]	Chloroform	1.3E-01	ug/m^3	3.6E-02	ug/m^3	2.3E-05	$(ug/m^3)^{-1}$	8.3E-07	N/A		N/A		N/A
				cis-1,2-Dichloroethene	2.9E-01	ug/m^3	8.0E-02	ug/m^3	N/A		N/A	N/A		N/A		N/A
				Trichloroethene	2.0E+00	ug/m^3	5.4E-01	ug/m^3	4.1E-06	$(ug/m^3)^{-1}$	2.2E-06	N/A		N/A		N/A
			Exp. Route Total								3.0E-06					N/A
		Exposure Point Total									3.0E-06					N/A
		Vapor Intrusion into Indoor Air	Inhalation	Chloroform	1.6E-01	ug/m^3	4.3E-02	ug/m^3	2.3E-05	$(ug/m^3)^{-1}$	9.9E-07	N/A		N/A		N/A
				Trichloroethene (†)	1.3E+01	ug/m^3	N/A		N/A		N/A	N/A		N/A		N/A
				Trichloroethene (Kidney)[4]	1.3E+01	ug/m^3			1.0E-06	$(ug/m^3)^{-1}$	1.3E-05	N/A		N/A		N/A
				Trichloroethene (NHL + Liver)	1.3E+01	ug/m^3	3.7E+00	ug/m^3	3.1E-06	$(ug/m^3)^{-1}$	1.1E-05	N/A		N/A		N/A
			Exp. Route Total								2.6E-05					N/A
		Exposure Point Total									2.6E-05					N/A
	Exposure Medium Total										2.9E-05					N/A
Groundwater Total											2.0E-04					N/A
										Total of Receptor Risk	3.3E-04				Total of Receptor Hazard	N/A

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABS of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

[2] DAevent for exposure to groundwater calculated on Table 7.7.RME Supplement A and Table 7.8.RME Supplement A.

[3] Inhalation exposure for groundwater while showering calculated on Table 7.7.RME Supplement C.

Children are not assumed to shower. Inhalation while showering pathway calculated for adult only. Inhalation exposure for groundwater while showering calculated on Table 7.7.RME Supplement C.

[4] See Table 7.9.RME Supplement A for calculation of intake and cancer risk following MMOA method.

† Carcinogenic risks were estimated for TCE by summing the risks for two different approaches: 1) Using the oral slope factor for kidney cancer, which has a mutagenic mode of action, and 2) using the oral slope factor for liver cancer and non-Hodgkin lymphoma (NHL).

TABLE 7.9.RME Supplement A

CALCULATION OF CHEMICAL CANCER RISKS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations										
					Value	Units	Intake					CSF/Unit Risk					Cancer Risk
							Value				Units	Value				Units	
							0-2 yrs	2-6 yrs	6-16 yrs	16-26 yrs		0-2 yrs (ADAF=10)	2-6 yrs (ADAF=3)	6-16 yrs (ADAF=3)	16-26 yrs (ADAF=1)		
Soil	Soil	Site 7	Ingestion	Chromium	1.7E+01	mg/kg	6.0E-06	1.2E-05	2.8E-06	2.8E-06	mg/kg-day	5.0E+00	1.5E+00	1.5E+00	5.0E-01	1/(mg/kg-day)	5.4E-05
			Dermal	Chromium	1.7E+01	mg/kg	1.6E-07	3.2E-07	1.2E-07	1.2E-07	mg/kg-day	2.0E+02	6.0E+01	6.0E+01	2.0E+01	1/(mg/kg-day)	6.1E-05
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	ug/m^3	3.3E-07	6.7E-07	1.7E-06	1.7E-06	ug/m^3	8.4E-01	2.5E-01	2.5E-01	8.4E-02	$1/(ug/m^3)$	1.0E-06
Groundwater	Groundwater	Tap Water	Ingestion	Trichloroethene (Kidney) Chromium	2.4E+01 2.5E+00	ug/L ug/L	3.4E-05 3.5E-06	6.8E-05 7.1E-06	1.0E-04 1.1E-05	1.0E-04 1.1E-05	mg/kg/day mg/kg/day	9.3E-02 5.0E+00	2.8E-02 1.5E+00	2.8E-02 1.5E+00	9.3E-03 5.0E-01	1/(mg/kg/day) 1/(mg/kg/day)	8.9E-06 5.0E-05
			Dermal	Trichloroethene (Kidney) Chromium	2.4E+01 2.5E+00	ug/L ug/L	5.0E-06 1.6E-08	1.0E-05 3.1E-08	1.8E-05 6.3E-08	1.8E-05 6.3E-08	mg/kg/day mg/kg/day	9.3E-02 2.0E+02	2.8E-02 6.0E+01	2.8E-02 6.0E+01	9.3E-03 2.0E+01	1/(mg/kg/day) 1/(mg/kg/day)	1.4E-06 1.0E-05
	Air	Vapor Intrusion Into Indoor Air	Inhalation	Trichloroethene (Kidney)	1.3E+01	ug/m^3	3.7E-01	7.3E-01	1.8E+00	1.8E+00	ug/m^3	1.0E-05	3.0E-06	3.0E-06	1.0E-06	$1/(ug/m^3)$	1.3E-05

[1] Children are not assumed to shower. Inhalation while showering pathway calculated for adult only.

Cancer risk = $(Intake_{0\text{-}2} \times CSF_{0\text{-}2}) + (Intake_{2\text{-}6} \times CSF_{2\text{-}6}) + (Intake_{6\text{-}16} \times CSF_{6\text{-}16}) + (Intake_{16\text{-}26} \times CSF_{16\text{-}26})$

Notes:
ADAF = Age-dependent adjustment factor
CSF = Cancer slope factor
EPC = Exposure point concentration
mg/kg = milligram per kilogram
mg/kg/day = milligram per kilogram per day
ug/m^3 = micrograms per cubic meter
ug/L = micrograms per liter

TABLE 7.10.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	1.5E-03	mg/kg-day	N/A		N/A	4.1E-03	mg/kg-day	1.0E+00	mg/kg-day	4.1E-03
				Arsenic	4.8E+00	mg/kg	7.3E-07	mg/kg-day	1.5E+00	1/mg/kg-day	1.1E-06	2.0E-06	mg/kg-day	3.0E-04	mg/kg-day	6.8E-03
				Chromium	1.7E+01	mg/kg	2.5E-06	mg/kg-day	5.0E-01	1/mg/kg-day	1.3E-06	7.1E-06	mg/kg-day	3.0E-03	mg/kg-day	2.4E-03
				Cobalt	2.8E+00	mg/kg	4.3E-07	mg/kg-day	N/A		N/A	1.2E-06	mg/kg-day	3.0E-04	mg/kg-day	4.0E-03
				Iron	1.9E+04	mg/kg	2.9E-03	mg/kg-day	N/A		N/A	8.1E-03	mg/kg-day	7.0E-01	mg/kg-day	1.2E-02
				Manganese	1.3E+02	mg/kg	2.1E-05	mg/kg-day	N/A		N/A	5.7E-05	mg/kg-day	2.4E-02	mg/kg-day	2.4E-03
				Thallium	7.4E-01	mg/kg	1.1E-07	mg/kg-day	N/A		N/A	3.2E-07	mg/kg-day	1.0E-05	mg/kg-day	3.2E-02
				Vanadium	2.5E+01	mg/kg	3.8E-06	mg/kg-day	N/A		N/A	1.1E-05	mg/kg-day	5.0E-03	mg/kg-day	2.2E-03
			Exp. Route Total								2.4E-06					6.5E-02
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	1.2E-04	mg/kg-day	N/A		N/A	3.4E-04	mg/kg-day	1.0E+00	mg/kg-day	3.4E-04
				Arsenic	4.8E+00	mg/kg	1.8E-07	mg/kg-day	1.5E+00	1/mg/kg-day	2.7E-07	5.1E-07	mg/kg-day	3.0E-04	mg/kg-day	1.7E-03
				Chromium	1.7E+01	mg/kg	2.1E-07	mg/kg-day	2.0E+01	1/mg/kg-day	4.2E-06	5.9E-07	mg/kg-day	7.5E-05	mg/kg-day	7.8E-03
				Cobalt	2.8E+00	mg/kg	3.6E-08	mg/kg-day	N/A		N/A	1.0E-07	mg/kg-day	3.0E-04	mg/kg-day	3.4E-04
				Iron	1.9E+04	mg/kg	2.4E-04	mg/kg-day	N/A		N/A	6.8E-04	mg/kg-day	7.0E-01	mg/kg-day	9.7E-04
				Manganese	1.3E+02	mg/kg	1.7E-06	mg/kg-day	N/A		N/A	4.8E-06	mg/kg-day	9.6E-04	mg/kg-day	5.0E-03
				Thallium	7.4E-01	mg/kg	9.4E-09	mg/kg-day	N/A		N/A	2.6E-08	mg/kg-day	1.0E-05	mg/kg-day	2.6E-03
				Vanadium	2.5E+01	mg/kg	3.2E-07	mg/kg-day	N/A		N/A	9.0E-07	mg/kg-day	1.3E-04	mg/kg-day	6.9E-03
			Exp. Route Total								4.5E-06					2.6E-02
		Exposure Point Total									6.8E-06					9.1E-02
	Exposure Medium Total										6.8E-06					9.1E-02
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	$\mu g/m^3$	9.9E-07	$\mu g/m^3$	8.4E-02	$(\mu g/m^3)^{-1}$	8.3E-08	2.8E-09	mg/m^3	1.0E-04	mg/m^3	2.8E-05
			Exp. Route Total								8.3E-08					2.8E-05
		Exposure Point Total									8.3E-08					2.8E-05
	Exposure Medium Total										8.3E-08					2.8E-05
Soil Total											6.9E-06					9.1E-02
Groundwater	Groundwater	Tap Water	Ingestion	Chloroform	1.6E+00	µg/L	6.1E-06	mg/kg-day	3.1E-02	1/mg/kg-day	1.9E-07	1.7E-05	mg/kg-day	1.0E-02	mg/kg-day	1.7E-03
				cis-1,2-Dichloroethene	3.2E+00	µg/L	1.2E-05	mg/kg-day	N/A		N/A	3.4E-05	mg/kg-day	2.0E-03	mg/kg-day	1.7E-02
				Trichloroethene	2.4E+01	µg/L	9.2E-05	mg/kg-day	4.6E-02	1/mg/kg-day	4.2E-06	2.6E-04	mg/kg-day	5.0E-04	mg/kg-day	5.1E-01
				2,4-Dinitrotoluene	8.7E-01	µg/L	3.3E-06	mg/kg-day	3.1E-01	1/mg/kg-day	1.0E-06	9.4E-06	mg/kg-day	2.0E-03	mg/kg-day	4.7E-03
				2,6-Dinitrotoluene	3.9E-01	µg/L	1.5E-06	mg/kg-day	1.5E+00	1/mg/kg-day	2.2E-06	4.2E-06	mg/kg-day	3.0E-04	mg/kg-day	1.4E-02
				4,4'-DDD	3.2E-02	µg/L	1.2E-07	mg/kg-day	2.4E-01	1/mg/kg-day	2.9E-08	3.4E-07	mg/kg-day	N/A		N/A
				Nitroglycerin	2.3E-01	µg/L	8.8E-07	mg/kg-day	1.7E-02	1/mg/kg-day	1.5E-08	2.5E-06	mg/kg-day	1.0E-04	mg/kg-day	2.5E-02
				Arsenic	3.9E+00	µg/L	1.5E-05	mg/kg-day	1.5E+00	1/mg/kg-day	2.2E-05	4.2E-05	mg/kg-day	3.0E-04	mg/kg-day	1.4E-01
				Cadmium	1.2E+00	µg/L	4.4E-06	mg/kg-day	N/A		N/A	1.2E-05	mg/kg-day	5.0E-04	mg/kg-day	2.5E-02
				Chromium	2.5E+00	µg/L	9.5E-06	mg/kg-day	5.0E-01	1/mg/kg-day	4.8E-06	2.7E-05	mg/kg-day	3.0E-03	mg/kg-day	8.9E-03
				Cobalt	4.0E+00	µg/L	1.5E-05	mg/kg-day	N/A		N/A	4.2E-05	mg/kg-day	3.0E-04	mg/kg-day	1.4E-01
				Manganese	1.6E+02	µg/L	6.0E-04	mg/kg-day	N/A		N/A	1.7E-03	mg/kg-day	2.4E-02	mg/kg-day	7.0E-02
			Exp. Route Total								3.5E-05					9.6E-01
		Exposure Point Total									3.5E-05					9.6E-01
	Exposure Medium Total										3.5E-05					9.6E-01

TABLE 7.10.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater (con't)	Air	Vapor Intrusion into Indoor Air	Inhalation	Trichloroethene	1.3E+01	ug/m^3	1.1E+00	ug/m^3	4.1E-06	(ug/m^3)$^{-1}$	4.5E-06	3.1E-03	mg/m^3	2.0E-03	mg/m^3	1.5E+00
			Exp. Route Total								4.5E-06					1.5E+00
		Exposure Point Total									4.5E-06					1.5E+00
	Exposure Medium Total										4.5E-06					1.5E+00
Groundwater Total											3.9E-05					2.5E+00
Total of Receptor Risks Across All Media											4.6E-05	Total of Receptor Hazards Across All Media				2.6E+00

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABs of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

TABLE 7.11.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	2.0E-04	mg/kg-day	N/A		N/A	1.4E-02	mg/kg-day	1.0E+00	mg/kg-day	1.4E-02
				Arsenic	4.8E+00	mg/kg	9.6E-08	mg/kg-day	1.5E+00	1/mg/kg-day	1.4E-07	6.7E-06	mg/kg-day	3.0E-04	mg/kg-day	2.2E-02
				Chromium	1.7E+01	mg/kg	3.3E-07	mg/kg-day	5.0E-01	1/mg/kg-day	1.7E-07	2.3E-05	mg/kg-day	5.0E-03	mg/kg-day	4.7E-03
				Cobalt	2.8E+00	mg/kg	5.7E-08	mg/kg-day	N/A		N/A	4.0E-06	mg/kg-day	3.0E-03	mg/kg-day	1.3E-03
				Iron	1.9E+04	mg/kg	3.8E-04	mg/kg-day	N/A		N/A	2.7E-02	mg/kg-day	7.0E-01	mg/kg-day	3.8E-02
				Manganese	1.3E+02	mg/kg	2.7E-06	mg/kg-day	N/A		N/A	1.9E-04	mg/kg-day	2.4E-02	mg/kg-day	7.9E-03
				Thallium	7.4E-01	mg/kg	1.5E-08	mg/kg-day	N/A		N/A	1.0E-06	mg/kg-day	4.0E-05	mg/kg-day	2.6E-02
				Vanadium	2.5E+01	mg/kg	5.1E-07	mg/kg-day	N/A		N/A	3.6E-05	mg/kg-day	1.0E-02	mg/kg-day	3.6E-03
			Exp. Route Total								3.1E-07					1.2E-01
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	2.5E-06	mg/kg-day	N/A		N/A	1.7E-04	mg/kg-day	1.0E+00	mg/kg-day	1.7E-04
				Arsenic	4.8E+00	mg/kg	3.6E-09	mg/kg-day	1.5E+00	1/mg/kg-day	5.5E-09	2.5E-07	mg/kg-day	3.0E-04	mg/kg-day	8.5E-04
				Chromium	1.7E+01	mg/kg	4.2E-09	mg/kg-day	2.0E+01	1/mg/kg-day	8.4E-08	2.9E-07	mg/kg-day	1.3E-04	mg/kg-day	2.4E-03
				Cobalt	2.8E+00	mg/kg	7.2E-10	mg/kg-day	N/A		N/A	5.0E-08	mg/kg-day	3.0E-03	mg/kg-day	1.7E-05
				Iron	1.9E+04	mg/kg	4.8E-06	mg/kg-day	N/A		N/A	3.4E-04	mg/kg-day	7.0E-01	mg/kg-day	4.8E-04
				Manganese	1.3E+02	mg/kg	3.4E-08	mg/kg-day	N/A		N/A	2.4E-06	mg/kg-day	9.6E-04	mg/kg-day	2.5E-03
				Thallium	7.4E-01	mg/kg	1.9E-10	mg/kg-day	N/A		N/A	1.3E-08	mg/kg-day	4.0E-05	mg/kg-day	3.3E-04
				Vanadium	2.5E+01	mg/kg	6.4E-09	mg/kg-day	N/A		N/A	4.5E-07	mg/kg-day	2.6E-04	mg/kg-day	2.6E-04
			Exp. Route Total								9.0E-08					7.0E-03
		Exposure Point Total									4.0E-07					1.2E-01
	Exposure Medium Total										4.0E-07					1.2E-01
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	$\mu g/m^3$	2.0E-08	$\mu g/m^3$	8.4E-02	$(\mu g/m^3)^{-1}$	1.7E-09	1.4E-09	mg/m^3	3.0E-04	mg/m^3	4.7E-06
			Exp. Route Total								1.7E-09					4.7E-06
		Exposure Point Total									1.7E-09					4.7E-06
	Exposure Medium Total										1.7E-09					4.7E-06
Soil Total											4.0E-07					1.2E-01
							Total of Receptor Risks Across All Media				4.0E-07	Total of Receptor Hazards Across All Media				1.2E-01

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABS of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

TABLE 7.1.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	N/A		N/A		N/A	2.3E-03	mg/kg/day	1.0E+00	mg/kg/day	2.3E-03
				Arsenic	4.8E+00	mg/kg	N/A		N/A		N/A	1.1E-06	mg/kg/day	3.0E-04	mg/kg/day	3.8E-03
				Chromium	1.7E+01	mg/kg	N/A		N/A		N/A	4.0E-06	mg/kg/day	3.0E-03	mg/kg/day	1.3E-03
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	6.8E-07	mg/kg/day	3.0E-04	mg/kg/day	2.3E-03
				Iron	1.9E+04	mg/kg	N/A		N/A		N/A	4.5E-03	mg/kg/day	7.0E-01	mg/kg/day	6.5E-03
				Manganese	1.3E+02	mg/kg	N/A		N/A		N/A	3.2E-05	mg/kg/day	2.4E-02	mg/kg/day	1.3E-03
				Thallium	7.4E-01	mg/kg	N/A		N/A		N/A	1.8E-07	mg/kg/day	1.0E-05	mg/kg/day	1.8E-02
				Vanadium	2.5E+01	mg/kg	N/A		N/A		N/A	6.0E-06	mg/kg/day	5.0E-03	mg/kg/day	1.2E-03
			Exp. Route Total								N/A					3.6E-02
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	N/A		N/A		N/A	7.0E-05	mg/kg/day	1.0E+00	mg/kg/day	7.0E-05
				Arsenic	4.8E+00	mg/kg	N/A		N/A		N/A	1.0E-07	mg/kg/day	3.0E-04	mg/kg/day	3.4E-04
				Chromium	1.7E+01	mg/kg	N/A		N/A		N/A	1.2E-07	mg/kg/day	7.5E-05	mg/kg/day	1.6E-03
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	2.0E-08	mg/kg/day	3.0E-04	mg/kg/day	6.8E-05
				Iron	1.9E+04	mg/kg	N/A		N/A		N/A	1.4E-04	mg/kg/day	7.0E-01	mg/kg/day	2.0E-04
				Manganese	1.3E+02	mg/kg	N/A		N/A		N/A	9.7E-07	mg/kg/day	9.6E-04	mg/kg/day	1.0E-03
				Thallium	7.4E-01	mg/kg	N/A		N/A		N/A	5.3E-09	mg/kg/day	1.0E-05	mg/kg/day	5.3E-04
				Vanadium	2.5E+01	mg/kg	N/A		N/A		N/A	1.8E-07	mg/kg/day	1.3E-04	mg/kg/day	1.4E-03
			Exp. Route Total								N/A					5.2E-03
		Exposure Point Total									N/A					4.2E-02
	Exposure Medium Total										N/A					4.2E-02
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	µg/m^3	N/A		N/A		N/A	1.2E-08	mg/m^3	1.0E-04	mg/m^3	1.2E-04
			Exp. Route Total								N/A					1.2E-04
		Exposure Point Total									N/A					1.2E-04
	Exposure Medium Total										N/A					1.2E-04
Soil Total											N/A					4.2E-02
Groundwater	Groundwater	Tap Water	Ingestion	Chloroform	1.6E+00	ug/L	N/A		N/A		N/A	1.9E-05	mg/kg/day	1.0E-02	mg/kg/day	1.9E-03
				cis-1,2-Dichloroethene	3.2E+00	ug/L	N/A		N/A		N/A	3.8E-05	mg/kg/day	2.0E-03	mg/kg/day	1.9E-02
				Trichloroethene	2.4E+01	ug/L	N/A		N/A		N/A	2.8E-04	mg/kg/day	5.0E-04	mg/kg/day	5.7E-01
				2,4-Dinitrotoluene	8.7E-01	ug/L	N/A		N/A		N/A	1.0E-05	mg/kg/day	2.0E-03	mg/kg/day	5.2E-03
				2,6-Dinitrotoluene	3.9E-01	ug/L	N/A		N/A		N/A	4.6E-06	mg/kg/day	3.0E-04	mg/kg/day	1.5E-02
				4,4'-DDD	3.2E-02	ug/L	N/A		N/A		N/A	3.8E-07	mg/kg/day	N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	N/A		N/A		N/A	2.7E-06	mg/kg/day	1.0E-04	mg/kg/day	2.7E-02
				Arsenic	3.9E+00	ug/L	N/A		N/A		N/A	4.6E-05	mg/kg/day	3.0E-04	mg/kg/day	1.5E-01
				Cadmium	1.2E+00	ug/L	N/A		N/A		N/A	1.4E-05	mg/kg/day	5.0E-04	mg/kg/day	2.7E-02
				Chromium	2.5E+00	ug/L	N/A		N/A		N/A	3.0E-05	mg/kg/day	3.0E-03	mg/kg/day	9.8E-03
				Cobalt	4.0E+00	ug/L	N/A		N/A		N/A	4.7E-05	mg/kg/day	3.0E-04	mg/kg/day	1.6E-01
				Manganese	1.6E+02	ug/L	N/A		N/A		N/A	1.9E-03	mg/kg/day	2.4E-02	mg/kg/day	7.7E-02
			Exp. Route Total								N/A					1.1E+00
			Dermal Absorption[2]	Chloroform	1.6E+00	ug/L	N/A		N/A		N/A	2.8E-06	mg/kg/day	1.0E-02	mg/kg/day	2.8E-04
				cis-1,2-Dichloroethene	3.2E+00	ug/L	N/A		N/A		N/A	5.4E-06	mg/kg/day	2.0E-03	mg/kg/day	2.7E-03
				Trichloroethene	2.4E+01	ug/L	N/A		N/A		N/A	7.8E-05	mg/kg/day	5.0E-04	mg/kg/day	1.6E-01
				2,4-Dinitrotoluene	8.7E-01	ug/L	N/A		N/A		N/A	1.0E-06	mg/kg/day	2.0E-03	mg/kg/day	5.2E-04
				2,6-Dinitrotoluene	3.9E-01	ug/L	N/A		N/A		N/A	3.2E-07	mg/kg/day	3.0E-04	mg/kg/day	1.1E-03
				4,4'-DDD	3.2E-02	ug/L	N/A		N/A		N/A	4.3E-06	mg/kg/day	N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	N/A		N/A		N/A	1.2E-07	mg/kg/day	1.0E-04	mg/kg/day	1.2E-03
				Arsenic	3.9E+00	ug/L	N/A		N/A		N/A	2.7E-07	mg/kg/day	3.0E-04	mg/kg/day	9.1E-04

TABLE 7.1.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater (cont'd)	Groundwater	Tap Water	Dermal Absorption[2]	Cadmium	1.2E+00	ug/L	N/A		N/A		N/A	8.1E-08	mg/kg/day	2.5E-05	mg/kg/day	3.2E-03
				Chromium	2.5E+00	ug/L	N/A		N/A		N/A	1.7E-07	mg/kg/day	7.5E-05	mg/kg/day	2.3E-03
				Cobalt	4.0E+00	ug/L	N/A		N/A		N/A	1.1E-07	mg/kg/day	3.0E-04	mg/kg/day	3.7E-04
				Manganese	1.6E+02	ug/L	N/A		N/A		N/A	1.1E-05	mg/kg/day	9.6E-04	mg/kg/day	1.1E-02
			Exp. Route Total								N/A					1.8E-01
		Exposure Point Total									N/A					1.2E+00
	Exposure Medium Total										N/A					1.2E+00
	Air	Water Vapors at Showerhead[3]	Inhalation	Chloroform	5.1E-05	mg/m^3	N/A		N/A		N/A	4.9E-05	mg/m^3	9.8E-02	mg/m^3	5.0E-04
				cis-1,2-Dichloroethene	1.1E-04	mg/m^3	N/A		N/A		N/A	1.1E-04	mg/m^3	N/A		N/A
				Trichloroethene	7.6E-04	mg/m^3	N/A		N/A		N/A	7.3E-04	mg/m^3	2.0E-03	mg/m^3	3.6E-01
			Exp. Route Total								N/A					3.6E-01
		Exposure Point Total									N/A					3.6E-01
		Vapor Intrusion into Indoor Air	Inhalation	Chloroform	1.6E-04	mg/m^3	N/A		N/A		N/A	1.5E-04	mg/m^3	9.8E-02	mg/m^3	1.5E-03
				Trichloroethene	1.3E-02	mg/m^3	N/A		N/A		N/A	1.3E-02	mg/m^3	2.0E-03	mg/m^3	6.4E+00
			Exp. Route Total								N/A					6.4E+00
		Exposure Point Total									N/A					6.4E+00
	Exposure Medium Total										N/A					6.8E+00
Groundwater Total											N/A					8.0E+00
										Total of Receptor Risk	N/A				Total of Receptor Hazard	8.1E+00

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABS of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

[2] DAevent for exposure to groundwater calculated on Table 7.1.CTE Supplement A.

[3] Inhalation exposure for groundwater while showering calculated on Table 7.1.CTE Supplement B.

Table 7.1.CTE Supplement A
Calculation of DAevent - Resident Adult
Central Tendency Exposure
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	1.6E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.28	1.1E-08	2
cis-1,2-Dichloroethene[1]	3.2E+00	7.7E-03	2.9E-02	3.7E-01	8.8E-01	1.0E+00	0.28	2.2E-08	2
Trichloroethene	2.4E+01	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	0.28	3.1E-07	2
2,4-Dinitrotoluene	8.7E-01	3.1E-03	1.6E-02	1.1E+00	2.7E+00	1.0E+00	0.28	4.2E-09	2
2,6-Dinitrotoluene	3.9E-01	2.1E-03	1.1E-02	1.1E+00	2.7E+00	1.0E+00	0.28	1.3E-09	2
4,4'-DDD	3.2E-02	1.8E-01	1.2E+00	6.6E+00	2.6E+01	8.0E-01	0.28	1.7E-08	2
Nitroglycerin[1]	2.3E-01	9.9E-04	5.8E-03	2.0E+00	4.7E+00	1.0E+00	0.28	4.7E-10	2
Arsenic	3.9E+00	1.0E-03	N/A	N/A	N/A	N/A	0.28	1.1E-09	1
Cadmium	1.2E+00	1.0E-03	N/A	N/A	N/A	N/A	0.28	3.2E-10	1
Chromium	2.5E+00	1.0E-03	N/A	N/A	N/A	N/A	0.28	7.0E-10	1
Cobalt	4.0E+00	4.0E-04	N/A	N/A	N/A	N/A	0.28	4.4E-10	1
Manganese	1.6E+02	1.0E-03	N/A	N/A	N/A	N/A	0.28	4.4E-08	1

Notes:

[1] Kp, B, lag time and t* values calculated on Table 7.7 Supplement B

N/A - Not applicable

All parameter values except water concentrations and duration of event from EPA 2004,*Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default permeability coefficient value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

Inorganics: DAevent (mg/cm2-event) =

Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Table 7.1.CTE Supplement B

Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model

Adult Resident

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Exposure Point Concentration Cwo (µg/L)	Molecular weight (MW) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl (VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (µg/L)	S (µg/m^3 -min)	Ca (mg/m^3)
Chloroform	1.6E+00	1.2E+02	3.7E-03	1.2E+03	1.2E+01	1.1E+01	1.5E+01	1.9E-01	1.6E-01	5.1E-05
cis-1,2-Dichloroethene	3.2E+00	9.7E+01	4.1E-03	1.3E+03	1.3E+01	1.3E+01	1.7E+01	4.3E-01	3.5E-01	1.1E-04
Trichloroethene	2.4E+01	1.3E+02	9.9E-03	1.1E+03	1.2E+01	1.1E+01	1.5E+01	2.9E+00	2.4E+00	7.6E-04

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	centipoise	1.002
Cwd = conc. leaving droplets after time sdt	µg/l	Solved by Eq 5
sdt = shower droplet drop time	sec	0.5
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	10
SV = shower room air volume	m^3	12
S = indoor VOC generation rate	µg/m^3-min	Solved by Eq 6
Ds = duration of shower	min	16.8
Dt = total duration in shower room	min	45
R = air exchange rate	min^{-1}	0.01667
Ca = indoor air concentration of VOCs	mg/m^3	Solved by Eq 7

Equation 1:	Kg(VOC) =	3000 * (18 / MW)$^{0.5}$
Equation 2:	Kl(VOC) =	20 * (44 / MW)$^{0.5}$
Equation 3:	KL =	((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))$^{-1}$
Equation 4:	Kal =	(KL * (((Tl * Us) / (Ts * Ul))$^{-0.5}$))
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))
Equation 6:	S =	(Cwd * FR / SV)
Equation 7:	Ca =	If t>Ds [(S / R) * (Ds + (EXP(-R * Dt) / R)-(EXP(R *(Ds - Dt)) / R)] * 1/1440 min/day * 1/1000 ug/mg

Notes:

MW and Henry's Law Constant from Oak Ridge National Laboratory (ORNL). May 2014. [Online]. Available: http://epa-prgs.ornl.gov/chemicals/index.shtml

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	N/A		N/A		N/A	2.9E-02	mg/kg/day	1.0E+00	mg/kg/day	2.9E-02
				Arsenic	4.8E+00	mg/kg	N/A		N/A		N/A	1.4E-05	mg/kg/day	3.0E-04	mg/kg/day	4.8E-02
				Chromium	1.7E+01	mg/kg	N/A		N/A		N/A	5.0E-05	mg/kg/day	3.0E-03	mg/kg/day	1.7E-02
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	8.5E-06	mg/kg/day	3.0E-04	mg/kg/day	2.8E-02
				Iron	1.9E+04	mg/kg	N/A		N/A		N/A	5.7E-02	mg/kg/day	7.0E-01	mg/kg/day	8.1E-02
				Manganese	1.3E+02	mg/kg	N/A		N/A		N/A	4.0E-04	mg/kg/day	2.4E-02	mg/kg/day	1.7E-02
				Thallium	7.4E-01	mg/kg	N/A		N/A		N/A	2.2E-06	mg/kg/day	1.0E-05	mg/kg/day	2.2E-01
				Vanadium	2.5E+01	mg/kg	N/A		N/A		N/A	7.6E-05	mg/kg/day	5.0E-03	mg/kg/day	1.5E-02
			Exp. Route Total								N/A					4.6E-01
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	N/A		N/A		N/A	6.7E-04	mg/kg/day	1.0E+00	mg/kg/day	6.7E-04
				Arsenic	4.8E+00	mg/kg	N/A		N/A		N/A	9.8E-07	mg/kg/day	3.0E-04	mg/kg/day	3.3E-03
				Chromium	1.7E+01	mg/kg	N/A		N/A		N/A	1.1E-06	mg/kg/day	7.5E-05	mg/kg/day	1.5E-02
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	1.9E-07	mg/kg/day	3.0E-04	mg/kg/day	6.5E-04
				Iron	1.9E+04	mg/kg	N/A		N/A		N/A	1.3E-03	mg/kg/day	7.0E-01	mg/kg/day	1.9E-03
				Manganese	1.3E+02	mg/kg	N/A		N/A		N/A	9.2E-06	mg/kg/day	9.6E-04	mg/kg/day	9.6E-03
				Thallium	7.4E-01	mg/kg	N/A		N/A		N/A	5.1E-08	mg/kg/day	1.0E-05	mg/kg/day	5.1E-03
				Vanadium	2.5E+01	mg/kg	N/A		N/A		N/A	1.7E-06	mg/kg/day	1.3E-04	mg/kg/day	1.3E-02
			Exp. Route Total								N/A					5.0E-02
		Exposure Point Total									N/A					5.1E-01
	Exposure Medium Total										N/A					5.1E-01
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	µg/m^3	N/A		N/A		N/A	1.2E-08	mg/m^3	1.0E-04	mg/m^3	1.2E-04
			Exp. Route Total								N/A					1.2E-04
		Exposure Point Total									N/A					1.2E-04
	Exposure Medium Total										N/A					1.2E-04
Soil Total											N/A					5.1E-01
Groundwater	Groundwater	Tap Water	Ingestion	Chloroform	1.6E+00	ug/L	N/A		N/A		N/A	3.2E-05	mg/kg/day	1.0E-02	mg/kg/day	3.2E-03
				cis-1,2-Dichloroethene	3.2E+00	ug/L	N/A		N/A		N/A	6.3E-05	mg/kg/day	2.0E-03	mg/kg/day	3.2E-02
				Trichloroethene	2.4E+01	ug/L	N/A		N/A		N/A	4.8E-04	mg/kg/day	5.0E-04	mg/kg/day	9.5E-01
				2,4-Dinitrotoluene	8.7E-01	ug/L	N/A		N/A		N/A	1.7E-05	mg/kg/day	2.0E-03	mg/kg/day	8.7E-03
				2,6-Dinitrotoluene	3.9E-01	ug/L	N/A		N/A		N/A	7.7E-06	mg/kg/day	3.0E-04	mg/kg/day	2.6E-02
				4,4'-DDD	3.2E-02	ug/L	N/A		N/A		N/A	6.3E-07	mg/kg/day	N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	N/A		N/A		N/A	4.6E-06	mg/kg/day	1.0E-04	mg/kg/day	4.6E-02
				Arsenic	3.9E+00	ug/L	N/A		N/A		N/A	7.8E-05	mg/kg/day	3.0E-04	mg/kg/day	2.6E-01
				Cadmium	1.2E+00	ug/L	N/A		N/A		N/A	2.3E-05	mg/kg/day	5.0E-04	mg/kg/day	4.6E-02
				Chromium	2.5E+00	ug/L	N/A		N/A		N/A	4.9E-05	mg/kg/day	3.0E-03	mg/kg/day	1.6E-02
				Cobalt	4.0E+00	ug/L	N/A		N/A		N/A	7.8E-05	mg/kg/day	3.0E-04	mg/kg/day	2.6E-01
				Manganese	1.6E+02	ug/L	N/A		N/A		N/A	3.1E-03	mg/kg/day	2.4E-02	mg/kg/day	1.3E-01
			Exp. Route Total								N/A					1.8E+00
			Dermal Absorption[2]	Chloroform	1.6E+00	ug/L	N/A		N/A		N/A	5.3E-06	mg/kg/day	1.0E-02	mg/kg/day	5.3E-04
				cis-1,2-Dichloroethene	3.2E+00	ug/L	N/A		N/A		N/A	1.0E-05	mg/kg/day	2.0E-03	mg/kg/day	5.1E-03
				Trichloroethene	2.4E+01	ug/L	N/A		N/A		N/A	1.5E-04	mg/kg/day	5.0E-04	mg/kg/day	2.9E-01
				2,4-Dinitrotoluene	8.7E-01	ug/L	N/A		N/A		N/A	2.0E-06	mg/kg/day	2.0E-03	mg/kg/day	9.8E-04
				2,6-Dinitrotoluene	3.9E-01	ug/L	N/A		N/A		N/A	5.9E-07	mg/kg/day	3.0E-04	mg/kg/day	2.0E-03
				4,4'-DDD	3.2E-02	ug/L	N/A		N/A		N/A	8.1E-06	mg/kg/day	N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	N/A		N/A		N/A	2.2E-07	mg/kg/day	1.0E-04	mg/kg/day	2.2E-03
				Arsenic	3.9E+00	ug/L	N/A		N/A		N/A	5.9E-07	mg/kg/day	3.0E-04	mg/kg/day	2.0E-03

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater (cont'd)	Groundwater	Tap Water	Dermal Absorption[2]	Cadmium	1.2E+00	ug/L	N/A		N/A		N/A	1.7E-07	mg/kg/day	2.5E-05	mg/kg/day	7.0E-03
				Chromium	2.5E+00	ug/L	N/A		N/A		N/A	3.8E-07	mg/kg/day	7.5E-05	mg/kg/day	5.0E-03
				Cobalt	4.0E+00	ug/L	N/A		N/A		N/A	2.4E-07	mg/kg/day	3.0E-04	mg/kg/day	8.0E-04
				Manganese	1.6E+02	ug/L	N/A		N/A		N/A	2.4E-05	mg/kg/day	9.6E-04	mg/kg/day	2.5E-02
			Exp. Route Total								N/A					3.4E-01
		Exposure Point Total									N/A					2.1E+00
	Exposure Medium Total										N/A					2.1E+00
	Air	Vapor Intrusion into Indoor Air	Inhalation	Chloroform	1.6E-04	mg/m^3	N/A		N/A		N/A	1.5E-04	mg/m^3	9.8E-02	mg/m^3	1.5E-03
				Trichloroethene	1.3E-02	mg/m^3	N/A		N/A		N/A	1.3E-02	mg/m^3	2.0E-03	mg/m^3	6.4E+00
			Exp. Route Total								N/A					6.4E+00
		Exposure Point Total									N/A					6.4E+00
	Exposure Medium Total										N/A					6.4E+00
Groundwater Total											N/A					8.5E+00
										Total of Receptor Risk	N/A				Total of Receptor Hazard	9.0E+00

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABS of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

DAevent for exposure to groundwater calculated on Table 7.2.CTE Supplement A.

Table 7.2.CTE Supplement A
Calculation of DAevent - Resident Adult
Central Tendency Exposure
Site 7 – Old DuPont Disposal Area Remedial Investigation
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	1.6E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.37	1.3E-08	2
cis-1,2-Dichloroethene[1]	3.2E+00	7.7E-03	2.9E-02	3.7E-01	8.8E-01	1.0E+00	0.37	2.5E-08	2
Trichloroethene	2.4E+01	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	0.37	3.6E-07	2
2,4-Dinitrotoluene	8.7E-01	3.1E-03	1.6E-02	1.1E+00	2.7E+00	1.0E+00	0.37	4.8E-09	2
2,6-Dinitrotoluene	3.9E-01	2.1E-03	1.1E-02	1.1E+00	2.7E+00	1.0E+00	0.37	1.5E-09	2
4,4'-DDD	3.2E-02	1.8E-01	1.2E+00	6.6E+00	2.6E+01	8.0E-01	0.37	2.0E-08	2
Nitroglycerin[1]	2.3E-01	9.9E-04	5.8E-03	2.0E+00	4.7E+00	1.0E+00	0.37	5.4E-10	2
Arsenic	3.9E+00	1.0E-03	N/A	N/A	N/A	N/A	0.37	1.4E-09	1
Cadmium	1.2E+00	1.0E-03	N/A	N/A	N/A	N/A	0.37	4.3E-10	1
Chromium	2.5E+00	1.0E-03	N/A	N/A	N/A	N/A	0.37	9.2E-10	1
Cobalt	4.0E+00	4.0E-04	N/A	N/A	N/A	N/A	0.37	5.9E-10	1
Manganese	1.6E+02	1.0E-03	N/A	N/A	N/A	N/A	0.37	5.8E-08	1

Notes:

[1] Kp, B, lag time and t* values calculated on Table 7.7 Supplement B

N/A - Not applicable

All parameter values except water concentrations and duration of event from EPA 2004,*Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default permeability coefficient value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

Inorganics: DAevent (mg/cm2-event) =

Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

TABLE 7.3.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	2.8E-03	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Arsenic	4.8E+00	mg/kg	1.4E-06	mg/kg-day	1.5E+00	1/mg/kg-day	2.1E-06	N/A		N/A		N/A
				Chromium[4]	1.7E+01	mg/kg			5.0E-01	1/mg/kg-day	1.2E-05	N/A		N/A		N/A
				Cobalt	2.8E+00	mg/kg	8.1E-07	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Iron	1.9E+04	mg/kg	5.5E-03	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.3E+02	mg/kg	3.9E-05	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Thallium	7.4E-01	mg/kg	2.1E-07	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Vanadium	2.5E+01	mg/kg	7.2E-06	mg/kg-day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								1.4E-05					N/A
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	6.6E-05	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Arsenic	4.8E+00	mg/kg	9.8E-08	mg/kg-day	1.5E+00	1/mg/kg-day	1.5E-07	N/A		N/A		N/A
				Chromium[4]	1.7E+01	mg/kg			2.0E+01	1/mg/kg-day	1.1E-05	N/A		N/A		N/A
				Cobalt	2.8E+00	mg/kg	1.9E-08	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Iron	1.9E+04	mg/kg	1.3E-04	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.3E+02	mg/kg	9.2E-07	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Thallium	7.4E-01	mg/kg	5.0E-09	mg/kg-day	N/A		N/A	N/A		N/A		N/A
				Vanadium	2.5E+01	mg/kg	1.7E-07	mg/kg-day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								1.1E-05					N/A
		Exposure Point Total									2.6E-05					N/A
	Exposure Medium Total										2.6E-05					N/A
	Air	Emissions from Site 7 Soil	Inhalation	Chromium[4]	1.2E-05	µg/m^3			8.4E-02	(µg/m^3)$^{-1}$	8.2E-07	N/A		N/A		N/A
			Exp. Route Total								8.2E-07					N/A
		Exposure Point Total									8.2E-07					N/A
	Exposure Medium Total										8.2E-07					N/A
Soil Total											2.6E-05					N/A
Groundwater	Groundwater	Tap Water	Ingestion	Chloroform	1.6E+00	ug/L	5.3E-06	mg/kg/day	3.1E-02	mg/kg/day	1.6E-07	N/A		N/A		N/A
				cis-1,2-Dichloroethene	3.2E+00	ug/L	1.1E-05	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Trichloroethene (†)	2.4E+01	ug/L	N/A		N/A		N/A	N/A		N/A		N/A
				Trichloroethene (Kidney)[4]	2.4E+01	ug/L			9.3E-03	mg/kg/day	3.0E-06	N/A		N/A		N/A
				Trichloroethene (NHL + Liver)	2.4E+01	ug/L	7.9E-05	mg/kg/day	3.7E-02	mg/kg/day	2.9E-06	N/A		N/A		N/A
				2,4-Dinitrotoluene	8.7E-01	ug/L	2.9E-06	mg/kg/day	3.1E-01	mg/kg/day	8.9E-07	N/A		N/A		N/A
				2,6-Dinitrotoluene	3.9E-01	ug/L	1.3E-06	mg/kg/day	1.5E+00	mg/kg/day	1.9E-06	N/A		N/A		N/A
				4,4'-DDD	3.2E-02	ug/L	1.0E-07	mg/kg/day	2.4E-01	mg/kg/day	2.5E-08	N/A		N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	7.6E-07	mg/kg/day	1.7E-02	mg/kg/day	1.3E-08	N/A		N/A		N/A
				Arsenic	3.9E+00	ug/L	1.3E-05	mg/kg/day	1.5E+00	mg/kg/day	1.9E-05	N/A		N/A		N/A
				Cadmium	1.2E+00	ug/L	3.8E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Chromium[4]	2.5E+00	ug/L			5.0E-01	mg/kg/day	1.7E-05	N/A		N/A		N/A
				Cobalt	4.0E+00	ug/L	1.3E-05	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.6E+02	ug/L	5.1E-04	mg/kg/day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								4.5E-05					N/A
			Dermal Absorption[1]	Chloroform	1.6E+00	ug/L	8.2E-07	mg/kg/day	3.1E-02	mg/kg/day	2.5E-08	N/A		N/A		N/A
				cis-1,2-Dichloroethene	3.2E+00	ug/L	1.6E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Trichloroethene (†)	2.4E+01	ug/L	N/A		N/A		N/A	N/A		N/A		N/A
				Trichloroethene (Kidney)[4]	2.4E+01	ug/L			9.3E-03	mg/kg/day	9.0E-07	N/A		N/A		N/A
				Trichloroethene (NHL + Liver)	2.4E+01	ug/L	2.2E-05	mg/kg/day	3.7E-02	mg/kg/day	8.3E-07	N/A		N/A		N/A
				2,4-Dinitrotoluene	8.7E-01	ug/L	3.0E-07	mg/kg/day	3.1E-01	mg/kg/day	9.3E-08	N/A		N/A		N/A

TABLE 7.3.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater (cont'd)	Groundwater	Tap Water	Dermal Absorption[1]	2,6-Dinitrotoluene	3.9E-01	ug/L	9.2E-08	mg/kg/day	1.5E+00	mg/kg/day	1.4E-07	N/A		N/A		N/A
				4,4'-DDD	3.2E-02	ug/L	1.3E-06	mg/kg/day	2.4E-01	mg/kg/day	3.0E-07	N/A		N/A		N/A
				Nitroglycerin	2.3E-01	ug/L	3.4E-08	mg/kg/day	1.7E-02	mg/kg/day	5.8E-10	N/A		N/A		N/A
				Arsenic	3.9E+00	ug/L	8.6E-08	mg/kg/day	1.5E+00	mg/kg/day	1.3E-07	N/A		N/A		N/A
				Cadmium	1.2E+00	ug/L	2.5E-08	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Chromium[4]	2.5E+00	ug/L			2.0E+01	mg/kg/day	4.8E-06	N/A		N/A		N/A
				Cobalt	4.0E+00	ug/L	3.5E-08	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.6E+02	ug/L	3.4E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								7.2E-06					N/A
		Exposure Point Total									5.2E-05					N/A
	Exposure Medium Total										5.2E-05					N/A
	Air	Water Vapors at Showerhead	Inhalation[3]	Chloroform	1.3E-01	ug/m^3	1.6E-02	mg/kg/day	2.3E-05	$(ug/m^3)^{-1}$	3.7E-07	N/A		N/A		N/A
				cis-1,2-Dichloroethene	2.9E-01	ug/m^3	3.6E-02	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Trichloroethene	2.0E+00	ug/m^3	2.4E-01	mg/kg/day	4.1E-06	$(ug/m^3)^{-1}$	9.9E-07	N/A		N/A		N/A
			Exp. Route Total								1.4E-06					N/A
		Exposure Point Total									1.4E-06					N/A
		Vapor Intrusion into Indoor Air	Inhalation	Chloroform	1.6E-01	ug/m^3	1.6E-02	ug/m^3	2.3E-05	$(ug/m^3)^{-1}$	3.7E-07	N/A		N/A		N/A
				Trichloroethene (†)	1.3E+01	ug/m^3	N/A		N/A		N/A	N/A		N/A		N/A
				Trichloroethene (Kidney)[4]	1.3E+01	ug/m^3	1.4E+00	ug/m^3	1.0E-06	$(ug/m^3)^{-1}$	1.1E-05	N/A		N/A		N/A
				Trichloroethene (NHL + Liver)	1.3E+01	ug/m^3	1.4E+00	ug/m^3	3.1E-06	$(ug/m^3)^{-1}$	4.3E-06	N/A		N/A		N/A
			Exp. Route Total								1.5E-05					N/A
		Exposure Point Total									1.5E-05					N/A
	Exposure Medium Total										1.7E-05					N/A
Groundwater Total											6.9E-05					N/A
										Total of Receptor Risk	9.6E-05				Total of Receptor Hazard	N/A

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.
DABs of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

DAevent for exposure to groundwater calculated on Table 7.1.RME Supplement A and Table 7.2.RME Supplement A.

[2] See Table 7.3.CTE Supplement A for calculation of intake and cancer risk following MMOA method.

[3] Children are not assumed to shower. Inhalation while showering pathway calculated for adult only. Inhalation exposure for groundwater while showering calculated on Table 7.1.CTE Supplement B.

[4] See Table 7.3.CTE Supplement A for calculation of intake and cancer risk following MMOA method.

† Carcinogenic risks were estimated for TCE by summing the risks for two different approaches: 1) Using the oral slope factor for kidney cancer, which has a mutagenic mode of action, and 2) using the oral slope factor for liver cancer and non-Hodgkin lymphoma (NHL).

TABLE 7.3.CTE Supplement A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations								
							Intake				CSF/Unit Risk				Cancer Risk
					Value	Units	Value			Units	Value			Units	
							0-2 yrs	2-6 yrs	6-15 yrs		0-2 yrs (ADAF=10)	2-6 yrs (ADAF=3)	6-15 yrs (ADAF=3)		
Soil	Soil	Site 7	Ingestion	Chromium	1.7E+01	mg/kg	1.4E-06	2.8E-06	5.1E-07	mg/kg-day	5.0E+00	1.5E+00	1.5E+00	1/(mg/kg-day)	1.2E-05
			Dermal	Chromium	1.7E+01	mg/kg	3.2E-08	6.5E-08	1.5E-08	mg/kg-day	2.0E+02	6.0E+01	6.0E+01	1/(mg/kg-day)	1.1E-05
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	ug/m^3	3.3E-07	6.7E-07	1.5E-06	ug/m^3	8.4E-01	2.5E-01	2.5E-01	$1/(ug/m^3)$	8.2E-07
Groundwater	Groundwater	Tap Water	Ingestion	Trichloroethene (Kidney) Chromium	2.4E+01 2.5E+00	ug/L ug/L	1.4E-05 1.4E-06	2.7E-05 2.8E-06	3.7E-05 3.8E-06	mg/kg/day mg/kg/day	9.3E-02 5.0E+00	2.8E-02 1.5E+00	2.8E-02 1.5E+00	1/(mg/kg/day) 1/(mg/kg/day)	3.0E-06 1.7E-05
			Dermal	Trichloroethene (Kidney) Chromium	2.4E+01 2.5E+00	ug/L ug/L	4.2E-06 1.1E-08	8.3E-06 2.1E-08	1.0E-05 2.2E-08	mg/kg/day mg/kg/day	9.3E-02 2.0E+02	2.8E-02 6.0E+01	2.8E-02 6.0E+01	1/(mg/kg/day) 1/(mg/kg/day)	9.0E-07 4.8E-06
		Vapor Intrusion Into Indoor Air	Inhalation	Trichloroethene (Kidney)	1.3E+01	ug/m^3	3.7E-01	7.3E-01	1.6E+00	ug/m^3	1.0E-05	3.0E-06	3.0E-06	$1/(ug/m^3)$	1.1E-05

[1] Children are not assumed to shower. Inhalation while showering pathway calculated for adult only.

Cancer risk = $(Intake_{0\text{-}2} \times CSF_{0\text{-}2}) + (Intake_{2\text{-}6} \times CSF_{2\text{-}6}) + (Intake_{6\text{-}15} \times CSF_{6\text{-}15})$

Notes:
ADAF = Age-dependent adjustment factor
CSF = Cancer slope factor
EPC = Exposure point concentration
mg/kg = milligram per kilogram
mg/kg-day = milligram per kilogram per day
ug/m^3 = micrograms per cubic meter
ug/L = micrograms per liter

TABLE 7.4.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 7	Ingestion	Aluminum	9.7E+03	mg/kg	4.7E-04	mg/kg-day	N/A		N/A	3.6E-03	mg/kg-day	1.0E+00	mg/kg-day	3.6E-03
				Arsenic	4.8E+00	mg/kg	2.3E-07	mg/kg-day	1.5E+00	1/mg/kg-day	3.4E-07	1.8E-06	mg/kg-day	3.0E-04	mg/kg-day	6.0E-03
				Chromium	1.7E+01	mg/kg	8.0E-07	mg/kg-day	5.0E-01	1/mg/kg-day	4.0E-07	6.2E-06	mg/kg-day	3.0E-03	mg/kg-day	2.1E-03
				Cobalt	2.8E+00	mg/kg	1.4E-07	mg/kg-day	N/A		N/A	1.1E-06	mg/kg-day	3.0E-04	mg/kg-day	3.5E-03
				Iron	1.9E+04	mg/kg	9.1E-04	mg/kg-day	N/A		N/A	7.1E-03	mg/kg-day	7.0E-01	mg/kg-day	1.0E-02
				Manganese	1.3E+02	mg/kg	6.5E-06	mg/kg-day	N/A		N/A	5.0E-05	mg/kg-day	2.4E-02	mg/kg-day	2.1E-03
				Thallium	7.4E-01	mg/kg	3.5E-08	mg/kg-day	N/A		N/A	2.8E-07	mg/kg-day	1.0E-05	mg/kg-day	2.8E-02
				Vanadium	2.5E+01	mg/kg	1.2E-06	mg/kg-day	N/A		N/A	9.4E-06	mg/kg-day	5.0E-03	mg/kg-day	1.9E-03
			Exp. Route Total								7.4E-07					5.7E-02
			Dermal Absorption[1]	Aluminum	9.7E+03	mg/kg	6.5E-06	mg/kg-day	N/A		N/A	5.0E-05	mg/kg-day	1.0E+00	mg/kg-day	5.0E-05
				Arsenic	4.8E+00	mg/kg	9.6E-09	mg/kg-day	1.5E+00	1/mg/kg-day	1.4E-08	7.4E-08	mg/kg-day	3.0E-04	mg/kg-day	2.5E-04
				Chromium	1.7E+01	mg/kg	1.1E-08	mg/kg-day	2.0E+01	1/mg/kg-day	2.2E-07	8.6E-08	mg/kg-day	7.5E-05	mg/kg-day	1.1E-03
				Cobalt	2.8E+00	mg/kg	1.9E-09	mg/kg-day	N/A		N/A	1.5E-08	mg/kg-day	3.0E-04	mg/kg-day	4.9E-05
				Iron	1.9E+04	mg/kg	1.3E-05	mg/kg-day	N/A		N/A	9.9E-05	mg/kg-day	7.0E-01	mg/kg-day	1.4E-04
				Manganese	1.3E+02	mg/kg	9.0E-08	mg/kg-day	N/A		N/A	7.0E-07	mg/kg-day	9.6E-04	mg/kg-day	7.3E-04
				Thallium	7.4E-01	mg/kg	4.9E-10	mg/kg-day	N/A		N/A	3.8E-09	mg/kg-day	1.0E-05	mg/kg-day	3.8E-04
				Vanadium	2.5E+01	mg/kg	1.7E-08	mg/kg-day	N/A		N/A	1.3E-07	mg/kg-day	1.3E-04	mg/kg-day	1.0E-03
			Exp. Route Total								2.4E-07					3.8E-03
		Exposure Point Total									9.8E-07					6.1E-02
	Exposure Medium Total										9.8E-07					6.1E-02
	Air	Emissions from Site 7 Soil	Inhalation	Chromium	1.2E-05	$\mu g/m^3$	3.1E-07	$\mu g/m^3$	8.4E-02	$(\mu g/m^3)^{-1}$	2.6E-08	2.4E-10	mg/m^3	1.0E-04	mg/m^3	2.4E-06
			Exp. Route Total								2.6E-08					2.4E-06
		Exposure Point Total									2.6E-08					2.4E-06
	Exposure Medium Total										2.6E-08					2.4E-06
Soil Total											1.0E-06					6.1E-02
Groundwater	Groundwater	Tap Water	Ingestion	Chloroform	1.6E+00	µg/L	7.7E-07	mg/kg-day	3.1E-02	1/mg/kg-day	2.4E-08	6.0E-06	mg/kg-day	1.0E-02	mg/kg-day	6.0E-04
				cis-1,2-Dichloroethene	3.2E+00	µg/L	1.5E-06	mg/kg-day	N/A		N/A	1.2E-05	mg/kg-day	2.0E-03	mg/kg-day	6.0E-03
				Trichloroethene	2.4E+01	µg/L	1.2E-05	mg/kg-day	4.6E-02	1/mg/kg-day	5.3E-07	9.0E-05	mg/kg-day	5.0E-04	mg/kg-day	1.8E-01
				2,4-Dinitrotoluene	8.7E-01	µg/L	4.2E-07	mg/kg-day	3.1E-01	1/mg/kg-day	1.3E-07	3.3E-06	mg/kg-day	2.0E-03	mg/kg-day	1.6E-03
				2,6-Dinitrotoluene	3.9E-01	µg/L	1.9E-07	mg/kg-day	1.5E+00	1/mg/kg-day	2.8E-07	1.5E-06	mg/kg-day	3.0E-04	mg/kg-day	4.9E-03
				4,4'-DDD	3.2E-02	µg/L	1.5E-08	mg/kg-day	2.4E-01	1/mg/kg-day	3.7E-09	1.2E-07	mg/kg-day	N/A		N/A
				Nitroglycerin	2.3E-01	µg/L	1.1E-07	mg/kg-day	1.7E-02	1/mg/kg-day	1.9E-09	8.7E-07	mg/kg-day	1.0E-04	mg/kg-day	8.7E-03
				Arsenic	3.9E+00	µg/L	1.9E-06	mg/kg-day	1.5E+00	1/mg/kg-day	2.8E-06	1.5E-05	mg/kg-day	3.0E-04	mg/kg-day	4.9E-02
				Cadmium	1.2E+00	µg/L	5.6E-07	mg/kg-day	N/A		N/A	4.3E-06	mg/kg-day	5.0E-04	mg/kg-day	8.7E-03
				Chromium	2.5E+00	µg/L	1.2E-06	mg/kg-day	5.0E-01	1/mg/kg-day	6.0E-07	9.3E-06	mg/kg-day	3.0E-03	mg/kg-day	3.1E-03
				Cobalt	4.0E+00	µg/L	1.9E-06	mg/kg-day	N/A		N/A	1.5E-05	mg/kg-day	3.0E-04	mg/kg-day	5.0E-02
				Manganese	1.6E+02	µg/L	7.5E-05	mg/kg-day	N/A		N/A	5.9E-04	mg/kg-day	2.4E-02	mg/kg-day	2.4E-02
			Exp. Route Total								4.4E-06					3.4E-01
		Exposure Point Total									4.4E-06					3.4E-01
	Exposure Medium Total										4.4E-06					3.4E-01

TABLE 7.4.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater (con't)	Air	Vapor Intrusion into Indoor Air	Inhalation	Trichloroethene	1.3E+01	ug/m^3	3.4E-01	ug/m^3	4.1E-06	(ug/m^3)$^{-1}$	1.4E-06	2.7E-03	mg/m^3	2.0E-03	mg/m^3	1.3E+00
			Exp. Route Total								1.4E-06					1.3E+00
		Exposure Point Total									1.4E-06					1.3E+00
	Exposure Medium Total										1.4E-06					1.3E+00
Groundwater Total											5.8E-06					1.7E+00
Total of Receptor Risks Across All Media											6.8E-06	Total of Receptor Hazards Across All Media				1.7E+00

Notes:

N/A =Not available; Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABs of 0.03 used for arsenic, DABS of 0.01 for all other inorganics.

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Receptor Population: Maintenance Worker/Landscaper
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	2E-03	N/A	7E-05	2E-03
			Arsenic	4E-07	N/A	5E-08	5E-07	Skin, Vascular	3E-03	N/A	3E-04	3E-03
			Chromium	5E-07	N/A	8E-07	1E-06	NOE	9E-04	N/A	2E-03	3E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-03	N/A	7E-05	2E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	5E-03	N/A	2E-04	5E-03
			Manganese	N/A	N/A	N/A	N/A	Neurological	1E-03	N/A	1E-03	2E-03
			Thallium	N/A	N/A	N/A	N/A	Hair	1E-02	N/A	5E-04	1E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	9E-04	N/A	1E-03	2E-03
			Chemical Total	9E-07	N/A	9E-07	2E-06		3E-02	N/A	5E-03	3E-02
		Exposure Point Total					2E-06					3E-02
	Exposure Medium Total						2E-06					3E-02
	Air	Emissions from Site 7 Soil	Chromium	N/A	2E-08	N/A	2E-08	Respiratory System	N/A	6E-06	N/A	6E-06
			Chemical Total	N/A	2E-08	N/A	2E-08		N/A	6E-06	N/A	6E-06
		Exposure Point Total					2E-08					6E-06
	Exposure Medium Total						2E-08					6E-06
Soil Total							2E-06					3E-02
Receptor Total							2E-06				Receptor HI Total	3E-02

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	4E-03
Total Skin HI Across All Media =	3E-03
Total Vascular HI Across All Media =	3E-03
Total Thyroid HI Across All Media =	2E-03
Total Gastrointestinal HI Across All Media =	2E-03
Total Hair HI Across All Media =	2E-02
Total Respiratory System HI Across All Media =	6E-06

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	2E-03	N/A	7E-05	2E-03
			Arsenic	4E-07	N/A	5E-08	4E-07	Skin, Vascular	3E-03	N/A	4E-04	3E-03
			Chromium	4E-07	N/A	7E-07	1E-06	NOE	1E-03	N/A	2E-03	3E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-03	N/A	7E-05	2E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	5E-03	N/A	2E-04	5E-03
			Manganese	N/A	N/A	N/A	N/A	Neurological	1E-03	N/A	1E-03	2E-03
			Thallium	N/A	N/A	N/A	N/A	Hair	1E-02	N/A	6E-04	1E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	9E-04	N/A	1E-03	2E-03
			Chemical Total	8E-07	N/A	8E-07	2E-06		3E-02	N/A	5E-03	3E-02
		Exposure Point Total					2E-06					3E-02
	Exposure Medium Total						2E-06					3E-02
	Air	Emissions from Site 7 Soil	Chromium	N/A	7E-09	N/A	7E-09	Respiratory System	N/A	3E-06	N/A	3E-06
			Chemical Total	N/A	7E-09	N/A	7E-09		N/A	3E-06	N/A	3E-06
		Exposure Point Total					7E-09					3E-06
	Exposure Medium Total						7E-09					3E-06
Soil Total							2E-06					3E-02
Receptor Total							2E-06				Receptor HI Total	3E-02

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	4E-03
Total Skin HI Across All Media =	3E-03
Total Vascular HI Across All Media =	3E-03
Total Thyroid HI Across All Media =	2E-03
Total Gastrointestinal HI Across All Media =	2E-03
Total Hair HI Across All Media =	2E-02
Total Respiratory System HI Across All Media =	3E-06

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	3E-03	N/A	3E-04	3E-03
			Arsenic	2E-07	N/A	8E-08	3E-07	Skin, Vascular	4E-03	N/A	1E-03	6E-03
			Chromium	8E-07	N/A	4E-06	5E-06	NOE	1E-03	N/A	7E-03	8E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-03	N/A	3E-04	3E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	7E-03	N/A	8E-04	8E-03
			Manganese	N/A	N/A	N/A	N/A	Neurological	1E-03	N/A	4E-03	6E-03
			Thallium	N/A	N/A	N/A	N/A	Hair	2E-02	N/A	2E-03	2E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	1E-03	N/A	6E-03	7E-03
			Chemical Total	1E-06	N/A	4E-06	5E-06		4E-02	N/A	2E-02	6E-02
		Exposure Point Total					5E-06					6E-02
	Exposure Medium Total						5E-06					6E-02
	Air	Emissions from Site 7 Soil	Chromium	N/A	9E-09	N/A	9E-09	Respiratory System	N/A	3E-06	N/A	3E-06
			Chemical Total	N/A	9E-09	N/A	9E-09		N/A	3E-06	N/A	3E-06
		Exposure Point Total					9E-09					3E-06
	Exposure Medium Total						9E-09					3E-06
Soil Total							5E-06					6E-02
Receptor Total							5E-06	Receptor HI Total				6E-02

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	9E-03
Total Skin HI Across All Media =	6E-03
Total Vascular HI Across All Media =	6E-03
Total Thyroid HI Across All Media =	3E-03
Total Gastrointestinal HI Across All Media =	8E-03
Total Hair HI Across All Media =	3E-02
Total Respiratory System HI Across All Media =	3E-06

TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	2E-03	N/A	7E-05	2E-03
			Arsenic	4E-07	N/A	5E-08	4E-07	Skin, Vascular	3E-03	N/A	4E-04	3E-03
			Chromium	4E-07	N/A	7E-07	1E-06	NOE	1E-03	N/A	2E-03	3E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-03	N/A	7E-05	2E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	5E-03	N/A	2E-04	5E-03
			Manganese	N/A	N/A	N/A	N/A	Neurological	1E-03	N/A	1E-03	2E-03
			Thallium	N/A	N/A	N/A	N/A	Hair	1E-02	N/A	6E-04	1E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	9E-04	N/A	1E-03	2E-03
			Chemical Total	8E-07	N/A	8E-07	2E-06		3E-02	N/A	5E-03	3E-02
		Exposure Point Total					2E-06					3E-02
	Exposure Medium Total						2E-06					3E-02
	Air	Emissions from Site 7 Soil	Chromium	N/A	7E-09	N/A	7E-09	Respiratory System	N/A	3E-06	N/A	3E-06
			Chemical Total	N/A	7E-09	N/A	7E-09		N/A	3E-06	N/A	3E-06
		Exposure Point Total					7E-09					3E-06
	Exposure Medium Total						7E-09					3E-06
Soil Total							2E-06					3E-02
Receptor Total							2E-06	Receptor HI Total				3E-02

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	4E-03
Total Skin HI Across All Media =	3E-03
Total Vascular HI Across All Media =	3E-03
Total Thyroid HI Across All Media =	2E-03
Total Gastrointestinal HI Across All Media =	5E-03
Total Hair HI Across All Media =	2E-02
Total Respiratory System HI Across All Media =	3E-06

TABLE 9.5.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	3E-03	N/A	3E-04	3E-03
			Arsenic	2E-07	N/A	8E-08	3E-07	Skin, Vascular	4E-03	N/A	1E-03	6E-03
			Chromium	8E-07	N/A	4E-06	5E-06	NOE	1E-03	N/A	7E-03	8E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-03	N/A	3E-04	3E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	7E-03	N/A	8E-04	8E-03
			Manganese	N/A	N/A	N/A	N/A	Neurological	1E-03	N/A	4E-03	6E-03
			Thallium	N/A	N/A	N/A	N/A	Hair	2E-02	N/A	2E-03	2E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	1E-03	N/A	6E-03	7E-03
			Chemical Total	1E-06	N/A	4E-06	5E-06		4E-02	N/A	2E-02	6E-02
		Exposure Point Total					5E-06					6E-02
	Exposure Medium Total						5E-06					6E-02
	Air	Emissions from Site 7 Soil	Chromium	N/A	9E-09	N/A	9E-09	Respiratory System	N/A	3E-06	N/A	3E-06
			Chemical Total	N/A	9E-09	N/A	9E-09		N/A	3E-06	N/A	3E-06
		Exposure Point Total					9E-09					3E-06
	Exposure Medium Total						9E-09					3E-06
Soil Total							5E-06					6E-02
Receptor Total							5E-06	Receptor HI Total				6E-02

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	9E-03
Total Skin HI Across All Media =	6E-03
Total Vascular HI Across All Media =	6E-03
Total Thyroid HI Across All Media =	3E-03
Total Gastrointestinal HI Across All Media =	8E-03
Total Hair HI Across All Media =	3E-02
Total Respiratory System HI Across All Media =	3E-06

TABLE 9.6.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	2E-02	N/A	5E-04	2E-02
			Arsenic	1E-06	N/A	9E-08	1E-06	Skin, Vascular	3E-02	N/A	2E-03	3E-02
			Chromium	7E-06	N/A	8E-06	1E-05	NOE	1E-02	N/A	1E-02	2E-02
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-02	N/A	5E-04	2E-02
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	5E-02	N/A	1E-03	5E-02
			Manganese	N/A	N/A	N/A	N/A	Neurological	1E-02	N/A	7E-03	2E-02
			Thallium	N/A	N/A	N/A	N/A	Hair	1E-01	N/A	4E-03	1E-01
			Vanadium	N/A	N/A	N/A	N/A	Hair	1E-02	N/A	1E-02	2E-02
			Chemical Total	8E-06	N/A	8E-06	2E-05		3E-01	N/A	4E-02	3E-01
		Exposure Point Total					2E-05					3E-01
	Exposure Medium Total						2E-05					3E-01
	Air	Emissions from Site 7 Soil	Chromium	N/A	1E-08	N/A	1E-08	Respiratory System	N/A	3E-06	N/A	3E-06
			Chemical Total	N/A	1E-08	N/A	1E-08		N/A	3E-06	N/A	3E-06
		Exposure Point Total					1E-08					3E-06
	Exposure Medium Total						1E-08					3E-06
Soil Total							2E-05					3E-01
Receptor Total							2E-05	Receptor HI Total				3E-01

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	4E-02
Total Skin HI Across All Media =	3E-02
Total Vascular HI Across All Media =	3E-02
Total Thyroid HI Across All Media =	2E-02
Total Gastrointestinal HI Across All Media =	5E-02
Total Hair HI Across All Media =	2E-01
Total Respiratory System HI Across All Media =	3E-06

TABLE 9.7.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	1E-02	N/A	5E-04	1E-02
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	2E-02	N/A	2E-03	2E-02
			Chromium	N/A	N/A	N/A	N/A	NOE	7E-03	N/A	1E-02	2E-02
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	1E-02	N/A	5E-04	1E-02
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	3E-02	N/A	1E-03	3E-02
			Manganese	N/A	N/A	N/A	N/A	Neurological	7E-03	N/A	7E-03	1E-02
			Thallium	N/A	N/A	N/A	N/A	Hair	9E-02	N/A	4E-03	9E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	6E-03	N/A	1E-02	2E-02
			Chemical Total	N/A	N/A	N/A	N/A		2E-01	N/A	4E-02	2E-01
		Exposure Point Total					N/A					2E-01
	Exposure Medium Total						N/A					2E-01
	Air	Emissions from Site 7 Soil	Chromium	N/A	N/A	N/A	N/A	Respiratory System	N/A	1E-04	N/A	1E-04
			Chemical Total	N/A	N/A	N/A	N/A		N/A	1E-04	N/A	1E-04
		Exposure Point Total					N/A					1E-04
	Exposure Medium Total						N/A					1E-04
Soil Total							N/A					2E-01
Groundwater	Groundwater	Tap Water	Chloroform	N/A	N/A	N/A	N/A	Liver	5E-03	N/A	5E-04	5E-03
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A	Kidney	5E-02	N/A	4E-03	5E-02
			Trichloroethene	N/A	N/A	N/A	N/A	Immune System, Developmental, Heart	1E+00	N/A	2E-01	2E+00
			2,4-Dinitrotoluene	N/A	N/A	N/A	N/A	Neurological, Blood, Biliary Tract	1E-02	N/A	8E-04	1E-02
			2,6-Dinitrotoluene	N/A	N/A	N/A	N/A	Spleen	4E-02	N/A	2E-03	4E-02
			4,4'-DDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Nitroglycerin	N/A	N/A	N/A	N/A	Blood	7E-02	N/A	2E-03	7E-02
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	4E-01	N/A	2E-03	4E-01
			Cadmium	N/A	N/A	N/A	N/A	Proteinuria (Kidney)	7E-02	N/A	8E-03	8E-02
			Chromium	N/A	N/A	N/A	N/A	NOE	2E-02	N/A	6E-03	3E-02
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	4E-01	N/A	9E-04	4E-01
			Manganese	N/A	N/A	N/A	N/A	Neurological	2E-01	N/A	3E-02	2E-01
			Chemical Total	N/A	N/A	N/A	N/A		3E+00	N/A	3E-01	3E+00
		Exposure Point Total					N/A					3E+00
	Exposure Medium Total						N/A					3E+00

TABLE 9.7.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater (cont'd)	Air	Water Vapors at Showerhead	Chloroform	N/A	N/A	N/A	N/A	Liver	N/A	1E-03	N/A	1E-03
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	9E-01	N/A	9E-01
			Chemical Total	N/A	N/A	N/A	N/A		N/A	9E-01	N/A	9E-01
		Exposure Point Total					N/A					9E-01
		Vapor Intrusion Into Indoor Air	Chloroform	N/A	N/A	N/A	N/A	Liver	N/A	2E-03	N/A	2E-03
			Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	6E+00	N/A	6E+00
			Chemical Total	N/A	N/A	N/A	N/A		N/A	6E+00	N/A	6E+00
		Exposure Point Total					N/A					6E+00
	Exposure Medium Total						N/A					7E+00
Groundwater Total							N/A					1E+01
Receptor Total							N/A	Receptor HI Total				1E+01

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	3E-01
Total Skin HI Across All Media =	4E-01
Total Vascular HI Across All Media =	4E-01
Total Thyroid HI Across All Media =	4E-01
Total Gastrointestinal HI Across All Media =	3E-02
Total Hair HI Across All Media =	1E-01
Total Respiratory System HI Across All Media =	1E-04
Total Liver HI Across All Media =	8E-03
Total Kidney HI Across All Media =	1E-01
Total Immune System/Immunotoxicity HI Across All Media =	**9E+00**
Total Developmental HI Across All Media =	**2E+00**
Total Heart HI Across All Media =	**9E+00**
Total Blood HI Across All Media =	9E-02
Total Biliary Tract HI Across All Media =	1E-02
Total Spleen HI Across All Media =	4E-02

TABLE 9.8.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	1E-01	N/A	3E-03	1E-01
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	2E-01	N/A	2E-02	2E-01
			Chromium	N/A	N/A	N/A	N/A	NOE	7E-02	N/A	8E-02	1E-01
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	1E-01	N/A	3E-03	1E-01
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	3E-01	N/A	9E-03	4E-01
			Manganese	N/A	N/A	N/A	N/A	Neurological	7E-02	N/A	5E-02	1E-01
			Thallium	N/A	N/A	N/A	N/A	Hair	9E-01	N/A	3E-02	1E+00
			Vanadium	N/A	N/A	N/A	N/A	Hair	6E-02	N/A	7E-02	1E-01
			Chemical Total	N/A	N/A	N/A	N/A		2E+00	N/A	2E-01	2E+00
		Exposure Point Total					N/A					2E+00
	Exposure Medium Total						N/A					2E+00
	Air	Emissions from Site 7 Soil	Chromium	N/A	N/A	N/A	N/A	Respiratory System	N/A	1E-04	N/A	1E-04
			Chemical Total	N/A	N/A	N/A	N/A		N/A	1E-04	N/A	1E-04
		Exposure Point Total					N/A					1E-04
	Exposure Medium Total						N/A					1E-04
Soil Total							N/A					2E+00
Groundwater	Groundwater	Tap Water	Chloroform	N/A	N/A	N/A	N/A	Liver	8E-03	N/A	6E-04	9E-03
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A	Kidney	8E-02	N/A	6E-03	9E-02
			Trichloroethene	N/A	N/A	N/A	N/A	Immune System, Developmental, Heart	2E+00	N/A	4E-01	3E+00
			2,4-Dinitrotoluene	N/A	N/A	N/A	N/A	Neurological, Blood, Biliary Tract	2E-02	N/A	1E-03	2E-02
			2,6-Dinitrotoluene	N/A	N/A	N/A	N/A	Spleen	6E-02	N/A	2E-03	7E-02
			4,4'-DDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Nitroglycerin	N/A	N/A	N/A	N/A	Blood	1E-01	N/A	3E-03	1E-01
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	7E-01	N/A	3E-03	7E-01
			Cadmium	N/A	N/A	N/A	N/A	Proteinuria (Kidney)	1E-01	N/A	1E-02	1E-01
			Chromium	N/A	N/A	N/A	N/A	NOE	4E-02	N/A	7E-03	5E-02
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	7E-01	N/A	1E-03	7E-01
			Manganese	N/A	N/A	N/A	N/A	Neurological	3E-01	N/A	4E-02	4E-01
			Chemical Total	N/A	N/A	N/A	N/A		4E+00	N/A	4E-01	5E+00
		Exposure Point Total					N/A					5E+00
	Exposure Medium Total						N/A					5E+00

TABLE 9.8.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater (cont'd)	Air	Vapor Intrusion Into Indoor Air	Chloroform	N/A	N/A	N/A	N/A	Liver	N/A	2E-03	N/A	2E-03
			Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	6E+00	N/A	6E+00
			Chemical Total	N/A	N/A	N/A	N/A		N/A	6E+00	N/A	6E+00
		Exposure Point Total					N/A					6E+00
	Exposure Medium Total						N/A					6E+00
Groundwater Total							N/A					1E+01
Receptor Total							N/A	Receptor HI Total				1E+01

Notes:
N/A = Not applicable
HI = Hazard Index
NOE = No observed effects

Total Neurological HI Across All Media =	6E-01
Total Skin HI Across All Media =	9E-01
Total Vascular HI Across All Media =	9E-01
Total Thyroid HI Across All Media =	8E-01
Total Gastrointestinal HI Across All Media =	4E-01
Total Hair HI Across All Media =	1E+00
Total Respiratory System HI Across All Media =	1E-04
Total Liver HI Across All Media =	1E-02
Total Kidney HI Across All Media =	2E-01
Total Immune System/Immunotoxicity HI Across All Media =	**9E+00**
Total Developmental HI Across All Media =	**3E+00**
Total Heart HI Across All Media =	**9E+00**
Total Blood HI Across All Media =	1E-01
Total Biliary Tract HI Across All Media =	2E-02
Total Spleen HI Across All Media =	7E-02

TABLE 9.9.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Arsenic	1E-05	N/A	9E-07	1E-05		N/A	N/A	N/A	N/A
			Chromium	5E-05	N/A	6E-05	1E-04		N/A	N/A	N/A	N/A
			Cobalt	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Iron	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Manganese	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Thallium	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Vanadium	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Chemical Total	6E-05	N/A	6E-05	1E-04		N/A	N/A	N/A	N/A
		Exposure Point Total					1E-04					N/A
	Exposure Medium Total						1E-04					N/A
	Air	Emissions from Site 7 Soil	Chromium	N/A	1E-06	N/A	1E-06		N/A	N/A	N/A	N/A
			Chemical Total	N/A	1E-06	N/A	1E-06		N/A	N/A	N/A	N/A
		Exposure Point Total					1E-06					N/A
	Exposure Medium Total						1E-06					N/A
Soil Total							1E-04					N/A
Groundwater	Groundwater	Tap Water	Chloroform	6E-07	N/A	6E-08	7E-07		N/A	N/A	N/A	N/A
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Trichloroethene	2E-05	N/A	3E-06	2E-05		N/A	N/A	N/A	N/A
			2,4-Dinitrotoluene	3E-06	N/A	2E-07	4E-06		N/A	N/A	N/A	N/A
			2,6-Dinitrotoluene	8E-06	N/A	3E-07	8E-06		N/A	N/A	N/A	N/A
			4,4'-DDD	1E-07	N/A	7E-07	8E-07		N/A	N/A	N/A	N/A
			Nitroglycerin	5E-08	N/A	1E-09	5E-08		N/A	N/A	N/A	N/A
			Arsenic	8E-05	N/A	4E-07	8E-05		N/A	N/A	N/A	N/A
			Cadmium	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Chromium	5E-05	N/A	1E-05	6E-05		N/A	N/A	N/A	N/A
			Cobalt	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Manganese	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Chemical Total	2E-04	N/A	2E-05	2E-04		N/A	N/A	N/A	N/A
		Exposure Point Total					2E-04					N/A
	Exposure Medium Total						2E-04					N/A

TABLE 9.9.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater (cont'd)	Air	Water Vapors at Showerhead	Chloroform	N/A	8E-07	N/A	8E-07		N/A	N/A	N/A	N/A
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Trichloroethene	N/A	2E-06	N/A	2E-06		N/A	N/A	N/A	N/A
			Chemical Total	N/A	3E-06	N/A	3E-06		N/A	N/A	N/A	N/A
		Exposure Point Total					3E-06					N/A
		Vapor Intrusion Into Indoor Air	Chloroform	N/A	1E-06	N/A	1E-06		N/A	N/A	N/A	N/A
			Trichloroethene	N/A	2E-05	N/A	2E-05		N/A	N/A	N/A	N/A
			Chemical Total	N/A	3E-05	N/A	3E-05		N/A	N/A	N/A	N/A
		Exposure Point Total					3E-05					N/A
	Exposure Medium Total						3E-05					N/A
Groundwater Total							2E-04					N/A
Receptor Total							3E-04				Receptor HI Total	N/A

