FINAL
RECORD OF DECISION
FOR
OPERABLE UNIT 2 – AREA 50 LANDFILL
DEFENSE SUPPLY CENTER RICHMOND

Prepared For

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And

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August 2008

Revision 3

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Acronyms and Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Chemical of Concern
COPC	Constituent of Potential Concern
DERA	Defense Environmental Restoration Account
DLA	Defense Logistics Agency
DSCR	Defense Supply Center Richmond
EO	Explosive Ordnance
ESD	Explanation of Significant Difference
FFS	Focused Feasibility Study
HHBRA	Human Health Baseline Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
LUC	Land Use Control
LUCIP	Land Use Control Implementation Plan
NGA	National Guard Area
NMOC	Non-methane Organic Compound
OE	Ordnance and Explosives
OSA	Open Storage Area
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PP	Proposed Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
ROD	Record of Decision
RPO	Remedial Process Optimization
SF	Slope Factor
TBC	To-be-considered Criteria
USACE	U.S. Army Corps of Engineers
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency

Acronyms and Abbreviations (continued)

USEPA	U.S. Environmental Protection Agency
UXO	Unexploded Ordnance
VC	Vinyl Chloride
VDEQ	Virginia Department of Environmental
VOC	Volatile Organic Compound

1 DECLARATION FOR THE RECORD OF DECISION

1.1 Site Name and Location

Operable Unit (OU) 2: Area 50 Landfill

Defense Supply Center Richmond (DSCR) (formerly known as Defense General Supply Center [DGSC]), Chesterfield County, Virginia

U.S. Environmental Protection Agency (USEPA) Identification (ID) VA3971520751

1.2 Statement of Basis and Purpose

This decision document presents the selected remedy for OU 2 at DSCR. This remedy was selected in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Part 300, Title 40, of the Code of Federal Regulations (CFR). This remedy is based on the Administrative Record for OU 2.

In accordance with CERCLA Section 120(e)(4), and the NCP at 40 CFR Section 300.430(f)(4)(iii), Defense Logistics Agency (DLA) and USEPA Region 3 jointly selected this remedy. The Virginia Department of Environmental Quality (VDEQ) concurs on the selected remedy.

1.3 Assessment of Site

Actual or threatened releases of hazardous substances from OU 2 may pose a threat to public health or welfare or the environment. The response action selected in this Record of Decision (ROD) is protective of human health and the environment.

1.4 Description of Selected Remedy

The selected remedy will effectively and cost-efficiently meet the following remedial action objectives (RAOs) for OU 2:

- Prevent human ingestion of, direct contact with, and inhalation of volatile emissions and fugitive dusts from impacted soils (primarily for workers).
- Be compatible with actions to reduce constituent migration to groundwater.

- Prevent exposure to ordnance and explosives (OE) hazards.

The selected remedy includes the following components:

- A soil cover that provides a grade to promote surface runoff and that has a minimum thickness of 6 inches; and
- Land use controls (LUCs), including institutional controls and maintenance of soil cover and existing access restrictions.

There are no highly toxic or mobile source materials that present a significant risk to human health or the environment or that constitute principal-threat wastes requiring treatment (USEPA, 1991b). While OU 2 may be one of several sources of chemicals in groundwater, the groundwater contamination is being addressed separately under OU 6 and OU 9.

Five-year reviews will be conducted in accordance with CERCLA Section 121(c) and 40 CFR Section 300.430(f)(4)(ii). The five-year review is required for sites where constituents remain in place at concentrations that preclude unlimited use and unrestricted exposure. Therefore, no less frequently than every five years, the success of the selected remedy will be evaluated using the most current OU 2 information. The five-year reviews will confirm and evaluate the effectiveness of the remedial response until such time as OU 2 is declared suitable for unlimited use and unrestricted exposure, or the statutory requirement for periodic performance reviews is revoked.

1.5 Statutory Determinations

The selected remedy satisfies the statutory requirements of CERCLA and, to the extent practicable, the NCP. The selected remedy:

- Is protective of human health and the environment and provides short-term and long-term protection and permanence, will meet RAOs within a reasonable timeframe, and is accepted by federal and state regulatory agencies.
- Complies with federal and state applicable or relevant and appropriate requirements (ARARs).
- Is cost-effective.
- Meets the statutory requirements of protectiveness and compliance with ARARs more cost effectively than the other remedial action alternatives.

- Uses permanent solutions and alternative treatment technologies, or resource recovery technologies, to the maximum extent practicable.
- Will result in hazardous substances, pollutants, or constituents remaining on-site above levels that allow for unlimited use and unrestricted exposure. Consequently, a statutory review will be conducted within five years after initiation of the response action, and at a subsequent frequency of at least once every five years, to ensure that the remedy is protective of human health and the environment. Protectiveness reviews will continue until such time as OU 2 is approved for unrestricted use, or the statutory requirement for continued remedy-performance monitoring is revoked.

1.6 ROD Data Certification Checklist

The following information is presented in the decision summary, Section 2.0:

- Chemicals of concern (COCs) and their respective concentrations
- Baseline risk posed by the COCs under current and likely future exposure scenarios.
- ARARs established for the COCs and the basis for these ARARs
- Absence of source materials constituting principal-threat wastes.
- Current and anticipated future land use assumptions and current and potential future groundwater uses evaluated in the Human Health Baseline Risk Assessment (HHBRA) and ROD.
- Potential land and groundwater uses that will be available at OU 2 as a result of the selected remedy.
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, along with the annual discount rate and the number of years over which the remedy cost estimates are projected.
- Key factors that led to the remedy selection.

Additional information can be found in the Administrative Record file for OU 2.

1.7 Authorizing Signatures

Date: 8.4.08

CHARLES R. CARRELL
Site Director, DES Richmond
Defense Supply Center Richmond (DSCR)

Date: 8/7/08

DENNIS LILLO
Staff Director, Environmental, Safety and Occupational Health
HQ, Defense Logistics Agency (DLA)

Date: 9/11/08

JAMES J. BURKE
Director, Hazardous Site Cleanup Division
U.S. Environmental Protection Agency (USEPA), Region 3

2 DECISION SUMMARY

2.1 Site Name, Location, and Description

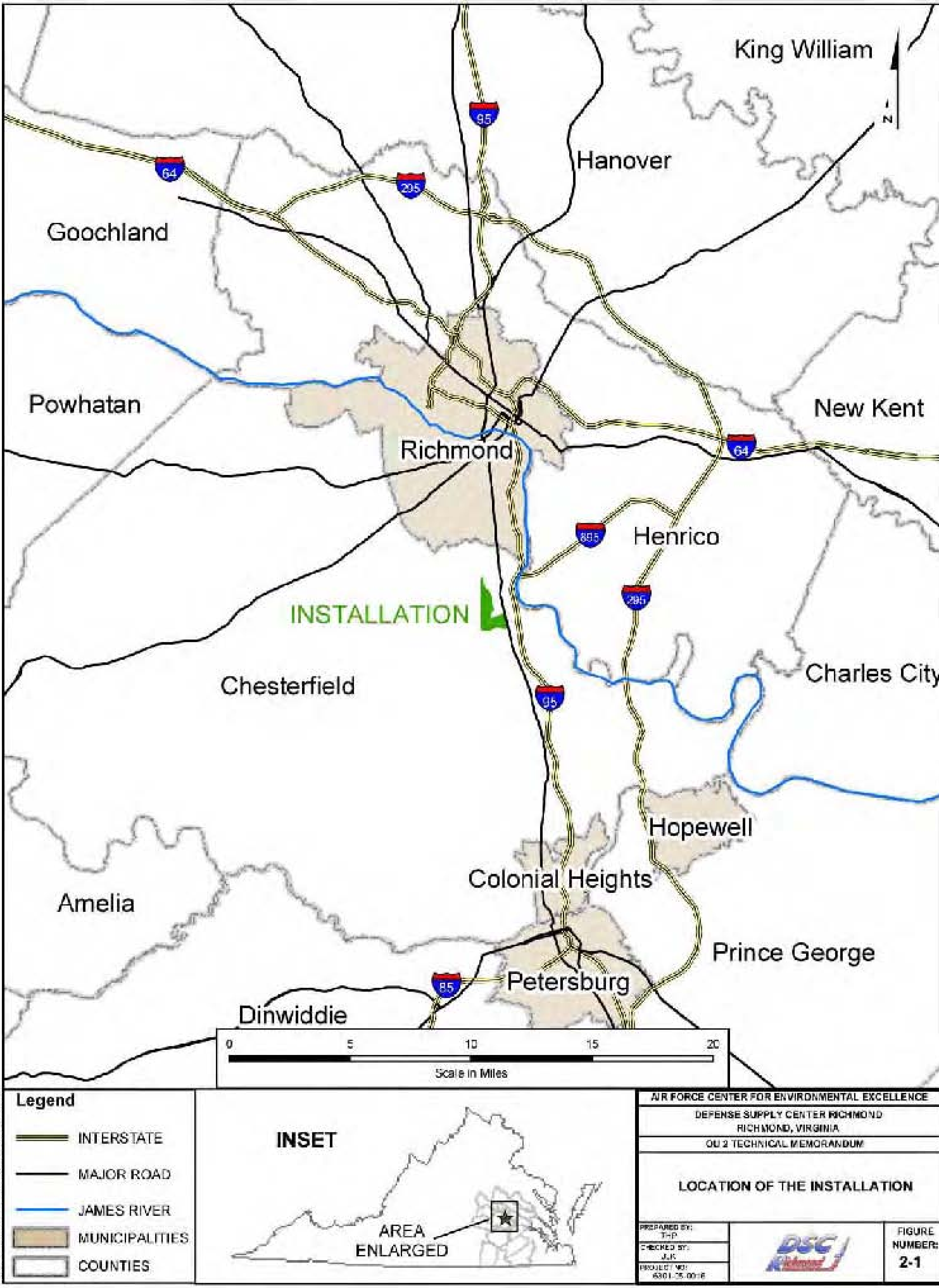
DSCR is located in Chesterfield County, Virginia, approximately 8 miles south of Richmond as depicted in **Figure 2-1**. DSCR is included on the National Priorities List (NPL) by the facility's former name, DGSC, and the USEPA ID number is VA3971520751. DLA is the lead federal agency, USEPA is the lead regulatory agency, and the VDEQ is the support regulatory agency for CERCLA activity at DSCR. The source of cleanup funds is the Defense Environmental Restoration Account.

DSCR is the lead U.S. Department of Defense (DoD) supply center for aviation weapons systems and environmental logistics support, as well as the aviation supply-and-demand chain manager for the DLA, supplying nearly 930,000 repair parts and operating items and nearly 700,000 supply items in over 200 commodity classes. The DSCR work force totals approximately 2,300.

OU 2 is located in the central portion of the DSCR between the Open Storage Area (OSA) (OU 1) and the National Guard Area (NGA) (OU 3) as shown in **Figure 2-2**. These three units are suspected to be contributing sources to contamination in the underlying groundwater, which has been designated as OU 6. OU 2 is now generally level and covered with grass. An area that stored transformers filled with dielectric fluid containing polychlorinated biphenyls (PCBs) for an 18-month period ending in late 1983 was located in the southwestern corner. A helipad and parking area are now located near the northern boundary and southeastern corner, respectively (Dames & Moore, 1989).

2.2 Site History and Enforcement Activities

The U.S. Army purchased the property known today as DSCR on 6 June 1941. Construction began in August 1941, and the Richmond General Depot was activated n January 1942. In the first two decades of its existence, the mission was traditional logistics support to the U.S. Army with emphasis on Quartermaster items. With activation of the Military General Supply Agency and its absorption by the Defense Supply Agency in 1962, the mission was expanded to provide



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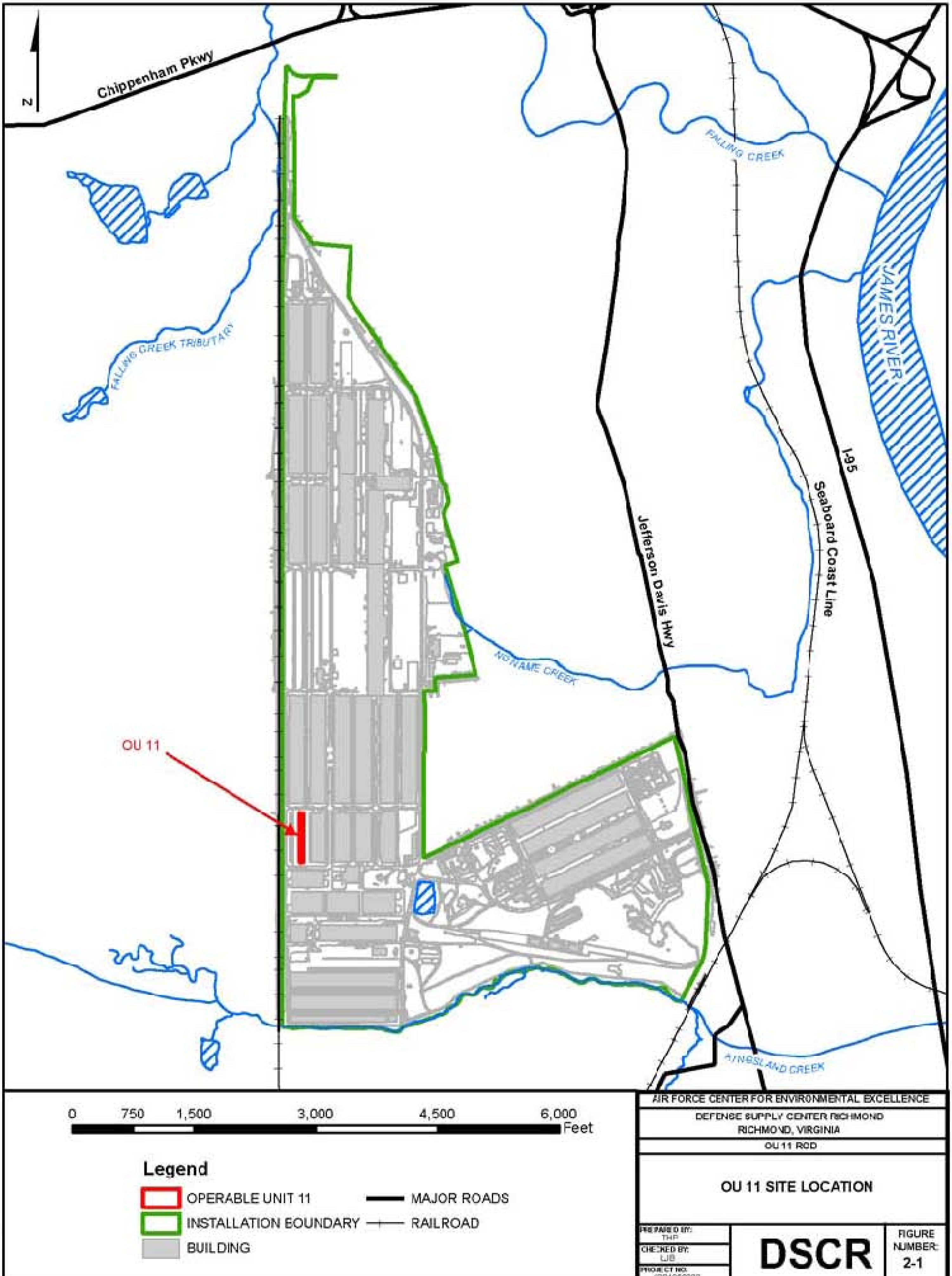
RICHMOND, VIRGINIA

OU 2 TECHNICAL MEMORANDUM

LOCATION OF THE INSTALLATION

PREPARED BY: THP
CHECKED BY: JJK
PROJECT NO: 6301-25-0016

FIGURE NUMBER: 2-1


N
Chippenham Pkwy
FALLING CREEK
FALLING CREEK TRIBUTARY
JAMES RIVER
I-95
Seaboard Coast Line
Jefferson Davis Hwy
NO NAME CREEK
OU 11
KINGSLAND CREEK
0
750
1,500
3,000
4,500
6,000
Feet
Legend
OPERABLE UNIT 11
INSTALLATION BOUNDARY
BUILDING
MAJOR ROADS
RAILROAD
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA
OU 11 ROD
OU 11 SITE LOCATION
PREPARED BY:
THP
CHECKED BY:
LJB
PROJECT NO:
6301050022
DSCR
FIGURE NUMBER:
2-1

supply management of more than 30,000 general items to the military and certain civilian agencies worldwide. The current installation was activated as the Richmond General Depot and was renamed (in sequence): the Richmond Armed Service Forces Depot; Richmond Quartermaster Depot; Richmond General Depot (again); Richmond Quartermaster Depot (again); and DGSC. The name DGSC was changed to DSCR on 1 January 1996. The Defense Supply Agency became the DLA in 1977 (DSCR, 2007a).