Notes:

N/A = Not applicable

HI = Hazard Index

TABLE 9.10.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	4E-03	N/A	3E-04	4E-03
			Arsenic	1E-06	N/A	3E-07	1E-06	Skin, Vascular	7E-03	N/A	2E-03	8E-03
			Chromium	1E-06	N/A	4E-06	5E-06	NOE	2E-03	N/A	8E-03	1E-02
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	4E-03	N/A	3E-04	4E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	1E-02	N/A	1E-03	1E-02
			Manganese	N/A	N/A	N/A	N/A	Neurological	2E-03	N/A	5E-03	7E-03
			Thallium	N/A	N/A	N/A	N/A	Hair	3E-02	N/A	3E-03	3E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	2E-03	N/A	7E-03	9E-03
			Chemical Total	2E-06	N/A	4E-06	7E-06		6E-02	N/A	3E-02	9E-02
		Exposure Point Total					7E-06					9E-02
	Exposure Medium Total						7E-06					9E-02
	Air	Emissions from Site 7 Soil	Chromium	N/A	8E-08	N/A	8E-08	Respiratory System	N/A	3E-05	N/A	3E-05
			Chemical Total	N/A	8E-08	N/A	8E-08		N/A	3E-05	N/A	3E-05
		Exposure Point Total					8E-08					3E-05
	Exposure Medium Total						8E-08					3E-05
Soil Total							7E-06					9E-02
Groundwater	Groundwater	Tap Water	Chloroform	2E-07	N/A	N/A	2E-07	Liver	2E-03	N/A	N/A	2E-03
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A	Kidney	2E-02	N/A	N/A	2E-02
			Trichloroethene	4E-06	N/A	N/A	4E-06	Immune System, Developmental, Heart	5E-01	N/A	N/A	5E-01
			2,4-Dinitrotoluene	1E-06	N/A	N/A	1E-06	Neurological, Blood, Biliary Tract	5E-03	N/A	N/A	5E-03
			2,6-Dinitrotoluene	2E-06	N/A	N/A	2E-06	Spleen	1E-02	N/A	N/A	1E-02
			4,4'-DDD	3E-08	N/A	N/A	3E-08	N/A	N/A	N/A	N/A	N/A
			Nitroglycerin	2E-08	N/A	N/A	2E-08	Blood	2E-02	N/A	N/A	2E-02
			Arsenic	2E-05	N/A	N/A	2E-05	Skin, Vascular	1E-01	N/A	N/A	1E-01
			Cadmium	N/A	N/A	N/A	N/A	Proteinuria (Kidney)	2E-02	N/A	N/A	2E-02
			Chromium	5E-06	N/A	N/A	5E-06	NOE	9E-03	N/A	N/A	9E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	1E-01	N/A	N/A	1E-01
			Manganese	N/A	N/A	N/A	N/A	Neurological	7E-02	N/A	N/A	7E-02
			Chemical Total	3E-05	N/A	N/A	3E-05		1E+00	N/A	N/A	1E+00
		Exposure Point Total					3E-05					1E+00
	Exposure Medium Total						3E-05					1E+00

TABLE 9.10.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Air	Vapor Intrusion Into Indoor Air	Trichloroethene	N/A	4E-06	N/A	4E-06	Immunotoxicity, Heart	N/A	2E+00	N/A	2E+00
			Chemical Total	N/A	4E-06	N/A	4E-06		N/A	2E+00	N/A	2E+00
		Exposure Point Total					4E-06					2E+00
	Exposure Medium Total						4E-06					2E+00
Groundwater Total							4E-05					3E+00
Receptor Total							5E-05	Receptor HI Total				3E+00

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	9E-02
Total Skin HI Across All Media =	1E-01
Total Vascular HI Across All Media =	1E-01
Total Thyroid HI Across All Media =	1E-01
Total Gastrointestinal HI Across All Media =	1E-02
Total Hair HI Across All Media =	4E-02
Total Respiratory System HI Across All Media =	3E-05
Total Liver HI Across All Media =	2E-03
Total Kidney HI Across All Media =	4E-02
Total Immune System/Immunotoxicity HI Across All Media =	**3E+00**
Total Developmental HI Across All Media =	5E-01
Total Heart HI Across All Media =	**3E+00**
Total Blood HI Across All Media =	3E-02
Total Biliary Tract HI Across All Media =	5E-03
Total Spleen HI Across All Media =	1E-02

TABLE 9.11.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	1E-02	N/A	2E-04	1E-02
			Arsenic	1E-07	N/A	5E-09	1E-07	Skin, Vascular	2E-02	N/A	8E-04	2E-02
			Chromium	2E-07	N/A	8E-08	3E-07	Blood	5E-03	N/A	2E-03	7E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	1E-03	N/A	2E-05	1E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	4E-02	N/A	5E-04	4E-02
			Manganese	N/A	N/A	N/A	N/A	Neurological	8E-03	N/A	2E-03	1E-02
			Thallium	N/A	N/A	N/A	N/A	Hair	3E-02	N/A	3E-04	3E-02
			Vanadium	N/A	N/A	N/A	N/A	Blood	4E-03	N/A	3E-04	4E-03
			Chemical Total	3E-07	N/A	9E-08	4E-07		1E-01	N/A	7E-03	1E-01
		Exposure Point Total					4E-07					1E-01
	Exposure Medium Total						4E-07					1E-01
	Air	Emissions from Site 7 Soil	Chromium	N/A	2E-09	N/A	2E-09	Respiratory System	N/A	5E-06	N/A	5E-06
			Chemical Total	N/A	2E-09	N/A	2E-09		N/A	5E-06	N/A	5E-06
		Exposure Point Total					2E-09					5E-06
	Exposure Medium Total						2E-09					5E-06
Soil Total							4E-07					1E-01
Receptor Total							4E-07				Receptor HI Total	1E-01

Notes:

N/A = Not applicable

HI = Hazard Index

Total Neurological HI Across All Media =	2E-02
Total Skin HI Across All Media =	2E-02
Total Vascular HI Across All Media =	2E-02
Total Thyroid HI Across All Media =	1E-03
Total Gastrointestinal HI Across All Media =	1E-02
Total Hair HI Across All Media =	3E-02
Total Respiratory System HI Across All Media =	5E-06
Total Blood HI Across All Media =	1E-02

TABLE 9.1.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	2E-03	N/A	7E-05	2E-03
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	4E-03	N/A	3E-04	4E-03
			Chromium	N/A	N/A	N/A	N/A	NOE	1E-03	N/A	2E-03	3E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-03	N/A	7E-05	2E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	6E-03	N/A	2E-04	7E-03
			Manganese	N/A	N/A	N/A	N/A	Neurological	1E-03	N/A	1E-03	2E-03
			Thallium	N/A	N/A	N/A	N/A	Hair	2E-02	N/A	5E-04	2E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	1E-03	N/A	1E-03	3E-03
			Chemical Total	N/A	N/A	N/A	N/A		4E-02	N/A	5E-03	4E-02
		Exposure Point Total					N/A					4E-02
	Exposure Medium Total						N/A					4E-02
	Air	Emissions from Site 7 Soil	Chromium	N/A	N/A	N/A	N/A	Respiratory System	N/A	1E-04	N/A	1E-04
			Chemical Total	N/A	N/A	N/A	N/A		N/A	1E-04	N/A	1E-04
		Exposure Point Total					N/A					1E-04
	Exposure Medium Total						N/A					1E-04
Soil Total							N/A					4E-02
Groundwater	Groundwater	Tap Water	Chloroform	N/A	N/A	N/A	N/A	Liver	2E-03	N/A	3E-04	2E-03
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A	Kidney	2E-02	N/A	3E-03	2E-02
			Trichloroethene	N/A	N/A	N/A	N/A	Immune System, Developmental, Heart	6E-01	N/A	2E-01	7E-01
			2,4-Dinitrotoluene	N/A	N/A	N/A	N/A	Neurological, Blood, Biliary Tract	5E-03	N/A	5E-04	6E-03
			2,6-Dinitrotoluene	N/A	N/A	N/A	N/A	Spleen	2E-02	N/A	1E-03	2E-02
			4,4'-DDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Nitroglycerin	N/A	N/A	N/A	N/A	Blood	3E-02	N/A	1E-03	3E-02
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	2E-01	N/A	9E-04	2E-01
			Cadmium	N/A	N/A	N/A	N/A	Proteinuria (Kidney)	3E-02	N/A	3E-03	3E-02
			Chromium	N/A	N/A	N/A	N/A	NOE	1E-02	N/A	2E-03	1E-02
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-01	N/A	4E-04	2E-01
			Manganese	N/A	N/A	N/A	N/A	Neurological	8E-02	N/A	1E-02	9E-02
			Chemical Total	N/A	N/A	N/A	N/A		1E+00	N/A	2E-01	1E+00
		Exposure Point Total					N/A					1E+00
	Exposure Medium Total						N/A					1E+00

TABLE 9.1.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater (cont'd)	Air	Water Vapors at Showerhead	Chloroform	N/A	N/A	N/A	N/A	Liver	N/A	5E-04	N/A	5E-04
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	4E-01	N/A	4E-01
			Chemical Total	N/A	N/A	N/A	N/A		N/A	4E-01	N/A	4E-01
		Exposure Point Total					N/A					4E-01
		Vapor Intrusion Into Indoor Air	Chloroform	N/A	N/A	N/A	N/A	Liver	N/A	2E-03	N/A	2E-03
			Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	6E+00	N/A	6E+00
			Chemical Total	N/A	N/A	N/A	N/A		N/A	6E+00	N/A	6E+00
		Exposure Point Total					N/A					6E+00
	Exposure Medium Total						N/A					7E+00
Groundwater Total							N/A					8E+00
Receptor Total							N/A	Receptor HI Total				8E+00

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	1E-01
Total Skin HI Across All Media =	2E-01
Total Vascular HI Across All Media =	2E-01
Total Thyroid HI Across All Media =	2E-01
Total Gastrointestinal HI Across All Media =	7E-03
Total Hair HI Across All Media =	2E-02
Total Respiratory System HI Across All Media =	1E-04
Total Liver HI Across All Media =	4E-03
Total Kidney HI Across All Media =	5E-02
Total Immune System/Immunotoxicity HI Across All Media =	**8E+00**
Total Developmental HI Across All Media =	7E-01
Total Heart HI Across All Media =	**8E+00**
Total Blood HI Across All Media =	3E-02
Total Biliary Tract HI Across All Media =	6E-03
Total Spleen HI Across All Media =	2E-02

TABLE 9.2.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	3E-02	N/A	7E-04	3E-02
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	5E-02	N/A	3E-03	5E-02
			Chromium	N/A	N/A	N/A	N/A	NOE	2E-02	N/A	2E-02	3E-02
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	3E-02	N/A	6E-04	3E-02
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	8E-02	N/A	2E-03	8E-02
			Manganese	N/A	N/A	N/A	N/A	Neurological	2E-02	N/A	1E-02	3E-02
			Thallium	N/A	N/A	N/A	N/A	Hair	2E-01	N/A	5E-03	2E-01
			Vanadium	N/A	N/A	N/A	N/A	Hair	2E-02	N/A	1E-02	3E-02
			Chemical Total	N/A	N/A	N/A	N/A		5E-01	N/A	5E-02	5E-01
		Exposure Point Total					N/A					5E-01
	Exposure Medium Total						N/A					5E-01
	Air	Emissions from Site 7 Soil	Chromium	N/A	N/A	N/A	N/A	Respiratory System	N/A	1E-04	N/A	1E-04
			Chemical Total	N/A	N/A	N/A	N/A		N/A	1E-04	N/A	1E-04
		Exposure Point Total					N/A					1E-04
	Exposure Medium Total						N/A					1E-04
Soil Total							N/A					5E-01
Groundwater	Groundwater	Tap Water	Chloroform	N/A	N/A	N/A	N/A	Liver	3E-03	N/A	5E-04	4E-03
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A	Kidney	3E-02	N/A	5E-03	4E-02
			Trichloroethene	N/A	N/A	N/A	N/A	Immune System, Developmental, Heart	1E+00	N/A	3E-01	1E+00
			2,4-Dinitrotoluene	N/A	N/A	N/A	N/A	Neurological, Blood, Biliary Tract	9E-03	N/A	1E-03	1E-02
			2,6-Dinitrotoluene	N/A	N/A	N/A	N/A	Spleen	3E-02	N/A	2E-03	3E-02
			4,4'-DDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Nitroglycerin	N/A	N/A	N/A	N/A	Blood	5E-02	N/A	2E-03	5E-02
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	3E-01	N/A	2E-03	3E-01
			Cadmium	N/A	N/A	N/A	N/A	Proteinuria (Kidney)	5E-02	N/A	7E-03	5E-02
			Chromium	N/A	N/A	N/A	N/A	NOE	2E-02	N/A	5E-03	2E-02
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	3E-01	N/A	8E-04	3E-01
			Manganese	N/A	N/A	N/A	N/A	Neurological	1E-01	N/A	2E-02	2E-01
			Chemical Total	N/A	N/A	N/A	N/A		2E+00	N/A	3E-01	2E+00
		Exposure Point Total					N/A					2E+00
	Exposure Medium Total						N/A					2E+00

TABLE 9.2.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater (cont'd)	Air	Vapor Intrusion Into Indoor Air	Chloroform	N/A	N/A	N/A	N/A	Liver	N/A	2E-03	N/A	2E-03
			Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	6E+00	N/A	6E+00
			Chemical Total	N/A	N/A	N/A	N/A		N/A	6E+00	N/A	6E+00
		Exposure Point Total					N/A					6E+00
	Exposure Medium Total						N/A					6E+00
Groundwater Total							N/A					9E+00
Receptor Total							N/A				Receptor HI Total	9E+00

Notes:
N/A = Not applicable
HI = Hazard Index
NOE = No observed effects

Total Neurological HI Across All Media =	2E-01
Total Skin HI Across All Media =	3E-01
Total Vascular HI Across All Media =	3E-01
Total Thyroid HI Across All Media =	3E-01
Total Gastrointestinal HI Across All Media =	8E-02
Total Hair HI Across All Media =	3E-01
Total Respiratory System HI Across All Media =	1E-04
Total Liver HI Across All Media =	5E-03
Total Kidney HI Across All Media =	9E-02
Total Immune System/Immunotoxicity HI Across All Media =	**8E+00**
Total Developmental HI Across All Media =	1E+00
Total Heart HI Across All Media =	**8E+00**
Total Blood HI Across All Media =	6E-02
Total Biliary Tract HI Across All Media =	1E-02
Total Spleen HI Across All Media =	3E-02

TABLE 9.3.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Arsenic	2E-06	N/A	1E-07	2E-06		N/A	N/A	N/A	N/A
			Chromium	1E-05	N/A	1E-05	2E-05		N/A	N/A	N/A	N/A
			Cobalt	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Iron	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Manganese	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Thallium	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Vanadium	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Chemical Total	1E-05	N/A	1E-05	3E-05		N/A	N/A	N/A	N/A
		Exposure Point Total					3E-05					N/A
	Exposure Medium Total						3E-05					N/A
	Air	Emissions from Site 7 Soil	Chromium	N/A	8E-07	N/A	8E-07		N/A	N/A	N/A	N/A
			Chemical Total	N/A	8E-07	N/A	8E-07		N/A	N/A	N/A	N/A
		Exposure Point Total					8E-07					N/A
	Exposure Medium Total						8E-07					N/A
Soil Total							3E-05					N/A
Groundwater	Groundwater	Tap Water	Chloroform	2E-07	N/A	3E-08	2E-07		N/A	N/A	N/A	N/A
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Trichloroethene	6E-06	N/A	2E-06	8E-06		N/A	N/A	N/A	N/A
			2,4-Dinitrotoluene	9E-07	N/A	9E-08	1E-06		N/A	N/A	N/A	N/A
			2,6-Dinitrotoluene	2E-06	N/A	1E-07	2E-06		N/A	N/A	N/A	N/A
			4,4'-DDD	3E-08	N/A	3E-07	3E-07		N/A	N/A	N/A	N/A
			Nitroglycerin	1E-08	N/A	6E-10	1E-08		N/A	N/A	N/A	N/A
			Arsenic	2E-05	N/A	1E-07	2E-05		N/A	N/A	N/A	N/A
			Cadmium	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Chromium	2E-05	N/A	5E-06	2E-05		N/A	N/A	N/A	N/A
			Cobalt	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Manganese	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Chemical Total	5E-05	N/A	7E-06	5E-05		N/A	N/A	N/A	N/A
		Exposure Point Total					5E-05					N/A
	Exposure Medium Total						5E-05					N/A

TABLE 9.3.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater (cont'd)	Air	Water Vapors at Showerhead	Chloroform	N/A	4E-07	N/A	4E-07		N/A	N/A	N/A	N/A
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
			Trichloroethene	N/A	1E-06	N/A	1E-06		N/A	N/A	N/A	N/A
			Chemical Total	N/A	2E-06	N/A	2E-06		N/A	N/A	N/A	N/A
		Exposure Point Total					2E-06					N/A
		Vapor Intrusion Into Indoor Air	Chloroform	N/A	4E-07	N/A	4E-07		N/A	N/A	N/A	N/A
			Trichloroethene	N/A	2E-05	N/A	2E-05		N/A	N/A	N/A	N/A
			Chemical Total	N/A	2E-05	N/A	2E-05		N/A	N/A	N/A	N/A
		Exposure Point Total					2E-05					N/A
	Exposure Medium Total						2E-05					N/A
Groundwater Total							7E-05					N/A
Receptor Total							1E-04				Receptor HI Total	N/A

Notes:

N/A = Not applicable

HI = Hazard Index

TABLE 9.4.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Aluminum	N/A	N/A	N/A	N/A	Neurological	4E-03	N/A	5E-05	4E-03
			Arsenic	3E-07	N/A	1E-08	4E-07	Skin, Vascular	6E-03	N/A	2E-04	6E-03
			Chromium	4E-07	N/A	2E-07	6E-07	NOE	2E-03	N/A	1E-03	3E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	4E-03	N/A	5E-05	4E-03
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	1E-02	N/A	1E-04	1E-02
			Manganese	N/A	N/A	N/A	N/A	Neurological	2E-03	N/A	7E-04	3E-03
			Thallium	N/A	N/A	N/A	N/A	Hair	3E-02	N/A	4E-04	3E-02
			Vanadium	N/A	N/A	N/A	N/A	Hair	2E-03	N/A	1E-03	3E-03
			Chemical Total	7E-07	N/A	2E-07	1E-06		6E-02	N/A	4E-03	6E-02
		Exposure Point Total					1E-06					6E-02
	Exposure Medium Total						1E-06					6E-02
	Air	Emissions from Site 7 Soil	Chromium	N/A	3E-08	N/A	3E-08	Respiratory System	N/A	2E-06	N/A	2E-06
			Chemical Total	N/A	3E-08	N/A	3E-08		N/A	2E-06	N/A	2E-06
		Exposure Point Total					3E-08					2E-06
	Exposure Medium Total						3E-08					2E-06
Soil Total							1E-06					6E-02
Groundwater	Groundwater	Tap Water	Chloroform	2E-08	N/A	N/A	2E-08	Liver	6E-04	N/A	N/A	6E-04
			cis-1,2-Dichloroethene	N/A	N/A	N/A	N/A	Kidney	6E-03	N/A	N/A	6E-03
			Trichloroethene	5E-07	N/A	N/A	5E-07	Immune System, Developmental, Heart	2E-01	N/A	N/A	2E-01
			2,4-Dinitrotoluene	1E-07	N/A	N/A	1E-07	Neurological, Blood, Biliary Tract	2E-03	N/A	N/A	2E-03
			2,6-Dinitrotoluene	3E-07	N/A	N/A	3E-07	Spleen	5E-03	N/A	N/A	5E-03
			4,4'-DDD	4E-09	N/A	N/A	4E-09	N/A	N/A	N/A	N/A	N/A
			Nitroglycerin	2E-09	N/A	N/A	2E-09	Blood	9E-03	N/A	N/A	9E-03
			Arsenic	3E-06	N/A	N/A	3E-06	Skin, Vascular	5E-02	N/A	N/A	5E-02
			Cadmium	N/A	N/A	N/A	N/A	Proteinuria (Kidney)	9E-03	N/A	N/A	9E-03
			Chromium	6E-07	N/A	N/A	6E-07	NOE	3E-03	N/A	N/A	3E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	5E-02	N/A	N/A	5E-02
			Manganese	N/A	N/A	N/A	N/A	Neurological	2E-02	N/A	N/A	2E-02
			Chemical Total	4E-06	N/A	N/A	4E-06		3E-01	N/A	N/A	3E-01
		Exposure Point Total					4E-06					3E-01
	Exposure Medium Total						4E-06					3E-01

TABLE 9.4.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Air	Vapor Intrusion Into Indoor Air	Trichloroethene	N/A	1E-06	N/A	1E-06	Immunotoxicity, Heart	N/A	1E+00	N/A	1E+00
			Chemical Total	N/A	1E-06	N/A	1E-06		N/A	1E+00	N/A	1E+00
		Exposure Point Total					1E-06					1E+00
	Exposure Medium Total						1E-06					1E+00
Groundwater Total							6E-06					2E+00
Receptor Total							7E-06	Receptor HI Total				2E+00

Notes:

N/A = Not applicable

HI = Hazard Index

NOE = No observed effects

Total Neurological HI Across All Media =	8E-03
Total Skin HI Across All Media =	6E-02
Total Vascular HI Across All Media =	6E-02
Total Thyroid HI Across All Media =	5E-02
Total Gastrointestinal HI Across All Media =	1E-02
Total Hair HI Across All Media =	3E-02
Total Respiratory System HI Across All Media =	2E-06
Total Liver HI Across All Media =	6E-04
Total Kidney HI Across All Media =	1E-02
Total Immune System/Immunotoxicity HI Across All Media =	**2E+00**
Total Developmental HI Across All Media =	2E-01
Total Heart HI Across All Media =	**2E+00**
Total Blood HI Across All Media =	1E-02
Total Biliary Tract HI Across All Media =	2E-03
Total Spleen HI Across All Media =	5E-03

TABLE 10.1.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap Water	Trichloroethene	N/A	N/A	N/A	N/A	Immune System, Developmental, Heart	1E+00	N/A	2E-01	2E+00
			Chemical Total	N/A	N/A	N/A	N/A		1E+00	N/A	2E-01	2E+00
		Exposure Point Total					N/A					2E+00
	Exposure Medium Total						N/A					2E+00
	Air	Water Vapors at Showerhead	Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	9E-01	N/A	9E-01
			Chemical Total	N/A	N/A	N/A	N/A		N/A	9E-01	N/A	9E-01
		Exposure Point Total					N/A					9E-01
		Vapor Intrusion Into Indoor Air	Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	6E+00	N/A	6E+00
			Chemical Total	N/A	N/A	N/A	N/A		N/A	6E+00	N/A	6E+00
		Exposure Point Total					N/A					6E+00
	Exposure Medium Total						N/A					7E+00
Groundwater Total							N/A					9E+00
Receptor Total							N/A	Receptor HI Total				9E+00

Notes:

N/A = Not applicable

HI = Hazard Index

Total Immune System/Immunotoxicity HI Across All Media =	**9E+00**
Total Developmental HI Across All Media =	**2E+00**
Total Heart HI Across All Media =	**9E+00**

TABLE 10.2.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap Water	Trichloroethene	N/A	N/A	N/A	N/A	Immune System, Developmental, Heart	2E+00	N/A	4E-01	3E+00
			Chemical Total	N/A	N/A	N/A	N/A		2E+00	N/A	4E-01	3E+00
		Exposure Point Total					N/A					3E+00
	Exposure Medium Total						N/A					3E+00
	Air	Vapor Intrusion Into Indoor Air	Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	6E+00	N/A	6E+00
			Chemical Total	N/A	N/A	N/A	N/A		N/A	6E+00	N/A	6E+00
		Exposure Point Total					N/A					6E+00
	Exposure Medium Total						N/A					6E+00
Groundwater Total							N/A					9E+00
Receptor Total							N/A	Receptor HI Total				9E+00

Notes:

N/A = Not applicable

HI = Hazard Index

Total Immune System/Immunotoxicity HI Across All Media =	**9E+00**
Total Developmental HI Across All Media =	**3E+00**
Total Heart HI Across All Media =	**9E+00**

TABLE 10.3.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Site 7	Arsenic	1E-05	N/A	9E-07	1E-05		N/A	N/A	N/A	N/A
			Chromium	5E-05	N/A	6E-05	1E-04		N/A	N/A	N/A	N/A
			Chemical Total	6E-05	N/A	6E-05	1E-04		N/A	N/A	N/A	N/A
		Exposure Point Total					1E-04					N/A
	Exposure Medium Total						1E-04					N/A
	Air	Emissions from Site 7 Soil	Chromium	N/A	1E-06	N/A	1E-06		N/A	N/A	N/A	N/A
			Chemical Total	N/A	1E-06	N/A	1E-06		N/A	N/A	N/A	N/A
		Exposure Point Total					1E-06					N/A
	Exposure Medium Total						1E-06					N/A
Soil Total							1E-04					N/A
Groundwater	Groundwater	Tap Water	Trichloroethene	2E-05	N/A	3E-06	2E-05		N/A	N/A	N/A	N/A
			2,4-Dinitrotoluene	3E-06	N/A	2E-07	4E-06		N/A	N/A	N/A	N/A
			2,6-Dinitrotoluene	8E-06	N/A	3E-07	8E-06		N/A	N/A	N/A	N/A
			Arsenic	8E-05	N/A	4E-07	8E-05		N/A	N/A	N/A	N/A
			Chromium	5E-05	N/A	1E-05	6E-05		N/A	N/A	N/A	N/A
			Chemical Total	2E-04	N/A	1E-05	2E-04		N/A	N/A	N/A	N/A
		Exposure Point Total					2E-04					N/A
	Exposure Medium Total						2E-04					N/A
	Air	Water Vapors at Showerhead	Trichloroethene	N/A	2E-06	N/A	2E-06		N/A	N/A	N/A	N/A
			Chemical Total	N/A	2E-06	N/A	2E-06		N/A	N/A	N/A	N/A
		Exposure Point Total					2E-06					N/A
		Vapor Intrusion Into Indoor Air	Trichloroethene	N/A	2E-05	N/A	2E-05		N/A	N/A	N/A	N/A
			Chemical Total	N/A	2E-05	N/A	2E-05		N/A	N/A	N/A	N/A
		Exposure Point Total					2E-05					N/A
	Exposure Medium Total						3E-05					N/A
Groundwater Total							2E-04					N/A
Receptor Total							3E-04				Receptor HI Total	N/A

Notes:

N/A = Not applicable

HI = Hazard Index

TABLE 10.4.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap Water	Trichloroethene					Immune System, Developmental, Heart	5E-01	N/A	N/A	5E-01
			Chemical Total						5E-01	N/A	N/A	5E-01
		Exposure Point Total										5E-01
	Exposure Medium Total											5E-01
	Air	Vapor Intrusion Into Indoor Air	Trichloroethene					Immunotoxicity, Heart	N/A	2E+00	N/A	2E+00
			Chemical Total						N/A	2E+00	N/A	2E+00
		Exposure Point Total										2E+00
	Exposure Medium Total											2E+00
Groundwater Total												2E+00
Receptor Total								Receptor HI Total				2E+00

Notes:

N/A = Not applicable

HI = Hazard Index

Total Immune System/Immunotoxicity HI Across All Media = 2E+00

Total Heart HI Across All Media = 2E+00

TABLE 10.1.CTE

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap Water	Trichloroethene	N/A	N/A	N/A	N/A	Immune System, Developmental, Heart	6E-01	N/A	2E-01	7E-01
			Chemical Total	N/A	N/A	N/A	N/A		6E-01	N/A	2E-01	7E-01
		Exposure Point Total					N/A					7E-01
	Exposure Medium Total						N/A					7E-01
	Air	Water Vapors at Showerhead	Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	4E-01	N/A	4E-01
			Chemical Total	N/A	N/A	N/A	N/A		N/A	4E-01	N/A	4E-01
		Exposure Point Total					N/A					4E-01
		Vapor Intrusion Into Indoor Air	Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	6E+00	N/A	6E+00
			Chemical Total	N/A	N/A	N/A	N/A		N/A	6E+00	N/A	6E+00
		Exposure Point Total					N/A					6E+00
	Exposure Medium Total						N/A					7E+00
Groundwater Total							N/A					8E+00
Receptor Total							N/A				Receptor HI Total	8E+00

Notes:

N/A = Not applicable

HI = Hazard Index

Total Immune System/Immunotoxicity HI Across All Media =	**8E+00**
Total Developmental HI Across All Media =	7E-01
Total Heart HI Across All Media =	**8E+00**

TABLE 10.2.CTE

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap Water	Trichloroethene	N/A	N/A	N/A	N/A	Heart	1E+00	N/A	3E-01	1E+00
			Chemical Total	N/A	N/A	N/A	N/A		1E+00	N/A	3E-01	1E+00
		Exposure Point Total					N/A					1E+00
	Exposure Medium Total						N/A					1E+00
	Air	Vapor Intrusion Into Indoor Air	Trichloroethene	N/A	N/A	N/A	N/A	Immunotoxicity, Heart	N/A	6E+00	N/A	6E+00
			Chemical Total	N/A	N/A	N/A	N/A		N/A	6E+00	N/A	6E+00
		Exposure Point Total					N/A					6E+00
	Exposure Medium Total						N/A					6E+00
Groundwater Total							N/A					8E+00
Receptor Total							N/A				Receptor HI Total	8E+00

Notes:

N/A = Not applicable

HI = Hazard Index

Total Immune System/Immunotoxicity HI Across All Media =	**8E+00**
Total Developmental HI Across All Media =	1E+00
Total Heart HI Across All Media =	**8E+00**

TABLE 10.3.CTE

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap Water	Trichloroethene	6E-06	N/A	2E-06	8E-06		N/A	N/A	N/A	N/A
			2,6-Dinitrotoluene	2E-06	N/A	1E-07	2E-06		N/A	N/A	N/A	N/A
			Arsenic	2E-05	N/A	1E-07	2E-05		N/A	N/A	N/A	N/A
			Chromium	2E-05	N/A	5E-06	2E-05		N/A	N/A	N/A	N/A
			Chemical Total	4E-05	N/A	7E-06	5E-05		N/A	N/A	N/A	N/A
		Exposure Point Total					5E-05					N/A
	Exposure Medium Total						5E-05					N/A
	Air	Water Vapors at Showerhead	Trichloroethene	N/A	1E-06	N/A	1E-06		N/A	N/A	N/A	N/A
			Chemical Total	N/A	1E-06	N/A	1E-06		N/A	N/A	N/A	N/A
		Exposure Point Total					1E-06					N/A
		Vapor Intrusion Into Indoor Air	Trichloroethene	N/A	2E-05	N/A	2E-05		N/A	N/A	N/A	N/A
			Chemical Total	N/A	2E-05	N/A	2E-05		N/A	N/A	N/A	N/A
		Exposure Point Total					2E-05					N/A
	Exposure Medium Total						2E-05					N/A
Groundwater Total							7E-05					N/A
Receptor Total							7E-05				Receptor HI Total	N/A

Notes:

N/A = Not applicable

HI = Hazard Index

TABLE 10.4.CTE

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Site 7 – Old DuPont Disposal Area Remedial Investigation

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap Water	Trichloroethene					Immune System, Developmental, Heart	2E-01	N/A	N/A	2E-01
			Chemical Total						2E-01	N/A	N/A	2E-01
		Exposure Point Total										2E-01
	Exposure Medium Total											2E-01
	Air	Vapor Intrusion Into Indoor Air	Trichloroethene					Immunotoxicity, Heart	N/A	1E+00	N/A	1E+00
			Chemical Total						N/A	1E+00	N/A	1E+00
		Exposure Point Total										1E+00
	Exposure Medium Total											1E+00
Groundwater Total												2E+00
Receptor Total								Receptor HI Total				2E+00

Notes:

N/A = Not applicable

HI = Hazard Index

Total Immune System/Immunotoxicity HI Across All Media =	**2E+00**
Total Developmental HI Across All Media =	2E-01
Total Heart HI Across All Media =	**2E+00**

Groundwater ProUCL Output

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	8/6/2014 1:39:45 PM
From File	input.xls.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chloroform

General Statistics

Total Number of Observations	7	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	6
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Chloroform was not processed!

cis-1,2-Dichloroethene

General Statistics

Total Number of Observations	7	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	4
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.48	Minimum Non-Detect	0.2
Maximum Detect	6.2	Maximum Non-Detect	0.2
Variance Detects	8.871	Percent Non-Detects	57.14%
Mean Detects	2.86	SD Detects	2.978
Median Detects	1.9	CV Detects	1.041
Skewness Detects	1.3	Kurtosis Detects	N/A
Mean of Logged Detects	0.577	SD of Logged Detects	1.28

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.922	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.293	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.34	Standard Error of Mean	0.956
SD	2.066	95% KM (BCA) UCL	N/A

Groundwater ProUCL Output			
95% KM (t) UCL	3.198	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.913	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.209	95% KM Chebyshev UCL	5.508
97.5% KM Chebyshev UCL	7.312	99% KM Chebyshev UCL	10.85
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.195	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.392	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	7.173	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.421	nu hat (KM)	5.891
		Adjusted Level of Significance (β)	0.0158
Approximate Chi Square Value (5.89, α)	1.584	Adjusted Chi Square Value (5.89, β)	1.005
95% Gamma Approximate KM-UCL (use when n>=50)	4.982	95% Gamma Adjusted KM-UCL (use when n<50)	7.854
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.998	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1.244	Mean in Log Scale	-2.109
SD in Original Scale	2.29	SD in Log Scale	2.834
95% t UCL (assumes normality of ROS data)	2.926	95% Percentile Bootstrap UCL	2.74
95% BCA Bootstrap UCL	3.556	95% Bootstrap t UCL	16.33
95% H-UCL (Log ROS)	359902		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-0.672	95% H-UCL (KM -Log)	12.29
KM SD (logged)	1.281	95% Critical H Value (KM-Log)	4.517
KM Standard Error of Mean (logged)	0.593		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.283	Mean in Log Scale	-1.068
SD in Original Scale	2.266	SD in Log Scale	1.708
95% t UCL (Assumes normality)	2.947	95% H-Stat UCL	85.88
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	3.198	95% KM (Percentile Bootstrap) UCL	N/A
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			

Groundwater ProUCL Output

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Trichloroethene

General Statistics

Total Number of Observations	7	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	3
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.33	Minimum Non-Detect	0.2
Maximum Detect	53.8	Maximum Non-Detect	0.2
Variance Detects	696.1	Percent Non-Detects	42.86%
Mean Detects	14.23	SD Detects	26.38
Median Detects	1.4	CV Detects	1.854
Skewness Detects	1.997	Kurtosis Detects	3.991
Mean of Logged Detects	0.876	SD of Logged Detects	2.186

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.65	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.433	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	8.219	Standard Error of Mean	8.125
SD	18.62	95% KM (BCA) UCL	N/A
95% KM (t) UCL	24.01	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	21.58	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	32.59	95% KM Chebyshev UCL	43.63
97.5% KM Chebyshev UCL	58.96	99% KM Chebyshev UCL	89.06

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.582	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.402	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.415	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.374	k star (bias corrected MLE)	0.26
Theta hat (MLE)	38.08	Theta star (bias corrected MLE)	54.72
nu hat (MLE)	2.99	nu star (bias corrected)	2.081
MLE Mean (bias corrected)	14.23	MLE Sd (bias corrected)	27.91

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.195	nu hat (KM)	2.729
Approximate Chi Square Value (2.73, α)	0.297	Adjusted Chi Square Value (2.73, β)	0.153
95% Gamma Approximate KM-UCL (use when n>=50)	75.56	95% Gamma Adjusted KM-UCL (use when n<50)	146.1

Groundwater ProUCL Output

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	8.137
Maximum	53.8	Median	0.33
SD	20.15	CV	2.476
k hat (MLE)	0.205	k star (bias corrected MLE)	0.213
Theta hat (MLE)	39.63	Theta star (bias corrected MLE)	38.28
nu hat (MLE)	2.874	nu star (bias corrected)	2.976
MLE Mean (bias corrected)	8.137	MLE Sd (bias corrected)	17.65
		Adjusted Level of Significance (β)	0.0158
Approximate Chi Square Value (2.98, α)	0.365	Adjusted Chi Square Value (2.98, β)	0.188
95% Gamma Approximate UCL (use when n>=50)	66.29	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.313	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	8.136	Mean in Log Scale	-1.883
SD in Original Scale	20.15	SD in Log Scale	3.903
95% t UCL (assumes normality of ROS data)	22.93	95% Percentile Bootstrap UCL	23.31
95% BCA Bootstrap UCL	23.79	95% Bootstrap t UCL	396.5
95% H-UCL (Log ROS)	2.477E+11		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.189	95% H-UCL (KM -Log)	673.6
KM SD (logged)	1.887	95% Critical H Value (KM-Log)	6.39
KM Standard Error of Mean (logged)	0.823		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.176	Mean in Log Scale	-0.486
SD in Original Scale	20.13	SD in Log Scale	2.297
95% t UCL (Assumes normality)	22.96	95% H-Stat UCL	11625

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	24.01	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

2,4-Dinitrotoluene

Groundwater ProUCL Output

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.0987	Minimum Non-Detect	0.154
Maximum Detect	1.09	Maximum Non-Detect	0.154
Variance Detects	0.167	Percent Non-Detects	20%
Mean Detects	0.563	SD Detects	0.408
Median Detects	0.532	CV Detects	0.726
Skewness Detects	0.449	Kurtosis Detects	1.317
Mean of Logged Detects	-0.876	SD of Logged Detects	1.022

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.231	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level
Detected Data appear Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.47	Standard Error of Mean	0.189
SD	0.367	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.874	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.782	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.038	95% KM Chebyshev UCL	1.296
97.5% KM Chebyshev UCL	1.653	99% KM Chebyshev UCL	2.355

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.296	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.269	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.81	k star (bias corrected MLE)	0.619
Theta hat (MLE)	0.311	Theta star (bias corrected MLE)	0.909
nu hat (MLE)	14.48	nu star (bias corrected)	4.953
MLE Mean (bias corrected)	0.563	MLE Sd (bias corrected)	0.715

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	1.642	nu hat (KM)	16.42
Approximate Chi Square Value (16.42, α)	8.261	Adjusted Chi Square Value (16.42, β)	5.904
95% Gamma Approximate KM-UCL (use when n>=50)	0.934	95% Gamma Adjusted KM-UCL (use when n<50)	1.308

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

Groundwater ProUCL Output			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.0775	Mean	0.466
Maximum	1.09	Median	0.481
SD	0.415	CV	0.891
k hat (MLE)	1.256	k star (bias corrected MLE)	0.636
Theta hat (MLE)	0.371	Theta star (bias corrected MLE)	0.733
nu hat (MLE)	12.56	nu star (bias corrected)	6.358
MLE Mean (bias corrected)	0.466	MLE Sd (bias corrected)	0.584
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (6.36, α)	1.826	Adjusted Chi Square Value (6.36, β)	0.956
95% Gamma Approximate UCL (use when n>=50)	1.622	95% Gamma Adjusted UCL (use when n<50)	N/A
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.306	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.472	Mean in Log Scale	-1.143
SD in Original Scale	0.408	SD in Log Scale	1.067
95% t UCL (assumes normality of ROS data)	0.861	95% Percentile Bootstrap UCL	0.765
95% BCA Bootstrap UCL	0.785	95% Bootstrap t UCL	0.992
95% H-UCL (Log ROS)	9.023		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-1.164	95% H-UCL (KM -Log)	5.318
KM SD (logged)	0.979	95% Critical H Value (KM-Log)	4.814
KM Standard Error of Mean (logged)	0.505		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.466	Mean in Log Scale	-1.213
SD in Original Scale	0.415	SD in Log Scale	1.163
95% t UCL (Assumes normality)	0.862	95% H-Stat UCL	15.32
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	0.874	95% KM (Percentile Bootstrap) UCL	N/A
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
2,6-Dinitrotoluene			
General Statistics			
Total Number of Observations	5	Number of Distinct Observations	3
Number of Detects	1	Number of Non-Detects	4

Groundwater ProUCL Output			
Number of Distinct Detects	1	Number of Distinct Non-Detects	2

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,6-Dinitrotoluene was not processed!

4,4'-DDD

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	2	Number of Non-Detects	3
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	0.00992	Minimum Non-Detect	0.00943
Maximum Detect	0.0398	Maximum Non-Detect	0.0102
Variance Detects	4.4641E-4	Percent Non-Detects	60%
Mean Detects	0.0249	SD Detects	0.0211
Median Detects	0.0249	CV Detects	0.85
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-3.919	SD of Logged Detects	0.982

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0156	Standard Error of Mean	0.00764
SD	0.0121	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0319	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0282	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0386	95% KM Chebyshev UCL	0.049
97.5% KM Chebyshev UCL	0.0634	99% KM Chebyshev UCL	0.0917

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	2.385	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0104	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	9.54	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.674	nu hat (KM)	16.74
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (16.74, α)	8.486	Adjusted Chi Square Value (16.74, β)	6.09

Groundwater ProUCL Output			
95% Gamma Approximate KM-UCL (use when n>=50)	0.0308	95% Gamma Adjusted KM-UCL (use when n<50)	0.043

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0113	Mean in Log Scale	-5.247
SD in Original Scale	0.0163	SD in Log Scale	1.331
95% t UCL (assumes normality of ROS data)	0.0268	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.882		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0129	Mean in Log Scale	-4.758
SD in Original Scale	0.0152	SD in Log Scale	0.911
95% t UCL (Assumes normality)	0.0274	95% H-Stat UCL	0.102

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0319	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Nitroglycerin

General Statistics

Total Number of Observations	5	Number of Distinct Observations	3
Number of Detects	1	Number of Non-Detects	4
Number of Distinct Detects	1	Number of Distinct Non-Detects	2

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Nitroglycerin was not processed!

Arsenic

General Statistics

Total Number of Observations	5	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	3
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	3.15	Minimum Non-Detect	1.5
Maximum Detect	4.26	Maximum Non-Detect	1.5
Variance Detects	0.616	Percent Non-Detects	60%
Mean Detects	3.705	SD Detects	0.785
Median Detects	3.705	CV Detects	0.212

Groundwater ProUCL Output			
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.298	SD of Logged Detects	0.213

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.382	Standard Error of Mean	0.718
SD	1.136	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.913	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.564	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.537	95% KM Chebyshev UCL	5.513
97.5% KM Chebyshev UCL	6.868	99% KM Chebyshev UCL	9.53

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	44.23	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0838	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	176.9	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.398	nu hat (KM)	43.98
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (43.98, α)	29.77	Adjusted Chi Square Value (43.98, β)	24.78
95% Gamma Approximate KM-UCL (use when n>=50)	3.519	95% Gamma Adjusted KM-UCL (use when n<50)	4.228

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.414	Mean in Log Scale	0.768
SD in Original Scale	1.278	SD in Log Scale	0.535
95% t UCL (assumes normality of ROS data)	3.633	95% Percentile Bootstrap UCL	3.349
95% BCA Bootstrap UCL	3.349	95% Bootstrap t UCL	4.989
95% H-UCL (Log ROS)	5.633		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.932	Mean in Log Scale	0.347
SD in Original Scale	1.665	SD in Log Scale	0.875
95% t UCL (Assumes normality)	3.52	95% H-Stat UCL	14.06

DL/2 is not a recommended method, provided for comparisons and historical reasons

Groundwater ProUCL Output

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.913	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Cadmium

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.716	Mean	0.979
Maximum	1.17	Median	1.05
SD	0.187	Std. Error of Mean	0.0834
Coefficient of Variation	0.191	Skewness	-0.699

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.157	95% Adjusted-CLT UCL (Chen-1995)	1.089
		95% Modified-t UCL (Johnson-1978)	1.153

Gamma GOF Test

A-D Test Statistic	0.345	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.276	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	31.99	k star (bias corrected MLE)	12.93
Theta hat (MLE)	0.0306	Theta star (bias corrected MLE)	0.0757
nu hat (MLE)	319.9	nu star (bias corrected)	129.3
MLE Mean (bias corrected)	0.979	MLE Sd (bias corrected)	0.272
		Approximate Chi Square Value (0.05)	104
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	94.12

Groundwater ProUCL Output			
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.217	95% Adjusted Gamma UCL (use when n<50)	1.345
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.909	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.264	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.334	Mean of logged Data	-0.0365
Maximum of Logged Data	0.157	SD of logged Data	0.202
Assuming Lognormal Distribution			
95% H-UCL	1.229	90% Chebyshev (MVUE) UCL	1.245
95% Chebyshev (MVUE) UCL	1.366	97.5% Chebyshev (MVUE) UCL	1.532
99% Chebyshev (MVUE) UCL	1.86		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.117	95% Jackknife UCL	1.157
95% Standard Bootstrap UCL	1.103	95% Bootstrap-t UCL	1.132
95% Hall's Bootstrap UCL	1.068	95% Percentile Bootstrap UCL	1.104
95% BCA Bootstrap UCL	1.094		
90% Chebyshev(Mean, Sd) UCL	1.23	95% Chebyshev(Mean, Sd) UCL	1.343
97.5% Chebyshev(Mean, Sd) UCL	1.501	99% Chebyshev(Mean, Sd) UCL	1.81
Suggested UCL to Use			
95% Student's-t UCL	1.157		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
Chromium			
General Statistics			
Total Number of Observations	5	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	2
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	1.67	Minimum Non-Detect	1
Maximum Detect	2.49	Maximum Non-Detect	1
Variance Detects	0.214	Percent Non-Detects	40%
Mean Detects	2.203	SD Detects	0.462
Median Detects	2.45	CV Detects	0.21
Skewness Detects	-1.717	Kurtosis Detects	N/A
Mean of Logged Detects	0.774	SD of Logged Detects	0.226

Groundwater ProUCL Output

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.37	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.722	Standard Error of Mean	0.36
SD	0.658	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.49	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.315	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.803	95% KM Chebyshev UCL	3.293
97.5% KM Chebyshev UCL	3.973	99% KM Chebyshev UCL	5.308

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	30.95	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0712	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	185.7	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	6.848	nu hat (KM)	68.48
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (68.48, α)	50.43	Adjusted Chi Square Value (68.48, β)	43.74
95% Gamma Approximate KM-UCL (use when n>=50)	2.338	95% Gamma Adjusted KM-UCL (use when n<50)	2.696

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.78	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.372	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.8	Mean in Log Scale	0.534
SD in Original Scale	0.647	SD in Log Scale	0.372
95% t UCL (assumes normality of ROS data)	2.417	95% Percentile Bootstrap UCL	2.232
95% BCA Bootstrap UCL	2.256	95% Bootstrap t UCL	2.751
95% H-UCL (Log ROS)	2.954		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.464	95% H-UCL (KM -Log)	2.963

Groundwater ProUCL Output			
KM SD (logged)	0.405	95% Critical H Value (KM-Log)	2.665
KM Standard Error of Mean (logged)	0.222		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.522	Mean in Log Scale	0.187
SD in Original Scale	0.989	SD in Log Scale	0.819
95% t UCL (Assumes normality)	2.464	95% H-Stat UCL	9.194

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.49	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Cobalt

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	1.43	Minimum Non-Detect	2.5
Maximum Detect	4.28	Maximum Non-Detect	2.5
Variance Detects	1.919	Percent Non-Detects	20%
Mean Detects	2.888	SD Detects	1.385
Median Detects	2.92	CV Detects	0.48
Skewness Detects	-0.0579	Kurtosis Detects	-4.709
Mean of Logged Detects	0.963	SD of Logged Detects	0.525

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.254	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.653	Standard Error of Mean	0.614
SD	1.178	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.961	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.662	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.494	95% KM Chebyshev UCL	5.328
97.5% KM Chebyshev UCL	6.485	99% KM Chebyshev UCL	8.759

Groundwater ProUCL Output

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.381	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.297	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	5.272	k star (bias corrected MLE)	1.485
Theta hat (MLE)	0.548	Theta star (bias corrected MLE)	1.945
nu hat (MLE)	42.18	nu star (bias corrected)	11.88
MLE Mean (bias corrected)	2.888	MLE Sd (bias corrected)	2.37
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	5.071	nu hat (KM)	50.71
Approximate Chi Square Value (50.71, α)	35.36	Adjusted Chi Square Value (50.71, β)	29.86
95% Gamma Approximate KM-UCL (use when n>=50)	3.805	95% Gamma Adjusted KM-UCL (use when n<50)	4.506
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	1.43	Mean	2.668
Maximum	4.28	Median	2
SD	1.296	CV	0.486
k hat (MLE)	5.435	k star (bias corrected MLE)	2.307
Theta hat (MLE)	0.491	Theta star (bias corrected MLE)	1.156
nu hat (MLE)	54.35	nu star (bias corrected)	23.07
MLE Mean (bias corrected)	2.668	MLE Sd (bias corrected)	1.756
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (23.07, α)	13.15	Adjusted Chi Square Value (23.07, β)	10.03
95% Gamma Approximate UCL (use when n>=50)	4.683	95% Gamma Adjusted UCL (use when n<50)	N/A
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	2.659	Mean in Log Scale	0.881
SD in Original Scale	1.304	SD in Log Scale	0.49
95% t UCL (assumes normality of ROS data)	3.902	95% Percentile Bootstrap UCL	3.56
95% BCA Bootstrap UCL	3.534	95% Bootstrap t UCL	6.947
95% H-UCL (Log ROS)	5.553		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	0.875	95% H-UCL (KM -Log)	4.963
KM SD (logged)	0.449	95% Critical H Value (KM-Log)	2.79
KM Standard Error of Mean (logged)	0.237		
DL/2 Statistics			

Groundwater ProUCL Output			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.56	Mean in Log Scale	0.815
SD in Original Scale	1.406	SD in Log Scale	0.562
95% t UCL (Assumes normality)	3.9	95% H-Stat UCL	6.417
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	3.961	95% KM (Percentile Bootstrap) UCL	N/A
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Manganese			
General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	18.5	Mean	83.24
Maximum	216	Median	57.1
SD	76.54	Std. Error of Mean	34.23
Coefficient of Variation	0.92	Skewness	1.885
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.765	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.38	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	156.2	95% Adjusted-CLT UCL (Chen-1995)	170.4
		95% Modified-t UCL (Johnson-1978)	161
Gamma GOF Test			
A-D Test Statistic	0.455	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.685	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.305	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.361	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.8	k star (bias corrected MLE)	0.853

Groundwater ProUCL Output			
Theta hat (MLE)	46.26	Theta star (bias corrected MLE)	97.57
nu hat (MLE)	18	nu star (bias corrected)	8.531
MLE Mean (bias corrected)	83.24	MLE Sd (bias corrected)	90.12
		Approximate Chi Square Value (0.05)	3.047
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	1.805
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	233.1	95% Adjusted Gamma UCL (use when n<50)	393.5
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.265	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.918	Mean of logged Data	4.119
Maximum of Logged Data	5.375	SD of logged Data	0.872
Assuming Lognormal Distribution			
95% H-UCL	602	90% Chebyshev (MVUE) UCL	175.4
95% Chebyshev (MVUE) UCL	217.6	97.5% Chebyshev (MVUE) UCL	276.3
99% Chebyshev (MVUE) UCL	391.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	139.5	95% Jackknife UCL	156.2
95% Standard Bootstrap UCL	132.8	95% Bootstrap-t UCL	369.4
95% Hall's Bootstrap UCL	477.3	95% Percentile Bootstrap UCL	144.7
95% BCA Bootstrap UCL	152.4		
90% Chebyshev(Mean, Sd) UCL	185.9	95% Chebyshev(Mean, Sd) UCL	232.4
97.5% Chebyshev(Mean, Sd) UCL	297	99% Chebyshev(Mean, Sd) UCL	423.8
Suggested UCL to Use			
95% Student's-t UCL	156.2		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Soil ProUCL Output

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	8/15/2014 3:31:47 PM
From File	ProUCL input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aluminum

General Statistics

Total Number of Observations	41	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	3530	Mean	8780
Maximum	20300	Median	7630
SD	3287	Std. Error of Mean	513.4
Coefficient of Variation	0.374	Skewness	1.587

Normal GOF Test

Shapiro Wilk Test Statistic	0.864	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.173	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.138	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9645	95% Adjusted-CLT UCL (Chen-1995)	9761
		95% Modified-t UCL (Johnson-1978)	9666

Gamma GOF Test

A-D Test Statistic	1.175	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.135	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.138	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.65	k star (bias corrected MLE)	8.034
Theta hat (MLE)	1015	Theta star (bias corrected MLE)	1093
nu hat (MLE)	709.3	nu star (bias corrected)	658.8
MLE Mean (bias corrected)	8780	MLE Sd (bias corrected)	3098
		Approximate Chi Square Value (0.05)	600.2
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	598.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	9637	95% Adjusted Gamma UCL (use when n<50)	9670

Soil ProUCL Output

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.123	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.138	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.169	Mean of logged Data	9.021
Maximum of Logged Data	9.918	SD of logged Data	0.341

Assuming Lognormal Distribution

95% H-UCL	9665	90% Chebyshev (MVUE) UCL	10192
95% Chebyshev (MVUE) UCL	10841	97.5% Chebyshev (MVUE) UCL	11741
99% Chebyshev (MVUE) UCL	13510		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9625	95% Jackknife UCL	9645
95% Standard Bootstrap UCL	9602	95% Bootstrap-t UCL	9814
95% Hall's Bootstrap UCL	9910	95% Percentile Bootstrap UCL	9630
95% BCA Bootstrap UCL	9784		
90% Chebyshev(Mean, Sd) UCL	10321	95% Chebyshev(Mean, Sd) UCL	11018
97.5% Chebyshev(Mean, Sd) UCL	11986	99% Chebyshev(Mean, Sd) UCL	13888

Suggested UCL to Use

95% Adjusted Gamma UCL	9670		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	41	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	1.1	Mean	2.329
Maximum	24.3	Median	1.6
SD	3.574	Std. Error of Mean	0.558
Coefficient of Variation	1.534	Skewness	6.099

Normal GOF Test

Shapiro Wilk Test Statistic	0.28	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.379	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.138	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Soil ProUCL Output

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.269	95% Adjusted-CLT UCL (Chen-1995)	3.815
		95% Modified-t UCL (Johnson-1978)	3.358
Gamma GOF Test			
A-D Test Statistic	6.248	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.32	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.133	k star (bias corrected MLE)	1.993
Theta hat (MLE)	1.092	Theta star (bias corrected MLE)	1.169
nu hat (MLE)	174.9	nu star (bias corrected)	163.4
MLE Mean (bias corrected)	2.329	MLE Sd (bias corrected)	1.65
		Approximate Chi Square Value (0.05)	134.9
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	133.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.823	95% Adjusted Gamma UCL (use when n<50)	2.842
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.667	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.239	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.138	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.0953	Mean of logged Data	0.593
Maximum of Logged Data	3.19	SD of logged Data	0.509
Assuming Lognormal Distribution			
95% H-UCL	2.401	90% Chebyshev (MVUE) UCL	2.567
95% Chebyshev (MVUE) UCL	2.8	97.5% Chebyshev (MVUE) UCL	3.123
99% Chebyshev (MVUE) UCL	3.757		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3.247	95% Jackknife UCL	3.269
95% Standard Bootstrap UCL	3.262	95% Bootstrap-t UCL	7.166
95% Hall's Bootstrap UCL	6.637	95% Percentile Bootstrap UCL	3.402
95% BCA Bootstrap UCL	4.127		
90% Chebyshev(Mean, Sd) UCL	4.004	95% Chebyshev(Mean, Sd) UCL	4.762
97.5% Chebyshev(Mean, Sd) UCL	5.815	99% Chebyshev(Mean, Sd) UCL	7.883

Soil ProUCL Output			
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	4.762		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Chromium

General Statistics			
Total Number of Observations	41	Number of Distinct Observations	35
		Number of Missing Observations	0
Minimum	4.8	Mean	11.01
Maximum	41.1	Median	7.7
SD	8.08	Std. Error of Mean	1.262
Coefficient of Variation	0.734	Skewness	2.491

Normal GOF Test		
Shapiro Wilk Test Statistic	0.692	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.228	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.138	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	13.14	95% Adjusted-CLT UCL (Chen-1995)	13.61
		95% Modified-t UCL (Johnson-1978)	13.22

Gamma GOF Test		
A-D Test Statistic	2.051	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.171	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.139	Data Not Gamma Distributed at 5% Significance Level
Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	3.091	k star (bias corrected MLE)	2.881
Theta hat (MLE)	3.564	Theta star (bias corrected MLE)	3.823
nu hat (MLE)	253.4	nu star (bias corrected)	236.2
MLE Mean (bias corrected)	11.01	MLE Sd (bias corrected)	6.49
		Approximate Chi Square Value (0.05)	201.6
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	200.5

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	12.9	95% Adjusted Gamma UCL (use when n<50)	12.98

Soil ProUCL Output			
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.148	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.138	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.569	Mean of logged Data	2.229
Maximum of Logged Data	3.716	SD of logged Data	0.542
Assuming Lognormal Distribution			
95% H-UCL	12.69	90% Chebyshev (MVUE) UCL	13.58
95% Chebyshev (MVUE) UCL	14.88	97.5% Chebyshev (MVUE) UCL	16.69
99% Chebyshev (MVUE) UCL	20.24		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	13.09	95% Jackknife UCL	13.14
95% Standard Bootstrap UCL	13.1	95% Bootstrap-t UCL	14.17
95% Hall's Bootstrap UCL	14.77	95% Percentile Bootstrap UCL	13.28
95% BCA Bootstrap UCL	13.73		
90% Chebyshev(Mean, Sd) UCL	14.8	95% Chebyshev(Mean, Sd) UCL	16.51
97.5% Chebyshev(Mean, Sd) UCL	18.89	99% Chebyshev(Mean, Sd) UCL	23.57
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	16.51		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Cobalt			
General Statistics			
Total Number of Observations	41	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	1.1	Mean	2.573
Maximum	5.8	Median	2.3
SD	0.938	Std. Error of Mean	0.147
Coefficient of Variation	0.365	Skewness	1.664
Normal GOF Test			
Shapiro Wilk Test Statistic	0.852	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.183	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.138	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Soil ProUCL Output

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.82	95% Adjusted-CLT UCL (Chen-1995)	2.855
		95% Modified-t UCL (Johnson-1978)	2.826
Gamma GOF Test			
A-D Test Statistic	1.183	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.151	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.138	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	9.361	k star (bias corrected MLE)	8.692
Theta hat (MLE)	0.275	Theta star (bias corrected MLE)	0.296
nu hat (MLE)	767.6	nu star (bias corrected)	712.7
MLE Mean (bias corrected)	2.573	MLE Sd (bias corrected)	0.873
		Approximate Chi Square Value (0.05)	651.8
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	649.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.814	95% Adjusted Gamma UCL (use when n<50)	2.823
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.132	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.138	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.0953	Mean of logged Data	0.891
Maximum of Logged Data	1.758	SD of logged Data	0.324
Assuming Lognormal Distribution			
95% H-UCL	2.815	90% Chebyshev (MVUE) UCL	2.963
95% Chebyshev (MVUE) UCL	3.143	97.5% Chebyshev (MVUE) UCL	3.393
99% Chebyshev (MVUE) UCL	3.884		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.814	95% Jackknife UCL	2.82
95% Standard Bootstrap UCL	2.812	95% Bootstrap-t UCL	2.897
95% Hall's Bootstrap UCL	2.895	95% Percentile Bootstrap UCL	2.817
95% BCA Bootstrap UCL	2.859		
90% Chebyshev(Mean, Sd) UCL	3.013	95% Chebyshev(Mean, Sd) UCL	3.212
97.5% Chebyshev(Mean, Sd) UCL	3.488	99% Chebyshev(Mean, Sd) UCL	4.031

Soil ProUCL Output

Suggested UCL to Use			
95% Student's-t UCL	2.82	or 95% Modified-t UCL	2.826
or 95% H-UCL	2.815		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Iron

General Statistics			
Total Number of Observations	41	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	3640	Mean	10382
Maximum	64000	Median	5750
SD	12605	Std. Error of Mean	1969
Coefficient of Variation	1.214	Skewness	3.406

Normal GOF Test		
Shapiro Wilk Test Statistic	0.534	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.296	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.138	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	13697	95% Adjusted-CLT UCL (Chen-1995)	14739
		95% Modified-t UCL (Johnson-1978)	13872

Gamma GOF Test		
A-D Test Statistic	3.379	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.764	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.206	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level
Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	1.625	k star (bias corrected MLE)	1.523
Theta hat (MLE)	6388	Theta star (bias corrected MLE)	6818
nu hat (MLE)	133.3	nu star (bias corrected)	124.9
MLE Mean (bias corrected)	10382	MLE Sd (bias corrected)	8414
		Approximate Chi Square Value (0.05)	100.1
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	99.25

Soil ProUCL Output			
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	12957	95% Adjusted Gamma UCL (use when n<50)	13062
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.832	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.169	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.138	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.2	Mean of logged Data	8.91
Maximum of Logged Data	11.07	SD of logged Data	0.713
Assuming Lognormal Distribution			
95% H-UCL	12049	90% Chebyshev (MVUE) UCL	12931
95% Chebyshev (MVUE) UCL	14498	97.5% Chebyshev (MVUE) UCL	16672
99% Chebyshev (MVUE) UCL	20943		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	13620	95% Jackknife UCL	13697
95% Standard Bootstrap UCL	13568	95% Bootstrap-t UCL	17777
95% Hall's Bootstrap UCL	30070	95% Percentile Bootstrap UCL	14019
95% BCA Bootstrap UCL	15270		
90% Chebyshev(Mean, Sd) UCL	16288	95% Chebyshev(Mean, Sd) UCL	18963
97.5% Chebyshev(Mean, Sd) UCL	22676	99% Chebyshev(Mean, Sd) UCL	29970
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	18963		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
For additional insight the user may want to consult a statistician.			
Manganese			
General Statistics			
Total Number of Observations	41	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	9.1	Mean	103.7
Maximum	466	Median	89.4
SD	93.65	Std. Error of Mean	14.63
Coefficient of Variation	0.903	Skewness	1.7

Soil ProUCL Output			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.847	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.156	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.138	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	128.3	95% Adjusted-CLT UCL (Chen-1995)	131.9
		95% Modified-t UCL (Johnson-1978)	129
Gamma GOF Test			
A-D Test Statistic	0.485	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.771	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.094	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.141	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.301	k star (bias corrected MLE)	1.222
Theta hat (MLE)	79.67	Theta star (bias corrected MLE)	84.82
nu hat (MLE)	106.7	nu star (bias corrected)	100.2
MLE Mean (bias corrected)	103.7	MLE Sd (bias corrected)	93.78
		Approximate Chi Square Value (0.05)	78.14
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	77.43
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	133	95% Adjusted Gamma UCL (use when n<50)	134.2
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.123	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.138	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.208	Mean of logged Data	4.21
Maximum of Logged Data	6.144	SD of logged Data	1.01
Assuming Lognormal Distribution			
95% H-UCL	163.5	90% Chebyshev (MVUE) UCL	171.1
95% Chebyshev (MVUE) UCL	198.7	97.5% Chebyshev (MVUE) UCL	237
99% Chebyshev (MVUE) UCL	312.2		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			

Soil ProUCL Output

Nonparametric Distribution Free UCLs			
95% CLT UCL	127.7	95% Jackknife UCL	128.3
95% Standard Bootstrap UCL	127.5	95% Bootstrap-t UCL	132.7
95% Hall's Bootstrap UCL	136.6	95% Percentile Bootstrap UCL	128.6
95% BCA Bootstrap UCL	130.1		
90% Chebyshev(Mean, Sd) UCL	147.6	95% Chebyshev(Mean, Sd) UCL	167.4
97.5% Chebyshev(Mean, Sd) UCL	195	99% Chebyshev(Mean, Sd) UCL	249.2

Suggested UCL to Use	
95% Adjusted Gamma UCL	134.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Thallium

General Statistics			
Total Number of Observations	41	Number of Distinct Observations	24
Number of Detects	12	Number of Non-Detects	29
Number of Distinct Detects	12	Number of Distinct Non-Detects	14
Minimum Detect	0.37	Minimum Non-Detect	0.53
Maximum Detect	2.4	Maximum Non-Detect	2.7
Variance Detects	0.387	Percent Non-Detects	70.73%
Mean Detects	0.995	SD Detects	0.622
Median Detects	0.935	CV Detects	0.625
Skewness Detects	0.985	Kurtosis Detects	0.821
Mean of Logged Detects	-0.187	SD of Logged Detects	0.64

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.169	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.256	Detected Data appear Normal at 5% Significance Level
Detected Data appear Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.601	Standard Error of Mean	0.0758
SD	0.436	95% KM (BCA) UCL	0.736
95% KM (t) UCL	0.728	95% KM (Percentile Bootstrap) UCL	0.736
95% KM (z) UCL	0.726	95% KM Bootstrap t UCL	0.767
90% KM Chebyshev UCL	0.828	95% KM Chebyshev UCL	0.931
97.5% KM Chebyshev UCL	1.074	99% KM Chebyshev UCL	1.355

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.412	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.178	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.248	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Soil ProUCL Output			
Gamma Statistics on Detected Data Only			
k hat (MLE)	2.897	k star (bias corrected MLE)	2.228
Theta hat (MLE)	0.343	Theta star (bias corrected MLE)	0.447
nu hat (MLE)	69.52	nu star (bias corrected)	53.48
MLE Mean (bias corrected)	0.995	MLE Sd (bias corrected)	0.667
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	1.897	nu hat (KM)	155.5
Approximate Chi Square Value (155.53, α)	127.7	Adjusted Chi Square Value (155.53, β)	126.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.732	95% Gamma Adjusted KM-UCL (use when n<50)	0.737
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.0292	Mean	0.551
Maximum	2.4	Median	0.41
SD	0.465	CV	0.843
k hat (MLE)	1.797	k star (bias corrected MLE)	1.682
Theta hat (MLE)	0.307	Theta star (bias corrected MLE)	0.328
nu hat (MLE)	147.4	nu star (bias corrected)	137.9
MLE Mean (bias corrected)	0.551	MLE Sd (bias corrected)	0.425
		Adjusted Level of Significance (β)	0.0441
Approximate Chi Square Value (137.91, α)	111.8	Adjusted Chi Square Value (137.91, β)	110.9
95% Gamma Approximate UCL (use when n>=50)	0.68	95% Gamma Adjusted UCL (use when n<50)	0.685
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.172	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.256	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.608	Mean in Log Scale	-0.648
SD in Original Scale	0.425	SD in Log Scale	0.507
95% t UCL (assumes normality of ROS data)	0.72	95% Percentile Bootstrap UCL	0.72
95% BCA Bootstrap UCL	0.744	95% Bootstrap t UCL	0.77
95% H-UCL (Log ROS)	0.693		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-0.667	95% H-UCL (KM -Log)	0.672
KM SD (logged)	0.494	95% Critical H Value (KM-Log)	1.892
KM Standard Error of Mean (logged)	0.0902		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.634	Mean in Log Scale	-0.713
SD in Original Scale	0.509	SD in Log Scale	0.688
95% t UCL (Assumes normality)	0.768	95% H-Stat UCL	0.776
DL/2 is not a recommended method, provided for comparisons and historical reasons			

Soil ProUCL Output

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.728	95% KM (Percentile Bootstrap) UCL	0.736

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Vanadium

General Statistics

Total Number of Observations	41	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	7.2	Mean	17.02
Maximum	63.1	Median	11.8
SD	12	Std. Error of Mean	1.873
Coefficient of Variation	0.705	Skewness	2.317

Normal GOF Test

Shapiro Wilk Test Statistic	0.726	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.225	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.138	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	20.17	95% Adjusted-CLT UCL (Chen-1995)	20.82
		95% Modified-t UCL (Johnson-1978)	20.28

Gamma GOF Test

A-D Test Statistic	1.914	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.181	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.139	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.184	k star (bias corrected MLE)	2.967
Theta hat (MLE)	5.345	Theta star (bias corrected MLE)	5.735
nu hat (MLE)	261.1	nu star (bias corrected)	243.3
MLE Mean (bias corrected)	17.02	MLE Sd (bias corrected)	9.879
		Approximate Chi Square Value (0.05)	208.2
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	207

Soil ProUCL Output										
Assuming Gamma Distribution										
95% Approximate Gamma UCL (use when n>=50))				19.89	95% Adjusted Gamma UCL (use when n<50)					20
Lognormal GOF Test										
Shapiro Wilk Test Statistic				0.901	**Shapiro Wilk Lognormal GOF Test**					
5% Shapiro Wilk Critical Value				0.941	Data Not Lognormal at 5% Significance Level					
Lilliefors Test Statistic				0.158	**Lilliefors Lognormal GOF Test**					
5% Lilliefors Critical Value				0.138	Data Not Lognormal at 5% Significance Level					
Data Not Lognormal at 5% Significance Level										
Lognormal Statistics										
Minimum of Logged Data				1.974	Mean of logged Data					2.669
Maximum of Logged Data				4.145	SD of logged Data					0.539
Assuming Lognormal Distribution										
95% H-UCL				19.65	90% Chebyshev (MVUE) UCL					21.04
95% Chebyshev (MVUE) UCL				23.05	97.5% Chebyshev (MVUE) UCL					25.83
99% Chebyshev (MVUE) UCL				31.3						
Nonparametric Distribution Free UCL Statistics										
Data do not follow a Discernible Distribution (0.05)										
Nonparametric Distribution Free UCLs										
95% CLT UCL				20.1	95% Jackknife UCL					20.17
95% Standard Bootstrap UCL				20.03	95% Bootstrap-t UCL					21.66
95% Hall's Bootstrap UCL				21.47	95% Percentile Bootstrap UCL					20.33
95% BCA Bootstrap UCL				20.95						
90% Chebyshev(Mean, Sd) UCL				22.64	95% Chebyshev(Mean, Sd) UCL					25.18
97.5% Chebyshev(Mean, Sd) UCL				28.72	99% Chebyshev(Mean, Sd) UCL					35.66
Suggested UCL to Use										
95% Chebyshev (Mean, Sd) UCL				25.18						
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)										
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.										
For additional insight the user may want to consult a statistician.										

Appendix H
Baseline Ecological Risk Assessment

APPENDIX H

Ecological Risk Assessment

This appendix contains a screening ecological risk assessment (SERA), constituting Steps 1 and 2 of the ecological risk assessment (ERA) process, and the first step (Step 3A) of a baseline ecological risk assessment (BERA) for Site 7. The previous ERA for Site 7 was conducted as part of the Site Inspection (SI) report (CH2M HILL, 2012) and consisted of an ecological risk screening, constituting a SERA and an abbreviated version of BERA Step 3A. This screening involved a comparison of soil (post-removal) and groundwater data collected in 2008 and 2011 with medium-specific ecological screening values (ESVs) and an evaluation of terrestrial food web exposures. No Chemicals of Potential Concern (COPCs) were identified in these media. A semi-quantitative evaluation of the potential transport of site-related constituents to the sediments of the adjacent York River was also conducted using selected pre-removal soil data; potential COPCs (primarily dioxins and metals) were identified during this evaluation but the results contained a high level of uncertainty.

The results of the 2012 SI were used to develop the sampling and analysis plan (SAP) for this Remedial Investigation (RI) (CH2M HILL, 2014). Additional groundwater data, as well as sediment data from the York River adjacent to the site (as well as upriver and downriver of the site), were collected in 2014 to support this RI. The 2008 (post-removal) and 2011 soil data used in the 2012 SI are also included in this ERA. However, the 2011 groundwater data for VOCs evaluated as part of the 2012 SI are not included in this ERA since more recent VOC data were collected in 2014.

H.1 Ecological Risk Assessment Process

This ERA was conducted in accordance with the *Navy Policy for Conducting Ecological Risk Assessments* (CNO, 1999) and the Navy guidance for implementing this ERA policy (NAVFAC, 2003; 2012). The Navy ERA policy and guidance, which describe a process consisting of eight steps organized into three tiers, are conceptually similar to the 8-step ERA process outlined in USEPA ERA guidance for the Superfund program (USEPA, 1997a). For both sets of guidance, Steps 1 and 2 involve conducting a SERA using very conservative assumptions. The BERA represents Steps 3 through 7. The BERA uses less conservative (but more realistic) assumptions and site-specific data to refine the risk estimates from the SERA for components that fail the initial screening. Step 8 addresses risk management issues. The major differences between the Navy ERA policy/guidance and the USEPA ERA guidance are:

- Navy policy/guidance provides clearly defined criteria for exiting the ERA process at specific points
- Navy policy/guidance divides Step 3 (the first step of the BERA) into two distinct sub-steps (Steps 3A and 3B), with a potential exit point after Step 3A
- Navy policy/guidance incorporates risk management considerations throughout all tiers of the ERA process

ERAs are conducted using a tiered, step-wise approach and are punctuated with Scientific Management Decision Points (SMDPs). SMDPs represent points in the ERA process where agreement on conclusions, actions, or methodologies is needed so that the ERA process can continue (or terminate) in a technically defensible manner. The results of the ERA at a particular SMDP are used to determine how the ERA process should proceed, for example, to the next step in the process or directly to a later step. The process continues until a final decision has been reached (for example, remedial action if unacceptable risks are identified, or no further action if risks are acceptable). The process can also be iterative if data needs are identified at any step; the needed data are collected and the process starts again at the point appropriate to the type of data collected.

The screening (preliminary) problem formulation is the first step of an ERA and establishes the goals, scope, and focus of the SERA. Step 1 of the ERA process is intended to answer two main questions:

- Do complete exposure pathways exist?

- Are sufficient data available to conduct the SERA?

If no complete exposure pathways exist, the ERA process terminates at Step 1 with a conclusion of negligible (acceptable) risk because exposure, and thus potential risk, can only occur if complete exposure pathways exist. If one or more complete exposure pathways are known to exist, or are likely to exist, the ERA process continues to Step 2 but only evaluates those exposure pathways that have been determined to be “critical” (ecologically important), that is, represent exposures to sensitive receptors that are associated with the predominant fate and transport mechanisms at the site (USEPA, 1997a). An evaluation of the available data is then conducted to determine if they are adequate to support the SERA. If not, additional data are collected before the ERA process continues. The second step of the ERA process involves conducting a screening exposure assessment, a screening effects assessment, and a screening risk calculation (risk characterization).

The results of the SERA are used to evaluate the potential for unacceptable ecological risks based on very conservative assumptions. If the results of the SERA suggest that further ecological risk evaluation is warranted, the ERA process proceeds to the BERA (Steps 3 through 7), which is a more detailed phase of the ERA process, for the exposure pathways, chemicals, receptors, and areas identified in the SERA. As previously indicated, the first step of the BERA (Step 3) is divided into two distinct sub-steps (3A and 3B) in Navy ERA guidance.

Step 3 of the USEPA ERA guidance consists of the following activities (USEPA, 1997a):

1. Refinement of the COPCs from the SERA
2. Further characterizing the potential ecological effects of contaminants
3. Refining information on contaminant fate and transport, complete exposure pathways, and receptors potentially at risk
4. Selecting assessment endpoints
5. Refining the conceptual site model and risk hypotheses from the SERA

Step 3A of the Navy policy/guidance (refinement of conservative exposure assumptions) corresponds to the first activity, previously listed, for the USEPA ERA guidance. In Step 3A, a refined evaluation of exposure estimates is conducted using less conservative (but more realistic) assumptions and additional methods relative to those used in the SERA, which is intended to be a very conservative assessment (NAVFAC, 2003). Examples of less conservative (but more realistic) exposure assumptions include using central tendency (such as means or medians) estimates (rather than maximums) for media concentrations, bioaccumulation factors (BAFs), and/or exposure parameters. Examples of additional methods include the consideration of background concentrations, bioavailability, and detection frequency (CNO, 1999; NAVFAC, 2003; 2012).

If risk estimates (and their associated uncertainty) are acceptable following Step 3A, the site will meet the conditions of the exit criterion specified in the Navy policy/guidance. If the Step 3A evaluation does not support a determination of acceptable risk within acceptable uncertainty, the site continues to Step 3B.

Step 3B of the Navy policy/guidance (problem formulation) corresponds conceptually to the last four activities, previously listed, for Step 3 of the USEPA ERA guidance. In Step 3B, the preliminary conceptual site model (CSM) from the SERA is refined based on the results of the Step 3A evaluation to develop a revised list of key receptors, critical exposure pathways, key COPCs, assessment endpoints, measurement endpoints, and risk hypotheses. Based on the refined CSM, the lines of evidence to be used in characterizing risk are determined. Agreement on the refined CSM, COPCs, exposure pathways, endpoints, and risk hypotheses constitutes the SMDP at the end of Step 3 in both Navy and USEPA ERA guidance.

Following the completion of Step 3, a decision point is reached with two potential outcomes. If the refined risk estimates are acceptable for each selected assessment endpoint, the investigation proceeds to risk characterization (Step 7) to document this conclusion, and the ERA process terminates. If the uncertainties associated with the refined risk estimates are unacceptable and/or the risk estimates indicate that unacceptable risks may exist, site-specific studies might be required and the ERA process continues (Steps 4 through 6). Step 4 is a work planning step where additional site-specific studies are scoped and designed. Step 5 consists of the

verification of the field sampling design developed in Step 4 while Step 6 constitutes the site investigation and data analysis phase of the process. The scope (the spatial extent of sampling) and components (for example, the collection of biological data such as tissue samples and toxicity testing) of any site-specific studies are determined by the conclusions of Step 3 and the pathways/endpoints associated with the potential unacceptable risks.

Step 7 consists of the documentation and synthesis of the information and data identified in Steps 1 through 3 (no additional study) or Steps 1 through 6 (additional study). In this step, ecological risk is evaluated and characterized using both quantitative and qualitative methods. Conclusions are made as to whether or not there is a reasonable potential for unacceptable ecological risk, and if there is a potential for unacceptable ecological risk, the magnitude of that risk. The results of the completed BERA (Step 7) are used to make any necessary risk management decisions (Step 8) related to current or future risks. Possible decisions include:

- Adequate information is available to conclude that no unacceptable ecological risks exist. The assessment should stop at Step 7.
- Adequate information is available to conclude that unacceptable ecological risks exist for which remedial actions or controls are warranted. Whether remedial actions or controls are taken, and the specific actions or controls taken, will depend on a number of risk management factors such as the results of any human health risk assessments (if applicable) and the potential impact of the remedial action or control itself on the habitats and biota present. This analysis would occur as part of Step 8.
- Adequate information is not available to estimate risk or the risk estimate is believed to be too conservative or uncertain to recommend remediation. The assessment should be refined.

H.2 Problem Formulation

Problem formulation establishes the goals, scope, and focus of the ERA. As part of problem formulation, the ecological setting of Site 7 is characterized in terms of the habitats and biota known or likely to be present. The types and concentrations of chemicals that are present in ecologically relevant media are also described based on available analytical data. Surface and shallow subsurface soil (0 to 24 inches below ground surface [bgs]) is the ecologically relevant terrestrial medium at the site. Surface sediment (0 to 6 inches bgs) is the ecologically relevant aquatic medium in the York River adjacent to the site. In addition, site groundwater is evaluated as a potential transport medium to the York River.

A CSM is developed that describes source areas, transport pathways and exposure media, exposure pathways and routes, and receptors. Assessment endpoints, measurement endpoints, and risk hypotheses are developed to evaluate those receptors for which critical exposure pathways exist. The fate, transport, and toxicological properties of the chemicals present in Site 7 media, particularly the potential for bioaccumulation, are also considered during this process.

H.2.1 Environmental Setting

Site 7 is approximately 1 acre in size and is located immediately adjacent to the York River, a tidal estuarine water body (**Figure 1-2**). Site 7 was reportedly used as a disposal area for non-hazardous, inert wastes from the former City of Penniman and the former DuPont Penniman Shell Loading Plant facility during the early 1900s. Information on the specific types and quantities of wastes disposed of is not available; however, the presence of ash, melted bottles, and charred metal indicates that at least some of the waste may have been incinerated before disposal. In September 2003, Hurricane Isabel eroded approximately 15 to 20 feet of the York River shoreline, exposing debris (mostly dinnerware, incinerated bottles, and metal) and ash at Site 7. Two recreational cabins, Buildings 169 and 170, were formerly located within the boundary of Site 7.

In February 2004, trenching and soil sampling was conducted at Site 7 to determine the extent of debris and potential soil contamination in preparation for a time-critical removal action (TCRA) to address shoreline erosion and exposure of debris. Potential soil contamination surrounding the footprints of Buildings 169 and 170 was also identified. In addition, ash and debris were identified in the southeastern portion of the site where erosion of the slope had occurred. In the summer of 2004, beach cleanup activities were conducted in an area approximately

150 feet by 200 feet along the shoreline of the York River at Site 7. The area was hand-cleared of debris consisting of glass, plastic, metal, and ceramic material. The TCRA was performed in July and August 2006 to clean up and stabilize the shoreline to prevent further erosion of waste into the York River. The TCRA consisted of the placement of sand-filled geotubes against the toe of approximately 240 feet of eroding shoreline (Figure 3 in the Final Site 7 RI UFP-SAP [CH2M HILL, 2014]). In addition, Buildings 169 and 170 were demolished. Based on the results of the 2004 trenching and soil sampling, an additional removal action was completed between December 2007 and April 2008 to remove waste and waste-contaminated soil. Following the 2008 removal action, the slope along the shoreline was graded from a near-vertical slope to a less severe, approximately 1:1 slope, and the excavated area was backfilled with clean backfill, followed by 6 inches of topsoil, and seeded.

Site 7 was forested prior to the 2007-2008 removal action. However, as part of the removal action, the excavation area was cleared of trees and brush. Currently, the portions of the site surrounding the removal area are forested, with the removal area consisting of successional old field habitat. Surface water from the site runs off to the York River or infiltrates the ground. Other than the York River, there are no wetlands or water bodies on, or immediately adjacent to, Site 7. During the 2011 SI, groundwater underlying Site 7 was encountered within the Yorktown-Eastover aquifer between 15 and 25 feet bgs. Based on water level measurements collected during the SI, groundwater flows east-northeast towards the York River.

Soils on the site are somewhat acidic, with an average pH of 5.64 (range of 4.85 to 6.36). The substrate along the shoreline of the York River is very coarse, consisting mostly of shell fragments and sand; there is very little organic matter present. Total organic carbon (TOC) levels generally increase further from the shoreline and the substrates become less sandy, with higher percentages of fines. Sediment conditions were generally comparable between site samples and upriver and downriver samples (**Table H-1**). The salinity of the York River in the vicinity of Site 7 is in the marine range, averaging 26.2 parts per thousand (ppt). The salinity is lower in upriver areas, averaging 17.3 ppt, and higher in downriver areas, averaging 34.3 ppt (**Table H-2**).

Currently, Site 7 is vacant and is surrounded by a fence to prevent trespassers from entering the site. There are no future anticipated uses for Site 7; however, due to its location, the site may eventually be used as a recreational area.

H.2.2 Analytical Data Used in the ERA

The soil data used in this ERA included 36 of the 41 post-removal (2008) samples, which represent all post-removal samples that are within the 0- to 24-inch depth range relative to the current (backfilled) site elevation; samples of the backfill material, however, were not included in the evaluation. This depth range was selected since ecological exposures are generally considered to be confined to the top two feet of the soil column. The soil samples used in the ERA were within 24 inches (the depth of potential ecological exposures) of the current ground elevation (following backfilling) and were below the backfill material (that is, represented soils in areas where less than 24 inches of backfill were placed). Thus, the use of these data is conservative since the samples are covered by backfill, but less than 24 inches of backfill is present, which means that some ecological exposures to these samples are still possible. Five soil samples collected in 2011 and analyzed for pH were also used in this ERA.

Surface (0 to 6 inches) sediment samples collected from the York River upriver, adjacent to, and downriver of Site 7 were quantitatively evaluated in this ERA. The upriver and downriver samples were both used to represent background conditions. Sediment samples were 5-point composites collected along 300-foot transects located parallel to the shoreline. At each location (site, upriver, and downriver), a total of 6 transects were sampled, with the first transect placed midway between the estimated mean low water and mean high water marks (which were approximately 50 feet from each other), the second transect placed 50 feet offshore from the first transect, and the third transect placed 50 feet offshore of the second transect. Transects 4 through 6 were placed further offshore where sediments began to be more soft and mucky (representing likely depositional areas). **Section 2.4** of the RI report provides a more detailed description of the sediment sampling conducted for this RI.

Although ecological receptors do not have direct exposure to groundwater, groundwater samples collected in 2014 as part of this RI were quantitatively evaluated in this ERA, as were groundwater samples collected in 2011 for the SI (except for the 2011 VOC data, which were replaced with the VOC data collected in 2014). This was

done to provide a conservative evaluation of the potential for significant contaminant transport via groundwater to downgradient receiving water bodies (York River) and the subsequent potential exposure of ecological receptors in this water body.

Background soil and groundwater (Yorktown-Eastover aquifer) upper tolerance limits (UTLs) from the Yorktown-CAX background study (CH2M HILL, 2011) were also considered in this ERA. The higher of the surface and subsurface soil UTLs were used because the site soil samples encompassed the total depth range of both sets of background samples (0 to 24 inches). The samples used in this ERA are listed in **Table H-3** and the locations are shown on **Figures 2-1 through 2-3**. The analytical results for these samples can be found in **Appendix D.**

H.2.3 Conceptual Site Model

The CSM relates potentially exposed receptor populations with potential source areas based on physical site characteristics and complete exposure pathways. Important components of the CSM are the identification of potential source areas, transport pathways, exposure media, exposure pathways and routes, and receptors. Actual or potential exposures of ecological receptors associated with a site are determined by identifying the most likely, and most important, mechanisms and pathways of contaminant release and transport. A complete exposure pathway has three components: (1) a source or sources of contamination that results in a release to the environment; (2) a pathway and mechanism of chemical transport through an environmental medium; and (3) an exposure or contact point for an ecological receptor. **Figure H-1** illustrates a diagrammatic CSM for Site 7. Key components of this CSM are discussed in the following subsections.

H.2.3.1 Source Areas

The site-related sources of potential contamination at Site 7 are the historical disposal areas, as discussed in **Section H.2.1**.

H.2.3.2 Transport Pathways and Exposure Media

A transport pathway describes the mechanisms whereby site-related chemicals, once released, may be transported from a source to ecologically relevant media (such as surface soil) where exposures may occur. These transport pathways are shown on **Figure H-1**.

The primary release mechanisms and transport pathways at the site include:

- Surface runoff from site-related source areas to other terrestrial areas of Site 7
- Uptake from the surface soil and accumulation in the tissues of terrestrial biota
- Infiltration, percolation, and leaching of contaminants to groundwater and subsequent discharge to the surface water and sediment of the York River
- Surface runoff from site-related source areas to the York River
- Uptake from the surface water and sediment of the York River and accumulation in the tissues of aquatic biota

Concentration gradients from potential source areas through the appropriate pathway(s) are evaluated in order to determine if there are any links between site contamination and potential ecological receptors (habitats and biota).

Exposure media for ecological receptors are typically limited to surface water, surface sediment, and surface soil. Due to the historical nature of potential direct releases from the site to the York River, surface water samples were not collected but surface sediment (0 to 6 inches) samples were collected in 2014 as part of this RI. As discussed in **Section H.2.2**, the soil samples evaluated in this ERA were all collected within 0 to 24 inches of the current site elevation. Groundwater is generally considered only as a transport medium since there are no ecological exposures to groundwater until it discharges to a water body or surfaces as a seep. In this ERA, groundwater is evaluated as a potential transport medium to downgradient water bodies (York River). Air is not addressed in this ERA since this medium is not likely to result in significant contributions to total exposures for non-VOCs (VOCs were rarely detected in site soil samples).

H.2.3.3 Exposure Pathways and Routes

An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Exposure, and thus potential risk, can only occur if complete exposure pathways exist. **Figure H-1** shows the potentially complete exposure pathways to ecological receptors associated with Site 7.

Complete exposure pathways exist to lower trophic level terrestrial receptors (plants, soil invertebrates, and reptiles) from direct contact with surface soil, and to terrestrial upper trophic level receptors (birds, mammals, and reptiles) from incidental ingestion of surface soil and exposure via terrestrial food webs. There is the potential for transport, primarily through historical surface runoff, from Site 7 former source areas to the York River, and subsequent exposure, via direct contact and/or direct ingestion of surface water and surface sediment, to lower trophic level aquatic receptors (aquatic plants, aquatic and benthic invertebrates, fish, and reptiles), as well as to upper trophic level aquatic receptors (birds, mammals, fish, and reptiles) via incidental ingestion (sediment) and exposure via aquatic food webs. There is the potential for groundwater transport and subsequent discharge from the site to the York River (a tidal estuarine water body). Groundwater is evaluated as a potential transport medium to this water body in this ERA. There was also documented transport of debris and soil from the site to the York River during Hurricane Isabel, which occurred prior to the completion of remedial actions at the site. This historical pathway, which is no longer complete following the completion of remedial actions on the site, is also evaluated in this ERA using the sediment samples collected from the York River.

An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium. The most common exposure routes are dermal contact, direct uptake, ingestion, and inhalation. Terrestrial plants may be exposed to chemicals present in surface soil through their root surfaces during water and nutrient uptake. Unrooted, floating aquatic plants, rooted submerged vascular aquatic plants, and algae may be exposed to chemicals directly from the water or (for rooted plants) from sediment. Terrestrial and aquatic/benthic invertebrates may be exposed to chemicals in surface soil, surface sediment, and/or surface water through direct contact and ingestion.

Animals may be exposed to chemicals through the: (1) inhalation of gaseous chemicals or of chemicals adhered to airborne particulate matter; (2) incidental ingestion of contaminated abiotic media (soil and/or sediment) during feeding or preening activities; (3) ingestion of contaminated water; (4) ingestion of contaminated plant and/or animal tissues for chemicals that have entered food webs; and/or (5) dermal contact with contaminated abiotic media. These routes, where applicable, are depicted on **Figure H-1**.

Direct contact is the primary exposure route for lower trophic level receptors (plants, invertebrates, and reptiles) at the site. Incidental ingestion of soil/sediment and exposure via food webs are the primary exposure routes for upper trophic level receptors (birds, mammals, fish, and reptiles). The contribution to the total dose from the inhalation route is generally insignificant for upper trophic level ecological receptors relative to ingestion pathways. Thus, the inhalation pathway is not generally considered for ecological receptors and was not evaluated in this ERA. Exposure to chemicals present in surface soil and surface sediment via dermal contact may occur but is unlikely to represent a major exposure pathway for most upper trophic level receptors because fur or feathers minimize transfer of chemicals across dermal tissue. Thus, dermal contact was not evaluated for upper trophic level receptors in this ERA. Incidental ingestion of surface soil or surface sediment during feeding, preening, or grooming activities was, however, considered in the risk estimates. Direct contact was considered for lower trophic level receptors (soil and benthic invertebrates).

Direct ingestion of drinking water is only considered when a permanent or semi-permanent source of water with a salinity below 15 ppt, the approximate toxic threshold for wildlife receptors (Humphreys, 1988), exists on a site. The salinity of the adjacent York River, the only potential drinking water source in the immediate site vicinity, exceeds this value (**Table H-2**). Thus, exposure via direct ingestion of drinking water was not included in the ERA.

H.2.3.4 Receptors

Because of the complexity of natural systems, it is generally not practical to directly assess the potential impacts to all ecological receptors present at a site. Therefore, specific receptor species (such as red-tailed hawk) or species

groups (such as plants) are selected as surrogates to evaluate potential risks to larger components of the ecological community (guilds; such as carnivorous birds) used to represent the assessment endpoints (such as survival and reproduction of carnivorous birds). Selection criteria typically include those species that:

- Are known to occur, or are likely to occur, at the site
- Have a particular ecological, economic, or aesthetic value
- Are representative of taxonomic groups, life history traits, and/or trophic levels in the habitats present for which complete exposure pathways are likely to exist
- Can, because of toxicological sensitivity or potential exposure magnitude, be expected to represent potentially sensitive populations

The following upper trophic level receptor species were selected for exposure modeling in terrestrial habitats based on the previously listed criteria and the habitats present on the site:

- Mourning dove (*Zenaida macroura*) – terrestrial avian herbivore
- American robin (*Turdus migratorius*) – terrestrial avian omnivore/invertivore (modeled as both)
- Red-tailed hawk (*Buteo jamaicensis*) – terrestrial avian carnivore
- Meadow vole (*Microtus pennsylvanicus*) – terrestrial mammalian herbivore
- Short-tailed shrew (*Blarina brevicauda*) – terrestrial mammalian invertivore
- White footed mouse (*Peromyscus leucopus*) – terrestrial mammalian omnivore
- Red fox (*Vulpes vulpes*) – terrestrial mammalian carnivore

The following upper trophic level receptors were selected for exposure modeling in aquatic habitats based on the previously listed criteria and the habitats present on/adjacent to the site:

- Mallard (*Anas platyrhynchos*) – aquatic avian omnivore
- Belted kingfisher (*Ceryle alcyon*) – aquatic avian piscivore/invertivore
- Great blue heron (*Ardea herodias*) – aquatic avian piscivore
- Osprey (*Pandion haliaetus*) – aquatic avian piscivore
- Spotted sandpiper (*Actitus macularia*) – aquatic avian invertivore
- Raccoon (*Procyon lotor*) – aquatic mammalian omnivore
- Mink (*Mustela vison*) – aquatic mammalian piscivore

Upper trophic level receptors quantitatively evaluated in the ERA were limited to birds and mammals, the taxonomic groups with the most available information regarding exposure and toxicological effects. Lower trophic level receptors were evaluated based on those taxonomic groupings for which medium-specific ESVs have been developed. As such, specific species of aquatic biota were not chosen as receptors because of the limited information available for specific species and because aquatic biota (aquatic/benthic invertebrates, fish, and reptiles) were evaluated on a community level via a comparison of sediment concentrations with sediment ESVs. Similarly, specific species of terrestrial biota (plants and soil invertebrates) were not chosen as receptors because of the limited information available for specific species and because these receptors were evaluated on a community level via a comparison of chemical concentrations in soil with soil ESVs developed for these groups.

Amphibians are unlikely to occur on the site based on the salinity of the York River. Reptiles are an applicable receptor group. Individual species of reptiles were not, however, selected for evaluation because of the general lack of available toxicological information for this taxonomic group for direct effects and effects from exposures via food webs. Potential risks to reptiles from food web exposures were evaluated using other fauna (birds and mammals) as surrogates. Similarly, potential risks to this group from direct exposures to surface soil and/or surface sediment were evaluated using ESVs developed for other taxonomic groups (described above). This is discussed further in **Section H.6** (uncertainties).

No federally or state-listed endangered or threatened species are currently known to occur on Site 7.

H.2.3.5 Endpoints and Risk Hypotheses

The conclusion of the problem formulation includes the selection of ecological endpoints and risk hypotheses, which are based on the CSM. Two types of endpoints, assessment endpoints and measurement endpoints, are defined as part of the ERA process (USEPA, 1997a). An assessment endpoint is an explicit expression of the environmental component or value that is to be protected. A measurement endpoint is a measurable ecological characteristic that is related to the component or value chosen as the assessment endpoint. The considerations for selecting assessment and measurement endpoints are summarized in USEPA (1997a) and discussed in detail in Suter (1989; 1990; 1993). Risk hypotheses are testable hypotheses about the relationship among the assessment endpoints and their predicted responses when exposed to contaminants.

Endpoints define ecological attributes that are to be protected (assessment endpoints) and measurable characteristics of those attributes (measurement endpoints) that can be used to gauge the degree of impact that has or may occur. Assessment endpoints most often relate to attributes of biological populations or communities, and are intended to focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals attributable to a site (USEPA, 1997a). Assessment endpoints contain an entity (such as hawk population) and an attribute of that entity (such as survival rate). Individual assessment endpoints usually encompass a group of species or populations (the receptor) with some common characteristic, such as specific exposure route or contaminant sensitivity, with the receptor then used to represent the assessment endpoint in the risk evaluation.

Assessment and measurement endpoints may involve ecological components from any level of biological organization, from individual organisms to the ecosystem itself. Effects on individual organisms are important for some receptors, such as rare and endangered species; population- and community-level effects are typically more relevant to ecosystems. Population- and community-level effects are usually difficult to evaluate directly without long-term and extensive study. However, measurement endpoint evaluations at the individual level, such as an evaluation of the effects of chemical exposure on reproduction, can be used to predict effects on an assessment endpoint at the population or community level. In addition, use of criteria values designed to protect the majority of the components of a community (such as the Ambient Water Quality Criteria [AWQC] for the Protection of Aquatic Life) can be useful in evaluating potential community- and/or population-level effects.

Table H-4 shows the assessment endpoints, risk hypotheses, and measurement endpoints used in the ERA. **Table H-4** also shows the receptors associated with each endpoint.

H.3 Exposure Assessment

The principal activity associated with the exposure assessment is the estimation of chemical concentrations in applicable media, termed exposure point concentrations (EPCs), to which the receptors may be exposed. This is accomplished through the selection of appropriate sets of the available analytical data using a set of criteria (such as validation status and sampling date). Once the analytical data sets are selected, EPCs are calculated as a particular point on the distribution of concentrations. At the screening level (SERA; Step 2), the EPC is the maximum detected concentration. At the baseline level (BERA; Step 3A), EPCs are central tendency estimates (such as the arithmetic mean). EPCs are then used in bioaccumulation and food web models to estimate exposures to upper trophic level receptors.

For conservatism, the maximum (SERA) and mean (BERA) reporting limits for chemicals analyzed for but not detected were also compared to medium-specific ESVs and (where applicable) used for food web exposure modeling. This was done to determine if reporting limits were less than chemical concentrations at which potential adverse effects to ecological receptors may occur.

H.3.1 Selection Criteria for Analytical Data

Available analytical data (**Section H.2.2**) were selected for use in the ERA based on the following:

- Data must have been validated by a qualified data validator using acceptable data validation methods. Rejected (R) values were not used in the ERA. Unqualified data and data qualified as J (estimated), L (biased

low), or K (biased high) were treated as detected. Sediment data (dioxin/furan congeners) qualified as X (estimated maximum possible concentration) were treated as detected. Data qualified as U (undetected) or B (blank contamination) were treated as non-detected.

- For samples with duplicate analyses, the higher of the two concentrations was used, for conservatism, when both values were detects or when both values were non-detects. In cases where one result was a detection and the other a non-detect, the detected value was used in the assessment.
- For non-detected results, the sample quantitation (reporting) limit (SQL) was used to represent the concentration. When calculating statistics (such as the arithmetic mean), one-half of the SQL was used for non-detected results.

H.3.2 Data Groupings

Sediment data were partitioned into the following spatial groups (**Table H-3; Figure 2-2**):

- Site
- Upriver (Reference/Background)
- Downriver (Reference/Background)

Facility-wide background surface/subsurface soil and groundwater (Yorktown-Eastover aquifer) UTLs were also used in the ERA to help evaluate the site-relatedness of the chemicals detected in these media.

H.3.3 Exposure Point Concentrations

EPCs are calculated as a particular point on the distribution of concentrations. At the screening level (SERA; Step 2), the EPC is the maximum detected concentration. At the baseline level (BERA; Step 3A), EPCs are central tendency estimates, which provide a more representative estimate of potential exposures and risks to receptor populations (the focus of the selected assessment endpoints). In this ERA, the maximum, arithmetic mean, and 95% upper confidence limit (UCL) of the arithmetic mean concentrations were evaluated for direct exposures. Exposures via food webs also utilized the maximum, arithmetic mean, and 95% UCL of the arithmetic mean. If the calculated 95% UCL and/or mean concentrations were greater than the maximum detected concentration, the maximum detected concentration was used in place of the 95% UCL and/or mean concentrations.

These three medium-specific EPCs were also used in bioaccumulation and food web models to estimate exposures to upper trophic level receptors. Dietary items for which tissue concentrations were modeled included terrestrial and aquatic plants, soil invertebrates, small mammals, benthic invertebrates, and fish. Incidental ingestion of soil and sediment were included when calculating the total dietary exposure. Due to the salinity of the York River, ingestion of drinking water was not included when calculating the total dietary exposure. The models and parameter values used for calculating the tissue concentrations are outlined in the following subsections.

Not all chemicals were evaluated for food web exposures. Only those chemicals with the potential to bioaccumulate to a significant extent, as defined in Table 4-2 of USEPA (2000), were evaluated. This list of bioaccumulating chemicals is provided in **Table H-5** for chemicals relevant to Site 7.

For the screening (SERA) exposure estimates, the uptake of chemicals from the abiotic media into food items was based on conservative (e.g., 90th percentile) bioconcentration factors (BCFs) or bioaccumulation factors (BAFs) from the literature, where available. The 90th percentile is generally recommended to provide for a conservative screening assessment (Sample et al., 1998a; 1998b; Bechtel Jacobs, 1998b). If 90th percentile values were not available in the cited reference, the maximum value was used, if available. If only central tendency (such as median) values were reported, they were used for both the SERA and BERA. Where an individual study (as opposed to a compilation of multiple studies) was cited, the best available value was sometimes a single value or the derivation was not specified. Default (assumed) factors of 1.0 were used only when data were not readily available for a chemical in the literature. In some cases, chemical concentrations in food items were directly estimated from maximum surface soil or surface sediment concentrations using available literature-based regression models.

BCFs and BAFs used for baseline (BERA) exposure estimates were based on, or modeled from, central tendency estimates (such as median or mean). Baseline values considered both the distribution of the data (normal or log normal) and the recommendations in the cited reference. Geometric means were preferred for log normal distributions and arithmetic means for normal distributions. In some cases, neither distribution was applicable or the distribution was biased by an outlying value. In these cases, point estimates like the median were then considered. Where an individual study (as opposed to a compilation of multiple studies) was cited, the best available value was sometimes a single value or the derivation was not specified. Default (assumed) factors of 1.0 were used only when data were not readily available for a chemical in the literature. In some cases, chemical concentrations in food items were directly estimated from mean and 95% UCL surface soil or surface sediment concentrations using available literature-based regression models.

In the BERA, using central tendency estimates (rather than high-end values or maximums) for exposure parameters such as BAFs provides a more representative estimate of potential exposures and risks to receptor populations (which are the focus of the selected assessment endpoints) of upper trophic level receptors. Since these upper trophic level species are highly mobile, they would be expected to effectively average their exposure over time as they forage within the area defining their home range. Average prey concentrations are most appropriately estimated using central tendency estimates of media concentrations and accumulation factors. For example, the wildlife dietary exposure models contained in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) specify the calculation of an average daily dose. Increasing the representativeness of the exposure estimates relative to population-level effects is consistent with the intent of the BERA. In cases where adequate spatial sampling coverage exists, mean concentrations are also appropriate for evaluating potential risks to populations of lower trophic level receptors because the members of the population are expected to be found throughout a site (where suitable habitat is present), rather than concentrated in one particular area. While effects on individual organisms might be important for some receptors, such as rare and endangered species, population- and community-level effects are typically more relevant to ecosystems. For this ERA, the receptor populations of interest are those that utilize all or part of the site, but such use is not necessarily exclusive to the site for the entire population. However, the exposure estimates in this ERA assume that the receptors receive 100 percent of their exposure from the site.

For direct exposures to soil, PAHs were evaluated based on the sum total concentration of the individual constituents for the high molecular weight (HMW) and low molecular weight (LMW) fractions. For direct exposures of aquatic receptors to sediment, indirect exposures of aquatic receptors to groundwater, direct exposures of terrestrial receptors to soil, and exposures via terrestrial and aquatic food webs, dioxin/furans were evaluated as a single group using the toxicity equivalency quotient (TEQ) approach. The TEQ approach relates the toxicity of dioxin-like chemicals to the toxicity of 2,3,7,8-TCDD, which is considered to be the most toxic of this group of chemicals. The TEQ approach is appropriate and applicable to ERAs for both terrestrial and aquatic systems. As part of this methodology, a toxicity equivalence factor (TEF), which denotes a congener's toxicity (potency) relative to 2,3,7,8-TCDD (which has a TEF of 1.0), is developed for each dioxin and furan congener. Consensus-based, internationally-accepted TEFs for 7 dioxin (PCDD) and 10 furan (PCDF) congeners (including 2,3,7,8-TCDD) have been developed for fish, birds, and mammals. Each TEF is multiplied by the concentration of its respective congener measured in an environmental sample (such as a sediment sample) and the products are summed. As shown in the following formula, the sum represents the TEQ and is a measure of exposure:

$$TEQ = \sum_{n=1}^{7}\left[PCDD_n \times TEF_n\right] + \sum_{p=1}^{10}\left[PCDF_p \times TEF_p\right]$$

The currently accepted TEFs for dioxin and furan congeners (Van den Berg et al., 1998; 2006) are listed in **Table H-6**. Fish TEFs were used to calculate concentrations for comparison to sediment and water ESVs. Mammalian TEFs were used to calculate concentrations for comparison to soil ESVs. Mammalian and bird TEFs were used to calculate the concentrations used in the food web models for mammalian and bird receptors, respectively.

H.3.3.1 Terrestrial Plants

For most chemicals, tissue concentrations in the aboveground vegetative portion of terrestrial plants were estimated by multiplying the maximum (SERA) or mean and 95% UCL (BERA) surface soil concentration for each bioaccumulative chemical by chemical-specific soil-to-plant BAFs obtained from the literature. These BAFs, for both the SERA and BERA, are listed in **Table H-7**. For some chemicals, tissue concentrations were directly estimated from surface soil concentrations using regression equations; these algorithms are listed in **Table H-8**.

The BAF values used were based on root uptake from soil and on the ratio between dry-weight soil and dry-weight plant tissue. Literature values based on the ratio between dry-weight soil and wet-weight plant tissue were converted to a dry-weight basis by dividing the wet-weight BAF by an estimated solids content for terrestrial plants (15 percent [0.15] [Sample et al., 1997]).

For inorganic chemicals lacking literature-based, chemical-specific BAFs or applicable algorithms, a soil-to-plant BAF of 1.0 was used. For non-ionic organic chemicals (with a log K_{ow} of between 3 and 8) without literature-based BAFs, soil-to-plant BAFs were estimated using the rinsed foliage algorithm provided on Figure 5B of USEPA (2007j):

$$\log BAF = (-0.4057)(\log K_{ow}) + 1.781$$

Where

BAF = Soil-to-plant BAF (unitless; dry-weight basis)

K_{ow} = Octanol-water partitioning coefficient (unitless)

The log K_{ow} values used in this equation are listed in **Table H-5**.

H.3.3.2 Soil Invertebrates (Earthworms)

For most chemicals, tissue concentrations in soil invertebrates (earthworms) were estimated by multiplying the maximum (SERA) or mean and 95% UCL (BERA) surface soil concentration for each bioaccumulative chemical by chemical-specific soil-to-invertebrate BCFs or BAFs obtained from the literature. These BCF/BAF values, for both the SERA and BERA, are listed in **Table H-9**. For some chemicals, tissue concentrations were directly estimated from surface soil concentrations using regression equations; these algorithms are listed in **Table H-8**.

BCFs are calculated by dividing the concentration of a chemical in earthworm tissue by the concentration of that same chemical in the surrounding environmental medium (surface soil) without accounting for uptake via the diet. BAFs consider both direct exposure to soil and exposure via the diet. Because earthworms consume soil, BAFs are more appropriate values and were used when available. BAFs based on depurated analyses (soil was purged from the gut of the earthworm prior to analysis) were given preference over undepurated analyses when selecting BAF values because direct ingestion of soil is accounted for separately in the food web model.

The BCF/BAF values selected were based on the ratio between dry-weight soil and dry-weight earthworm tissue. Literature values based on the ratio between dry-weight soil and wet-weight earthworm tissue were converted to a dry-weight basis by dividing the wet-weight BCF/BAF by the estimated solids content for earthworms (16 percent [0.16]; USEPA, 1993). For chemicals without available measured BAFs/BCFs, an earthworm BAF was estimated using available regression equations from the literature, was estimated using data for similar chemicals, or a BAF of 1.0 was assumed.

H.3.3.3 Small Mammals

Whole-body tissue concentrations in small mammals (omnivores, herbivores, and insectivores) were estimated using one of two methodologies. For chemicals with literature-based soil-to-small mammal BAFs, the small mammal tissue concentration was calculated by multiplying the maximum (SERA) or mean and 95% UCL (BERA) surface soil concentration for each bioaccumulative chemical by a chemical-specific soil-to-small mammal BAF obtained from the literature. These BAFs, for both the SERA and BERA, are listed in **Tables H-10 through H-12**. For some chemicals, tissue concentrations were directly estimated from surface soil concentrations using regression equations; these algorithms are listed in **Table H-8**.

The BAF values selected were based on the ratio between dry-weight soil and whole-body dry-weight tissue. Literature values based on the ratio between dry-weight soil and wet-weight tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for small mammals (32 percent [0.32] [USEPA, 1993]).

For chemicals without soil-to-small mammal BAF values or algorithms, an alternate approach was used to estimate whole-body tissue concentrations. Because most chemical exposure for these small mammals is via the diet, it was assumed that the concentration of each bioaccumulative chemical in the small mammal's tissues was equal to the chemical concentration in its diet multiplied by a diet to whole-body BAF derived from the literature. The small mammal tissue concentration was calculated as follows:

$$TC_x = [[\sum_i (FC_{xi})(PDF_i)] + [(SC_x)(PDS)]] \, (BAF_{diet\text{-}whole\ body})$$

Where

TC_x	=	Small mammal tissue concentration for chemical x (mg/kg, dry weight)
FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry weight)
PDF_i	=	Proportion of diet composed of food item i (dry weight basis)
SC_x	=	Concentration of chemical x in soil (mg/kg, dry weight)
PDS	=	Proportion of diet composed of soil (dry weight basis)
BAF	=	Diet to whole-body BAF (unitless, dry weight basis)

This equation is basically a weighted average of the chemical concentration in the various dietary components (including soil ingestion) for the small mammal (vole, shrew, and mouse, weighted equally), multiplied by a diet-to-whole body BAF, and thus excludes water ingestion.

For chemicals lacking diet to whole-body BAF values (not to be confused with the soil-to-small mammal BAFs listed in **Tables H-10 through H-12**), a diet to whole-body BAF of 1 was assumed. The use of a diet to whole-body BAF of 1 is likely to result in a conservative estimate of concentrations for chemicals that are not known to biomagnify in terrestrial food webs and a reasonable estimate of concentrations for chemicals that are known to bioaccumulate or biomagnify, based on reported literature values. For example, a maximum diet to whole-body BAF value of 1.0 was reported by Simmons and McKee (1992) for PCBs based on laboratory studies with white-footed mice. Menzie et al. (1992) reported diet to whole-body BAF values for DDT of 0.3 for voles and 0.2 for short-tailed shrews. Reported diet to whole-body BAF values for dioxin were only slightly above 1 (1.4) for the deer mouse (USEPA, 1990).

H.3.3.4 Aquatic Plants

Tissue concentrations in the above-ground vegetative portion of rooted aquatic plants were estimated by multiplying the sediment concentration for each bioaccumulative chemical by chemical-specific soil-to-plant BCFs (extrapolated to sediments) obtained from the literature (see **Section H.3.3.1**).

The BCF values were based on root uptake from sediment and on the ratio between dry-weight sediment and dry-weight plant tissue. Literature values based on the ratio between dry-weight sediment and wet-weight plant tissue were converted to a dry-weight basis by dividing the wet-weight BCF by the estimated solids content for plants (15 percent [0.15]; Sample et al., 1997).

H.3.3.5 Benthic Invertebrates

Tissue concentrations in benthic invertebrates were estimated by multiplying the maximum (SERA) or mean and 95% UCL (BERA) sediment concentration for each bioaccumulative chemical by chemical-specific sediment-to-invertebrate BAF values obtained from the literature. These BAF values, for both the SERA and BERA, are listed in **Table H-13**. For some chemicals, tissue concentrations were directly estimated from sediment concentrations using regression equations; these algorithms are listed in **Table H-8**.

The BAF values selected were based on the ratio between dry-weight sediment and dry-weight invertebrate tissue. BAFs based on depurated analyses (sediment was purged from the gut of the organism prior to analysis) were given preference over undepurated analyses when selecting BAF values because direct ingestion of sediment is accounted for separately in the food web model. However, in some cases, the depurated data set was limited or highly variable, and the pooled or undepurated data were considered.

Literature values based on the ratio between dry-weight sediment and wet-weight invertebrate tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for benthic invertebrates (21 percent [0.21]; USEPA, 1993). For chemicals without available measured BAFs, a BAF was estimated using available regression equations from the literature, was estimated using data for similar chemicals, or a BAF of 1.0 was assumed.

H.3.3.6 Fish

Tissue concentrations in whole-body fish were estimated by multiplying the maximum (SERA) or mean and 95% UCL (BERA) sediment concentration for each bioaccumulative chemical by chemical-specific sediment-to-fish BAF or biota-sediment accumulation factor (BSAF) values obtained from the literature. BSAF (wet-weight) values were converted to BAF values (dry-weight) for use in the food web models using the percent lipid and percent solids values listed in **Table H-14** and the measured site-wide sediment TOC (0.33 percent). These BSAF/BAF values, for both the SERA and BERA, are listed in **Table H-14**.

The BAF values were based on the ratio between dry-weight sediment and dry-weight fish tissue. Literature values based on the ratio between dry-weight sediment and wet-weight fish tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for fish (25 percent [0.25]; USEPA, 1993). For chemicals without literature-based sediment-to-fish BAFs, a BAF was estimated using data for similar chemicals or a BAF of 1.0 was assumed.

H.3.3.7 Dietary Intakes

Upper trophic level receptor exposures via food webs to chemicals present in surface soil and surface sediment were determined using estimated chemical concentrations in each relevant dietary component for each upper trophic level receptor, as described in the previous subsections. Incidental ingestion of surface soil and surface sediment was also included when calculating the total dose. Drinking water exposures were not included due to the high salinity of the York River.

Dietary intakes for each upper trophic level receptor were calculated using the following formula (modified from USEPA [1993]):

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

Where

DI_x	=	Dietary intake for chemical x (mg chemical/kg body weight/day)
FIR	=	Food ingestion rate (kg/day, dry-weight)
FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry-weight)
PDF_i	=	Proportion of diet composed of food item i (dry-weight basis)
SC_x	=	Concentration of chemical x in soil or sediment (mg/kg, dry-weight)
PDS	=	Proportion of diet composed of soil or sediment (dry-weight basis)
WIR	=	Water ingestion rate (L/day)
WC_x	=	Concentration of chemical x in water (mg/L)
BW	=	Body weight (kg)

Incidental ingestion of soil/sediment was modeled as a dietary component rather than using a separate soil/sediment ingestion rate. Parameter values for the selected receptors are listed in **Tables H-15** (SERA) and **H-16** (BERA). When measured food ingestion rates were not available for a receptor from the literature, the rates were estimated using allometric equations from Nagy (2001). For receptors that consume small mammals (red fox and red-tailed hawk), it was assumed that the small mammal portion of the diet was composed of equal parts voles (herbivores), shrews (insectivores), and mice (omnivores).

The exposure parameter values were selected to provide for a conservative evaluation at the screening level (Step 2). Examples of these conservative assumptions include:

- All of the dietary items consumed by the receptor are obtained from the site (an Area Use Factor [AUF] of 1 was assumed) at the point of maximum concentration
- Chemicals are 100 percent bioavailable
- Maximum food ingestion rates were used (calculated maximum ingestion rates using allometric equations were based on the maximum adult body weight)
- Minimum adult body weights were used. The selection focused on the most geographically appropriate values available from standard literature sources (such as USEPA, 1993).

For the baseline (Step 3A) estimates:

- Central tendency estimates (such as mean, median, or midpoint) for adult body weight and ingestion rates were used. Central tendency estimates for these exposure parameters are more relevant for a BERA because they better represent the characteristics of a greater proportion of the individuals in the population. Populations or communities (rather than individual organisms) were emphasized when developing the assessment endpoints for the BERA.
- An AUF of 1.0 was retained in the BERA

H.4 Effects Assessment

One of the purposes of the effects assessment is to establish chemical exposure levels (ESVs) that represent conservative thresholds for adverse ecological effects. Typically, one set of ESVs is developed for each selected assessment endpoint. Based on the CSM, direct exposure to surface and shallow subsurface soil and surface sediment, exposure via terrestrial and aquatic food webs, and indirect exposure to groundwater are the complete pathways at the site that are relevant to this RI.

The effects assessment defines the methods and data used to define an adverse ecological effect. Effects data are available from multiple lines of evidence, which are reflected in the measurement endpoints, and include:

- **ESVs for Water, Sediment, and Soil** – Analytical data are compared to the literature-based, medium-specific ESVs developed in **Section H.4.1**
- **Toxicity Reference Values (TRVs) for Ingestion Exposures** – Food web exposure estimates are compared to the ingestion-based TRVs developed in **Section H.4.2** for upper trophic level receptors
- **Bioavailability Measures** - Additional data were collected to help evaluate chemical-specific bioavailability in soil, sediment, and groundwater

In addition, a comparison of site soil and groundwater concentrations to facility-specific background soil and groundwater UTLs, and a comparison of site sediment concentrations to upriver and downriver reference (background) concentrations, was conducted as an additional line of evidence (see **Sections H.5.3 and H.5.4**).

H.4.1 Medium-Specific ESVs

Medium-specific ESVs were established for each ecologically relevant medium. Based on the CSM (**Figure H-1**), direct exposure to surface/shallow subsurface soil and sediment, and indirect exposure to groundwater, are the potentially complete pathways relevant to this RI.

H.4.1.1 Soil ESVs

The soil ESVs used in the ERA are summarized in **Table H-17**. When more than one ESV was available (such as fauna and flora) from a particular source for a chemical, the lowest of these values was selected.

H.4.1.2 Water ESVs

The York River, the receiving water body for groundwater flow from Site 7, is a tidal estuarine water body with measured salinities well above 10 ppt (**Table H-2**) so marine ESVs were used for the groundwater evaluation. However, freshwater values were considered if a chemical lacked an available marine ESV. The water ESVs used in the ERA considered Region 3 BTAG screening values (USEPA, 2006b) as well as other ESVs available from the literature. When more than one ESV was available (such as fauna and flora) from a particular source for a chemical, the lowest of these values was selected.

For water, the ESVs for chemicals known to bioaccumulate in aquatic food webs were based on the final chronic value (rather than the final residue value) as per USEPA (1996b, 2009) and Suter and Tsao (1996). The use of final chronic values is intended to protect aquatic receptors from direct exposures to chemicals in surface water, rather than from exposure via food webs. Potential risks to upper trophic level receptors from food web exposures were evaluated separately using the ingestion-based TRVs outlined in **Section H.4.2**. The water ESVs used in the ERA are listed in **Table H-18**.

H.4.1.3 Sediment ESVs

The York River is a tidal estuarine water body with measured salinities well above 10 ppt (**Table H-2**) so marine ESVs were used. The sediment ESVs used in the ERA considered Region 3 BTAG screening values (USEPA, 2006b) as well as other ESVs available from the literature. When more than one ESV was available (such as fauna and flora) from a particular source for a chemical, the lowest of these values was selected. The sediment ESVs used in the ERA are listed in **Table H-19**.

H.4.2 Ingestion TRVs

Ingestion TRVs for dietary exposures were derived for each bioaccumulative chemical evaluated in the ERA. TRVs were derived for mammalian and avian upper trophic level receptors, the only two taxonomic groups for which sufficient toxicological information was generally available for the range of bioaccumulative chemicals evaluated. Toxicological information from the literature for wildlife species most closely related to the receptor species were used, where available, but were supplemented by laboratory studies of non-wildlife species (such as laboratory mice) where necessary. The ingestion TRVs are expressed as milligrams of the chemical per kilogram body weight of the receptor per day (mg/kg-BW/day).

Survival, growth, and reproduction were emphasized as toxicological endpoints because they are the most relevant, ecologically, to maintaining viable populations and because they are generally the most studied toxicological endpoints for ecological receptors. Endpoints based on reproduction were generally preferred to those based on growth which were preferred to those based on survival. If several chronic toxicological studies were available from the literature, the most appropriate study was selected for each receptor based on study design, study methodology, study duration, study endpoint, and test species.

Ingestion TRVs were derived for both chronic No Observed Adverse Effect Level (NOAEL) and chronic Lowest Observed Effect Level (LOAEL) endpoints. The applicable uncertainty factors from **Table H-20** were used to derive these TRVs where appropriate (uncertainty factors were not generally applied to TRVs obtained from Eco-SSL documents because these TRVs often encompassed multiple studies). Because assessment endpoints were based on population- or community-level effects, no intraspecies uncertainty factors were applied. Taxonomic class-type uncertainty factors were also not applied because the TRVs selected were typically derived based on data from a

broad range of taxonomic groups. Maximum Acceptable Toxicant Concentrations (MATCs), defined as the geometric mean of the NOAEL and LOAEL, were also calculated.

In terrestrial habitats, Step 2 food web COPCs were selected by first comparing the maximum surface soil concentration with the lower of the available bird and mammal Eco-SSLs (**Table H-21**). Chemicals that exceeded the Eco-SSLs based on the maximum detected surface soil concentration were retained for site-specific food web modeling. Those that did not were not evaluated further for terrestrial food web exposures. The final Step 2 food web COPCs were selected based on a comparison of maximum exposure doses from site-specific food web modeling with the NOAEL-based ingestion TRV. Those chemicals with an exposure dose equaling or exceeding the NOAEL-based ingestion TRV were identified as Step 2 COPCs. For Step 3A, ingestion-based (food web) COPCs were based on a comparison of mean and 95% UCL exposure doses with ingestion TRVs based on the NOAEL, MATC, and LOAEL. Only Step 2 COPCs were evaluated in Step 3A. An exceedance of the MATC was generally considered an unacceptable effect at Step 3A, although chemicals that exceeded the MATC, but not the LOAEL, were discussed for possible risk management considerations.

Ingestion TRVs for mammals and birds are provided in **Tables H-22 and H-23**, respectively. For some chemicals, relevant toxicological information was available for more than one test species that represented different guilds (based on factors such as dietary composition and trophic level). In these instances, the TRV considered most applicable to the target wildlife receptor evaluated at the site was used in the food web model. **Tables H-22 and H-23** specifically indicate which test organism TRV was applied to each target wildlife receptor in the exposure dose calculations (see **Attachments H-1 and H-2**).

H.4.3 Bioavailability Measures

Data collected to evaluate the potential chemical-specific bioavailability in abiotic media included:

- **Soil** – pH
- **Sediment** – TOC, pH, simultaneously extracted metals/acid-volatile sulfide (SEM/AVS), and grain size
- **Groundwater** – Dissolved metals

These data were integrated into the risk characterization and risk evaluation (**Sections H.5.3, H.5.4, and H.5.5**).

H.5 Risk Characterization

The risk characterization portion of the ERA uses the information generated during the three previous parts of the ERA (problem formulation, exposure assessment, and effects assessment) to estimate potential risks to ecological receptors.

H.5.1 SERA Approach

The main objective of risk characterization at the screening level (termed risk calculation) is to derive a list of COPCs. As part of this risk calculation, the maximum exposure concentrations (abiotic media) or maximum exposure doses (upper trophic level receptors) are compared with the corresponding ESVs or TRVs to derive risk estimates using the hazard quotient (HQ) method. HQs are calculated by dividing the chemical concentration in the medium being evaluated by the corresponding medium-specific ESV or by dividing the exposure dose by the corresponding ingestion-based TRV. HQs equaling or exceeding 1 indicate the potential for unacceptable risk since the chemical concentration or dose (exposure) equals or exceeds the ESV or TRV (effect); these chemicals are identified as COPCs at Step 2. However, ESVs/TRVs and exposure estimates are derived using intentionally conservative assumptions at the screening level such that HQs greater than or equal to 1 do not necessarily indicate that unacceptable risks are present. Rather, it identifies chemical-pathway-receptor combinations requiring further evaluation using less conservative (but more realistic) exposure scenarios and assumptions. HQs less than 1 indicate that unacceptable risks are unlikely, enabling a conclusion of negligible (acceptable) risk to be reached with high confidence.

In addition to chemicals that equaled or exceeded medium-specific ESVs based on maximum detected concentrations, or that equaled or exceeded TRVs based on maximum ingestion doses, the following also applied to COPC selection at Step 2:

- Non-detected chemicals were retained as COPCs if the maximum detection limit equaled or exceeded the ESV for that medium or if the ingestion dose calculated using the maximum detection limit equaled or exceeded the TRV
- All detected chemicals lacking a TRV and/or ESV were retained as COPCs
- The essential nutrients calcium, magnesium, potassium, and sodium were excluded as potential COPCs since they are essential macronutrients that are needed in relatively high concentrations for normal metabolism, growth, and reproduction

H.5.2 BERA Approach

COPCs from the SERA were reevaluated in the BERA (Step 3A). As discussed previously, this reevaluation involves using less conservative (but more realistic) assumptions about exposures and a comparison of these revised exposure estimates (based on central tendency estimates of media concentrations, BAFs, and/or exposure parameters) with ESVs and TRVs.

In addition to chemicals that equaled or exceeded medium-specific ESVs based on mean and/or 95% UCL detected concentrations, or that equaled or exceeded TRVs based on mean and/or 95% UCL ingestion doses, the following also applied to COPC selection at Step 3A:

- All detected chemicals lacking a TRV and/or ESV were retained as COPCs for risk evaluation
- Ingestion-based (food web) COPCs were based on a comparison of mean and 95% UCL exposure doses with ingestion TRVs based on the NOAEL, MATC, and LOAEL. An exceedance of the MATC was generally considered an unacceptable risk at Step 3A, although chemicals that exceeded the MATC, but not the LOAEL, were discussed for possible risk management considerations. Exceedances of the LOAEL are almost always considered unacceptable and thus do not normally need to be discussed by the risk managers. Dose estimates that are less than the MATC are generally considered acceptable and also normally do not need to be discussed by the risk managers except in limited cases (such as when listed species are present). Thus, it is generally only those results between the MATC and LOAEL that risk managers need to decide are unacceptable or not.

For Step 3A, the following additional factors were also considered, as appropriate:

- **Frequency of Detection.** Frequency of detection was used as a line of evidence in Step 3A but was not used as the sole basis for eliminating a chemical from further evaluation. Chemicals that were detected in less than five percent of the samples in a medium were generally eliminated as COPCs in that medium if at least 20 samples were available (USEPA, 1989). It is unlikely that infrequently detected chemicals represent an unacceptable risk to receptors at the population level, due to limited spatial exposure. However, the magnitude of any ESV exceedances was also considered concurrently with frequency of detection to ensure that “hot spot” areas were not eliminated from consideration based on this screening criterion.
- **Background Concentrations.** Facility-specific background concentrations were also considered in Step 3A for soil and groundwater. The background evaluation consisted of a direct comparison of site concentrations to the 95% UTLs developed for inorganic constituents in the background study in a manner analogous to the comparison to ESVs. Soil background 95% UTL values have been developed separately for surface and subsurface soils (CH2M HILL, 2011); the higher of these two values were used because the site soil samples encompassed the total depth range of both sets of background samples (0 to 24 inches). Surface sediment was also sampled at locations in the York River upriver and downriver of Site 7 (reference areas). The maximum and mean concentrations from both the upriver and downriver reference areas were used to represent background sediment and were directly compared to the maximum and mean site sediment concentrations.

H.5.3 Terrestrial Habitats

Currently, the terrestrial habitats on the site surrounding the removal area are forested, with the removal area consisting of successional old field habitat.

H.5.3.1 Comparison With Ecological Screening Values

As discussed in **Section H.3.3**, the maximum, arithmetic mean, and 95% UCL of the arithmetic mean concentrations were compared with ESVs. Chemicals were excluded from further consideration in the SERA (Step 2) if the HQ based on the maximum concentration was less than 1. Chemicals were generally excluded from further consideration in the BERA (Step 3A) if the HQ based on the 95% UCL was less than 1 and/or if the maximum detected concentration was less than the background UTL.

Soil

Maximum soil (0 to 24 inches) concentrations are compared to soil ESVs for plants and soil invertebrates in **Table H-24**. **Table H-25** identifies the exceedances of ESVs and background UTLs for each soil sample. Eight metals (aluminum, arsenic, iron, lead, manganese, mercury, selenium, and thallium) and one pesticide (endrin) equaled or exceeded ESVs based on maximum detected concentrations (**Tables H-24 and H-25**). The ESVs for aluminum and iron were based on soil pH; soil pH data are reported in **Table H-25**. These nine chemicals were identified as Step 2 COPCs. Two pesticides (endrin aldehyde and endrin ketone) and two SVOCs (4-nitrophenol and atrazine) were not detected but maximum detection limits equaled or exceeded ESVs. These four chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL soil concentrations are compared to soil ESVs for plants and soil invertebrates in **Table H-24**. One metal (selenium) and one pesticide (endrin) had HQs that equaled or exceeded 1 based on detected 95% UCL concentrations and also equaled or exceeded background UTLs (where available). These two chemicals were identified as COPCs for further risk evaluation (**Section H.5.5**).

H.5.3.2 Terrestrial Food Web Exposures

Step 2 food web COPCs were selected by first comparing maximum soil concentrations with the lower of the available bird and mammal Eco-SSLs for the chemicals listed in **Table H-5**. These Eco-SSL values are listed in **Table H-21**. Chemicals that equaled or exceeded the Eco-SSLs based on the maximum soil concentration were retained for site-specific food web modeling. Those that did not were not evaluated further for terrestrial food web exposures. Chemicals that were on the bioaccumulative chemicals list (**Table H-5**) and did not have Eco-SSLs were automatically included in site-specific food web modeling. The final Step 2 food web COPCs were selected based on a comparison of maximum exposure doses from site-specific food web modeling with the NOAEL-based ingestion TRV. Those chemicals with an exposure dose equaling or exceeding the NOAEL-based ingestion TRV were identified as Step 2 COPCs. For Step 3A, ingestion-based (food web) COPCs were based on a comparison of mean and 95% UCL exposure doses with ingestion TRVs based on the NOAEL, MATC, and LOAEL. An exceedance of the 95% UCL-based MATC was generally considered an unacceptable risk at Step 3A, although chemicals that exceeded the MATC, but not the LOAEL, were discussed for possible risk management considerations.

Table H-26 shows the results of the initial screening against bird and mammal Eco-SSLs. Five metals (chromium, copper, lead, selenium, and zinc) equaled or exceeded one or both of the Eco-SSLs based on the maximum detected soil concentration and were retained for site-specific food web modeling, as was 4,4'-DDT, which was not detected but whose maximum detection limit exceeded the mammalian Eco-SSL.

HQs based on maximum exposure doses for each upper trophic level terrestrial receptor are listed in **Table H-27** (calculations are shown in **Attachment H-1**). Based on a comparison to NOAELs, four metals (chromium, lead, mercury, and selenium) had HQs equaling or exceeding 1 for one or more receptors and were identified as Step 2 COPCs. Ingestion TRVs were not available for any receptor for 1,2,4,5-tetrachlorobenzene, 4-bromophenyl-phenylether, and 4-chlorophenyl-phenylether, none of which was detected in site soil samples.

HQs based on 95% UCL exposure doses for each upper trophic level terrestrial receptor are listed in **Table H-28** (calculations are shown in **Attachment H-1**). Based on a comparison to NOAELs, no chemical had a HQ that equaled or exceeded 1 for any receptor. Because there were no exceedances based on 95% UCL exposure doses, mean exposure doses were not calculated. Based on these results, no COPCs for further risk evaluation were identified for terrestrial food web exposures and risks from this exposure pathway are considered acceptable.

H.5.4 Aquatic Habitats

There are no wetland or aquatic habitats on Site 7. The York River, a tidal estuarine water body, occurs directly adjacent to Site 7.

H.5.4.1 Comparison With Ecological Screening Values

As discussed in **Section H.3.3**, the maximum, arithmetic mean, and 95% UCL of the arithmetic mean concentrations were compared with ESVs. Chemicals were excluded from further consideration in the SERA (Step 2) if the HQ based on the maximum concentration was less than 1. Chemicals were generally excluded from further consideration in the BERA (Step 3A) if the HQ based on the 95% UCL was less than 1.

Surface Sediment

Maximum surface sediment concentrations are compared to sediment ESVs in **Table H-29**. **Table H-30** identifies the exceedances of ESVs for each surface sediment sample. One metal (manganese) and dioxin/furans (TEQ) equaled or exceeded ESVs based on maximum detected concentrations. Beryllium was detected in at least one surface sediment sample but an ESV was not available. These three chemicals were identified as Step 2 COPCs.

Mean and 95% UCL surface sediment concentrations are compared to sediment ESVs in **Table H-29**. No chemical had a HQ that equaled or exceeded 1 based on detected 95% UCL concentrations and also equaled or exceeded upriver and downriver background concentrations. Thus, no chemicals were identified as COPCs for further risk evaluation and risks from this exposure pathway are considered acceptable.

H.5.4.2 Aquatic Food Web Exposures

Step 2 food web COPCs were selected based on a comparison of maximum exposure doses from site-specific food web modeling (using maximum site sediment concentrations and SERA model inputs) with the NOAEL-based ingestion TRV. Those chemicals with an exposure dose equaling or exceeding the NOAEL-based ingestion TRV were identified as Step 2 COPCs. Because sediment samples were 5-point composites, the maximum site sediment concentration was also used in Step 3A. For Step 3A, ingestion-based (food web) COPCs were based on a comparison of exposure doses (using maximum sediment concentrations and BERA model inputs) with ingestion TRVs based on the NOAEL, MATC, and LOAEL. An exceedance of the MATC was considered an unacceptable risk at Step 3A.

HQs based on maximum exposure doses for each upper trophic level aquatic receptor are listed in **Table H-31** (calculations are shown in **Attachment H-2**). Based on a comparison to NOAELs, copper, mercury, and dioxin/furans had HQs that equaled or exceeded 1 and were identified as Step 2 COPCs.

HQs based on BERA exposure doses for each upper trophic level aquatic receptor are listed in **Table H-32** (calculations are shown in **Attachment H-2**). Based on a comparison to NOAELs, no chemical had a HQ that equaled or exceeded 1. Based on these results, no chemicals were identified as COPCs for further risk evaluation and risks from this exposure pathway are considered acceptable.

H.5.4.3 Groundwater

As discussed in **Section H.3.3**, the maximum, mean, and 95% UCL of the mean groundwater concentrations were compared with ESVs. Since site groundwater is likely to discharge to the York River (tidal estuarine), marine ESVs were used for these comparisons although freshwater ESVs were considered if marine ESVs were not available. Chemicals were excluded from further consideration in the SERA if the HQ based on the maximum concentration was less than 1. Chemicals were excluded from further consideration in the BERA if the HQ based on the mean concentration was less than 1 (with dilution).

Although ecological receptors do not typically have direct exposure to groundwater, surface water ESVs were compared to site groundwater data (with and without dilution factors) in order to provide a conservative evaluation of the potential for significant contaminant transport via groundwater to the water body (York River) located downgradient of the site. In the absence of site-specific dilution factors for groundwater, Buchman (1999) recommends using a dilution factor of 10 to account for the dilution expected during migration and upon discharge of groundwater to surface water.

Although both total and dissolved groundwater data were included in the screening tables, only dissolved metals data were used when selecting COPCs for further risk evaluation because chemicals in groundwater are most likely to travel dissolved in water rather than adhered to particles since they must travel through soil pores or fractured rock. Similarly, when groundwater discharges to a water body (at which time ecological exposures become possible), the bulk of the discharged chemicals are likely to be dissolved in water since the discharge must pass through the pores in the underlying sediments. Thus, the dissolved concentrations are likely to be more representative of what would be transported via the groundwater than the total concentrations. Once discharged, the dissolved metal fraction in water (filtered samples) is more representative of the bioavailable fraction to aquatic receptors than the total metal fraction (unfiltered samples) (USEPA, 1996b). This is reflected in how the most recent Ambient Water Quality Criteria have been developed for many metals, that is, they are based on the dissolved fraction (USEPA, 2009).

Maximum groundwater concentrations are compared to ESVs in **Table H-33**. **Table H-34** identifies the exceedances of ESVs and background UTLs for each groundwater sample. Two metals (aluminum and manganese) and two pesticides (4,4'-DDD and gamma-chlordane) equaled or exceeded ESVs based on maximum detected concentrations in total (unfiltered) samples collected from site monitoring wells. Only manganese also equaled or exceeded ESVs based on maximum detected concentrations in filtered samples. Thus, aluminum, manganese, 4,4'-DDD, and gamma-chlordane were identified as Step 2 COPCs. Eleven SVOCs, 10 pesticides, seven PCBs, cyanide, and total and dissolved silver were not detected but maximum detection limits equaled or exceeded ESVs. These 30 chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL groundwater concentrations are compared to ESVs in **Table H-33**. Only gamma-chlordane exceeded ESVs based on mean concentrations and also exceeded background UTLs, where available. Thus, gamma-chlordane was identified as a COPC for further risk evaluation.

H.5.5 Risk Evaluation

In this section, the various lines of evidence discussed in the previous section are integrated in order to evaluate the potential for unacceptable risks.

H.5.5.1 Terrestrial Habitats

Ten assessment endpoints were developed for terrestrial habitats on the site (**Table H-4**). Lines of evidence for terrestrial habitats included:

- Comparison of soil concentrations with ESVs
- Comparison of modeled dietary doses with ingestion TRVs
- Comparison of site soil concentrations with background concentrations

In soil, one metal (selenium) and one pesticide (endrin) were identified as COPCs for further risk evaluation (**Table H-24**). No COPCs for further risk evaluation were identified for terrestrial food web exposures.

The 95% UCL HQ for selenium (2.24) exceeded one. However, this constituent is not likely to be site related since it was not detected in 2004 (pre-removal) surface and subsurface soil samples (all samples were flagged U or B). In addition, the ESV used is based on potential impacts to plants. Soil ESVs for other receptors (e.g., 4.10 mg/kg for soil invertebrates) were not exceeded (maximum selenium concentrations in soil were 2.90 mg/kg). Further, selenium concentrations of up to 2.70 mg/kg have been detected in facility-specific background soil samples. Thus, selenium is not likely to constitute a risk to ecological receptors at the site above naturally occurring levels and this constituent was not identified as a final COPC.

Endrin was detected in 1 of 36 soil samples at a maximum concentration of 2.40 µg/kg. This concentration was less than concentrations that were detected in background surface soil samples (3.50 µg/kg) collected during the background study (CH2M HILL, 2011). Thus, endrin was not identified as a final COPC.

No final COPCs were identified for Site 7 soil. Thus, there are no unacceptable ecological risks associated with this medium.

H.5.5.2 Aquatic Habitats

Twelve assessment endpoints were developed for aquatic habitats associated with Site 7 (**Table H-4**). Lines of evidence for aquatic habitats included:

- Comparison of surface sediment and groundwater concentrations with ESVs
- Comparison of modeled dietary doses (based on sediment) with ingestion TRVs

Bioavailability measures

- Comparison of site surface sediment and groundwater concentrations with background concentrations

The results of bioavailability measures and their potential influence on exposures are integrated into this section. For metals in groundwater, the discussion focused on dissolved (filtered) versus total (unfiltered) concentrations. Although both total and dissolved data were included in the screening tables, the dissolved metals data were used to select final COPCs. USEPA (1996b) indicates that the dissolved metal fraction should be preferentially used compared to the total metal fraction in surface water (and by extension groundwater) evaluations because dissolved metal concentrations best represent the bioavailable fraction. High levels of suspended solids and sediment-adsorbed metals, which could be present in unfiltered samples, could result in overstating bioavailable concentrations and thus potential exposures and risks. This is reflected in how the most recent Ambient Water Quality Criteria have been developed for many metals, that is, they are based on the dissolved fraction (USEPA, 2009).

In sediment, no chemicals were identified as COPCs for further risk evaluation (**Table H-29**). No COPCs for further risk evaluation were identified for aquatic food web exposures. Thus, there are no unacceptable ecological risks associated with these media/pathways.

In site groundwater, gamma-chlordane was identified as a COPC for further risk evaluation (**Table H-33**). Based on the mean concentration, gamma-chlordane exceeded its ESV by a factor of 2.31. Thus, the mean HQ would be below 1 assuming a dilution factor of 10. Gamma-chlordane was detected in samples from upgradient wells at generally similar concentrations found in site wells (the mean ratio between site and upgradient samples was 1.29). Further, gamma-chlordane was not detected in soil samples collected on the site (including 2004 pre-removal samples). Thus, this chemical does not appear to be site related and was not identified as a final COPC. Based on the results of this evaluation, groundwater is not a significant transport medium for site-related constituents to the York River, and site-related constituents that might reach this water body via groundwater would not pose an unacceptable risk to aquatic biota.

H.6 Uncertainties

Uncertainties are present in all ERAs because of the limitations of the available data and the need to make certain assumptions and extrapolations based on incomplete information. In addition, the use of various models (such as for uptake and food web exposures) carries with it some associated uncertainty as to how well the model reflects actual conditions. Since conservative assumptions were generally used in the exposure and effects assessments, these uncertainties are more likely to result in an overestimation rather than an underestimation of the likelihood and magnitude of risks to ecological receptors.

The ERA uses “standard” methods and typical ranges of values for EPCs (maximum, mean, and 95% UCL), TRVs (NOAEL, MATC, LOAEL), and other parameters. This results in risk estimates that adequately span the risk range from extremely conservative (screening estimates) to central tendency (mean baseline estimates). The uncertainties associated with many of the particular inputs to the risk estimates are discussed below. What constitutes an unacceptable risk within this risk range is ultimately a risk management decision.

The uncertainties in this ERA are mainly attributable to the following factors:

- Reporting Limits – Reporting limits for some undetected analytes exceeded applicable ESVs in some media. **Table H-35** summarizes these chemicals, by medium, and reports both the ratio of the minimum and maximum reporting limits to the ESV as well as the ratio of the mean value (calculated using one-half of the

reporting limit for each sample) to the ESV. Because these chemicals were not detected, they are not known to be present on the site but the potential for unacceptable risks cannot be totally discounted because the reporting limits are higher than the ESVs. The magnitude of the ratios can be used to qualitatively evaluate the magnitude of the associated uncertainty (that is, higher ratios are indicative of a greater likelihood that chemicals are present at concentrations that exceed the ESV relative to lower ratios). In soil, four undetected chemicals exceeded reporting limits based on the mean ratio, which exceeded 1.5 for only one of the four. In sediment, no chemical had a mean ratio that exceeded 1. In groundwater, 22 undetected chemicals exceeded reporting limits based on the mean ratio, which exceeded 5 for only four of the 22.

In summary, there were no chemicals with very high mean ratios, suggesting that the associated uncertainties are relatively low. Because standard analytical methods were used and the sample reporting limits were not elevated relative to the method reporting limits for the vast majority of samples and analytes, these uncertainties are considered acceptable and are unlikely to impact the conclusions of the ERA.

- Duplicate Analyses – When evaluating samples with field duplicates, the value used in the ERA was always the detect when one result was a detect and the duplicate was a non-detect, regardless of whether or not the non-detected value was higher. In these cases, the use of the detect has less uncertainty since it represents an actual measured value (versus an upper limit bound) and the two samples will have identical or similar reporting limits.

Selection of COPCs – Chemicals without available ESVs for a medium were not retained as COPCs for risk evaluation unless they were detected. These uncertainties are unlikely to impact the conclusions of the ERA since these chemicals are not known to be present on the site.

- Ingestion TRVs – Data on the toxicity of many chemicals to the receptor species were sparse or lacking, requiring the extrapolation of data from other wildlife species or from laboratory studies with non-wildlife species. This is a typical limitation and extrapolation for ERAs because so few wildlife species have been tested directly for most chemicals. The uncertainties associated with toxicity extrapolation were minimized through the selection of the most appropriate test species for which suitable toxicity data were available. The factors considered in selecting a test species to represent a receptor species included taxonomic relatedness, trophic level, foraging method, and similarity of diet. It is difficult to predict if these extrapolations would result in overestimating or underestimating potential risks.

  A second uncertainty related to the derivation of ingestion TRVs applies to metals. Most of the toxicological studies on which the ingestion TRVs for metals were based used forms of the metal (such as salts) that have high water solubility and high bioavailability to receptors. Because the analytical samples on which site-specific exposure estimates were based measured total metal concentration, regardless of form, and these highly bioavailable forms are expected to compose only a fraction of the total metal concentration, this is likely to result in an overestimation of potential risks for these chemicals but not to the extent that it would unduly impact the conclusions of the ERA.

  A third source of uncertainty related to the derivation of ingestion-based TRVs applies to mercury and selenium. The ingestion-based TRVs used for these two metals were based on organometallic (methylated) forms. TRVs for inorganic forms tend to be substantially higher. Given that inorganic forms likely contribute significantly to the total mercury and selenium, the use of TRVs based on organometallic forms tends to make the TRVs for these metals extremely conservative and likely overestimates potential risk.

- Chemical Mixtures – Information on the toxicological effects of chemical interactions is generally lacking for ecological receptors, which required (as is standard for ERAs) that the chemicals be evaluated on a compound-by-compound basis during the comparison to ESVs and TRVs. This could result in an underestimation of risk (if there are additive or synergistic effects among chemicals) or an overestimation of risks (if there are antagonistic effects among chemicals).

- Receptor Species Selection – Reptiles were selected as receptors in the ERA, but were not evaluated quantitatively even when exposure pathways were likely to be complete. For food web exposures, these taxa

were evaluated using other fauna (birds and mammals) as surrogates due to the general lack of taxon-specific toxicological data. This represents an uncertainty in the ERA. It was also assumed that any reptiles present on the site were not exposed to significantly higher concentrations of chemicals and were not more sensitive to chemicals than other receptor species evaluated in the ERA that were used as surrogates for this group. This assumption was a source of uncertainty in the ERA. In addition, there is some uncertainty associated with the use of specific receptor species to represent larger groups of organisms (such as guilds).

- Calculation of the Total Exposure Dose – For most chemicals, the contribution to the total dose from the inhalation route is insignificant for upper trophic level ecological receptors, especially relative to ingestion pathways. Thus, and given the general lack of data for evaluating this pathway (USEPA, 1999), the air pathway is not generally included in the total dose calculations for these ecological receptors. This could lead to an underestimation of the total dose to which these receptors are exposed. However, this underestimation is likely to be very small, especially given the relatively low frequency of detection and the low magnitude of the concentrations of volatile organic compounds (the constituents most likely to contribute to exposures via the inhalation route) in site soils. Exposure to chemicals present in surface soil and surface sediment via dermal contact may occur but is unlikely to represent a major exposure pathway for most upper trophic level receptors because fur or feathers minimize transfer of chemicals across dermal tissue. As for the inhalation pathway, there is a general lack of data for evaluating this pathway (USEPA, 1999) and not including this pathway in the calculation of the total dose is not likely to significantly underestimate total exposure, especially since incidental ingestion of surface soil or surface sediment during feeding, preening, or grooming activities is included in the total dose calculations.

- Food Web Exposure Modeling – Chemical concentrations in terrestrial and aquatic food items (plants, soil and benthic invertebrates, small mammals, and fish) were modeled from measured surface soil or surface sediment concentrations and were not directly measured. The use of generic, literature-derived exposure models and BAFs introduces some uncertainty into the resulting estimates. The values selected and methodology employed were intended to provide a conservative (Step 2) or reasonable (Step 3A) estimate of potential food web exposure concentrations.

  Another source of uncertainty is the use of default assumptions for exposure parameters such as BCFs and BAFs. Although BCFs or BAFs for many bioaccumulative chemicals were readily available from the literature and were used in the ERA, the use of a default factor of 1.0 to estimate the concentration of some chemicals in receptor prey items is a source of uncertainty.

  AUFs were assumed to equal 1. This is a very conservative assumption given the small size of the site (about 1 acre) since a significant percentage of each upper trophic level receptor species' time could be spent foraging off-site in unimpacted areas or in areas where chemical concentrations are expected to be significantly lower.

- Mean Versus Maximum Media Concentrations – As is typical in an ERA, a finite number of samples of environmental media were used to develop the exposure estimates. The maximum measured concentration provides a conservative estimate for immobile biota or those with a limited home range. The most realistic exposure estimates for mobile species with relatively large home ranges and for species populations (even those that are immobile or have limited home ranges) are those based on the mean chemical concentrations in each medium to which these receptors are exposed. This is reflected in the wildlife dietary exposure models contained in the *Wildlife Exposure Factors Handbook* (USEPA, 1993), which specify the use of average media concentrations. Given the mobility of the upper trophic level receptor species used in the ERA, the use of maximum chemical concentrations (rather than mean concentrations) in the SERA (Step 2) to estimate the exposure via food webs is very conservative. This conservatism was reduced to more realistic levels in the values selected for use in the BERA (Step 3A) evaluation. The 95% UCL of the arithmetic mean was typically used quantitatively in the BERA portion of this ERA to represent the average exposure scenarios during COPC selection.

- Comparisons to Background Concentrations – Background concentrations were used to judge the site-relatedness of individual chemicals. If site concentrations were consistent with background levels, it was

assumed that the concentrations were not related to known site-related source areas. There exists the possibility that concentrations below background were indeed site-related, rendering the assumption false. However, the potential impact of this possibility is minimal since chemicals at concentrations consistent with background should exhibit no different ecological effects than commonly occurring in areas not affected by releases, regardless of their source.

- Total Versus Dissolved Metals – USEPA guidance (USEPA, 1996b) indicates that the dissolved metal fraction should be preferentially used to the total metal fraction in surface water (and by extension, groundwater) screening. Although both total and dissolved groundwater data were included in the screening tables, only dissolved metals data were used when selecting COPCs for further risk evaluation because high levels of suspended solids and sediment-adsorbed metals would result in overstating bioavailable concentrations and thus potential exposures and risks. Chemicals in groundwater are most likely to travel dissolved in water rather than adhered to particles since they must travel through soil pores or fractured rock. Similarly, when groundwater discharges to a water body (at which time ecological exposures become possible), the bulk of the discharged chemicals are likely to be dissolved in water since the discharge must pass through the pores in the underlying sediments. Thus, the dissolved concentrations are likely to be more representative of what would be transported via the groundwater than the total concentrations. Once discharged, the dissolved metal fraction in water (filtered samples) is more representative of the bioavailable fraction to aquatic receptors than the total metal fraction (unfiltered samples) (USEPA, 1996b). This is reflected in how the most recent Ambient Water Quality Criteria have been developed for many metals, that is, they are based on the dissolved fraction (USEPA, 2009).

- Evaluation of the Groundwater Transport Pathway – Potential ecological risks from groundwater discharge to downgradient surface water bodies (the York River) were indirectly evaluated through a comparison of groundwater concentrations from site wells with surface water ESVs. Surface water and pore water samples were not collected from this water body as part of this investigation and sediment samples focused on a limited set of analytes related to potential surface runoff pathways. The direct screening of groundwater data is normally the first step in such an evaluation (e.g., USEPA, 2008b), with surface water, pore water, and/or sediment samples only collected from the receiving water body or bodies if the initial screening indicates the potential for significant transport and exposure from this pathway. Based on the results of the groundwater screening, potential site-related ecological risks were not high enough to warrant further evaluation or sample collection in the receiving water bodies.

H.7 Risk Summary and Conclusions

This section provides a summary of the results of the ERA and outlines the conclusions.

H.7.1 Terrestrial Habitats

In summary, no final COPCs were identified for Site 7 soil or for terrestrial food web exposures. Thus, there are no unacceptable ecological risks associated with these media/pathways.

H.7.2 Aquatic Habitats

In summary, no final COPCs were identified for sediment or aquatic food web exposures. Based on the results of this evaluation, groundwater is not a significant transport medium for site-related constituents to the York River and site-related constituents that might reach this water body via groundwater would not pose an unacceptable risk to aquatic biota.