Located in a ravine, the Area 50 landfill was used for disposal of chemicals and construction debris from the late 1950s to the early 1970s. While the area was used as a landfill, material was placed in various parts of the original ravine, and when full, areas of the ravine were sequentially regraded and revegetated. By 1975, the entire area had been graded and seeded (Dames & Moore, 1989).

2.2.1 Preliminary Environmental Investigations

In 1980, DoD placed DSCR in its Installation Restoration Program (IRP). During Phase I of the IRP, the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) conducted an installation assessment. Their Installation Assessment Report (USATHAMA, 1981) determined that the materials that may have been disposed of include organic solvents; pesticides and herbicides; acidic and alkaline chemicals; petroleum, oil, and lubricants; and PCBs. The report also indicated possible soil impacts from past waste disposal practices at six locations and possible groundwater impacts from the Area 50 Landfill, the former Fire Training Area, and the NGA.

2.2.2 CERCLA Activities

In 1984, USEPA identified the DSCR as a candidate for the Superfund NPL. In 1987, the installation was officially placed on the NPL because of high levels of chlorinated volatile organic compounds (VOCs) in groundwater and the potential for off-installation migration. In 1990, DLA, DSCR, USEPA, and VDEQ signed a Federal Facilities Agreement (FFA) that established DLA as the lead federal agency responsible for developing and implementing remedial actions to ensure protection of human health and the environment from releases at DSCR. In accordance with CERCLA Section 120(e)(4)(A) and 40 CFR Section

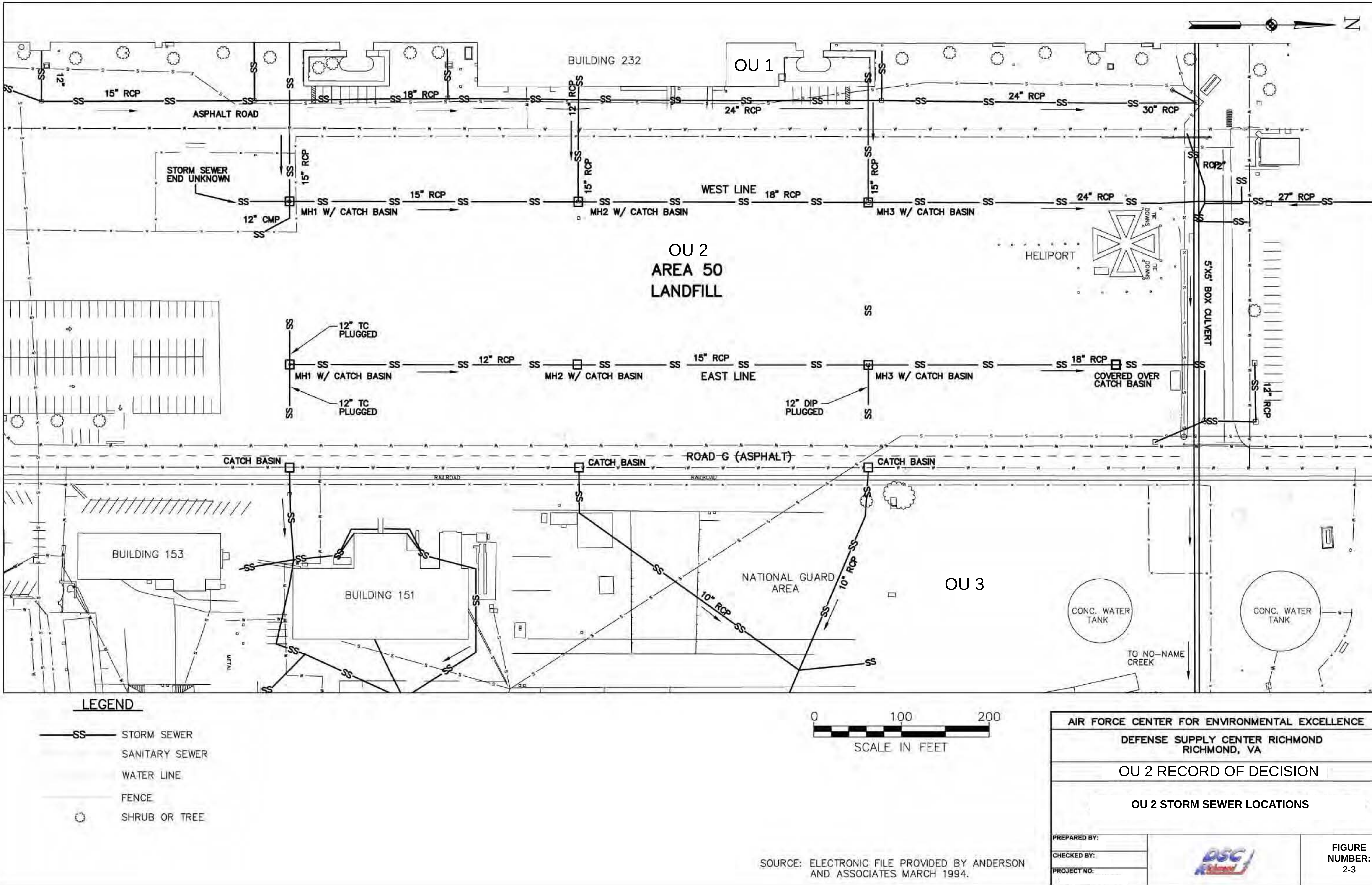
300.430(f)(4)(iii), the FFA provides that selection of the remedy is made jointly by the DLA and the USEPA, or, if unable to reach agreement, by the USEPA.

2.2.2.1 Summary of Remedial Investigations and Activities

Several soil borings and monitoring wells were installed at OU 2 during USATHAMA investigations and RI activities. Most of these soil borings encountered wood, rubber, cinders, brick, concrete, wires, metal, and glass down to 10 feet below ground surface (bgs) (Dames & Moore, 1985). A geophysical survey was conducted at OU 2 during the RI to identify potential areas of contamination. The results of the geophysical survey were used to outline the RI sampling effort and a trenching investigation. Thirty test trenches with average dimensions of 20 feet by 5 feet and depths ranging from 2 to 13 feet bgs were excavated at OU 2 in 1994. Waste material similar to that listed above for soil borings was encountered, along with coal ash and slag, crushed asphalt and automotive parts (Law, 1995). Seven trenches contained ordnance and explosives (OE), including 40-millimeter (mm) grenades and 90-mm recoilless rifle rounds, while one trench had jet-assisted takeoff bottles. Five trenches had petroleum-stained soil, and two trenches had free-phase fuel oil. One trench had photographic chemicals and another trench had 55-gallon drums with unknown contents (Law, 1995). Organic and inorganic constituents, including metals, PCBs, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs), were detected in soil and groundwater samples during these investigative activities.

A baseline risk assessment was conducted for OUs 1, 2, and 3 during the RI (Dames & Moore, 1989) and revised in the Final RI report addendum (Law, 1994). This risk assessment addressed soils from OUs 1, 2, and 3 as one OU. The results of the baseline risk assessment showed unacceptable carcinogenic and non-carcinogenic risks for the future residential exposure scenario due to exposure to the OU 2 soils.

Buried storm sewer lines transect OU 2 (**Figure 2-3**). These storm sewers originate in OU 1 (OSA) and convey storm water from OUs 1 and 2 to outfall 006A located along the OU 3 eastern boundary. This outfall discharges to No Name Creek, which flows south along the eastern NGA boundary. The creek ultimately discharges into the James River approximately 2 miles from the installation (see **Figure 2-2**).



SOURCE: ELECTRONIC FILE PROVIDED BY ANDERSON AND ASSOCIATES MARCH 1994.

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OU 2 RECORD OF DECISION

OU 2 STORM SEWER LOCATIONS

PREPARED BY:
CHECKED BY:
PROJECT NO:

FIGURE NUMBER: 2-3

While OU 2 covers the soil source area of the former Area 50 landfill, impacted groundwater from OU 2 as well as the adjacent OU 1 (OSA) and OU 3 (NGA) sites is being addressed as OU 6. An interim remedial action for the OU 6 groundwater was designated as OU 9, which is a groundwater extraction and treatment system. An Interim Record of Decision (ROD) for OU 9 was issued in September 1993. An Explanation of Significant Differences was issued in 1995 to allow treated groundwater to discharge to Falling Creek. The OU 9 system was constructed and started in 1995 to treat groundwater downgradient of OUs 1, 2, and 3.

2.2.2.2 OU 2 Focused Feasibility Study and Revisions

A focused feasibility study (FFS) was prepared in 1999 to address contaminated soil at OU 2 (Law, 1999). The preferred remedial action alternative from that study included:

- Capping the Area 50 landfill with a clay cover
- Storm sewer rehabilitation by slip lining or abandonment and relocation
- Institutional controls
- Source removal of soils saturated with free product

This preferred alternative was revised in a subsequent Technical Memorandum (Law, 2001) to the following remedial actions:

- Surface grading to promote drainage
- Storm sewer rehabilitation
- Institutional controls
- Groundwater monitoring requirements
- Maintaining access restrictions (fencing)

The most significant changes in the 2001 revised remedy included re-evaluation of the saturated soil removal action and elimination of the clay cap. The saturated soil removal action was re-evaluated because the risk associated with exposure to OE would be significant with any intrusive activity and free product or significant dissolved-phase fuel contamination was not observed in the OU 2 monitoring wells indicating that the contamination was not significantly leaching to the groundwater. The clay cap was re-evaluated because RAOs would be met if the remedial alternative was changed to include storm sewer rehabilitation, surface grading, and institutional controls/LUCs. This remedial alternative would also be more cost efficient. The 2001 Final Technical Memorandum (Law, 2001) also proposed a future recreational land use scenario for the site. This revised preferred alternative was modified again in a subsequent Technical Memorandum (MACTEC, 2007) based on the revised DSCR conceptual site model, an updated OU 2 risk assessment, risk assessment and monitoring of the creeks adjacent to DSCR, as well as DLA's designation of this land for industrial use only. The new site information, future land use, and revised HHBRA are presented in Sections 2.5 through 2.7 of this decision document. This latest feasibility evaluation is summarized below in Section 2.9.

2.2.2.3 Proposed Plan

A Proposed Plan was prepared to provide information to the public regarding planned actions at OU 2 and to seek public input before making a final decision (DSCR, 2007b). It presented remedial alternatives and the preferred alternative with the rationale for selection. The preferred alternative presented in the Proposed Plan is the same alternative being selected as the remedy in this ROD.

2.3 Community Participation

The Proposed Plan summarizing the remedial action alternatives considered for OU 2 was published in November 2007 and was made available to the public in the Administrative Record located at the Chesterfield County Public Library, Central Branch, Local History Department, 9501 Lori Road, Chesterfield, Virginia 23832 (phone 804-748-1603). The Administrative Record can also be viewed online at http://www.adminrec.com/dla.asp.

The public comment period for the Proposed Plan ran from 5 November to 21 December 2007. A public meeting was conducted on 10 December 2007 at 7:30 pm at the Bensley Park and Community Center, 2900 Drewry's Bluff Road, Richmond, Virginia 23237. Notification of the public comment period and public meeting was published on 4 November 2007 in the *Richmond Times Dispatch*. The public notice invited the community to submit comments on the Proposed Plan to DSCR, USEPA, or VDEQ during the 45-day comment period and to attend the public meeting (conducted to provide a forum for the community to ask questions and offer comments on the OU 2 Proposed Plan). Responses to public comments are provided in Appendix A.

2.4 Scope and Role of Response Action

The environmental issues at the installation are complex. The overall environmental management plan for OU 2 is based on the following factors:

- The installation is currently an industrial facility and is expected to remain industrial.
- The installation will remain the property of the federal government for the foreseeable future. In the event of future property transfer for civilian use, land and groundwater use controls incorporated into this ROD and in effect at the time of transfer will be attached to the property deed. Therefore, the reliability of land use controls (LUCs) is high.
- Groundwater beneath the installation is not potable, and such future use has been restricted installation-wide in the Environmental Land Use Control Implementation Plan (LUCIP) (DSCR, 2007a) and the DLA One Book. The DLA One Book is a managerial tool used to document DLA policies, processes, and procedures on a web site and is available to all DLA employees. A Chesterfield County Ordinance (Chapter 12, Article IV, Section 12-51(c)) requires a hydrologic study before private well installation to evaluate groundwater quantity and quality. Residences with a property line within 200 feet of a water utility line are required to tie into the public water supply system (Code, County of Chesterfield, Virginia, Chapter 18, Section 18-60).

The Environmental Restoration Program at DSCR is being conducted under CERCLA, as amended, and has been organized into the following 13 OUs consisting of 9 source (soil) OUs, 3 groundwater OUs, and 1 groundwater interim action OU.