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TABLE H-1

Physical Parameter Measurements - York River Sediment

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Location	Station ID	Sample ID	Date	Depth (inches)	Total Organic Carbon		pH	Grain Size (percent)					SEM/AVS Ratio
					mg/kg	percent		Gravel	Coarse Sand	Medium Sand	Fine Sand	Fines	
Sediment													
Site - Nearshore 1	CAS07-SD01	CAS07-SD01-0414	4/14/2014	0-6	2,070	0.21	8.84	1.2	6.3	12.8	70.9	8.8	0.21
Site - Nearshore 2	CAS07-SD02	CAS07-SD02-0414	4/14/2014	0-6	874	0.09	8.45	0.0	0.0	0.4	95.0	4.6	0.19
Site - Nearshore 3	CAS07-SD03	CAS07-SD03-0414	4/14/2014	0-6	954	0.10	8.55	0.0	0.0	0.2	95.8	4.0	0.05
Site - Offshore 1	CAS07-SD04	CAS07-SD04-0414	4/18/2014	0-6	888	0.09	7.99	0.0	0.0	0.5	96.5	3.0	0.05
Site - Offshore 2	CAS07-SD05	CAS07-SD05-0414	4/18/2014	0-6	2,780	0.28	8.17	0.0	0.0	1.4	88.1	10.5	0.14
Site - Offshore 3	CAS07-SD06	CAS07-SD06-0414	4/18/2014	0-6	12,300	1.23	8.56	0.0	0.4	1.0	43.6	55.0	0.08
			Mean:		3,311	0.33	8.43	0.2	1.1	2.7	81.7	14.3	
Upriver - Nearshore 1	CAS07-SD07	CAS07-SD07-0414	4/22/2014	0-6	1,610	0.16	8.84	2.2	5.0	13.3	70.8	8.7	0.03
Upriver - Nearshore 2	CAS07-SD08	CAS07-SD08-0414	4/22/2014	0-6	2,240	0.22	8.73	0.0	0.0	0.7	92.2	7.1	0.05
Upriver - Nearshore 3	CAS07-SD09	CAS07-SD09-0414	4/22/2014	0-6	2,760	0.28	8.61	0.0	0.0	0.4	90.0	9.6	0.08
Upriver - Offshore 1	CAS07-SD10	CAS07-SD10-0414	4/22/2014	0-6	9,320	0.93	8.56	0.0	0.0	0.5	32.0	67.5	0.07
Upriver - Offshore 2	CAS07-SD11	CAS07-SD11-0414	4/22/2014	0-6	11,900	1.19	8.39	0.0	0.0	1.2	27.8	71.0	0.09
Upriver - Offshore 3	CAS07-SD12	CAS07-SD12-0414	4/22/2014	0-6	9,080	0.91	8.49	0.0	0.0	0.6	25.6	73.8	0.11
			Mean:		6,152	0.62	8.60	0.4	0.8	2.8	56.4	39.6	
Downriver - Nearshore 1	CAS07-SD13	CAS07-SD13-0414	4/18/2014	0-6	3,870	0.39	8.64	2.6	7.5	50.6	38.8	0.5	0.13
Downriver - Nearshore 2	CAS07-SD14	CAS07-SD14-0414	4/18/2014	0-6	2,020	0.20	8.85	5.6	9.0	48.2	36.5	0.7	0.04
Downriver - Nearshore 3	CAS07-SD15	CAS07-SD15-0414	4/18/2014	0-6	13,700	1.37	8.79	7.1	11.3	45.6	35.2	0.8	0.03
Downriver - Offshore 1	CAS07-SD16	CAS07-SD16-0414	4/18/2014	0-6	788	0.08	7.74	0.0	0.0	12.5	86.3	1.2	0.02
Downriver - Offshore 2	CAS07-SD17	CAS07-SD17-0414	4/18/2014	0-6	1,400	0.14	8.33	0.0	0.2	12.5	82.7	4.6	0.03
Downriver - Offshore 3	CAS07-SD18	CAS07-SD18-0414	4/18/2014	0-6	2,920	0.29	8.22	0.1	0.4	16.5	75.2	7.8	0.05
			Mean:		4,116	0.41	8.43	2.6	4.7	31.0	59.1	2.6	

TABLE H-2

Water Column Parameter Measurements - York River

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Location	Station ID	Date	Water Depth (feet)	Turbidity (NTU)	Temperature (°C)	pH	Conductivity (ms/cm)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Oxidation Reduction Potential (mV)
Site - Nearshore 1	CAS07-SD01-0414	4/14/2014	0	NS	NS	NS	NS	NS	NS	NS	NS
Site - Nearshore 2	CAS07-SD02-0414	4/14/2014	0.17	NS	NS	NS	NS	NS	NS	NS	NS
Site - Nearshore 3	CAS07-SD03-0414	4/14/2014	0.58	18.4	20.22	7.30	48.86	31.96	8.87	118.3	307
Site - Offshore 1	CAS07-SD04-0414	4/18/2014	5.30	21.1	12.56	8.08	35.15	22.14	9.95	107.5	258
Site - Offshore 2	CAS07-SD05-0414	4/18/2014	6.86	14.0	12.83	7.98	39.67	25.35	9.78	108.3	287
Site - Offshore 3	CAS07-SD06-0414	4/18/2014	6.13	25.2	12.82	7.86	39.93	25.42	8.59	95.1	211
		Mean:		19.7	14.61	7.81	40.90	26.22	9.30	107.3	266
Upriver - Nearshore 1	CAS07-SD07-0414	4/22/2014	0	NS	NS	NS	NS	NS	NS	NS	NS
Upriver - Nearshore 2	CAS07-SD08-0414	4/22/2014	0.33	NS	NS	NS	NS	NS	NS	NS	NS
Upriver - Nearshore 3	CAS07-SD09-0414	4/22/2014	0.91	66.2	18.92	7.94	29.46	18.27	9.92	119.8	158
Upriver - Offshore 1	CAS07-SD10-0414	4/22/2014	3.84	28.5	15.47	7.35	25.90	15.69	10.26	112.4	185
Upriver - Offshore 2	CAS07-SD11-0414	4/22/2014	4.24	43.0	15.79	7.70	28.20	17.42	11.13	124.5	204
Upriver - Offshore 3	CAS07-SD12-0414	4/22/2014	4.25	36.1	16.18	7.89	28.72	17.77	11.40	128.5	178
		Mean:		43.5	16.59	7.72	28.07	17.29	10.68	121.3	181
Downriver - Nearshore 1	CAS07-SD13-0414	4/18/2014	0	NS	NS	NS	NS	NS	NS	NS	NS
Downriver - Nearshore 2	CAS07-SD14-0414	4/18/2014	0.33	NS	NS	NS	NS	NS	NS	NS	NS
Downriver - Nearshore 3	CAS07-SD15-0414	4/18/2014	4.10	5.7	13.17	7.70	49.89	32.73	8.62	109.0	328
Downriver - Offshore 1	CAS07-SD16-0414	4/18/2014	6.35	9.0	12.27	7.77	52.50	34.80	7.95	91.9	258
Downriver - Offshore 2	CAS07-SD17-0414	4/18/2014	8.30	7.9	12.18	7.68	53.26	35.05	7.90	92.5	226
Downriver - Offshore 3	CAS07-SD18-0414	4/18/2014	8.10	6.3	12.43	7.63	52.37	34.43	8.11	94.4	305
		Mean:		7.2	12.51	7.70	52.01	34.25	8.15	97.0	279

NS - Not Sampled

TABLE H-3

Samples Used in the Ecological Risk Assessment

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	Sample ID	Date	Depth (inches)	Area
Soil				
CAS07-SO001	NWSY-90-7-SC-PER-132	2/28/2008	< 24	--
CAS07-SO002	NWSY-90-7-SC-PER-135	2/28/2008	< 24	--
CAS07-SO002	NWSY-90-7-SC-PER-183	4/9/2008	< 24	--
CAS07-SO005	NWSY-90-7-SC-FLR-138	2/28/2008	< 24	--
CAS07-SO006	NWSY-90-7-SC-FLR-139	2/28/2008	< 24	--
CAS07-SO007	NWSY-90-7-SC-FLR-140	2/28/2008	< 24	--
CAS07-SO008	NWSY-90-7-SC-PER-143	2/28/2008	< 24	--
CAS07-SO008	NWSY-90-7-SC-PER-184	4/9/2008	< 24	--
CAS07-SO008	NWSY-90-7-SC-PER-185	4/9/2008	< 24	--
CAS07-SO009	NWSY-90-7-SC-FLR-144	2/28/2008	< 24	--
CAS07-SO010	NWSY-90-7-SC-FLR-145	2/28/2008	< 24	--
CAS07-SO011	NWSY-90-7-SC-FLR-146	2/28/2008	< 24	--
CAS07-SO012	NWSY-90-7-SC-FLR-147	2/28/2008	< 24	--
CAS07-SO013	NWSY-90-7-SC-PER-148	2/28/2008	< 24	--
CAS07-SO013	NWSY-90-7-SC-PER-149	2/28/2008	< 24	--
CAS07-SO014	NWSY-90-7-SC-PER-150	2/28/2008	< 24	--
CAS07-SO014	NWSY-90-7-SC-PER-151	2/28/2008	< 24	--
CAS07-SO014	NWSY-90-7-SC-PER-152	2/28/2008	< 24	--
CAS07-SO015	NWSY-90-7-SC-PER-153	2/28/2008	< 24	--
CAS07-SO015	NWSY-90-7-SC-PER-154	2/28/2008	< 24	--
CAS07-SO016	NWSY-90-7-SC-PER-159	2/29/2008	< 24	--
CAS07-SO016	NWSY-90-7-SC-PER-186	4/9/2008	< 24	--
CAS07-SO018	NWSY-90-7-SC-PER-161	2/29/2008	< 24	--
CAS07-SO018	NWSY-90-7-SC-PER-162	2/29/2008	< 24	--
CAS07-SO019	NWSY-90-7-SC-PER-163	2/29/2008	< 24	--
CAS07-SO019	NWSY-90-7-SC-PER-164	2/29/2008	< 24	--
CAS07-SO021	NWSY-90-7-SC-FLR-166	2/29/2008	< 24	--
CAS07-SO022	NWSY-90-7-SC-FLR-167	2/29/2008	< 24	--
CAS07-SO023	NWSY-90-7-SC-PER-169	2/29/2008	< 24	--
CAS07-SO023	NWSY-90-7-SC-PER-170	2/29/2008	< 24	--
CAS07-SO023	NWSY-90-7-SC-PER-187	4/9/2008	< 24	--
CAS07-SO024	NWSY-90-7-SC-PER-172	2/29/2008	< 24	--
CAS07-SO024	NWSY-90-7-SC-PER-188	4/9/2008	< 24	--
CAS07-SO024	NWSY-90-7-SC-PER-193	4/9/2008	< 24	--
CAS07-SO025	NWSY-90-7-SC-FLR-173	2/29/2008	< 24	--
CAS07-SO026	NWSY-90-7-SC-FLR-174	2/29/2008	< 24	--
CAS07-SO027	NWSY-90-7-SC-PER-175	2/29/2008	< 24	--
CAS07-SO027	NWSY-90-7-SC-PER-176	2/29/2008	< 24	--
CAS07-SO028	NWSY-90-7-SC-PER-177	2/29/2008	< 24	--
CAS07-SO028	NWSY-90-7-SC-PER-178	2/29/2008	< 24	--
CAS07-SO028	NWSY-90-7-SC-PER-179	2/29/2008	< 24	--
CAS07-SO035	CAS07-SS01-0024-0111	1/25/2011	< 24	--
CAS07-SO036	CAS07-SS02-0024-0111	1/25/2011	< 24	--
CAS07-SO037	CAS07-SS03-0024-0111	1/25/2011	< 24	--
CAS07-SO038	CAS07-SS04-0024-0111	1/25/2011	< 24	--
CAS07-SO039	CAS07-SS05-0024-0111	1/25/2011	< 24	--
CAS07-SO039	CAS07-SS05P-0024-0111	1/25/2011	< 24	--
Sediment				
CAS07-SD01	CAS07-SD01-0414	4/14/2014	0-6	Site - Nearshore 1
CAS07-SD02	CAS07-SD02-0414	4/14/2014	0-6	Site - Nearshore 2
CAS07-SD02	CAS07-SD02P-0414	4/14/2014	0-6	Site - Nearshore 2

TABLE H-3

Samples Used in the Ecological Risk Assessment

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Station ID	Sample ID	Date	Depth (inches)	Area
CAS07-SD03	CAS07-SD03-0414	4/14/2014	0-6	Site - Nearshore 3
CAS07-SD04	CAS07-SD04-0414	4/18/2014	0-6	Site - Offshore 1
CAS07-SD05	CAS07-SD05-0414	4/18/2014	0-6	Site - Offshore 2
CAS07-SD06	CAS07-SD06-0414	4/18/2014	0-6	Site - Offshore 3
CAS07-SD07	CAS07-SD07-0414	4/22/2014	0-6	Upriver - Nearshore 1
CAS07-SD08	CAS07-SD08-0414	4/22/2014	0-6	Upriver - Nearshore 2
CAS07-SD09	CAS07-SD09-0414	4/22/2014	0-6	Upriver - Nearshore 3
CAS07-SD10	CAS07-SD10-0414	4/22/2014	0-6	Upriver - Offshore 1
CAS07-SD11	CAS07-SD11-0414	4/22/2014	0-6	Upriver - Offshore 2
CAS07-SD12	CAS07-SD12-0414	4/22/2014	0-6	Upriver - Offshore 3
CAS07-SD13	CAS07-SD13-0414	4/18/2014	0-6	Downriver - Nearshore 1
CAS07-SD13	CAS07-SD13P-0414	4/18/2014	0-6	Downriver - Nearshore 1
CAS07-SD14	CAS07-SD14-0414	4/18/2014	0-6	Downriver - Nearshore 2
CAS07-SD15	CAS07-SD15-0414	4/18/2014	0-6	Downriver - Nearshore 3
CAS07-SD16	CAS07-SD16-0414	4/18/2014	0-6	Downriver - Offshore 1
CAS07-SD17	CAS07-SD17-0414	4/18/2014	0-6	Downriver - Offshore 2
CAS07-SD18	CAS07-SD18-0414	4/18/2014	0-6	Downriver - Offshore 3
Groundwater				
CAS07-MW01	CAS07-MW01-0111	1/28/2011	--	Upgradient
CAS07-MW02	CAS07-MW02-0111	1/28/2011	--	Upgradient
CAS07-MW03	CAS07-MW03-0111	1/25/2011	--	Site
CAS07-MW03	CAS07-GW03-0414	4/9/2014	--	Site
CAS07-MW03	CAS07-GW03P-0414	4/9/2014	--	Site
CAS07-MW04	CAS07-MW04-0111	1/28/2011	--	Site
CAS07-MW04	CAS07-GW04-0414	4/9/2014	--	Site
CAS07-MW05	CAS07-MW05-0111	1/25/2011	--	Site
CAS07-MW05	CAS07-GW05-0414	4/9/2014	--	Site
CAS07-MW06	CAS07-MW06-0111	1/24/2011	--	Site
CAS07-MW06	CAS07-MW06P-0111	1/24/2011	--	Site
CAS07-MW06	CAS07-GW06-0414	4/9/2014	--	Site
CAS07-MW07	CAS07-MW07-0111	1/24/2011	--	Site
CAS07-MW07	CAS07-GW07-0414	4/9/2014	--	Site
CAS07-MW08	CAS07-GW08-0414	4/10/2014	--	Site
CAS07-MW09	CAS07-GW09-0414	4/10/2014	--	Site

Shaded cells indicate field duplicates

TABLE H-4

Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities	Are site-related chemical concentrations in surface soil sufficient to adversely affect soil invertebrate communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil ESVs	Soil invertebrates
Survival, growth, and reproduction of terrestrial plant communities	Are site-related chemical concentrations in surface soil sufficient to adversely affect terrestrial plant communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil ESVs	Terrestrial plants
Survival, growth, and reproduction of terrestrial reptile populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial reptile populations?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil ESVs Evidence of potential risk to other upper trophic level terrestrial receptors evaluated in the ERA (birds and mammals used as surrogates)	Reptiles
Survival, growth, and reproduction of avian terrestrial herbivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants (seeds) from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Mourning dove
Survival, growth, and reproduction of avian terrestrial invertivore/omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	American robin
Survival, growth, and reproduction of avian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume small mammals from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Red-tailed hawk
Survival, growth, and reproduction of mammalian terrestrial herbivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume terrestrial plants from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Meadow vole
Survival, growth, and reproduction of mammalian terrestrial invertivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Short-tailed shrew

TABLE H-4

Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of mammalian terrestrial omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	White-footed mouse
Survival, growth, and reproduction of mammalian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume small mammals from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Red fox
Aquatic Habitats			
Survival, growth, and reproduction of aquatic plant communities	Are site-related chemical concentrations in surface sediment sufficient to adversely affect aquatic plant communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface sediment with sediment ESVs	Aquatic plants
Survival, growth, and reproduction of benthic invertebrate communities	Are site-related chemical concentrations in surface sediment sufficient to adversely affect benthic invertebrate communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface sediment with sediment ESVs	Benthic invertebrates
Survival, growth, and reproduction of fish communities	Are site-related chemical concentrations in surface sediment sufficient to adversely affect fish communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface sediment with sediment ESVs	Fish
Survival, growth, and reproduction of aquatic reptile populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to aquatic reptile populations?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface sediment with sediment ESVs Evidence of potential risk to other upper trophic level aquatic receptors evaluated in the ERA (birds and mammals used as surrogates)	Reptiles
Survival, growth, and reproduction of avian aquatic omnivore populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume aquatic prey from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface sediment concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Mallard
Survival, growth, and reproduction of avian aquatic piscivore populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume fish from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface sediment concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Belted kingfisher Great blue heron Osprey

TABLE H-4

Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of mammalian aquatic omnivore populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume aquatic prey from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface sediment concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Raccoon
Survival, growth, and reproduction of mammalian piscivore populations	Are site-related chemical concentrations in surface sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume fish from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface sediment concentrations with literature-based ingestion TRVs; ratios >1 based on the NOAEL-LOAEL range indicate an effect	Mink
Survival, growth, and reproduction of aquatic plant communities	Are site-related chemical concentrations in groundwater sufficient to adversely affect aquatic plant communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in groundwater with surface water ESVs	Aquatic plants
Survival, growth, and reproduction of aquatic and benthic invertebrate communities	Are site-related chemical concentrations in groundwater sufficient to adversely affect aquatic and benthic invertebrate communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in groundwater with surface water ESVs	Aquatic and benthic invertebrates
Survival, growth, and reproduction of fish communities	Are site-related chemical concentrations in groundwater sufficient to adversely affect fish communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in groundwater with surface water ESVs	Fish
Survival, growth, and reproduction of aquatic reptile populations	Are site-related chemical concentrations in groundwater sufficient to adversely affect aquatic reptile populations?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in groundwater with surface water ESVs	Reptiles

TABLE H-5

Bioaccumulative Chemicals List and Log K_{ow} Values for Relevant Chemicals

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
Metals			
Arsenic	-- - --	--	--
Cadmium	-- - --	--	--
Chromium[1]	-- - --	--	--
Copper	-- - --	--	--
Lead	-- - --	--	--
Mercury[2]	-- - --	--	--
Nickel	-- - --	--	--
Selenium	-- - --	--	--
Silver	-- - --	--	--
Zinc	-- - --	--	--
Polychlorinated Biphenyls[3]			
Aroclor-1016	Not reported	5.60	Sample et al. 1996
Aroclor-1221	Not reported	4.70	Jones et al. 1997
Aroclor-1232	Not reported	5.10	Jones et al. 1997
Aroclor-1242	Not reported	5.60	Jones et al. 1997
Aroclor-1248	Not reported	6.20	Jones et al. 1997
Aroclor-1254	Not reported	6.50	Jones et al. 1997
Aroclor-1260	Not reported	6.80	Jones et al. 1997
Aroclor-1262	-- - --	6.80	Aroclor-1260
Aroclor-1268	-- - --	6.80	Aroclor-1260
Pesticides			
4,4'-DDD	5.90 - 6.65	6.10	USEPA 1995a
4,4'-DDE	5.63 - 6.96	6.76	USEPA 1995a
4,4'-DDT	5.56 - 7.01	6.53	USEPA 1995a
Aldrin	5.11 - 7.50	6.50	USEPA 1995a
alpha-BHC	3.75 - 3.81	3.80	USEPA 1995a
alpha-Chlordane[4]	5.80 - 6.41	6.32	USEPA 1995a
beta-BHC	3.75 - 3.84	3.81	USEPA 1995a
delta-BHC	Not reported	4.10	USEPA 1996a
Dieldrin	3.63 - 6.20	5.37	USEPA 1995a
Endosulfan I	3.55 - 3.85	3.83	USEPA 1995a
Endosulfan II	3.62 - 4.52	4.52	USEPA 1995a
Endrin	2.92 - 5.20	5.06	USEPA 1995a
gamma-BHC (Lindane)	3.61 - 3.90	3.73	USEPA 1995a
gamma-Chlordane[4]	5.80 - 6.41	6.32	USEPA 1995a
Heptachlor	4.93 - 6.26	6.26	USEPA 1995a
Heptachlor epoxide	3.50 - 5.40	5.00	USEPA 1995a
Methoxychlor	4.20 - 5.60	5.08	USEPA 1995a
Toxaphene	4.33 - 5.56	5.50	USEPA 1995a
Volatile and Semivolatile Organic Compounds			
1,1,2,2-Tetrachloroethane[5]	2.31 - 2.64	2.39	USEPA 1995a
1,2,4,5-Tetrachlorobenzene	4.51 - 4.83	4.64	USEPA 1995a
1,2,4-Trichlorobenzene	3.89 - 4.23	4.01	USEPA 1995a
1,2-Dichlorobenzene	3.20 - 3.61	3.43	USEPA 1995a
1,3-Dichlorobenzene	Not reported	3.50	USEPA 1996a
1,4-Dichlorobenzene	3.26 - 3.62	3.42	USEPA 1995a
4-Bromophenyl-phenylether	4.89 - 5.24	5.00	USEPA 1995a
4-Chlorophenyl-phenylether	4.08 - 5.09	4.95	USEPA 1995a
Acenaphthene	3.77 - 4.49	3.92	USEPA 1995a

TABLE H-5

Bioaccumulative Chemicals List and Log K_{ow} Values for Relevant Chemicals

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
Acenaphthylene	Not reported	4.10	USEPA 1996a
Anthracene	4.44 - 4.80	4.55	USEPA 1995a
Benzo(a)anthracene	5.61 - 5.79	5.70	USEPA 1995a
Benzo(a)pyrene	5.98 - 6.34	6.11	USEPA 1995a
Benzo(b)fluoranthene	5.79 - 6.40	6.20	USEPA 1995a
Benzo(g,h,i)perylene	6.58 - 7.05	6.70	USEPA 1995a
Benzo(k)fluoranthene	6.12 - 6.27	6.20	USEPA 1995a
Chrysene	5.41 - 5.79	5.70	USEPA 1995a
Dibenz(a,h)anthracene	6.50 - 6.88	6.69	USEPA 1995a
Fluoranthene	4.84 - 5.39	5.12	USEPA 1995a
Fluorene	4.04 - 4.40	4.21	USEPA 1995a
Hexachlorobenzene	5.23 - 6.92	5.89	USEPA 1995a
Hexachlorobutadiene	4.74 - 5.16	4.81	USEPA 1995a
Hexachlorocyclopentadiene	5.05 - 5.51	5.39	USEPA 1995a
Hexachloroethane	3.82 - 4.14	4.00	USEPA 1995a
Indeno(1,2,3-cd)pyrene	6.58 - 6.72	6.65	USEPA 1995a
Pentachlorophenol	5.01 - 5.24	5.09	USEPA 1995a
Phenanthrene	4.37 - 4.57	4.55	USEPA 1995a
Pyrene	4.76 - 5.52	5.11	USEPA 1995a
Dioxins/Furans			
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	-- - --	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	-- - --	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran	-- - --	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	-- - --	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	-- - --	--	--
1,2,3,7,8-Pentachlorodibenzofuran	-- - --	--	--
2,3,4,7,8-Pentachlorodibenzofuran	-- - --	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin	6.42 - 7.02	6.53	USEPA 1995a
2,3,7,8-Tetrachlorodibenzofuran	-- - --	--	--

[1] Listed as chromium VI but applied to total chromium

[2] Listed as methylmercury but applied to total mercury

[3] PCB congeners 8, 18, 28, 44, 52, 66, 77, 81, 101, 105, 118, 126, 128, 138, 153, 156, 169, 170, 180, 187, 195, 206, and 209 are also listed in USEPA (2000)

[4] Listed as "chlordane"

[5] Listed as "tetrachloroethane"

TABLE H-6

Toxicity Equivalency Factors for Dioxins and Furans

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Congener	Mammal TEF	Bird TEF	Fish TEF
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	0.001	0.001
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.01	0.01
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	0.05	0.5
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.1	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	0.01	0.01
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.1	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	0.1	0.01
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.1	0.1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	1	1
1,2,3,7,8-Pentachlorodibenzofuran	0.03	0.1	0.05
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.1	0.1
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1	0.5
2,3,7,8-TCDD (dioxin)	1	1	1
2,3,7,8-Tetrachlorodibenzofuran	0.1	1	0.05
Octachlorodibenzo-p-dioxin	0.0003	0.0001	0.0001
Octachlorodibenzofuran	0.0003	0.0001	0.0001

TABLE H-7

Soil Bioccumulation Factors For Terrestrial Plants (Also Extrapolated to Sediments and Aquatic Plants)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	See Table H-8	--	--	See Table H-8	--
Cadmium	--	See Table H-8	--	--	See Table H-8	--
Chromium	0.084	90th percentile	Bechtel Jacobs 1998a	0.041	Median	Bechtel Jacobs 1998a; USEPA 2007j
Copper	--	See Table H-8	--	--	See Table H-8	--
Lead	--	See Table H-8	--	--	See Table H-8	--
Mercury	--	See Table H-8	--	--	See Table H-8	--
Nickel	--	See Table H-8	--	--	See Table H-8	--
Selenium	--	See Table H-8	--	--	See Table H-8	--
Silver	0.037	90th percentile	Bechtel Jacobs 1998a	0.014	Median	Bechtel Jacobs 1998a; USEPA 2007j
Zinc	--	See Table H-8	--	--	See Table H-8	--
Polychlorinated Biphenyls						
Aroclor-1016	0.323	Calculated[1]	USEPA 2007j	0.323	Calculated[1]	USEPA 2007j
Aroclor-1221	0.749	Calculated	USEPA 2007j	0.749	Calculated	USEPA 2007j
Aroclor-1232	0.515	Calculated	USEPA 2007j	0.515	Calculated	USEPA 2007j
Aroclor-1242	0.323	Calculated	USEPA 2007j	0.323	Calculated	USEPA 2007j
Aroclor-1248	0.184	Calculated	USEPA 2007j	0.184	Calculated	USEPA 2007j
Aroclor-1254	0.139	Calculated	USEPA 2007j	0.139	Calculated	USEPA 2007j
Aroclor-1260	0.105	Calculated	USEPA 2007j	0.105	Calculated	USEPA 2007j
Aroclor-1262	0.105	Calculated	USEPA 2007j	0.105	Calculated	USEPA 2007j
Aroclor-1268	0.105	Calculated	USEPA 2007j	0.105	Calculated	USEPA 2007j
Pesticides						
4,4'-DDD	--	See Table H-8	--	--	See Table H-8	--
4,4'-DDE	--	See Table H-8	--	--	See Table H-8	--
4,4'-DDT	--	See Table H-8	--	--	See Table H-8	--
Aldrin	0.139	Calculated	USEPA 2007j	0.139	Calculated	USEPA 2007j
alpha-BHC	1.735	Calculated	USEPA 2007j	1.735	Calculated	USEPA 2007j
alpha-Chlordane	0.165	Calculated	USEPA 2007j	0.165	Calculated	USEPA 2007j
beta-BHC	1.719	Calculated	USEPA 2007j	1.719	Calculated	USEPA 2007j
delta-BHC	1.311	Calculated	USEPA 2007j	1.311	Calculated	USEPA 2007j
Dieldrin	1.500	90th percentile	USEPA 2007j	0.410	Median	USEPA 2007j
Endosulfan I	1.687	Calculated	USEPA 2007j	1.687	Calculated	USEPA 2007j
Endosulfan II	0.886	Calculated	USEPA 2007j	0.886	Calculated	USEPA 2007j
Endrin	0.535	Calculated	USEPA 2007j	0.535	Calculated	USEPA 2007j
gamma-BHC (Lindane)	1.852	Calculated	USEPA 2007j	1.852	Calculated	USEPA 2007j
gamma-Chlordane	0.165	Calculated	USEPA 2007j	0.165	Calculated	USEPA 2007j
Heptachlor	0.174	Calculated	USEPA 2007j	0.174	Calculated	USEPA 2007j

TABLE H-7

Soil Bioccumulation Factors For Terrestrial Plants (Also Extrapolated to Sediments and Aquatic Plants]

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Heptachlor epoxide	0.566	Calculated	USEPA 2007j	0.566	Calculated	USEPA 2007j
Methoxychlor	0.525	Calculated	USEPA 2007j	0.525	Calculated	USEPA 2007j
Toxaphene	0.355	Calculated	USEPA 2007j	0.355	Calculated	USEPA 2007j
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	1.000	Assumed	--	1.000	Assumed	--
1,2,4,5-Tetrachlorobenzene	0.792	Calculated	USEPA 2007j	0.792	Calculated	USEPA 2007j
1,2,4-Trichlorobenzene	1.426	Calculated	USEPA 2007j	1.426	Calculated	USEPA 2007j
1,2-Dichlorobenzene	2.452	Calculated	USEPA 2007j	2.452	Calculated	USEPA 2007j
1,3-Dichlorobenzene	2.296	Calculated	USEPA 2007j	2.296	Calculated	USEPA 2007j
1,4-Dichlorobenzene	2.475	Calculated	USEPA 2007j	2.475	Calculated	USEPA 2007j
4-Bromophenyl-phenylether	0.566	Calculated	USEPA 2007j	0.566	Calculated	USEPA 2007j
4-Chlorophenyl-phenylether	0.593	Calculated	USEPA 2007j	0.593	Calculated	USEPA 2007j
Acenaphthene	--	See Table H-8	--	--	See Table H-8	--
Acenaphthylene	--	See Table H-8	--	--	See Table H-8	--
Anthracene	--	See Table H-8	--	--	See Table H-8	--
Benzo(a)anthracene	--	See Table H-8	--	--	See Table H-8	--
Benzo(a)pyrene	--	See Table H-8	--	--	See Table H-8	--
Benzo(b)fluoranthene	0.480	Maximum	USEPA 2007j	0.310	Median	USEPA 2007j
Benzo(g,h,i)perylene	--	See Table H-8	--	--	See Table H-8	--
Benzo(k)fluoranthene	--	See Table H-8	--	--	See Table H-8	--
Chrysene	--	See Table H-8	--	--	See Table H-8	--
Dibenz(a,h)anthracene	0.230	Maximum	USEPA 2007j	0.130	Median	USEPA 2007j
Fluoranthene	4.700	90th percentile	USEPA 2007j	0.500	Median	USEPA 2007j
Fluorene	--	See Table H-8	--	--	See Table H-8	--
Hexachlorobenzene	0.246	Calculated	USEPA 2007j	0.246	Calculated	USEPA 2007j
Hexachlorobutadiene	0.675	Calculated	USEPA 2007j	0.675	Calculated	USEPA 2007j
Hexachlorocyclopentadiene	0.393	Calculated	USEPA 2007j	0.393	Calculated	USEPA 2007j
Hexachloroethane	1.439	Calculated	USEPA 2007j	1.439	Calculated	USEPA 2007j
Indeno(1,2,3-cd)pyrene	0.150	Maximum	USEPA 2007j	0.110	Median	USEPA 2007j
Pentachlorophenol	30.10	90th percentile	USEPA 2007j	5.930	Median	USEPA 2007j
Phenanthrene	--	See Table H-8	--	--	See Table H-8	--
Pyrene	2.400	90th percentile	USEPA 2007j	0.720	Median	USEPA 2007j
Dioxins/Furans						
2,3,7,8-TCDD	0.135	Calculated	USEPA 2007j	0.135	Calculated	USEPA 2007j

[1] Calculated as described in the text using the "selected" log K_{ow} from Table H-5

TABLE H-8

Bioconcentration/Bioaccumulation Factor Models (Dry Weight)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Plants[1]	Reference	Soil Invertebrates[2]	Reference	Benthic Invertebrates[3]	Reference
Metals						
Arsenic	$C_p = e^{(-1.992 + 0.564(\ln Cs))}$	Bechtel Jacobs 1998a	$C_w = e^{(-1.421 + 0.706(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	--	--
Cadmium	$C_p = e^{(-0.476 + 0.546(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(2.114 + 0.795(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	--	--
Chromium	--	--	--	--	--	--
Copper	$C_p = e^{(0.669 + 0.394(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(1.675 + 0.264(\ln Cs))}$	Sample et al. 1998a	--	--
Lead	$C_p = e^{(-1.328 + 0.561(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(-0.218 + 0.807(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	$C_i = 10^{(-0.515 + 0.653(\log Csd))}$	Bechtel Jacobs 1998b
Mercury	$C_p = e^{(-0.996 + 0.544(\ln Cs))}$	Bechtel Jacobs 1998a	--	--	--	--
Nickel	$C_p = e^{(-2.224 + 0.748(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	--	--	--	--
Selenium	$C_p = e^{(-0.678 + 1.104(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(-0.075 + 0.733(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	--	--
Zinc	$C_p = e^{(1.575 + 0.555(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(4.449 + 0.328(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	$C_i = 10^{(1.89 + 0.126(\log Csd))}$	Bechtel Jacobs 1998b
Polychlorinated Biphenyls						
Aroclor-1016	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--
Aroclor-1221	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--
Aroclor-1232	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--
Aroclor-1242	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--
Aroclor-1248	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--
Aroclor-1254	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--
Aroclor-1260	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--

TABLE H-8

Bioconcentration/Bioaccumulation Factor Models (Dry Weight)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Plants[1]	Reference	Soil Invertebrates[2]	Reference	Benthic Invertebrates[3]	Reference
Aroclor-1262	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--
Aroclor-1268	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--
Pesticides						
4,4'-DDD	$C_p = e^{(-2.5119 + 0.7524(\ln Cs))}$	USEPA 2007j	$C_w = e^{(1.1613 + 0.6975(\ln Cs))}$	USEPA 2007j	--	--
4,4'-DDE	$C_p = e^{(-2.5119 + 0.7524(\ln Cs))}$	USEPA 2007j	$C_w = e^{(2.4771 + 0.8804(\ln Cs))}$	USEPA 2007j	--	--
4,4'-DDT	$C_p = e^{(-2.5119 + 0.7524(\ln Cs))}$	USEPA 2007j	$C_w = e^{(2.1247 + 0.8689(\ln Cs))}$	USEPA 2007j	--	--
PAHs						
Acenaphthene	$C_p = e^{(-5.562 - 0.8556(\ln Cs))}$	USEPA 2007j	--	--	--	--
Acenaphthylene	$C_p = e^{(-1.144 + 0.791(\ln Cs))}$	USEPA 2007j	--	--	--	--
Anthracene	$C_p = e^{(-0.9887 + 0.7784(\ln Cs))}$	USEPA 2007j	--	--	--	--
Benzo(a)anthracene	$C_p = e^{(-2.7078 + 0.5944(\ln Cs))}$	USEPA 2007j	--	--	--	--
Benzo(a)pyrene	$C_p = e^{(-2.0615 + 0.9750(\ln Cs))}$	USEPA 2007j	--	--	--	--
Benzo(g,h,i)perylene	$C_p = e^{(-0.9313 + 1.1829(\ln Cs))}$	USEPA 2007j	--	--	--	--
Benzo(k)fluoranthene	$C_p = e^{(-2.1579 + 0.8595(\ln Cs))}$	USEPA 2007j	--	--	--	--
Chrysene	$C_p = e^{(-2.7078 + 0.5944(\ln Cs))}$	USEPA 2007j	--	--	--	--
Fluorene	$C_p = e^{(-5.562 - 0.8556(\ln Cs))}$	USEPA 2007j	--	--	--	--
Phenanthrene	$C_p = e^{(-0.1665 + 0.6203(\ln Cs))}$	USEPA 2007j	--	--	--	--
Dioxin/Furans						
2,3,7,8-TCDD	--	--	$C_w = e^{(3.533 + 1.182(\ln Cs))}$	Sample et al. 1998a	--	--

[1] Where C_p = Concentration in aboveground portion of plant (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)

[2] Where C_w = Concentration in earthworm (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)

TABLE H-8

Bioconcentration/Bioaccumulation Factor Models (Dry Weight)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Small Mammal Omnivores[4]	Reference	Small Mammal Herbivores[4]	Reference	Small Mammal Insectivores[4]	Reference
Metals						
Arsenic	$C_m = e^{(-4.5796 + 0.7354(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(-5.6531 + 1.1382(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(-4.8471 + 0.8188(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j
Cadmium	$C_m = e^{(-1.5383 + 0.5660(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(-1.2571 + 0.4723(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(0.8150 + 0.9638(\ln Cs))}$	Sample et al. 1998b
Chromium	$C_m = e^{(-1.4945 + 0.7326(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(-1.4599 + 0.7338(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-1.4599 + 0.7338(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j
Copper	$C_m = e^{(1.4592 + 0.2681(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(2.0420 + 0.1444(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(2.1042 + 0.1783(\ln Cs))}$	Sample et al. 1998b
Lead	$C_m = e^{(0.0761 + 0.4422(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-0.6114 + 0.5181(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(0.4819 + 0.4869(\ln Cs))}$	Sample et al. 1998b
Mercury	--	--	--	--	--	--
Nickel	$C_m = e^{(-0.2462 + 0.4658(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-0.2462 + 0.4658(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-0.2462 + 0.4658(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j
Selenium	$C_m = e^{(-0.4158 + 0.3764(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-0.4158 + 0.3764(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-0.4158 + 0.3764(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j
Zinc	$C_m = e^{(4.4713 + 0.0738(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(4.3632 + 0.0706(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(4.2479 + 0.1324(\ln Cs))}$	Sample et al. 1998b
PCBs						
Aroclor-1016	--	--	--	--	--	--
Aroclor-1221	--	--	--	--	--	--
Aroclor-1232	--	--	--	--	--	--
Aroclor-1242	--	--	--	--	--	--
Aroclor-1248	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--

TABLE H-8

Bioconcentration/Bioaccumulation Factor Models (Dry Weight)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Small Mammal Omnivores[4]	Reference	Small Mammal Herbivores[4]	Reference	Small Mammal Insectivores[4]	Reference
Aroclor-1262	--	--	--	--	--	--
Aroclor-1268	--	--	--	--	--	--
Pesticides						
4,4'-DDD	--	--	--	--	--	--
4,4'-DDE	--	--	--	--	--	--
4,4'-DDT	--	--	--	--	--	--
PAHs						
Acenaphthene	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--
Dioxin/Furans						
2,3,7,8-TCDD	$C_m = e^{(0.8113 + 1.0993(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(0.8113 + 1.0993(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(0.8113 + 1.0993(\ln Cs))}$	Sample et al. 1998b

[3] Where C_i = Concentration in benthic invertebrate (mg/kg dry wt) and C_{sd} = Concentration in sediment (mg/kg dry wt)

[4] Where C_m = Concentration in whole-body small mammal (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)

TABLE H-9

Soil Bioaccumulation Factors For Soil Invertebrates (Dry Weight)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	See Table H-8	--	--	See Table H-8	--
Cadmium	--	See Table H-8	--	--	See Table H-8	--
Chromium	3.162	90th percentile	Sample et al. 1998a	0.320	Geometric mean	Sample et al. 1998a
Copper	--	See Table H-8	--	--	See Table H-8	--
Lead	--	See Table H-8	--	--	See Table H-8	--
Mercury	20.63	90th percentile	Sample et al. 1998a	1.186	Geometric mean	Sample et al. 1998a
Nickel	4.730	90th percentile	Sample et al. 1998a	1.656	Arithmetic mean	Sample et al. 1998a
Selenium	--	See Table H-8	--	--	See Table H-8	--
Silver	15.34	90th percentile	Sample et al. 1998a	2.045	Median	Sample et al. 1998a
Zinc	--	See Table H-8	--	--	See Table H-8	--
Polychlorinated Biphenyls						
Aroclor-1016	--	See Table H-8	--	--	See Table H-8	--
Aroclor-1221	--	See Table H-8	--	--	See Table H-8	--
Aroclor-1232	--	See Table H-8	--	--	See Table H-8	--
Aroclor-1242	--	See Table H-8	--	--	See Table H-8	--
Aroclor-1248	--	See Table H-8	--	--	See Table H-8	--
Aroclor-1254	--	See Table H-8	--	--	See Table H-8	--
Aroclor-1260	--	See Table H-8	--	--	See Table H-8	--
Aroclor-1262	--	See Table H-8	--	--	See Table H-8	--
Aroclor-1268	--	See Table H-8	--	--	See Table H-8	--
Pesticides						
4,4'-DDD	--	See Table H-8	--	--	See Table H-8	--
4,4'-DDE	--	See Table H-8	--	--	See Table H-8	--
4,4'-DDT	--	See Table H-8	--	--	See Table H-8	--
Aldrin	3.300	Mean	Edwards and Bohlen 1992	3.300	Mean	Edwards and Bohlen 1992
alpha-BHC	1.000	Assumed	--	1.000	Assumed	--
alpha-Chlordane	4.000	Mean	Edwards and Bohlen 1992	4.000	Mean	Edwards and Bohlen 1992
beta-BHC	1.000	Assumed	--	1.000	Assumed	--
delta-BHC	1.000	Assumed	--	1.000	Assumed	--
Dieldrin	52.10	90th percentile	USEPA 2007j	14.70	Median	USEPA 2007j
Endosulfan I	1.000	Assumed	--	1.000	Assumed	--
Endosulfan II	1.000	Assumed	--	1.000	Assumed	--
Endrin	3.600	Mean	Edwards and Bohlen 1992	3.600	Mean	Edwards and Bohlen 1992
gamma-BHC (Lindane)	26.60	Maximum	Romijn et al. 1994	13.70	Mean	Romijn et al. 1994
gamma-Chlordane	4.000	Mean	Edwards and Bohlen 1992	4.000	Mean	Edwards and Bohlen 1992
Heptachlor	3.000	Mean	Edwards and Bohlen 1992	3.000	Mean	Edwards and Bohlen 1992
Heptachlor epoxide	10.00	Mean	Beyer and Gish 1980	10.00	Mean	Beyer and Gish 1980
Methoxychlor	1.000	Assumed	--	1.000	Assumed	--

TABLE H-9

Soil Bioaccumulation Factors For Soil Invertebrates (Dry Weight)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Toxaphene	1.000	Assumed	--	1.000	Assumed	--
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	1.000	Assumed	--	1.000	Assumed	--
1,2,4,5-Tetrachlorobenzene	0.500	Mean	Beyer 1996	0.500	Mean	Beyer 1996
1,2,4-Trichlorobenzene	0.560	Mean	Beyer 1996	0.560	Mean	Beyer 1996
1,2-Dichlorobenzene	1.000	Assumed	--	1.000	Assumed	--
1,3-Dichlorobenzene	1.000	Assumed	--	1.000	Assumed	--
1,4-Dichlorobenzene	1.000	Assumed	--	1.000	Assumed	--
4-Bromophenyl-phenylether	1.000	Assumed	--	1.000	Assumed	--
4-Chlorophenyl-phenylether	1.000	Assumed	--	1.000	Assumed	--
Acenaphthene	0.300	Median	Beyer and Stafford 1993	0.300	Median	Beyer and Stafford 1993
Acenaphthylene	0.220	Median	Beyer and Stafford 1993	0.220	Median	Beyer and Stafford 1993
Anthracene	0.320	Median	Beyer and Stafford 1993	0.320	Median	Beyer and Stafford 1993
Benzo(a)anthracene	0.270	Median	Beyer and Stafford 1993	0.270	Median	Beyer and Stafford 1993
Benzo(a)pyrene	0.340	Median	Beyer and Stafford 1993	0.340	Median	Beyer and Stafford 1993
Benzo(b)fluoranthene	0.210	Median	Beyer and Stafford 1993	0.210	Median	Beyer and Stafford 1993
Benzo(g,h,i)perylene	0.150	Median	Beyer and Stafford 1993	0.150	Median	Beyer and Stafford 1993
Benzo(k)fluoranthene	0.210	Median	Beyer and Stafford 1993	0.210	Median	Beyer and Stafford 1993
Chrysene	0.440	Median	Beyer and Stafford 1993	0.440	Median	Beyer and Stafford 1993
Dibenz(a,h)anthracene	0.490	Median	Beyer and Stafford 1993	0.490	Median	Beyer and Stafford 1993
Fluoranthene	0.370	Median	Beyer and Stafford 1993	0.370	Median	Beyer and Stafford 1993
Fluorene	0.200	Median	Beyer and Stafford 1993	0.200	Median	Beyer and Stafford 1993
Hexachlorobenzene	1.690	Mean	Beyer 1996	1.690	Mean	Beyer 1996
Hexachlorobutadiene	1.000	Assumed	--	1.000	Assumed	--
Hexachlorocyclopentadiene	1.000	Assumed	--	1.000	Assumed	--
Hexachloroethane	1.000	Assumed	--	1.000	Assumed	--
Indeno(1,2,3-cd)pyrene	0.410	Median	Beyer and Stafford 1993	0.410	Median	Beyer and Stafford 1993
Pentachlorophenol	88.10	90th percentile	USEPA 2007j	14.63	Median	USEPA 2007j
Phenanthrene	0.280	Median	Beyer and Stafford 1993	0.280	Median	Beyer and Stafford 1993
Pyrene	0.390	Median	Beyer and Stafford 1993	0.390	Median	Beyer and Stafford 1993
Dioxin/Furans						
2,3,7,8-TCDD	--	See Table H-8	--	--	See Table H-8	--

TABLE H-10

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Omnivores

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	See Table H-8	--	--	See Table H-8	--
Cadmium	--	See Table H-8	--	--	See Table H-8	--
Chromium	--	See Table H-8	--	--	See Table H-8	--
Copper	--	See Table H-8	--	--	See Table H-8	--
Lead	--	See Table H-8	--	--	See Table H-8	--
Mercury	0.130	90th percentile	Sample et al. 1998b	0.054	Median	Sample et al. 1998b
Nickel	--	See Table H-8	--	--	See Table H-8	--
Selenium	--	See Table H-8	--	--	See Table H-8	--
Silver	0.810	90th percentile	Sample et al. 1998b	0.151	Median	Sample et al. 1998b
Zinc	--	See Table H-8	--	--	See Table H-8	--
Polychlorinated Biphenyls						
Aroclor-1016	NA	--	--	NA	--	--
Aroclor-1221	NA	--	--	NA	--	--
Aroclor-1232	NA	--	--	NA	--	--
Aroclor-1242	NA	--	--	NA	--	--
Aroclor-1248	NA	--	--	NA	--	--
Aroclor-1254	NA	--	--	NA	--	--
Aroclor-1260	NA	--	--	NA	--	--
Aroclor-1262	NA	--	--	NA	--	--
Aroclor-1268	NA	--	--	NA	--	--
Pesticides						
4,4'-DDD	NA	--	--	NA	--	--
4,4'-DDE	NA	--	--	NA	--	--
4,4'-DDT	NA	--	--	NA	--	--
Aldrin	NA	--	--	NA	--	--
alpha-BHC	NA	--	--	NA	--	--
alpha-Chlordane	NA	--	--	NA	--	--
beta-BHC	NA	--	--	NA	--	--
delta-BHC	NA	--	--	NA	--	--
Dieldrin	NA	--	--	NA	--	--
Endosulfan I	NA	--	--	NA	--	--
Endosulfan II	NA	--	--	NA	--	--
Endrin	NA	--	--	NA	--	--
gamma-BHC (Lindane)	NA	--	--	NA	--	--
gamma-Chlordane	NA	--	--	NA	--	--
Heptachlor	NA	--	--	NA	--	--
Heptachlor epoxide	NA	--	--	NA	--	--
Methoxychlor	NA	--	--	NA	--	--

TABLE H-10

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Omnivores

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Toxaphene	NA	--	--	NA	--	--
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	NA	--	--	NA	--	--
1,2,4,5-Tetrachlorobenzene	NA	--	--	NA	--	--
1,2,4-Trichlorobenzene	NA	--	--	NA	--	--
1,2-Dichlorobenzene	NA	--	--	NA	--	--
1,3-Dichlorobenzene	NA	--	--	NA	--	--
1,4-Dichlorobenzene	NA	--	--	NA	--	--
4-Bromophenyl-phenylether	NA	--	--	NA	--	--
4-Chlorophenyl-phenylether	NA	--	--	NA	--	--
Acenaphthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Acenaphthylene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(a)anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(a)pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(b)fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(g,h,i)perylene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(k)fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Chrysene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Dibenz(a,h)anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Fluorene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Hexachlorobenzene	NA	--	--	NA	--	--
Hexachlorobutadiene	NA	--	--	NA	--	--
Hexachlorocyclopentadiene	NA	--	--	NA	--	--
Hexachloroethane	NA	--	--	NA	--	--
Indeno(1,2,3-cd)pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Pentachlorophenol	NA	--	--	NA	--	--
Phenanthrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Dioxin/Furans						
2,3,7,8-TCDD	--	See Table H-8	--	--	See Table H-8	--

NA - Not Available (see text)

TABLE H-11

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Herbivores

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	See Table H-8	--	--	See Table H-8	--
Cadmium	--	See Table H-8	--	--	See Table H-8	--
Chromium	--	See Table H-8	--	--	See Table H-8	--
Copper	--	See Table H-8	--	--	See Table H-8	--
Lead	--	See Table H-8	--	--	See Table H-8	--
Mercury	0.192	90th percentile	Sample et al. 1998b	0.067	Geometric mean	Sample et al. 1998b
Nickel	--	See Table H-8	--	--	See Table H-8	--
Selenium	--	See Table H-8	--	--	See Table H-8	--
Silver	0.007	90th percentile	Sample et al. 1998b	0.006	Geometric mean	Sample et al. 1998b
Zinc	--	See Table H-8	--	--	See Table H-8	--
Polychlorinated Biphenyls						
Aroclor-1016	NA	--	--	NA	--	--
Aroclor-1221	NA	--	--	NA	--	--
Aroclor-1232	NA	--	--	NA	--	--
Aroclor-1242	NA	--	--	NA	--	--
Aroclor-1248	NA	--	--	NA	--	--
Aroclor-1254	NA	--	--	NA	--	--
Aroclor-1260	NA	--	--	NA	--	--
Aroclor-1262	NA	--	--	NA	--	--
Aroclor-1268	NA	--	--	NA	--	--
Pesticides						
4,4'-DDD	NA	--	--	NA	--	--
4,4'-DDE	NA	--	--	NA	--	--
4,4'-DDT	NA	--	--	NA	--	--
Aldrin	NA	--	--	NA	--	--
alpha-BHC	NA	--	--	NA	--	--
alpha-Chlordane	NA	--	--	NA	--	--
beta-BHC	NA	--	--	NA	--	--
delta-BHC	NA	--	--	NA	--	--
Dieldrin	NA	--	--	NA	--	--
Endosulfan I	NA	--	--	NA	--	--
Endosulfan II	NA	--	--	NA	--	--
Endrin	NA	--	--	NA	--	--
gamma-BHC (Lindane)	NA	--	--	NA	--	--
gamma-Chlordane	NA	--	--	NA	--	--
Heptachlor	NA	--	--	NA	--	--
Heptachlor epoxide	NA	--	--	NA	--	--
Methoxychlor	NA	--	--	NA	--	--

TABLE H-11

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Herbivores

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Toxaphene	NA	--	--	NA	--	--
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	NA	--	--	NA	--	--
1,2,4,5-Tetrachlorobenzene	NA	--	--	NA	--	--
1,2,4-Trichlorobenzene	NA	--	--	NA	--	--
1,2-Dichlorobenzene	NA	--	--	NA	--	--
1,3-Dichlorobenzene	NA	--	--	NA	--	--
1,4-Dichlorobenzene	NA	--	--	NA	--	--
4-Bromophenyl-phenylether	NA	--	--	NA	--	--
4-Chlorophenyl-phenylether	NA	--	--	NA	--	--
Acenaphthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Acenaphthylene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(a)anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(a)pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(b)fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(g,h,i)perylene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(k)fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Chrysene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Dibenz(a,h)anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Fluorene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Hexachlorobenzene	NA	--	--	NA	--	--
Hexachlorobutadiene	NA	--	--	NA	--	--
Hexachlorocyclopentadiene	NA	--	--	NA	--	--
Hexachloroethane	NA	--	--	NA	--	--
Indeno(1,2,3-cd)pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Pentachlorophenol	NA	--	--	NA	--	--
Phenanthrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Dioxin/Furans						
2,3,7,8-TCDD	--	See Table H-8	--	--	See Table H-8	--

NA - Not Available (see text)

TABLE H-12

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Insectivores

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	See Table H-8	--	--	See Table H-8	--
Cadmium	--	See Table H-8	--	--	See Table H-8	--
Chromium	--	See Table H-8	--	--	See Table H-8	--
Copper	--	See Table H-8	--	--	See Table H-8	--
Lead	--	See Table H-8	--	--	See Table H-8	--
Mercury	0.192	90th percentile	Sample et al. 1998b	0.067	Geometric mean	Sample et al. 1998b
Nickel	--	See Table H-8	--	--	See Table H-8	--
Selenium	--	See Table H-8	--	--	See Table H-8	--
Silver	0.501	90th percentile	Sample et al. 1998b	0.036	Geometric mean	Sample et al. 1998b
Zinc	--	See Table H-8	--	--	See Table H-8	--
Polychlorinated Biphenyls						
Aroclor-1016	NA	--	--	NA	--	--
Aroclor-1221	NA	--	--	NA	--	--
Aroclor-1232	NA	--	--	NA	--	--
Aroclor-1242	NA	--	--	NA	--	--
Aroclor-1248	NA	--	--	NA	--	--
Aroclor-1254	NA	--	--	NA	--	--
Aroclor-1260	NA	--	--	NA	--	--
Aroclor-1262	NA	--	--	NA	--	--
Aroclor-1268	NA	--	--	NA	--	--
Pesticides						
4,4'-DDD	NA	--	--	NA	--	--
4,4'-DDE	NA	--	--	NA	--	--
4,4'-DDT	NA	--	--	NA	--	--
Aldrin	NA	--	--	NA	--	--
alpha-BHC	NA	--	--	NA	--	--
alpha-Chlordane	NA	--	--	NA	--	--
beta-BHC	NA	--	--	NA	--	--
delta-BHC	NA	--	--	NA	--	--
Dieldrin	NA	--	--	NA	--	--
Endosulfan I	NA	--	--	NA	--	--
Endosulfan II	NA	--	--	NA	--	--
Endrin	NA	--	--	NA	--	--
gamma-BHC (Lindane)	NA	--	--	NA	--	--
gamma-Chlordane	NA	--	--	NA	--	--
Heptachlor	NA	--	--	NA	--	--
Heptachlor epoxide	NA	--	--	NA	--	--
Methoxychlor	NA	--	--	NA	--	--

TABLE H-12

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Insectivores

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Toxaphene	NA	--	--	NA	--	--
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	NA	--	--	NA	--	--
1,2,4,5-Tetrachlorobenzene	NA	--	--	NA	--	--
1,2,4-Trichlorobenzene	NA	--	--	NA	--	--
1,2-Dichlorobenzene	NA	--	--	NA	--	--
1,3-Dichlorobenzene	NA	--	--	NA	--	--
1,4-Dichlorobenzene	NA	--	--	NA	--	--
4-Bromophenyl-phenylether	NA	--	--	NA	--	--
4-Chlorophenyl-phenylether	NA	--	--	NA	--	--
Acenaphthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Acenaphthylene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(a)anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(a)pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(b)fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(g,h,i)perylene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Benzo(k)fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Chrysene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Dibenz(a,h)anthracene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Fluoranthene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Fluorene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Hexachlorobenzene	NA	--	--	NA	--	--
Hexachlorobutadiene	NA	--	--	NA	--	--
Hexachlorocyclopentadiene	NA	--	--	NA	--	--
Hexachloroethane	NA	--	--	NA	--	--
Indeno(1,2,3-cd)pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Pentachlorophenol	NA	--	--	NA	--	--
Phenanthrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Pyrene	0.000	Assumed	USEPA 2007j	0.000	Assumed	USEPA 2007j
Dioxin/Furans						
2,3,7,8-TCDD	--	See Table H-8	--	--	See Table H-8	--

NA - Not Available (see text)

TABLE H-13

Sediment Bioaccumulation Factors (Dry Weight) for Benthic Invertebrates

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)					Baseline (Step 3A)				
	BAF (dw)	Type	Principal Organisms	Basis	Reference	BAF (dw)	Type	Principal Organisms	Basis	Reference
Metals										
Copper	7.957	Fresh	Invertebrate infauna	90th percentile	Bechtel Jacobs 1998b	0.824	Fresh	Invertebrate infauna	Geometric mean	Bechtel Jacobs 1998b
Lead	--	--	--	See Table H-8	--	--	--	--	See Table H-8	--
Mercury	2.868	Fresh	Invertebrate infauna	90th percentile	Bechtel Jacobs 1998b	1.186	Fresh	Invertebrate infauna	Geometric mean	Bechtel Jacobs 1998b
Zinc	--	--	--	See Table H-8	--	--	--	--	See Table H-8	--
Dioxin/Furans										
2,3,7,8-TCDD	1.000	--	--	Assumed	--	1.000	--	--	Assumed	--

TABLE H-14

Biota Sediment Accumulation Factors (Wet Weight) and Sediment Bioaccumulation Factors (Dry Weight) for Fish

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Screening (Step 2)					Baseline (Step 3A)				
	BSAF (ww)	BAF (dw)[1]	Type	Basis	Reference	BSAF (ww)	BAF (dw)[1]	Type	Basis	Reference
Metals										
Copper	--	0.100	Fresh	Mean	Krantzberg and Boyd 1992	--	0.100	Fresh	Mean	Krantzberg and Boyd 1992
Lead	--	0.070	Fresh	Mean	Krantzberg and Boyd 1992	--	0.070	Fresh	Mean	Krantzberg and Boyd 1992
Mercury	--	4.580	Fresh	Maximum	Cope et al. 1990	--	3.250	Fresh	Mean	Cope et al. 1990
Zinc	--	0.147	Fresh	Mean	Pascoe et al. 1996	--	0.147	Fresh	Mean	Pascoe et al. 1996
Dioxin/Furans										
2,3,7,8-TCDD	0.059	4.291	Fresh/Marine	Median	USEPA 1997c	0.059	4.291	Fresh/Marine	Median	USEPA 1997c

[1] Wet-weight (ww) BSAFs are converted to dry-weight (dw) using the following values:

Lipids (%):	6.00	USEPA 1997c; USACOE 2010
TOC (%):	0.33	Mean measured value (site)
Percent soilds:	0.25	USEPA 1993

TABLE H-15

Exposure Parameters for Upper Trophic Level Ecological Receptors - Screening (Step 2)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

	Minimum Body Weight (kg)		Maximum Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)		Dietary Composition (percent)									Soil/ Sediment Ingestion (percent)	
Receptor	Value	Reference	Value	Reference	Value	Reference	Value	Reference	Terr Plants	Terr Invert	Mouse	Vole	Shrew	Aq Plants	Aq Invert	Fish	Reference	Value	Reference
Mammals																			
Meadow vole	0.0300	Silva and Downing 1995	0.0635	Silva and Downing 1995	0.01334	USEPA 1993	0.00310	USEPA 1993	95.6	2.0	0.0	0.0	0.0	0.0	0.0	0.0	USEPA 1993	2.4	Beyer et al. 1994
Mink	0.7260	Silva and Downing 1995	1.0200	Silva and Downing 1995	0.02856	USEPA 1993	0.03494	USEPA 1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	USEPA 1993	0.0	Sample and Suter 1994
Raccoon	4.2300	Silva and Downing 1995	7.5300	Silva and Downing 1995	0.60919	allometric equation (USEPA 1993)[1]	0.13067	Conover 1989	0.0	0.0	0.0	0.0	0.0	40.0	43.6	7.0	USEPA 1993	9.4	Beyer et al. 1994
Red fox	3.1700	Silva and Downing 1995	4.8700	Silva and Downing 1995	0.41154	allometric equation (USEPA 1993)[1]	0.14763	Sample and Suter 1994	7.0	2.8	29.2	29.1	29.1	0.0	0.0	0.0	USEPA 1993	2.8	Beyer et al. 1994
Short-tailed shrew	0.0133	USEPA 1993	0.02131	USEPA 1993	0.00475	USEPA 1993	0.00189	USEPA 1993	4.7	82.3	0.0	0.0	0.0	0.0	0.0	0.0	USEPA 1993; Sample and Suter 1994	13.0	Sample and Suter 1994
White-footed mouse	0.0141	Silva and Downing 1995	0.0305	Silva and Downing 1995	0.00915	Sample and Suter 1994	0.00073	Sample and Suter 1994	51.0	47.0	0.0	0.0	0.0	0.0	0.0	0.0	Martin et al. 1951; Sample and Suter 1994	2.0	Beyer et al. 1994
Birds																			
American robin (omnivore)	0.0635	USEPA 1993	0.1030	USEPA 1993	0.01287	allometric equation (USEPA 1993)[2]	0.00736	Levey and Karasov 1989	51.9	43.5	0.0	0.0	0.0	0.0	0.0	0.0	Martin et al. 1951	4.6	Sample and Suter 1994
American robin (invertivore)	0.0635	USEPA 1993	0.1030	USEPA 1993	0.01287	allometric equation (USEPA 1993)[2]	0.00511	Levey and Karasov 1989	0.0	95.4	0.0	0.0	0.0	0.0	0.0	0.0	exclusive diet	4.6	Sample and Suter 1994
Belted kingfisher	0.1250	Dunning 2008	0.2150	Dunning 2008	0.02107	allometric equation (USEPA 1993)[2]	0.02619	USEPA 1993	0.0	0.0	0.0	0.0	0.0	0.0	16.0	84.0	USEPA 1993	0.0	Sample and Suter 1994
Great blue heron	2.1000	Butler 1992	2.5000	Butler 1992	0.10901	allometric equation (USEPA 1993)[2]	0.13565	allometric equation (Nagy 2001)[3]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	USEPA 1993; Quinney and Smith 1980	0.0	Sample and Suter 1994
Mallard	0.6120	Bellrose 1980	1.7240	Bellrose 1980	0.08498	allometric equation (USEPA 1993)[2]	0.07168	allometric equation (Nagy 2001)[4]	0.0	0.0	0.0	0.0	0.0	86.7	10.0	0.0	Palmer 1976	3.3	Beyer et al. 1994
Mourning dove	0.1050	Tomlinson et al. 1994	0.1630	Tomlinson et al. 1994	0.01750	allometric equation (USEPA 1993)[2]	0.02090	allometric equation (Nagy 2001)[3]	95.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Tomlinson et al. 1994	5.0	Assumed based on diet
Osprey	1.2350	Dunning 2008	1.7500	Dunning 2008	0.08584	allometric equation (USEPA 1993)[2]	0.09188	USEPA 1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	USEPA 1993	0.0	Assumed based on diet
Red-tailed hawk	0.9570	USEPA 1993	1.2350	USEPA 1993	0.06796	allometric equation (USEPA 1993)[2]	0.03952	Sample and Suter 1994	0.0	0.0	34.0	33.0	33.0	0.0	0.0	0.0	USEPA 1993; Sample and Suter 1994	0.0	Sample and Suter 1994
Spotted sandpiper	0.0294	Dunning 2008	0.0598	Dunning 2008	0.00894	allometric equation (USEPA 1993)[2]	0.01052	allometric equation (Nagy 2001)[3]	0.0	0.0	0.0	0.0	0.0	0.0	82.0	0.0	USEPA 1993	18.0	Beyer et al. 1994

[1] All mammals equation: $0.099\ (BW)^{0.90}$ (maximum body weight used)

[2] All birds equation: $0.059\ (BW)^{0.67}$ (maximum body weight used)

[3] All birds equation: $(0.638*((BW*1000)^{0.685}))/1000$ (maximum body weight used)

[4] Omnivorous birds equation: $(0.67*((BW*1000)^{0.627}))/1000$ (maximum body weight used)

TABLE H-16

Exposure Parameters for Upper Trophic Level Ecological Receptors - Baseline (Step 3A)

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)		Home Range (ha)		Dietary Composition (percent)									Soil/ Sediment Ingestion (percent)	
Receptor	Value	Reference	Value	Reference	Value	Reference	Value	Reference	Terr Plants	Terr Invert	Mouse	Vole	Shrew	Aq Plants	Aq Invert	Fish	Reference	Value	Reference
Mammals																			
Meadow vole	0.0428	Silva and Downing 1995	0.00899	USEPA 1993	0.00209	USEPA 1993	0.013	USEPA 1993	95.6	2.0	0.0	0.0	0.0	0.0	0.0	0.0	USEPA 1993	2.4	Beyer et al. 1994
Mink	0.7770	Silva and Downing 1995	0.02176	USEPA 1993	0.02661	USEPA 1993	770	USEPA 1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	USEPA 1993	0.0	Sample and Suter 1994
Raccoon	5.9400	Silva and Downing 1995	0.49209	allometric equation (USEPA 1993)[1]	0.10308	Conover 1989	289	USEPA 1993	0.0	0.0	0.0	0.0	0.0	40.0	43.6	7.0	USEPA 1993	9.4	Beyer et al. 1994
Red fox	4.0600	Silva and Downing 1995	0.34939	allometric equation (USEPA 1993)[1]	0.12308	Sample and Suter 1994	400	USEPA 1993	7.0	2.8	29.2	29.1	29.1	0.0	0.0	0.0	USEPA 1993	2.8	Beyer et al. 1994
Short-tailed shrew	0.0169	USEPA 1993	0.00376	USEPA 1993	0.00149	USEPA 1993	0.390	Sample and Suter 1994	4.7	82.3	0.0	0.0	0.0	0.0	0.0	0.0	USEPA 1993; Sample and Suter 1994	13.0	Sample and Suter 1994
White-footed mouse	0.0208	Silva and Downing 1995	0.00624	Sample and Suter 1994	0.00050	Sample and Suter 1994	0.059	Sample and Suter 1994	51.0	47.0	0.0	0.0	0.0	0.0	0.0	0.0	Martin et al. 1951; Sample and Suter 1994	2.0	Beyer et al. 1994
Birds																			
American robin (omnivore)	0.0773	USEPA 1993	0.01062	allometric equation (USEPA 1993)[2]	0.00552	Levey and Karasov 1989	0.500	USEPA 1993 (foraging)	51.9	43.5	0.0	0.0	0.0	0.0	0.0	0.0	Martin et al. 1951	4.6	Sample and Suter 1994
American robin (invertivore)	0.0773	USEPA 1993	0.01062	allometric equation (USEPA 1993)[2]	0.00383	Levey and Karasov 1989	0.500	USEPA 1993 (foraging)	0.0	95.4	0.0	0.0	0.0	0.0	0.0	0.0	exclusive diet	4.6	Sample and Suter 1994
Belted kingfisher	0.1480	Dunning 2008	0.01640	allometric equation (USEPA 1993)[2]	0.01803	USEPA 1993	800	Cornwell 1963 (foraging)	0.0	0.0	0.0	0.0	0.0	0.0	16.0	84.0	USEPA 1993	0.0	Sample and Suter 1994
Great blue heron	2.2300	Quinney 1982	0.10098	allometric equation (USEPA 1993)[2]	0.12543	allometric equation (Nagy 2001)[3]	4.50	USEPA 1993 (foraging)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	USEPA 1993; Quinney and Smith 1980	0.0	Sample and Suter 1994
Mallard	1.1770	Bellrose 1980	0.06581	allometric equation (USEPA 1993)[2]	0.05642	allometric equation (Nagy 2001)[4]	435	USEPA 1993	0.0	0.0	0.0	0.0	0.0	86.7	10.0	0.0	Palmer 1976	3.3	Beyer et al. 1994
Mourning dove	0.1265	Tomlinson et al. 1994	0.01477	allometric equation (USEPA 1993)[2]	0.01757	allometric equation (Nagy 2001)[3]	956	Losito and Mirarchi 1991	95.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Tomlinson et al. 1994	5.0	Assumed based on diet
Osprey	1.4860	Dunning 2008	0.07693	allometric equation (USEPA 1993)[2]	0.07802	USEPA 1993	9,500	USEPA 1993 (foraging)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	USEPA 1993	0.0	Assumed based on diet
Red-tailed hawk	1.1260	Sample and Suter 1994	0.06388	allometric equation (USEPA 1993)[2]	0.03603	Sample and Suter 1994	233	Sample and Suter 1994	0.0	0.0	34.0	33.0	33.0	0.0	0.0	0.0	USEPA 1993; Sample and Suter 1994	0.0	Sample and Suter 1994
Spotted sandpiper	0.0404	Dunning 2008	0.00687	allometric equation (USEPA 1993)[2]	0.00804	allometric equation (Nagy 2001)[3]	0.250	USEPA 1993	0.0	0.0	0.0	0.0	0.0	0.0	82.0	0.0	USEPA 1993	18.0	Beyer et al. 1994

[1] All mammals equation: $0.099\ (BW)^{0.90}$

[2] All birds equation: $0.059\ (BW)^{0.67}$

[3] All birds equation: $(0.638*((BW*1000)^{0.685}))/1000$

[4] Omnivorous birds equation: $(0.67*((BW*1000)^{0.627}))/1000$

TABLE H-17

Ecological Screening Values (ESVs) for Soils - Plants and Soil Invertebrates

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
Inorganics					
Aluminum	pH < 5.5	--	Eco-SSL	USEPA 2003a	
Antimony	78.0	mg/kg	Eco-SSL - Invertebrate	USEPA 2005a	
Arsenic	18.0	mg/kg	Eco-SSL - Plant	USEPA 2005b	
Barium	330	mg/kg	Eco-SSL - Invertebrate	USEPA 2005c	
Beryllium	40.0	mg/kg	Eco-SSL - Invertebrate	USEPA 2005d	
Cadmium	32.0	mg/kg	Eco-SSL - Plant	USEPA 2005e	
Chromium	64.0	mg/kg	Soil Quality Guideline	CCME 2007	
Cobalt	13.0	mg/kg	Eco-SSL - Plant	USEPA 2005f	
Copper	70.0	mg/kg	Eco-SSL - Plant	USEPA 2007a	
Cyanide	15.8	mg/kg		MHSPE 2000	Geometric mean of target and intervention values (complex)
Iron	5 < pH > 8	--	Eco-SSL	USEPA 2003b	
Lead	120	mg/kg	Eco-SSL - Plant	USEPA 2005g	
Manganese	220	mg/kg	Eco-SSL - Plant	USEPA 2007b	
Mercury	0.10	mg/kg	Invertebrate	Efroymson et al. 1997b	
Nickel	38.0	mg/kg	Eco-SSL - Plant	USEPA 2007c	
Selenium	0.52	mg/kg	Eco-SSL - Plant	USEPA 2007d	
Silver	560	mg/kg	Eco-SSL - Plant	USEPA 2006a	
Thallium	1.00	mg/kg	Plant	Efroymson et al. 1997a	
Vanadium	130	mg/kg	Soil Quality Guideline	CCME 2007	
Zinc	120	mg/kg	Eco-SSL - Invertebrate	USEPA 2007e	
Pesticides					
4,4'-DDD	583	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
4,4'-DDE	114	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
4,4'-DDT	100	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Aldrin	3.63	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
alpha-BHC	226	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
alpha-Chlordane	11.0	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
beta-BHC	342	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
delta-BHC	226	ug/kg		alpha-BHC value	
Dieldrin	10.5	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Endosulfan I	6.32	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
Endosulfan II	6.32	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
Endosulfan sulfate	6.32	ug/kg		Endosulfan value	
Endrin	1.95	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Endrin aldehyde	1.95	ug/kg		Endrin value	
Endrin ketone	1.95	ug/kg		Endrin value	
gamma-BHC (Lindane)	7.75	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
gamma-Chlordane	11.0	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
Heptachlor	52.9	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
Heptachlor epoxide	52.9	ug/kg		Heptachlor value	

TABLE H-17

Ecological Screening Values (ESVs) for Soils - Plants and Soil Invertebrates

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
Methoxychlor	500	ug/kg		Beyer 1990	B value ("moderate soil contamination")
Toxaphene	500	ug/kg		Beyer 1990	B value ("moderate soil contamination")
Polychlorinated Biphenyls					
Aroclor-1016	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1221	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1232	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1242	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1248	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1254	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1260	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1262	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1268	8,000	ug/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Semivolatile Organic Compounds					
1,1-Biphenyl	13,600	ug/kg	Plant	Efroymson et al. 1997a	EC50 (68,000); UF of 5
1,2,4,5-Tetrachlorobenzene	1,000	ug/kg		Beyer 1990	B value ("moderate soil contamination")
1,4-Dioxane	2,050	ug/kg		USEPA 2003c	
1-Methylnaphthalene	NSV	--		--	
2,2'-Oxybis(1-chloropropane)	NSV	--		--	
2,3,4,6-Tetrachlorophenol	500	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
2,4,5-Trichlorophenol	1,350	ug/kg	Plant	Efroymson et al. 1997a	NOEC
2,4,6-Trichlorophenol	580	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 58,000; UF of 100
2,4-Dichlorophenol	500	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
2,4-Dimethylphenol	1,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
2,4-Dinitrophenol	20,000	ug/kg	Plant	Efroymson et al. 1997a	NOEC
2,4-Dinitrotoluene	11,000	ug/kg	Plant/Invertebrate	NRCC 2006	
2,6-Dinitrotoluene	8,500	ug/kg	Plant/Invertebrate	NRCC 2006	
2-Chloronaphthalene	LMW PAH	--		--	
2-Chlorophenol	500	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
2-Methylnaphthalene	LMW PAH	--		--	
2-Methylphenol	1,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
2-Nitroaniline	NSV	--		--	
2-Nitrophenol	1,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")

TABLE H-17

Ecological Screening Values (ESVs) for Soils - Plants and Soil Invertebrates

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
3- and 4-Methylphenol	1,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
3,3'-Dichlorobenzidine	NSV	--		--	
3-Nitroaniline	NSV	--		--	
4,6-Dinitro-2-methylphenol	1,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
4-Bromophenyl-phenylether	NSV	--		--	
4-Chloro-3-methylphenol	500	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
4-Chloroaniline	500	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
4-Chlorophenyl-phenylether	NSV	--		--	
4-Nitroaniline	NSV	--		--	
4-Nitrophenol	380	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 38,000; UF of 100
Acenaphthene	LMW PAH	--		--	
Acenaphthylene	LMW PAH	--		--	
Acetophenone	NSV	--		--	
Anthracene	LMW PAH	--		--	
Atrazine	11.9	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Benzaldehyde	58,400	ug/kg	Plant	Hulzebos et al. 1993	EC50 of 292,000; UF of 5
Benzo(a)anthracene	HMW PAH	--		--	
Benzo(a)pyrene	HMW PAH	--		--	
Benzo(b)fluoranthene	HMW PAH	--		--	
Benzo(g,h,i)perylene	HMW PAH	--		--	
Benzo(k)fluoranthene	HMW PAH	--		--	
bis(2-Chloroethoxy)methane	NSV	--		--	
bis(2-Chloroethyl)ether	NSV	--		--	
bis(2-Ethylhexyl)phthalate	30,000	ug/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Butylbenzylphthalate	30,000	ug/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Caprolactam	NSV	--		--	
Carbazole	7,000	ug/kg	Invertebrate	Sverdrup 2001; 2002	EC50 of 35,000; UF of 5
Chrysene	HMW PAH	--		--	
Dibenz(a,h)anthracene	HMW PAH	--		--	
Dibenzofuran	4,600	ug/kg	Invertebrate	Sverdrup 2001; 2002	EC50 of 23,000; UF of 5
Diethylphthalate	26,800	ug/kg	Plant	Efroymson et al. 1997a	EC50 (134,000); UF of 5
Dimethyl phthalate	10,640	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 1,064,000; UF of 100
Di-n-butylphthalate	40,000	ug/kg	Plant	Efroymson et al. 1997a	LOEC (200,000); UF of 5
Di-n-octylphthalate	30,000	ug/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Fluoranthene	LMW PAH	--		--	
Fluorene	LMW PAH	--		--	
Hexachlorobenzene	1,000	ug/kg		Beyer 1990	B value ("moderate soil contamination")

TABLE H-17

Ecological Screening Values (ESVs) for Soils - Plants and Soil Invertebrates

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
Hexachlorobutadiene	NSV	--		--	
Hexachlorocyclopentadiene	2,000	ug/kg	Plant	Efroymson et al. 1997a	LOEC (10,000); UF of 5
Hexachloroethane	NSV	--		--	
Indeno(1,2,3-cd)pyrene	HMW PAH	--		--	
Isophorone	NSV	--		--	
Naphthalene	LMW PAH	--		--	
Nitrobenzene	2,260	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 226,000; UF of 100
n-Nitroso-di-n-propylamine	NSV	--		--	
n-Nitrosodiphenylamine	1,090	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 109,000; UF of 100
PAH (HMW)	18,000	ug/kg	Eco-SSL - Invertebrate	USEPA 2007h	
PAH (LMW)	29,000	ug/kg	Eco-SSL - Invertebrate	USEPA 2007h	
Pentachlorophenol	5,000	ug/kg	Eco-SSL - Plant	USEPA 2007i	
Phenanthrene	LMW PAH	--		--	
Phenol	1,880	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 188,000; UF of 100
Pyrene	HMW PAH	--		--	
Volatile Organic Compounds					
1,1,1-Trichloroethane	1,025	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
1,1,2,2-Tetrachloroethane	5,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	NSV	--		--	
1,1,2-Trichloroethane	2,000	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
1,1-Dichloroethane	548	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
1,1-Dichloroethene	173	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
1,2,3-Trichlorobenzene	1,150	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 115,000; UF of 100
1,2,4-Trichlorobenzene	1,270	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 127,000; UF of 100
1,2-Dibromo-3-chloropropane	NSV	--		--	
1,2-Dibromoethane	300	ug/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
1,2-Dichlorobenzene	1,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
1,2-Dichloroethane	2,190	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
1,2-Dichloroethene (total)	447	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
1,2-Dichloropropane	38,800	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 3,880,000; UF of 100
1,3-Dichlorobenzene	1,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
1,4-Dichlorobenzene	1,280	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 128,000; UF of 100
2-Butanone	NSV	--		--	
2-Hexanone	NSV	--		--	
4-Methyl-2-pentanone	NSV	--		--	
Acetone	NSV	--		--	

TABLE H-17

Ecological Screening Values (ESVs) for Soils - Plants and Soil Invertebrates

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
Benzene	1,140	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Bromochloromethane	NSV	--		--	
Bromodichloromethane	NSV	--		--	
Bromoform	300	ug/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Bromomethane	NSV	--		--	
Carbon disulfide	NSV	--		--	
Carbon tetrachloride	3,400	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Chlorobenzene	2,400	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 240,000; UF of 100
Chloroethane	5,000	ug/kg		CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Chloroform	1,844	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Chloromethane	5,000	ug/kg		CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
cis-1,2-Dichloroethene	447	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
cis-1,3-Dichloropropene	5,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
Cyclohexane	6,000	ug/kg		Beyer 1990	B value ("moderate soil contamination")
Dibromochloromethane	NSV	--		--	
Dichlorodifluoromethane(Freon-12)	NSV	--		--	
Ethylbenzene	1,815	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Isopropylbenzene	NSV	--		--	
m- and p-Xylene	1,300	ug/kg		Total xylenes	
Methyl acetate	NSV	--		--	
Methylcyclohexane	NSV	--		--	
Methylene chloride	1,250	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Methyl-tert-butyl ether (MTBE)	NSV	--		--	
o-Xylene	1,300	ug/kg		Total xylenes	
Styrene	64,000	ug/kg	Plant	Efroymson et al. 1997a	EC50 (320,000); UF of 5
Tetrachloroethene	179	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Toluene	40,000	ug/kg	Plant	Efroymson et al. 1997a	EC50 (200,000); UF of 5
trans-1,2-Dichloroethene	447	ug/kg		MHSPE 2000	Geometric mean of target and intervention values
trans-1,3-Dichloropropene	5,000	ug/kg		Beyer 1990; CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland; B value ("moderate soil contamination")
Trichloroethene	500	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Trichlorofluoromethane(Freon-11)	NSV	--		--	
Vinyl chloride	412	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Xylene, total	1,300	ug/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Explosives					
1,3,5-Trinitrobenzene	NSV	--		--	
1,3-Dinitrobenzene	NSV	--		--	
2,4,6-Trinitrotoluene	10,000	ug/kg	Plant	Talmage et al. 1999	
2-Amino-4,6-dinitrotoluene	80,000	ug/kg	Plant	Talmage et al. 1999	

TABLE H-17

Ecological Screening Values (ESVs) for Soils - Plants and Soil Invertebrates

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
2-Nitrotoluene	NSV	--		--	
3-Nitrotoluene	NSV	--		--	
4-Amino-2,6-dinitrotoluene	80,000	ug/kg	Plant	2-Amino-4,6-dinitrotoluene	
4-Nitrotoluene	NSV	--		--	
HMX	10,000	ug/kg	Invertebrate	Talmage et al. 1999	
RDX	10,000	ug/kg	Invertebrate	Talmage et al. 1999	
Tetryl	10,000	ug/kg	Plant	Talmage et al. 1999	
Dioxin/Furans					
2,3,7,8-TCDD (dioxin)	4.00	pg/g		CCME 2007	Soil Quality Guideline

NSV - No Screening Value

TABLE H-18

Ecological Screening Values (ESVs) for Water

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type	Reference	Comments[1]
Inorganics					
Aluminum	87.0	ug/L	Fresh	USEPA 2009	AWQC
Antimony	500	ug/L	Marine	USEPA 2006b	
Arsenic	36.0	ug/L	Marine	USEPA 2009	AWQC
Barium	200	ug/L	Marine	Buchman 2008	
Beryllium	100	ug/L	Marine	Buchman 2008	
Cadmium	8.85	ug/L	Marine	USEPA 2009	AWQC
Chromium	50.4	ug/L	Marine	USEPA 2009	AWQC
Cobalt	23.0	ug/L	Fresh	Suter and Tsao 1996	SCV
Copper	3.73	ug/L	Marine	USEPA 2009	AWQC
Cyanide	1.00	ug/L	Marine	USEPA 2009	AWQC
Iron	1,000	ug/L	Fresh	USEPA 2009	AWQC
Lead	8.52	ug/L	Marine	USEPA 2009	AWQC
Manganese	100	ug/L	Marine	Buchman 2008	
Mercury	1.11	ug/L	Marine	USEPA 2009	AWQC
Nickel	8.28	ug/L	Marine	USEPA 2009	AWQC
Selenium	71.1	ug/L	Marine	USEPA 2009	AWQC
Silver	0.23	ug/L	Marine	USEPA 2001	
Thallium	21.3	ug/L	Marine	USEPA 2001	
Vanadium	50.0	ug/L	Marine	Buchman 2008	
Zinc	85.6	ug/L	Marine	USEPA 2009	AWQC
Dissolved Metals					
Aluminum	87.0	ug/L	Fresh	USEPA 2009	AWQC
Antimony	500	ug/L	Marine	USEPA 2006b	
Arsenic	36.0	ug/L	Marine	USEPA 2009	AWQC
Barium	200	ug/L	Marine	Buchman 2008	
Beryllium	100	ug/L	Marine	Buchman 2008	
Cadmium	8.80	ug/L	Marine	USEPA 2009	AWQC
Chromium	50.0	ug/L	Marine	USEPA 2009	AWQC
Cobalt	23.0	ug/L	Fresh	Suter and Tsao 1996	SCV
Copper	3.10	ug/L	Marine	USEPA 2009	AWQC
Iron	1,000	ug/L	Fresh	USEPA 2009	AWQC
Lead	8.10	ug/L	Marine	USEPA 2009	AWQC
Manganese	100	ug/L	Marine	Buchman 2008	
Mercury	0.94	ug/L	Marine	USEPA 2009	AWQC
Nickel	8.20	ug/L	Marine	USEPA 2009	AWQC

TABLE H-18

Ecological Screening Values (ESVs) for Water

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type	Reference	Comments[1]
Selenium	71.0	ug/L	Marine	USEPA 2009	AWQC
Silver	0.23	ug/L	Marine	USEPA 2001	
Thallium	21.3	ug/L	Marine	USEPA 2001	
Vanadium	50.0	ug/L	Marine	Buchman 2008	
Zinc	81.0	ug/L	Marine	USEPA 2009	AWQC
Pesticides					
4,4'-DDD	0.025	ug/L	Marine	USEPA 2001	
4,4'-DDE	0.14	ug/L	Marine	USEPA 2001	
4,4'-DDT	0.0065	ug/L	Marine	USEPA 2006b	
Aldrin	0.13	ug/L	Marine	USEPA 2001	
alpha-BHC	25.0	ug/L	Marine	USEPA 2006b	
alpha-Chlordane	0.004	ug/L	Marine	USEPA 2009	FRV - AWQC
beta-BHC	25.0	ug/L	Marine	alpha-BHC	
delta-BHC	25.0	ug/L	Marine	alpha-BHC	
Dieldrin	0.11	ug/L	Marine	USEPA 1996b	FCV
Endosulfan I	0.0087	ug/L	Marine	USEPA 2009	AWQC
Endosulfan II	0.0087	ug/L	Marine	USEPA 2009	AWQC
Endosulfan sulfate	0.0087	ug/L	Marine	USEPA 2009	AWQC
Endrin	0.01	ug/L	Marine	USEPA 1996b	FCV
Endrin aldehyde	0.01	ug/L	Marine	Endrin	
Endrin ketone	0.01	ug/L	Marine	Endrin	
gamma-BHC (Lindane)	0.016	ug/L	Marine	USEPA 2001	
gamma-Chlordane	0.004	ug/L	Marine	USEPA 2009	FRV - AWQC
Heptachlor	0.0036	ug/L	Marine	USEPA 2009	FRV - AWQC
Heptachlor epoxide	0.0036	ug/L	Marine	USEPA 2009	FRV - AWQC
Methoxychlor	0.03	ug/L	Marine	USEPA 2009	AWQC
Toxaphene	0.21	ug/L	Marine	USEPA 1996b	FCV
Polychlorinated Biphenyls					
Aroclor-1016	0.03	ug/L	Marine	USEPA 2009	FRV - AWQC
Aroclor-1221	0.03	ug/L	Marine	USEPA 2009	FRV - AWQC
Aroclor-1232	0.03	ug/L	Marine	USEPA 2009	FRV - AWQC
Aroclor-1242	0.03	ug/L	Marine	USEPA 2009	FRV - AWQC
Aroclor-1248	0.03	ug/L	Marine	USEPA 2009	FRV - AWQC
Aroclor-1254	0.03	ug/L	Marine	USEPA 2009	FRV - AWQC
Aroclor-1260	0.03	ug/L	Marine	USEPA 2009	FRV - AWQC