- OU 1 – Open Storage Area
- **OU 2 – Area 50 Landfill Source Area**
- OU 3 – National Guard Source Area
- OU 4 – Fire Training Source Area
- OU 5 – ANPs Source Area
- OU 6 – Area 50/Open Storage Area/National Guard Area Groundwater
- OU 7 – Fire Training Area Groundwater
- OU 8 – ANPs Area Groundwater
- OU 9 – Interim Action for OU 6
- OU 10 – Former Building 68
- OU 11 – Transitory Shelter 202
- OU 12 – Former Building 112
- OU 13 – Polycyclic Aromatic Hydrocarbon Area

Final RODs have been issued for OUs 1, 3, 4, 5, 8, 10, 11 and 12. Final remedial actions were implemented at OUs 1, 3, and 5. An ESD was issued for OU 5, which called for no further action at the site. A final ROD with an interim remedy and subsequent ESD was issued for OU 9 (Interim remedial action for OU 6 groundwater was implemented as OU 9). A removal action was completed at OU 4. The OU 12 remedial action construction was completed in September 2006. The remedial actions for OUs 8, 10 and 11 are ongoing.

This ROD addresses impacted OU 2 source area soils in accordance with CERCLA and the NCP. The objectives of the ROD are to:

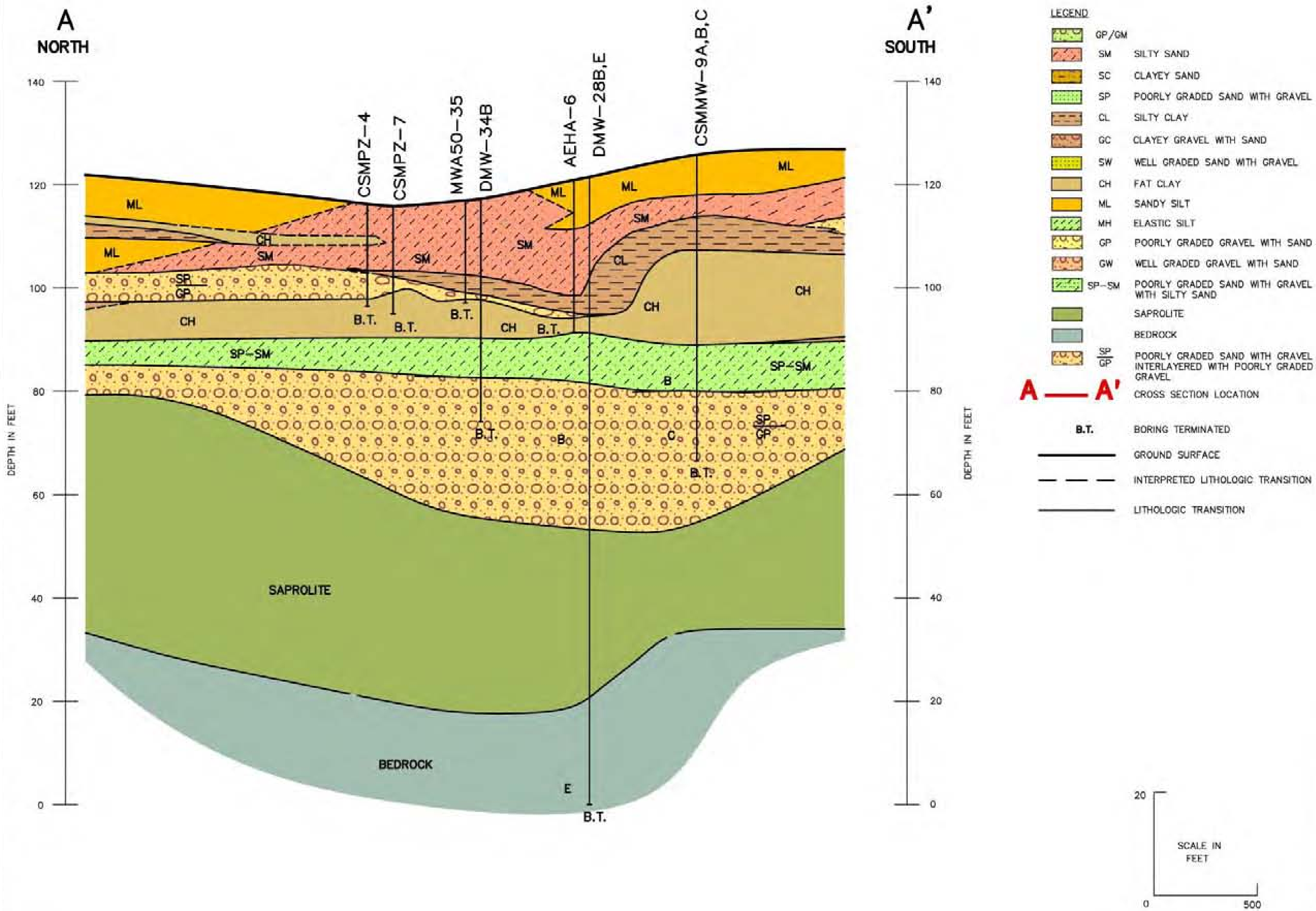
- Summarize the conditions warranting a response action at OU 2.
- Specify the RAOs that must be achieved to ensure protection of human health and the environment.
- Define the scope of the response actions and the performance metrics to be used to assess the effectiveness (protectiveness) of the selected remedy and whether additional response action is necessary.

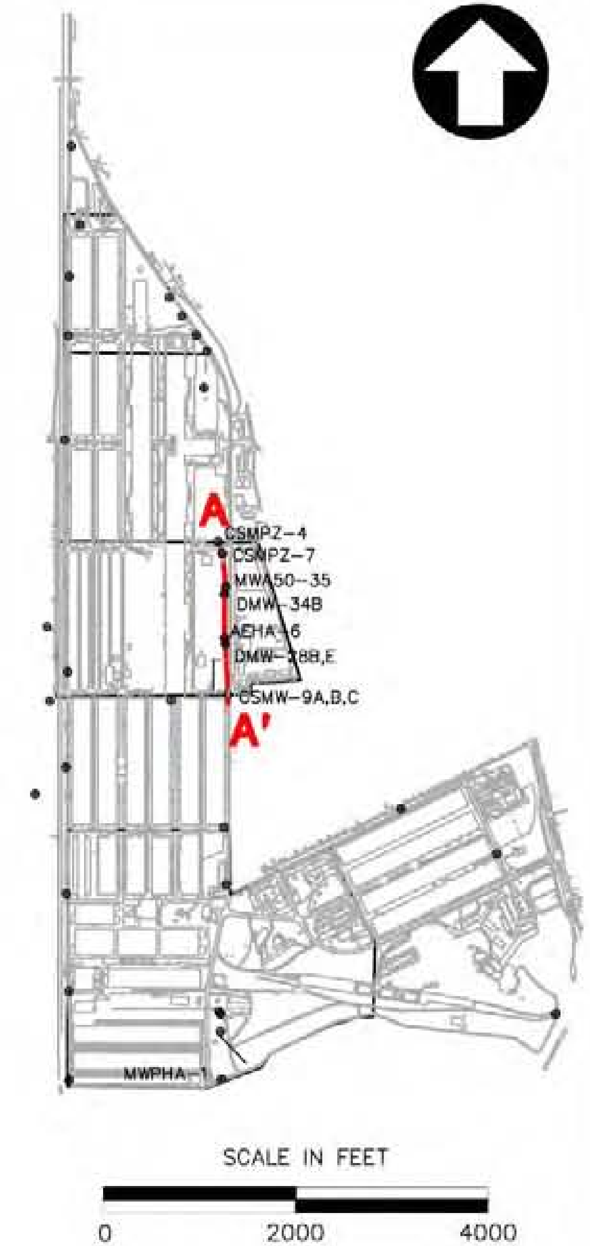
2.5 Site Characteristics

2.5.1 Geology and Hydrogeology

OU 2 covers approximately 13 acres of land that is generally flat and covered with grass. The United States Geological Survey has categorized the unconsolidated sediments beneath OU 2 into the following five separate formations (see **Figure 2-4**):

- **The surface soils** are primarily of fill material, ranging from approximately 0 to 5 feet below ground surface (bgs) in depth.
- **The Eastover Formation** occurs immediately below the surface soil zone and consists of silty sand, sandy silt, and silty or fat clay. The top of the unit is at the ground surface, and the bottom of the unit is approximately 12 to 25 feet bgs. The thickness of this unit is approximately 12 to 25 feet.
- **The Calvert Formation** consists of poorly graded sand with gravel, interlayered with poorly graded gravel. The top of the unit is approximately 12 to 25 feet bgs, and the bottom of the unit is approximately 16 to 30 feet bgs. The thickness of this unit is 0 to approximately 10 feet. The unit is present throughout most of Zone 2 (OUs 1, 2, and 3) and is absent in the southeastern portion of the zone.
- **The Aquia Formation** consists of silty and/or fat clay. The top of the unit is approximately 16 to 30 feet bgs, and the bottom of the unit is approximately 25 to 41 feet bgs. The





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OU 2 RECORD OF DECISION

CROSS SECTION A-A'

PREPARED BY:		FIGURE NUMBER: 2-4
CHECKED BY:		
PROJECT NO:		

thickness of this unit is approximately 3 to 27 feet. This unit is present throughout Zone 2 and is beneath the poorly graded sand with gravel unit where it is present in Zone 2.

- **The Potomac Formation** underlies the Calvert and Aquia Formations. This formation consists of poorly graded sand with gravel and silty sand, poorly graded sand with gravel, and/or poorly graded sand with gravel interlayered with poorly graded gravel. The top of the unit is approximately 25 to 41 feet bgs, and the bottom of the unit is approximately 42 to 72 feet bgs. The thickness of this unit is approximately 10 to 37 feet. This unit is present throughout Zone 2.
- **Saprolite,** a name for highly weathered bedrock, underlies the coastal plain sediments starting at depths of between 42 and 72 feet bgs. The thickness of the saprolite unit in deep soil borings was 18 to 40 feet (Law, 1999). The competent crystalline bedrock, named Petersburg Granite Bedrock, occurs in three borings starting at depths of between 94 feet and 106 feet bgs.

Groundwater beneath OU 2 first occurs at approximately 7 feet bgs in the southern portion of OU 2 progressing deeper to 22 feet bgs in the north within the Eastover Formation. This shallow (or upper) water-bearing unit is hydraulically separated from the confined or semi-confined groundwater (also known as the lower water-bearing unit) in the Potomac Formation by the Aquia Formation. OU 2 is one of several contributing sources to constituents in groundwater, which is being addressed separately as part of OU 6 and OU 9.

2.5.2 Nature and Extent

Chemicals and waste materials disposed in the Area 50 Landfill were the primary source of contamination at OU 2. In addition to the historical investigations (presented in section 2.2), fieldwork was undertaken in the OU 2 area in 2003 to update the DSCR conceptual site model (MACTEC, 2006). This field work included performance of a geophysical survey and installation of soil borings and monitoring wells. Chemicals and waste materials detected at OU 2 during these investigations are described in this section. The nature and extent of chemicals in groundwater will be addressed separately as part of OU 6.

During these historical investigations, SVOCs were the predominant constituents detected in the OU 2 soils. SVOCs were detected most frequently and at the highest concentrations in the samples from ground surface to 2 feet bgs. At one location in the southern portion of the site (DMS-36) and one location in the northern portion (DMS-44) of OU 2, several PAHs in surface soil exceeded industrial soil RBCs. At a test pit in the central portion of OU 2 (TP-A50-19), several PAHs in subsurface soil exceeded industrial soil RBCs. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and dibenzo(a,h)anthracene, exceeded industrial soil RBCs at this location. Benzo(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene also exceeded industrial soil RBCs at DMS-36 and DMW-44. TCE exceeded the industrial soil RBC in subsurface soil at TP-A50-19 (where several PAHs exceeded respective industrial soil RBCs), and at TP-A50-20. Arsenic was detected above the industrial RBC in surface soil samples located along the eastern (DMS-43 and DMS-46), western (DMS-45 and DMS-48) and southern portions (DMS-66 and DMS-37) of OU 2. Arochlor-1260 was detected above the industrial surface soils RBC at one sample location (DMS-44) in the northern portion of OU 2.

Table 2-1 lists the chemicals in the surface and subsurface soils at OU 2. The distribution of chemicals in soil is depicted in **Figures 2-5** through **2-18** (data distribution derived from sampling events conducted from 1984 through 1998). These chemicals are listed in **Table 2-2**, with the maximum detected concentrations for each chemical listed in **Table 2-3**.

2.6 Current and Potential Future Site and Resource Uses

The future use of the installation is expected to remain industrial, under federal control, fenced, and regularly patrolled for the foreseeable future. The helicopter landing pad in the northern part of the site will remain in use; thus, OU 2 land use will be limited to ground level structures and low-growing vegetation. OU 2 is expected to provide limited natural habitat due to its current and anticipated future use as a helicopter glide path. Site and installation use and access restrictions are currently in place and readily enforced at OU 2. In the event of future property transfer for civilian use, land and groundwater use controls in effect at the time of transfer would be attached to the property deed.

Groundwater beneath the installation has not been used for potable purposes, and future groundwater use has been restricted by the LUCIP and DLA One Book. Until 1988, the installation obtained potable water from the Falling Creek Reservoir. From November 1988 to 1993, the installation received its drinking water from Chesterfield County. The installation currently obtains drinking water from the City of Richmond Water System. Public water supply is widely available off-installation, and where available it must be used as the potable water supply source in accordance with county ordinances (Code, County of Chesterfield, Virginia Chapter 18 Section 18-60). In addition, groundwater in the unconfined Eastover formation can

TABLE 2-1

CHEMICALS OF CONCERN IN SURFACE AND SUBSURFACE SOILS
OPERABLE UNIT 2 – AREA 50 LANDFILL
Defense Supply Center Richmond
Richmond, Virginia

Metals	**PCBs**	**PAHs**	**VOCs**
Arsenic	Aroclor-1260	Benzo(a)anthracene	Trichloroethene
		Benzo(a)pyrene	
		Benzo(b)fluoranthene	
		Benzo(k)fluoranthene	
		Chrysene	
		Dibenzo(a,h)anthracene	
		Indeno(1,2,3-cd)pyrene	

Source: MACTEC 2006

TABLE 2-2

CHEMICALS AND WASTE MATERIALS DETECTED FROM 1984 TO 1998
OPERABLE UNIT 2 – AREA 50 LANDFILL
Defense Supply Center Richmond
Richmond, Virginia

SOIL	
Volatile Organic Compounds	Diesel Fuel
2,4-Dinitrotoluene	Gasoline
Semivolatile Organic Compounds	Jet Fuel
Metals	Kerosene
Hexavalent Chromium	Mineral Oil
Pesticides	Paint Thinner
Total Petroleum Hydrocarbons	Naptha
Polychlorinated Biphenyls	Stoddard Solvent

Source: MACTEC 2006

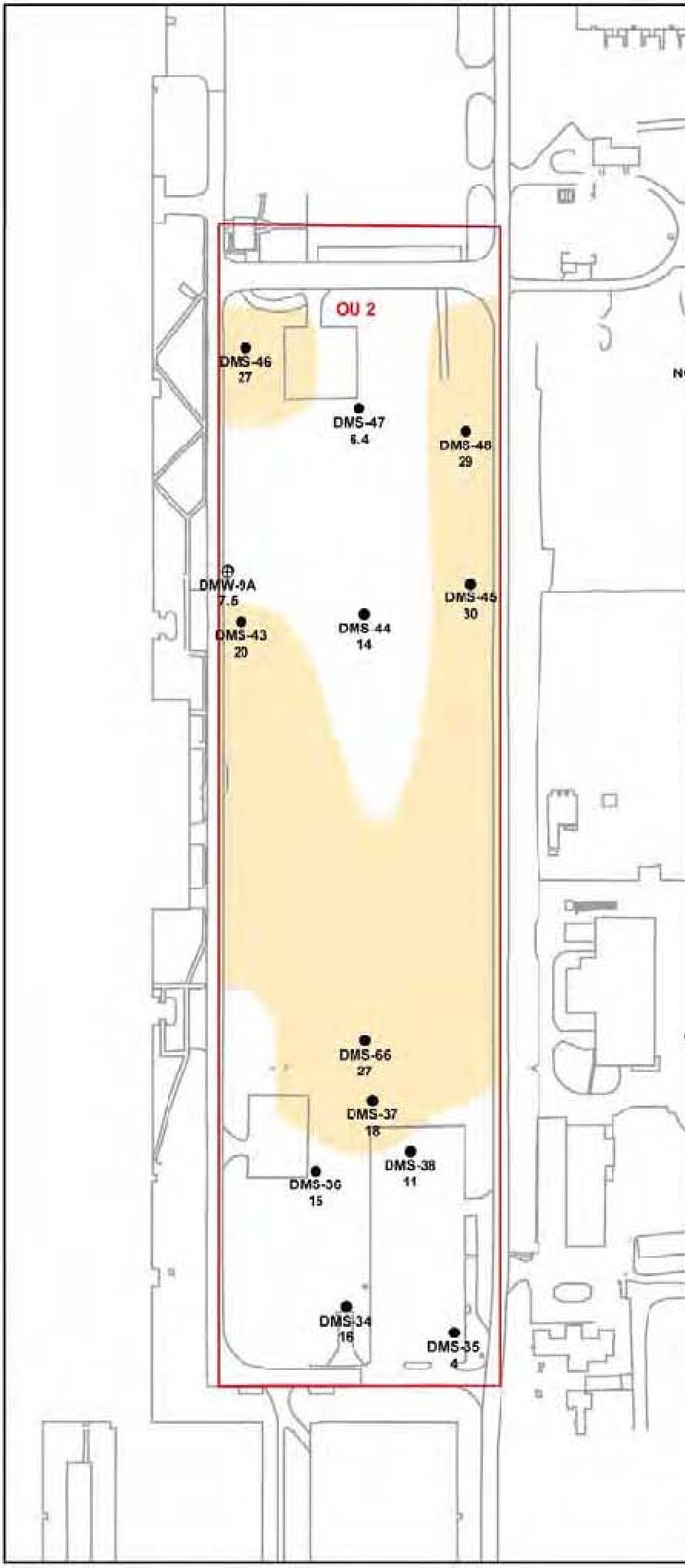
TABLE 2-3

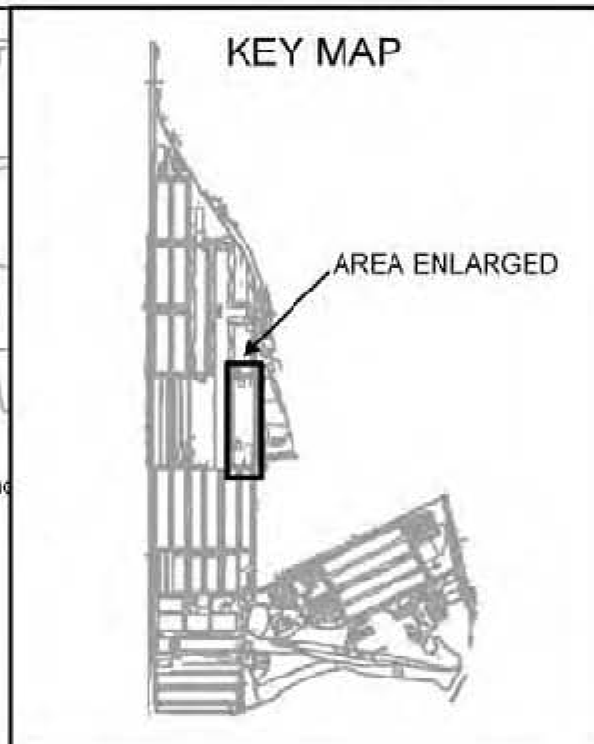
MAXIMUM HISTORICAL DETECTIONS FOR EACH CHEMICALS OF CONCERN
OPERABLE UNIT 2 – AREA 50 LANDFILL
Defense Supply Center Richmond
Richmond, Virginia

FIGURE #	CONSTITUENT	MAXIMUM (mg/kg)
2-1	Arsenic	30
2-2	Benzo(a)anthracene	360
2-3	Banzo(a)pyrene	340
2-4	Benzo(b)fluoranthene	540
2-5	Benzo(k)fluoranthene	540
2-6	Dibenzo(ah)anthracene	72
2-7	Indeno(1,2,3-cd)pyrene	180
2-8	Aroclor 1260	47
2-9	Trichloroethene	53.4
2-10	Benzo(a)anthracene	360
2-11	Benzo(a)pyrene	340
2-12	Benzo(b)fluoranthene	540
2-13	Dibenzo(ah)anthracene	72
2-14	Indeno(1,2,3-cd)pyrene	180

(Taken from sampling events conducted during September and October 1984; May, June, and July 1985; October 1986; October 1988; October, November, and December 1994; and October 1998)

Source: MACTEC 2006





Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- DMS-44 14 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF ARSENIC EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (18 mg/kg)

N

0 100 200 400

Scale in Feet

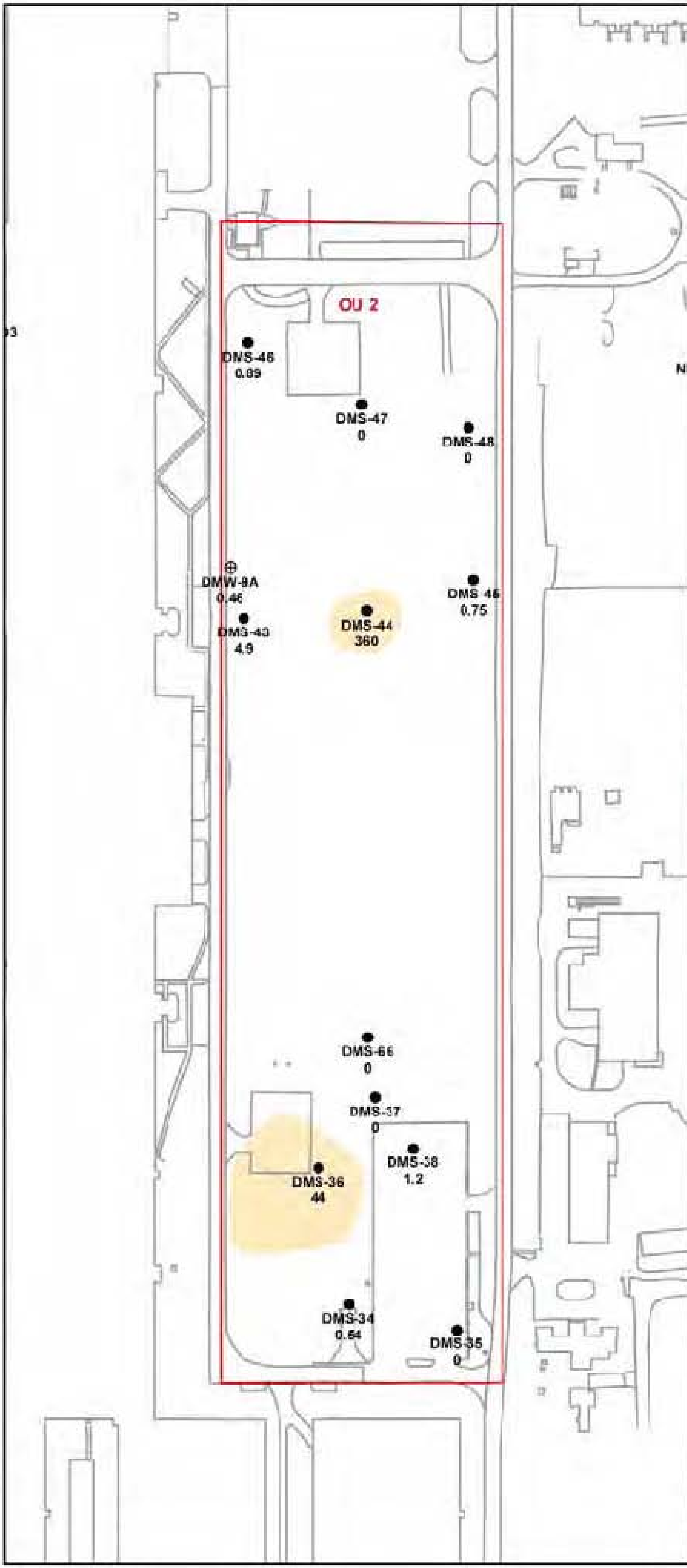
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

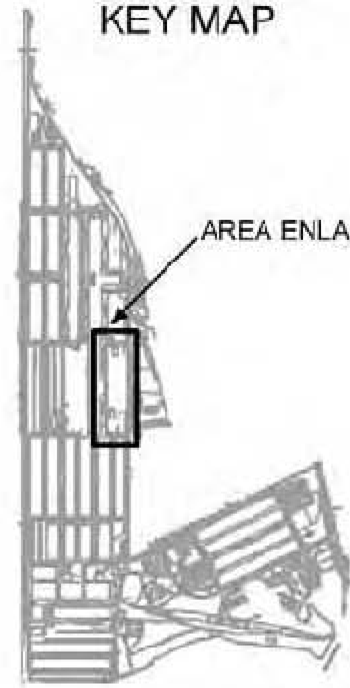
DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

OU2 TECHNICAL MEMORANDUM

OU 2 COC IN SURFACE SOIL (0 - 2' bgs)
ARSENIC

PREPARED BY: CGH CHECKED BY: THE PROJECT NO: 6001-06-9016	DSC Richmond	FIGURE NUMBER: 2-7





Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- DMS-44 / 360 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF BENZO(a)ANTHRACENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (23 mg/kg)

N

0 100 200 400

Scale in Feet

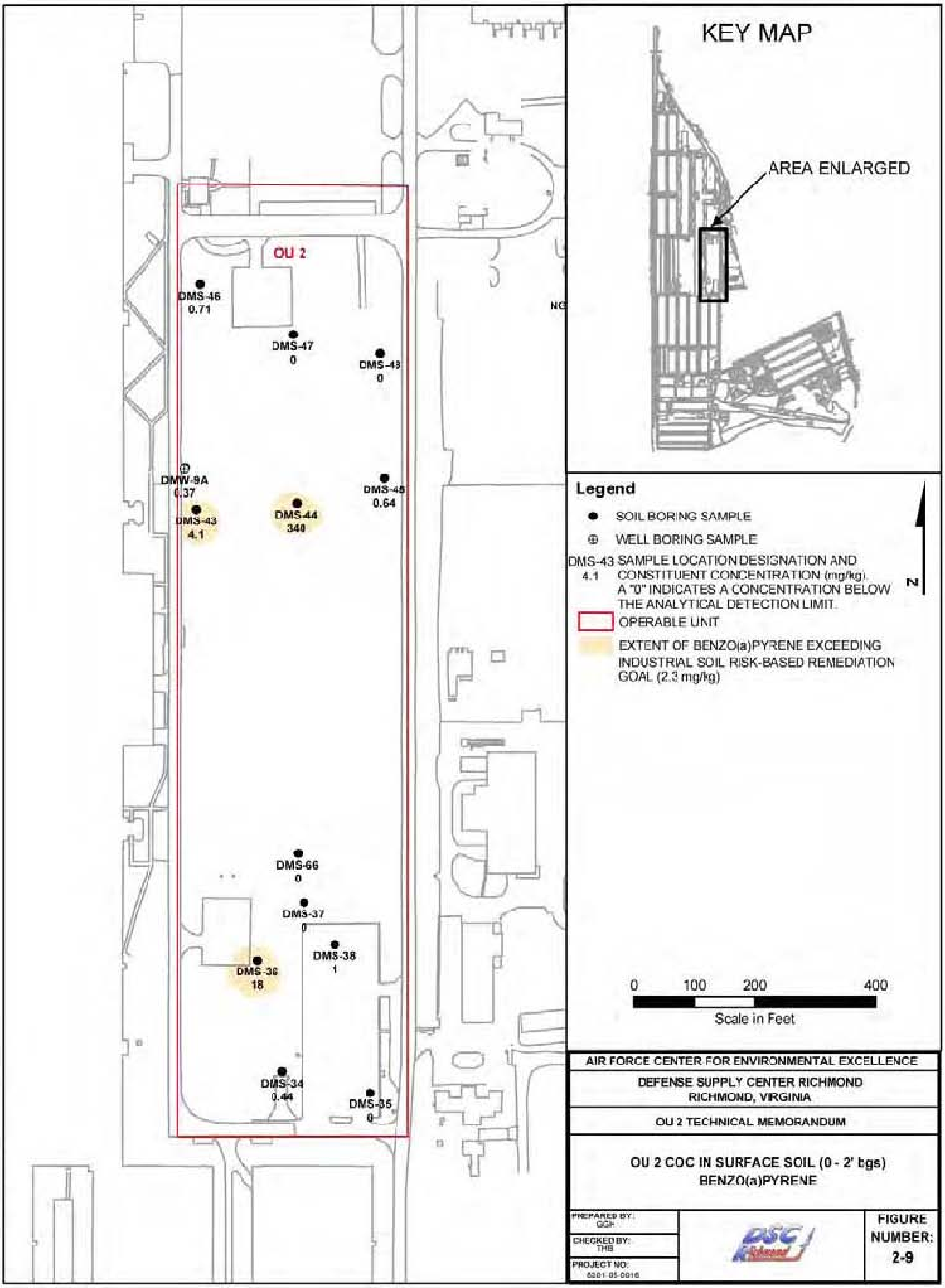
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