TABLE H-18

Ecological Screening Values (ESVs) for Water

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type	Reference	Comments[1]
Semivolatile Organic Compounds					
1,1-Biphenyl	14.0	ug/L	Fresh	USEPA 1996b	SCV
2,2'-Oxybis(1-chloropropane)	NSV	--	--	--	
2,4,5-Trichlorophenol	12.0	ug/L	Marine	USEPA 2006b	
2,4,6-Trichlorophenol	61.0	ug/L	Marine	USEPA 2006b	
2,4-Dichlorophenol	11.0	ug/L	Fresh	USEPA 2006b	SCV
2,4-Dimethylphenol	100	ug/L	Fresh	Buchman 2008	
2,4-Dinitrophenol	48.5	ug/L	Marine	USEPA 2001	
2,4-Dinitrotoluene	480	ug/L	Marine	Nipper et al. 2001	NOEC; algae
2,6-Dinitrotoluene	1,000	ug/L	Marine	Nipper et al. 2001	NOEC; algae
2-Chloronaphthalene	0.40	ug/L	Fresh	Buchman 2008	
2-Chlorophenol	265	ug/L	Marine	USEPA 2006b	
2-Methylnaphthalene	330	ug/L	Fresh	Buchman 2008	
2-Methylphenol	1,020	ug/L	Marine	USEPA 2006b	
2-Nitroaniline	NSV	--	--	--	
2-Nitrophenol	2,940	ug/L	Marine	USEPA 2006b	
3,3'-Dichlorobenzidine	73.0	ug/L	Marine	USEPA 2006b	
3-Nitroaniline	NSV	--	--	--	
4,6-Dinitro-2-methylphenol	2.30	ug/L	Fresh	USEPA 2001	
4-Bromophenyl-phenylether	1.50	ug/L	Fresh	USEPA 1996b	SCV
4-Chloro-3-methylphenol	0.30	ug/L	Fresh	USEPA 2001	
4-Chloroaniline	232	ug/L	Fresh	USEPA 2006b	
4-Chlorophenyl-phenylether	NSV	--	--	--	
4-Methylphenol	543	ug/L	Fresh	USEPA 2006b	
4-Nitroaniline	NSV	--	--	--	
4-Nitrophenol	71.7	ug/L	Marine	USEPA 2001	
Acenaphthene	40.0	ug/L	Marine	USEPA 1996b	FCV
Acenaphthylene	4,840	ug/L	Fresh	Buchman 2008	
Acetophenone	NSV	--	--	--	
Anthracene	0.18	ug/L	Marine	USEPA 2006b	
Atrazine	10.0	ug/L	Marine	Buchman 2008	
Benzaldehyde	NSV	--	--	--	
Benzo(a)anthracene	0.027	ug/L	Fresh	Suter and Tsao 1996	SCV
Benzo(a)pyrene	0.014	ug/L	Fresh	Suter and Tsao 1996	SCV
Benzo(b)fluoranthene	9.07	ug/L	Fresh	Buchman 2008	
Benzo(g,h,i)perylene	7.64	ug/L	Fresh	Buchman 2008	

TABLE H-18

Ecological Screening Values (ESVs) for Water

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type	Reference	Comments[1]
Benzo(k)fluoranthene	9.07	ug/L	Fresh	Benzo(b)fluoranthene value	
bis(2-Chloroethoxy)methane	NSV	--	--	--	
bis(2-Chloroethyl)ether	1,900	ug/L	Fresh	Buchman 2008	
bis(2-Ethylhexyl)phthalate	360	ug/L	Marine	Buchman 2008	
Butylbenzylphthalate	29.4	ug/L	Marine	USEPA 2001	
Caprolactam	NSV	--	--	--	
Carbazole	NSV	--	--	--	
Chrysene	NSV	--	--	--	
Dibenz(a,h)anthracene	NSV	--	--	--	
Dibenzofuran	65.0	ug/L	Marine	USEPA 2006b	
Diethylphthalate	75.9	ug/L	Marine	USEPA 2001	
Dimethyl phthalate	580	ug/L	Marine	USEPA 2001	
Di-n-butylphthalate	3.40	ug/L	Marine	USEPA 2001	
Di-n-octylphthalate	22.0	ug/L	Fresh	USEPA 2006b	
Fluoranthene	11.0	ug/L	Marine	USEPA 1996b	FCV
Fluorene	3.90	ug/L	Fresh	USEPA 1996b	SCV
Hexachlorobenzene	3.68	ug/L	Fresh	Buchman 2008	
Hexachlorobutadiene	0.32	ug/L	Marine	USEPA 2001	
Hexachlorocyclopentadiene	0.07	ug/L	Marine	USEPA 2001	
Hexachloroethane	9.40	ug/L	Marine	USEPA 2001	
Indeno(1,2,3-cd)pyrene	4.31	ug/L	Fresh	Buchman 2008	
Isophorone	129	ug/L	Marine	USEPA 2001	
Naphthalene	23.5	ug/L	Marine	USEPA 2001	
Nitrobenzene	66.8	ug/L	Marine	USEPA 2001	
n-Nitroso-di-n-propylamine	120	ug/L	Marine	USEPA 2006b	
n-Nitrosodiphenylamine	33,000	ug/L	Marine	USEPA 2001	
Pentachlorophenol	7.90	ug/L	Marine	USEPA 2009	AWQC
Phenanthrene	8.30	ug/L	Marine	USEPA 1996b	FCV
Phenol	58.0	ug/L	Marine	USEPA 2001	
Pyrene	0.24	ug/L	Marine	USEPA 2006b	
Volatile Organic Compounds					
1,1,1-Trichloroethane	312	ug/L	Marine	USEPA 2001	
1,1,2,2-Tetrachloroethane	90.2	ug/L	Marine	USEPA 2001	
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	NSV	--	--	--	
1,1,2-Trichloroethane	550	ug/L	Marine	USEPA 2006b	
1,1-Dichloroethane	47.0	ug/L	Fresh	Suter and Tsao 1996	SCV

TABLE H-18

Ecological Screening Values (ESVs) for Water

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type	Reference	Comments[1]
1,1-Dichloroethene	2,240	ug/L	Marine	USEPA 2001	
1,2,3-Trichlorobenzene	8.00	ug/L	Fresh	USEPA 2006b	
1,2,4-Trichlorobenzene	5.40	ug/L	Marine	USEPA 2006b	
1,2-Dibromo-3-chloropropane	NSV	--	--	--	
1,2-Dibromoethane	NSV	--	--	--	
1,2-Dichlorobenzene	42.0	ug/L	Marine	USEPA 2006b	
1,2-Dichloroethane	1,130	ug/L	Marine	USEPA 2001	
1,2-Dichloropropane	2,400	ug/L	Marine	USEPA 2001	
1,3-Dichlorobenzene	28.5	ug/L	Marine	USEPA 2001	
1,4-Dichlorobenzene	19.9	ug/L	Marine	USEPA 2001	
2-Butanone	14,000	ug/L	Fresh	Suter and Tsao 1996	SCV
2-Hexanone	99.0	ug/L	Fresh	Suter and Tsao 1996	SCV
4-Methyl-2-pentanone	123,000	ug/L	Marine	USEPA 2006b	
Acetone	564,000	ug/L	Marine	USEPA 2006b	
Benzene	110	ug/L	Marine	USEPA 2006b	
Bromochloromethane	NSV	--	--	--	
Bromodichloromethane	NSV	--	--	--	
Bromoform	640	ug/L	Marine	USEPA 2001	
Bromomethane	120	ug/L	Marine	USEPA 2001	
Carbon disulfide	0.92	ug/L	Fresh	Suter and Tsao 1996	SCV
Carbon tetrachloride	1,500	ug/L	Marine	USEPA 2001	
Chlorobenzene	25.0	ug/L	Marine	USEPA 2006b	
Chloroethane	NSV	--	--	--	
Chloroform	815	ug/L	Marine	USEPA 2001	
Chloromethane	2,700	ug/L	Marine	USEPA 2001	
cis-1,2-Dichloroethene	680	ug/L	Marine	USEPA 2006b	
cis-1,3-Dichloropropene	7.90	ug/L	Marine	USEPA 2001	
Cyclohexane	NSV	--	--	--	
Dibromochloromethane	NSV	--	--	--	
Dichlorodifluoromethane (Freon-12)	NSV	--	--	--	
Ethylbenzene	25.0	ug/L	Marine	USEPA 2006b	
Isopropylbenzene	2.60	ug/L	Fresh	USEPA 2006b	
m- and p-Xylene	19.0	ug/L	Marine	USEPA 2006b	Total xylenes
Methyl acetate	NSV	--	--	--	
Methylcyclohexane	NSV	--	--	--	
Methylene chloride	2,560	ug/L	Marine	USEPA 2001	

TABLE H-18

Ecological Screening Values (ESVs) for Water

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type	Reference	Comments[1]
Methyl-tert-butyl ether (MTBE)	5,000	ug/L	Marine	Buchman 2008	
o-Xylene	19.0	ug/L	Marine	USEPA 2006b	Total xylenes
Styrene	910	ug/L	Marine	USEPA 2006b	
Tetrachloroethene	45.0	ug/L	Marine	USEPA 2001	
Toluene	215	ug/L	Marine	USEPA 2006b	
trans-1,2-Dichloroethene	680	ug/L	Marine	USEPA 2006b	
trans-1,3-Dichloropropene	7.90	ug/L	Marine	USEPA 2001	
Trichloroethene	1,940	ug/L	Marine	USEPA 2006b	
Trichlorofluoromethane (Freon-11)	NSV	--	--	--	
Vinyl chloride	930	ug/L	Fresh	USEPA 2006b	FCV
Xylene, total	19.0	ug/L	Marine	USEPA 2006b	
Explosives					
1,3,5-Trinitrobenzene	15.0	ug/L	Marine	Nipper et al. 2001	NOEC; algae
1,3-Dinitrobenzene	180	ug/L	Marine	Nipper et al. 2001	NOEC; algae
2,4,6-Trinitrotoluene	100	ug/L	Marine	USEPA 2006b	
2-Amino-4,6-dinitrotoluene	19.0	ug/L	Fresh	Talmage et al. 1999	SCV
2-Nitrotoluene	3,400	ug/L	Fresh	NAVFAC 2007	
3-Nitrotoluene	750	ug/L	Fresh	USEPA 2006b	
4-Amino-2,6-dinitrotoluene	19.0	ug/L	Fresh	2-Amino-4,6-dinitrotoluene	
4-Nitrotoluene	1,900	ug/L	Fresh	USEPA 2006b	
HMX	330	ug/L	Fresh	Talmage et al. 1999	SCV
Nitroglycerine	138	ug/L	Fresh	USEPA 2006b	
PETN	85,000	ug/L	Fresh	USEPA 2006b	
RDX	5,000	ug/L	Marine	Nipper et al. 2001	NOEC; algae
Tetryl	8.00	ug/L	Marine	Nipper et al. 2001	NOEC; polychaete
Dioxin/Furans					
2,3,7,8-TCDD (dioxin)	0.002	ng/L	Fresh	Buchman 2008	LOEC and UF of 5

[1] AWQC - Ambient Water Quality Criterion; FCV - Final Chronic Value; FRV - Final Residue Value; NOEC - No Observed Effect Concentration; SCV - Secondary Chronic Value; LOEC - Lowest Observed Effect Concentration

TABLE H-19

Ecological Screening Values (ESVs) for Marine Sediment

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	ESV	Units	Type[1]	Reference	Comments
Inorganics					
Barium	48.0	mg/kg	AET	Buchman 2008	
Beryllium	NSV	--	--	--	
Copper	34.0	mg/kg	ER-L	Long et al. 1995	
Lead	46.7	mg/kg	ER-L	Long et al. 1995	
Manganese	260	mg/kg	AET	Buchman 2008	
Mercury	0.15	mg/kg	ER-L	Long et al. 1995	
Zinc	150	mg/kg	ER-L	Long et al. 1995	
Semivolatile Organic Compounds					
bis(2-Ethylhexyl)phthalate	182	ug/kg	TEL	Buchman 2008	
Di-n-octylphthalate	61.0	ug/kg	AET	Buchman 2008	
Dioxin/Furans					
2,3,7,8-TCDD (dioxin)	0.85	pg/g	ISQC	CCME 2002	

[1] AET = Apparent Effects Threshold; ER-L = Effects Range-Low; ISQC = Interim Sediment Quality Criteria; TEL = Threshold Effect Level

TABLE H-20

Uncertainty Factors

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Convert From	Convert To	Uncertainty Factor
Chronic NOAEL or NOEC	Chronic NOAEL or NOEC	1
Chronic LOAEL or LOEC	Chronic NOAEL or NOEC	5
Chronic NOAEL or NOEC	Chronic LOAEL or LOEC	5
Subchronic NOAEL or NOEC	Chronic NOAEL or NOEC	10
Subchronic LOAEL or LOEC	Chronic NOAEL or NOEC	20
Acute NOAEL or NOEC	Chronic NOAEL or NOEC	30
Acute LOAEL or LOEC	Chronic NOAEL or NOEC	50
LD50 or LC50	Chronic NOAEL or NOEC	100

Uncertainty factors from Wentsel et al. (1996)

Durations are defined as follows (USEPA 1999; Sample et al. 1996):

- Acute: <3 days (plants, invertebrates) and <14 days (fish, birds, mammals)
- Subchronic: 3 - 6 days (plants, invertebrates) and 14 - 90 days (fish, birds, mammals)
- Chronic: >7 days (plants, invertebrates) and >90 days or during critical life stage (fish, birds, mammals)

TABLE H-21

Eco-SSL Values for Birds and Mammals

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Bird	Mammal	Units	Reference
Metals				
Arsenic	43.0	46.0	mg/kg	USEPA 2005b
Cadmium	0.77	0.36	mg/kg	USEPA 2005e
Chromium	26.0	34.0	mg/kg	USEPA 2008a
Copper	28.0	49.0	mg/kg	USEPA 2007a
Lead	11.0	56.0	mg/kg	USEPA 2005g
Nickel	210	130	mg/kg	USEPA 2007c
Selenium	1.20	0.63	mg/kg	USEPA 2007d
Silver	4.20	14.0	mg/kg	USEPA 2006a
Zinc	46.0	79.0	mg/kg	USEPA 2007e
Organics				
4,4'-DDT (and metabolites)	0.093	0.021	mg/kg	USEPA 2007f
Dieldrin	0.022	0.0049	mg/kg	USEPA 2007g
Pentachlorophenol	2.10	2.80	mg/kg	USEPA 2007i
PAHs - LMW	--	100	mg/kg	USEPA 2007h
PAHs - HMW	--	1.10	mg/kg	USEPA 2007h

TABLE H-22

Ingestion-Based Toxicity Reference Values (TRVs) for Mammals

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Chemical Form	Test Organism	Duration	Critical Life Stage?	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)	Meadow vole	Mink	Raccoon	Red fox	Short-tailed shrew	White-footed mouse
Metals																	
Arsenic	Arsenite (As+3)	mouse	3 generations	Yes	oral in water/food	reproduction	1.26	Sample et al. 1996	0.252 a	--	0.56	X				X	X
Arsenic	--	dog	chronic	--	oral	survival, growth, reproduction	1.66	USEPA 2005b	1.04	USEPA 2005b	1.31		X	X	X		
Cadmium	--	rat	chronic	--	oral	survival, growth, reproduction	7.70	USEPA 2005e	0.77	USEPA 2005e	2.43	X	X	X	X	X	X
Chromium	Cr+3	multiple	chronic	--	oral	survival, growth, reproduction	12.0 b	--	2.40	USEPA 2008a	5.37	X	X	X	X	X	X
Copper	--	pig	chronic	--	oral	survival, growth, reproduction	9.34	USEPA 2007a	5.60	USEPA 2007a	7.23	X				X	X
Copper	Copper sulfate	mink	357 days	Yes	oral in diet	reproduction	15.1	Sample et al. 1996	11.7	Sample et al. 1996	13.3		X	X	X		
Lead	--	rat	chronic	--	oral	survival, growth, reproduction	8.90	USEPA 2005g	4.70	USEPA 2005g	6.47	X	X	X	X	X	X
Mercury	Methyl mercury chloride	rat	3 generations	Yes	oral in diet	reproduction	0.160	Sample et al. 1996	0.032	Sample et al. 1996	0.072	X				X	X
Mercury	Methyl mercury chloride	mink	93 days	No	oral in diet	survival/weight loss/ataxia	0.247 c	Sample et al. 1996	0.150 c	Sample et al. 1996	0.192		X	X	X		
Nickel	--	multiple	chronic	--	oral	survival, growth, reproduction	3.40	USEPA 2007c	1.70	USEPA 2007c	2.40	X	X	X	X	X	X
Selenium	Potassium selenate (SeO4)	rat	1 year	Yes	oral in water	reproduction	0.33	Sample et al. 1996	0.20	Sample et al. 1996	0.26	X	X	X	X	X	X
Silver	--	pig	chronic	--	oral	survival, growth, reproduction	60.2	USEPA 2006a	12.0 a	--	26.9	X	X	X	X	X	X
Zinc	--	multiple	chronic	--	oral	survival, growth, reproduction	377 b	--	75.4	USEPA 2007e	169	X	X	X	X	X	X
Polychlorinated Biphenyls																	
Aroclor-1016	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X				X	X
Aroclor-1016	--	mink	18 months	Yes	oral in diet	reproduction	3.43	Sample et al. 1996	1.37	Sample et al. 1996	2.17		X	X	X		
Aroclor-1221	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X				X	X
Aroclor-1221	--	mink	7 months	Yes	oral in diet	reproduction	0.685	Aroclor-1242 value	0.137 a	Aroclor-1242 value	0.306		X	X	X		
Aroclor-1232	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X				X	X
Aroclor-1232	--	mink	7 months	Yes	oral in diet	reproduction	0.685	Aroclor-1242 value	0.137 a	Aroclor-1242 value	0.306		X	X	X		
Aroclor-1242	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X				X	X
Aroclor-1242	--	mink	7 months	Yes	oral in diet	reproduction	0.685	Sample et al. 1996	0.137 a	--	0.306		X	X	X		
Aroclor-1248	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X				X	X
Aroclor-1248	--	mink	4.5 months	Yes	oral in diet	reproduction	0.685	Aroclor-1254 value	0.137	Aroclor-1254 value	0.306		X	X	X		
Aroclor-1254	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Sample et al. 1996	0.136 a	--	0.304	X				X	X
Aroclor-1254	--	mink	4.5 months	Yes	oral in diet	reproduction	0.685	Sample et al. 1996	0.137	Sample et al. 1996	0.306		X	X	X		
Aroclor-1260	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X				X	X
Aroclor-1260	--	mink	4.5 months	Yes	oral in diet	reproduction	0.685	Aroclor-1254 value	0.137	Aroclor-1254 value	0.306		X	X	X		
Aroclor-1262	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X				X	X
Aroclor-1262	--	mink	4.5 months	Yes	oral in diet	reproduction	0.685	Aroclor-1254 value	0.137	Aroclor-1254 value	0.306		X	X	X		
Aroclor-1268	--	oldfield mouse	12 months	Yes	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X				X	X
Aroclor-1268	--	mink	4.5 months	Yes	oral in diet	reproduction	0.685	Aroclor-1254 value	0.137	Aroclor-1254 value	0.306		X	X	X		
Pesticides																	
4,4'-DDD	--	rat	chronic	--	oral	survival, growth, reproduction	0.735	USEPA 2007f	0.147	USEPA 2007f	0.329	X	X	X	X	X	X
4,4'-DDE	--	rat	chronic	--	oral	survival, growth, reproduction	0.735	USEPA 2007f	0.147	USEPA 2007f	0.329	X	X	X	X	X	X
4,4'-DDT	--	rat	chronic	--	oral	survival, growth, reproduction	0.735	USEPA 2007f	0.147	USEPA 2007f	0.329	X	X	X	X	X	X
Aldrin	--	rat	3 generations	Yes	oral in diet	reproduction	1.00	Sample et al. 1996	0.20	Sample et al. 1996	0.45	X	X	X	X	X	X
alpha-BHC	BHC - mixed isomers	rat	4 generations	Yes	oral in diet	reproduction	3.20	Sample et al. 1996	1.60	Sample et al. 1996	2.26	X	X	X	X	X	X
alpha-Chlordane	Chlordane	mouse	6 generations	Yes	oral in diet	reproduction	9.16	Sample et al. 1996	4.58	Sample et al. 1996	6.48	X	X	X	X	X	X
beta-BHC	BHC - mixed isomers	rat	4 generations	Yes	oral in diet	reproduction	3.20	Sample et al. 1996	1.60	Sample et al. 1996	2.26	X	X	X	X	X	X
delta-BHC	BHC - mixed isomers	rat	4 generations	Yes	oral in diet	reproduction	3.20	Sample et al. 1996	1.60	Sample et al. 1996	2.26	X	X	X	X	X	X
Dieldrin	--	rat	chronic	--	oral	survival, growth, reproduction	0.030	USEPA 2007g	0.015	USEPA 2007g	0.021	X	X	X	X	X	X
Endosulfan I	Endosulfan	rat	30 days	No	oral (gavage)	reproduction	0.75 b	--	0.15	Sample et al. 1996	0.34	X	X	X	X	X	X
Endosulfan II	Endosulfan	rat	30 days	No	oral (gavage)	reproduction	0.75 b	--	0.15	Sample et al. 1996	0.34	X	X	X	X	X	X
Endrin	--	mouse	120 days	Yes	oral in diet	reproduction	0.920	Sample et al. 1996	0.184 a	--	0.411	X	X	X	X	X	X
gamma-BHC (Lindane)	--	rat	3 generations	Yes	oral in diet	reproduction	40.0 b	--	8.00	Sample et al. 1996	17.9	X	X	X	X	X	X
gamma-Chlordane	Chlordane	mouse	6 generations	Yes	oral in diet	reproduction	9.16	Sample et al. 1996	4.58	Sample et al. 1996	6.48	X	X	X	X	X	X
Heptachlor	--	mink	181 days	Yes	oral in diet	reproduction	1.00	Sample et al. 1996	0.20 a	--	0.45	X	X	X	X	X	X
Heptachlor epoxide	--	mink	181 days	Yes	oral in diet	reproduction	1.00	Heptachlor value	0.20 a	--	0.45	X	X	X	X	X	X
Methoxychlor	--	rat	11 months	Yes	oral in diet	reproduction	8.00	Sample et al. 1996	4.00	Sample et al. 1996	5.66	X	X	X	X	X	X
Toxaphene	--	rat	3 generations	Yes	oral in diet	reproduction	40.0 b	--	8.00	Sample et al. 1996	17.9	X	X	X	X	X	X
Volatile and Semivolatile Organic Compounds																	
1,1,2,2-Tetrachloroethane	--	rat	78 weeks	Yes	oral (gavage)	reproduction	380 b	--	76.0	ATSDR 2008	170	X	X	X	X	X	X
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	NA	--	NA	--	NA	X	X	X	X	X	X
1,2,4-Trichlorobenzene	--	rat	3 generations	Yes	oral in water	reproduction	106	Coulston and Kolbye 1994	53.0	Coulston and Kolbye 1994	75.0	X	X	X	X	X	X

TABLE H-22

Ingestion-Based Toxicity Reference Values (TRVs) for Mammals

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Chemical Form	Test Organism	Duration	Critical Life Stage?	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)	Meadow vole	Mink	Raccoon	Red fox	Short-tailed shrew	White-footed mouse
1,2-Dichlorobenzene	--	rat	chronic	No	oral (gavage)	liver/kidney	429 b	--	85.7	Coulston and Kolbye 1994	192	X	X	X	X	X	X
1,3-Dichlorobenzene	--	rat	chronic	No	oral (gavage)	liver/kidney	429 b	--	85.7	Value for 1,2-Dichlorobenzene	192	X	X	X	X	X	X
1,4-Dichlorobenzene	--	rat	2 generations	Yes	oral (gavage)	developmental	90.0	ATSDR 2006	30.0	ATSDR 2006	52.0	X	X	X	X	X	X
4-Bromophenyl-phenylether	--	--	--		--	--	NA	--	NA	--	NA	X	X	X	X	X	X
4-Chlorophenyl-phenylether	--	--	--		--	--	NA	--	NA	--	NA	X	X	X	X	X	X
Acenaphthene	--	rat	chronic	--	oral	survival, growth, reproduction	328	USEPA 2007h	65.6	USEPA 2007h	147	X	X	X	X	X	X
Acenaphthylene	--	rat	chronic	--	oral	survival, growth, reproduction	328	USEPA 2007h	65.6	USEPA 2007h	147	X	X	X	X	X	X
Anthracene	--	rat	chronic	--	oral	survival, growth, reproduction	328	USEPA 2007h	65.6	USEPA 2007h	147	X	X	X	X	X	X
Benzo(a)anthracene	--	mouse	chronic	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Benzo(a)pyrene	--	mouse	chronic	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Benzo(b)fluoranthene	--	mouse	chronic	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Benzo(g,h,i)perylene	--	mouse	chronic	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Benzo(k)fluoranthene	--	mouse	chronic	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Chrysene	--	mouse	chronic	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Dibenz(a,h)anthracene	--	mouse	chronic	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Fluoranthene	--	rat	chronic	--	oral	survival, growth, reproduction	328	USEPA 2007h	65.6	USEPA 2007h	147	X	X	X	X	X	X
Fluorene	--	rat	chronic	--	oral	survival, growth, reproduction	328	USEPA 2007h	65.6	USEPA 2007h	147	X	X	X	X	X	X
Hexachlorobenzene	--	rat	4 generations	Yes	oral in diet	reproduction	4.00	ATSDR 2002	2.00	ATSDR 2002	2.83	X	X	X	X	X	X
Hexachlorobutadiene	--	rat	GD 1-22; LD 1-21	Yes	oral in diet	developmental	20.0	ATSDR 1994	2.00	ATSDR 1994	6.32	X	X	X	X	X	X
Hexachlorocyclopentadiene	--	mouse	GD 6-15	Yes	oral (gavage)	developmental	375 b	--	75.0	ATSDR 1999	168	X	X	X	X	X	X
Hexachloroethane	--	rat	GD 6-16	Yes	oral (gavage)	reproduction	500	ATSDR 1997	100	ATSDR 1997	224	X	X	X	X	X	X
Indeno(1,2,3-cd)pyrene	--	mouse	65 weeks	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Pentachlorophenol	--	multiple	chronic	--	oral	survival, growth, reproduction	42.1 b	--	8.42	USEPA 2007i	18.8	X	X	X	X	X	X
Phenanthrene	--	rat	chronic	--	oral	survival, growth, reproduction	328	USEPA 2007h	65.6	USEPA 2007h	147	X	X	X	X	X	X
Pyrene	--	mouse	chronic	--	oral	survival, growth, reproduction	3.07	USEPA 2007h	0.615	USEPA 2007h	1.37	X	X	X	X	X	X
Dioxin/Furans																	
2,3,7,8-TCDD	--	rat	3 generations	Yes	oral in diet	reproduction	0.00001	Sample et al. 1996	0.000001	Sample et al. 1996	0.000003	X	X	X	X	X	X

NA - Not Available

[a] Uncertainty factor of 5 applied to LOAEL

[b] Uncertainty factor of 5 applied to NOAEL

[c] Does not include subchronic uncertainty factor of 10 applied by Sample et al (1996) since the study duration meets the criteria for a chronic study in Table H-20

TABLE H-23

Ingestion-Based Toxicity Reference Values (TRVs) for Birds

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Chemical Form	Test Organism	Duration	Critical Life Stage?	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)	American robin	Belted kingfisher	Great blue heron	Mallard	Mourning dove	Osprey	Red-tailed hawk	Spotted sandpiper
Metals																			
Arsenic	Copper acetoarsenite	brown-headed cowbird	7 months	No	oral in diet	survival	7.38	Sample et al. 1996	2.46	Sample et al. 1996	4.26	X						X	
Arsenic	--	chicken	chronic	--	oral	survival, growth,reproduction	11.2 b	--	2.24	USEPA 2005b	5.01					X			
Cadmium	--	multiple	chronic	--	oral	survival, growth,reproduction	7.35 b	--	1.47	USEPA 2005e	3.29	X				X		X	
Chromium	Cr+3	multiple	chronic	--	oral	survival, growth,reproduction	13.3 b	--	2.66	USEPA 2008a	5.95	X				X		X	
Copper	--	chicken	chronic	--	oral	survival, growth,reproduction	12.1	USEPA 2007a	4.05	USEPA 2007a	7.00	X	X	X	X	X	X	X	X
Lead	--	chicken	chronic	--	oral	survival, growth,reproduction	3.26	USEPA 2005g	1.63	USEPA 2005g	2.31				X	X			
Lead	Metallic	American kestrel	7 months	Yes	oral in diet	reproduction	19.3 b	--	3.85	Sample et al. 1996	8.61	X	X	X			X	X	X
Mercury	Mercury chloride	Japanese quail	1 year	Yes	oral in diet	reproduction	0.90	Sample et al. 1996	0.45	Sample et al. 1996	0.64					X			
Mercury	--	red-tailed hawk	12 weeks	Yes	oral in diet	survival/neurological	1.20	USEPA 1995b	0.49	USEPA 1995b	0.77	X					X	X	
Mercury	Methyl mercury	mallard	3 generations	Yes	oral in diet	reproduction	0.078	USEPA 1997b	0.026	USEPA 1997b	0.045		X	X	X				X
Nickel	--	multiple	chronic	--	oral	survival, growth,reproduction	33.6 b	--	6.71	USEPA 2007c	15.0	X				X		X	
Selenium	Selanomethionine	screech owl	13.7 weeks	Yes	oral in diet	reproduction	1.50	Sample et al. 1996	0.44	Sample et al. 1996	0.81	X						X	
Selenium	--	chicken	chronic	--	oral	survival, growth,reproduction	0.58	USEPA 2007d	0.29	USEPA 2007d	0.41					X			
Silver	--	turkey	chronic	--	oral	survival, growth	20.2	USEPA 2006a	4.04 a	--	9.03	X				X		X	
Zinc	--	multiple	chronic	--	oral	survival, growth,reproduction	331 b	--	66.1	USEPA 2007e	148	X	X	X	X	X	X	X	X
Polychlorinated Biphenyls																			
Aroclor-1016	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80					X			
Aroclor-1016	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X						X	
Aroclor-1221	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80					X			
Aroclor-1221	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X						X	
Aroclor-1232	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80					X			
Aroclor-1232	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X						X	
Aroclor-1242	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80					X			
Aroclor-1242	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	--	0.41	Sample et al. 1996	0.92	X						X	
Aroclor-1248	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80					X			
Aroclor-1248	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X						X	
Aroclor-1254	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Sample et al. 1996	0.36 a	--	0.80					X			
Aroclor-1254	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X						X	
Aroclor-1260	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80					X			
Aroclor-1260	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X						X	
Aroclor-1262	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80					X			
Aroclor-1262	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X						X	
Aroclor-1268	--	ring-necked pheasant	17 weeks	Yes	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80					X			
Aroclor-1268	--	screech owl	2 generations	Yes	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X						X	
Pesticides																			
4,4'-DDD	--	Japanese quail	3 generations	Yes	oral in diet	reproduction	5.00	DDT value	0.50	DDT value	1.58	X				X			
4,4'-DDD	--	barn owl	2 years	Yes	oral in diet	reproduction	0.40 b	DDE value	0.08	DDE value	0.18							X	
4,4'-DDE	--	Japanese quail	3 generations	Yes	oral in diet	reproduction	5.00	DDT value	0.50	DDT value	1.58	X				X			
4,4'-DDE	--	barn owl	2 years	Yes	oral in diet	reproduction	0.40 b	--	0.08	Blus 1996	0.18							X	
4,4'-DDT	--	Japanese quail	3 generations	Yes	oral in diet	reproduction	5.00	USEPA 1995b	0.50	USEPA 1995b	1.58	X				X			
4,4'-DDT	--	barn owl	2 years	Yes	oral in diet	reproduction	0.40 b	DDE value	0.08	DDE value	0.18							X	
Aldrin	--	ring-necked pheasant	5 days	No	oral in diet	survival	0.351 b	--	0.070 e	Hill et al. 1975	0.157	X				X		X	
alpha-BHC	BHC - mixed isomers	Japanese quail	90 days	Yes	oral in diet	reproduction	2.25	Sample et al. 1996	0.56	Sample et al. 1996	1.13	X				X		X	
alpha-Chlordane	Chlordane	red-winged blackbird	84 days	Yes	oral in diet	survival	10.7	Sample et al. 1996	2.14	Sample et al. 1996	4.79	X						X	
alpha-Chlordane	--	northern bobwhite	not specified	Yes	oral in diet	reproduction	5.95 b	--	1.19	Wiemeyer 1996	2.66					X			
beta-BHC	BHC - mixed isomers	Japanese quail	90 days	Yes	oral in diet	reproduction	2.25	Sample et al. 1996	0.56	Sample et al. 1996	1.13	X				X		X	
delta-BHC	BHC - mixed isomers	Japanese quail	90 days	Yes	oral in diet	reproduction	2.25	Sample et al. 1996	0.56	Sample et al. 1996	1.13	X				X		X	
Dieldrin	--	mallard	chronic	--	oral	survival, growth,reproduction	3.78	USEPA 2007g	0.071	USEPA 2007g	0.52	X				X		X	
Endosulfan I	--	gray partridge	4 weeks	Yes	oral in diet	reproduction	50.0 b	--	10.0	Sample et al. 1996	22.4	X				X		X	
Endosulfan II	--	gray partridge	4 weeks	Yes	oral in diet	reproduction	50.0 b	--	10.0	Sample et al. 1996	22.4	X				X		X	
Endrin	--	mallard	>200 days	Yes	oral in diet	reproduction	1.50 b	--	0.30	Sample et al. 1996	0.67					X			
Endrin	--	screech owl	>83 days	Yes	oral in diet	reproduction	0.104	Sample et al. 1996	0.021 a	--	0.046	X						X	
gamma-BHC (Lindane)	--	mallard	8 weeks	Yes	oral (gavage)	reproduction	20.0	Sample et al. 1996	4.00 a	--	8.94	X				X		X	
gamma-Chlordane	Chlordane	red-winged blackbird	84 days	Yes	oral in diet	survival	10.7	Sample et al. 1996	2.14	Sample et al. 1996	4.79	X						X	
gamma-Chlordane	--	northern bobwhite	not specified	Yes	oral in diet	reproduction	5.95 b	--	1.19	Wiemeyer 1996	2.66					X			
Heptachlor	--	ring-necked pheasant	5 days	No	oral in diet	survival	1.38 b	--	0.28 e	Hill et al. 1975	0.62	X				X		X	
Heptachlor epoxide	--	ring-necked pheasant	5 days	No	oral in diet	survival	1.38 b	--	0.28 e	Heptachlor value	0.62	X				X		X	
Methoxychlor	--	chicken	16 weeks	Yes	oral in diet	reproduction	1,775 b	--	355	Wiemeyer 1996	794	X				X		X	
Toxaphene	--	American black duck	2 seasons	Yes	oral in diet	reproduction	5.00	Wiemeyer 1996	1.00	Wiemeyer 1996	2.24	X				X		X	
Volatile and Semivolatile Organic Compounds																			
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	NA	--	NA	--	NA	X				X		X	
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	NA	--	NA	--	NA	X				X		X	

TABLE H-23

Ingestion-Based Toxicity Reference Values (TRVs) for Birds

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Chemical Form	Test Organism	Duration	Critical Life Stage?	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)	American robin	Belted kingfisher	Great blue heron	Mallard	Mourning dove	Osprey	Red-tailed hawk	Spotted sandpiper
1,2,4-Trichlorobenzene	--	northern bobwhite	14 days	No	oral	survival	402 b	1,4-Dichlorobenzene value	80.4 d	1,4-Dichlorobenzene value	180	X				X		X	
1,2-Dichlorobenzene	--	northern bobwhite	14 days	No	oral	survival	402 b	1,4-Dichlorobenzene value	80.4 d	1,4-Dichlorobenzene value	180	X				X		X	
1,3-Dichlorobenzene	--	northern bobwhite	14 days	No	oral	survival	402 b	1,4-Dichlorobenzene value	80.4 d	1,4-Dichlorobenzene value	180	X				X		X	
1,4-Dichlorobenzene	--	northern bobwhite	14 days	No	oral	survival	402 b	--	80.4 d	TERRETOX 2002	180	X				X		X	
4-Bromophenyl-phenylether	--	--	--	--	--	--	NA	--	NA	--	NA	X				X		X	
4-Chlorophenyl-phenylether	--	--	--	--	--	--	NA	--	NA	--	NA	X				X		X	
Acenaphthene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Acenaphthylene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Anthracene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Benzo(a)anthracene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Benzo(a)pyrene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Rigdon and Neal 1963	15.9	X				X		X	
Benzo(b)fluoranthene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Benzo(g,h,i)perylene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Benzo(k)fluoranthene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Chrysene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Dibenz(a,h)anthracene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Fluoranthene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Fluorene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Hexachlorobenzene	--	Japanese quail	90 days	Yes	oral in diet	reproduction	0.565	Coulston and Kolbye 1994; TERRETOX 2002	0.113	Coulston and Kolbye 1994; TERRETOX 2002	0.253	X				X		X	
Hexachlorobutadiene	--	Japanese quail	90 days	Yes	oral in diet	reproduction	17.0 b	--	3.39	Coulston and Kolbye 1994; TERRETOX 2002	7.58	X				X		X	
Hexachlorocyclopentadiene	--	--	--	--	--	--	NA	--	NA	--	NA	X				X		X	
Hexachloroethane	--	--	--	--	--	--	NA	--	NA	--	NA	X				X		X	
Indeno(1,2,3-cd)pyrene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Pentachlorophenol	--	chicken	chronic	--	oral	survival, growth,reproduction	67.3	USEPA 2007i	6.73	USEPA 2007i	21.3	X				X		X	
Phenanthrene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Pyrene	--	chicken	35 days	No	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X				X		X	
Dioxin/Furans																			
2,3,7,8-TCDD	--	ring-necked pheasant	10 weeks	Yes	injection	reproduction	0.00014	Sample et al. 1996	0.000014	Sample et al. 1996	0.000044	X	X	X	X	X	X	X	X

NA - Not Available

[a] Uncertainty factor of 5 applied to LOAEL

[b] Uncertainty factor of 5 applied to NOAEL

[c] Subchronic to chronic uncertainty factor of 10 applied

[d] Subchronic to chronic uncertainty factor of 20 applied

[e] Uncertainty factor of 100 applied to LD50

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS07-SO001	CAS07-SO002		CAS07-SO005	CAS07-SO006	CAS07-SO007	CAS07-SO008		
			NWSY-90-7-SC-PER-132	NWSY-90-7-SC-PER-135	NWSY-90-7-SC-PER-183	NWSY-90-7-SC-FLR-138	NWSY-90-7-SC-FLR-139	NWSY-90-7-SC-FLR-140	NWSY-90-7-SC-PER-143	NWSY-90-7-SC-PER-184	NWSY-90-7-SC-PER-185
			02/28/08	02/28/08	04/09/08	02/28/08	02/28/08	02/28/08	02/28/08	04/09/08	04/09/08
Volatile Organic Compounds (UG/KG)											
Methylene chloride	1,250	--	25.6 B	69.2 B	69.4 B	70.7 B	51.1 B	36.0 B	43.3 B	60.2 B	50.0 B
o-Xylene	1,300	--	4.70 U	7.40 U	7.70 U	8.10 U	6.90 U	6.30 U	8.60 U	7.80 U	8.40 U
Semivolatile Organic Compounds (UG/KG)											
Benzo(a)anthracene	HMW PAH	--	67.0 U	61.0 U	63.0 U	63.0 U	62.0 U	62.0 U	63.0 U	62.0 U	62.0 U
Benzo(b)fluoranthene	HMW PAH	--	67.0 U	61.0 U	63.0 U	63.0 U	62.0 U	62.0 U	63.0 U	62.0 U	62.0 U
bis(2-Ethylhexyl)phthalate	30,000	--	420 U	380 U	390 U	390 U	380 U	380 U	390 U	380 U	390 U
Chrysene	HMW PAH	--	67.0 U	61.0 U	63.0 U	63.0 U	62.0 U	62.0 U	63.0 U	62.0 U	62.0 U
PAH (HMW)	18,000	--	438 U	399 U	407 U	407 U	403 U	403 U	407 U	403 U	403 U
Pesticides (UG/KG)											
Endrin	1.95	--	**2.40 J**	3.80 U	3.90 U	3.90 U	3.80 U	3.90 U	3.80 U	3.90 U	3.80 U
Polychlorinated Biphenyls (UG/KG)											
No Detections	--	--									
Dioxin/Furans (PG/G)											
2,3,7,8-TCDD (dioxin)	4.00	--	0.248 U	0.138 U	**0.119 J**	0.190 U	**0.267 J**	0.182 U	0.201 U	0.109 U	**0.135 J**
Explosives (UG/KG)											
No Detections	--	--									
Inorganics (MG/KG)											
Aluminum	pH < 5.5	13,000	**11,200**	**6,710**	**9,730**	**14,100**	**6,880**	**11,000**	**7,400**	**7,350**	**8,900**
Antimony	78.0	11.0	3.70 UL	3.40 UL	13.0 UL	0.54 B	3.40 UL	3.30 UL	3.50 UL	3.40 UL	**0.23 L**
Arsenic	18.0	6.36	**4.30 L**	**1.50**	**2.60**	**2.00**	**1.50**	**1.20**	**1.40**	**1.80**	**1.90**
Barium	330	84.5	**24.2 J**	**57.7 J**	**90.4**	**51.7 J**	**101 J**	**42.2 J**	**69.1 J**	**57.6**	**53.7**
Beryllium	40.0	0.587	**0.47**	**0.97**	**1.30**	**0.60**	**1.10**	**0.39**	**0.91**	**0.39**	**0.41**
Cadmium	32.0	1.50	0.25 UL	0.23 U	0.90 U	1.20 U	0.23 U	1.10 U	0.23 U	0.22 U	0.22 U
Chromium	64.0	33.7	**23.3 J**	**5.10 J**	**7.40**	**16.3 J**	**7.60 J**	**15.3 J**	**7.60 J**	**7.40**	**10.0**
Cobalt	13.0	9.93	**1.10 J**	**3.30**	**5.10 J**	**1.90 J**	**2.80 J**	**2.00 J**	**2.90**	**2.10 J**	**2.30 J**
Copper	70.0	4.25	**7.50 J**	**3.30 J**	**2.90 J**	**3.50 J**	**12.9 J**	**3.70 J**	**5.20 J**	**2.90**	**7.00**
Cyanide	15.8	2.70	0.14 U	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U	0.14 U	0.13 U	0.13 U
Iron	pH < 5 or >8	32,000	**11,100**	**4,050**	**5,750**	**15,400**	**3,640**	**17,000**	**3,680**	**6,200**	**7,850**
Lead	120	17.4	**20.2 J**	**6.90 J**	**10.0 J**	**6.60 J**	**84.3 J**	**2.20 J**	**81.9 J**	**13.6**	**37.3**
Manganese	220	324	**16.1 J**	**126 J**	**258**	**20.1 J**	**169 J**	**15.0 J**	**114 J**	**30.4**	**69.2**
Mercury	0.10	0.14	**0.044 K**	**0.021 K**	**0.025 J**	**0.036 K**	**0.043 K**	**0.047 K**	**0.031 K**	**0.025 J**	**0.080 J**
Nickel	38.0	17.6	**2.50**	**3.70**	**6.00 J**	**3.70**	**4.90**	**2.50**	**3.90**	**3.50**	**3.90**
Selenium	0.52	0.64	**1.00 L**	**0.47 J**	22.0 U	**1.20 J**	**0.37 J**	**1.20 J**	**0.26 J**	5.60 U	5.50 U
Thallium	1.00	--	**0.38 J**	0.57 U	2.20 U	**0.87**	0.57 U	**1.00**	0.58 U	2.20 U	2.20 U
Vanadium	130	48.3	**34.3 J**	**8.10 J**	**10.5 J**	**28.5 J**	**7.20 J**	**26.1 J**	**7.50 J**	**12.7**	**15.7**
Zinc	120	28.0	**22.9 J**	**14.2 J**	**15.3**	**11.3 J**	**51.2 J**	**12.5 J**	**23.2 J**	**13.2**	**26.6**
Other Parameters											
pH	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS07-SO009	CAS07-SO010	CAS07-SO011	CAS07-SO012	CAS07-SO013		CAS07-SO014		
			NWSY-90-7-SC-FLR-144	NWSY-90-7-SC-FLR-145	NWSY-90-7-SC-FLR-146	NWSY-90-7-SC-FLR-147	NWSY-90-7-SC-PER-148	NWSY-90-7-SC-PER-149	NWSY-90-7-SC-PER-150	NWSY-90-7-SC-PER-151	NWSY-90-7-SC-PER-152
			02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08
Volatile Organic Compounds (UG/KG)											
Methylene chloride	1,250	--	56.3 B	57.3 B	77.9 B	87.9 B	123 B	13.1 B	14.8 B	11.0 B	9.80 B
o-Xylene	1,300	--	8.10 U	5.70 U	8.40 U	8.00 U	13.0 UJ	6.50 U	13.0 U	6.40 U	6.90 U
Semivolatile Organic Compounds (UG/KG)											
Benzo(a)anthracene	HMW PAH	--	**18.4 J**	61.0 U	60.0 U	59.0 U	76.0 U	66.0 U	76.0 U	63.0 U	63.0 U
Benzo(b)fluoranthene	HMW PAH	--	**16.6 J**	61.0 U	60.0 U	59.0 U	76.0 U	66.0 U	76.0 U	63.0 U	63.0 U
bis(2-Ethylhexyl)phthalate	30,000	--	380 U	380 U	**256 J**	370 U	480 U	410 U	480 U	400 U	390 U
Chrysene	HMW PAH	--	**22.5 J**	61.0 U	60.0 U	59.0 U	76.0 U	66.0 U	76.0 U	63.0 U	63.0 U
PAH (HMW)	18,000	--	**365 J**	399 U	390 U	381 U	494 U	429 U	494 U	412 U	407 U
Pesticides (UG/KG)											
Endrin	1.95	--	3.90 U	3.80 U	3.80 U	3.60 U	4.70 U	4.10 U	4.60 U	4.00 U	3.90 U
Polychlorinated Biphenyls (UG/KG)											
No Detections	--	--									
Dioxin/Furans (PG/G)											
2,3,7,8-TCDD (dioxin)	4.00	--	0.189 U	0.175 U	**0.104 J**	**0.102 J**	0.289 U	0.104 U	**0.217 J**	0.088 U	0.150 U
Explosives (UG/KG)											
No Detections	--	--									
Inorganics (MG/KG)											
Aluminum	pH < 5.5	13,000	**7,220**	**6,370**	**7,140**	**8,830 J**	**6,990 J**	**7,630 J**	**7,760 J**	**7,190 J**	**7,300 J**
Antimony	78.0	11.0	3.30 UL	3.40 UL	3.30 UL	3.20 UL	4.10 UL	3.50 UL	4.20 UL	3.40 UL	3.50 UL
Arsenic	18.0	6.36	**1.80**	**1.10**	**2.10**	**1.80 L**	**24.3**	**1.90**	**2.00**	**1.50**	**1.40**
Barium	330	84.5	**90.1 J**	**44.5 J**	**57.5 J**	**48.3 J**	**250 J**	**56.8 J**	**42.0 J**	**54.0 J**	**54.3 J**
Beryllium	40.0	0.587	**0.85**	**0.52**	**0.75**	**0.57**	**0.94**	**0.70**	**0.50**	**0.69**	**0.61**
Cadmium	32.0	1.50	0.22 U	0.23 U	0.22 U	0.21 UL	**0.12 J**	0.24 U	0.28 U	0.23 U	0.23 U
Chromium	64.0	33.7	**11.6 J**	**5.30 J**	**6.80 J**	**8.70 J**	**18.0 J**	**6.30 J**	**7.70 J**	**5.00 J**	**5.60 J**
Cobalt	13.0	9.93	**2.40 J**	**2.30 J**	**2.20 J**	**2.20 L**	**2.00 J**	**2.10 J**	**1.90 J**	**2.10 J**	**1.80 J**
Copper	70.0	4.25	**39.6 J**	**2.40 J**	**9.80 J**	**2.60**	**42.7**	**3.60**	**4.90**	**3.00**	**2.70**
Cyanide	15.8	2.70	0.14 U	0.14 U	0.13 U	0.13 U	**0.33**	0.15 U	**0.24**	0.13 U	0.14 U
Iron	pH < 5 or >8	32,000	**7,120**	**4,450**	**4,690**	**8,060 J**	**4,240 J**	**4,730 J**	**6,760 J**	**4,010 J**	**4,410 J**
Lead	120	17.4	**204 J**	**8.00 J**	**41.5 J**	**6.40 J**	**42.1 J**	**11.5 J**	**15.6 J**	**10.3 J**	**8.10 J**
Manganese	220	324	**184 J**	**50.3 J**	**122 J**	**92.9 J**	**466 J**	**89.4 J**	**102 J**	**204 J**	**110 J**
Mercury	0.10	0.14	**0.043 K**	**0.019 K**	**0.037 K**	**0.027 K**	**0.048 K**	**0.026 K**	**0.058 K**	**0.030 K**	**0.019 K**
Nickel	38.0	17.6	**4.60**	**3.20**	**4.10**	**3.20 J**	**6.60 J**	**3.70 J**	**3.90 J**	**3.40 J**	**3.20 J**
Selenium	0.52	0.64	**0.58 J**	**0.41 J**	**0.63 J**	**0.77 L**	**0.33 J**	**0.52 J**	**0.82 J**	**0.63 J**	**0.48 J**
Thallium	1.00	--	0.56 U	0.57 U	0.56 U	0.53 UL	2.70 U	0.59 U	0.71 U	0.57 U	0.58 U
Vanadium	130	48.3	**10.2 J**	**9.50 J**	**10.0 J**	**15.5 J**	**16.3 J**	**11.2 J**	**18.4 J**	**9.30 J**	**10.2 J**
Zinc	120	28.0	**79.4 J**	**10.2 J**	**29.0 J**	**9.80 L**	**119**	**20.3**	**23.3**	**13.7**	**11.6**
Other Parameters											
pH	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

			CAS07-SO015		CAS07-SO016		CAS07-SO018		CAS07-SO019		CAS07-SO021	CAS07-SO022
			NWSY-90-7-SC-PER-153	NWSY-90-7-SC-PER-154	NWSY-90-7-SC-PER-159	NWSY-90-7-SC-PER-186	NWSY-90-7-SC-PER-161	NWSY-90-7-SC-PER-162	NWSY-90-7-SC-PER-163	NWSY-90-7-SC-PER-164	NWSY-90-7-SC-FLR-166	NWSY-90-7-SC-FLR-167
Chemical	**Soil ESV**	**Background UTL**	**02/28/08**	**02/28/08**	**02/29/08**	**04/09/08**	**02/29/08**	**02/29/08**	**02/29/08**	**02/29/08**	**02/29/08**	**02/29/08**
Volatile Organic Compounds (UG/KG)												
Methylene chloride	1,250	--	13.5 B	14.8 B	33.1 B	**42.2**	37.7 B	25.0 B	42.7 B	15.2 B	11.0 B	25.7 B
o-Xylene	1,300	--	6.80 U	6.90 U	6.70 U	6.40 U	6.50 U	6.30 U	8.10 U	7.50 U	7.60 U	6.10 U
Semivolatile Organic Compounds (UG/KG)												
Benzo(a)anthracene	HMW PAH	--	66.0 U	59.0 U	57.0 U	65.0 U	60.0 U	61.0 U	60.0 U	62.0 U	64.0 U	59.0 U
Benzo(b)fluoranthene	HMW PAH	--	66.0 U	59.0 U	57.0 U	65.0 U	60.0 U	61.0 U	60.0 U	62.0 U	64.0 U	59.0 U
bis(2-Ethylhexyl)phthalate	30,000	--	410 U	370 U	360 U	400 U	380 U	380 U	380 U	390 U	400 U	370 U
Chrysene	HMW PAH	--	66.0 U	59.0 U	57.0 U	65.0 U	60.0 U	61.0 U	60.0 U	62.0 U	64.0 U	59.0 U
PAH (HMW)	18,000	--	429 U	381 U	368 U	420 U	390 U	394 U	390 U	403 U	416 U	381 U
Pesticides (UG/KG)												
Endrin	1.95	--	4.10 U	3.60 U	3.60 U	4.00 U	3.70 U	3.80 U	3.80 U	3.90 U	4.00 U	3.70 U
Polychlorinated Biphenyls (UG/KG)												
No Detections	--	--										
Dioxin/Furans (PG/G)												
2,3,7,8-TCDD (dioxin)	4.00	--	0.272 U	0.457 U	0.071 U	0.113 U	0.623 U	0.187 U	1.13 U	0.127 U	0.506 U	0.348 U
Explosives (UG/KG)												
No Detections	--	--										
Inorganics (MG/KG)												
Aluminum	pH < 5.5	13,000	**7,150 J**	**4,010 J**	**6,220 J**	**6,060**	**7,500 J**	**8,460 J**	**5,550 J**	**7,000 J**	**7,140 J**	**8,190 J**
Antimony	78.0	11.0	3.60 UL	3.20 UL	3.20 UL	3.60 UL	3.20 UL	3.30 UL	3.30 UL	3.40 UL	3.50 UL	3.30 UL
Arsenic	18.0	6.36	**1.60**	**3.50**	**1.40**	**1.20**	**1.40**	**1.40**	**1.30**	**1.40**	**1.60**	**2.10**
Barium	330	84.5	**54.6 J**	**17.8 J**	**42.6 J**	**44.9**	**69.1 J**	**51.4 J**	**54.0 J**	**50.4 J**	**64.8 J**	**64.9 J**
Beryllium	40.0	0.587	**0.74**	**1.60**	**0.39**	**0.39**	**0.89**	**0.48**	**0.66**	**0.73**	**0.93**	**0.53**
Cadmium	32.0	1.50	0.24 U	1.10 U	0.21 U	0.24 U	0.22 U	0.22 U	0.22 U	0.22 U	0.23 U	0.22 U
Chromium	64.0	33.7	**5.90 J**	**16.2 J**	**7.00 J**	**5.50**	**5.40 J**	**8.30 J**	**5.50 J**	**6.20 J**	**5.90 J**	**10.1 J**
Cobalt	13.0	9.93	**2.10 J**	**4.00**	**1.60 J**	**2.10 J**	**2.60 J**	**1.90 J**	**2.50 J**	**2.30 J**	**2.90**	**2.60 J**
Copper	70.0	4.25	**3.80**	**4.80**	**3.40 J**	**1.30 J**	**3.50 J**	**2.50 J**	**6.00 J**	**1.50 J**	**14.3 J**	**3.70 J**
Cyanide	15.8	2.70	0.15 U	0.13 U	0.12 U	0.13 U	0.13 U	0.14 U	0.13 U	0.14 U	0.14 U	0.13 U
Iron	pH < 5 or >8	32,000	**5,150 J**	**19,800 J**	**6,480 J**	**4,280**	**4,360 J**	**8,230 J**	**4,050 J**	**5,550 J**	**3,900 J**	**10,200 J**
Lead	120	17.4	**11.8 J**	**1.80 J**	**10.8 J**	**6.60 K**	**14.7 J**	**9.20 J**	**34.4 J**	**4.80 J**	**58.5 J**	**4.00 J**
Manganese	220	324	**125 J**	**100 J**	**31.6 J**	**50.9**	**149 J**	**37.4 J**	**143 J**	**63.5 J**	**196 J**	**33.2 J**
Mercury	0.10	0.14	**0.100 K**	0.092 U	**0.015 K**	**0.023 J**	**0.019 K**	0.085 U	**0.046 K**	**0.019 K**	**0.042 K**	0.088 U
Nickel	38.0	17.6	**3.40 J**	**2.80 J**	**2.20 J**	**3.00**	**3.80 J**	**3.00 J**	**3.60 J**	**3.20 J**	**4.60 J**	**3.10 J**
Selenium	0.52	0.64	**0.47 J**	**1.70 J**	**0.51 J**	6.00 U	**0.41 J**	**0.78 J**	**0.62 J**	**0.59 J**	**0.51 J**	**0.67 J**
Thallium	1.00	--	0.60 U	**1.40**	**0.37 J**	2.40 U	0.54 U	0.55 U	1.10 U	0.56 U	0.58 U	0.55 U
Vanadium	130	48.3	**10.6 J**	**18.6 J**	**12.4 J**	**8.90**	**9.10 J**	**15.9 J**	**9.40 J**	**11.0 J**	**9.50 J**	**18.7 J**
Zinc	120	28.0	**18.5**	**16.4**	**8.30 J**	**8.30**	**13.9 J**	**9.20 J**	**31.7 J**	**8.20 J**	**39.3 J**	**9.40 J**
Other Parameters												
pH	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

			CAS07-SO023			CAS07-SO024			CAS07-SO025	CAS07-SO026	CAS07-SO027	
			NWSY-90-7-SC-PER-169	NWSY-90-7-SC-PER-170	NWSY-90-7-SC-PER-187	NWSY-90-7-SC-PER-172	NWSY-90-7-SC-PER-188	NWSY-90-7-SC-PER-193	NWSY-90-7-SC-FLR-173	NWSY-90-7-SC-FLR-174	NWSY-90-7-SC-PER-175	NWSY-90-7-SC-PER-176
Chemical	**Soil ESV**	**Background UTL**	**02/29/08**	**02/29/08**	**04/09/08**	**02/29/08**	**04/09/08**	**04/09/08**	**02/29/08**	**02/29/08**	**02/29/08**	**02/29/08**
Volatile Organic Compounds (UG/KG)												
Methylene chloride	1,250	--	21.8 B	12.1 B	29.7 B	13.3 B	25.5 B	24.6 B	15.4 B	17.9 B	11.2 B	16.5 B
o-Xylene	1,300	--	6.30 U	6.80 U	6.90 U	6.50 U	8.30 U	8.80 U	8.50 U	6.50 U	5.50 U	6.00 U
Semivolatile Organic Compounds (UG/KG)												
Benzo(a)anthracene	HMW PAH	--	61.0 U	62.0 U	64.0 U	62.0 U	64.0 U	63.0 U	63.0 U	59.0 U	62.0 U	61.0 U
Benzo(b)fluoranthene	HMW PAH	--	61.0 U	62.0 U	64.0 U	62.0 U	64.0 U	63.0 U	63.0 U	59.0 U	62.0 U	61.0 U
bis(2-Ethylhexyl)phthalate	30,000	--	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
Chrysene	HMW PAH	--	61.0 U	62.0 U	64.0 U	62.0 U	64.0 U	63.0 U	63.0 U	59.0 U	62.0 U	61.0 U
PAH (HMW)	18,000	--	394 U	403 U	416 U	403 U	416 U	412 U	407 U	386 U	403 U	399 U
Pesticides (UG/KG)												
Endrin	1.95	--	3.80 U	3.90 U	4.10 U	3.90 U	4.00 U	4.10 U	4.00 U	3.80 U	3.90 U	3.80 U
Polychlorinated Biphenyls (UG/KG)												
No Detections	--	--										
Dioxin/Furans (PG/G)												
2,3,7,8-TCDD (dioxin)	4.00	--	0.176 U	0.163 U	0.205 U	0.188 U	0.233 U	0.187 U	0.174 U	0.121 U	0.132 U	0.153 U
Explosives (UG/KG)												
No Detections	--	--										
Inorganics (MG/KG)												
Aluminum	pH < 5.5	13,000	**9,100 J**	**8,610 J**	**8,390**	**7,080 J**	**9,730**	**11,900**	**17,300 J**	**10,600 J**	**13,500 J**	**9,590**
Antimony	78.0	11.0	3.30 UL	3.40 UL	14.0 UL	3.40 UL	14.0 UL	14.0 UL	**0.29 L**	3.40 UL	3.30 UL	3.30 UL
Arsenic	18.0	6.36	**1.40**	**1.50**	**1.80 J**	**1.40**	**2.30**	**2.90**	**2.60**	**1.80**	**1.10**	**1.50**
Barium	330	84.5	**47.2 J**	**47.7 J**	**80.3**	**60.8 J**	**83.4**	**98.5**	**25.5 J**	**49.9 J**	**33.2 J**	**52.6**
Beryllium	40.0	0.587	**0.61**	**0.58**	**1.00 J**	**0.98**	**1.20**	**1.30**	**0.67**	**0.57**	**0.43**	**0.69**
Cadmium	32.0	1.50	0.88 U	0.92 U	0.95 U	0.23 U	0.91 U	0.96 U	2.30 U	0.23 U	0.88 U	0.22 U
Chromium	64.0	33.7	**9.60 J**	**9.50 J**	**6.80**	**5.20 J**	**6.30**	**8.10**	**39.0 J**	**11.8 J**	**19.0 J**	**10.0**
Cobalt	13.0	9.93	**2.20 J**	**2.00 J**	**4.10 J**	**4.10**	**5.00 J**	**5.80 J**	**2.00 J**	**2.10 J**	**2.00 J**	**2.40 J**
Copper	70.0	4.25	**2.10 J**	**2.20 J**	**5.10 J**	**6.50 J**	**5.50 J**	**6.40**	**2.90 J**	**3.40 J**	**2.60 J**	**3.40**
Cyanide	15.8	2.70	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U	0.14 U	0.14 U	0.13 U	0.14 U	0.14 U
Iron	pH < 5 or >8	32,000	**8,820 J**	**8,750 J**	**5,070**	**3,800 J**	**4,820**	**5,820**	**57,800 J**	**10,700 J**	**18,000 J**	**8,480**
Lead	120	17.4	**6.30 J**	**8.00 J**	**18.9 J**	**20.4 J**	**12.8 J**	**13.9 J**	5.80 U	**7.50 J**	**3.10 J**	**7.20 J**
Manganese	220	324	**27.7 J**	**29.0 J**	**241**	**157 J**	**225**	**270**	**17.0 J**	**22.1 J**	**14.4 J**	**36.2**
Mercury	0.10	0.14	**0.031 K**	**0.043 K**	0.088 U	**0.025 K**	**0.027 J**	**0.027 J**	**0.014 K**	**0.026 K**	**0.041 K**	**0.013 K**
Nickel	38.0	17.6	**3.70 J**	**3.40 J**	**5.20 J**	**4.00 J**	**5.60 J**	**7.00 J**	**3.20 J**	**3.70 J**	**3.30 J**	**4.00**
Selenium	0.52	0.64	**0.73 J**	**0.63 J**	24.0 U	**0.36 J**	23.0 U	24.0 U	**2.90 J**	**0.81 J**	**1.50 J**	**0.70 J**
Thallium	1.00	--	**0.33 J**	**0.41 J**	2.40 U	0.57 U	2.30 U	2.40 U	**1.60**	**0.57**	**0.44 J**	0.55 U
Vanadium	130	48.3	**17.4 J**	**16.9 J**	**9.60 J**	**7.80 J**	**9.20 J**	**11.8 J**	**63.1 J**	**21.0 J**	**29.0 J**	**17.9**
Zinc	120	28.0	**9.40 J**	**9.90 J**	**21.2**	**17.4 J**	**14.9**	**19.6**	**15.3 J**	**20.2 J**	**11.3 J**	**13.5 J**
Other Parameters												
pH	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

			CAS07-SO028			CAS07-SO035	CAS07-SO036	CAS07-SO037	CAS07-SO038	CAS07-SO039	
			NWSY-90-7-SC-PER-177	NWSY-90-7-SC-PER-178	NWSY-90-7-SC-PER-179	CAS07-SS01-0024-0111	CAS07-SS02-0024-0111	CAS07-SS03-0024-0111	CAS07-SS04-0024-0111	CAS07-SS05-0024-0111	CAS07-SS05P-0024-0111
Chemical	**Soil ESV**	**Background UTL**	**02/29/08**	**02/29/08**	**02/29/08**	**01/25/11**	**01/25/11**	**01/25/11**	**01/25/11**	**01/25/11**	**01/25/11**
Volatile Organic Compounds (UG/KG)											
Methylene chloride	1,250	--	13.5 B	16.7 B	15.3 B	NA	NA	NA	NA	NA	NA
o-Xylene	1,300	--	6.40 U	**7.30 J**	6.10 UJ	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/KG)											
Benzo(a)anthracene	HMW PAH	--	73.0 U	62.0 U	62.0 U	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	HMW PAH	--	73.0 U	62.0 U	62.0 U	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	30,000	--	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
Chrysene	HMW PAH	--	73.0 U	62.0 U	62.0 U	NA	NA	NA	NA	NA	NA
PAH (HMW)	18,000	--	477 U	403 U	403 U	NA	NA	NA	NA	NA	NA
Pesticides (UG/KG)											
Endrin	1.95	--	4.60 U	3.90 U	3.90 U	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (UG/KG)											
No Detections	--	--									
Dioxin/Furans (PG/G)											
2,3,7,8-TCDD (dioxin)	4.00	--	0.190 U	0.136 U	0.181 U	NA	NA	NA	NA	NA	NA
Explosives (UG/KG)											
No Detections	--	--									
Inorganics (MG/KG)											
Aluminum	pH < 5.5	13,000	**6,810**	**7,910**	**7,840**	NA	NA	NA	NA	NA	NA
Antimony	78.0	11.0	4.10 UL	3.50 UL	3.30 UL	NA	NA	NA	NA	NA	NA
Arsenic	18.0	6.36	**2.00**	**1.30**	**1.10**	NA	NA	NA	NA	NA	NA
Barium	330	84.5	**76.0**	**54.6**	**53.1**	NA	NA	NA	NA	NA	NA
Beryllium	40.0	0.587	**0.90**	**0.75**	**0.77**	NA	NA	NA	NA	NA	NA
Cadmium	32.0	1.50	0.27 U	0.23 U	0.22 U	NA	NA	NA	NA	NA	NA
Chromium	64.0	33.7	**6.70**	**6.70**	**6.60**	NA	NA	NA	NA	NA	NA
Cobalt	13.0	9.93	**2.80 J**	**2.90**	**2.90**	NA	NA	NA	NA	NA	NA
Copper	70.0	4.25	**8.90**	**2.50**	**2.70**	NA	NA	NA	NA	NA	NA
Cyanide	15.8	2.70	0.16 U	0.14 U	0.14 U	NA	NA	NA	NA	NA	NA
Iron	pH < 5 or >8	32,000	**4,240**	**5,300**	**5,230**	NA	NA	NA	NA	NA	NA
Lead	120	17.4	**62.9 J**	**6.50 J**	**7.00 J**	NA	NA	NA	NA	NA	NA
Manganese	220	324	**166**	**56.7**	**57.3**	NA	NA	NA	NA	NA	NA
Mercury	0.10	0.14	**0.071 K**	**0.022 K**	**0.023 K**	NA	NA	NA	NA	NA	NA
Nickel	38.0	17.6	**4.20**	**4.10**	**4.00**	NA	NA	NA	NA	NA	NA
Selenium	0.52	0.64	**0.66 J**	**0.42 J**	**0.38 J**	NA	NA	NA	NA	NA	NA
Thallium	1.00	--	0.68 U	0.58 U	0.55 U	NA	NA	NA	NA	NA	NA
Vanadium	130	48.3	**9.60**	**11.6**	**11.2**	NA	NA	NA	NA	NA	NA
Zinc	120	28.0	**35.5 J**	**9.60 J**	**9.70 J**	NA	NA	NA	NA	NA	NA
Other Parameters											
pH	--	--	NA	NA	NA	**6.11 H3**	**5.27 H3**	**4.85 H3**	**5.62 H3**	**6.30 H3**	**6.36 H3**

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS07-SO001	CAS07-SO002		CAS07-SO005	CAS07-SO006	CAS07-SO007	CAS07-SO008		
			NWSY-90-7-SC-PER-132	NWSY-90-7-SC-PER-135	NWSY-90-7-SC-PER-183	NWSY-90-7-SC-FLR-138	NWSY-90-7-SC-FLR-139	NWSY-90-7-SC-FLR-140	NWSY-90-7-SC-PER-143	NWSY-90-7-SC-PER-184	NWSY-90-7-SC-PER-185
			02/28/08	02/28/08	04/09/08	02/28/08	02/28/08	02/28/08	02/28/08	04/09/08	04/09/08
Volatile Organic Compounds (UG/KG)											
Methylene chloride	1,250	--	25.6 B	69.2 B	69.4 B	70.7 B	51.1 B	36.0 B	43.3 B	60.2 B	50.0 B
o-Xylene	1,300	--	4.70 U	7.40 U	7.70 U	8.10 U	6.90 U	6.30 U	8.60 U	7.80 U	8.40 U
Semivolatile Organic Compounds (UG/KG)											
Benzo(a)anthracene	HMW PAH	--	67.0 U	61.0 U	63.0 U	63.0 U	62.0 U	62.0 U	63.0 U	62.0 U	62.0 U
Benzo(b)fluoranthene	HMW PAH	--	67.0 U	61.0 U	63.0 U	63.0 U	62.0 U	62.0 U	63.0 U	62.0 U	62.0 U
bis(2-Ethylhexyl)phthalate	30,000	--	420 U	380 U	390 U	390 U	380 U	380 U	390 U	380 U	390 U
Chrysene	HMW PAH	--	67.0 U	61.0 U	63.0 U	63.0 U	62.0 U	62.0 U	63.0 U	62.0 U	62.0 U
PAH (HMW)	18,000	--	438 U	399 U	407 U	407 U	403 U	403 U	407 U	403 U	403 U
Pesticides (UG/KG)											
Endrin	1.95	--	**2.40 J**	3.80 U	3.90 U	3.90 U	3.80 U	3.90 U	3.80 U	3.90 U	3.80 U
Polychlorinated Biphenyls (UG/KG)											
No Detections	--	--									
Dioxin/Furans (PG/G)											
2,3,7,8-TCDD (dioxin)	4.00	--	0.248 U	0.138 U	**0.119 J**	0.190 U	**0.267 J**	0.182 U	0.201 U	0.109 U	**0.135 J**
Explosives (UG/KG)											
No Detections	--	--									
Inorganics (MG/KG)											
Aluminum	pH < 5.5	13,000	**11,200**	**6,710**	**9,730**	**14,100**	**6,880**	**11,000**	**7,400**	**7,350**	**8,900**
Antimony	78.0	11.0	3.70 UL	3.40 UL	13.0 UL	0.54 B	3.40 UL	3.30 UL	3.50 UL	3.40 UL	**0.23 L**
Arsenic	18.0	6.36	**4.30 L**	**1.50**	**2.60**	**2.00**	**1.50**	**1.20**	**1.40**	**1.80**	**1.90**
Barium	330	84.5	**24.2 J**	**57.7 J**	**90.4**	**51.7 J**	**101 J**	**42.2 J**	**69.1 J**	**57.6**	**53.7**
Beryllium	40.0	0.587	**0.47**	**0.97**	**1.30**	**0.60**	**1.10**	**0.39**	**0.91**	**0.39**	**0.41**
Cadmium	32.0	1.50	0.25 UL	0.23 U	0.90 U	1.20 U	0.23 U	1.10 U	0.23 U	0.22 U	0.22 U
Chromium	64.0	33.7	**23.3 J**	**5.10 J**	**7.40**	**16.3 J**	**7.60 J**	**15.3 J**	**7.60 J**	**7.40**	**10.0**
Cobalt	13.0	9.93	**1.10 J**	**3.30**	**5.10 J**	**1.90 J**	**2.80 J**	**2.00 J**	**2.90**	**2.10 J**	**2.30 J**
Copper	70.0	4.25	**7.50 J**	**3.30 J**	**2.90 J**	**3.50 J**	**12.9 J**	**3.70 J**	**5.20 J**	**2.90**	**7.00**
Cyanide	15.8	2.70	0.14 U	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U	0.14 U	0.13 U	0.13 U
Iron	pH < 5 or >8	32,000	**11,100**	**4,050**	**5,750**	**15,400**	**3,640**	**17,000**	**3,680**	**6,200**	**7,850**
Lead	120	17.4	**20.2 J**	**6.90 J**	**10.0 J**	**6.60 J**	**84.3 J**	**2.20 J**	**81.9 J**	**13.6**	**37.3**
Manganese	220	324	**16.1 J**	**126 J**	**258**	**20.1 J**	**169 J**	**15.0 J**	**114 J**	**30.4**	**69.2**
Mercury	0.10	0.14	**0.044 K**	**0.021 K**	**0.025 J**	**0.036 K**	**0.043 K**	**0.047 K**	**0.031 K**	**0.025 J**	**0.080 J**
Nickel	38.0	17.6	**2.50**	**3.70**	**6.00 J**	**3.70**	**4.90**	**2.50**	**3.90**	**3.50**	**3.90**
Selenium	0.52	0.64	**1.00 L**	**0.47 J**	22.0 U	**1.20 J**	**0.37 J**	**1.20 J**	**0.26 J**	5.60 U	5.50 U
Thallium	1.00	--	**0.38 J**	0.57 U	2.20 U	**0.87**	0.57 U	**1.00**	0.58 U	2.20 U	2.20 U
Vanadium	130	48.3	**34.3 J**	**8.10 J**	**10.5 J**	**28.5 J**	**7.20 J**	**26.1 J**	**7.50 J**	**12.7**	**15.7**
Zinc	120	28.0	**22.9 J**	**14.2 J**	**15.3**	**11.3 J**	**51.2 J**	**12.5 J**	**23.2 J**	**13.2**	**26.6**
Other Parameters											
pH	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS07-SO009	CAS07-SO010	CAS07-SO011	CAS07-SO012	CAS07-SO013		CAS07-SO014		
			NWSY-90-7-SC-FLR-144	NWSY-90-7-SC-FLR-145	NWSY-90-7-SC-FLR-146	NWSY-90-7-SC-FLR-147	NWSY-90-7-SC-PER-148	NWSY-90-7-SC-PER-149	NWSY-90-7-SC-PER-150	NWSY-90-7-SC-PER-151	NWSY-90-7-SC-PER-152
			02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08	02/28/08
Volatile Organic Compounds (UG/KG)											
Methylene chloride	1,250	--	56.3 B	57.3 B	77.9 B	87.9 B	123 B	13.1 B	14.8 B	11.0 B	9.80 B
o-Xylene	1,300	--	8.10 U	5.70 U	8.40 U	8.00 U	13.0 UJ	6.50 U	13.0 U	6.40 U	6.90 U
Semivolatile Organic Compounds (UG/KG)											
Benzo(a)anthracene	HMW PAH	--	**18.4 J**	61.0 U	60.0 U	59.0 U	76.0 U	66.0 U	76.0 U	63.0 U	63.0 U
Benzo(b)fluoranthene	HMW PAH	--	**16.6 J**	61.0 U	60.0 U	59.0 U	76.0 U	66.0 U	76.0 U	63.0 U	63.0 U
bis(2-Ethylhexyl)phthalate	30,000	--	380 U	380 U	**256 J**	370 U	480 U	410 U	480 U	400 U	390 U
Chrysene	HMW PAH	--	**22.5 J**	61.0 U	60.0 U	59.0 U	76.0 U	66.0 U	76.0 U	63.0 U	63.0 U
PAH (HMW)	18,000	--	**365 J**	399 U	390 U	381 U	494 U	429 U	494 U	412 U	407 U
Pesticides (UG/KG)											
Endrin	1.95	--	3.90 U	3.80 U	3.80 U	3.60 U	4.70 U	4.10 U	4.60 U	4.00 U	3.90 U
Polychlorinated Biphenyls (UG/KG)											
No Detections	--	--									
Dioxin/Furans (PG/G)											
2,3,7,8-TCDD (dioxin)	4.00	--	0.189 U	0.175 U	**0.104 J**	**0.102 J**	0.289 U	0.104 U	**0.217 J**	0.088 U	0.150 U
Explosives (UG/KG)											
No Detections	--	--									
Inorganics (MG/KG)											
Aluminum	pH < 5.5	13,000	**7,220**	**6,370**	**7,140**	**8,830 J**	**6,990 J**	**7,630 J**	**7,760 J**	**7,190 J**	**7,300 J**
Antimony	78.0	11.0	3.30 UL	3.40 UL	3.30 UL	3.20 UL	4.10 UL	3.50 UL	4.20 UL	3.40 UL	3.50 UL
Arsenic	18.0	6.36	**1.80**	**1.10**	**2.10**	**1.80 L**	**24.3**	**1.90**	**2.00**	**1.50**	**1.40**
Barium	330	84.5	**90.1 J**	**44.5 J**	**57.5 J**	**48.3 J**	**250 J**	**56.8 J**	**42.0 J**	**54.0 J**	**54.3 J**
Beryllium	40.0	0.587	**0.85**	**0.52**	**0.75**	**0.57**	**0.94**	**0.70**	**0.50**	**0.69**	**0.61**
Cadmium	32.0	1.50	0.22 U	0.23 U	0.22 U	0.21 UL	**0.12 J**	0.24 U	0.28 U	0.23 U	0.23 U
Chromium	64.0	33.7	**11.6 J**	**5.30 J**	**6.80 J**	**8.70 J**	**18.0 J**	**6.30 J**	**7.70 J**	**5.00 J**	**5.60 J**
Cobalt	13.0	9.93	**2.40 J**	**2.30 J**	**2.20 J**	**2.20 L**	**2.00 J**	**2.10 J**	**1.90 J**	**2.10 J**	**1.80 J**
Copper	70.0	4.25	**39.6 J**	**2.40 J**	**9.80 J**	**2.60**	**42.7**	**3.60**	**4.90**	**3.00**	**2.70**
Cyanide	15.8	2.70	0.14 U	0.14 U	0.13 U	0.13 U	**0.33**	0.15 U	**0.24**	0.13 U	0.14 U
Iron	pH < 5 or >8	32,000	**7,120**	**4,450**	**4,690**	**8,060 J**	**4,240 J**	**4,730 J**	**6,760 J**	**4,010 J**	**4,410 J**
Lead	120	17.4	**204 J**	**8.00 J**	**41.5 J**	**6.40 J**	**42.1 J**	**11.5 J**	**15.6 J**	**10.3 J**	**8.10 J**
Manganese	220	324	**184 J**	**50.3 J**	**122 J**	**92.9 J**	**466 J**	**89.4 J**	**102 J**	**204 J**	**110 J**
Mercury	0.10	0.14	**0.043 K**	**0.019 K**	**0.037 K**	**0.027 K**	**0.048 K**	**0.026 K**	**0.058 K**	**0.030 K**	**0.019 K**
Nickel	38.0	17.6	**4.60**	**3.20**	**4.10**	**3.20 J**	**6.60 J**	**3.70 J**	**3.90 J**	**3.40 J**	**3.20 J**
Selenium	0.52	0.64	**0.58 J**	**0.41 J**	**0.63 J**	**0.77 L**	**0.33 J**	**0.52 J**	**0.82 J**	**0.63 J**	**0.48 J**
Thallium	1.00	--	0.56 U	0.57 U	0.56 U	0.53 UL	2.70 U	0.59 U	0.71 U	0.57 U	0.58 U
Vanadium	130	48.3	**10.2 J**	**9.50 J**	**10.0 J**	**15.5 J**	**16.3 J**	**11.2 J**	**18.4 J**	**9.30 J**	**10.2 J**
Zinc	120	28.0	**79.4 J**	**10.2 J**	**29.0 J**	**9.80 L**	**119**	**20.3**	**23.3**	**13.7**	**11.6**
Other Parameters											
pH	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