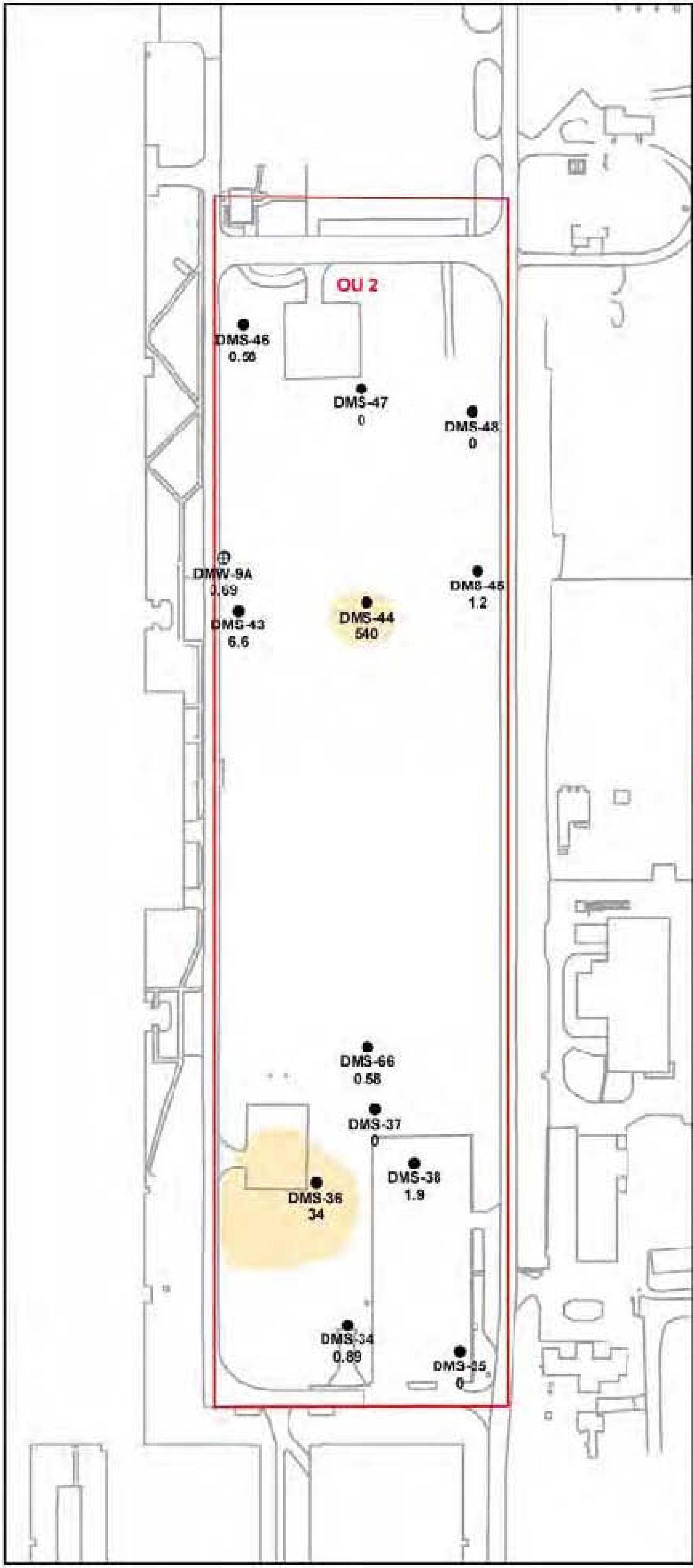
DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

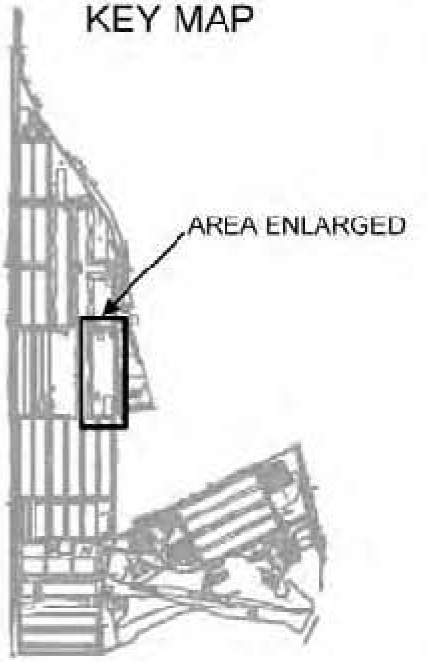
OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SURFACE SOIL (0 - 2' bgs)
BENZO(a)ANTHRACENE

PREPARED BY: GGH		FIGURE NUMBER: 2-8
CHECKED BY: THD		
PROJECT NO: 6301-05-8016		


KEY MAP
AREA ENLARGED
OU 2
DMS-46
0.71
DMS-47
0
DMS-49
0
DMW-9A
0.37
DMS-48
0.64
DMS-43
4.1
DMS-44
340
DMS-66
0
DMS-37
0
DMS-38
1
DMS-36
18
DMS-34
0.44
DMS-35
0
Legend
SOIL BORING SAMPLE
WELL BORING SAMPLE
DMS-43 4.1 SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
OPERABLE UNIT
EXTENT OF BENZO(a)PYRENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (2.3 mg/kg)
N
0
100
200
400
Scale in Feet
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA
OU 2 TECHNICAL MEMORANDUM
OU 2 COC IN SURFACE SOIL (0 - 2' bgs)
BENZO(a)PYRENE
PREPARED BY: GGH
CHECKED BY: THB
PROJECT NO: 6201 05 0016
FIGURE NUMBER: 2-9





Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- DMS-42 88 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF BENZO(b)FLUORANTHENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (23 mg/kg)

N

0 100 200 400

Scale in Feet

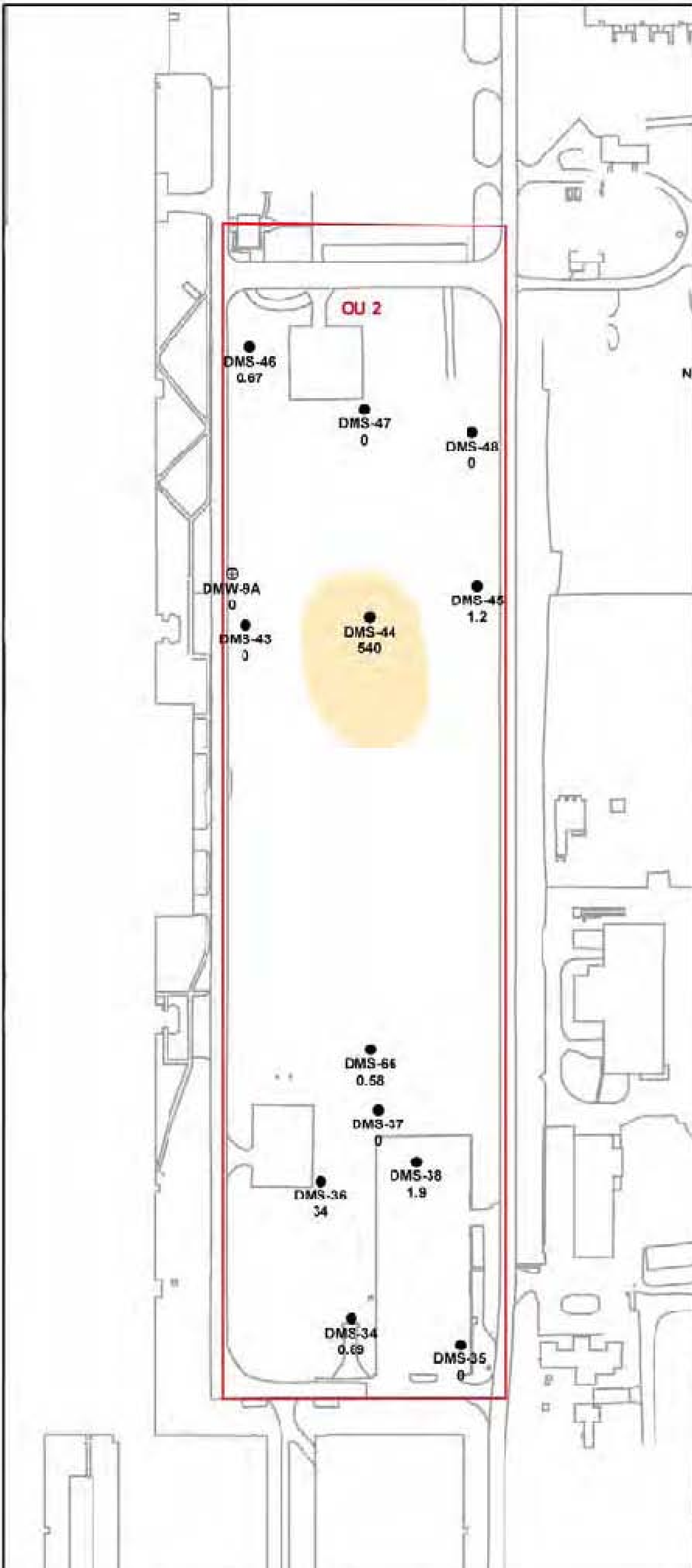
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

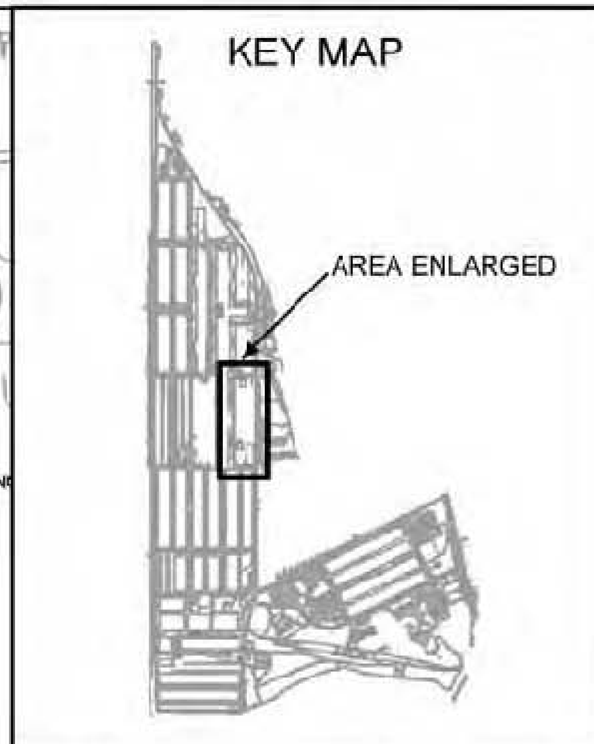
DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SURFACE SOIL (0 - 2' bgs)
BENZO(b)FLUORANTHENE

PREPARED BY: DGH		FIGURE NUMBER: 2-10
CHECKED BY:		
PROJECT NO: 8301-05-0016		





Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- DMS-44 540 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF BENZO(k)FLUORANTHENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (230 mg/kg)

N

0 100 200 400

Scale in Feet

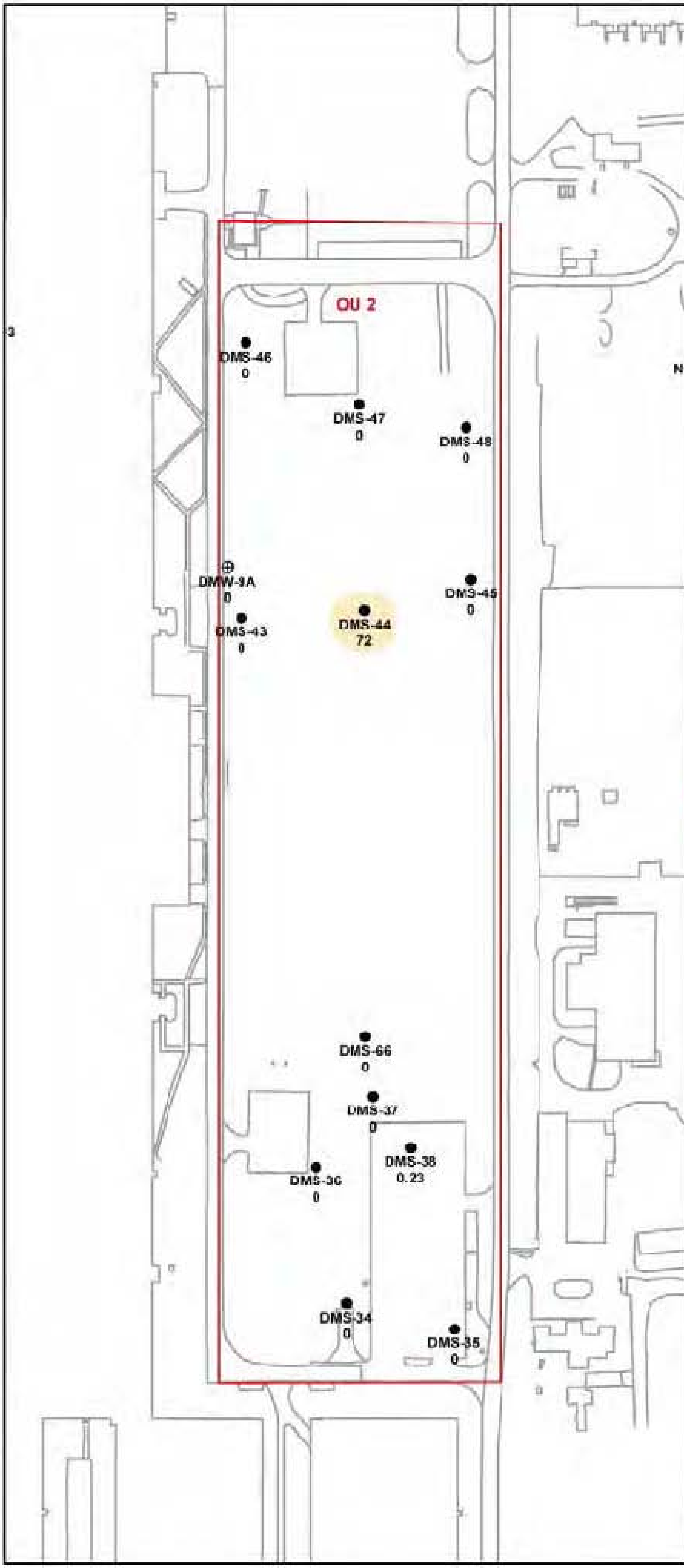
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