			CAS07-SO015		CAS07-SO016		CAS07-SO018		CAS07-SO019		CAS07-SO021	CAS07-SO022
			NWSY-90-7-SC-PER-153	NWSY-90-7-SC-PER-154	NWSY-90-7-SC-PER-159	NWSY-90-7-SC-PER-186	NWSY-90-7-SC-PER-161	NWSY-90-7-SC-PER-162	NWSY-90-7-SC-PER-163	NWSY-90-7-SC-PER-164	NWSY-90-7-SC-FLR-166	NWSY-90-7-SC-FLR-167
Chemical	**Soil ESV**	**Background UTL**	**02/28/08**	**02/28/08**	**02/29/08**	**04/09/08**	**02/29/08**	**02/29/08**	**02/29/08**	**02/29/08**	**02/29/08**	**02/29/08**
Volatile Organic Compounds (UG/KG)												
Methylene chloride	1,250	--	13.5 B	14.8 B	33.1 B	**42.2**	37.7 B	25.0 B	42.7 B	15.2 B	11.0 B	25.7 B
o-Xylene	1,300	--	6.80 U	6.90 U	6.70 U	6.40 U	6.50 U	6.30 U	8.10 U	7.50 U	7.60 U	6.10 U
Semivolatile Organic Compounds (UG/KG)												
Benzo(a)anthracene	HMW PAH	--	66.0 U	59.0 U	57.0 U	65.0 U	60.0 U	61.0 U	60.0 U	62.0 U	64.0 U	59.0 U
Benzo(b)fluoranthene	HMW PAH	--	66.0 U	59.0 U	57.0 U	65.0 U	60.0 U	61.0 U	60.0 U	62.0 U	64.0 U	59.0 U
bis(2-Ethylhexyl)phthalate	30,000	--	410 U	370 U	360 U	400 U	380 U	380 U	380 U	390 U	400 U	370 U
Chrysene	HMW PAH	--	66.0 U	59.0 U	57.0 U	65.0 U	60.0 U	61.0 U	60.0 U	62.0 U	64.0 U	59.0 U
PAH (HMW)	18,000	--	429 U	381 U	368 U	420 U	390 U	394 U	390 U	403 U	416 U	381 U
Pesticides (UG/KG)												
Endrin	1.95	--	4.10 U	3.60 U	3.60 U	4.00 U	3.70 U	3.80 U	3.80 U	3.90 U	4.00 U	3.70 U
Polychlorinated Biphenyls (UG/KG)												
No Detections	--	--										
Dioxin/Furans (PG/G)												
2,3,7,8-TCDD (dioxin)	4.00	--	0.272 U	0.457 U	0.071 U	0.113 U	0.623 U	0.187 U	1.13 U	0.127 U	0.506 U	0.348 U
Explosives (UG/KG)												
No Detections	--	--										
Inorganics (MG/KG)												
Aluminum	pH < 5.5	13,000	**7,150 J**	**4,010 J**	**6,220 J**	**6,060**	**7,500 J**	**8,460 J**	**5,550 J**	**7,000 J**	**7,140 J**	**8,190 J**
Antimony	78.0	11.0	3.60 UL	3.20 UL	3.20 UL	3.60 UL	3.20 UL	3.30 UL	3.30 UL	3.40 UL	3.50 UL	3.30 UL
Arsenic	18.0	6.36	**1.60**	**3.50**	**1.40**	**1.20**	**1.40**	**1.40**	**1.30**	**1.40**	**1.60**	**2.10**
Barium	330	84.5	**54.6 J**	**17.8 J**	**42.6 J**	**44.9**	**69.1 J**	**51.4 J**	**54.0 J**	**50.4 J**	**64.8 J**	**64.9 J**
Beryllium	40.0	0.587	**0.74**	**1.60**	**0.39**	**0.39**	**0.89**	**0.48**	**0.66**	**0.73**	**0.93**	**0.53**
Cadmium	32.0	1.50	0.24 U	1.10 U	0.21 U	0.24 U	0.22 U	0.22 U	0.22 U	0.22 U	0.23 U	0.22 U
Chromium	64.0	33.7	**5.90 J**	**16.2 J**	**7.00 J**	**5.50**	**5.40 J**	**8.30 J**	**5.50 J**	**6.20 J**	**5.90 J**	**10.1 J**
Cobalt	13.0	9.93	**2.10 J**	**4.00**	**1.60 J**	**2.10 J**	**2.60 J**	**1.90 J**	**2.50 J**	**2.30 J**	**2.90**	**2.60 J**
Copper	70.0	4.25	**3.80**	**4.80**	**3.40 J**	**1.30 J**	**3.50 J**	**2.50 J**	**6.00 J**	**1.50 J**	**14.3 J**	**3.70 J**
Cyanide	15.8	2.70	0.15 U	0.13 U	0.12 U	0.13 U	0.13 U	0.14 U	0.13 U	0.14 U	0.14 U	0.13 U
Iron	pH < 5 or >8	32,000	**5,150 J**	**19,800 J**	**6,480 J**	**4,280**	**4,360 J**	**8,230 J**	**4,050 J**	**5,550 J**	**3,900 J**	**10,200 J**
Lead	120	17.4	**11.8 J**	**1.80 J**	**10.8 J**	**6.60 K**	**14.7 J**	**9.20 J**	**34.4 J**	**4.80 J**	**58.5 J**	**4.00 J**
Manganese	220	324	**125 J**	**100 J**	**31.6 J**	**50.9**	**149 J**	**37.4 J**	**143 J**	**63.5 J**	**196 J**	**33.2 J**
Mercury	0.10	0.14	**0.100 K**	0.092 U	**0.015 K**	**0.023 J**	**0.019 K**	0.085 U	**0.046 K**	**0.019 K**	**0.042 K**	0.088 U
Nickel	38.0	17.6	**3.40 J**	**2.80 J**	**2.20 J**	**3.00**	**3.80 J**	**3.00 J**	**3.60 J**	**3.20 J**	**4.60 J**	**3.10 J**
Selenium	0.52	0.64	**0.47 J**	**1.70 J**	**0.51 J**	6.00 U	**0.41 J**	**0.78 J**	**0.62 J**	**0.59 J**	**0.51 J**	**0.67 J**
Thallium	1.00	--	0.60 U	**1.40**	**0.37 J**	2.40 U	0.54 U	0.55 U	1.10 U	0.56 U	0.58 U	0.55 U
Vanadium	130	48.3	**10.6 J**	**18.6 J**	**12.4 J**	**8.90**	**9.10 J**	**15.9 J**	**9.40 J**	**11.0 J**	**9.50 J**	**18.7 J**
Zinc	120	28.0	**18.5**	**16.4**	**8.30 J**	**8.30**	**13.9 J**	**9.20 J**	**31.7 J**	**8.20 J**	**39.3 J**	**9.40 J**
Other Parameters												
pH	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

			CAS07-SO023			CAS07-SO024			CAS07-SO025	CAS07-SO026	CAS07-SO027	
			NWSY-90-7-SC-PER-169	NWSY-90-7-SC-PER-170	NWSY-90-7-SC-PER-187	NWSY-90-7-SC-PER-172	NWSY-90-7-SC-PER-188	NWSY-90-7-SC-PER-193	NWSY-90-7-SC-FLR-173	NWSY-90-7-SC-FLR-174	NWSY-90-7-SC-PER-175	NWSY-90-7-SC-PER-176
Chemical	**Soil ESV**	**Background UTL**	**02/29/08**	**02/29/08**	**04/09/08**	**02/29/08**	**04/09/08**	**04/09/08**	**02/29/08**	**02/29/08**	**02/29/08**	**02/29/08**
Volatile Organic Compounds (UG/KG)												
Methylene chloride	1,250	--	21.8 B	12.1 B	29.7 B	13.3 B	25.5 B	24.6 B	15.4 B	17.9 B	11.2 B	16.5 B
o-Xylene	1,300	--	6.30 U	6.80 U	6.90 U	6.50 U	8.30 U	8.80 U	8.50 U	6.50 U	5.50 U	6.00 U
Semivolatile Organic Compounds (UG/KG)												
Benzo(a)anthracene	HMW PAH	--	61.0 U	62.0 U	64.0 U	62.0 U	64.0 U	63.0 U	63.0 U	59.0 U	62.0 U	61.0 U
Benzo(b)fluoranthene	HMW PAH	--	61.0 U	62.0 U	64.0 U	62.0 U	64.0 U	63.0 U	63.0 U	59.0 U	62.0 U	61.0 U
bis(2-Ethylhexyl)phthalate	30,000	--	380 U	390 U	400 U	390 U	400 U	400 U	390 U	370 U	390 U	380 U
Chrysene	HMW PAH	--	61.0 U	62.0 U	64.0 U	62.0 U	64.0 U	63.0 U	63.0 U	59.0 U	62.0 U	61.0 U
PAH (HMW)	18,000	--	394 U	403 U	416 U	403 U	416 U	412 U	407 U	386 U	403 U	399 U
Pesticides (UG/KG)												
Endrin	1.95	--	3.80 U	3.90 U	4.10 U	3.90 U	4.00 U	4.10 U	4.00 U	3.80 U	3.90 U	3.80 U
Polychlorinated Biphenyls (UG/KG)												
No Detections	--	--										
Dioxin/Furans (PG/G)												
2,3,7,8-TCDD (dioxin)	4.00	--	0.176 U	0.163 U	0.205 U	0.188 U	0.233 U	0.187 U	0.174 U	0.121 U	0.132 U	0.153 U
Explosives (UG/KG)												
No Detections	--	--										
Inorganics (MG/KG)												
Aluminum	pH < 5.5	13,000	**9,100 J**	**8,610 J**	**8,390**	**7,080 J**	**9,730**	**11,900**	**17,300 J**	**10,600 J**	**13,500 J**	**9,590**
Antimony	78.0	11.0	3.30 UL	3.40 UL	14.0 UL	3.40 UL	14.0 UL	14.0 UL	**0.29 L**	3.40 UL	3.30 UL	3.30 UL
Arsenic	18.0	6.36	**1.40**	**1.50**	**1.80 J**	**1.40**	**2.30**	**2.90**	**2.60**	**1.80**	**1.10**	**1.50**
Barium	330	84.5	**47.2 J**	**47.7 J**	**80.3**	**60.8 J**	**83.4**	**98.5**	**25.5 J**	**49.9 J**	**33.2 J**	**52.6**
Beryllium	40.0	0.587	**0.61**	**0.58**	**1.00 J**	**0.98**	**1.20**	**1.30**	**0.67**	**0.57**	**0.43**	**0.69**
Cadmium	32.0	1.50	0.88 U	0.92 U	0.95 U	0.23 U	0.91 U	0.96 U	2.30 U	0.23 U	0.88 U	0.22 U
Chromium	64.0	33.7	**9.60 J**	**9.50 J**	**6.80**	**5.20 J**	**6.30**	**8.10**	**39.0 J**	**11.8 J**	**19.0 J**	**10.0**
Cobalt	13.0	9.93	**2.20 J**	**2.00 J**	**4.10 J**	**4.10**	**5.00 J**	**5.80 J**	**2.00 J**	**2.10 J**	**2.00 J**	**2.40 J**
Copper	70.0	4.25	**2.10 J**	**2.20 J**	**5.10 J**	**6.50 J**	**5.50 J**	**6.40**	**2.90 J**	**3.40 J**	**2.60 J**	**3.40**
Cyanide	15.8	2.70	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U	0.14 U	0.14 U	0.13 U	0.14 U	0.14 U
Iron	pH < 5 or >8	32,000	**8,820 J**	**8,750 J**	**5,070**	**3,800 J**	**4,820**	**5,820**	**57,800 J**	**10,700 J**	**18,000 J**	**8,480**
Lead	120	17.4	**6.30 J**	**8.00 J**	**18.9 J**	**20.4 J**	**12.8 J**	**13.9 J**	5.80 U	**7.50 J**	**3.10 J**	**7.20 J**
Manganese	220	324	**27.7 J**	**29.0 J**	**241**	**157 J**	**225**	**270**	**17.0 J**	**22.1 J**	**14.4 J**	**36.2**
Mercury	0.10	0.14	**0.031 K**	**0.043 K**	0.088 U	**0.025 K**	**0.027 J**	**0.027 J**	**0.014 K**	**0.026 K**	**0.041 K**	**0.013 K**
Nickel	38.0	17.6	**3.70 J**	**3.40 J**	**5.20 J**	**4.00 J**	**5.60 J**	**7.00 J**	**3.20 J**	**3.70 J**	**3.30 J**	**4.00**
Selenium	0.52	0.64	**0.73 J**	**0.63 J**	24.0 U	**0.36 J**	23.0 U	24.0 U	**2.90 J**	**0.81 J**	**1.50 J**	**0.70 J**
Thallium	1.00	--	**0.33 J**	**0.41 J**	2.40 U	0.57 U	2.30 U	2.40 U	**1.60**	**0.57**	**0.44 J**	0.55 U
Vanadium	130	48.3	**17.4 J**	**16.9 J**	**9.60 J**	**7.80 J**	**9.20 J**	**11.8 J**	**63.1 J**	**21.0 J**	**29.0 J**	**17.9**
Zinc	120	28.0	**9.40 J**	**9.90 J**	**21.2**	**17.4 J**	**14.9**	**19.6**	**15.3 J**	**20.2 J**	**11.3 J**	**13.5 J**
Other Parameters												
pH	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-25

Exceedances - Site 7 Soil

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

			CAS07-SO028			CAS07-SO035	CAS07-SO036	CAS07-SO037	CAS07-SO038	CAS07-SO039	
			NWSY-90-7-SC-PER-177	NWSY-90-7-SC-PER-178	NWSY-90-7-SC-PER-179	CAS07-SS01-0024-0111	CAS07-SS02-0024-0111	CAS07-SS03-0024-0111	CAS07-SS04-0024-0111	CAS07-SS05-0024-0111	CAS07-SS05P-0024-0111
Chemical	**Soil ESV**	**Background UTL**	**02/29/08**	**02/29/08**	**02/29/08**	**01/25/11**	**01/25/11**	**01/25/11**	**01/25/11**	**01/25/11**	**01/25/11**
Volatile Organic Compounds (UG/KG)											
Methylene chloride	1,250	--	13.5 B	16.7 B	15.3 B	NA	NA	NA	NA	NA	NA
o-Xylene	1,300	--	6.40 U	**7.30 J**	6.10 UJ	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/KG)											
Benzo(a)anthracene	HMW PAH	--	73.0 U	62.0 U	62.0 U	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	HMW PAH	--	73.0 U	62.0 U	62.0 U	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	30,000	--	460 U	390 U	390 U	NA	NA	NA	NA	NA	NA
Chrysene	HMW PAH	--	73.0 U	62.0 U	62.0 U	NA	NA	NA	NA	NA	NA
PAH (HMW)	18,000	--	477 U	403 U	403 U	NA	NA	NA	NA	NA	NA
Pesticides (UG/KG)											
Endrin	1.95	--	4.60 U	3.90 U	3.90 U	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (UG/KG)											
No Detections	--	--									
Dioxin/Furans (PG/G)											
2,3,7,8-TCDD (dioxin)	4.00	--	0.190 U	0.136 U	0.181 U	NA	NA	NA	NA	NA	NA
Explosives (UG/KG)											
No Detections	--	--									
Inorganics (MG/KG)											
Aluminum	pH < 5.5	13,000	**6,810**	**7,910**	**7,840**	NA	NA	NA	NA	NA	NA
Antimony	78.0	11.0	4.10 UL	3.50 UL	3.30 UL	NA	NA	NA	NA	NA	NA
Arsenic	18.0	6.36	**2.00**	**1.30**	**1.10**	NA	NA	NA	NA	NA	NA
Barium	330	84.5	**76.0**	**54.6**	**53.1**	NA	NA	NA	NA	NA	NA
Beryllium	40.0	0.587	**0.90**	**0.75**	**0.77**	NA	NA	NA	NA	NA	NA
Cadmium	32.0	1.50	0.27 U	0.23 U	0.22 U	NA	NA	NA	NA	NA	NA
Chromium	64.0	33.7	**6.70**	**6.70**	**6.60**	NA	NA	NA	NA	NA	NA
Cobalt	13.0	9.93	**2.80 J**	**2.90**	**2.90**	NA	NA	NA	NA	NA	NA
Copper	70.0	4.25	**8.90**	**2.50**	**2.70**	NA	NA	NA	NA	NA	NA
Cyanide	15.8	2.70	0.16 U	0.14 U	0.14 U	NA	NA	NA	NA	NA	NA
Iron	pH < 5 or >8	32,000	**4,240**	**5,300**	**5,230**	NA	NA	NA	NA	NA	NA
Lead	120	17.4	**62.9 J**	**6.50 J**	**7.00 J**	NA	NA	NA	NA	NA	NA
Manganese	220	324	**166**	**56.7**	**57.3**	NA	NA	NA	NA	NA	NA
Mercury	0.10	0.14	**0.071 K**	**0.022 K**	**0.023 K**	NA	NA	NA	NA	NA	NA
Nickel	38.0	17.6	**4.20**	**4.10**	**4.00**	NA	NA	NA	NA	NA	NA
Selenium	0.52	0.64	**0.66 J**	**0.42 J**	**0.38 J**	NA	NA	NA	NA	NA	NA
Thallium	1.00	--	0.68 U	0.58 U	0.55 U	NA	NA	NA	NA	NA	NA
Vanadium	130	48.3	**9.60**	**11.6**	**11.2**	NA	NA	NA	NA	NA	NA
Zinc	120	28.0	**35.5 J**	**9.60 J**	**9.70 J**	NA	NA	NA	NA	NA	NA
Other Parameters											
pH	--	--	NA	NA	NA	**6.11 H3**	**5.27 H3**	**4.85 H3**	**5.62 H3**	**6.30 H3**	**6.36 H3**

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-26

Screening Statistics - Site 7 Soil - Mammal/Bird Eco-SSLs

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Mammal Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient	Bird Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient
Inorganics (MG/KG)									
Arsenic	-- - --	36 / 36	24.3	46.0	0 / 36	0.53	43.0	0 / 36	0.57
Cadmium	0.21 - 2.30	1 / 36	0.12	0.36	0 / 36	0.33	0.77	0 / 36	0.16
Chromium	-- - --	36 / 36	39.0	34.0	1 / 36	1.15	26.0	1 / 36	1.50
Copper	-- - --	36 / 36	42.7	49.0	0 / 36	0.87	28.0	2 / 36	1.53
Lead	5.80 - 5.80	35 / 36	204	56.0	5 / 36	3.64	11.0	17 / 36	18.5
Nickel	-- - --	36 / 36	7.00	130	0 / 36	0.05	210	0 / 36	0.03
Selenium	5.60 - 24.0	31 / 36	2.90	0.63	16 / 36	4.60	1.20	5 / 36	2.42
Silver[1]	0.53 - 2.40	0 / 36	--	14.0	-- / --	0.17	4.20	-- / --	0.57
Zinc	-- - --	36 / 36	119	79.0	2 / 36	1.51	46.0	3 / 36	2.59
Pesticides (UG/KG)									
4,4'-DDD[1]	3.60 - 4.70	0 / 36	--	21.0	-- / --	0.22	93.0	-- / --	0.05
4,4'-DDE[1]	3.60 - 4.70	0 / 36	--	21.0	-- / --	0.22	93.0	-- / --	0.05
4,4'-DDT[1]	3.60 - 46.0	0 / 36	--	21.0	-- / --	2.19	93.0	-- / --	0.49
Dieldrin[1]	1.80 - 2.30	0 / 36	--	4.90	-- / --	0.47	22.0	-- / --	0.10
Semivolatile Organic Compounds (UG/KG)									
PAH (HMW)	368 - 494	1 / 36	365	1,100	0 / 36	0.33	--	-- / --	--
PAH (LMW)[1]	1,210 - 1,640	0 / 36	--	100,000	-- / --	0.02	--	-- / --	--
Pentachlorophenol[1]	890 - 1,200	0 / 36	--	2,800	-- / --	0.43	2,100	-- / --	0.57

Shaded cells indicate HQ ≥ 1

[1] HQs based upon reporting limits

TABLE H-27

Summary of Hazard Quotients for Terrestrial Food Web Exposures - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																								
Chromium	2.81E-01	1.26E-01	5.62E-02	**6.30E+00**	**2.82E+00**	**1.26E+00**	**1.31E+00**	5.84E-01	2.61E-01	1.51E-01	6.73E-02	3.01E-02	**2.49E+00**	**1.11E+00**	4.98E-01	**3.61E+00**	**1.62E+00**	7.23E-01	3.79E-01	1.69E-01	7.57E-02	5.30E-02	2.37E-02	1.06E-02
Copper	1.75E-01	1.36E-01	1.05E-01	4.50E-01	3.49E-01	2.70E-01	1.11E-01	8.60E-02	6.66E-02	5.97E-02	5.25E-02	4.62E-02	3.63E-01	2.10E-01	1.21E-01	3.12E-01	1.80E-01	1.04E-01	5.05E-01	2.92E-01	1.69E-01	1.49E-01	8.63E-02	4.99E-02
Lead	2.43E-01	1.77E-01	1.28E-01	**2.27E+00**	**1.65E+00**	**1.20E+00**	3.80E-01	2.76E-01	2.00E-01	2.07E-01	1.50E-01	1.09E-01	**1.13E+00**	5.07E-01	2.27E-01	**1.37E+00**	6.12E-01	2.74E-01	**1.85E+00**	**1.31E+00**	9.27E-01	1.61E-01	7.22E-02	3.23E-02
Mercury	4.66E-01	2.08E-01	9.32E-02	**7.60E+00**	**3.40E+00**	**1.52E+00**	**1.66E+00**	7.44E-01	3.33E-01	2.63E-02	2.04E-02	1.58E-02	2.26E-01	1.45E-01	9.24E-02	3.24E-01	2.07E-01	1.32E-01	4.66E-02	3.29E-02	2.33E-02	1.62E-03	1.03E-03	6.61E-04
Selenium	8.68E-01	6.76E-01	5.26E-01	**1.50E+00**	**1.17E+00**	9.11E-01	4.80E-01	3.73E-01	2.91E-01	2.59E-01	2.02E-01	1.57E-01	4.92E-01	2.66E-01	1.44E-01	3.78E-01	2.04E-01	1.11E-01	**1.17E+00**	8.29E-01	5.87E-01	9.25E-02	5.01E-02	2.71E-02
Zinc	1.05E-01	4.69E-02	2.10E-02	6.70E-01	2.99E-01	1.34E-01	1.58E-01	7.08E-02	3.17E-02	7.74E-02	3.46E-02	1.55E-02	3.85E-01	1.72E-01	7.70E-02	4.83E-01	2.16E-01	9.66E-02	2.14E-01	9.57E-02	4.28E-02	7.55E-02	3.38E-02	1.51E-02
Polychlorinated Biphenyls																								
Aroclor-1016	6.17E-03	2.76E-03	1.23E-03	2.42E-02	1.08E-02	4.84E-03	5.95E-03	2.66E-03	1.19E-03	5.28E-04	3.34E-04	2.11E-04	4.36E-03	1.95E-03	8.71E-04	4.73E-03	2.11E-03	9.45E-04	4.54E-03	2.03E-03	9.07E-04	1.58E-03	7.06E-04	3.16E-04
Aroclor-1221	1.33E-02	5.94E-03	2.65E-03	2.47E-02	1.10E-02	4.93E-03	7.86E-03	3.51E-03	1.57E-03	6.97E-03	3.12E-03	1.39E-03	5.79E-03	2.59E-03	1.16E-03	4.73E-03	2.11E-03	9.45E-04	9.68E-03	4.33E-03	1.94E-03	2.07E-03	9.27E-04	4.15E-04
Aroclor-1232	9.38E-03	4.19E-03	1.88E-03	2.44E-02	1.09E-02	4.88E-03	6.81E-03	3.05E-03	1.36E-03	6.04E-03	2.70E-03	1.21E-03	5.01E-03	2.24E-03	1.00E-03	4.73E-03	2.11E-03	9.45E-04	6.86E-03	3.07E-03	1.37E-03	1.80E-03	8.06E-04	3.60E-04
Aroclor-1242	6.17E-03	2.76E-03	1.23E-03	2.42E-02	1.08E-02	4.84E-03	5.95E-03	2.66E-03	1.19E-03	5.28E-03	2.36E-03	1.06E-03	4.36E-03	1.95E-03	8.71E-04	4.73E-03	2.11E-03	9.45E-04	4.54E-03	2.03E-03	9.07E-04	1.58E-03	7.06E-04	3.16E-04
Aroclor-1248	3.86E-03	1.73E-03	7.72E-04	2.40E-02	1.07E-02	4.80E-03	5.33E-03	2.38E-03	1.07E-03	4.73E-03	2.12E-03	9.46E-04	3.89E-03	1.74E-03	7.78E-04	4.73E-03	2.11E-03	9.45E-04	2.86E-03	1.28E-03	5.73E-04	1.42E-03	6.34E-04	2.83E-04
Aroclor-1254	3.11E-03	1.39E-03	6.22E-04	2.40E-02	1.07E-02	4.79E-03	5.13E-03	2.29E-03	1.03E-03	4.55E-03	2.03E-03	9.10E-04	3.74E-03	1.67E-03	7.47E-04	4.73E-03	2.11E-03	9.45E-04	2.32E-03	1.04E-03	4.64E-04	1.36E-03	6.10E-04	2.73E-04
Aroclor-1260	2.54E-03	1.14E-03	5.08E-04	2.39E-02	1.07E-02	4.79E-03	4.98E-03	2.23E-03	9.95E-04	4.42E-03	1.97E-03	8.83E-04	3.62E-03	1.62E-03	7.24E-04	4.73E-03	2.11E-03	9.45E-04	1.91E-03	8.53E-04	3.82E-04	1.33E-03	5.93E-04	2.65E-04
Aroclor-1262	2.54E-03	1.14E-03	5.08E-04	2.39E-02	1.07E-02	4.79E-03	4.98E-03	2.23E-03	9.95E-04	4.42E-03	1.97E-03	8.83E-04	3.62E-03	1.62E-03	7.24E-04	4.73E-03	2.11E-03	9.45E-04	1.91E-03	8.53E-04	3.82E-04	1.33E-03	5.93E-04	2.65E-04
Aroclor-1268	2.54E-03	1.14E-03	5.08E-04	2.39E-02	1.07E-02	4.79E-03	4.98E-03	2.23E-03	9.95E-04	4.42E-03	1.97E-03	8.83E-04	3.62E-03	1.62E-03	7.24E-04	4.73E-03	2.11E-03	9.45E-04	1.91E-03	8.53E-04	3.82E-04	1.33E-03	5.93E-04	2.65E-04
PCB (total)	6.57E-03	2.94E-03	1.31E-03	6.14E-02	2.75E-02	1.23E-02	1.31E-02	5.85E-03	2.62E-03	1.13E-02	5.03E-03	2.25E-03	9.42E-03	4.21E-03	1.88E-03	1.24E-02	5.53E-03	2.47E-03	4.74E-03	2.12E-03	9.48E-04	3.41E-03	1.52E-03	6.81E-04
Pesticides																								
4,4'-DDT	1.42E-02	6.37E-03	2.85E-03	4.64E-01	2.07E-01	9.27E-02	9.74E-02	4.36E-02	1.95E-02	7.51E-02	3.36E-02	1.50E-02	5.96E-02	1.88E-02	5.96E-03	8.88E-02	2.81E-02	8.88E-03	3.94E-03	1.25E-03	3.94E-04	1.29E-01	5.78E-02	2.59E-02
Aldrin	2.65E-04	1.18E-04	5.30E-05	4.65E-03	2.08E-03	9.30E-04	9.80E-04	4.38E-04	1.96E-04	7.89E-04	3.53E-04	1.58E-04	5.91E-03	2.64E-03	1.18E-03	8.43E-03	3.77E-03	1.69E-03	1.19E-03	5.33E-04	2.38E-04	2.08E-03	9.32E-04	4.17E-04
alpha-BHC	2.53E-04	1.79E-04	1.26E-04	2.11E-04	1.49E-04	1.05E-04	1.03E-04	7.25E-05	5.13E-05	9.20E-05	6.50E-05	4.60E-05	6.58E-04	3.28E-04	1.64E-04	3.30E-04	1.65E-04	8.22E-05	1.39E-03	6.93E-04	3.46E-04	2.32E-04	1.16E-04	5.78E-05
alpha-Chlordane	1.36E-05	9.58E-06	6.78E-06	2.44E-04	1.73E-04	1.22E-04	5.17E-05	3.66E-05	2.59E-05	4.13E-05	2.92E-05	2.06E-05	2.33E-04	1.04E-04	4.66E-05	3.34E-04	1.49E-04	6.68E-05	7.95E-05	3.55E-05	1.59E-05	8.19E-05	3.66E-05	1.64E-05
beta-BHC	2.50E-04	1.77E-04	1.25E-04	2.11E-04	1.49E-04	1.05E-04	1.02E-04	7.21E-05	5.10E-05	9.14E-05	6.46E-05	4.57E-05	6.54E-04	3.26E-04	1.63E-04	3.30E-04	1.65E-04	8.22E-05	1.38E-03	6.86E-04	3.42E-04	2.31E-04	1.15E-04	5.74E-05
delta-BHC	1.92E-04	1.36E-04	9.62E-05	2.07E-04	1.46E-04	1.03E-04	8.64E-05	6.11E-05	4.32E-05	7.75E-05	5.48E-05	3.88E-05	5.53E-04	2.76E-04	1.38E-04	3.30E-04	1.65E-04	8.22E-05	1.06E-03	5.28E-04	2.64E-04	1.96E-04	9.78E-05	4.88E-05
Endosulfan I	2.62E-03	1.17E-03	5.24E-04	2.24E-03	1.00E-03	4.49E-04	1.07E-03	4.81E-04	2.15E-04	9.63E-04	4.31E-04	1.93E-04	3.62E-05	1.62E-05	7.23E-06	1.85E-05	8.28E-06	3.70E-06	7.57E-05	3.38E-05	1.51E-05	1.28E-05	5.71E-06	2.55E-06
Endosulfan II	2.88E-03	1.29E-03	5.76E-04	4.42E-03	1.98E-03	8.83E-04	1.53E-03	6.85E-04	3.06E-04	1.37E-03	6.15E-04	2.75E-04	5.12E-05	2.29E-05	1.02E-05	3.78E-05	1.69E-05	7.56E-06	8.34E-05	3.73E-05	1.67E-05	1.83E-05	8.18E-06	3.66E-06
Endrin	8.17E-04	3.66E-04	1.63E-04	5.76E-03	2.58E-03	1.15E-03	1.34E-03	6.01E-04	2.69E-04	1.09E-03	4.87E-04	2.18E-04	2.53E-02	1.13E-02	5.05E-03	3.23E-02	1.44E-02	6.46E-03	8.89E-04	3.97E-04	1.78E-04	8.87E-03	3.97E-03	1.77E-03
gamma-BHC (Lindane)	6.90E-05	3.09E-05	1.38E-05	9.01E-04	4.03E-04	1.80E-04	2.01E-04	8.99E-05	4.02E-05	1.55E-04	6.93E-05	3.10E-05	8.38E-04	3.75E-04	1.68E-04	1.18E-03	5.26E-04	2.35E-04	2.07E-04	9.26E-05	4.14E-05	2.90E-04	1.30E-04	5.80E-05
gamma-Chlordane	1.36E-05	9.58E-06	6.78E-06	2.44E-04	1.73E-04	1.22E-04	5.17E-05	3.66E-05	2.59E-05	4.13E-05	2.92E-05	2.06E-05	2.33E-04	1.04E-04	4.66E-05	3.34E-04	1.49E-04	6.68E-05	7.95E-05	3.55E-05	1.59E-05	8.19E-05	3.66E-05	1.64E-05
Heptachlor	2.97E-03	1.33E-03	5.95E-04	4.25E-02	1.90E-02	8.50E-03	9.07E-03	4.05E-03	1.81E-03	7.35E-03	3.29E-03	1.47E-03	1.40E-02	6.24E-03	2.79E-03	1.95E-02	8.74E-03	3.91E-03	3.59E-03	1.60E-03	7.17E-04	4.93E-03	2.20E-03	9.86E-04
Heptachlor epoxide	9.07E-04	4.06E-04	1.81E-04	1.37E-02	6.11E-03	2.73E-03	2.99E-03	1.34E-03	5.98E-04	2.33E-03	1.04E-03	4.66E-04	4.54E-03	2.03E-03	9.08E-04	6.44E-03	2.88E-03	1.29E-03	9.77E-04	4.37E-04	1.95E-04	1.58E-03	7.06E-04	3.16E-04
Methoxychlor	6.48E-04	4.58E-04	3.24E-04	1.59E-03	1.13E-03	7.97E-04	4.52E-04	3.20E-04	2.26E-04	4.06E-04	2.87E-04	2.03E-04	1.13E-05	5.06E-06	2.26E-06	1.04E-05	4.66E-06	2.08E-06	1.42E-05	6.33E-06	2.83E-06	4.08E-06	1.82E-06	8.15E-07
Toxaphene	5.93E-04	2.65E-04	1.19E-04	2.06E-03	9.22E-04	4.12E-04	5.22E-04	2.34E-04	1.04E-04	4.69E-04	2.10E-04	9.39E-05	9.25E-03	4.14E-03	1.85E-03	9.65E-03	4.32E-03	1.93E-03	9.24E-03	4.13E-03	1.85E-03	3.35E-03	1.50E-03	6.70E-04
Volatile/Semivolatile Organics																								
1,1,2,2-Tetrachloroethane	1.77E-05	7.89E-06	3.53E-06	2.42E-05	1.08E-05	4.85E-06	8.88E-06	3.97E-06	1.78E-06	7.96E-06	3.56E-06	1.59E-06	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	3.54E-05	2.50E-05	1.77E-05	2.29E-05	1.62E-05	1.14E-05	1.29E-05	9.10E-06	6.43E-06	1.19E-05	8.42E-06	5.95E-06	1.93E-05	8.63E-06	3.86E-06	7.55E-06	3.38E-06	1.51E-06	4.52E-05	2.02E-05	9.04E-06	6.87E-06	3.07E-06	1.37E-06
1,2-Dichlorobenzene	3.74E-05	1.67E-05	7.47E-06	2.30E-05	1.03E-05	4.59E-06	1.37E-05	6.13E-06	2.74E-06	1.23E-05	5.49E-06	2.46E-06	3.29E-05	1.47E-05	6.57E-06	1.30E-05	5.82E-06	2.60E-06	7.66E-05	3.42E-05	1.53E-05	1.15E-05	5.16E-06	2.31E-06
1,3-Dichlorobenzene	3.51E-05	1.57E-05	7.01E-06	2.28E-05	1.02E-05	4.56E-06	1.31E-05	5.85E-06	2.62E-06	1.17E-05	5.24E-06	2.34E-06	3.14E-05	1.40E-05	6.27E-06	1.30E-05	5.82E-06	2.60E-06	7.18E-05	3.21E-05	1.44E-05	1.10E-05	4.93E-06	2.20E-06
1,4-Dichlorobenzene	1.08E-04	6.22E-05	3.59E-05	6.57E-05	3.79E-05	2.19E-05	3.94E-05	2.27E-05	1.31E-05	3.53E-05	2.04E-05	1.18E-05	3.31E-05	1.48E-05	6.62E-06	1.30E-05	5.82E-06	2.60E-06	7.73E-05	3.46E-05	1.55E-05	1.16E-05	5.19E-06	2.32E-06
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	3.63E-03	2.57E-03	1.82E-03	2.61E-02	1.84E-02	1.30E-02	5.85E-03	4.14E-03	2.93E-03	4.98E-03	3.52E-03	2.49E-03	2.24E-01	1.00E-01	4.48E-02	2.83E-01	1.27E-01	5.67E-02	1.20E-01	5.37E-02	2.40E-02	8.01E-02	3.58E-02	1.60E-02
Hexachlorobutadiene	8.54E-03	2.70E-03	8.54E-04	1.67E-02	5.30E-03	1.67E-03	5.20E-03	1.64E-03	5.20E-04	4.67E-03	1.48E-03	4.67E-04	6.82E-03	3.05E-03	1.36E-03	5.70E-03	2.55E-03	1.14E-03	9.75E-03	4.36E-03	1.95E-03	2.45E-03	1.09E-03	4.90E-04
Hexachlorocyclopentadiene	1.39E-04	6.20E-05	2.77E-05	4.41E-04	1.97E-04	8.81E-05	1.15E-04	5.13E-05	2.29E-05	1.03E-04	4.61E-05	2.06E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	3.52E-04	1.57E-04	7.03E-05	3.47E-04	1.55E-04	6.94E-05	1.52E-04	6.82E-05	3.05E-05	1.37E-04	6.11E-05	2.73E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxin/Furans																								
2,3,7,8 TCDD (TEQ)	5.43E-03	1.72E-03	5.43E-04	7.30E-02	2.31E-02	7.30E-03	1.54E-02	4.88E-03	1.54E-03	6.67E-03	2.11E-03	6.67E-04	2.35E-03	7.43E-04	2.35E-04	3.26E-03	1.03E-03	3.26E-04	6.78E-04	2.15E-04	6.78E-05	3.94E-04	1.25E-04	3.94E-05

Shaded cells indicate HQ ≥ 1

TABLE H-28

Summary of Hazard Quotients for Terrestrial Food Web Exposures - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																								
Chromium	1.69E-02	7.55E-03	3.38E-03	1.74E-01	7.78E-02	3.48E-02	2.28E-02	1.02E-02	4.56E-03	2.18E-02	9.76E-03	4.36E-03	6.62E-02	2.96E-02	1.32E-02	7.82E-02	3.50E-02	1.56E-02	5.54E-02	2.48E-02	1.11E-02	1.72E-02	7.71E-03	3.45E-03
Lead	4.13E-02	3.00E-02	2.18E-02	4.34E-01	3.15E-01	2.29E-01	5.87E-02	4.26E-02	3.10E-02	5.73E-02	4.16E-02	3.03E-02	2.26E-01	1.01E-01	4.53E-02	2.72E-01	1.22E-01	5.43E-02	4.20E-01	2.97E-01	2.10E-01	6.37E-02	2.85E-02	1.27E-02
Mercury	9.87E-02	4.41E-02	1.97E-02	1.36E-01	6.09E-02	2.72E-02	4.31E-02	1.93E-02	8.63E-03	1.94E-03	1.50E-03	1.16E-03	8.38E-03	5.36E-03	3.42E-03	4.97E-03	3.18E-03	2.03E-03	1.99E-02	1.41E-02	9.94E-03	1.83E-04	1.17E-04	7.47E-05
Selenium	1.52E-01	1.18E-01	9.22E-02	4.57E-01	3.56E-01	2.77E-01	9.81E-02	7.63E-02	5.94E-02	1.08E-01	8.43E-02	6.56E-02	1.33E-01	7.18E-02	3.89E-02	1.18E-01	6.37E-02	3.45E-02	3.01E-01	2.13E-01	1.51E-01	5.08E-02	2.75E-02	1.49E-02

Shaded cells indicate HQ ≥ 1

TABLE H-29

Ecological Screening Statistics - Site 7 Sediment

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Maximum Upriver	Mean Upriver	Maximum Ratio	Mean Ratio	Maximum Downriver	Mean Downriver	Maximum Ratio	Mean Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Semivolatile Organic Compounds (UG/KG)																							
bis(2-Ethylhexyl)phthalate	41.5 - 68.4	0 / 6	--	--	--	23.4	5.31	--	182	-- / --	0.38	NO	--	--	--	--	--	--	--	--	--	--	NO
Di-n-octylphthalate	2.00 - 3.40	0 / 6	--	--	--	1.16	0.27	--	61.0	-- / --	0.06	NO	--	--	--	--	--	--	--	--	--	--	NO
Dioxin/Furans (PG/G)																							
1,2,3,4,6,7,8-Heptachlorodibenzofuran	-- - --	6 / 6	0.27	10.4	CAS07-SD06-0414	3.86	4.12	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	-- - --	6 / 6	7.01	144	CAS07-SD06-0414	46.7	52.4	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.63 - 1.00	1 / 6	1.25	1.25	CAS07-SD06-0414	0.57	0.34	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran	0.086 - 0.92	3 / 6	0.82	1.51	CAS07-SD06-0414	0.63	0.55	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.41 - 0.41	5 / 6	0.23	2.25	CAS07-SD06-0414	0.70	0.80	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran	0.16 - 0.97	3 / 6	0.25	0.54	CAS07-SD06-0414	0.35	0.17	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	-- - --	6 / 6	0.29	5.76	CAS07-SD06-0414	1.89	2.08	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran	0.14 - 1.06	0 / 6	--	--	--	0.31	0.20	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	-- - --	6 / 6	0.46	6.58	CAS07-SD06-0414	2.01	2.33	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran	0.97 - 1.53	1 / 6	0.23	0.23	CAS07-SD04-0414	0.50	0.17	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.97 - 0.97	5 / 6	0.15	0.87	CAS07-SD06-0414	0.43	0.26	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran	0.11 - 0.22	3 / 6	0.39	0.99	CAS07-SD06-0414	0.34	0.36	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran	0.97 - 1.06	2 / 6	0.30	0.66	CAS07-SD06-0414	0.50	0.12	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDD (dioxin)	0.19 - 0.35	0 / 6	--	--	--	0.14	0.031	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran	0.19 - 0.25	2 / 6	0.24	0.50	CAS07-SD06-0414	0.20	0.16	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
Octachlorodibenzofuran	-- - --	6 / 6	0.25	31.8	CAS07-SD06-0414	11.7	13.2	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
Octachlorodibenzo-p-dioxin	-- - --	6 / 6	167	2,090	CAS07-SD06-0414	704	722	--	TEQ	-- / --	--	--	--	--	--	--	--	--	--	--	--	--	--
TEQ (fish)	-- - --	6 / 6	0.93	3.46	CAS07-SD06-0414	1.59	0.97	--	0.85	6 / 6	4.07	**YES**	4.53	2.56	0.76	0.62	1.19	0.86	2.91	1.84	--	--	NO
Inorganics (MG/KG)																							
Barium	-- - --	6 / 6	3.40	23.3	CAS07-SD06-0414	9.74	6.91	--	48.0	0 / 6	0.49	NO	--	--	--	--	--	--	--	--	--	--	NO
Beryllium	0.16 - 0.26	3 / 6	0.40	1.05	CAS07-SD01-0414	0.36	0.37	--	NSV	-- / --	NSV	**YES**	2.82	1.66	0.37	0.22	--	0.08	--	4.65	--	--	NO
Copper	0.52 - 0.86	3 / 6	1.46	3.61	CAS07-SD01-0414	1.26	1.29	--	34.0	0 / 6	0.11	NO	--	--	--	--	--	--	--	--	--	--	NO
Lead	-- - --	6 / 6	2.83	16.8	CAS07-SD06-0414	8.25	5.36	--	46.7	0 / 6	0.36	NO	--	--	--	--	--	--	--	--	--	--	NO
Manganese	-- - --	6 / 6	21.1	286	CAS07-SD06-0414	85.5	102	--	260	1 / 6	1.10	**YES**	518	282	0.55	0.30	59.4	38.1	4.81	2.24	--	--	NO
Mercury	0.006 - 0.006	2 / 6	0.006	0.036	CAS07-SD06-0414	0.009	0.013	--	0.15	0 / 6	0.24	NO	--	--	--	--	--	--	--	--	--	--	NO
Zinc	-- - --	6 / 6	10.8	82.1	CAS07-SD06-0414	29.4	26.8	--	150	0 / 6	0.55	NO	--	--	--	--	--	--	--	--	--	--	NO
Other Parameters																							
pH	-- - --	6 / 6	7.99	8.84	CAS07-SD01-0414	8.43	0.30	--	--	-- / --	--	--	8.84	8.60	1.00	0.98	8.85	8.43	1.00	1.00	--	--	--
Total organic carbon (MG/KG)	-- - --	6 / 6	874	12,300	CAS07-SD06-0414	3,311	4,472	--	--	-- / --	--	--	11,900	6,152	1.03	0.54	13,700	4,116	0.90	0.80	--	--	--

NSV - No Screening Value

[1] Count of detected samples exceeding or equaling ESV

[2] Shaded cells indicate hazard quotient based on reporting limits

TABLE H-30

Exceedances - Site 7 Sediment

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Marine Sediment ESV	Maximum Upriver	Maximum Downriver	CAS07-SD01	CAS07-SD02		CAS07-SD03	CAS07-SD04	CAS07-SD05	CAS07-SD06
				CAS07-SD01-0414	CAS07-SD02-0414	CAS07-SD02P-0414	CAS07-SD03-0414	CAS07-SD04-0414	CAS07-SD05-0414	CAS07-SD06-0414
				Site - Nearshore	Site - Nearshore	Site - Nearshore	Site - Nearshore	Site - Offshore	Site - Offshore	Site - Offshore
				4/14/2014	4/14/2014	4/14/2014	4/14/2014	4/18/2014	4/18/2014	4/18/2014
Semivolatile Organic Compounds (UG/KG)										
No Detections	--	--	--							
Dioxin/Furans (PG/G)										
1,2,3,4,6,7,8-Heptachlorodibenzofuran	TEQ	--	--	**0.784 J**	**0.318 J**	**0.242 X**	**0.269 X**	**5.24**	**6.12**	**10.4**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	TEQ	--	--	**18.2**	**6.05 J**	**7.51 J**	**7.01**	**39.6**	**63.8**	**144**
1,2,3,4,7,8,9-Heptachlorodibenzofuran	TEQ	--	--	0.995 U	1.00 U	0.915 U	0.972 U	0.742 B	0.626 B	**1.25 X**
1,2,3,4,7,8-Hexachlorodibenzofuran	TEQ	--	--	0.197 B	0.088 B	0.915 U	0.086 B	**0.834 X**	**0.820 X**	**1.51 J**
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	TEQ	--	--	**0.409 J**	**0.183 X**	**0.228 J**	**0.247 J**	0.412 B	**0.863 X**	**2.25 J**
1,2,3,6,7,8-Hexachlorodibenzofuran	TEQ	--	--	0.158 B	0.073 B	0.915 U	0.972 U	**0.251 J**	**0.295 X**	**0.537 J**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	TEQ	--	--	**0.694 X**	**0.268 X**	**0.291 X**	**0.341 X**	**1.90 J**	**2.38 J**	**5.76**
1,2,3,7,8,9-Hexachlorodibenzofuran	TEQ	--	--	0.138 B	0.134 B	0.915 U	0.972 U	0.229 B	1.06 U	0.415 B
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	TEQ	--	--	**1.26 J**	**0.359 X**	**0.476 J**	**0.456 J**	**1.06 J**	**2.20 J**	**6.58**
1,2,3,7,8-Pentachlorodibenzofuran	TEQ	--	--	0.995 U	1.00 U	0.915 U	0.972 U	**0.226 X**	1.06 U	1.53 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	TEQ	--	--	**0.279 X**	1.00 U	**0.150 X**	0.972 U	**0.249 X**	**0.523 J**	**0.865 J**
2,3,4,6,7,8-Hexachlorodibenzofuran	TEQ	--	--	0.220 B	0.083 B	0.107 B	0.106 B	**0.391 X**	**0.456 J**	**0.988 J**
2,3,4,7,8-Pentachlorodibenzofuran	TEQ	--	--	0.995 U	1.00 U	0.915 U	0.972 U	**0.297 X**	1.06 U	**0.662 X**
2,3,7,8-Tetrachlorodibenzofuran	TEQ	--	--	0.248 U	0.249 U	0.194 U	0.199 U	0.192 U	**0.239 J**	**0.502 J**
Octachlorodibenzofuran	TEQ	--	--	**0.903 J**	2.00 U	**0.332 J**	**0.251 J**	**18.4**	**18.3**	**31.8**
Octachlorodibenzo-p-dioxin	TEQ	--	--	**619 L**	**154 J**	**195 J**	**167**	**356 K**	**798 K**	**2,090 K**
TEQ (fish)	0.85	4.53	1.19	**1.05**	**1.10**	**0.879**	**1.19**	**0.934**	**1.83**	**3.46**
Inorganics (MG/KG)										
Barium	48.0	39.6	9.91	**7.17**	**5.14 J**	**7.56**	**8.62**	**3.40 J**	**8.38**	**23.3**
Beryllium	NSV	2.82	--	**1.05**	**0.402**	**0.402**	**0.422**	0.155 U	0.167 U	0.257 U
Copper	34.0	14.8	0.61	**3.61**	**1.52**	**1.31**	**1.46**	0.516 U	0.558 U	0.856 U
Lead	46.7	23.8	3.96	**12.7**	**6.46**	**6.98**	**5.18**	**2.83**	**5.02**	**16.8**
Manganese	260	518	59.4	**44.0 K**	**20.3**	**21.1**	**22.3**	**47.2**	**92.2**	**286**
Mercury	0.15	0.055	0.017	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	**0.006 J**	**0.036**
Zinc	150	132	22.5	**30.1 K**	**14.0**	**14.0**	**14.8**	**10.8**	**24.6**	**82.1**
Other Parameters										
pH	--	--	--	**8.84 H**	**8.45 H**	NA	**8.55 H**	**7.99 H**	**8.17 H**	**8.56 H**
Total organic carbon (MG/KG)	--	--	--	**2,070 D**	**874**	NA	**954**	**888**	**2,780 D**	**12,300 E**

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ upriver and downriver; or ≥ upriver and downriver and no ESV (applies to site samples [SD-01 thorugh SD-06] only)

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-30

Exceedances - Site 7 Sediment

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Marine Sediment ESV	Maximum Upriver	Maximum Downriver	CAS07-SD07 CAS07-SD07-0414 Upriver - Nearshore 4/22/2014	CAS07-SD08 CAS07-SD08-0414 Upriver - Nearshore 4/22/2014	CAS07-SD09 CAS07-SD09-0414 Upriver - Nearshore 4/22/2014	CAS07-SD10 CAS07-SD10-0414 Upriver - Offshore 4/22/2014	CAS07-SD11 CAS07-SD11-0414 Upriver - Offshore 4/22/2014	CAS07-SD12 CAS07-SD12-0414 Upriver - Offshore 4/22/2014
Semivolatile Organic Compounds (UG/KG)									
No Detections	--	--	--						
Dioxin/Furans (PG/G)									
1,2,3,4,6,7,8-Heptachlorodibenzofuran	TEQ	--	--	**5.40**	**5.78**	**5.80**	**11.6**	**12.3**	**12.7**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	TEQ	--	--	**40.1**	**43.4**	**60.7**	**162**	**212**	**203**
1,2,3,4,7,8,9-Heptachlorodibenzofuran	TEQ	--	--	**0.655 J**	**0.784 J**	**0.487 J**	**1.34 J**	**1.28 X**	**1.13 J**
1,2,3,4,7,8-Hexachlorodibenzofuran	TEQ	--	--	**0.660 J**	**0.615 J**	**0.790 J**	**1.60 J**	**1.69 J**	**1.55 X**
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	TEQ	--	--	**0.449 X**	**0.410 X**	**0.810 J**	**2.18 J**	**3.06 X**	**2.77 X**
1,2,3,6,7,8-Hexachlorodibenzofuran	TEQ	--	--	0.192 B	0.154 B	0.225 B	0.481 B	0.413 B	**0.645 J**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	TEQ	--	--	**1.68 J**	**1.85 J**	**2.21 J**	**5.67 J**	**7.62**	**6.78 J**
1,2,3,7,8,9-Hexachlorodibenzofuran	TEQ	--	--	0.921 U	1.04 U	1.04 U	1.82 U	0.295 B	**0.362 X**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	TEQ	--	--	**0.951 J**	**1.19 J**	**1.82 J**	**5.72 J**	**8.66**	**7.05**
1,2,3,7,8-Pentachlorodibenzofuran	TEQ	--	--	0.921 U	1.04 U	1.04 U	1.82 U	2.04 U	**0.443 X**
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	TEQ	--	--	**0.151 J**	**0.169 X**	**0.271 X**	**0.818 J**	**1.22 J**	**1.05 X**
2,3,4,6,7,8-Hexachlorodibenzofuran	TEQ	--	--	**0.284 X**	**0.327 X**	**0.312 J**	**0.646 J**	**0.919 X**	**0.928 J**
2,3,4,7,8-Pentachlorodibenzofuran	TEQ	--	--	**0.212 X**	**0.181 X**	1.04 U	**0.513 X**	**0.644 X**	**0.364 X**
2,3,7,8-Tetrachlorodibenzofuran	TEQ	--	--	**0.114 X**	0.207 U	0.209 U	**0.439 J**	**0.848 X**	**0.534 J**
Octachlorodibenzofuran	TEQ	--	--	**18.9**	**21.5**	**19.7**	**36.6**	**38.9**	**39.6**
Octachlorodibenzo-p-dioxin	TEQ	--	--	**748 K**	**420**	**734**	**2,450**	**3,370**	**3,410**
TEQ (fish)	0.85	4.53	1.19	**0.956**	**0.937**	**1.48**	**3.41**	**4.53**	**4.05**
Inorganics (MG/KG)									
Barium	48.0	39.6	9.91	**6.99**	**6.26**	**7.47**	**34.2**	**37.4**	**39.6**
Beryllium	NSV	2.82	--	**0.538**	**0.545**	**0.616**	**2.66**	**2.81**	**2.82**
Copper	34.0	14.8	0.61	**1.62**	**2.13**	**2.71**	**13.2**	**14.6**	**14.8**
Lead	46.7	23.8	3.96	**4.79**	**4.18**	**4.68**	**21.9**	**23.8**	**23.2**
Manganese	260	518	59.4	**56.1 K**	**61.9**	**70.9**	**471**	**518**	**514**
Mercury	0.15	0.055	0.017	**0.007 J**	**0.014**	**0.011 J**	**0.051**	**0.055**	**0.055**
Zinc	150	132	22.5	**12.7 K**	**18.0**	**22.3**	**124**	**132**	**130**
Other Parameters									
pH	--	--	--	**8.84 H**	**8.73 H**	**8.61 H**	**8.56 H**	**8.39 H**	**8.49 H**
Total organic carbon (MG/KG)	--	--	--	**1,610**	**2,240 D**	**2,760 D**	**9,320 E**	**11,900 E**	**9,080 E**

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ upriver and downriver; or ≥ upriver and downriver and no ESV (applies to site samples [SD-01 thorugh SD-06] only)

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-30

Exceedances - Site 7 Sediment

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Marine Sediment ESV	Maximum Upriver	Maximum Downriver	CAS07-SD13		CAS07-SD14	CAS07-SD15	CAS07-SD16	CAS07-SD17	CAS07-SD18
				CAS07-SD13-0414	CAS07-SD13P-0414	CAS07-SD14-0414	CAS07-SD15-0414	CAS07-SD16-0414	CAS07-SD17-0414	CAS07-SD18-0414
				Downriver - Nearshore	Downriver - Nearshore	Downriver - Nearshore	Downriver - Nearshore	Downriver - Offshore	Downriver - Offshore	Downriver - Offshore
				4/18/2014	4/18/2014	4/18/2014	4/18/2014	4/18/2014	4/18/2014	4/18/2014
Semivolatile Organic Compounds (UG/KG)										
No Detections	--	--	--							
Dioxin/Furans (PG/G)										
1,2,3,4,6,7,8-Heptachlorodibenzofuran	TEQ	--	--	**4.48**	**5.71**	**5.17**	**4.43**	**4.55**	**5.50**	**5.82**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	TEQ	--	--	**22.6**	**27.3**	**25.7**	**24.7**	**26.0**	**38.5**	**51.6**
1,2,3,4,7,8,9-Heptachlorodibenzofuran	TEQ	--	--	0.510 B	0.604 B	0.683 B	0.526 B	0.628 B	0.529 B	0.325 B
1,2,3,4,7,8-Hexachlorodibenzofuran	TEQ	--	--	**0.767 J**	**0.796 X**	**0.744 J**	**0.768 J**	**0.780 J**	**0.832 X**	**0.867 X**
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	TEQ	--	--	0.361 B	0.314 B	0.248 B	0.243 B	0.176 B	**0.548 J**	**0.510 J**
1,2,3,6,7,8-Hexachlorodibenzofuran	TEQ	--	--	**0.205 J**	**0.356 J**	**0.277 X**	**0.289 X**	**0.162 J**	**0.203 J**	**0.206 J**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	TEQ	--	--	**1.25 J**	**1.36 J**	**1.39 X**	**1.29 X**	**1.27 J**	**2.1 J**	**2.04 X**
1,2,3,7,8,9-Hexachlorodibenzofuran	TEQ	--	--	0.187 B	0.201 B	0.289 B	0.222 B	0.119 B	1.03 U	0.166 B
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	TEQ	--	--	**0.449 X**	**0.615 J**	**0.529 J**	**0.562 X**	**0.452 J**	**1.20 J**	**1.90 J**
1,2,3,7,8-Pentachlorodibenzofuran	TEQ	--	--	0.907 U	**0.175 J**	**0.146 X**	0.925 U	0.960 U	1.03 U	**0.177 X**
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	TEQ	--	--	**0.155 X**	**0.162 X**	**0.202 X**	**0.126 J**	**0.084 X**	**0.182 J**	**0.331 X**
2,3,4,6,7,8-Hexachlorodibenzofuran	TEQ	--	--	**0.340 X**	**0.401 J**	**0.337 J**	**0.292 J**	**0.254 J**	**0.401 J**	**0.390 J**
2,3,4,7,8-Pentachlorodibenzofuran	TEQ	--	--	**0.304 J**	**0.378 X**	**0.257 X**	**0.191 J**	0.960 U	**0.185 X**	**0.217 J**
2,3,7,8-Tetrachlorodibenzofuran	TEQ	--	--	0.181 U	0.180 U	0.181 U	0.185 U	0.192 U	0.205 U	**0.226 J**
Octachlorodibenzofuran	TEQ	--	--	**15.6 J**	**20.2 J**	**18.7**	**15.1**	**15.4**	**17.5**	**17.8**
Octachlorodibenzo-p-dioxin	TEQ	--	--	**82.7 J**	**121 J**	**111 K**	**112 K**	**118 K**	**334 K**	**594 K**
TEQ (fish)	0.85	4.53	1.19	**0.752**	**0.819**	**0.758**	**0.651**	**0.723**	**1.04**	**1.19**
Inorganics (MG/KG)										
Barium	48.0	39.6	9.91	**4.25 J**	**2.84 J**	**5.19**	**9.91**	**1.88 J**	**4.36 J**	**5.61**
Beryllium	NSV	2.82	--	0.157 U	0.154 U	0.151 U	0.148 U	0.159 U	0.159 U	0.157 U
Copper	34.0	14.8	0.61	0.523 UL	0.514 U	**0.607 J**	0.493 U	0.531 U	0.530 U	0.522 U
Lead	46.7	23.8	3.96	**2.44**	**2.13**	**2.18**	**3.57**	**1.35**	**2.87**	**3.96**
Manganese	260	518	59.4	**31.3 K**	**21.0 J**	**39.3**	**31.5**	**26.5**	**40.8**	**59.4**
Mercury	0.15	0.055	0.017	0.006 U	0.006 U	**0.017**	0.006 U	0.006 U	0.006 U	0.006 U
Zinc	150	132	22.5	**8.61 J**	**22.5 J**	**21.3**	**16.7**	4.45 B	**12.3**	**18.7**
Other Parameters										
pH	--	--	--	**8.64 H**	NA	**8.85 H**	**8.79 H**	**7.74 H**	**8.33 H**	**8.22 H**
Total organic carbon (MG/KG)	--	--	--	**3,870 D**	NA	**2,020 D**	**13,700 E**	**788**	**1,400 D**	**2,920 D**

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ upriver and downriver; or ≥ upriver and downriver and no ESV (applies to site samples [SD-01 thorugh SD-06] only)

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-31

Summary of Hazard Quotients for Aquatic Food Web Exposures - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Belted Kingfisher			Great Blue Heron			Mallard			Osprey			Spotted Sandpiper			Mink			Raccoon		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																					
Copper	2.53E-01	1.47E-01	8.48E-02	5.76E-03	3.33E-03	1.93E-03	1.68E-01	9.70E-02	5.61E-02	6.63E-03	3.84E-03	2.22E-03	**2.14E+00**	**1.24E+00**	7.16E-01	1.48E-03	1.30E-03	1.15E-03	3.74E-02	3.29E-02	2.89E-02
Lead	7.05E-02	3.15E-02	1.41E-02	1.97E-02	8.82E-03	3.95E-03	1.34E-01	9.48E-02	6.70E-02	2.27E-02	1.02E-02	4.54E-03	4.28E-01	1.91E-01	8.56E-02	1.20E-02	8.75E-03	6.36E-03	1.98E-02	1.44E-02	1.05E-02
Mercury	**1.25E+00**	7.21E-01	4.16E-01	4.10E-01	2.36E-01	1.37E-01	2.88E-01	1.66E-01	9.61E-02	2.50E-02	1.60E-02	1.02E-02	**1.25E+00**	7.24E-01	4.18E-01	5.29E-02	4.12E-02	3.21E-02	1.73E-02	1.35E-02	1.05E-02
Zinc	1.01E-01	4.50E-02	2.01E-02	1.18E-02	5.27E-03	2.36E-03	1.14E-01	5.12E-02	2.29E-02	1.36E-02	6.07E-03	2.72E-03	6.80E-01	3.04E-01	1.36E-01	7.70E-03	3.44E-03	1.54E-03	3.68E-02	1.65E-02	7.36E-03
Dioxin/Furans																					
2,3,7,8 TCDD (TEQ)	2.19E-01	6.92E-02	2.19E-02	7.69E-02	2.43E-02	7.69E-03	8.14E-03	2.57E-03	8.14E-04	8.85E-02	2.80E-02	8.85E-03	9.92E-02	3.14E-02	9.92E-03	**1.09E+00**	3.44E-01	1.09E-01	1.44E-01	4.55E-02	1.44E-02

Shaded cells indicate HQ ≥ 1

TABLE H-32

Summary of Hazard Quotients for Aquatic Food Web Exposures - Baseline (Step 3A) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Belted Kingfisher			Great Blue Heron			Mallard			Osprey			Spotted Sandpiper			Mink			Raccoon		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																					
Copper	2.34E-02	1.36E-02	7.84E-03	5.01E-03	2.90E-03	1.68E-03	3.82E-02	2.21E-02	1.28E-02	4.68E-03	2.71E-03	1.57E-03	1.52E-01	8.78E-02	5.08E-02	1.06E-03	9.29E-04	8.17E-04	4.38E-03	3.85E-03	3.39E-03
Lead	4.10E-02	1.83E-02	8.20E-03	1.72E-02	7.68E-03	3.44E-03	5.49E-02	3.88E-02	2.74E-02	1.60E-02	7.17E-03	3.21E-03	2.38E-01	1.06E-01	4.76E-02	8.57E-03	6.23E-03	4.53E-03	1.11E-02	8.10E-03	5.89E-03
Mercury	4.92E-01	2.84E-01	1.64E-01	2.53E-01	1.46E-01	8.44E-02	1.07E-01	6.17E-02	3.56E-02	1.25E-02	8.01E-03	5.12E-03	3.17E-01	1.83E-01	1.06E-01	2.67E-02	2.08E-02	1.62E-02	6.29E-03	4.90E-03	3.82E-03
Zinc	5.86E-02	2.62E-02	1.17E-02	1.03E-02	4.59E-03	2.05E-03	4.68E-02	2.10E-02	9.37E-03	9.59E-03	4.29E-03	1.92E-03	3.78E-01	1.69E-01	7.57E-02	5.48E-03	2.45E-03	1.10E-03	2.07E-02	9.25E-03	4.14E-03
Dioxin/Furans																					
2,3,7,8 TCDD (TEQ)	1.27E-01	4.02E-02	1.27E-02	6.69E-02	2.12E-02	6.69E-03	3.33E-03	1.05E-03	3.33E-04	6.25E-02	1.98E-02	6.25E-03	5.52E-02	1.75E-02	5.52E-03	7.74E-01	2.45E-01	7.74E-02	8.08E-02	2.56E-02	8.08E-03

Shaded cells indicate HQ ≥ 1

TABLE H-33

Ecological Screening Statistics - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Volatile Organic Compounds (UG/L)																		
1,1,1-Trichloroethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	312	-- / --	0.001	NO	--	-- / --	--	--	--	NO
1,1,2,2-Tetrachloroethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	90.2	-- / --	0.002	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloroethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	550	-- / --	0.0004	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	47.0	-- / --	0.004	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	2,240	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
1,2,3-Trichlorobenzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	8.00	-- / --	0.03	NO	--	-- / --	--	--	--	NO
1,2,4-Trichlorobenzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	5.40	-- / --	0.04	NO	--	-- / --	--	--	--	NO
1,2-Dibromo-3-chloropropane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,2-Dibromoethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,2-Dichlorobenzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	42.0	-- / --	0.005	NO	--	-- / --	--	--	--	NO
1,2-Dichloroethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	1,130	-- / --	0.0002	NO	--	-- / --	--	--	--	NO
1,2-Dichloropropane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	2,400	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
1,3-Dichlorobenzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	28.5	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,4-Dichlorobenzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	19.9	-- / --	0.01	NO	--	-- / --	--	--	--	NO
2-Butanone	2.50 - 2.50	0 / 7	--	--	--	1.25	0.0	--	14,000	-- / --	0.0002	NO	--	-- / --	--	--	--	NO
2-Hexanone	2.50 - 2.50	0 / 7	--	--	--	1.25	0.0	--	99.0	-- / --	0.03	NO	--	-- / --	--	--	--	NO
4-Methyl-2-pentanone	1.00 - 1.00	0 / 7	--	--	--	0.50	0.0	--	123,000	-- / --	0.00001	NO	--	-- / --	--	--	--	NO
Acetone	1.00 - 1.00	0 / 7	--	--	--	0.50	0.0	--	564,000	-- / --	0.000002	NO	--	-- / --	--	--	--	NO
Benzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	110	-- / --	0.002	NO	--	-- / --	--	--	--	NO
Bromochloromethane	0.50 - 0.50	0 / 7	--	--	--	0.25	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Bromodichloromethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Bromoform	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	640	-- / --	0.0003	NO	--	-- / --	--	--	--	NO
Bromomethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	120	-- / --	0.002	NO	--	-- / --	--	--	--	NO
Carbon disulfide	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	0.92	-- / --	0.22	NO	--	-- / --	--	--	--	NO
Carbon tetrachloride	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	1,500	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
Chlorobenzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	25.0	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Chloroethane	0.50 - 0.50	0 / 7	--	--	--	0.25	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chloroform	0.20 - 0.20	1 / 7	1.60	1.60	CAS07-GW09-0414	0.31	0.57	--	815	0 / 7	0.002	NO	--	-- / --	--	--	--	NO
Chloromethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	2,700	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
cis-1,2-Dichloroethene	0.20 - 0.20	3 / 7	0.48	6.20	CAS07-GW07-0414	1.28	2.27	--	680	0 / 7	0.01	NO	--	-- / --	--	--	--	NO
cis-1,3-Dichloropropene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	7.90	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Cyclohexane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Dibromochloromethane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Dichlorodifluoromethane (Freon-12)	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Ethylbenzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	25.0	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Isopropylbenzene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	2.60	-- / --	0.08	NO	--	-- / --	--	--	--	NO
m- and p-Xylene	0.40 - 0.40	0 / 7	--	--	--	0.20	0.0	--	19.0	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Methyl acetate	0.50 - 0.50	0 / 7	--	--	--	0.25	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylcyclohexane	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylene chloride	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	2,560	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
Methyl-tert-butyl ether (MTBE)	0.50 - 0.50	0 / 7	--	--	--	0.25	0.0	--	5,000	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
o-Xylene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	19.0	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Styrene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	910	-- / --	0.0002	NO	--	-- / --	--	--	--	NO
Tetrachloroethene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	45.0	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Toluene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	215	-- / --	0.001	NO	--	-- / --	--	--	--	NO
trans-1,2-Dichloroethene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	680	-- / --	0.0003	NO	--	-- / --	--	--	--	NO
trans-1,3-Dichloropropene	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	7.90	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Trichloroethene	0.20 - 0.20	4 / 7	0.33	53.8	CAS07-GW07-0414	8.18	20.1	--	1,940	0 / 7	0.03	NO	--	-- / --	--	--	--	NO
Trichlorofluoromethane (Freon-11)	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Vinyl chloride	0.20 - 0.20	0 / 7	--	--	--	0.100	0.0	--	930	-- / --	0.0002	NO	--	-- / --	--	--	--	NO
Semivolatile Organic Compounds (UG/L)																		
1,1-Biphenyl	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	14.0	-- / --	0.18	NO	--	-- / --	--	--	--	NO
2,2'-Oxybis(1-chloropropane)	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO

TABLE H-33

Ecological Screening Statistics - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
2,4,5-Trichlorophenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	12.0	-- / --	0.21	NO	--	-- / --	--	--	--	NO
2,4,6-Trichlorophenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	61.0	-- / --	0.04	NO	--	-- / --	--	--	--	NO
2,4-Dichlorophenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	11.0	-- / --	0.23	NO	--	-- / --	--	--	--	NO
2,4-Dimethylphenol	9.26 - 10.2	0 / 5	--	--	--	4.79	0.18	--	100	-- / --	0.10	NO	--	-- / --	--	--	--	NO
2,4-Dinitrophenol	23.1 - 25.5	0 / 5	--	--	--	12.0	0.46	--	48.5	-- / --	0.53	NO	--	-- / --	--	--	--	NO
2,4-Dinitrotoluene	0.15 - 0.15	4 / 5	0.099	1.09	CAS07-MW04-0111	0.47	0.42	--	480	0 / 5	0.002	NO	--	-- / --	--	--	--	NO
2,6-Dinitrotoluene	0.15 - 0.16	1 / 5	0.39	0.39	CAS07-MW04-0111	0.14	0.14	--	1,000	0 / 5	0.0004	NO	--	-- / --	--	--	--	NO
2-Chloronaphthalene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	0.40	-- / --	6.38	**YES**	--	-- / --	--	--	3.00	NO[4]
2-Chlorophenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	265	-- / --	0.01	NO	--	-- / --	--	--	--	NO
2-Methylnaphthalene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	330	-- / --	0.01	NO	--	-- / --	--	--	--	NO
2-Methylphenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	1,020	-- / --	0.003	NO	--	-- / --	--	--	--	NO
2-Nitroaniline	9.26 - 10.2	0 / 5	--	--	--	4.79	0.18	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2-Nitrophenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	2,940	-- / --	0.001	NO	--	-- / --	--	--	--	NO
3,3'-Dichlorobenzidine	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	73.0	-- / --	0.03	NO	--	-- / --	--	--	--	NO
3-Nitroaniline	9.26 - 10.2	0 / 5	--	--	--	4.79	0.18	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4,6-Dinitro-2-methylphenol	9.26 - 10.2	0 / 5	--	--	--	4.79	0.18	--	2.30	-- / --	4.43	**YES**	--	-- / --	--	--	2.08	NO[4]
4-Bromophenyl-phenylether	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	1.50	-- / --	1.70	**YES**	--	-- / --	--	--	0.80	NO
4-Chloro-3-methylphenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	0.30	-- / --	8.50	**YES**	--	-- / --	--	--	3.99	NO[4]
4-Chloroaniline	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	232	-- / --	0.01	NO	--	-- / --	--	--	--	NO
4-Chlorophenyl-phenylether	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Methylphenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	543	-- / --	0.005	NO	--	-- / --	--	--	--	NO
4-Nitroaniline	9.26 - 10.2	0 / 5	--	--	--	4.79	0.18	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitrophenol	9.26 - 10.2	0 / 5	--	--	--	4.79	0.18	--	71.7	-- / --	0.14	NO	--	-- / --	--	--	--	NO
Acenaphthene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	40.0	-- / --	0.06	NO	--	-- / --	--	--	--	NO
Acenaphthylene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	4,840	-- / --	0.001	NO	--	-- / --	--	--	--	NO
Acetophenone	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Anthracene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	0.18	-- / --	14.2	**YES**	--	-- / --	--	--	6.66	NO[4]
Atrazine	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	10.0	-- / --	0.26	NO	--	-- / --	--	--	--	NO
Benzaldehyde	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Benzo(a)anthracene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	0.027	-- / --	94.4	**YES**	--	-- / --	--	--	44.4	NO[4]
Benzo(a)pyrene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	0.014	-- / --	182	**YES**	--	-- / --	--	--	85.6	NO[4]
Benzo(b)fluoranthene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	9.07	-- / --	0.28	NO	--	-- / --	--	--	--	NO
Benzo(g,h,i)perylene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	7.64	-- / --	0.33	NO	--	-- / --	--	--	--	NO
Benzo(k)fluoranthene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	9.07	-- / --	0.28	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethoxy)methane	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethyl)ether	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	1,900	-- / --	0.001	NO	--	-- / --	--	--	--	NO
bis(2-Ethylhexyl)phthalate	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	360	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Butylbenzylphthalate	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	29.4	-- / --	0.09	NO	--	-- / --	--	--	--	NO
Caprolactam	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbazole	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chrysene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Dibenz(a,h)anthracene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Dibenzofuran	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	65.0	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Diethylphthalate	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	75.9	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Dimethyl phthalate	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	580	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Di-n-butylphthalate	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	3.40	-- / --	0.75	NO	--	-- / --	--	--	--	NO
Di-n-octylphthalate	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	22.0	-- / --	0.12	NO	--	-- / --	--	--	--	NO
Fluoranthene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	11.0	-- / --	0.23	NO	--	-- / --	--	--	--	NO
Fluorene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	3.90	-- / --	0.65	NO	--	-- / --	--	--	--	NO
Hexachlorobenzene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	3.68	-- / --	0.69	NO	--	-- / --	--	--	--	NO
Hexachlorobutadiene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	0.32	-- / --	7.97	**YES**	--	-- / --	--	--	3.74	NO[4]
Hexachlorocyclopentadiene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	0.07	-- / --	36.4	**YES**	--	-- / --	--	--	17.1	NO[4]
Hexachloroethane	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	9.40	-- / --	0.27	NO	--	-- / --	--	--	--	NO
Indeno(1,2,3-cd)pyrene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	4.31	-- / --	0.59	NO	--	-- / --	--	--	--	NO
Isophorone	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	129	-- / --	0.02	NO	--	-- / --	--	--	--	NO

TABLE H-33

Ecological Screening Statistics - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Naphthalene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	23.5	-- / --	0.11	NO	--	-- / --	--	--	--	NO
n-Nitroso-di-n-propylamine	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	120	-- / --	0.02	NO	--	-- / --	--	--	--	NO
n-Nitrosodiphenylamine	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	33,000	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
Nitrobenzene	0.15 - 0.29	0 / 5	--	--	--	0.10	0.034	--	66.8	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Pentachlorophenol	9.26 - 10.2	0 / 5	--	--	--	4.79	0.18	--	7.90	-- / --	1.29	**YES**	--	-- / --	--	--	0.61	NO
Phenanthrene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	8.30	-- / --	0.31	NO	--	-- / --	--	--	--	NO
Phenol	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	58.0	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Pyrene	2.31 - 2.55	0 / 5	--	--	--	1.20	0.046	--	0.24	-- / --	10.6	**YES**	--	-- / --	--	--	4.99	NO[4]
Pesticides (UG/L)																		
4,4'-DDD	0.0094 - 0.010	2 / 5	0.0099	0.040	CAS07-MW04-0111	0.013	0.015	--	0.025	1 / 5	1.59	**YES**	--	-- / --	--	--	0.52	NO
4,4'-DDE	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.14	-- / --	0.07	NO	--	-- / --	--	--	--	NO
4,4'-DDT	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.0065	-- / --	1.57	**YES**	--	-- / --	--	--	0.74	NO
Aldrin	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.13	-- / --	0.08	NO	--	-- / --	--	--	--	NO
alpha-BHC	0.0093 - 0.010	1 / 5	0.0053	0.0053	CAS07-MW04-0111	0.0049	0.0003	--	25.0	0 / 5	0.0002	NO	--	-- / --	--	--	--	NO
alpha-Chlordane	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.004	-- / --	2.55	**YES**	--	-- / --	--	--	1.20	NO[4]
beta-BHC	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	25.0	-- / --	0.0004	NO	--	-- / --	--	--	--	NO
delta-BHC	0.0093 - 0.010	1 / 5	0.0056	0.0056	CAS07-MW03-0111	0.0050	0.0004	--	25.0	0 / 5	0.0002	NO	--	-- / --	--	--	--	NO
Dieldrin	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.11	-- / --	0.09	NO	--	-- / --	--	--	--	NO
Endosulfan I	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.0087	-- / --	1.17	**YES**	--	-- / --	--	--	0.55	NO
Endosulfan II	0.0094 - 0.010	2 / 5	0.0058	0.0071	CAS07-MW07-0111	0.0055	0.0010	--	0.0087	0 / 5	0.82	NO	--	-- / --	--	--	--	NO
Endosulfan sulfate	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.0087	-- / --	1.17	**YES**	--	-- / --	--	--	0.55	NO
Endrin	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.01	-- / --	1.02	**YES**	--	-- / --	--	--	0.48	NO
Endrin aldehyde	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.01	-- / --	1.02	**YES**	--	-- / --	--	--	0.48	NO
Endrin ketone	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.01	-- / --	1.02	**YES**	--	-- / --	--	--	0.48	NO
gamma-BHC (Lindane)	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.016	-- / --	0.64	NO	--	-- / --	--	--	--	NO
gamma-Chlordane	0.0094 - 0.010	2 / 5	0.0065	0.025	CAS07-MW04-0111	0.0093	0.0089	--	0.004	2 / 5	6.28	**YES**	--	-- / --	--	--	2.31	**YES**
Heptachlor	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.0036	-- / --	2.83	**YES**	--	-- / --	--	--	1.34	NO[4]
Heptachlor epoxide	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.0036	-- / --	2.83	**YES**	--	-- / --	--	--	1.34	NO[4]
Methoxychlor	0.0093 - 0.010	0 / 5	--	--	--	0.0048	0.0002	--	0.03	-- / --	0.34	NO	--	-- / --	--	--	--	NO
Toxaphene	0.62 - 0.68	0 / 5	--	--	--	0.32	0.013	--	0.21	-- / --	3.24	**YES**	--	-- / --	--	--	1.53	NO[4]
Polychlorinated Biphenyls (UG/L)																		
Aroclor-1016	0.24 - 0.26	0 / 5	--	--	--	0.12	0.0049	--	0.03	-- / --	8.50	**YES**	--	-- / --	--	--	4.07	NO[4]
Aroclor-1221	0.24 - 0.26	0 / 5	--	--	--	0.12	0.0049	--	0.03	-- / --	8.50	**YES**	--	-- / --	--	--	4.07	NO[4]
Aroclor-1232	0.24 - 0.26	0 / 5	--	--	--	0.12	0.0049	--	0.03	-- / --	8.50	**YES**	--	-- / --	--	--	4.07	NO[4]
Aroclor-1242	0.24 - 0.26	0 / 5	--	--	--	0.12	0.0049	--	0.03	-- / --	8.50	**YES**	--	-- / --	--	--	4.07	NO[4]
Aroclor-1248	0.24 - 0.26	0 / 5	--	--	--	0.12	0.0049	--	0.03	-- / --	8.50	**YES**	--	-- / --	--	--	4.07	NO[4]
Aroclor-1254	0.24 - 0.26	0 / 5	--	--	--	0.12	0.0049	--	0.03	-- / --	8.50	**YES**	--	-- / --	--	--	4.07	NO[4]
Aroclor-1260	0.24 - 0.26	0 / 5	--	--	--	0.12	0.0049	--	0.03	-- / --	8.50	**YES**	--	-- / --	--	--	4.07	NO[4]
Dioxin/Furans (NG/L)																		
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.0004 - 0.0005	0 / 5	--	--	--	0.00022	0.00002	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.0007 - 0.0009	1 / 5	0.0014	0.0014	CAS07-MW04-0111	0.00060	0.00043	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.0005 - 0.0007	0 / 5	--	--	--	0.00031	0.00003	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran	0.0003 - 0.0005	1 / 5	0.0006	0.0006	CAS07-MW03-0111	0.00028	0.00018	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.0006 - 0.0007	0 / 5	--	--	--	0.00034	0.00004	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran	0.0003 - 0.0005	0 / 5	--	--	--	0.00019	0.00004	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.0005 - 0.0007	0 / 5	--	--	--	0.00031	0.00004	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran	0.0004 - 0.0007	0 / 5	--	--	--	0.00026	0.00006	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.0006 - 0.0008	0 / 5	--	--	--	0.00035	0.00005	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran	0.0003 - 0.0006	0 / 5	--	--	--	0.00022	0.00006	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.0006 - 0.0008	0 / 5	--	--	--	0.00034	0.00004	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran	0.0003 - 0.0006	0 / 5	--	--	--	0.00021	0.00005	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran	0.0003 - 0.0006	1 / 5	0.0004	0.0004	CAS07-MW03-0111	0.00027	0.00011	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
2,3,7,8-TCDD (dioxin)	0.0007 - 0.0009	0 / 5	--	--	--	0.00038	0.00004	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran	0.0004 - 0.0006	0 / 5	--	--	--	0.00027	0.00003	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
Octachlorodibenzofuran	0.0008 - 0.0012	0 / 5	--	--	--	0.00049	0.00008	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--