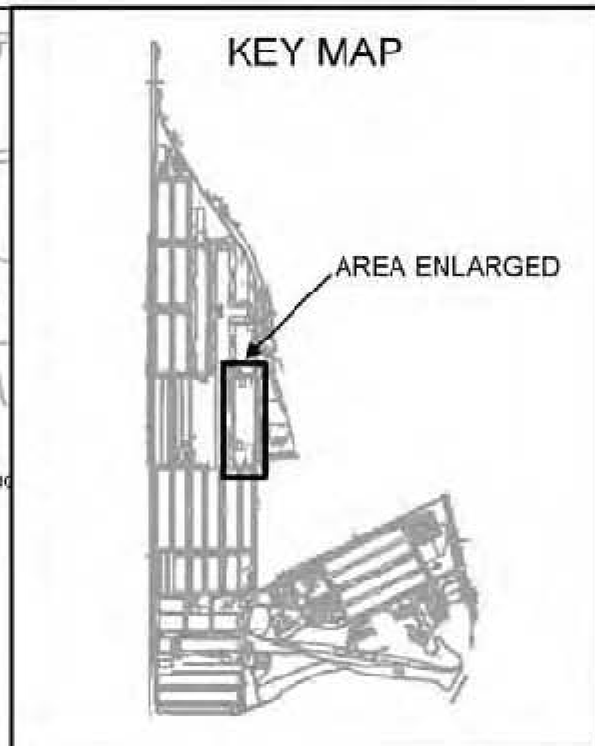
DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SURFACE SOIL (0 - 2' bgs)
BENZO(k)FLUORANTHENE

PREPARED BY: GGH CHECKED BY: THB PROJECT NO: 6301-05-9016	DSC Richmond	FIGURE NUMBER: 2-11





Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- TEST TRENCH SAMPLE
- DMS-44 / 72 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF DIBENZO(ah)ANTHRACENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (2.3 mg/kg)

N

0 100 200 400

Scale in Feet

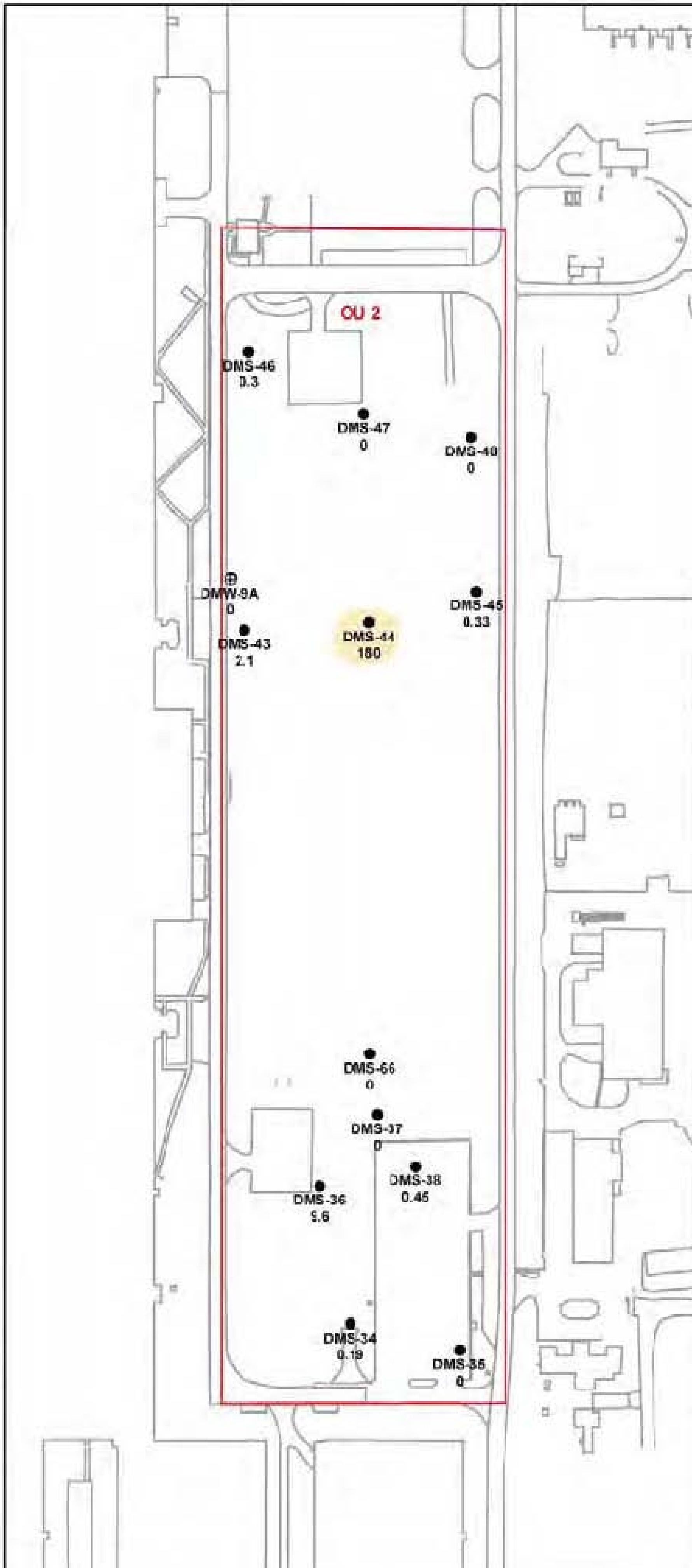
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

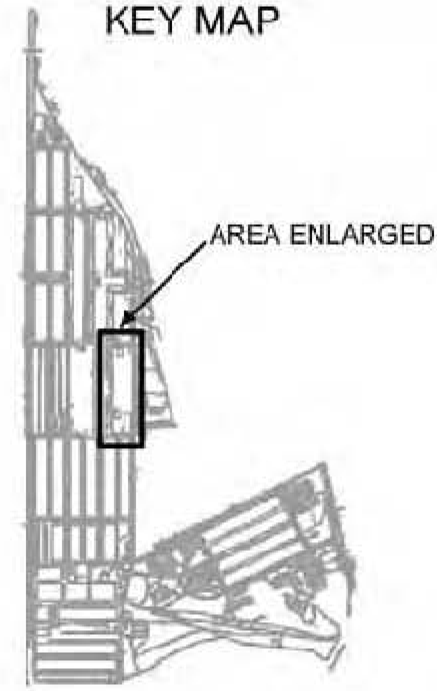
OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SURFACE SOIL (0 - 2' bgs)
DIBENZO(ah)ANTHRACENE

PREPARED BY: GGH		FIGURE NUMBER:
CHECKED BY: THB		2-12
PROJECT NO: 5301-05-8016		



KEY MAP



Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- DMS-44 180 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF INDENO(1,2,3-cd)PYRENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (23 mg/kg)

N

0 100 200 400

Scale in Feet

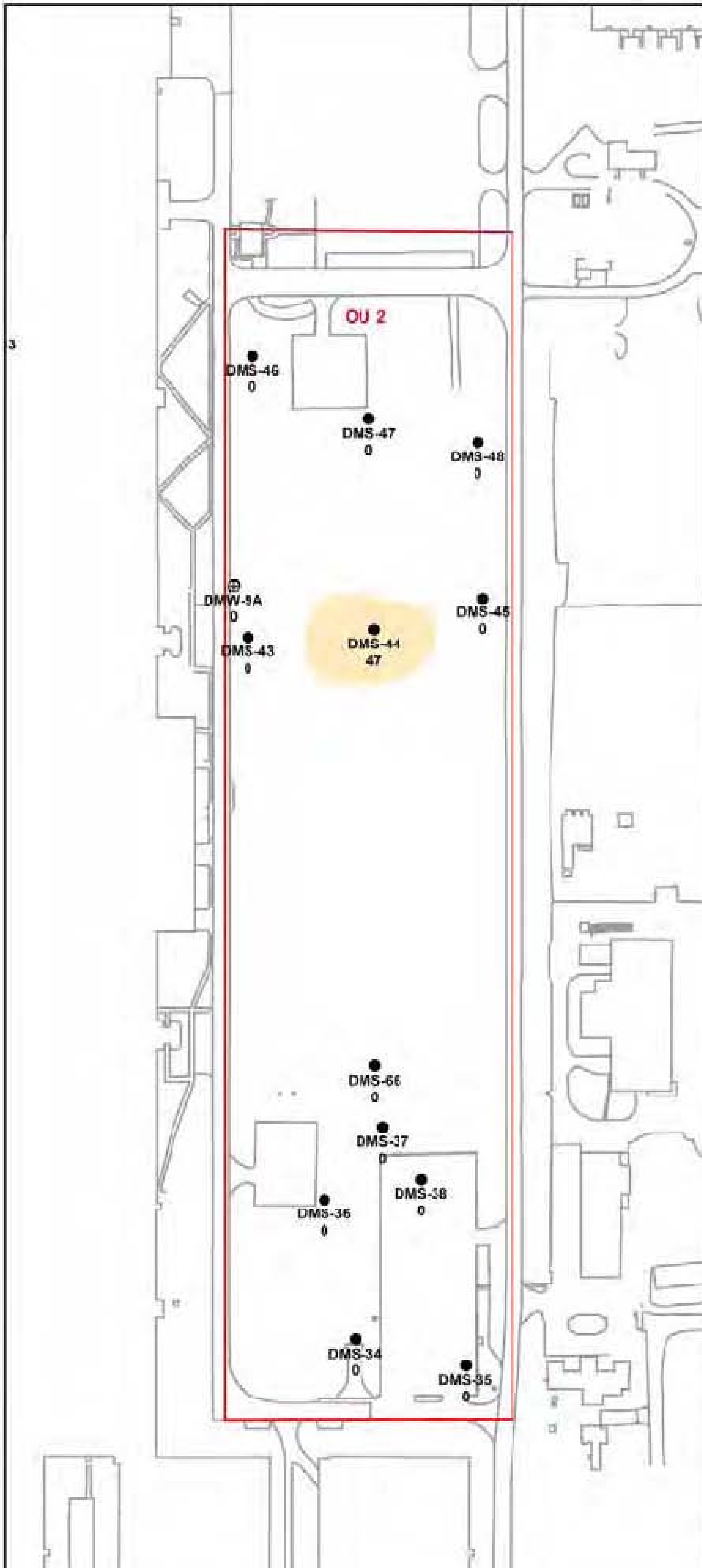
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

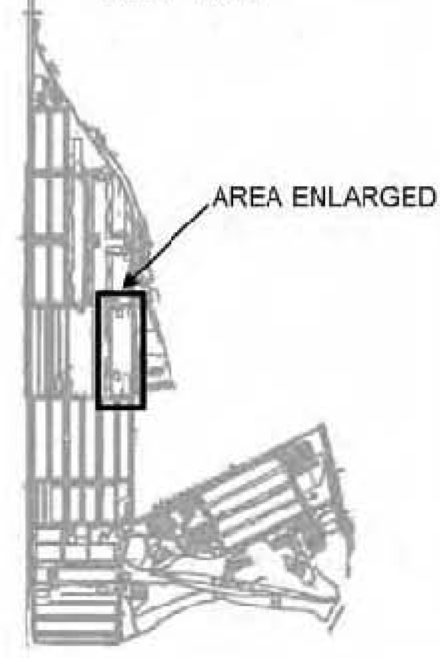
OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SURFACE SOIL (0 - 2' bgs)
INDENO(1,2,3-cd)PYRENE

PREPARED BY: GGH CHECKED BY: THD PROJECT NO: 6501-05-0016	DSC Richmond	FIGURE NUMBER: 2-13



KEY MAP



Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- DMS-44 47 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF AROCLOR 1260 EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (8.3 mg/kg)

N

0 100 200 400

Scale in Feet

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

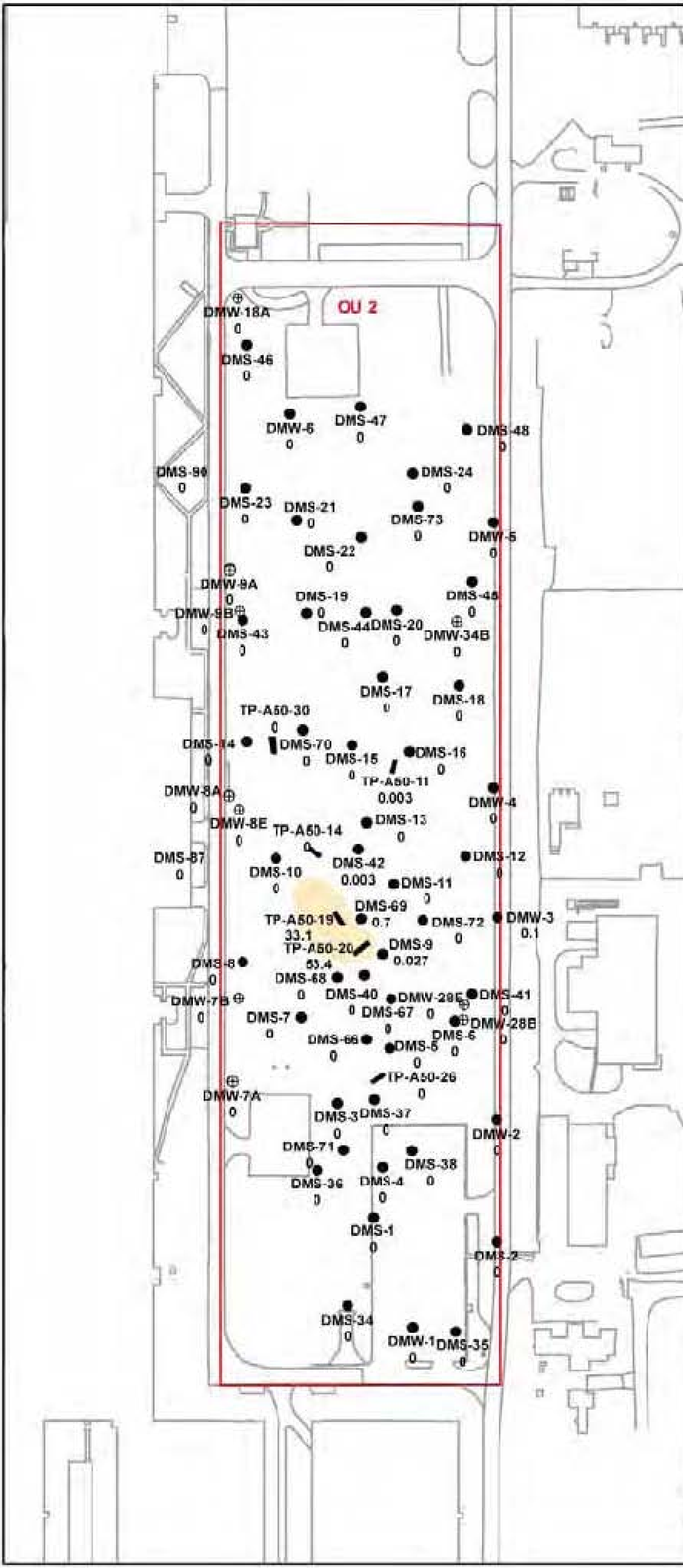
DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