TABLE H-33

Ecological Screening Statistics - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Octachlorodibenzo-p-dioxin	0.0008 - 0.0008	4 / 5	0.0031	0.061	CAS07-MW04-0111	0.01648	0.02497	--	TEQ	-- / --	--	--	--	-- / --	--	--	--	--
TEQ (fish)	0.0010 - 0.0010	4 / 5	0.0010	0.0012	CAS07-MW06-0111	0.00104	0.00032	--	0.002	0 / 5	0.62	NO	--	-- / --	--	--	--	NO
Explosives (UG/L)																		
1,3,5-Trinitrobenzene	0.15 - 0.16	1 / 5	0.13	0.13	CAS07-MW04-0111	0.089	0.024	--	15.0	0 / 5	0.01	NO	--	-- / --	--	--	--	NO
1,3-Dinitrobenzene	0.15 - 0.52	0 / 5	--	--	--	0.13	0.081	--	180	-- / --	0.003	NO	--	-- / --	--	--	--	NO
2,4,6-Trinitrotoluene	0.15 - 0.16	1 / 5	0.21	0.21	CAS07-MW06-0111	0.11	0.061	--	100	0 / 5	0.002	NO	--	-- / --	--	--	--	NO
2-Amino-4,6-dinitrotoluene	0.15 - 0.16	1 / 5	0.12	0.12	CAS07-MW06-0111	0.086	0.018	--	19.0	0 / 5	0.01	NO	--	-- / --	--	--	--	NO
2-Nitrotoluene	0.095 - 0.64	0 / 5	--	--	--	0.13	0.11	--	3,400	-- / --	0.0002	NO	--	-- / --	--	--	--	NO
3-Nitrotoluene	0.13 - 0.15	2 / 5	0.14	0.14	CAS07-MW07-0111	0.098	0.039	--	750	0 / 5	0.0002	NO	--	-- / --	--	--	--	NO
4-Amino-2,6-dinitrotoluene	0.15 - 0.16	1 / 5	0.20	0.20	CAS07-MW06-0111	0.10	0.056	--	19.0	0 / 5	0.01	NO	--	-- / --	--	--	--	NO
4-Nitrotoluene	0.15 - 0.16	0 / 5	--	--	--	0.078	0.0017	--	1,900	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
HMX	0.15 - 0.16	3 / 5	0.11	0.53	CAS07-MW04-0111	0.19	0.19	--	330	0 / 5	0.002	NO	--	-- / --	--	--	--	NO
Nitroglycerin	0.39 - 0.40	1 / 5	0.23	0.23	CAS07-MW04-0111	0.20	0.017	--	138	0 / 5	0.002	NO	--	-- / --	--	--	--	NO
PETN	0.39 - 0.40	3 / 5	0.25	0.46	CAS07-MW04-0111	0.28	0.11	--	85,000	0 / 5	0.00001	NO	--	-- / --	--	--	--	NO
RDX	0.15 - 0.15	4 / 5	0.13	0.65	CAS07-MW04-0111	0.28	0.22	--	5,000	0 / 5	0.0001	NO	--	-- / --	--	--	--	NO
Tetryl	0.15 - 0.36	0 / 5	--	--	--	0.099	0.047	--	8.00	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Inorganics (UG/L)																		
Aluminum	24.7 - 158	3 / 5	60.3	298	CAS07-MW07-0111	142	129	--	87.0	2 / 5	3.43	**YES**	2,230	0 / 5	0.13	--	--	NO
Antimony	2.00 - 2.00	0 / 5	--	--	--	1.00	0.0	--	500	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Arsenic	1.50 - 1.50	2 / 5	3.15	4.26	CAS07-MW07-0111	1.93	1.67	--	36.0	0 / 5	0.12	NO	--	-- / --	--	--	--	NO
Barium	-- - --	5 / 5	22.3	41.5	CAS07-MW05-0111	30.6	6.95	--	200	0 / 5	0.21	NO	--	-- / --	--	--	--	NO
Beryllium	0.50 - 0.50	0 / 5	--	--	--	0.25	0.0	--	100	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Cadmium	-- - --	5 / 5	0.72	1.17	CAS07-MW06-0111	0.98	0.19	--	8.85	0 / 5	0.13	NO	--	-- / --	--	--	--	NO
Calcium [3]	-- - --	5 / 5	84,700	140,000	CAS07-MW05-0111	105,180	21,224	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chromium	1.00 - 1.00	3 / 5	1.67	2.49	CAS07-MW05-0111	1.52	0.99	--	50.4	0 / 5	0.05	NO	--	-- / --	--	--	--	NO
Cobalt	2.50 - 2.50	4 / 5	1.43	4.28	CAS07-MW03-0111	2.56	1.41	--	23.0	0 / 5	0.19	NO	--	-- / --	--	--	--	NO
Copper	2.00 - 2.00	2 / 5	1.12	2.04	CAS07-MW06-0111	1.23	0.45	--	3.73	0 / 5	0.55	NO	--	-- / --	--	--	--	NO
Cyanide	10.0 - 10.0	0 / 5	--	--	--	5.00	0.0	--	1.00	-- / --	10.0	**YES**	--	-- / --	--	--	5.00	NO[4]
Iron	15.0 - 28.5	3 / 5	104	603	CAS07-MW07-0111	212	255	--	1,000	0 / 5	0.60	NO	--	-- / --	--	--	--	NO
Lead	0.75 - 3.75	0 / 5	--	--	--	0.68	0.67	--	8.52	-- / --	0.44	NO	--	-- / --	--	--	--	NO
Magnesium [3]	-- - --	5 / 5	2,080	6,490	CAS07-MW05-0111	3,266	1,867	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Manganese	-- - --	5 / 5	18.5	216	CAS07-MW04-0111	83.2	76.5	--	100	1 / 5	2.16	**YES**	57.9	2 / 5	3.73	--	0.83	NO
Mercury	0.20 - 0.20	0 / 5	--	--	--	0.10	0.0	--	1.11	-- / --	0.18	NO	--	-- / --	--	--	--	NO
Nickel	-- - --	5 / 5	2.61	3.94	CAS07-MW03-0111	2.93	0.57	--	8.28	0 / 5	0.48	NO	--	-- / --	--	--	--	NO
Potassium [3]	-- - --	5 / 5	1,130	2,260	CAS07-MW05-0111	1,596	434	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Selenium	1.25 - 1.25	2 / 5	0.88	2.40	CAS07-MW05-0111	1.03	0.77	--	71.1	0 / 5	0.03	NO	--	-- / --	--	--	--	NO
Silver	0.50 - 0.50	0 / 5	--	--	--	0.25	0.0	--	0.23	-- / --	2.17	**YES**	--	-- / --	--	--	1.09	NO[4]
Sodium [3]	-- - --	5 / 5	7,270	21,100	CAS07-MW05-0111	12,148	6,057	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Thallium	1.00 - 1.00	0 / 5	--	--	--	0.50	0.0	--	21.3	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Vanadium	2.50 - 2.50	1 / 5	1.46	1.46	CAS07-MW07-0111	1.29	0.094	--	50.0	0 / 5	0.03	NO	--	-- / --	--	--	--	NO
Zinc	12.5 - 12.5	4 / 5	2.13	9.91	CAS07-MW03-0111	4.71	3.36	--	85.6	0 / 5	0.12	NO	--	-- / --	--	--	--	NO
Dissolved Metals (UG/L)																		
Aluminum	25.0 - 161	2 / 5	15.4	16.9	CAS07-MW04-0111	41.1	35.8	--	87.0	0 / 5	0.19	NO	--	-- / --	--	--	--	NO
Antimony	2.00 - 2.00	0 / 5	--	--	--	1.00	0.0	--	500	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Arsenic	1.50 - 1.50	2 / 5	2.56	3.55	CAS07-MW07-0111	1.67	1.31	--	36.0	0 / 5	0.10	NO	--	-- / --	--	--	--	NO
Barium	-- - --	5 / 5	20.7	41.3	CAS07-MW05-0111	29.9	7.39	--	200	0 / 5	0.21	NO	--	-- / --	--	--	--	NO
Beryllium	0.50 - 0.50	0 / 5	--	--	--	0.25	0.0	--	100	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Cadmium	-- - --	5 / 5	0.65	1.12	CAS07-MW03-0111	0.95	0.19	--	8.80	0 / 5	0.13	NO	--	-- / --	--	--	--	NO
Calcium [3]	-- - --	5 / 5	85,900	141,000	CAS07-MW05-0111	104,480	21,718	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chromium	1.00 - 1.00	2 / 5	0.82	2.52	CAS07-MW05-0111	0.97	0.88	--	50.0	0 / 5	0.05	NO	--	-- / --	--	--	--	NO
Cobalt	2.50 - 2.50	3 / 5	1.84	4.59	CAS07-MW03-0111	2.49	1.50	--	23.0	0 / 5	0.20	NO	--	-- / --	--	--	--	NO
Copper	2.00 - 2.00	0 / 5	--	--	--	1.00	0.0	--	3.10	-- / --	0.65	NO	--	-- / --	--	--	--	NO
Iron	15.0 - 30.2	2 / 5	8.22	338	CAS07-MW03-0111	75.3	147	--	1,000	0 / 5	0.34	NO	--	-- / --	--	--	--	NO
Lead	0.75 - 3.75	0 / 5	--	--	--	0.68	0.67	--	8.10	-- / --	0.46	NO	--	-- / --	--	--	--	NO
Magnesium [3]	-- - --	5 / 5	1,970	6,520	CAS07-MW05-0111	3,226	1,923	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO

TABLE H-33

Ecological Screening Statistics - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Manganese	-- - --	12 / 12	3.31	208	CAS07-MW04-0111	44.3	56.2	73.4	100	1 / 12	2.08	**YES**	49.5	4 / 12	4.20	0.73	0.44	NO
Mercury	0.20 - 0.20	0 / 5	--	--	--	0.10	0.0	--	0.94	-- / --	0.21	NO	--	-- / --	--	--	--	NO
Nickel	-- - --	5 / 5	1.80	4.58	CAS07-MW03-0111	2.64	1.14	--	8.20	0 / 5	0.56	NO	--	-- / --	--	--	--	NO
Potassium [3]	-- - --	5 / 5	1,170	2,240	CAS07-MW05-0111	1,536	426	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Selenium	1.25 - 1.25	1 / 5	2.29	2.29	CAS07-MW05-0111	0.96	0.74	--	71.0	0 / 5	0.03	NO	--	-- / --	--	--	--	NO
Silver	0.50 - 0.50	0 / 5	--	--	--	0.25	0.0	--	0.23	-- / --	2.17	**YES**	--	-- / --	--	--	1.09	NO[4]
Sodium [3]	-- - --	5 / 5	7,370	21,000	CAS07-MW05-0111	12,026	6,092	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Thallium	1.00 - 1.00	0 / 5	--	--	--	0.50	0.0	--	21.3	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Vanadium	2.50 - 2.50	0 / 5	--	--	--	1.25	0.0	--	50.0	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Zinc	2.50 - 12.5	2 / 5	1.83	12.0	CAS07-MW03-0111	4.52	4.68	--	81.0	0 / 5	0.15	NO	--	-- / --	--	--	--	NO

NSV - No Screening Value

[1] Count of detected samples exceeding or equaling ESV

[2] Shaded cells indicate hazard quotient based on reporting limits

[3] Macronutrient - Not considered to be a COPC

[4] See uncertainty section

TABLE H-34

Exceedances - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Surface Water ESV	Background UTL	CAS07-MW03			CAS07-MW04		CAS07-MW05	
			CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414	CAS07-MW05-0111	CAS07-GW05-0414
			1/25/2011	4/9/2014	4/9/2014	1/28/2011	4/9/2014	1/25/2011	4/9/2014
Volatile Organic Compounds (UG/L)									
Chloroform	815	--	--	0.20 U	0.20 U	--	0.20 U	--	0.20 U
cis-1,2-Dichloroethene	680	--	--	**1.90**	**1.90**	--	0.20 U	--	0.20 U
Trichloroethene	1,940	--	--	**1.70**	**1.60**	--	0.20 U	--	0.20 U
Semivolatile Organic Compounds (UG/L)									
2,4-Dinitrotoluene	480	--	**0.582 J**	NA	NA	**1.090**	NA	0.154 U	NA
2,6-Dinitrotoluene	1,000	--	0.154 U	NA	NA	**0.390**	NA	0.154 U	NA
Pesticide/Polychlorinated Biphenyls (UG/L)									
4,4'-DDD	0.025	--	0.00943 U	NA	NA	**0.03980 J**	NA	0.01020 U	NA
alpha-BHC	25.0	--	0.00943 U	NA	NA	**0.00531 J**	NA	0.01020 U	NA
delta-BHC	25.0	--	**0.00558 J**	NA	NA	0.00943 UJ	NA	0.01020 U	NA
Endosulfan II	0.0087	--	0.00943 U	NA	NA	0.00943 UJ	NA	0.01020 U	NA
gamma-Chlordane	0.004	--	0.00943 U	NA	NA	**0.02510 J**	NA	0.01020 U	NA
Dioxin/Furans (NG/L)									
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	TEQ	--	0.00084 U	NA	NA	**0.00136 J**	NA	0.00069 U	NA
1,2,3,4,7,8-Hexachlorodibenzofuran	TEQ	--	**0.00060 J**	NA	NA	0.00033 U	NA	0.00039 U	NA
2,3,4,7,8-Pentachlorodibenzofuran	TEQ	--	**0.00043 J**	NA	NA	0.00031 U	NA	0.00040 U	NA
Octachlorodibenzo-p-dioxin	TEQ	--	**0.00817 J**	NA	NA	**0.06060 J**	NA	0.00079 U	NA
TEQ (fish)	0.002	--	**0.00124 J**	NA	NA	**0.00101 J**	NA	0.00101 U	NA
Explosives (UG/L)									
1,3,5-Trinitrobenzene	15.0	--	0.154 U	NA	NA	**0.132 J**	NA	0.154 U	NA
2,4,6-Trinitrotoluene	100	--	0.154 U	NA	NA	0.157 U	NA	0.154 U	NA
2-Amino-4,6-dinitrotoluene	19.0	--	0.154 U	NA	NA	0.157 U	NA	0.154 U	NA
3-Nitrotoluene	750	--	0.138 B	NA	NA	0.125 B	NA	0.154 U	NA
4-Amino-2,6-dinitrotoluene	19.0	--	0.154 U	NA	NA	0.157 U	NA	0.154 U	NA
HMX	330	--	**0.122 J**	NA	NA	**0.532 J**	NA	0.154 U	NA
Nitroglycerin	138	--	0.385 U	NA	NA	**0.231 J**	NA	0.385 U	NA
PETN	85,000	--	**0.251 J**	NA	NA	**0.463 J**	NA	0.385 U	NA
RDX	5,000	--	**0.133 J**	NA	NA	**0.651 J**	NA	**0.263 J**	NA
Inorganics (UG/L)									
Aluminum	87.0	2,230	24.7 B	NA	NA	**262**	NA	158 B	NA
Arsenic	36.0	2.28	1.50 U	NA	NA	**3.15**	NA	1.50 U	NA
Barium	200	118	**28.6**	NA	NA	**22.3**	NA	**41.5**	NA
Cadmium	8.85	0.605	**1.10 J**	NA	NA	**1.05 J**	NA	**0.86 J**	NA
Chromium	50.4	15.1	1.00 U	NA	NA	**2.45 J**	NA	**2.49 J**	NA
Cobalt	23.0	20.6	**4.28**	NA	NA	**3.84**	NA	2.50 U	NA
Copper	3.73	12.2	2.00 U	NA	NA	**1.12 J**	NA	2.00 U	NA
Iron	1,000	894	15.0 U	NA	NA	**333**	NA	28.5 B	NA
Manganese	100	57.9	**57.1**	NA	NA	**216**	NA	**18.5**	NA
Nickel	8.28	11.4	**3.94**	NA	NA	**2.70**	NA	**2.63**	NA
Selenium	71.1	--	1.25 U	NA	NA	1.25 U	NA	**2.40 J**	NA
Vanadium	50.0	26.2	2.50 U	NA	NA	2.50 U	NA	2.50 U	NA
Zinc	85.6	4.52	**9.91**	NA	NA	**2.13 J**	NA	12.5 U	NA
Dissolved Metals (UG/L)									
Aluminum	87.0	100	161 B	NA	NA	**16.9 J**	NA	160 B	NA
Arsenic	36.0	1.37	1.50 U	NA	NA	**2.56**	NA	1.50 U	NA
Barium	200	127	**29.1**	NA	NA	**20.7**	NA	**41.3**	NA
Cadmium	8.80	0.177	**1.12 J**	NA	NA	**0.95 J**	NA	**0.90 J**	NA
Chromium	50.0	6.04	**0.82 J**	NA	NA	1.00 U	NA	**2.52**	NA

TABLE H-34

Exceedances - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Surface Water ESV	Background UTL	CAS07-MW03			CAS07-MW04		CAS07-MW05	
			CAS07-MW03-0111	CAS07-GW03-0414	CAS07-GW03P-0414	CAS07-MW04-0111	CAS07-GW04-0414	CAS07-MW05-0111	CAS07-GW05-0414
			1/25/2011	4/9/2014	4/9/2014	1/28/2011	4/9/2014	1/25/2011	4/9/2014
Cobalt	23.0	0.70	**4.59**	NA	NA	**3.53**	NA	2.50 U	NA
Iron	1,000	275	**338**	NA	NA	**8.22 J**	NA	30.2 B	NA
Manganese	100	49.5	**58.5**	**19**	NA	**208**	**40.6**	**18.3**	**3.31 J**
Nickel	8.20	12.2	**4.58**	NA	NA	**1.80 J**	NA	**2.65**	NA
Selenium	71.0	--	1.25 U	NA	NA	1.25 U	NA	**2.29 J**	NA
Zinc	81.0	--	**12.0**	NA	NA	2.50 U	NA	12.5 U	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-34

Exceedances - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virgini

Chemical	Surface Water ESV	Background UTL	CAS07-MW06			CAS07-MW07		CAS07-MW08	CAS07-MW09
			CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414	CAS07-GW08-0414	CAS07-GW09-0414
			1/24/2011	1/24/2011	4/9/2014	1/24/2011	4/9/2014	4/10/2014	4/10/2014
Volatile Organic Compounds (UG/L)									
Chloroform	815	--	--	--	0.20 U	--	0.20 U	0.20 U	**1.60**
cis-1,2-Dichloroethene	680	--	--	--	0.20 U	--	**6.20**	**0.48 J**	0.20 U
Trichloroethene	1,940	--	--	--	0.20 U	--	**53.8**	**1.10**	**0.33 J**
Semivolatile Organic Compounds (UG/L)									
2,4-Dinitrotoluene	480	--	**0.412 J**	**0.481 J**	NA	**0.099 J**	NA	NA	NA
2,6-Dinitrotoluene	1,000	--	0.151 U	0.154 U	NA	0.162 U	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (UG/L)									
4,4'-DDD	0.025	--	0.00980 UJ	0.00926 UJ	NA	**0.00992 J**	NA	NA	NA
alpha-BHC	25.0	--	0.00980 UJ	0.00926 UJ	NA	0.00926 U	NA	NA	NA
delta-BHC	25.0	--	0.00980 UJ	0.00926 UJ	NA	0.00926 U	NA	NA	NA
Endosulfan II	0.0087	--	0.00980 UJ	**0.00575 J**	NA	**0.00714 J**	NA	NA	NA
gamma-Chlordane	0.004	--	0.00980 UJ	0.00926 UJ	NA	**0.00646 J**	NA	NA	NA
Dioxin/Furans (NG/L)									
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	TEQ	--	0.00079 U	0.00088 U	NA	0.00083 U	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzofuran	TEQ	--	0.00046 U	0.00046 U	NA	0.00046 U	NA	NA	NA
2,3,4,7,8-Pentachlorodibenzofuran	TEQ	--	0.00050 U	0.00064 U	NA	0.00050 U	NA	NA	NA
Octachlorodibenzo-p-dioxin	TEQ	--	**0.00204 J**	**0.00311 J**	NA	**0.01010 J**	NA	NA	NA
TEQ (fish)	0.002	--	**0.00117 J**	**0.00124 J**	NA	**0.00121 J**	NA	NA	NA
Explosives (UG/L)									
1,3,5-Trinitrobenzene	15.0	--	0.151 U	0.154 U	NA	0.162 U	NA	NA	NA
2,4,6-Trinitrotoluene	100	--	0.151 U	**0.214 J**	NA	0.162 U	NA	NA	NA
2-Amino-4,6-dinitrotoluene	19.0	--	**0.080 J**	**0.118 J**	NA	0.162 U	NA	NA	NA
3-Nitrotoluene	750	--	**0.138 J**	0.154 U	NA	**0.143 J**	NA	NA	NA
4-Amino-2,6-dinitrotoluene	19.0	--	**0.188 J**	**0.204 J**	NA	0.162 U	NA	NA	NA
HMX	330	--	**0.114 J**	**0.109 J**	NA	0.162 U	NA	NA	NA
Nitroglycerin	138	--	0.377 U	0.385 U	NA	0.404 U	NA	NA	NA
PETN	85,000	--	**0.288 J**	**0.269 J**	NA	0.404 U	NA	NA	NA
RDX	5,000	--	0.151 U	0.154 U	NA	**0.282 J**	NA	NA	NA
Inorganics (UG/L)									
Aluminum	87.0	2,230	**59.9**	**60.3**	NA	**298**	NA	NA	NA
Arsenic	36.0	2.28	1.50 U	1.50 U	NA	**4.26**	NA	NA	NA
Barium	200	118	**28.3**	**29.4**	NA	**31.1**	NA	NA	NA
Cadmium	8.85	0.605	**1.14 J**	**1.17 J**	NA	**0.72 J**	NA	NA	NA
Chromium	50.4	15.1	1.00 U	1.00 U	NA	**1.67 J**	NA	NA	NA
Cobalt	23.0	20.6	**1.84 J**	**2.00 J**	NA	**1.43 J**	NA	NA	NA
Copper	3.73	12.2	**2.04 J**	2.00 U	NA	2.00 U	NA	NA	NA
Iron	1,000	894	**89.2**	**104**	NA	**603**	NA	NA	NA
Manganese	100	57.9	**56.9**	**55.9**	NA	**67.7**	NA	NA	NA
Nickel	8.28	11.4	**2.48 J**	**2.61**	NA	**2.76**	NA	NA	NA
Selenium	71.1	--	**0.88 J**	1.25 U	NA	1.25 U	NA	NA	NA
Vanadium	50.0	26.2	2.50 U	2.50 U	NA	**1.46 J**	NA	NA	NA
Zinc	85.6	4.52	**1.98 J**	**2.17 J**	NA	**3.11 J**	NA	NA	NA
Dissolved Metals (UG/L)									
Aluminum	87.0	100	**14.9 J**	**15.4 J**	NA	25.0 U	NA	NA	NA
Arsenic	36.0	1.37	1.50 U	1.50 U	NA	**3.55**	NA	NA	NA
Barium	200	127	**28.2**	**27.7**	NA	**30.4**	NA	NA	NA
Cadmium	8.80	0.177	**1.12 J**	**1.12 J**	NA	**0.65 J**	NA	NA	NA
Chromium	50.0	6.04	1.00 U	1.00 U	NA	1.00 U	NA	NA	NA

TABLE H-34

Exceedances - Site 7 Groundwater

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virgini

Chemical	Surface Water ESV	Background UTL	CAS07-MW06			CAS07-MW07		CAS07-MW08	CAS07-MW09
			CAS07-MW06-0111	CAS07-MW06P-0111	CAS07-GW06-0414	CAS07-MW07-0111	CAS07-GW07-0414	CAS07-GW08-0414	CAS07-GW09-0414
			1/24/2011	1/24/2011	4/9/2014	1/24/2011	4/9/2014	4/10/2014	4/10/2014
Cobalt	23.0	0.70	**1.84 J**	**1.84 J**	NA	2.50 U	NA	NA	NA
Iron	1,000	275	15.0 U	15.0 U	NA	15.0 U	NA	NA	NA
Manganese	100	49.5	**55.0**	**53.9**	**4.50 J**	**70.4**	**9.00 J**	**12.3**	**32.4**
Nickel	8.20	12.2	**2.25 J**	**2.27 J**	NA	**1.89 J**	NA	NA	NA
Selenium	71.0	--	1.25 U	1.25 U	NA	1.25 U	NA	NA	NA
Zinc	81.0	--	**1.83 J**	**1.54 J**	NA	2.50 U	NA	NA	NA

Notes:

Grey highlighting indicates value greater than ESV

Yellow highlighting indicates value equal to ESV

Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL

Bold indicates detections

NSV - No Screening Value

NA - Not analyzed

TABLE H-35

Reporting Limit to ESV Comparison

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Units	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Mean Concentration	ESV	Minimum Ratio	Maximum Ratio	Mean Ratio
Soil									
4-Nitrophenol	UG/KG	0 / 36	890	1,200	490	380	2.34	3.16	1.29
Atrazine	UG/KG	0 / 36	180	240	98.5	11.9	15.1	20.2	8.27
Endrin aldehyde	UG/KG	0 / 36	3.60	4.70	1.97	1.95	1.85	2.41	1.01
Endrin ketone	UG/KG	0 / 36	3.60	4.70	1.97	1.95	1.85	2.41	1.01
Groundwater									
2-Chloronaphthalene	UG/L	0 / 5	2.31	2.55	1.20	0.40	5.78	6.38	3.00
4,6-Dinitro-2-methylphenol	UG/L	0 / 5	9.26	10.2	4.79	2.30	4.03	4.43	2.08
4-Bromophenyl-phenylether	UG/L	0 / 5	2.31	2.55	1.20	1.50	1.54	1.70	0.80
4-Chloro-3-methylphenol	UG/L	0 / 5	2.31	2.55	1.20	0.30	7.70	8.50	3.99
Anthracene	UG/L	0 / 5	2.31	2.55	1.20	0.18	12.8	14.2	6.66
Benzo(a)anthracene	UG/L	0 / 5	2.31	2.55	1.20	0.027	85.6	94.4	44.4
Benzo(a)pyrene	UG/L	0 / 5	2.31	2.55	1.20	0.014	165	182	85.6
Hexachlorobutadiene	UG/L	0 / 5	2.31	2.55	1.20	0.32	7.22	7.97	3.74
Hexachlorocyclopentadiene	UG/L	0 / 5	2.31	2.55	1.20	0.07	33.0	36.4	17.1
Pentachlorophenol	UG/L	0 / 5	9.26	10.2	4.79	7.90	1.17	1.29	0.61
Pyrene	UG/L	0 / 5	2.31	2.55	1.20	0.24	9.63	10.6	4.99
4,4'-DDT	UG/L	0 / 5	0.00926	0.0102	0.00481	0.0065	1.42	1.57	0.74
alpha-Chlordane	UG/L	0 / 5	0.00926	0.0102	0.00481	0.004	2.32	2.55	1.20
Endosulfan I	UG/L	0 / 5	0.00926	0.0102	0.00481	0.0087	1.06	1.17	0.55
Endosulfan sulfate	UG/L	0 / 5	0.00926	0.0102	0.00481	0.0087	1.06	1.17	0.55
Endrin	UG/L	0 / 5	0.00926	0.0102	0.00481	0.01	0.93	1.02	0.48
Endrin aldehyde	UG/L	0 / 5	0.00926	0.0102	0.00481	0.01	0.93	1.02	0.48
Endrin ketone	UG/L	0 / 5	0.00926	0.0102	0.00481	0.01	0.93	1.02	0.48
Heptachlor	UG/L	0 / 5	0.00926	0.0102	0.00481	0.0036	2.57	2.83	1.34
Heptachlor epoxide	UG/L	0 / 5	0.00926	0.0102	0.00481	0.0036	2.57	2.83	1.34
Toxaphene	UG/L	0 / 5	0.618	0.681	0.321	0.21	2.94	3.24	1.53
Aroclor-1016	UG/L	0 / 5	0.236	0.255	0.122	0.03	7.87	8.50	4.07
Aroclor-1221	UG/L	0 / 5	0.236	0.255	0.122	0.03	7.87	8.50	4.07
Aroclor-1232	UG/L	0 / 5	0.236	0.255	0.122	0.03	7.87	8.50	4.07
Aroclor-1242	UG/L	0 / 5	0.236	0.255	0.122	0.03	7.87	8.50	4.07
Aroclor-1248	UG/L	0 / 5	0.236	0.255	0.122	0.03	7.87	8.50	4.07
Aroclor-1254	UG/L	0 / 5	0.236	0.255	0.122	0.03	7.87	8.50	4.07
Aroclor-1260	UG/L	0 / 5	0.236	0.255	0.122	0.03	7.87	8.50	4.07
Cyanide	UG/L	0 / 5	10.0	10.0	5.00	1.00	10.0	10.0	5.00
Silver, total	UG/L	0 / 5	0.50	0.50	0.25	0.23	2.17	2.17	1.09
Silver, dissolved	UG/L	0 / 5	0.50	0.50	0.25	0.23	2.17	2.17	1.09

Shaded cells indicate ratio ≥ 1

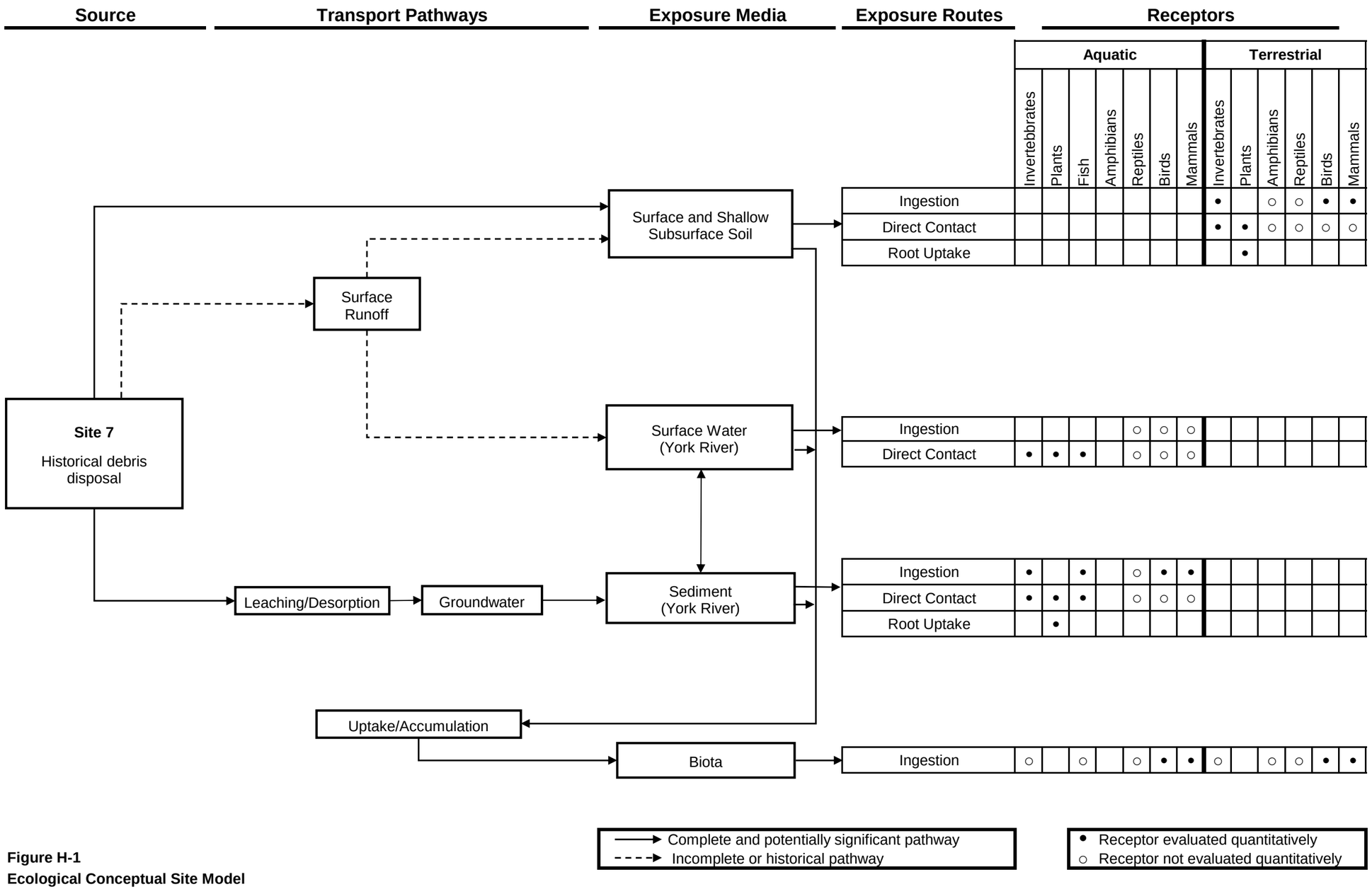

Figure H-1
Ecological Conceptual Site Model
Remedial Investigation - Site 7
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Attachment Table H-1-1

Summary of Meadow Vole Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	3.90E+01	3.162	1.23E+02	0.084	3.27E+00	0.00E+00	6.74E-01	2.40	5.37	12.0	2.81E-01	1.26E-01	5.62E-02
Copper	4.27E+01	Regression	1.44E+01	Regresson	8.57E+00	0.00E+00	9.81E-01	5.60	7.23	9.34	1.75E-01	1.36E-01	1.05E-01
Lead	2.04E+02	Regression	5.88E+01	Regresson	5.24E+00	0.00E+00	1.14E+00	4.70	6.47	8.90	2.43E-01	1.77E-01	1.28E-01
Mercury	1.00E-01	20.63	2.06E+00	Regresson	1.06E-01	0.00E+00	1.49E-02	0.032	0.072	0.16	4.66E-01	2.08E-01	9.32E-02
Selenium	2.90E+00	Regression	2.02E+00	Regresson	1.64E+00	0.00E+00	1.74E-01	0.20	0.26	0.33	8.68E-01	6.76E-01	5.26E-01
Silver	2.40E+00	15.34	3.68E+01	0.037	8.81E-02	0.00E+00	9.06E-02	12.0	26.9	60.2	7.53E-03	3.37E-03	1.51E-03
Polychlorinated Biphenyls													
Aroclor-1016	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	8.39E-04	0.136	0.304	0.680	6.17E-03	2.76E-03	1.23E-03
Aroclor-1221	2.30E-02	Regression	2.41E-02	0.749	1.72E-02	0.00E+00	1.81E-03	0.136	0.304	0.680	1.33E-02	5.94E-03	2.65E-03
Aroclor-1232	2.30E-02	Regression	2.41E-02	0.515	1.18E-02	0.00E+00	1.28E-03	0.136	0.304	0.680	9.38E-03	4.19E-03	1.88E-03
Aroclor-1242	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	8.39E-04	0.136	0.304	0.680	6.17E-03	2.76E-03	1.23E-03
Aroclor-1248	2.30E-02	Regression	2.41E-02	0.184	4.24E-03	0.00E+00	5.25E-04	0.136	0.304	0.680	3.86E-03	1.73E-03	7.72E-04
Aroclor-1254	2.30E-02	Regression	2.41E-02	0.139	3.20E-03	0.00E+00	4.23E-04	0.136	0.304	0.680	3.11E-03	1.39E-03	6.22E-04
Aroclor-1260	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	3.46E-04	0.136	0.304	0.680	2.54E-03	1.14E-03	5.08E-04
Aroclor-1262	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	3.46E-04	0.136	0.304	0.680	2.54E-03	1.14E-03	5.08E-04
Aroclor-1268	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	3.46E-04	0.136	0.304	0.680	2.54E-03	1.14E-03	5.08E-04
PCB (total)	4.70E-02	Regression	6.38E-02	0.139	6.55E-03	0.00E+00	8.94E-04	0.136	0.304	0.680	6.57E-03	2.94E-03	1.31E-03
Pesticides													
4,4'-DDT	4.60E-02	Regression	5.77E-01	Regresson	8.00E-03	0.00E+00	2.09E-03	0.147	0.329	0.735	1.42E-02	6.37E-03	2.85E-03
Aldrin	2.30E-03	3.300	7.59E-03	0.139	3.20E-04	0.00E+00	5.30E-05	0.20	0.45	1.00	2.65E-04	1.18E-04	5.30E-05
alpha-BHC	2.30E-03	1.000	2.30E-03	1.735	3.99E-03	0.00E+00	4.04E-04	1.60	2.26	3.20	2.53E-04	1.79E-04	1.26E-04
alpha-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	6.21E-05	4.58	6.48	9.16	1.36E-05	9.58E-06	6.78E-06
beta-BHC	2.30E-03	1.000	2.30E-03	1.719	3.95E-03	0.00E+00	4.00E-04	1.60	2.26	3.20	2.50E-04	1.77E-04	1.25E-04
delta-BHC	2.30E-03	1.000	2.30E-03	1.311	3.02E-03	0.00E+00	3.08E-04	1.60	2.26	3.20	1.92E-04	1.36E-04	9.62E-05
Endosulfan I	2.30E-03	1.000	2.30E-03	1.687	3.88E-03	0.00E+00	3.93E-04	0.15	0.34	0.75	2.62E-03	1.17E-03	5.24E-04
Endosulfan II	4.70E-03	1.000	4.70E-03	0.886	4.16E-03	0.00E+00	4.32E-04	0.15	0.34	0.75	2.88E-03	1.29E-03	5.76E-04
Endrin	2.40E-03	3.600	8.64E-03	0.535	1.28E-03	0.00E+00	1.50E-04	0.184	0.411	0.920	8.17E-04	3.66E-04	1.63E-04
gamma-BHC (Lindane)	2.30E-03	26.60	6.12E-02	1.852	4.26E-03	0.00E+00	5.52E-04	8.00	17.9	40.0	6.90E-05	3.09E-05	1.38E-05
gamma-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	6.21E-05	4.58	6.48	9.16	1.36E-05	9.58E-06	6.78E-06
Heptachlor	2.30E-02	3.000	6.90E-02	0.174	4.01E-03	0.00E+00	5.95E-04	0.20	0.45	1.00	2.97E-03	1.33E-03	5.95E-04
Heptachlor epoxide	2.30E-03	10.00	2.30E-02	0.566	1.30E-03	0.00E+00	1.81E-04	0.20	0.45	1.00	9.07E-04	4.06E-04	1.81E-04
Methoxychlor	4.60E-02	1.000	4.60E-02	0.525	2.41E-02	0.00E+00	2.59E-03	4.00	5.66	8.00	6.48E-04	4.58E-04	3.24E-04
Toxaphene	1.20E-01	1.000	1.20E-01	0.355	4.25E-02	0.00E+00	4.74E-03	8.00	17.9	40.0	5.93E-04	2.65E-04	1.19E-04
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	1.30E-02	1.000	1.30E-02	1.000	1.30E-02	0.00E+00	1.34E-03	76.0	170	380	1.77E-05	7.89E-06	3.53E-06
1,2,4,5-Tetrachlorobenzene	2.40E-01	0.500	1.20E-01	0.792	1.90E-01	0.00E+00	1.96E-02	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.30E-02	0.560	7.28E-03	1.426	1.85E-02	0.00E+00	1.88E-03	53.0	75.0	106	3.54E-05	2.50E-05	1.77E-05
1,2-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.452	3.19E-02	0.00E+00	3.20E-03	85.7	192	429	3.74E-05	1.67E-05	7.47E-06
1,3-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.296	2.99E-02	0.00E+00	3.00E-03	85.7	192	429	3.51E-05	1.57E-05	7.01E-06
1,4-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.475	3.22E-02	0.00E+00	3.23E-03	30.0	52.0	90.0	1.08E-04	6.22E-05	3.59E-05

Attachment Table H-1-1

Summary of Meadow Vole Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
4-Bromophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.566	1.36E-01	0.00E+00	1.45E-02	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.593	1.42E-01	0.00E+00	1.51E-02	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	2.40E-01	1.690	4.06E-01	0.246	5.91E-02	0.00E+00	7.26E-03	2.00	2.83	4.00	3.63E-03	2.57E-03	1.82E-03
Hexachlorobutadiene	2.40E-01	1.000	2.40E-01	0.675	1.62E-01	0.00E+00	1.71E-02	2.00	6.32	20.0	8.54E-03	2.70E-03	8.54E-04
Hexachlorocyclopentadiene	2.40E-01	1.000	2.40E-01	0.393	9.43E-02	0.00E+00	1.04E-02	75.0	168	375	1.39E-04	6.20E-05	2.77E-05
Hexachloroethane	2.40E-01	1.000	2.40E-01	1.439	3.45E-01	0.00E+00	3.52E-02	100	224	500	3.52E-04	1.57E-04	7.03E-05
Dioxin/Furans													
2,3,7,8 TCDD (TEQ)	2.67E-07	Regression	5.81E-07	0.135	3.62E-08	0.00E+00	5.43E-09	0.000001	0.000003	0.00001	5.43E-03	1.72E-03	5.43E-04

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0031 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.020 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.956 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.024 = Proportion of diet composed of soil
WIR = 0.0133 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0300 = Body weight (kg)

Attachment Table H-1-2

Summary of Short-Tailed Shrew Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	3.90E+01	3.162	1.23E+02	0.084	3.27E+00	0.00E+00	1.51E+01	2.40	5.37	12.0	**6.30E+00**	**2.82E+00**	**1.26E+00**
Copper	4.27E+01	Regression	1.44E+01	Regresson	8.57E+00	0.00E+00	2.52E+00	5.60	7.23	9.34	4.50E-01	3.49E-01	2.70E-01
Lead	2.04E+02	Regression	5.88E+01	Regresson	5.24E+00	0.00E+00	1.06E+01	4.70	6.47	8.90	**2.27E+00**	**1.65E+00**	**1.20E+00**
Mercury	1.00E-01	20.63	2.06E+00	Regresson	1.06E-01	0.00E+00	2.43E-01	0.032	0.072	0.16	**7.60E+00**	**3.40E+00**	**1.52E+00**
Selenium	2.90E+00	Regression	2.02E+00	Regresson	1.64E+00	0.00E+00	3.01E-01	0.20	0.26	0.33	**1.50E+00**	**1.17E+00**	9.11E-01
Silver	2.40E+00	15.34	3.68E+01	0.037	8.81E-02	0.00E+00	4.34E+00	12.0	26.9	60.2	3.60E-01	1.61E-01	7.21E-02
Polychlorinated Biphenyls													
Aroclor-1016	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	3.29E-03	0.136	0.304	0.680	2.42E-02	1.08E-02	4.84E-03
Aroclor-1221	2.30E-02	Regression	2.41E-02	0.749	1.72E-02	0.00E+00	3.35E-03	0.136	0.304	0.680	2.47E-02	1.10E-02	4.93E-03
Aroclor-1232	2.30E-02	Regression	2.41E-02	0.515	1.18E-02	0.00E+00	3.32E-03	0.136	0.304	0.680	2.44E-02	1.09E-02	4.88E-03
Aroclor-1242	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	3.29E-03	0.136	0.304	0.680	2.42E-02	1.08E-02	4.84E-03
Aroclor-1248	2.30E-02	Regression	2.41E-02	0.184	4.24E-03	0.00E+00	3.27E-03	0.136	0.304	0.680	2.40E-02	1.07E-02	4.80E-03
Aroclor-1254	2.30E-02	Regression	2.41E-02	0.139	3.20E-03	0.00E+00	3.26E-03	0.136	0.304	0.680	2.40E-02	1.07E-02	4.79E-03
Aroclor-1260	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	3.26E-03	0.136	0.304	0.680	2.39E-02	1.07E-02	4.79E-03
Aroclor-1262	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	3.26E-03	0.136	0.304	0.680	2.39E-02	1.07E-02	4.79E-03
Aroclor-1268	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	3.26E-03	0.136	0.304	0.680	2.39E-02	1.07E-02	4.79E-03
PCB (total)	4.70E-02	Regression	6.38E-02	0.139	6.55E-03	0.00E+00	8.36E-03	0.136	0.304	0.680	6.14E-02	2.75E-02	1.23E-02
Pesticides													
4,4'-DDT	4.60E-02	Regression	5.77E-01	Regresson	8.00E-03	0.00E+00	6.81E-02	0.147	0.329	0.735	4.64E-01	2.07E-01	9.27E-02
Aldrin	2.30E-03	3.300	7.59E-03	0.139	3.20E-04	0.00E+00	9.30E-04	0.20	0.45	1.00	4.65E-03	2.08E-03	9.30E-04
alpha-BHC	2.30E-03	1.000	2.30E-03	1.735	3.99E-03	0.00E+00	3.37E-04	1.60	2.26	3.20	2.11E-04	1.49E-04	1.05E-04
alpha-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	1.12E-03	4.58	6.48	9.16	2.44E-04	1.73E-04	1.22E-04
beta-BHC	2.30E-03	1.000	2.30E-03	1.719	3.95E-03	0.00E+00	3.37E-04	1.60	2.26	3.20	2.11E-04	1.49E-04	1.05E-04
delta-BHC	2.30E-03	1.000	2.30E-03	1.311	3.02E-03	0.00E+00	3.31E-04	1.60	2.26	3.20	2.07E-04	1.46E-04	1.03E-04
Endosulfan I	2.30E-03	1.000	2.30E-03	1.687	3.88E-03	0.00E+00	3.37E-04	0.15	0.34	0.75	2.24E-03	1.00E-03	4.49E-04
Endosulfan II	4.70E-03	1.000	4.70E-03	0.886	4.16E-03	0.00E+00	6.63E-04	0.15	0.34	0.75	4.42E-03	1.98E-03	8.83E-04
Endrin	2.40E-03	3.600	8.64E-03	0.535	1.28E-03	0.00E+00	1.06E-03	0.184	0.411	0.920	5.76E-03	2.58E-03	1.15E-03
gamma-BHC (Lindane)	2.30E-03	26.60	6.12E-02	1.852	4.26E-03	0.00E+00	7.21E-03	8.00	17.9	40.0	9.01E-04	4.03E-04	1.80E-04
gamma-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	1.12E-03	4.58	6.48	9.16	2.44E-04	1.73E-04	1.22E-04
Heptachlor	2.30E-02	3.000	6.90E-02	0.174	4.01E-03	0.00E+00	8.50E-03	0.20	0.45	1.00	4.25E-02	1.90E-02	8.50E-03
Heptachlor epoxide	2.30E-03	10.00	2.30E-02	0.566	1.30E-03	0.00E+00	2.73E-03	0.20	0.45	1.00	1.37E-02	6.11E-03	2.73E-03
Methoxychlor	4.60E-02	1.000	4.60E-02	0.525	2.41E-02	0.00E+00	6.37E-03	4.00	5.66	8.00	1.59E-03	1.13E-03	7.97E-04
Toxaphene	1.20E-01	1.000	1.20E-01	0.355	4.25E-02	0.00E+00	1.65E-02	8.00	17.9	40.0	2.06E-03	9.22E-04	4.12E-04
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	1.30E-02	1.000	1.30E-02	1.000	1.30E-02	0.00E+00	1.84E-03	76.0	170	380	2.42E-05	1.08E-05	4.85E-06
1,2,4,5-Tetrachlorobenzene	2.40E-01	0.500	1.20E-01	0.792	1.90E-01	0.00E+00	1.97E-02	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.30E-02	0.560	7.28E-03	1.426	1.85E-02	0.00E+00	1.21E-03	53.0	75.0	106	2.29E-05	1.62E-05	1.14E-05
1,2-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.452	3.19E-02	0.00E+00	1.97E-03	85.7	192	429	2.30E-05	1.03E-05	4.59E-06
1,3-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.296	2.99E-02	0.00E+00	1.95E-03	85.7	192	429	2.28E-05	1.02E-05	4.56E-06
1,4-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.475	3.22E-02	0.00E+00	1.97E-03	30.0	52.0	90.0	6.57E-05	3.79E-05	2.19E-05

Attachment Table H-1-2

Summary of Short-Tailed Shrew Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
4-Bromophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.566	1.36E-01	0.00E+00	3.33E-02	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.593	1.42E-01	0.00E+00	3.34E-02	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	2.40E-01	1.690	4.06E-01	0.246	5.91E-02	0.00E+00	5.21E-02	2.00	2.83	4.00	2.61E-02	1.84E-02	1.30E-02
Hexachlorobutadiene	2.40E-01	1.000	2.40E-01	0.675	1.62E-01	0.00E+00	3.35E-02	2.00	6.32	20.0	1.67E-02	5.30E-03	1.67E-03
Hexachlorocyclopentadiene	2.40E-01	1.000	2.40E-01	0.393	9.43E-02	0.00E+00	3.30E-02	75.0	168	375	4.41E-04	1.97E-04	8.81E-05
Hexachloroethane	2.40E-01	1.000	2.40E-01	1.439	3.45E-01	0.00E+00	3.47E-02	100	224	500	3.47E-04	1.55E-04	6.94E-05
Dioxin/Furans													
2,3,7,8 TCDD (TEQ)	2.67E-07	Regression	5.81E-07	0.135	3.62E-08	0.00E+00	7.30E-08	0.000001	0.000003	0.00001	7.30E-02	2.31E-02	7.30E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0019 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.823 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.047 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.130 = Proportion of diet composed of soil
WIR = 0.0048 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0133 = Body weight (kg)

Attachment Table H-1-3

Summary of White-Footed Mouse Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	3.90E+01	3.162	1.23E+02	0.084	3.27E+00	0.00E+00	3.14E+00	2.40	5.37	12.0	**1.31E+00**	5.84E-01	2.61E-01
Copper	4.27E+01	Regression	1.44E+01	Regresson	8.57E+00	0.00E+00	6.22E-01	5.60	7.23	9.34	1.11E-01	8.60E-02	6.66E-02
Lead	2.04E+02	Regression	5.88E+01	Regresson	5.24E+00	0.00E+00	1.78E+00	4.70	6.47	8.90	3.80E-01	2.76E-01	2.00E-01
Mercury	1.00E-01	20.63	2.06E+00	Regresson	1.06E-01	0.00E+00	5.32E-02	0.032	0.072	0.16	**1.66E+00**	7.44E-01	3.33E-01
Selenium	2.90E+00	Regression	2.02E+00	Regresson	1.64E+00	0.00E+00	9.59E-02	0.20	0.26	0.33	4.80E-01	3.73E-01	2.91E-01
Silver	2.40E+00	15.34	3.68E+01	0.037	8.81E-02	0.00E+00	9.03E-01	12.0	26.9	60.2	7.50E-02	3.35E-02	1.50E-02
Polychlorinated Biphenyls													
Aroclor-1016	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	8.09E-04	0.136	0.304	0.680	5.95E-03	2.66E-03	1.19E-03
Aroclor-1221	2.30E-02	Regression	2.41E-02	0.749	1.72E-02	0.00E+00	1.07E-03	0.136	0.304	0.680	7.86E-03	3.51E-03	1.57E-03
Aroclor-1232	2.30E-02	Regression	2.41E-02	0.515	1.18E-02	0.00E+00	9.26E-04	0.136	0.304	0.680	6.81E-03	3.05E-03	1.36E-03
Aroclor-1242	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	8.09E-04	0.136	0.304	0.680	5.95E-03	2.66E-03	1.19E-03
Aroclor-1248	2.30E-02	Regression	2.41E-02	0.184	4.24E-03	0.00E+00	7.25E-04	0.136	0.304	0.680	5.33E-03	2.38E-03	1.07E-03
Aroclor-1254	2.30E-02	Regression	2.41E-02	0.139	3.20E-03	0.00E+00	6.97E-04	0.136	0.304	0.680	5.13E-03	2.29E-03	1.03E-03
Aroclor-1260	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	6.77E-04	0.136	0.304	0.680	4.98E-03	2.23E-03	9.95E-04
Aroclor-1262	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	6.77E-04	0.136	0.304	0.680	4.98E-03	2.23E-03	9.95E-04
Aroclor-1268	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	6.77E-04	0.136	0.304	0.680	4.98E-03	2.23E-03	9.95E-04
PCB (total)	4.70E-02	Regression	6.38E-02	0.139	6.55E-03	0.00E+00	1.78E-03	0.136	0.304	0.680	1.31E-02	5.85E-03	2.62E-03
Pesticides													
4,4'-DDT	4.60E-02	Regression	5.77E-01	Regresson	8.00E-03	0.00E+00	1.43E-02	0.147	0.329	0.735	9.74E-02	4.36E-02	1.95E-02
Aldrin	2.30E-03	3.300	7.59E-03	0.139	3.20E-04	0.00E+00	1.96E-04	0.20	0.45	1.00	9.80E-04	4.38E-04	1.96E-04
alpha-BHC	2.30E-03	1.000	2.30E-03	1.735	3.99E-03	0.00E+00	1.64E-04	1.60	2.26	3.20	1.03E-04	7.25E-05	5.13E-05
alpha-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	2.37E-04	4.58	6.48	9.16	5.17E-05	3.66E-05	2.59E-05
beta-BHC	2.30E-03	1.000	2.30E-03	1.719	3.95E-03	0.00E+00	1.63E-04	1.60	2.26	3.20	1.02E-04	7.21E-05	5.10E-05
delta-BHC	2.30E-03	1.000	2.30E-03	1.311	3.02E-03	0.00E+00	1.38E-04	1.60	2.26	3.20	8.64E-05	6.11E-05	4.32E-05
Endosulfan I	2.30E-03	1.000	2.30E-03	1.687	3.88E-03	0.00E+00	1.61E-04	0.15	0.34	0.75	1.07E-03	4.81E-04	2.15E-04
Endosulfan II	4.70E-03	1.000	4.70E-03	0.886	4.16E-03	0.00E+00	2.30E-04	0.15	0.34	0.75	1.53E-03	6.85E-04	3.06E-04
Endrin	2.40E-03	3.600	8.64E-03	0.535	1.28E-03	0.00E+00	2.47E-04	0.184	0.411	0.920	1.34E-03	6.01E-04	2.69E-04
gamma-BHC (Lindane)	2.30E-03	26.60	6.12E-02	1.852	4.26E-03	0.00E+00	1.61E-03	8.00	17.9	40.0	2.01E-04	8.99E-05	4.02E-05
gamma-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	2.37E-04	4.58	6.48	9.16	5.17E-05	3.66E-05	2.59E-05
Heptachlor	2.30E-02	3.000	6.90E-02	0.174	4.01E-03	0.00E+00	1.81E-03	0.20	0.45	1.00	9.07E-03	4.05E-03	1.81E-03
Heptachlor epoxide	2.30E-03	10.00	2.30E-02	0.566	1.30E-03	0.00E+00	5.98E-04	0.20	0.45	1.00	2.99E-03	1.34E-03	5.98E-04
Methoxychlor	4.60E-02	1.000	4.60E-02	0.525	2.41E-02	0.00E+00	1.81E-03	4.00	5.66	8.00	4.52E-04	3.20E-04	2.26E-04
Toxaphene	1.20E-01	1.000	1.20E-01	0.355	4.25E-02	0.00E+00	4.18E-03	8.00	17.9	40.0	5.22E-04	2.34E-04	1.04E-04
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	1.30E-02	1.000	1.30E-02	1.000	1.30E-02	0.00E+00	6.75E-04	76.0	170	380	8.88E-06	3.97E-06	1.78E-06
1,2,4,5-Tetrachlorobenzene	2.40E-01	0.500	1.20E-01	0.792	1.90E-01	0.00E+00	8.21E-03	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.30E-02	0.560	7.28E-03	1.426	1.85E-02	0.00E+00	6.82E-04	53.0	75.0	106	1.29E-05	9.10E-06	6.43E-06
1,2-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.452	3.19E-02	0.00E+00	1.17E-03	85.7	192	429	1.37E-05	6.13E-06	2.74E-06
1,3-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.296	2.99E-02	0.00E+00	1.12E-03	85.7	192	429	1.31E-05	5.85E-06	2.62E-06
1,4-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.475	3.22E-02	0.00E+00	1.18E-03	30.0	52.0	90.0	3.94E-05	2.27E-05	1.31E-05

Attachment Table H-1-3

Summary of White-Footed Mouse Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
4-Bromophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.566	1.36E-01	0.00E+00	9.70E-03	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.593	1.42E-01	0.00E+00	9.87E-03	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	2.40E-01	1.690	4.06E-01	0.246	5.91E-02	0.00E+00	1.17E-02	2.00	2.83	4.00	5.85E-03	4.14E-03	2.93E-03
Hexachlorobutadiene	2.40E-01	1.000	2.40E-01	0.675	1.62E-01	0.00E+00	1.04E-02	2.00	6.32	20.0	5.20E-03	1.64E-03	5.20E-04
Hexachlorocyclopentadiene	2.40E-01	1.000	2.40E-01	0.393	9.43E-02	0.00E+00	8.60E-03	75.0	168	375	1.15E-04	5.13E-05	2.29E-05
Hexachloroethane	2.40E-01	1.000	2.40E-01	1.439	3.45E-01	0.00E+00	1.52E-02	100	224	500	1.52E-04	6.82E-05	3.05E-05
Dioxin/Furans													
2,3,7,8 TCDD (TEQ)	2.67E-07	Regression	5.81E-07	0.135	3.62E-08	0.00E+00	1.54E-08	0.000001	0.000003	0.00001	1.54E-02	4.88E-03	1.54E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.00073 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.470 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.510 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.020 = Proportion of diet composed of soil
WIR = 0.0092 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0141 = Body weight (kg)

Attachment Table H-1-4

Summary of Red Fox Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Omnivore Soil-Mammal BAF	Omnivore Small Mammal Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																			
Chromium	3.90E+01	3.162	1.23E+02	0.084	3.27E+00	Regresson	3.29E+00	Regresson	3.42E+00	Regresson	3.42E+00	0.00E+00	3.61E-01	2.40	5.37	12.0	1.51E-01	6.73E-02	3.01E-02
Copper	4.27E+01	Regression	1.44E+01	Regresson	8.57E+00	Regresson	1.18E+01	Regresson	1.33E+01	Regresson	1.60E+01	0.00E+00	6.98E-01	11.7	13.3	15.1	5.97E-02	5.25E-02	4.62E-02
Lead	2.04E+02	Regression	5.88E+01	Regresson	5.24E+00	Regresson	1.13E+01	Regresson	8.53E+00	Regresson	2.16E+01	0.00E+00	9.72E-01	4.70	6.47	8.90	2.07E-01	1.50E-01	1.09E-01
Mercury	1.00E-01	20.63	2.06E+00	Regresson	1.06E-01	0.130	1.30E-02	0.192	1.92E-02	0.192	1.92E-02	0.00E+00	3.94E-03	0.15	0.19	0.25	2.63E-02	2.04E-02	1.58E-02
Selenium	2.90E+00	Regression	2.02E+00	Regresson	1.64E+00	Regresson	9.85E-01	Regresson	9.85E-01	Regresson	9.85E-01	0.00E+00	5.19E-02	0.20	0.26	0.33	2.59E-01	2.02E-01	1.57E-01
Silver	2.40E+00	15.34	3.68E+01	0.037	8.81E-02	0.810	1.94E+00	0.007	1.68E-02	0.501	1.20E+00	0.00E+00	7.62E-02	12.0	26.9	60.2	6.33E-03	2.83E-03	1.27E-03
Polychlorinated Biphenyls																			
Aroclor-1016	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	See footnote	1.56E-02	See footnote	8.13E-03	See footnote	2.32E-02	0.00E+00	7.23E-04	1.37	2.17	3.43	5.28E-04	3.34E-04	2.11E-04
Aroclor-1221	2.30E-02	Regression	2.41E-02	0.749	1.72E-02	See footnote	2.06E-02	See footnote	1.75E-02	See footnote	2.37E-02	0.00E+00	9.55E-04	0.137	0.306	0.685	6.97E-03	3.12E-03	1.39E-03
Aroclor-1232	2.30E-02	Regression	2.41E-02	0.515	1.18E-02	See footnote	1.78E-02	See footnote	1.24E-02	See footnote	2.34E-02	0.00E+00	8.28E-04	0.137	0.306	0.685	6.04E-03	2.70E-03	1.21E-03
Aroclor-1242	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	See footnote	1.56E-02	See footnote	8.13E-03	See footnote	2.32E-02	0.00E+00	7.23E-04	0.137	0.306	0.685	5.28E-03	2.36E-03	1.06E-03
Aroclor-1248	2.30E-02	Regression	2.41E-02	0.184	4.24E-03	See footnote	1.40E-02	See footnote	5.09E-03	See footnote	2.31E-02	0.00E+00	6.48E-04	0.137	0.306	0.685	4.73E-03	2.12E-03	9.46E-04
Aroclor-1254	2.30E-02	Regression	2.41E-02	0.139	3.20E-03	See footnote	1.34E-02	See footnote	4.10E-03	See footnote	2.30E-02	0.00E+00	6.23E-04	0.137	0.306	0.685	4.55E-03	2.03E-03	9.10E-04
Aroclor-1260	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	See footnote	1.30E-02	See footnote	3.35E-03	See footnote	2.30E-02	0.00E+00	6.05E-04	0.137	0.306	0.685	4.42E-03	1.97E-03	8.83E-04
Aroclor-1262	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	See footnote	1.30E-02	See footnote	3.35E-03	See footnote	2.30E-02	0.00E+00	6.05E-04	0.137	0.306	0.685	4.42E-03	1.97E-03	8.83E-04
Aroclor-1268	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	See footnote	1.30E-02	See footnote	3.35E-03	See footnote	2.30E-02	0.00E+00	6.05E-04	0.137	0.306	0.685	4.42E-03	1.97E-03	8.83E-04
PCB (total)	4.70E-02	Regression	6.38E-02	0.139	6.55E-03	See footnote	3.43E-02	See footnote	8.66E-03	See footnote	5.90E-02	0.00E+00	1.54E-03	0.137	0.306	0.685	1.13E-02	5.03E-03	2.25E-03
Pesticides																			
4,4'-DDT	4.60E-02	Regression	5.77E-01	Regresson	8.00E-03	See footnote	2.76E-01	See footnote	2.03E-02	See footnote	4.81E-01	0.00E+00	1.10E-02	0.147	0.329	0.735	7.51E-02	3.36E-02	1.50E-02
Aldrin	2.30E-03	3.300	7.59E-03	0.139	3.20E-04	See footnote	3.78E-03	See footnote	5.13E-04	See footnote	6.56E-03	0.00E+00	1.58E-04	0.20	0.45	1.00	7.89E-04	3.53E-04	1.58E-04
alpha-BHC	2.30E-03	1.000	2.30E-03	1.735	3.99E-03	See footnote	3.16E-03	See footnote	3.92E-03	See footnote	2.38E-03	0.00E+00	1.47E-04	1.60	2.26	3.20	9.20E-05	6.50E-05	4.60E-05
alpha-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	See footnote	4.56E-03	See footnote	6.02E-04	See footnote	7.89E-03	0.00E+00	1.89E-04	4.58	6.48	9.16	4.13E-05	2.92E-05	2.06E-05
beta-BHC	2.30E-03	1.000	2.30E-03	1.719	3.95E-03	See footnote	3.14E-03	See footnote	3.88E-03	See footnote	2.38E-03	0.00E+00	1.46E-04	1.60	2.26	3.20	9.14E-05	6.46E-05	4.57E-05
delta-BHC	2.30E-03	1.000	2.30E-03	1.311	3.02E-03	See footnote	2.66E-03	See footnote	2.98E-03	See footnote	2.33E-03	0.00E+00	1.24E-04	1.60	2.26	3.20	7.75E-05	5.48E-05	3.88E-05
Endosulfan I	2.30E-03	1.000	2.30E-03	1.687	3.88E-03	See footnote	3.11E-03	See footnote	3.81E-03	See footnote	2.37E-03	0.00E+00	1.45E-04	0.15	0.34	0.75	9.63E-04	4.31E-04	1.93E-04
Endosulfan II	4.70E-03	1.000	4.70E-03	0.886	4.16E-03	See footnote	4.43E-03	See footnote	4.19E-03	See footnote	4.67E-03	0.00E+00	2.06E-04	0.15	0.34	0.75	1.37E-03	6.15E-04	2.75E-04
Endrin	2.40E-03	3.600	8.64E-03	0.535	1.28E-03	See footnote	4.76E-03	See footnote	1.46E-03	See footnote	7.48E-03	0.00E+00	2.01E-04	0.184	0.411	0.920	1.09E-03	4.87E-04	2.18E-04
gamma-BHC (Lindane)	2.30E-03	26.60	6.12E-02	1.852	4.26E-03	See footnote	3.10E-02	See footnote	5.35E-03	See footnote	5.09E-02	0.00E+00	1.24E-03	8.00	17.9	40.0	1.55E-04	6.93E-05	3.10E-05
gamma-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	See footnote	4.56E-03	See footnote	6.02E-04	See footnote	7.89E-03	0.00E+00	1.89E-04	4.58	6.48	9.16	4.13E-05	2.92E-05	2.06E-05
Heptachlor	2.30E-02	3.000	6.90E-02	0.174	4.01E-03	See footnote	3.49E-02	See footnote	5.76E-03	See footnote	6.00E-02	0.00E+00	1.47E-03	0.20	0.45	1.00	7.35E-03	3.29E-03	1.47E-03
Heptachlor epoxide	2.30E-03	10.00	2.30E-02	0.566	1.30E-03	See footnote	1.15E-02	See footnote	1.76E-03	See footnote	1.93E-02	0.00E+00	4.66E-04	0.20	0.45	1.00	2.33E-03	1.04E-03	4.66E-04
Methoxychlor	4.60E-02	1.000	4.60E-02	0.525	2.41E-02	See footnote	3.49E-02	See footnote	2.51E-02	See footnote	4.50E-02	0.00E+00	1.62E-03	4.00	5.66	8.00	4.06E-04	2.87E-04	2.03E-04
Toxaphene	1.20E-01	1.000	1.20E-01	0.355	4.25E-02	See footnote	8.05E-02	See footnote	4.60E-02	See footnote	1.16E-01	0.00E+00	3.75E-03	8.00	17.9	40.0	4.69E-04	2.10E-04	9.39E-05
Volatile/Semivolatile Organics																			
1,1,2,2-Tetrachloroethane	1.30E-02	1.000	1.30E-02	1.000	1.30E-02	See footnote	1.30E-02	See footnote	1.30E-02	See footnote	1.30E-02	0.00E+00	6.05E-04	76.0	170	380	7.96E-06	3.56E-06	1.59E-06
1,2,4,5-Tetrachlorobenzene	2.40E-01	0.500	1.20E-01	0.792	1.90E-01	See footnote	1.58E-01	See footnote	1.90E-01	See footnote	1.39E-01	0.00E+00	7.78E-03	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.30E-02	0.560	7.28E-03	1.426	1.85E-02	See footnote	1.31E-02	See footnote	1.82E-02	See footnote	8.55E-03	0.00E+00	6.31E-04	53.0	75.0	106	1.19E-05	8.42E-06	5.95E-06
1,2-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.452	3.19E-02	See footnote	2.26E-02	See footnote	3.10E-02	See footnote	1.39E-02	0.00E+00	1.05E-03	85.7	192	429	1.23E-05	5.49E-06	2.46E-06
1,3-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.296	2.99E-02	See footnote	2.16E-02	See footnote	2.91E-02	See footnote	1.38E-02	0.00E+00	1.00E-03	85.7	192	429	1.17E-05	5.24E-06	2.34E-06
1,4-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.475	3.22E-02	See footnote	2.28E-02	See footnote	3.13E-02	See footnote	1.39E-02	0.00E+00	1.06E-03	30.0	52.0	90.0	3.53E-05	2.04E-05	1.18E-05
4-Bromophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.566	1.36E-01	See footnote	1.87E-01	See footnote	1.40E-01	See footnote	2.35E-01	0.00E+00	8.71E-03	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.593	1.42E-01	See footnote	1.90E-01	See footnote	1.47E-01	See footnote	2.35E-01	0.00E+00	8.86E-03	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	2.40E-01	1.690	4.06E-01	0.246	5.91E-02	See footnote	2.26E-01	See footnote	7.04E-02	See footnote	3.68E-01	0.00E+00	9.95E-03	2.00	2.83	4.00	4.98E-03	3.52E-03	2.49E-03
Hexachlorobutadiene	2.40E-01	1.000	2.40E-01	0.675	1.62E-01	See footnote	2.00E-01	See footnote	1.66E-01	See footnote	2.36E-01	0.00E+00	9.33E-03	2.00	6.32	20.0	4.67E-03	1.48E-03	4.67E-04
Hexachlorocyclopentadiene	2.40E-01	1.000	2.40E-01	0.393	9.43E-02	See footnote	1.66E-01	See footnote	1.01E-01	See footnote	2.33E-01	0.00E+00	7.73E-03	75.0	168	375	1.03E-04	4.61E-05	2.06E-05
Hexachloroethane	2.40E-01	1.000	2.40E-01	1.439	3.45E-01	See footnote	2.94E-01	See footnote	3.41E-01	See footnote	2.45E-01	0.00E+00	1.37E-02	100	224	500	1.37E-04	6.11E-05	2.73E-05

Attachment Table H-1-4

Summary of Red Fox Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Omnivore Soil-Mammal BAF	Omnivore Small Mammal Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Dioxin/Furans																			
2,3,7,8 TCDD (TEQ)	2.67E-07	Regression	5.81E-07	0.135	3.62E-08	Regresson	1.34E-07	Regresson	1.34E-07	Regresson	1.34E-07	0.00E+00	6.67E-09	0.000001	0.000003	0.00001	6.67E-03	2.11E-03	6.67E-04

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specifi	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.1476	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specifi	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.028	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specifi	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.070	= Proportion of diet composed of food item (terrestrial plants)
FCxi =	Chemical-specifi	= Concentration of chemical in food item (omnivorous small mammals, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (omnivorous small mammals)
FCxi =	Chemical-specifi	= Concentration of chemical in food item (herbivorous small mammals, dry weight basis)
PDFi =	0.437	= Proportion of diet composed of food item (herbivorous small mammals)
FCxi =	Chemical-specifi	= Concentration of chemical in food item (insectivorous small mammals, dry weight basis)
PDFi =	0.437	= Proportion of diet composed of food item (insectivorous small mammals)
SCx =	Chemical-specifi	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.028	= Proportion of diet composed of soil
WIR =	0.4115	= Water ingestion rate (L/day)
WC =	Chemical-specifi	= Concentration of chemical in water (mg/L)
BW =	3.17	= Body weight (kg)

Attachment Table H-1-5

Summary of American Robin Exposure Doses (Omnivore) - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	3.90E+01	3.162	1.23E+02	0.084	3.27E+00	0.00E+00	6.62E+00	2.66	5.95	13.3	**2.49E+00**	**1.11E+00**	4.98E-01
Copper	4.27E+01	Regression	1.44E+01	Regresson	8.57E+00	0.00E+00	1.47E+00	4.05	7.00	12.1	3.63E-01	2.10E-01	1.21E-01
Lead	2.04E+02	Regression	5.88E+01	Regresson	5.24E+00	0.00E+00	4.37E+00	3.85	8.61	19.3	**1.13E+00**	5.07E-01	2.27E-01
Mercury	1.00E-01	20.63	2.06E+00	Regresson	1.06E-01	0.00E+00	1.11E-01	0.49	0.77	1.20	2.26E-01	1.45E-01	9.24E-02
Selenium	2.90E+00	Regression	2.02E+00	Regresson	1.64E+00	0.00E+00	2.16E-01	0.44	0.81	1.50	4.92E-01	2.66E-01	1.44E-01
Silver	2.40E+00	15.34	3.68E+01	0.037	8.81E-02	0.00E+00	1.87E+00	4.04	9.03	20.2	4.64E-01	2.07E-01	9.28E-02
Polychlorinated Biphenyls													
Aroclor-1016	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	1.79E-03	0.41	0.92	2.05	4.36E-03	1.95E-03	8.71E-04
Aroclor-1221	2.30E-02	Regression	2.41E-02	0.749	1.72E-02	0.00E+00	2.38E-03	0.41	0.92	2.05	5.79E-03	2.59E-03	1.16E-03
Aroclor-1232	2.30E-02	Regression	2.41E-02	0.515	1.18E-02	0.00E+00	2.05E-03	0.41	0.92	2.05	5.01E-03	2.24E-03	1.00E-03
Aroclor-1242	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	1.79E-03	0.41	0.92	2.05	4.36E-03	1.95E-03	8.71E-04
Aroclor-1248	2.30E-02	Regression	2.41E-02	0.184	4.24E-03	0.00E+00	1.59E-03	0.41	0.92	2.05	3.89E-03	1.74E-03	7.78E-04
Aroclor-1254	2.30E-02	Regression	2.41E-02	0.139	3.20E-03	0.00E+00	1.53E-03	0.41	0.92	2.05	3.74E-03	1.67E-03	7.47E-04
Aroclor-1260	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	1.49E-03	0.41	0.92	2.05	3.62E-03	1.62E-03	7.24E-04
Aroclor-1262	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	1.49E-03	0.41	0.92	2.05	3.62E-03	1.62E-03	7.24E-04
Aroclor-1268	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	1.49E-03	0.41	0.92	2.05	3.62E-03	1.62E-03	7.24E-04
PCB (total)	4.70E-02	Regression	6.38E-02	0.139	6.55E-03	0.00E+00	3.86E-03	0.41	0.92	2.05	9.42E-03	4.21E-03	1.88E-03
Pesticides													
4,4'-DDT	4.60E-02	Regression	5.77E-01	Regresson	8.00E-03	0.00E+00	2.98E-02	0.50	1.58	5.00	5.96E-02	1.88E-02	5.96E-03
Aldrin	2.30E-03	3.300	7.59E-03	0.139	3.20E-04	0.00E+00	4.14E-04	0.07	0.16	0.35	5.91E-03	2.64E-03	1.18E-03
alpha-BHC	2.30E-03	1.000	2.30E-03	1.735	3.99E-03	0.00E+00	3.68E-04	0.56	1.12	2.25	6.58E-04	3.28E-04	1.64E-04
alpha-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	4.99E-04	2.14	4.79	10.7	2.33E-04	1.04E-04	4.66E-05
beta-BHC	2.30E-03	1.000	2.30E-03	1.719	3.95E-03	0.00E+00	3.66E-04	0.56	1.12	2.25	6.54E-04	3.26E-04	1.63E-04
delta-BHC	2.30E-03	1.000	2.30E-03	1.311	3.02E-03	0.00E+00	3.10E-04	0.56	1.12	2.25	5.53E-04	2.76E-04	1.38E-04
Endosulfan I	2.30E-03	1.000	2.30E-03	1.687	3.88E-03	0.00E+00	3.62E-04	10.0	22.4	50.0	3.62E-05	1.62E-05	7.23E-06
Endosulfan II	4.70E-03	1.000	4.70E-03	0.886	4.16E-03	0.00E+00	5.12E-04	10.0	22.4	50.0	5.12E-05	2.29E-05	1.02E-05
Endrin	2.40E-03	3.600	8.64E-03	0.535	1.28E-03	0.00E+00	5.26E-04	0.021	0.047	0.104	2.53E-02	1.13E-02	5.05E-03
gamma-BHC (Lindane)	2.30E-03	26.60	6.12E-02	1.852	4.26E-03	0.00E+00	3.35E-03	4.00	8.94	20.0	8.38E-04	3.75E-04	1.68E-04
gamma-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	4.99E-04	2.14	4.79	10.7	2.33E-04	1.04E-04	4.66E-05
Heptachlor	2.30E-02	3.000	6.90E-02	0.174	4.01E-03	0.00E+00	3.84E-03	0.28	0.62	1.38	1.40E-02	6.24E-03	2.79E-03
Heptachlor epoxide	2.30E-03	10.00	2.30E-02	0.566	1.30E-03	0.00E+00	1.25E-03	0.28	0.62	1.38	4.54E-03	2.03E-03	9.08E-04
Methoxychlor	4.60E-02	1.000	4.60E-02	0.525	2.41E-02	0.00E+00	4.02E-03	355	794	1,775	1.13E-05	5.06E-06	2.26E-06
Toxaphene	1.20E-01	1.000	1.20E-01	0.355	4.25E-02	0.00E+00	9.25E-03	1.00	2.24	5.00	9.25E-03	4.14E-03	1.85E-03
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	1.30E-02	1.000	1.30E-02	1.000	1.30E-02	0.00E+00	1.51E-03	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	2.40E-01	0.500	1.20E-01	0.792	1.90E-01	0.00E+00	1.88E-02	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.30E-02	0.560	7.28E-03	1.426	1.85E-02	0.00E+00	1.55E-03	80.4	180	402	1.93E-05	8.63E-06	3.86E-06
1,2-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.452	3.19E-02	0.00E+00	2.64E-03	80.4	180	402	3.29E-05	1.47E-05	6.57E-06
1,3-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.296	2.99E-02	0.00E+00	2.52E-03	80.4	180	402	3.14E-05	1.40E-05	6.27E-06
1,4-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.475	3.22E-02	0.00E+00	2.66E-03	80.4	180	402	3.31E-05	1.48E-05	6.62E-06

Attachment Table H-1-5

Summary of American Robin Exposure Doses (Omnivore) - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
4-Bromophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.566	1.36E-01	0.00E+00	2.15E-02	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.593	1.42E-01	0.00E+00	2.19E-02	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	2.40E-01	1.690	4.06E-01	0.246	5.91E-02	0.00E+00	2.53E-02	0.113	0.253	0.565	2.24E-01	1.00E-01	4.48E-02
Hexachlorobutadiene	2.40E-01	1.000	2.40E-01	0.675	1.62E-01	0.00E+00	2.31E-02	3.39	7.58	17.0	6.82E-03	3.05E-03	1.36E-03
Hexachlorocyclopentadiene	2.40E-01	1.000	2.40E-01	0.393	9.43E-02	0.00E+00	1.91E-02	NA	NA	NA	NA	NA	NA
Hexachloroethane	2.40E-01	1.000	2.40E-01	1.439	3.45E-01	0.00E+00	3.42E-02	NA	NA	NA	NA	NA	NA
Dioxin/Furans													
2,3,7,8 TCDD (TEQ)	2.67E-07	Regression	5.81E-07	0.135	3.62E-08	0.00E+00	3.29E-08	0.000014	0.000044	0.00014	2.35E-03	7.43E-04	2.35E-04

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0074 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.435 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.519 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.046 = Proportion of diet composed of soil
WIR = 0.0129 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0635 = Body weight (kg)