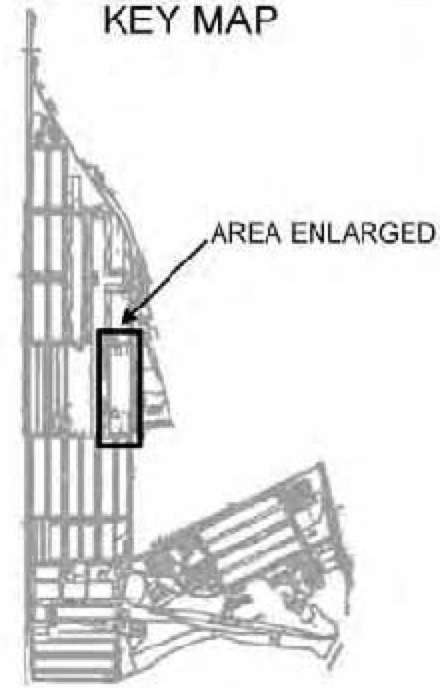
OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SURFACE SOIL (0 - 2' bgs)
AROCLOR 1260

PREPARED BY: GGH
CHECKED BY: THB
PROJECT NO: 5501-05-8016

FIGURE NUMBER: 2-14





Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- TEST TRENCH SAMPLE
- DMS-42 0.003 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF TRICHLOROETHENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (2.5 mg/kg)

N

0 100 200 400

Scale in Feet

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

OU 2 TECHNICAL MEMORANDUM

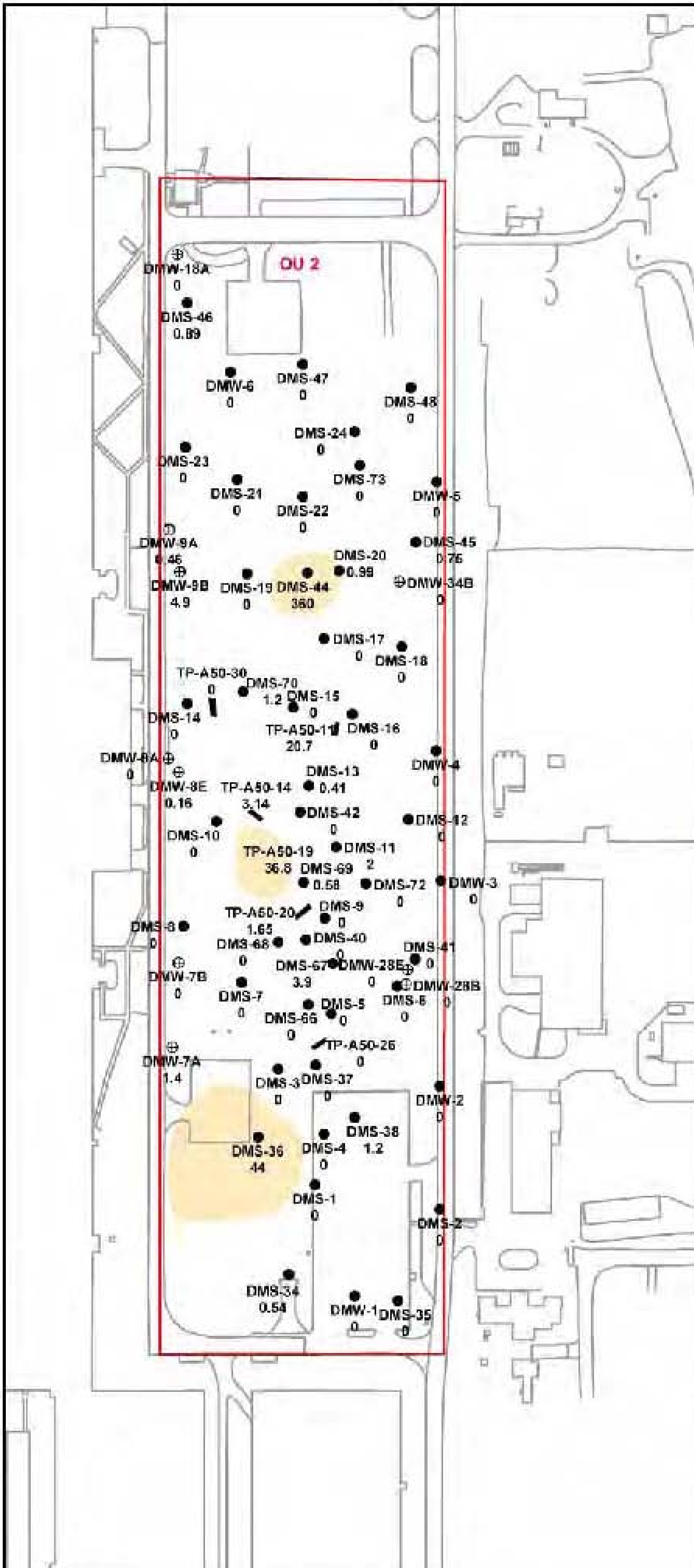
OU 2 COC IN SUBSURFACE SOIL (0 - 10' bgs)
TRICHLOROETHENE

PREPARED BY: GGH

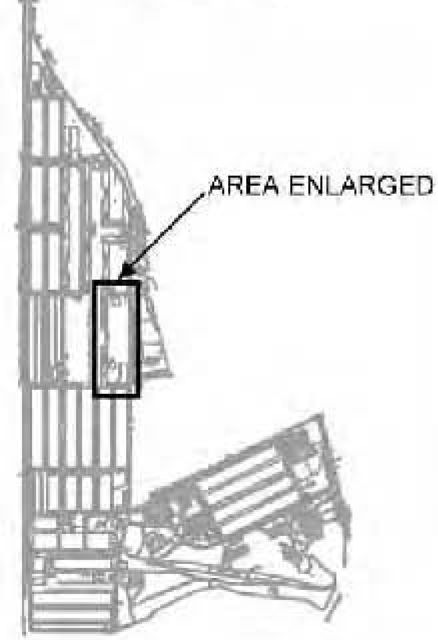
CHECKED BY: THB

PROJECT NO: 6301-05-9016

FIGURE NUMBER: 2-15



KEY MAP



Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- TEST TRENCH SAMPLE
- DMS-13 0.41 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF BENZO(a)ANTHRACENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (23 mg/kg)

N

0 100 200 400

Scale in Feet

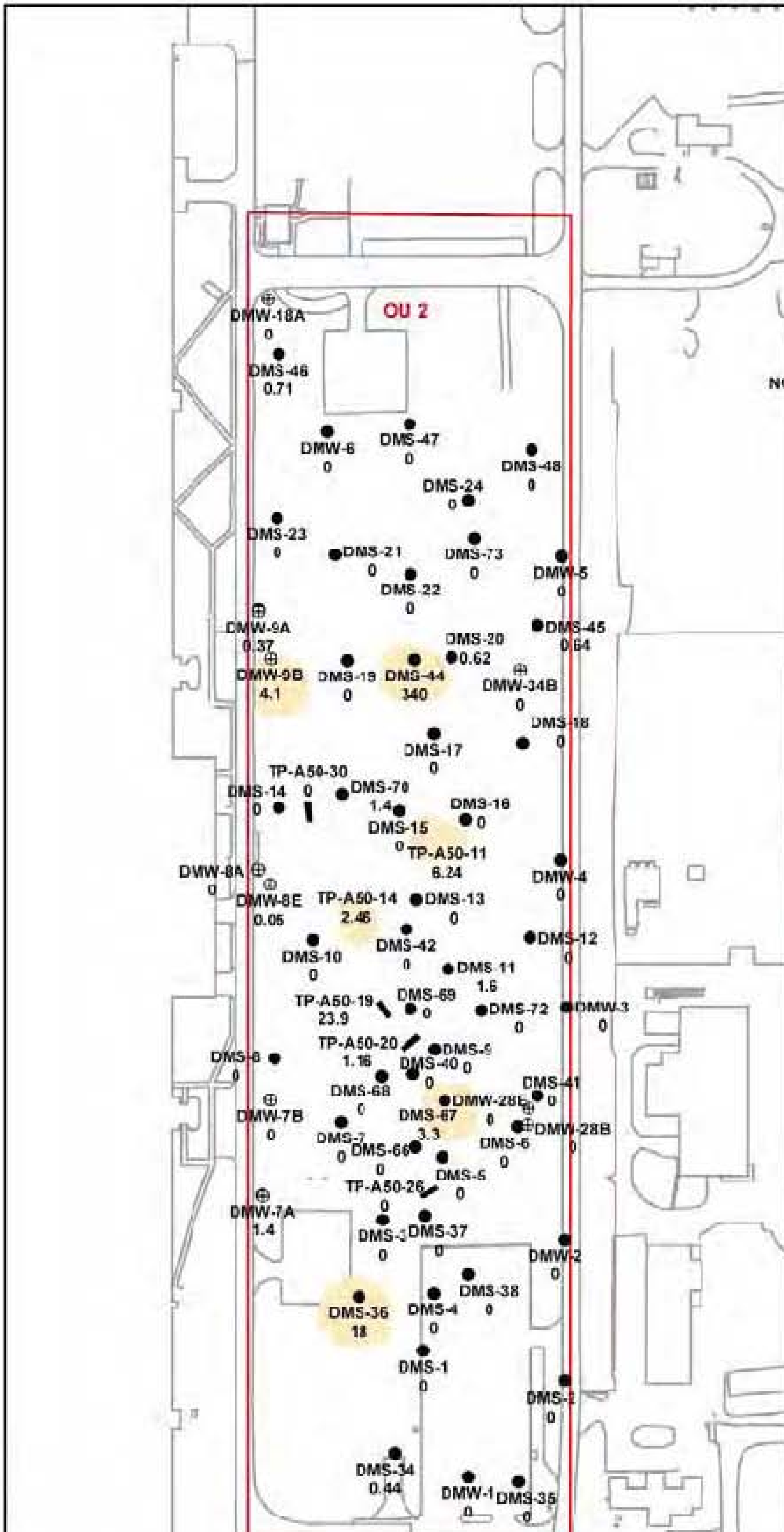
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

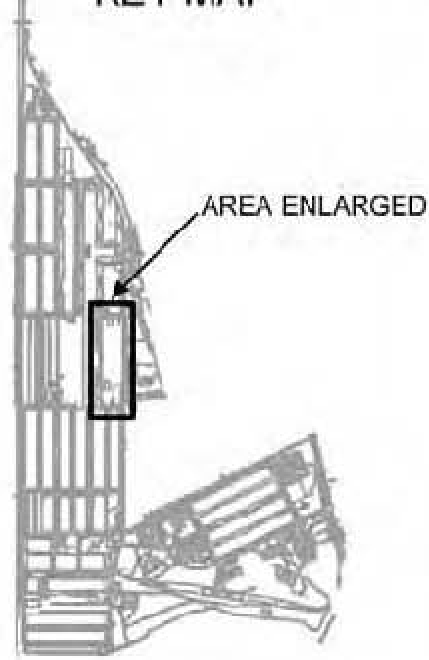
OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SUBSURFACE SOIL (0 - 10' bgs)
BENZO(a)ANTHRACENE

PREPARED BY:		FIGURE NUMBER:
CHECKED BY: THE		2-16
PROJECT NO: 6301-05-0016		



KEY MAP



Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- ▬ TEST TRENCH SAMPLE
- DMS-20 0.62 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF BENZO(a)PYRENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (2.3 mg/kg)

N

0 100 200 400

Scale in Feet

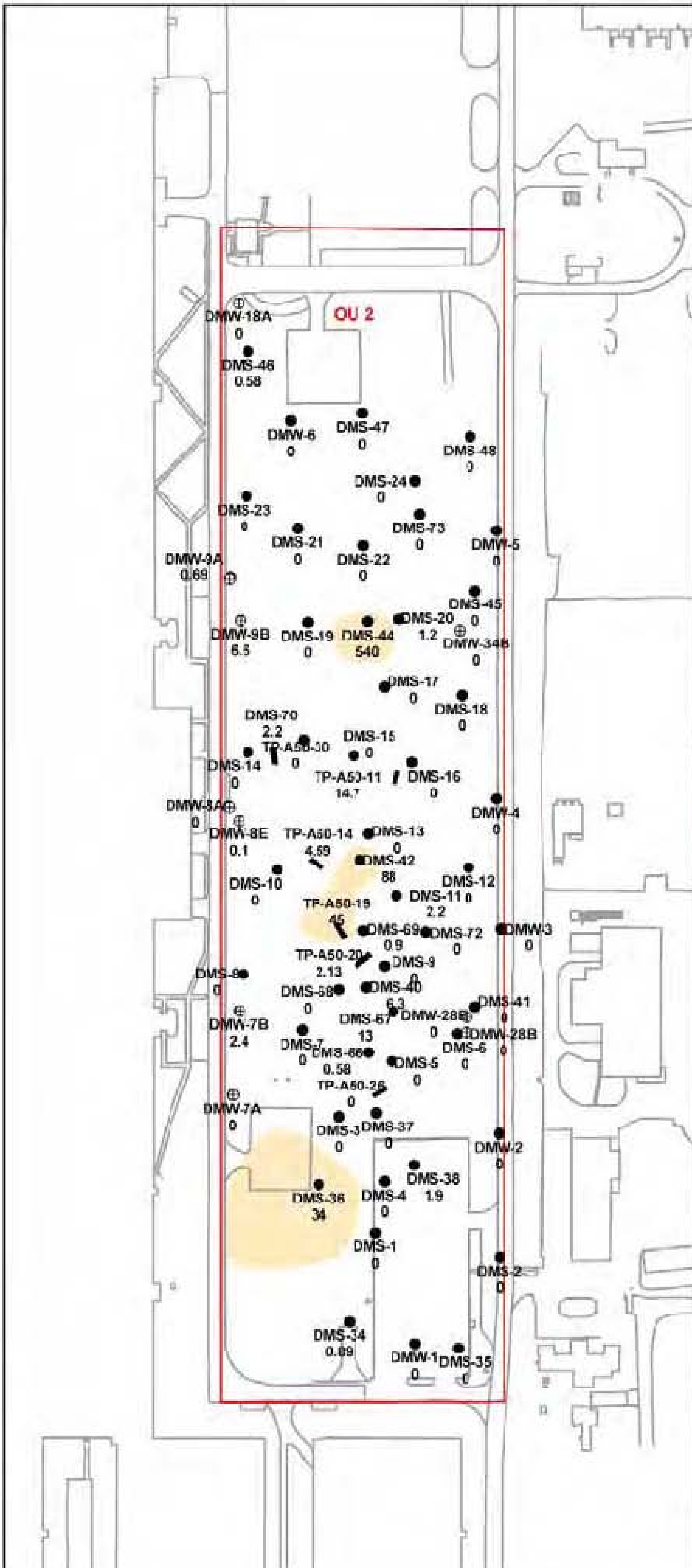
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