Attachment Table H-1-6

Summary of American Robin Exposure Doses (Invertivore) - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	3.90E+01	3.162	1.23E+02	0.084	3.27E+00	0.00E+00	9.61E+00	2.66	5.95	13.3	**3.61E+00**	**1.62E+00**	7.23E-01
Copper	4.27E+01	Regression	1.44E+01	Regresson	8.57E+00	0.00E+00	1.26E+00	4.05	7.00	12.1	3.12E-01	1.80E-01	1.04E-01
Lead	2.04E+02	Regression	5.88E+01	Regresson	5.24E+00	0.00E+00	5.27E+00	3.85	8.61	19.3	**1.37E+00**	6.12E-01	2.74E-01
Mercury	1.00E-01	20.63	2.06E+00	Regresson	1.06E-01	0.00E+00	1.59E-01	0.49	0.77	1.20	3.24E-01	2.07E-01	1.32E-01
Selenium	2.90E+00	Regression	2.02E+00	Regresson	1.64E+00	0.00E+00	1.66E-01	0.44	0.81	1.50	3.78E-01	2.04E-01	1.11E-01
Silver	2.40E+00	15.34	3.68E+01	0.037	8.81E-02	0.00E+00	2.83E+00	4.04	9.03	20.2	7.02E-01	3.14E-01	1.40E-01
Polychlorinated Biphenyls													
Aroclor-1016	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
Aroclor-1221	2.30E-02	Regression	2.41E-02	0.749	1.72E-02	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
Aroclor-1232	2.30E-02	Regression	2.41E-02	0.515	1.18E-02	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
Aroclor-1242	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
Aroclor-1248	2.30E-02	Regression	2.41E-02	0.184	4.24E-03	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
Aroclor-1254	2.30E-02	Regression	2.41E-02	0.139	3.20E-03	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
Aroclor-1260	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
Aroclor-1262	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
Aroclor-1268	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	1.94E-03	0.41	0.92	2.05	4.73E-03	2.11E-03	9.45E-04
PCB (total)	4.70E-02	Regression	6.38E-02	0.139	6.55E-03	0.00E+00	5.07E-03	0.41	0.92	2.05	1.24E-02	5.53E-03	2.47E-03
Pesticides													
4,4'-DDT	4.60E-02	Regression	5.77E-01	Regresson	8.00E-03	0.00E+00	4.44E-02	0.50	1.58	5.00	8.88E-02	2.81E-02	8.88E-03
Aldrin	2.30E-03	3.300	7.59E-03	0.139	3.20E-04	0.00E+00	5.91E-04	0.07	0.16	0.35	8.43E-03	3.77E-03	1.69E-03
alpha-BHC	2.30E-03	1.000	2.30E-03	1.735	3.99E-03	0.00E+00	1.85E-04	0.56	1.12	2.25	3.30E-04	1.65E-04	8.22E-05
alpha-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	7.15E-04	2.14	4.79	10.7	3.34E-04	1.49E-04	6.68E-05
beta-BHC	2.30E-03	1.000	2.30E-03	1.719	3.95E-03	0.00E+00	1.85E-04	0.56	1.12	2.25	3.30E-04	1.65E-04	8.22E-05
delta-BHC	2.30E-03	1.000	2.30E-03	1.311	3.02E-03	0.00E+00	1.85E-04	0.56	1.12	2.25	3.30E-04	1.65E-04	8.22E-05
Endosulfan I	2.30E-03	1.000	2.30E-03	1.687	3.88E-03	0.00E+00	1.85E-04	10.0	22.4	50.0	1.85E-05	8.28E-06	3.70E-06
Endosulfan II	4.70E-03	1.000	4.70E-03	0.886	4.16E-03	0.00E+00	3.78E-04	10.0	22.4	50.0	3.78E-05	1.69E-05	7.56E-06
Endrin	2.40E-03	3.600	8.64E-03	0.535	1.28E-03	0.00E+00	6.72E-04	0.021	0.047	0.104	3.23E-02	1.44E-02	6.46E-03
gamma-BHC (Lindane)	2.30E-03	26.60	6.12E-02	1.852	4.26E-03	0.00E+00	4.70E-03	4.00	8.94	20.0	1.18E-03	5.26E-04	2.35E-04
gamma-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	7.15E-04	2.14	4.79	10.7	3.34E-04	1.49E-04	6.68E-05
Heptachlor	2.30E-02	3.000	6.90E-02	0.174	4.01E-03	0.00E+00	5.38E-03	0.28	0.62	1.38	1.95E-02	8.74E-03	3.91E-03
Heptachlor epoxide	2.30E-03	10.00	2.30E-02	0.566	1.30E-03	0.00E+00	1.77E-03	0.28	0.62	1.38	6.44E-03	2.88E-03	1.29E-03
Methoxychlor	4.60E-02	1.000	4.60E-02	0.525	2.41E-02	0.00E+00	3.70E-03	355	794	1,775	1.04E-05	4.66E-06	2.08E-06
Toxaphene	1.20E-01	1.000	1.20E-01	0.355	4.25E-02	0.00E+00	9.65E-03	1.00	2.24	5.00	9.65E-03	4.32E-03	1.93E-03
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	1.30E-02	1.000	1.30E-02	1.000	1.30E-02	0.00E+00	1.05E-03	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	2.40E-01	0.500	1.20E-01	0.792	1.90E-01	0.00E+00	1.01E-02	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.30E-02	0.560	7.28E-03	1.426	1.85E-02	0.00E+00	6.07E-04	80.4	180	402	7.55E-06	3.38E-06	1.51E-06
1,2-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.452	3.19E-02	0.00E+00	1.05E-03	80.4	180	402	1.30E-05	5.82E-06	2.60E-06
1,3-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.296	2.99E-02	0.00E+00	1.05E-03	80.4	180	402	1.30E-05	5.82E-06	2.60E-06
1,4-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.475	3.22E-02	0.00E+00	1.05E-03	80.4	180	402	1.30E-05	5.82E-06	2.60E-06

Attachment Table H-1-6

Summary of American Robin Exposure Doses (Invertivore) - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
4-Bromophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.566	1.36E-01	0.00E+00	1.93E-02	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.593	1.42E-01	0.00E+00	1.93E-02	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	2.40E-01	1.690	4.06E-01	0.246	5.91E-02	0.00E+00	3.20E-02	0.113	0.253	0.565	2.83E-01	1.27E-01	5.67E-02
Hexachlorobutadiene	2.40E-01	1.000	2.40E-01	0.675	1.62E-01	0.00E+00	1.93E-02	3.39	7.58	17.0	5.70E-03	2.55E-03	1.14E-03
Hexachlorocyclopentadiene	2.40E-01	1.000	2.40E-01	0.393	9.43E-02	0.00E+00	1.93E-02	NA	NA	NA	NA	NA	NA
Hexachloroethane	2.40E-01	1.000	2.40E-01	1.439	3.45E-01	0.00E+00	1.93E-02	NA	NA	NA	NA	NA	NA
Dioxin/Furans													
2,3,7,8 TCDD (TEQ)	2.67E-07	Regression	5.81E-07	0.135	3.62E-08	0.00E+00	4.56E-08	0.000014	0.000044	0.00014	3.26E-03	1.03E-03	3.26E-04

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0051 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.954 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.046 = Proportion of diet composed of soil
WIR = 0.0129 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0635 = Body weight (kg)

Attachment Table H-1-7

Summary of Mourning Dove Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	3.90E+01	3.162	1.23E+02	0.084	3.27E+00	0.00E+00	1.01E+00	2.66	5.95	13.3	3.79E-01	1.69E-01	7.57E-02
Copper	4.27E+01	Regression	1.44E+01	Regresson	8.57E+00	0.00E+00	2.05E+00	4.05	7.00	12.1	5.05E-01	2.92E-01	1.69E-01
Lead	2.04E+02	Regression	5.88E+01	Regresson	5.24E+00	0.00E+00	3.02E+00	1.63	2.31	3.26	**1.85E+00**	**1.31E+00**	9.27E-01
Mercury	1.00E-01	20.63	2.06E+00	Regresson	1.06E-01	0.00E+00	2.10E-02	0.45	0.64	0.90	4.66E-02	3.29E-02	2.33E-02
Selenium	2.90E+00	Regression	2.02E+00	Regresson	1.64E+00	0.00E+00	3.40E-01	0.29	0.41	0.58	**1.17E+00**	8.29E-01	5.87E-01
Silver	2.40E+00	15.34	3.68E+01	0.037	8.81E-02	0.00E+00	4.05E-02	4.04	9.03	20.2	1.00E-02	4.49E-03	2.01E-03
Polychlorinated Biphenyls													
Aroclor-1016	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	1.63E-03	0.36	0.80	1.80	4.54E-03	2.03E-03	9.07E-04
Aroclor-1221	2.30E-02	Regression	2.41E-02	0.749	1.72E-02	0.00E+00	3.48E-03	0.36	0.80	1.80	9.68E-03	4.33E-03	1.94E-03
Aroclor-1232	2.30E-02	Regression	2.41E-02	0.515	1.18E-02	0.00E+00	2.47E-03	0.36	0.80	1.80	6.86E-03	3.07E-03	1.37E-03
Aroclor-1242	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	0.00E+00	1.63E-03	0.36	0.80	1.80	4.54E-03	2.03E-03	9.07E-04
Aroclor-1248	2.30E-02	Regression	2.41E-02	0.184	4.24E-03	0.00E+00	1.03E-03	0.36	0.80	1.80	2.86E-03	1.28E-03	5.73E-04
Aroclor-1254	2.30E-02	Regression	2.41E-02	0.139	3.20E-03	0.00E+00	8.35E-04	0.36	0.80	1.80	2.32E-03	1.04E-03	4.64E-04
Aroclor-1260	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	6.87E-04	0.36	0.80	1.80	1.91E-03	8.53E-04	3.82E-04
Aroclor-1262	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	6.87E-04	0.36	0.80	1.80	1.91E-03	8.53E-04	3.82E-04
Aroclor-1268	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	0.00E+00	6.87E-04	0.36	0.80	1.80	1.91E-03	8.53E-04	3.82E-04
PCB (total)	4.70E-02	Regression	6.38E-02	0.139	6.55E-03	0.00E+00	1.71E-03	0.36	0.80	1.80	4.74E-03	2.12E-03	9.48E-04
Pesticides													
4,4'-DDT	4.60E-02	Regression	5.77E-01	Regresson	8.00E-03	0.00E+00	1.97E-03	0.50	1.58	5.00	3.94E-03	1.25E-03	3.94E-04
Aldrin	2.30E-03	3.300	7.59E-03	0.139	3.20E-04	0.00E+00	8.35E-05	0.07	0.16	0.35	1.19E-03	5.33E-04	2.38E-04
alpha-BHC	2.30E-03	1.000	2.30E-03	1.735	3.99E-03	0.00E+00	7.78E-04	0.56	1.12	2.25	1.39E-03	6.93E-04	3.46E-04
alpha-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	9.46E-05	1.19	2.66	5.95	7.95E-05	3.55E-05	1.59E-05
beta-BHC	2.30E-03	1.000	2.30E-03	1.719	3.95E-03	0.00E+00	7.71E-04	0.56	1.12	2.25	1.38E-03	6.86E-04	3.42E-04
delta-BHC	2.30E-03	1.000	2.30E-03	1.311	3.02E-03	0.00E+00	5.93E-04	0.56	1.12	2.25	1.06E-03	5.28E-04	2.64E-04
Endosulfan I	2.30E-03	1.000	2.30E-03	1.687	3.88E-03	0.00E+00	7.57E-04	10.0	22.4	50.0	7.57E-05	3.38E-05	1.51E-05
Endosulfan II	4.70E-03	1.000	4.70E-03	0.886	4.16E-03	0.00E+00	8.34E-04	10.0	22.4	50.0	8.34E-05	3.73E-05	1.67E-05
Endrin	2.40E-03	3.600	8.64E-03	0.535	1.28E-03	0.00E+00	2.67E-04	0.30	0.67	1.50	8.89E-04	3.97E-04	1.78E-04
gamma-BHC (Lindane)	2.30E-03	26.60	6.12E-02	1.852	4.26E-03	0.00E+00	8.29E-04	4.00	8.94	20.0	2.07E-04	9.26E-05	4.14E-05
gamma-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	0.00E+00	9.46E-05	1.19	2.66	5.95	7.95E-05	3.55E-05	1.59E-05
Heptachlor	2.30E-02	3.000	6.90E-02	0.174	4.01E-03	0.00E+00	9.87E-04	0.28	0.62	1.38	3.59E-03	1.60E-03	7.17E-04
Heptachlor epoxide	2.30E-03	10.00	2.30E-02	0.566	1.30E-03	0.00E+00	2.69E-04	0.28	0.62	1.38	9.77E-04	4.37E-04	1.95E-04
Methoxychlor	4.60E-02	1.000	4.60E-02	0.525	2.41E-02	0.00E+00	5.02E-03	355	794	1,775	1.42E-05	6.33E-06	2.83E-06
Toxaphene	1.20E-01	1.000	1.20E-01	0.355	4.25E-02	0.00E+00	9.24E-03	1.00	2.24	5.00	9.24E-03	4.13E-03	1.85E-03
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	1.30E-02	1.000	1.30E-02	1.000	1.30E-02	0.00E+00	2.59E-03	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	2.40E-01	0.500	1.20E-01	0.792	1.90E-01	0.00E+00	3.83E-02	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.30E-02	0.560	7.28E-03	1.426	1.85E-02	0.00E+00	3.64E-03	80.4	180	402	4.52E-05	2.02E-05	9.04E-06
1,2-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.452	3.19E-02	0.00E+00	6.16E-03	80.4	180	402	7.66E-05	3.42E-05	1.53E-05
1,3-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.296	2.99E-02	0.00E+00	5.77E-03	80.4	180	402	7.18E-05	3.21E-05	1.44E-05
1,4-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.475	3.22E-02	0.00E+00	6.21E-03	80.4	180	402	7.73E-05	3.46E-05	1.55E-05

Attachment Table H-1-7

Summary of Mourning Dove Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
4-Bromophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.566	1.36E-01	0.00E+00	2.81E-02	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.593	1.42E-01	0.00E+00	2.93E-02	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	2.40E-01	1.690	4.06E-01	0.246	5.91E-02	0.00E+00	1.36E-02	0.113	0.253	0.565	1.20E-01	5.37E-02	2.40E-02
Hexachlorobutadiene	2.40E-01	1.000	2.40E-01	0.675	1.62E-01	0.00E+00	3.30E-02	3.39	7.58	17.0	9.75E-03	4.36E-03	1.95E-03
Hexachlorocyclopentadiene	2.40E-01	1.000	2.40E-01	0.393	9.43E-02	0.00E+00	2.02E-02	NA	NA	NA	NA	NA	NA
Hexachloroethane	2.40E-01	1.000	2.40E-01	1.439	3.45E-01	0.00E+00	6.77E-02	NA	NA	NA	NA	NA	NA
Dioxin/Furans													
2,3,7,8 TCDD (TEQ)	2.67E-07	Regression	5.81E-07	0.135	3.62E-08	0.00E+00	9.50E-09	0.000014	0.000044	0.00014	6.78E-04	2.15E-04	6.78E-05

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0209 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.950 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.050 = Proportion of diet composed of soil
WIR = 0.0175 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.1050 = Body weight (kg)

Attachment Table H-1-8

Summary of Red-tailed Hawk Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Omnivore Soil-Mammal BAF	Omnivore Small Mammal Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																			
Chromium	3.90E+01	3.162	1.23E+02	0.084	3.27E+00	Regresson	3.29E+00	Regresson	3.42E+00	Regresson	3.42E+00	0.00E+00	1.41E-01	2.66	5.95	13.3	5.30E-02	2.37E-02	1.06E-02
Copper	4.27E+01	Regression	1.44E+01	Regresson	8.57E+00	Regresson	1.18E+01	Regresson	1.33E+01	Regresson	1.60E+01	0.00E+00	6.04E-01	4.05	7.00	12.1	1.49E-01	8.63E-02	4.99E-02
Lead	2.04E+02	Regression	5.88E+01	Regresson	5.24E+00	Regresson	1.13E+01	Regresson	8.53E+00	Regresson	2.16E+01	0.00E+00	6.22E-01	3.85	8.61	19.3	1.61E-01	7.22E-02	3.23E-02
Mercury	1.00E-01	20.63	2.06E+00	Regresson	1.06E-01	0.130	1.30E-02	0.192	1.92E-02	0.192	1.92E-02	0.00E+00	7.93E-04	0.49	0.77	1.20	1.62E-03	1.03E-03	6.61E-04
Selenium	2.90E+00	Regression	2.02E+00	Regresson	1.64E+00	Regresson	9.85E-01	Regresson	9.85E-01	Regresson	9.85E-01	0.00E+00	4.07E-02	0.44	0.81	1.50	9.25E-02	5.01E-02	2.71E-02
Silver	2.40E+00	15.34	3.68E+01	0.037	8.81E-02	0.810	1.94E+00	0.007	1.68E-02	0.501	1.20E+00	0.00E+00	2.52E-02	4.04	9.03	20.2	6.23E-03	2.79E-03	1.25E-03
Polychlorinated Biphenyls																			
Aroclor-1016	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	See footnote	1.56E-02	See footnote	8.13E-03	See footnote	2.32E-02	0.00E+00	6.47E-04	0.41	0.92	2.05	1.58E-03	7.06E-04	3.16E-04
Aroclor-1221	2.30E-02	Regression	2.41E-02	0.749	1.72E-02	See footnote	2.06E-02	See footnote	1.75E-02	See footnote	2.37E-02	0.00E+00	8.50E-04	0.41	0.92	2.05	2.07E-03	9.27E-04	4.15E-04
Aroclor-1232	2.30E-02	Regression	2.41E-02	0.515	1.18E-02	See footnote	1.78E-02	See footnote	1.24E-02	See footnote	2.34E-02	0.00E+00	7.39E-04	0.41	0.92	2.05	1.80E-03	8.06E-04	3.60E-04
Aroclor-1242	2.30E-02	Regression	2.41E-02	0.323	7.43E-03	See footnote	1.56E-02	See footnote	8.13E-03	See footnote	2.32E-02	0.00E+00	6.47E-04	0.41	0.92	2.05	1.58E-03	7.06E-04	3.16E-04
Aroclor-1248	2.30E-02	Regression	2.41E-02	0.184	4.24E-03	See footnote	1.40E-02	See footnote	5.09E-03	See footnote	2.31E-02	0.00E+00	5.81E-04	0.41	0.92	2.05	1.42E-03	6.34E-04	2.83E-04
Aroclor-1254	2.30E-02	Regression	2.41E-02	0.139	3.20E-03	See footnote	1.34E-02	See footnote	4.10E-03	See footnote	2.30E-02	0.00E+00	5.60E-04	0.41	0.92	2.05	1.36E-03	6.10E-04	2.73E-04
Aroclor-1260	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	See footnote	1.30E-02	See footnote	3.35E-03	See footnote	2.30E-02	0.00E+00	5.43E-04	0.41	0.92	2.05	1.33E-03	5.93E-04	2.65E-04
Aroclor-1262	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	See footnote	1.30E-02	See footnote	3.35E-03	See footnote	2.30E-02	0.00E+00	5.43E-04	0.41	0.92	2.05	1.33E-03	5.93E-04	2.65E-04
Aroclor-1268	2.30E-02	Regression	2.41E-02	0.105	2.42E-03	See footnote	1.30E-02	See footnote	3.35E-03	See footnote	2.30E-02	0.00E+00	5.43E-04	0.41	0.92	2.05	1.33E-03	5.93E-04	2.65E-04
PCB (total)	4.70E-02	Regression	6.38E-02	0.139	6.55E-03	See footnote	3.43E-02	See footnote	8.66E-03	See footnote	5.90E-02	0.00E+00	1.40E-03	0.41	0.92	2.05	3.41E-03	1.52E-03	6.81E-04
Pesticides																			
4,4'-DDT	4.60E-02	Regression	5.77E-01	Regresson	8.00E-03	See footnote	2.76E-01	See footnote	2.03E-02	See footnote	4.81E-01	0.00E+00	1.03E-02	0.08	0.18	0.40	1.29E-01	5.78E-02	2.59E-02
Aldrin	2.30E-03	3.300	7.59E-03	0.139	3.20E-04	See footnote	3.78E-03	See footnote	5.13E-04	See footnote	6.56E-03	0.00E+00	1.46E-04	0.07	0.16	0.35	2.08E-03	9.32E-04	4.17E-04
alpha-BHC	2.30E-03	1.000	2.30E-03	1.735	3.99E-03	See footnote	3.16E-03	See footnote	3.92E-03	See footnote	2.38E-03	0.00E+00	1.30E-04	0.56	1.12	2.25	2.32E-04	1.16E-04	5.78E-05
alpha-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	See footnote	4.56E-03	See footnote	6.02E-04	See footnote	7.89E-03	0.00E+00	1.75E-04	2.14	4.79	10.7	8.19E-05	3.66E-05	1.64E-05
beta-BHC	2.30E-03	1.000	2.30E-03	1.719	3.95E-03	See footnote	3.14E-03	See footnote	3.88E-03	See footnote	2.38E-03	0.00E+00	1.29E-04	0.56	1.12	2.25	2.31E-04	1.15E-04	5.74E-05
delta-BHC	2.30E-03	1.000	2.30E-03	1.311	3.02E-03	See footnote	2.66E-03	See footnote	2.98E-03	See footnote	2.33E-03	0.00E+00	1.10E-04	0.56	1.12	2.25	1.96E-04	9.78E-05	4.88E-05
Endosulfan I	2.30E-03	1.000	2.30E-03	1.687	3.88E-03	See footnote	3.11E-03	See footnote	3.81E-03	See footnote	2.37E-03	0.00E+00	1.28E-04	10.0	22.4	50.0	1.28E-05	5.71E-06	2.55E-06
Endosulfan II	4.70E-03	1.000	4.70E-03	0.886	4.16E-03	See footnote	4.43E-03	See footnote	4.19E-03	See footnote	4.67E-03	0.00E+00	1.83E-04	10.0	22.4	50.0	1.83E-05	8.18E-06	3.66E-06
Endrin	2.40E-03	3.600	8.64E-03	0.535	1.28E-03	See footnote	4.76E-03	See footnote	1.46E-03	See footnote	7.48E-03	0.00E+00	1.85E-04	0.021	0.047	0.104	8.87E-03	3.97E-03	1.77E-03
gamma-BHC (Lindane)	2.30E-03	26.60	6.12E-02	1.852	4.26E-03	See footnote	3.10E-02	See footnote	5.35E-03	See footnote	5.09E-02	0.00E+00	1.16E-03	4.00	8.94	20.0	2.90E-04	1.30E-04	5.80E-05
gamma-Chlordane	2.30E-03	4.000	9.20E-03	0.165	3.79E-04	See footnote	4.56E-03	See footnote	6.02E-04	See footnote	7.89E-03	0.00E+00	1.75E-04	2.14	4.79	10.7	8.19E-05	3.66E-05	1.64E-05
Heptachlor	2.30E-02	3.000	6.90E-02	0.174	4.01E-03	See footnote	3.49E-02	See footnote	5.76E-03	See footnote	6.00E-02	0.00E+00	1.36E-03	0.28	0.62	1.38	4.93E-03	2.20E-03	9.86E-04
Heptachlor epoxide	2.30E-03	10.00	2.30E-02	0.566	1.30E-03	See footnote	1.15E-02	See footnote	1.76E-03	See footnote	1.93E-02	0.00E+00	4.35E-04	0.28	0.62	1.38	1.58E-03	7.06E-04	3.16E-04
Methoxychlor	4.60E-02	1.000	4.60E-02	0.525	2.41E-02	See footnote	3.49E-02	See footnote	2.51E-02	See footnote	4.50E-02	0.00E+00	1.45E-03	355	794	1,775	4.08E-06	1.82E-06	8.15E-07
Toxaphene	1.20E-01	1.000	1.20E-01	0.355	4.25E-02	See footnote	8.05E-02	See footnote	4.60E-02	See footnote	1.16E-01	0.00E+00	3.35E-03	1.00	2.24	5.00	3.35E-03	1.50E-03	6.70E-04
Volatile/Semivolatile Organics																			
1,1,2,2-Tetrachloroethane	1.30E-02	1.000	1.30E-02	1.000	1.30E-02	See footnote	1.30E-02	See footnote	1.30E-02	See footnote	1.30E-02	0.00E+00	5.37E-04	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	2.40E-01	0.500	1.20E-01	0.792	1.90E-01	See footnote	1.58E-01	See footnote	1.90E-01	See footnote	1.39E-01	0.00E+00	6.79E-03	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.30E-02	0.560	7.28E-03	1.426	1.85E-02	See footnote	1.31E-02	See footnote	1.82E-02	See footnote	8.55E-03	0.00E+00	5.52E-04	80.4	180	402	6.87E-06	3.07E-06	1.37E-06
1,2-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.452	3.19E-02	See footnote	2.26E-02	See footnote	3.10E-02	See footnote	1.39E-02	0.00E+00	9.28E-04	80.4	180	402	1.15E-05	5.16E-06	2.31E-06
1,3-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.296	2.99E-02	See footnote	2.16E-02	See footnote	2.91E-02	See footnote	1.38E-02	0.00E+00	8.86E-04	80.4	180	402	1.10E-05	4.93E-06	2.20E-06
1,4-Dichlorobenzene	1.30E-02	1.000	1.30E-02	2.475	3.22E-02	See footnote	2.28E-02	See footnote	3.13E-02	See footnote	1.39E-02	0.00E+00	9.34E-04	80.4	180	402	1.16E-05	5.19E-06	2.32E-06
4-Bromophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.566	1.36E-01	See footnote	1.87E-01	See footnote	1.40E-01	See footnote	2.35E-01	0.00E+00	7.75E-03	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	2.40E-01	1.000	2.40E-01	0.593	1.42E-01	See footnote	1.90E-01	See footnote	1.47E-01	See footnote	2.35E-01	0.00E+00	7.89E-03	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	2.40E-01	1.690	4.06E-01	0.246	5.91E-02	See footnote	2.26E-01	See footnote	7.04E-02	See footnote	3.68E-01	0.00E+00	9.05E-03	0.113	0.253	0.565	8.01E-02	3.58E-02	1.60E-02
Hexachlorobutadiene	2.40E-01	1.000	2.40E-01	0.675	1.62E-01	See footnote	2.00E-01	See footnote	1.66E-01	See footnote	2.36E-01	0.00E+00	8.30E-03	3.39	7.58	17.0	2.45E-03	1.09E-03	4.90E-04
Hexachlorocyclopentadiene	2.40E-01	1.000	2.40E-01	0.393	9.43E-02	See footnote	1.66E-01	See footnote	1.01E-01	See footnote	2.33E-01	0.00E+00	6.89E-03	NA	NA	NA	NA	NA	NA
Hexachloroethane	2.40E-01	1.000	2.40E-01	1.439	3.45E-01	See footnote	2.94E-01	See footnote	3.41E-01	See footnote	2.45E-01	0.00E+00	1.21E-02	NA	NA	NA	NA	NA	NA

Attachment Table H-1-8

Summary of Red-tailed Hawk Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Omnivore Soil-Mammal BAF	Omnivore Small Mammal Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Dioxin/Furans																			
2,3,7,8 TCDD (TEQ)	2.67E-07	Regression	5.81E-07	0.135	3.62E-08	Regresson	1.34E-07	Regresson	1.34E-07	Regresson	1.34E-07	0.00E+00	5.52E-09	0.000014	0.000044	0.00014	3.94E-04	1.25E-04	3.94E-05

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0395 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
FCxi = Chemical-specific = Concentration of chemical in food item (omnivorous small mammals, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (omnivorous small mammals)
FCxi = Chemical-specific = Concentration of chemical in food item (herbivorous small mammals, dry weight basis)
PDFi = 0.500 = Proportion of diet composed of food item (herbivorous small mammals)
FCxi = Chemical-specific = Concentration of chemical in food item (insectivorous small mammals, dry weight basis)
PDFi = 0.500 = Proportion of diet composed of food item (insectivorous small mammals)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.000 = Proportion of diet composed of soil
WIR = 0.0680 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.957 = Body weight (kg)

Attachment Table H-1-9

Summary of Meadow Vole Exposure Doses - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	95% UCL Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	1.19E+01	0.320	3.82E+00	0.041	4.89E-01	0.00E+00	4.05E-02	2.40	5.37	12.0	1.69E-02	7.55E-03	3.38E-03
Lead	5.23E+01	Regression	1.96E+01	Regresson	2.44E+00	0.00E+00	1.94E-01	4.70	6.47	8.90	4.13E-02	3.00E-02	2.18E-02
Mercury	4.17E-02	1.186	4.95E-02	Regresson	6.56E-02	0.00E+00	3.16E-03	0.032	0.072	0.16	9.87E-02	4.41E-02	1.97E-02
Selenium	1.17E+00	Regression	1.04E+00	Regresson	6.01E-01	0.00E+00	3.04E-02	0.20	0.26	0.33	1.52E-01	1.18E-01	9.22E-02

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0021	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.020	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.956	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.024	= Proportion of diet composed of soil
WIR =	0.0090	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.0428	= Body weight (kg)

Attachment Table H-1-10

Summary of Short-Tailed Shrew Exposure Doses - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	95% UCL Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	1.19E+01	0.320	3.82E+00	0.041	4.89E-01	0.00E+00	4.17E-01	2.40	5.37	12.0	1.74E-01	7.78E-02	3.48E-02
Lead	5.23E+01	Regression	1.96E+01	Regresson	2.44E+00	0.00E+00	2.04E+00	4.70	6.47	8.90	4.34E-01	3.15E-01	2.29E-01
Mercury	4.17E-02	1.186	4.95E-02	Regresson	6.56E-02	0.00E+00	4.36E-03	0.032	0.072	0.16	1.36E-01	6.09E-02	2.72E-02
Selenium	1.17E+00	Regression	1.04E+00	Regresson	6.01E-01	0.00E+00	9.15E-02	0.20	0.26	0.33	4.57E-01	3.56E-01	2.77E-01

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0015	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.823	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.047	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.130	= Proportion of diet composed of soil
WIR =	0.0038	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.0169	= Body weight (kg)

Attachment Table H-1-11

Summary of White-Footed Mouse Exposure Doses - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	95% UCL Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	1.19E+01	0.320	3.82E+00	0.041	4.89E-01	0.00E+00	5.48E-02	2.40	5.37	12.0	2.28E-02	1.02E-02	4.56E-03
Lead	5.23E+01	Regression	1.96E+01	Regresson	2.44E+00	0.00E+00	2.76E-01	4.70	6.47	8.90	5.87E-02	4.26E-02	3.10E-02
Mercury	4.17E-02	1.186	4.95E-02	Regresson	6.56E-02	0.00E+00	1.38E-03	0.032	0.072	0.16	4.31E-02	1.93E-02	8.63E-03
Selenium	1.17E+00	Regression	1.04E+00	Regresson	6.01E-01	0.00E+00	1.96E-02	0.20	0.26	0.33	9.81E-02	7.63E-02	5.94E-02

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.00050	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.470	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.510	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.020	= Proportion of diet composed of soil
WIR =	0.0062	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.0208	= Body weight (kg)

Attachment Table H-1-12

Summary of Red Fox Exposure Doses - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Omnivore Soil-Mammal BAF	Omnivore Small Mammal Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	95% UCL Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																			
Chromium	1.19E+01	0.320	3.82E+00	0.041	4.89E-01	Regresson	1.38E+00	Regresson	1.43E+00	Regresson	1.43E+00	0.00E+00	5.24E-02	2.40	5.37	12.0	2.18E-02	9.76E-03	4.36E-03
Lead	5.23E+01	Regression	1.96E+01	Regresson	2.44E+00	Regresson	6.21E+00	Regresson	4.21E+00	Regresson	1.11E+01	0.00E+00	2.69E-01	4.70	6.47	8.90	5.73E-02	4.16E-02	3.03E-02
Mercury	4.17E-02	1.186	4.95E-02	Regresson	6.56E-02	0.130	5.42E-03	0.067	2.80E-03	0.067	2.80E-03	0.00E+00	2.91E-04	0.15	0.19	0.25	1.94E-03	1.50E-03	1.16E-03
Selenium	1.17E+00	Regression	1.04E+00	Regresson	6.01E-01	Regresson	6.99E-01	Regresson	6.99E-01	Regresson	6.99E-01	0.00E+00	2.17E-02	0.20	0.26	0.33	1.08E-01	8.43E-02	6.56E-02

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specifi = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.1231 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specifi = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.028 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specifi = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.070 = Proportion of diet composed of food item (terrestrial plants)
FCxi = Chemical-specifi = Concentration of chemical in food item (omnivorous small mammals, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (omnivorous small mammals)
FCxi = Chemical-specifi = Concentration of chemical in food item (herbivorous small mammals, dry weight basis)
PDFi = 0.437 = Proportion of diet composed of food item (herbivorous small mammals)
FCxi = Chemical-specifi = Concentration of chemical in food item (insectivorous small mammals, dry weight basis)
PDFi = 0.437 = Proportion of diet composed of food item (insectivorous small mammals)
SCx = Chemical-specifi = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.028 = Proportion of diet composed of soil
WIR = 0.3494 = Water ingestion rate (L/day)
WC = Chemical-specifi = Concentration of chemical in water (mg/L)
BW = 4.06 = Body weight (kg)

Attachment Table H-1-13

Summary of American Robin Exposure Doses (Omnivore) - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	95% UCL Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	1.19E+01	0.320	3.82E+00	0.041	4.89E-01	0.00E+00	1.76E-01	2.66	5.95	13.3	6.62E-02	2.96E-02	1.32E-02
Lead	5.23E+01	Regression	1.96E+01	Regresson	2.44E+00	0.00E+00	8.71E-01	3.85	8.61	19.3	2.26E-01	1.01E-01	4.53E-02
Mercury	4.17E-02	1.186	4.95E-02	Regresson	6.56E-02	0.00E+00	4.11E-03	0.49	0.77	1.20	8.38E-03	5.36E-03	3.42E-03
Selenium	1.17E+00	Regression	1.04E+00	Regresson	6.01E-01	0.00E+00	5.84E-02	0.44	0.81	1.50	1.33E-01	7.18E-02	3.89E-02

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0055	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.435	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.519	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.046	= Proportion of diet composed of soil
WIR =	0.0106	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.077	= Body weight (kg)

Attachment Table H-1-14

Summary of American Robin Exposure Doses (Invertivore) - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	95% UCL Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	1.19E+01	0.320	3.82E+00	0.041	4.89E-01	0.00E+00	2.08E-01	2.66	5.95	13.3	7.82E-02	3.50E-02	1.56E-02
Lead	5.23E+01	Regression	1.96E+01	Regresson	2.44E+00	0.00E+00	1.05E+00	3.85	8.61	19.3	2.72E-01	1.22E-01	5.43E-02
Mercury	4.17E-02	1.186	4.95E-02	Regresson	6.56E-02	0.00E+00	2.44E-03	0.49	0.77	1.20	4.97E-03	3.18E-03	2.03E-03
Selenium	1.17E+00	Regression	1.04E+00	Regresson	6.01E-01	0.00E+00	5.18E-02	0.44	0.81	1.50	1.18E-01	6.37E-02	3.45E-02

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0038	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.954	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.046	= Proportion of diet composed of soil
WIR =	0.0106	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.077	= Body weight (kg)

Attachment Table H-1-15

Summary of Mourning Dove Exposure Doses - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	95% UCL Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Chromium	1.19E+01	0.320	3.82E+00	0.041	4.89E-01	0.00E+00	1.47E-01	2.66	5.95	13.3	5.54E-02	2.48E-02	1.11E-02
Lead	5.23E+01	Regression	1.96E+01	Regresson	2.44E+00	0.00E+00	6.85E-01	1.63	2.31	3.26	4.20E-01	2.97E-01	2.10E-01
Mercury	4.17E-02	1.186	4.95E-02	Regresson	6.56E-02	0.00E+00	8.94E-03	0.45	0.64	0.90	1.99E-02	1.41E-02	9.94E-03
Selenium	1.17E+00	Regression	1.04E+00	Regresson	6.01E-01	0.00E+00	8.74E-02	0.29	0.41	0.58	3.01E-01	2.13E-01	1.51E-01

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0176	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.950	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.050	= Proportion of diet composed of soil
WIR =	0.0148	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.1265	= Body weight (kg)

Attachment Table H-1-16

Summary of Red-tailed Hawk Exposure Doses - Baseline (Step 3A) - 95% UCL

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Omnivore Soil-Mammal BAF	Omnivore Small Mammal Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	95% UCL Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																			
Chromium	1.19E+01	0.320	3.82E+00	0.041	4.89E-01	Regresson	1.38E+00	Regresson	1.43E+00	Regresson	1.43E+00	0.00E+00	4.58E-02	2.66	5.95	13.3	1.72E-02	7.71E-03	3.45E-03
Lead	5.23E+01	Regression	1.96E+01	Regresson	2.44E+00	Regresson	6.21E+00	Regresson	4.21E+00	Regresson	1.11E+01	0.00E+00	2.45E-01	3.85	8.61	19.3	6.37E-02	2.85E-02	1.27E-02
Mercury	4.17E-02	1.186	4.95E-02	Regresson	6.56E-02	0.130	5.42E-03	0.067	2.80E-03	0.067	2.80E-03	0.00E+00	8.96E-05	0.49	0.77	1.20	1.83E-04	1.17E-04	7.47E-05
Selenium	1.17E+00	Regression	1.04E+00	Regresson	6.01E-01	Regresson	6.99E-01	Regresson	6.99E-01	Regresson	6.99E-01	0.00E+00	2.24E-02	0.44	0.81	1.50	5.08E-02	2.75E-02	1.49E-02

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0360	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (omnivorous small mammals, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (omnivorous small mammals)
FCxi =	Chemical-specific	= Concentration of chemical in food item (herbivorous small mammals, dry weight basis)
PDFi =	0.500	= Proportion of diet composed of food item (herbivorous small mammals)
FCxi =	Chemical-specific	= Concentration of chemical in food item (insectivorous small mammals, dry weight basis)
PDFi =	0.500	= Proportion of diet composed of food item (insectivorous small mammals)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
WIR =	0.0639	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	1.126	= Body weight (kg)

Attachment Table H-2-1

Summary of Belted Kingfisher Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	7.957	2.87E+01	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	1.03E+00	4.05	7.00	12.1	2.53E-01	1.47E-01	8.48E-02
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	2.72E-01	3.85	8.61	19.3	7.05E-02	3.15E-02	1.41E-02
Mercury	3.60E-02	2.868	1.03E-01	Regresson	6.05E-02	4.580	1.65E-01	0.00E+00	3.25E-02	0.026	0.045	0.078	**1.25E+00**	7.21E-01	4.16E-01
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	6.66E+00	66.1	148	331	1.01E-01	4.50E-02	2.01E-02
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	3.06E-06	0.000014	0.000044	0.00014	2.19E-01	6.92E-02	2.19E-02

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0262	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.160	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	0.840	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of sediment
WIR =	0.0211	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.125	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-2

Summary of Great Blue Heron Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	7.957	2.87E+01	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	2.33E-02	4.05	7.00	12.1	5.76E-03	3.33E-03	1.93E-03
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	7.60E-02	3.85	8.61	19.3	1.97E-02	8.82E-03	3.95E-03
Mercury	3.60E-02	2.868	1.03E-01	Regresson	6.05E-02	4.580	1.65E-01	0.00E+00	1.07E-02	0.026	0.045	0.078	4.10E-01	2.36E-01	1.37E-01
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	7.80E-01	66.1	148	331	1.18E-02	5.27E-03	2.36E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	1.08E-06	0.000014	0.000044	0.00014	7.69E-02	2.43E-02	7.69E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.1356	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of sediment
WIR =	0.1090	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	2.10	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-3

Summary of Mallard Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	7.957	2.87E+01	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	6.79E-01	4.05	7.00	12.1	1.68E-01	9.70E-02	5.61E-02
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	2.19E-01	1.63	2.31	3.26	1.34E-01	9.48E-02	6.70E-02
Mercury	3.60E-02	2.868	1.03E-01	Regresson	6.05E-02	4.580	1.65E-01	0.00E+00	7.50E-03	0.026	0.045	0.078	2.88E-01	1.66E-01	9.61E-02
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	7.57E+00	66.1	148	331	1.14E-01	5.12E-02	2.29E-02
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	1.14E-07	0.000014	0.000044	0.00014	8.14E-03	2.57E-03	8.14E-04

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

				Invertebrates	Bivalves	Fish
DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)	Lipids (%):	2.58	1.48	6.00
FIR =	0.0717	= Food ingestion rate (kg/day dry weight)	TOC (%):	0.33	0.33	0.33
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)	Percent soilds:	0.21	0.21	0.25
PDFi =	0.100	= Proportion of diet composed of food item (aquatic invertebrates)				
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)				
PDFi =	0.867	= Proportion of diet composed of food item (aquatic plants)				
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)				
PDFi =	0.000	= Proportion of diet composed of food item (fish)				
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)				
PDS =	0.033	= Proportion of diet composed of sediment				
WIR =	0.0850	= Water ingestion rate (L/day)				
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)				
BW =	0.612	= Body weight (kg)				

Attachment Table H-2-4

Summary of Osprey Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	7.957	2.87E+01	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	2.69E-02	4.05	7.00	12.1	6.63E-03	3.84E-03	2.22E-03
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	8.75E-02	3.85	8.61	19.3	2.27E-02	1.02E-02	4.54E-03
Mercury	3.60E-02	2.868	1.03E-01	Regresson	6.05E-02	4.580	1.65E-01	0.00E+00	1.23E-02	0.49	0.77	1.20	2.50E-02	1.60E-02	1.02E-02
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	8.98E-01	66.1	148	331	1.36E-02	6.07E-03	2.72E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	1.24E-06	0.000014	0.000044	0.00014	8.85E-02	2.80E-02	8.85E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0919 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (aquatic invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (aquatic plants)
FCxi = Chemical-specific = Concentration of chemical in food item (fish, dry weight basis)
PDFi = 1.000 = Proportion of diet composed of food item (fish)
SCx = Chemical-specific = Concentration of chemical in sediment (mg/kg, dry weight)
PDS = 0.000 = Proportion of diet composed of sediment
WIR = 0.0858 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 1.235 = Body weight (kg)

Attachment Table H-2-5

Summary of Spotted Sandpiper Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	7.957	2.87E+01	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	8.66E+00	4.05	7.00	12.1	**2.14E+00**	**1.24E+00**	7.16E-01
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	1.65E+00	3.85	8.61	19.3	4.28E-01	1.91E-01	8.56E-02
Mercury	3.60E-02	2.868	1.03E-01	Regresson	6.05E-02	4.580	1.65E-01	0.00E+00	3.26E-02	0.026	0.045	0.078	**1.25E+00**	7.24E-01	4.18E-01
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	4.50E+01	66.1	148	331	6.80E-01	3.04E-01	1.36E-01
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	1.39E-06	0.000014	0.000044	0.00014	9.92E-02	3.14E-02	9.92E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0105	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.820	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.180	= Proportion of diet composed of sediment
WIR =	0.0089	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.0294	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-6

Summary of Mink Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	7.957	2.87E+01	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	1.74E-02	11.7	13.3	15.1	1.48E-03	1.30E-03	1.15E-03
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	5.66E-02	4.70	6.47	8.90	1.20E-02	8.75E-03	6.36E-03
Mercury	3.60E-02	2.868	1.03E-01	Regresson	6.05E-02	4.580	1.65E-01	0.00E+00	7.93E-03	0.150	0.192	0.247	5.29E-02	4.12E-02	3.21E-02
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	5.81E-01	75.4	169	377	7.70E-03	3.44E-03	1.54E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	5.27E-06	1.000	5.27E-06	0.135	7.13E-07	4.291	2.26E-05	0.00E+00	1.09E-06	0.000001	0.000003	0.00001	**1.09E+00**	3.44E-01	1.09E-01

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0349	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of sediment
WIR =	0.0286	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.726	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-7

Summary of Raccoon Exposure Doses - Screening (Step 2) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	7.957	2.87E+01	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	4.38E-01	11.7	13.3	15.1	3.74E-02	3.29E-02	2.89E-02
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	9.32E-02	4.70	6.47	8.90	1.98E-02	1.44E-02	1.05E-02
Mercury	3.60E-02	2.868	1.03E-01	Regresson	6.05E-02	4.580	1.65E-01	0.00E+00	2.60E-03	0.150	0.192	0.247	1.73E-02	1.35E-02	1.05E-02
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	2.78E+00	75.4	169	377	3.68E-02	1.65E-02	7.36E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	5.27E-06	1.000	5.27E-06	0.135	7.13E-07	4.291	2.26E-05	0.00E+00	1.44E-07	0.000001	0.000003	0.00001	1.44E-01	4.55E-02	1.44E-02

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.1307	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.436	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.400	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	0.070	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.094	= Proportion of diet composed of sediment
WIR =	0.6092	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	4.23	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-8

Summary of Belted Kingfisher Exposure Doses - Baseline (Step 3A) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	0.824	2.98E+00	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	9.49E-02	4.05	7.00	12.1	2.34E-02	1.36E-02	7.84E-03
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	1.58E-01	3.85	8.61	19.3	4.10E-02	1.83E-02	8.20E-03
Mercury	3.60E-02	1.186	4.27E-02	Regresson	6.05E-02	3.250	1.17E-01	0.00E+00	1.28E-02	0.026	0.045	0.078	4.92E-01	2.84E-01	1.64E-01
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	3.87E+00	66.1	148	331	5.86E-02	2.62E-02	1.17E-02
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	1.78E-06	0.000014	0.000044	0.00014	1.27E-01	4.02E-02	1.27E-02

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0180	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.160	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	0.840	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of sediment
WIR =	0.0164	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.1480	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-9

Summary of Great Blue Heron Exposure Doses - Baseline (Step 3A) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	0.824	2.98E+00	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	2.03E-02	4.05	7.00	12.1	5.01E-03	2.90E-03	1.68E-03
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	6.61E-02	3.85	8.61	19.3	1.72E-02	7.68E-03	3.44E-03
Mercury	3.60E-02	1.186	4.27E-02	Regresson	6.05E-02	3.250	1.17E-01	0.00E+00	6.58E-03	0.026	0.045	0.078	2.53E-01	1.46E-01	8.44E-02
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	6.79E-01	66.1	148	331	1.03E-02	4.59E-03	2.05E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	9.37E-07	0.000014	0.000044	0.00014	6.69E-02	2.12E-02	6.69E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.1254	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of sediment
WIR =	0.1010	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	2.230	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-10

Summary of Mallard Exposure Doses - Baseline (Step 3A) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	0.824	2.98E+00	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	1.55E-01	4.05	7.00	12.1	3.82E-02	2.21E-02	1.28E-02
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	8.94E-02	1.63	2.31	3.26	5.49E-02	3.88E-02	2.74E-02
Mercury	3.60E-02	1.186	4.27E-02	Regresson	6.05E-02	3.250	1.17E-01	0.00E+00	2.78E-03	0.026	0.045	0.078	1.07E-01	6.17E-02	3.56E-02
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	3.10E+00	66.1	148	331	4.68E-02	2.10E-02	9.37E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	4.66E-08	0.000014	0.000044	0.00014	3.33E-03	1.05E-03	3.33E-04

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0564	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.100	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.867	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.033	= Proportion of diet composed of sediment
WIR =	0.0658	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	1.177	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-11

Summary of Osprey Exposure Doses - Baseline (Step 3A) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	0.824	2.98E+00	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	1.90E-02	4.05	7.00	12.1	4.68E-03	2.71E-03	1.57E-03
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	6.17E-02	3.85	8.61	19.3	1.60E-02	7.17E-03	3.21E-03
Mercury	3.60E-02	1.186	4.27E-02	Regresson	6.05E-02	3.250	1.17E-01	0.00E+00	6.14E-03	0.49	0.77	1.20	1.25E-02	8.01E-03	5.12E-03
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	6.34E-01	66.1	148	331	9.59E-03	4.29E-03	1.92E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	8.75E-07	0.000014	0.000044	0.00014	6.25E-02	1.98E-02	6.25E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0780	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of sediment
WIR =	0.0769	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	1.486	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-12

Summary of Spotted Sandpiper Exposure Doses - Baseline (Step 3A) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	0.824	2.98E+00	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	6.15E-01	4.05	7.00	12.1	1.52E-01	8.78E-02	5.08E-02
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	9.16E-01	3.85	8.61	19.3	2.38E-01	1.06E-01	4.76E-02
Mercury	3.60E-02	1.186	4.27E-02	Regresson	6.05E-02	3.250	1.17E-01	0.00E+00	8.25E-03	0.026	0.045	0.078	3.17E-01	1.83E-01	1.06E-01
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	2.50E+01	66.1	148	331	3.78E-01	1.69E-01	7.57E-02
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	3.88E-06	1.000	3.88E-06	0.135	5.26E-07	4.291	1.67E-05	0.00E+00	7.73E-07	0.000014	0.000044	0.00014	5.52E-02	1.75E-02	5.52E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0080	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.820	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.180	= Proportion of diet composed of sediment
WIR =	0.0069	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.0404	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-13

Summary of Mink Exposure Doses - Baseline (Step 3A) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	0.824	2.98E+00	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	1.24E-02	11.7	13.3	15.1	1.06E-03	9.29E-04	8.17E-04
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	4.03E-02	4.70	6.47	8.90	8.57E-03	6.23E-03	4.53E-03
Mercury	3.60E-02	1.186	4.27E-02	Regresson	6.05E-02	3.250	1.17E-01	0.00E+00	4.01E-03	0.150	0.192	0.247	2.67E-02	2.08E-02	1.62E-02
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	4.13E-01	75.4	169	377	5.48E-03	2.45E-03	1.10E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	5.27E-06	1.000	5.27E-06	0.135	7.13E-07	4.291	2.26E-05	0.00E+00	7.74E-07	0.000001	0.000003	0.00001	7.74E-01	2.45E-01	7.74E-02

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0266	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of sediment
WIR =	0.0218	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.777	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Attachment Table H-2-14

Summary of Raccoon Exposure Doses - Baseline (Step 3A) - Maximum

Remedial Investigation - Site 7

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Maximum Sediment Concentration (mg/kg)	Sediment-Invertebrate BAF	Aquatic Invertebrate Concentration (mg/kg dw)	Sediment-Plant BAF	Aquatic Plant Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals															
Copper	3.61E+00	0.824	2.98E+00	Regresson	3.24E+00	0.100	3.61E-01	0.00E+00	5.13E-02	11.7	13.3	15.1	4.38E-03	3.85E-03	3.39E-03
Lead	1.68E+01	Regression	1.93E+00	Regresson	1.29E+00	0.070	1.18E+00	0.00E+00	5.24E-02	4.70	6.47	8.90	1.11E-02	8.10E-03	5.89E-03
Mercury	3.60E-02	1.186	4.27E-02	Regresson	6.05E-02	3.250	1.17E-01	0.00E+00	9.44E-04	0.150	0.192	0.247	6.29E-03	4.90E-03	3.82E-03
Zinc	8.21E+01	Regression	1.35E+02	Regresson	5.58E+01	0.147	1.21E+01	0.00E+00	1.56E+00	75.4	169	377	2.07E-02	9.25E-03	4.14E-03
Dioxin/Furans															
2,3,7,8 TCDD (TEQ)	5.27E-06	1.000	5.27E-06	0.135	7.13E-07	4.291	2.26E-05	0.00E+00	8.08E-08	0.000001	0.000003	0.00001	8.08E-02	2.56E-02	8.08E-03

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.1031	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic invertebrates, dry weight basis)
PDFi =	0.436	= Proportion of diet composed of food item (aquatic invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (aquatic plants, dry weight basis)
PDFi =	0.400	= Proportion of diet composed of food item (aquatic plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis)
PDFi =	0.070	= Proportion of diet composed of food item (fish)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0.094	= Proportion of diet composed of sediment
WIR =	0.4921	= Water ingestion rate (L/day)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	5.940	= Body weight (kg)

	Invertebrates	Bivalves	Fish
Lipids (%):	2.58	1.48	6.00
TOC (%):	0.33	0.33	0.33
Percent soilds:	0.21	0.21	0.25

Regulatory Acceptance

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
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Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

February 24, 2015

Mr. Scott Park
NAVFAC MIDLANT, Building N-26
Hampton Roads Restoration Product Line, Code OPHREV4
9742 Maryland Avenue
Norfolk, VA 23511-3095

Remedial Investigation Report
Site 7 – Old DuPont Disposal Area
Naval Weapons Station Yorktown
Cheatham Annex
Williamsburg, Virginia

Dear Mr. Park:

The Virginia Department of Environmental Quality (DEQ) has received the *Draft Remedial Investigation Report* (RI Report) for Site 7 at Naval Weapons Station Yorktown, Cheatham Annex (CAX), Williamsburg, Virginia. The RI Report, prepared by CH2M HILL, was received by the DEQ on January 6, 2015.

Thank you for providing the DEQ's Office of Remediation Programs the opportunity to review the above-referenced RI Report. Subsequent to DEQ's internal review, discussion during previous CAX Partnering Meetings, and the Decision Tree contained in the Final UFP-SAP (March 2014), this office concurs with the recommendation to prepare a Focused Feasibility Study (FFS) to develop and evaluate remedial alternatives to address potentially unacceptable human health risks associated with site-related constituents of concern (COCs). The DEQ has no additional comments and recommends submittal of the *Final Remedial Investigation Report*.

Please contact me at (804) 698-4125 or wade.smith@deq.virginia.gov with any additional questions.

Sincerely,

Wade M. Smith
Remediation Project Manager
Office of Remediation Programs

cc: Jerry Hoover, EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

June 11, 2015

Mr. Tom Kowalski
NAVFAC MIDLANT, Building N-26
Attention: Code OPHE3
9742 Maryland Avenue
Norfolk, VA 23511-3095

Subject: Draft Remedial Investigation Report for Site 7 – Old DuPont Disposal Area, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia, December 2014

Mr. Kowalski:

Thank you for the opportunity to review the subject document. Your responses to EPA's draft comments on the document are acceptable. EPA has no further comments on the document. Please make the appropriate changes to the document and submit a final copy for our records. If you have any questions, please contact me at 215-814-2077.

Sincerely,

Gerald F. Hoover, RPM
NPL/BRAC Federal Facilities Branch

cc: Wade Smith, VDEQ

From: Hoover, Gerald [mailto:Hoover.Gerald@epa.gov]
Sent: Tuesday, March 10, 2015 5:06 PM
To: Ivester, Marlene/VBO; scott.park@navy.mil; Sawyer, Stephanie/VBO; Wade.Smith@deq.virginia.gov
Subject: EPA Draft Comments on Site 7 RI Report

Team,

Attached are draft comments on the Site 7 RI Report from BTAG, EPA Hydro, and EPA Tox. As we've done in the past, I would like to set up a conference call, after you've had a chance to review these, and discuss the comments.

Please advise as to an appropriate time to have a confernence call.

Thanks,

Jerry

~~~~~~

Jerry Hoover
Remedial Project Manager
Federal Facility Program Coordinator
Environmental Protection Agency, Region III
Mail Code (3HS11)
1650 Arch Str.
Philadelphia, PA 19103
(215) 814-2077
~~~~~~

Draft BTAG Comments on Site 7 RI Report

In response to your request, representatives of the BTAG have completed the review of the subject document and offer the comments presented below. It should be noted that BTAG focused its review on Appendix H: Baseline Ecological Risk Assessment.

1. Page H-4, Section H.2.2 Analytical Data Used in the ERA: The text indicates the backfill material "…likely contains lower chemical concentrations…" than original site soil. The basis of this statement should be provided. If the statement cannot be supported it should be deleted.

2. Page H-6, Section H.2.3.3 Exposure Pathways and Routes: The list of "…aquatic biota (aquatic/benthic invertebrates, fish, and reptiles)…" needs to include plants (as shown in table H-4) and amphibians.

3. Page H-8, Section H.2.3.3: The text states "Amphibians are unlikely to occur on this site based on the salinity of the York River." However, Site 7 is approximately 400 feet from Cheatham Pond. This would be well within the distance amphibians are known to travel (e.g., up to 30 kilometers). The quoted statement only describes a portion of the potential "sources" of receptors. Amphibians need to be included as an ecological receptor, even if only in the uncertainty section.

4. Page H-13, Section H.3.3.4 Aquatic Plants: This section indicates that tissue concentrations for only above ground vegetative portion of plants were estimated. Since some ecological receptors consume the roots (tubers), this only represents a portion of the potential exposure. It should be noted that the contaminant concentrations in roots may be different than the above ground portion of the plant.

5. Page H-19, Section H.5.3.1 Comparison with Ecological Screening Values: Under soils, the text indicates mean soil concentrations are compared to soil ecological screening values (ESVs) for plants and invertebrates. Because both of these ecological receptor groups have no or limited mobility, maximum concentrations compared with ESVs need to be used to identify contaminants of potential concern (COPCs).

6. Page H-21 Section 5.4.3 Groundwater: Even in the baseline ecological risk assessment, the maximum concentrations are used to identify COPCs likely to potentially pose risk to ecological receptors.

7. Section H.5.5.2 on page H-22 of Appendix H states that based on the mean concentration, gamma-chlordane exceeded its ecological screening value by a factor of 2.31 in groundwater. The section further states that gamma-chlordane was not selected as a final contaminant of potential concern since the mean hazard quotient would be below 1 assuming a dilution factor of 10, and does not appear to be site-related since it was

detected in samples from upgradient wells at similar concentrations and was not detected in site soils. The use of a dilution factor is not appropriate for receptors in the hyporheic zone where receptors would be exposed to undiluted groundwater. While the data suggest that gamma-chlordane in groundwater may not be related to Site 7, there may be an upgradient source that needs to be identified and investigated.

8. Page H-23, Section H.6 Uncertainties: The reporting limits discussion is not adequate. The text states "Because these chemicals were not detected, they are not known to be present on the site…." When a reporting limit exceeds the ESVs and there is no background value, a conclusion about whether or not the chemical is potentially present at levels of concern cannot be made. The chemicals that meet this criteria cannot be eliminated as COPCs.

9. Table H-24 Ecological Screening Statistics – Site 7 Soil: The ESVs for DDD, DDE, and DDT are not adequately protective. All three ESVs need to change to the EcoSSL value for DDT and metabolites (21 µg/kg). This means that DDT would be a Step 2 and 3a COPC because the maximum detection limit exceeds the ESV and there is no background value.

10. Table H-24: Regarding plants and invertebrates, this table identifies 17 VOCs, 18 SVOCs, three pesticides, five explosives, and seven inorganics that are COPCs. The reasons that support these chemicals as COPCs include (a) because no ESVs exist, (b) the maximum detection limit is greater than the ESV, (c) the detected concentration exceeds the ESV and background, or (d) the detected concentration exceeds the ESV and no background value exists.

11. Table H-33 Ecological Screening statistics – Site 7 Groundwater: This table shows the maximum HQ for 33 chemicals exceeded one, with a range from 1.02 to 182. Please adequately explain why these groundwater contaminants were not carried forward as COPCs.

12. Table H-34 Exceedances – Site 7 Groundwater: This table shows that three chemicals (4,4'-DDD, gamma-Chlordane, and manganese (total and dissolved)) at sample location CAS07-MW04-0111 had concentrations exceeding the surface water ESV and background (when available) in 2011 but not 2014. Additional data would be required to support that groundwater concentrations of chemicals would likely not cause risk to ecological receptors during long term monitoring.

Thank you for the opportunity to review this document. Please contact me at x 2380 or John McCloskey at (804) 824-2404 if you have questions or wish to discuss these comments.

Draft Hydro Comments on Site 7 RI

I have reviewed the Remedial Investigation for site 7 at NWS Yorktown Cheatham Annex, including the soil data from 2008, the groundwater monitoring data from 2011 and the current 2014 groundwater data from the existing wells and newly installed wells MW-8 and MW-9. This investigation report shows that the source of groundwater contamination (buried waste and debris) were removed from site 7, the soil data do not indicates a potential soil to groundwater migration pathway, and that the groundwater seems to be properly characterized. Hence, I agree with the recommendation in the report to develop a Focused Feasibility Study to evaluate remedial alternatives for the COCs (2,4-DNT, 2,6-DNT, TCE and Chloroform) identified in the groundwater during this remedial investigation at site 7.

Tox Comments Site 7 RI

Thank you for the opportunity to review the draft *Site 7 – Old DuPont Disposal Area Remedial Investigation Report* for the Naval Weapons Station Yorktown, Cheatham Annex. Overall, the analysis and conclusions within the report appear appropriate. Within the Human Health Risk Assessment, the conceptual site model, the identification of COPCs, the description of the exposure and toxicity assessment, and the risk characterization were sufficient and accurate. The recommendation to develop a focused feasibility study to address site-related COCs (TCE, 2,4-dinitrotoluene, 2,6-dinitrotoluene, and chloroform) is supported by the evidence and assessment. The comments below are for your consideration.

Primary Concern:

1. Page H-19, Section F.8 (as well as Section F.6.2.9 and F.6.2.10) – According to the COC selection criteria, COCs are COPCs that contribute "a carcinogenic risk greater than 1E-6 to a cumulative carcinogenic risk that exceeds 1E-4." For the future resident, the cumulative carcinogenic risk is 3E-4 (which exceeds 1E-4), therefore:
    - Future Resident, 2nd bullet – cancer risk due to chromium in soil (1E-4) exceeds 1E-6
    - Future Resident, 6th bullet – cancer risk due to TCE in groundwater via vapor intrusion (2E-5) exceeds 1E-6; however, TCE is a COC in groundwater due to HI exceedance.

    Further consideration of chromium in soil as a COC is requested.

Additional Comments:

2. Section 4, Nature and Extent of Contamination – Recommend deletion of references to background in this section. The purpose of this section, as outlined in the first sentence, is to evaluate "the nature and extent of contamination" with comparison to screening values. The discussion of background levels introduces a complicating comparison at this stage of the RI report, as comparisons to background are to be made only after risk calculations have been conducted (as the RI report states).

3. Page H-5, Section F.3.3, *COPCs* and Appendix G, Table 2-5 – endosulfan II, gamma-chlordane, and dioxin have HLC > 1E-5 and should be considered in the groundwater-air exposure scenario.

4. Page H-6, Section F.4.1, *Conceptual Site Model for Human Health* and Figure F-1 – the recreator receptor is characterized as current/future in Figure F-1; however, the bullet in Section F.4.1 states the recreator receptor as future. Please correct in Figure F-1 as only future.

5. Page H-16, Section F.6.2.10, *Future Industrial Worker* – The cumulative HI (RME) for groundwater is 3 (2.0 for VI and 0.5 for groundwater) and not 2 as provided in the sub-bullet. In addition, the HI for TCE in potable groundwater was 0.5, which is greater than 0.1 to a cumulative target organ HI that exceeds 1 (in this case, the HI for immune and heart effects was 3E+0), and TCE should be characterized in the last bullet of this section as a COC for the VI pathway and potable groundwater. This change must also be reflected in Section F.8 under industrial worker (4th bullet).

6. Page H-17, Section F.7.3, 1st paragraph – Delete, "The noncarcinogenic toxicity factors are most likely an overestimate of toxicity." This statement is conjecture, as the toxicity factors are estimates but the direction of estimation, either over- or under-, is impossible to ascertain.

7. Page H-17, Section F.7.3, 2nd paragraph – Delete, "however, most of the experimental studies indicate the existence of a threshold level." This is incorrect. A threshold for carcinogenicity cannot be determined by individual experimental study, and the statement that 'most' experimental studies support a threshold is not supported.

8. Page H-18, Section F.7.3, 5th paragraph – Delete, "however, these values should be interpreted cautiously because USEPA has not approved these toxicity values." PPRTVs <u>are</u> supported by the Agency, as evidenced by their availability on an Agency website.

9. Appendix G, Table 2.6 and 2.7 – A VISL value for trans-1,2-dichloroethene could not be located. Please clarify.

10. Appendix G, Table 7.7 – The cancer risk for the adult from water vapors at showerhead need to be calculated for chloroform and TCE, 8.7E-7 and 2.7E-6, respectively, because this route of exposure is not evaluated for children. The lifetime cancer risk for this route is then removed from Table 7.9.

11. Appendix G – some of the total organ HI sums were incorrect and, although the conclusions do not change, the sums should be accurate.
    - Table 9.3 – total neuro HI = 9E-3
    - Table 9.3 – total gastro HI = 8E-3
    - Table 9.4 – total gastro HI = 5E-3
    - Table 9.5 – total neuro HI = 9E-3
    - Table 9.5 – total gastro HI = 8E-3
    - Table 9.6 – total gastro HI = 5E-2
    - Table 9.8 – total neuro HI = 6E-1
    - Table 9.10 – total neuro HI = 9E-2
    - Table 9.10 – total immune = 3E+0
    - Table 9.10 – total heart = 3E+0

Thank you for the opportunity to review this report. If you have any questions, comments, or concerns, please contact me.

Draft BTAG Comments on CAX Site 7 Draft RI Report

In response to your request, representatives of the BTAG have completed the review of the subject document and offer the comments presented below. It should be noted that BTAG focused its review on Appendix H: Baseline Ecological Risk Assessment.

General Response to Overall Comments: The ERA contained in the Site 7 RI report was basically a "repackaging" of the ecological risk screening contained in the SI report for soils since there were no new soil data collected at the site for the RI; the main difference was that the SI only looked at detected chemicals. The final SI concluded no unacceptable risk for ecological receptors related to soil exposures. Groundwater samples were collected in 2014 but were only analyzed for VOCs and dissolved manganese. The 2014 VOC data were used in the RI in place of the 2011 VOC data (which were used in the SI) but there were no changes in risk conclusions (the final SI concluded no unacceptable ecological risks associated with groundwater) since there were no exceedances of ESVs for VOCs in either data set. Similarly, the inclusion of the 2014 manganese data in the RI ERA did not change the risk conclusions from the SI since the 2014 manganese data showed lower concentrations compared with the 2011 data. Given that the final SI report concluded no unacceptable risk to ecological receptors from potential soil and groundwater exposures, and there were no significant changes in the analytical data set used in the RI for these media, comments on the RI ERA suggesting large numbers of ecological COPCs in these media are not warranted. There were extensive comments on the SI report which were resolved prior to the report being finalized, and the new data collected in 2014 for the RI were based on the conclusions of the final SI report. The main focus of the ecologically-related RI sampling conducted in 2014 was to sample surface sediments in the adjacent York River since the SI analysis related to this medium had relatively high levels of uncertainty. The inclusion of these new sediment data is the only significant difference between the SI and RI ERAs; there were no BTAG comments on the sediment portion of the RI ERA.

1. Page H-4, Section H.2.2 Analytical Data Used in the ERA: The text indicates the backfill material "…likely contains lower chemical concentrations…" than original site soil. The basis of this statement should be provided. If the statement cannot be supported it should be deleted.

   Response: The portion of the sentence which reads "… , which likely contains lower chemical concentrations, …" will be removed from the text.

2. Page H-6, Section H.2.3.3 Exposure Pathways and Routes: The list of "…aquatic biota (aquatic/benthic invertebrates, fish, and reptiles)…" needs to include plants (as shown in table H-4) and amphibians.

Response: Aquatic plants are already included in the text (see the second paragraph, second sentence). For amphibians, please see the response to Comment 3.

3. Page H-8, Section H.2.3.3: The text states "Amphibians are unlikely to occur on this site based on the salinity of the York River." However, Site 7 is approximately 400 feet from Cheatham Pond. This would be well within the distance amphibians are known to travel (e.g., up to 30 kilometers). The quoted statement only describes a portion of the potential "sources" of receptors. Amphibians need to be included as an ecological receptor, even if only in the uncertainty section.

   Response: Even if Site 7 is within the dispersal distance of some amphibian species that may occur in Cheatham Pond, there are no freshwater wetland or aquatic habitats on Site 7 that would support the aquatic life stages of these receptors. Thus, amphibians are not appropriate receptors for this site under current site conditions.

4. Page H-13, Section H.3.3.4 Aquatic Plants: This section indicates that tissue concentrations for only above ground vegetative portion of plants were estimated. Since some ecological receptors consume the roots (tubers), this only represents a portion of the potential exposure. It should be noted that the contaminant concentrations in roots may be different than the above ground portion of the plant.

   Response: While it is true that some receptors will consume roots/tubers, there is very little in the way of emergent aquatic vegetation along the shoreline of Site 7. For that reason, receptors such as the muskrat were not included in the list of aquatic receptors that were evaluated in the ERA. Thus, consumption of the roots of aquatic plants is not a significant potential exposure for ecological receptors at the site.

5. Page H-19, Section H.5.3.1 Comparison with Ecological Screening Values: Under soils, the text indicates mean soil concentrations are compared to soil ecological screening values (ESVs) for plants and invertebrates. Because both of these ecological receptor groups have no or limited mobility, maximum concentrations compared with ESVs need to be used to identify contaminants of potential concern (COPCs).

   Response: Maximum concentrations were used to select Step 2 COPCs consistent with EPA and Navy ERA guidance. For Step 3A, COPC selection considered background UTLs and central tendency chemical concentrations (since the endpoints evaluated for these receptor groups were based on communities/populations and not individual organisms), as well as the magnitude and frequency of ESV and UTL exceedances (which account for maximum concentrations).

6. Page H-21 Section 5.4.3 Groundwater: Even in the baseline ecological risk assessment, the maximum concentrations are used to identify COPCs likely to potentially pose risk to ecological receptors.

Response: The Navy strongly disagrees with this comment. There are no direct exposures of ecological receptors to groundwater; exposures only become possible at the point groundwater begins to discharge to a surface water body or surfaces as a seep. The sole use of maximum groundwater concentrations is thus unrealistically conservative. While maximum concentrations are used in the screening portion of an ERA (Step 2) to identify initial COPCs, per EPA and Navy ERA guidance, the BERA incorporates other factors, including central tendency concentrations, to develop more realistic estimates of potential ecological risks. See also the general response.

7. Section H.5.5.2 on page H-22 of Appendix H states that based on the mean concentration, gamma-chlordane exceeded its ecological screening value by a factor of 2.31 in groundwater. The section further states that gamma-chlordane was not selected as a final contaminant of potential concern since the mean hazard quotient would be below 1 assuming a dilution factor of 10, and does not appear to be site-related since it was detected in samples from upgradient wells at similar concentrations and was not detected in site soils. The use of a dilution factor is not appropriate for receptors in the hyporheic zone where receptors would be exposed to undiluted groundwater. While the data suggest that gamma-chlordane in groundwater may not be related to Site 7, there may be an upgradient source that needs to be identified and investigated.

Response: Dilution factors account for dilution and attenuation as groundwater travels from the location of the monitoring well to the receiving water body, as well as when it discharges to the water body. The first part of the dilution (prior to discharge) is still applicable to pore water concentrations within the hyporheic zone. See also the general response.

8. Page H-23, Section H.6 Uncertainties: The reporting limits discussion is not adequate. The text states "Because these chemicals were not detected, they are not known to be present on the site…." When a reporting limit exceeds the ESVs and there is no background value, a conclusion about whether or not the chemical is potentially present at levels of concern cannot be made. The chemicals that meet this criteria cannot be eliminated as COPCs.

Response: These chemicals are identified as COPCs in Step 2. In Step 3A, however, they are not retained as COPCs since the uncertainties are considered acceptable based on the evaluation contained in this section.

9. Table H-24 Ecological Screening Statistics – Site 7 Soil: The ESVs for DDD, DDE, and DDT are not adequately protective. All three ESVs need to change to the EcoSSL value for DDT and metabolites (21 µg/kg). This means that DDT would be a Step 2 and 3a COPC because the maximum detection limit exceeds the ESV and there is no background value.

Response: The Eco-SSL ESVs referenced in the comment are based on food web exposures for bird and mammal receptors while the soil screen in Table H-24 is based on exposures of lower trophic level receptors (plants and invertebrates). Thus, the SSL values are not appropriate for use in the screen provided in Table H-24. The Eco-SSL values for DDT and metabolites are considered, however, in the food web exposure evaluation of the ERA (see Table H-26), as described in Section H.5.3.2.

10. Table H-24: Regarding plants and invertebrates, this table identifies 17 VOCs, 18 SVOCs, three pesticides, five explosives, and seven inorganics that are COPCs. The reasons that support these chemicals as COPCs include (a) because no ESVs exist, (b) the maximum detection limit is greater than the ESV, (c) the detected concentration exceeds the ESV and background, or (d) the detected concentration exceeds the ESV and no background value exists.

Response: The Navy disagrees that all of the chemicals identified in the comment are COPCs, even at Step 2. For example, non-detected chemicals without ESVs or UTLs are not considered COPCs; this is considered a "standard" uncertainty in ERAs. See also the general response.

11. Table H-33 Ecological Screening statistics – Site 7 Groundwater: This table shows the maximum HQ for 33 chemicals exceeded one, with a range from 1.02 to 182. Please adequately explain why these groundwater contaminants were not carried forward as COPCs.

Response: The rationale for excluding these chemicals is contained in Sections H.5.4.3 and H.5.5.2. See also the general response.

12. Table H-34 Exceedances – Site 7 Groundwater: This table shows that three chemicals (4,4'-DDD, gamma-Chlordane, and manganese (total and dissolved)) at sample location CAS07-MW04-0111 had concentrations exceeding the surface water ESV and background (when available) in 2011 but not 2014. Additional data would be required to support that groundwater concentrations of chemicals would likely not cause risk to ecological receptors during long term monitoring.

Response: Pesticides and total manganese were not analyzed for in 2014 groundwater samples per the final SAP and the results of the final SI. In terms of the 2011 data,

please see the general response. No additional data are warranted for these chemicals.

Tox Comments – CAX Site 7 Draft RI

Thank you for the opportunity to review the draft *Site 7 – Old DuPont Disposal Area Remedial Investigation Report* for the Naval Weapons Station Yorktown, Cheatham Annex. Overall, the analysis and conclusions within the report appear appropriate. Within the Human Health Risk Assessment, the conceptual site model, the identification of COPCs, the description of the exposure and toxicity assessment, and the risk characterization were sufficient and accurate. The recommendation to develop a focused feasibility study to address site-related COCs (TCE, 2,4-dinitrotoluene, 2,6-dinitrotoluene, and chloroform) is supported by the evidence and assessment. The comments below are for your consideration.

Primary Concern:

1. Page H-19, Section F.8 (as well as Section F.6.2.9 and F.6.2.10) – According to the COC selection criteria, COCs are COPCs that contribute "a carcinogenic risk greater than 1E-6 to a cumulative carcinogenic risk that exceeds 1E-4." For the future resident, the cumulative carcinogenic risk is 3E-4 (which exceeds 1E-4), therefore:
    - Future Resident, 2nd bullet – cancer risk due to chromium in soil (1E-4) exceeds 1E-6
    - Future Resident, 6th bullet – cancer risk due to TCE in groundwater via vapor intrusion (2E-5) exceeds 1E-6; however, TCE is a COC in groundwater due to HI exceedance.

    Further consideration of chromium in soil as a COC is requested.

    Response: Exposure to soil alone does not result in a carcinogenic risk above 1E-4, which is why chromium in soil was not considered a COC for soil. It is unlikely shallow groundwater (the groundwater evaluated in the HHRA) will be used as a potable water supply, and therefore unlikely the future resident would be exposed to both soil and groundwater. Additionally, chromium was identified as a COPC for soil and risks were calculated for chromium in soil assuming all of the detected chromium is hexavalent chromium is in the hexavalent form, which is conservative and unlikely. However, we will add the following text as an additional bullet item to Sections F.8 and F.6.2.9; COC for soil assuming future resident exposed to both soil and groundwater: chromium (assuming all detected chromium is hexavalent chromium).

Additional Comments:

2. Section 4, Nature and Extent of Contamination – Recommend deletion of references to background in this section. The purpose of this section, as outlined in the first sentence, is to evaluate "the nature and extent of contamination" with comparison to screening values. The discussion of background levels introduces a complicating comparison at this stage of the RI report, as comparisons to background are to be made only after risk calculations have been conducted (as the RI report states).

    Response: The purpose of this section is to evaluate the nature and extent of contamination, which includes the nature of contamination as it relates to being associated with past site use or background conditions at the base and the site. The following sentence will be added to the last paragraph of the introduction section of Section 4.0. "The constituents exceeding the screening criteria are discussed in the following subsections in terms of nature and extent of contamination, historic site use, and concentration relative to base-wide or site background concentrations".

3. Page H-5, Section F.3.3, *COPCs* and Appendix G, Table 2-5 – endosulfan II, gamma-chlordane, and dioxin have HLC > 1E-5 and should be considered in the groundwater-air exposure scenario.

   Response: Endosulfan II, gamma-chlordane, and dioxin are not considered volatile on the RSL table. The reason their HLCs are > 1E-5 is not because they are volatile, but because their water solubilities are very low. USEPA guidance in RAGS Part B uses two criteria to determine chemicals that easily volatilize, HLC > 1E-5 and MW < 200. These chemicals all have MWs over 300. Pesticides and dioxin are not very volatile and we have never treated them as VOCs for evaluation in the groundwater-to-air pathway.

4. Page H-6, Section F.4.1, *Conceptual Site Model for Human Health* and Figure F-1 – the recreator receptor is characterized as current/future in Figure F-1; however, the bullet in Section F.4.1 states the recreator receptor as future. Please correct in Figure F-1 as only future.

   Response: The recreator receptor will be identified as future only on Figure F-1.

- Page H-16, Section F.6.2.10, *Future Industrial Worker* – The cumulative HI (RME) for groundwater is 3 (2.0 for VI and 0.5 for groundwater) and not 2 as provided in the sub-bullet. In addition, the HI for TCE in potable groundwater was 0.5, which is greater than 0.1 to a cumulative target organ HI that exceeds 1 (in this case, the HI for immune and heart effects was 3E+0), and TCE should be characterized in the last bullet of this section as a COC for the VI pathway and potable groundwater. This change must also be reflected in Section F.8 under industrial worker (4th bullet).

  Response: Based on the rounding in Microsoft excel the cumulative HI for groundwater is 2 (value is 2.49 based on 0.96 from ingestion and 1.53 from VI). However, as it doesn't change the results or conclusions of the HHRA, the HI will be changed to 3. The following sentence will be added to the last bullet in Section F.6.2.10 and in Section F.8: "When considering exposure through both the VI pathway and potable use, trichloroethene would also be a COC for the potable use pathway."

5. Page H-17, Section F.7.3, 1st paragraph – Delete, "The noncarcinogenic toxicity factors are most likely an overestimate of toxicity." This statement is conjecture, as the toxicity factors are estimates but the direction of estimation, either over- or under-, is impossible to ascertain.

   Response: As requested, the sentence will be deleted. However, the toxicity factors and adjustment used are designed to be conservative and to be more likely to over-estimate the hazard instead of underestimate the hazard.

6. Page H-17, Section F.7.3, 2nd paragraph – Delete, "however, most of the experimental studies indicate the existence of a threshold level." This is incorrect. A threshold for carcinogenicity cannot be determined by individual experimental study, and the statement that 'most' experimental studies support a threshold is not supported.

   Response: Text will be deleted as requested.

7. Page H-18, Section F.7.3, 5th paragraph – Delete, "however, these values should be interpreted cautiously because USEPA has not approved these toxicity values." PPRTVs are supported by the Agency, as evidenced by their availability on an Agency website.

   Response: Text will be deleted as requested.

Appendix G, Table 2.6 and 2.7 – A VISL value for trans-1,2-dichloroethene could not be located. Please clarify.

Response: The VISL was calculated for trans-1,2-DCE based on an RfC for trans-1,2-DCE from the PPRTV archive (as included in the RAIS database). However, as indicated in the June 17, 2014 memo Removal of the trans-1,2-Dichloroethylene (CASRN 156-60-5) Provisional Peer-Reviewed Toxicity Value (PPRTV) assessment from the Electronic Library from Scott Wesselkamper, Director, Superfund Health Risk Technical Support Center (STSC), the trans-1,2-DCE PPRTV was archived due to inconsistencies in the conclusions regarding the RfC derivation. Therefore, this VISL will be removed from Tables 2.6 and 2.7.

Appendix G, Table 7.7 – The cancer risk for the adult from water vapors at showerhead need to be calculated for chloroform and TCE, 8.7E-7 and 2.7E-6, respectively, because this route of exposure is not evaluated for children. The lifetime cancer risk for this route is then removed from Table 7.9.

Response: No change will be made. The cancer risk associated with adult showering is included on Table 7.9 to calculate the cumulative cancer risk to the lifetime resident, which includes exposure while an adult.

Appendix G – some of the total organ HI sums were incorrect and, although the conclusions do not change, the sums should be accurate.

- Table 9.3 – total neuro HI = 9E-3
- Table 9.3 – total gastro HI = 8E-3
- Table 9.4 – total gastro HI = 5E-3
- Table 9.5 – total neuro HI = 9E-3
- Table 9.5 – total gastro HI = 8E-3
- Table 9.6 – total gastro HI = 5E-2
- Table 9.8 – total neuro HI = 6E-1
- Table 9.10 – total neuro HI = 9E-2
- Table 9.10 – total immune = 3E+0
- Table 9.10 – total heart = 3E+0

Response: Table 9.3 total gastro HI, Table 9.4 total gastro HI, Table 9.5 total gastro HI, Table 9.6 total gastro HI, Table 9.8 total neuro HI, and Table 9.10 total neuro HI, will be changed as indicated.

In terms of Table 9.4 total neuro HI, Table 9.5 total neuro HI, Table 9.10 total immune, and Table 9.10 total heart, these are the values Microsoft excel calculated based on rounding of the individual and total numbers. However, as these changes would not change the results or conclusions of the HHRA, they will be made.