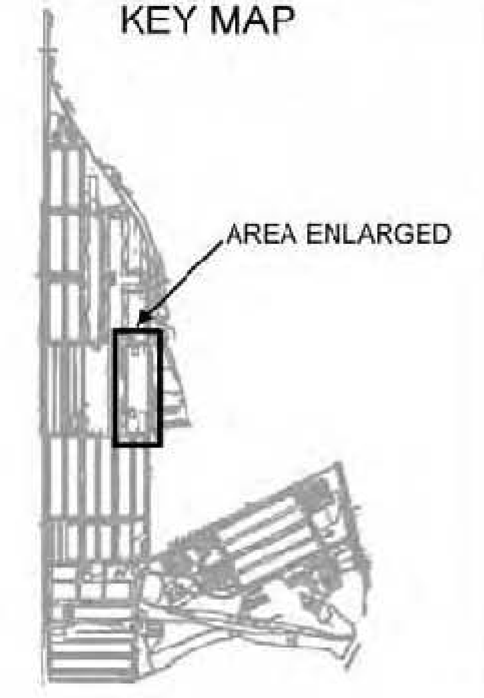
OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SUBSURFACE SOIL (0 - 10' bgs)
BENZO(a)PYRENE

PREPARED BY: GGH	DSC Richmond	FIGURE NUMBER: 2-17
CHECKED BY: THB		
PROJECT NO: 6001-05-0016		



KEY MAP



Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- TEST TRENCH SAMPLE
- DMS-42 88 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT
- OPERABLE UNIT
- EXTENT OF BENZO(b)FLUORANTHENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (23 mg/kg)

N

0 100 200 400

Scale in Feet

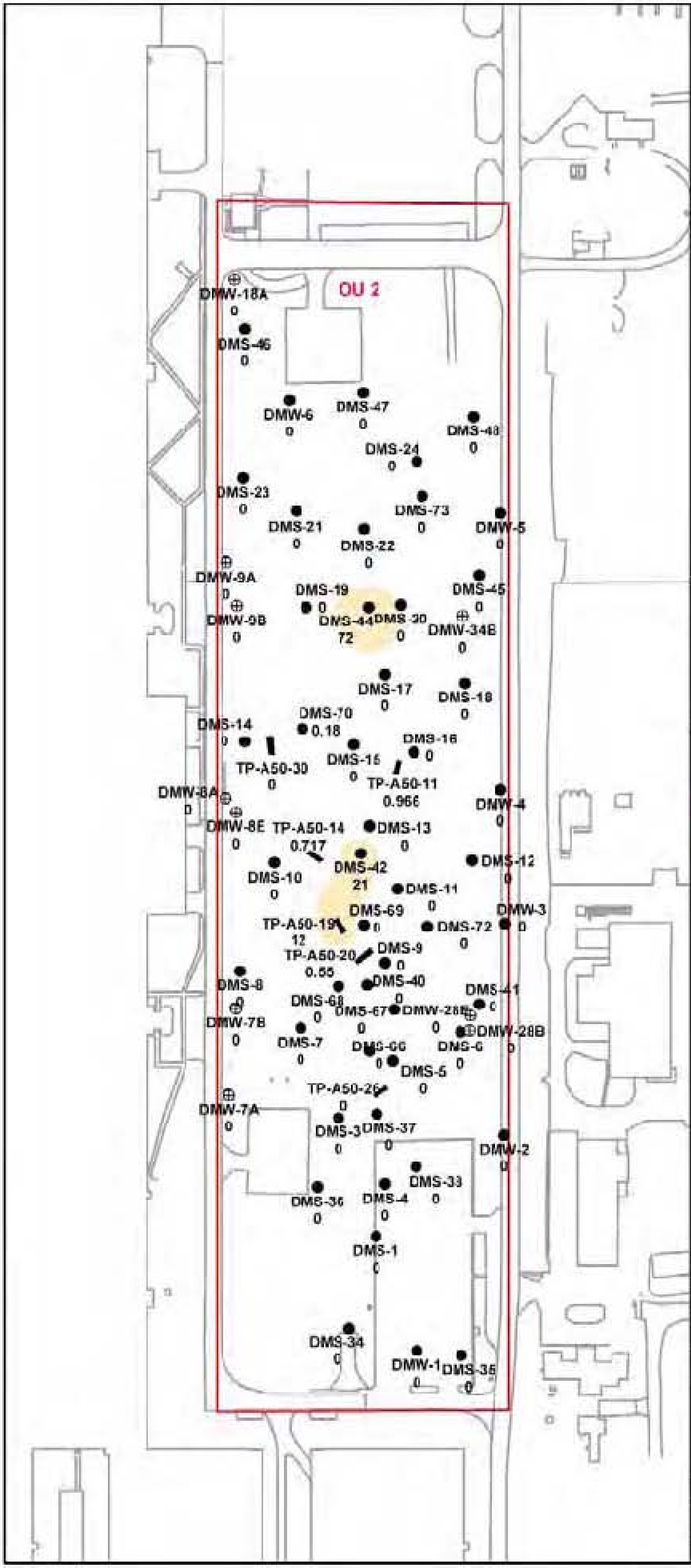
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

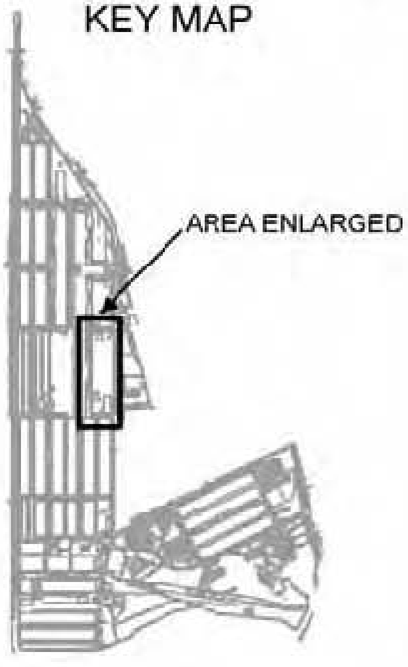
OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SUBSURFACE SOIL (0 - 10' bgs)
BENZO(b)FLUORANTHENE

PREPARED BY: GGH		FIGURE NUMBER: 2-18
CHECKED BY: THD		
PROJECT NO: 6301-05-8016		



KEY MAP



Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- TEST TRENCH SAMPLE
- DMS-42 21 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF DIBENZO(a,h)ANTHRACENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (2.3 mg/kg)

N

0 100 200 400

Scale in Feet

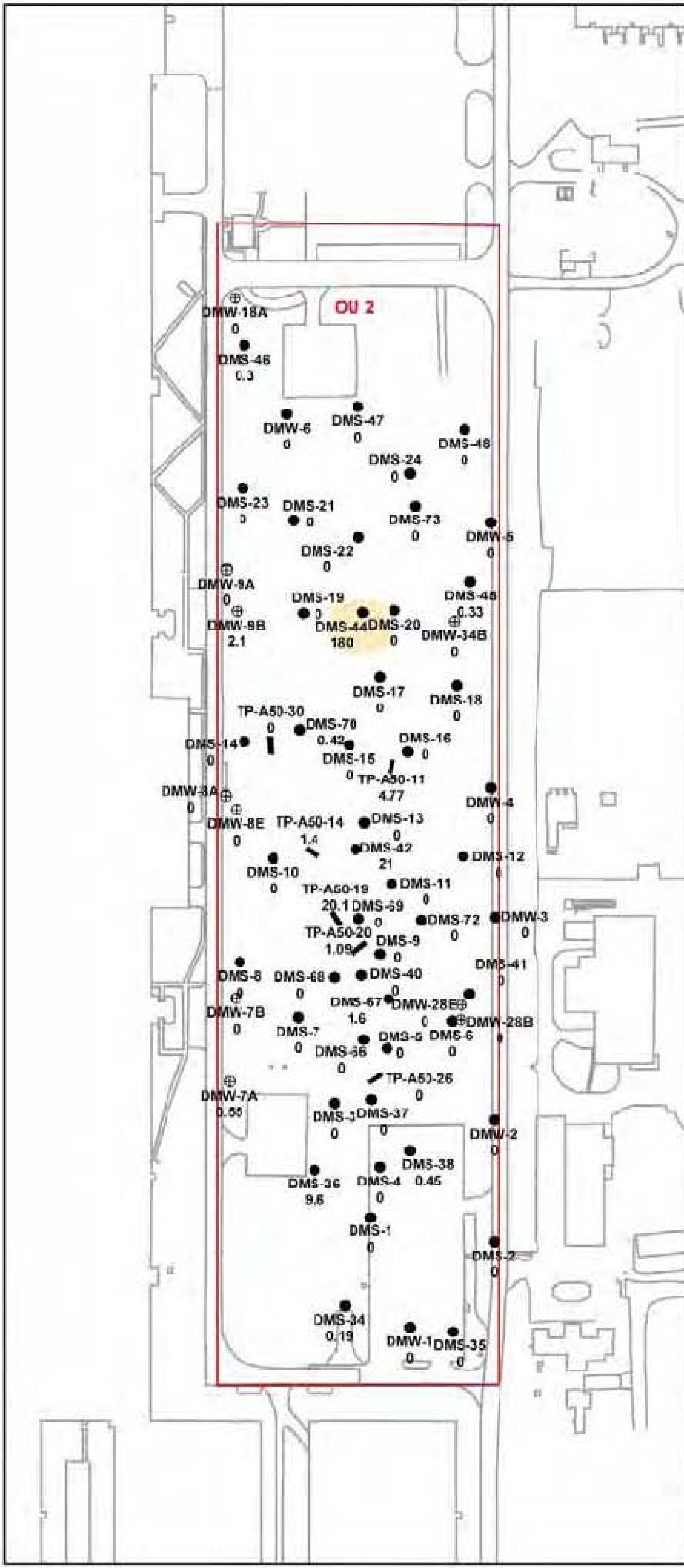
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

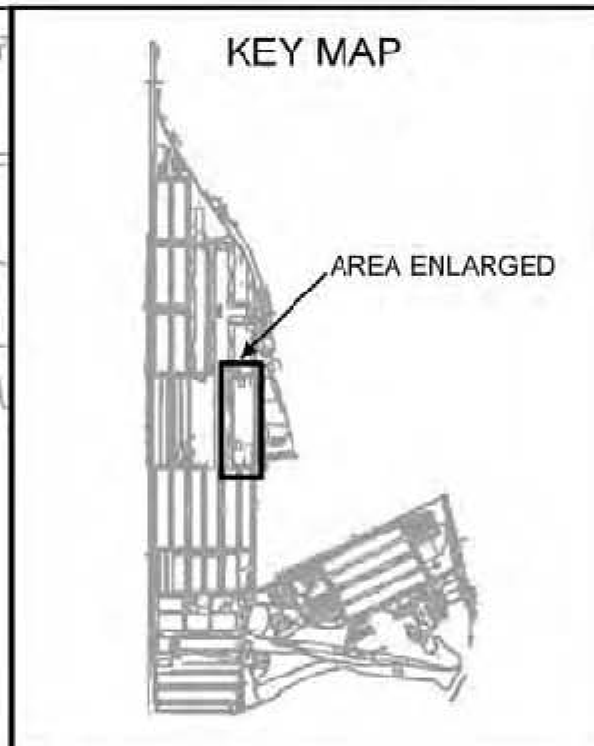
DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

OU 2 TECHNICAL MEMORANDUM

OU 2 COC IN SUBSURFACE SOIL (0 - 10' bgs)
DIBENZO(a,h)ANTHRACENE

PREPARED BY: GGH		FIGURE NUMBER: 2-19
CHECKED BY: THB		
PROJECT NO. 6001-05-0616		





Legend

- ● SOIL BORING SAMPLE
- ⊕ WELL BORING SAMPLE
- TEST TRENCH SAMPLE
- DMS-42 / 21 — SAMPLE LOCATION DESIGNATION AND CONSTITUENT CONCENTRATION (mg/kg). A "0" INDICATES A CONCENTRATION BELOW THE ANALYTICAL DETECTION LIMIT.
- OPERABLE UNIT
- EXTENT OF INDENO (1,2,3-cd) PYRENE EXCEEDING INDUSTRIAL SOIL RISK-BASED REMEDIATION GOAL (23 mg/kg)

N

0 100 200 400

Scale in Feet

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VIRGINIA

OU 2 TECHNICAL MEMORANDUM

**OU 2 COC IN SUBSURFACE SOIL (0 - 10' bgs)
INDENO(1,2,3-cd)PYRENE**

PREPARED BY: GGH		FIGURE NUMBER:
CHECKED BY: THB		2-20
PROJECT NO: 6501-06-9016		

not be used as a potable water supply source due to capacity limitations and iron fouling problems.

2.7 Summary of Site Risks

The original baseline risk assessment (Law, 1995) considered potential residential land use on-installation. Since future on-installation land use will be restricted to industrial purposes, the risk assessment was revised to evaluate industrial and construction workers on-installation and residents off-installation. A risk assessment summary based on the revised HHBRA is provided below.

2.7.1 HHBRA Methodology

The HHBRA was conducted using methods from USEPA's applicable risk assessment guidances (USEPA, 1989a; USEPA, 1991a; USEPA, 2004b) and other applicable guidance, including relevant USEPA Region 3 guidance (USEPA, 1994; USEPA, 2003). The HHBRA was conducted using a conservative and protective approach that included the following four components:

- Identification of chemicals of potential concern (COPCs), also known as the hazard identification.
- Exposure assessment, including identifying and characterizing exposure pathways and estimating chemical intakes.
- Toxicity assessment of the COPCs.
- Risk characterization.

Data from the following reports were used to update potential risks to human health and the environment from site soils.

- Results of Three-year Creek Monitoring Program 2001-2004 (MACTEC, 2005c).
- Creeks HHBRA (MACTEC, 2005b).
- Final Supplemental Feasibility Study Investigation Report, Defense Supply Center Richmond, Richmond, Virginia (MACTEC, 2006).

2.7.2 Identification of COPCs

COPCs are contaminants present in maximum concentrations that exceed a conservative risk-based screening value, namely USEPA Region III risk-based criteria (RBC). The COPCs are then further evaluated in the HHBRA to identify those COCs that require remediation to protect human health.

A total of 11 COPCs (3 metals, 7 PAHs, and 1 PCB) were identified for surficial soils based on direct contact (**Table 2-4**). A total of 16 COPCs (5 metals, 3 VOCs, 7 PAHs, and PCB-1260) were identified for subsurface soils based on direct contact (**Table 2-5**). These direct-contact soil COPCs include aluminum (subsurface only), arsenic, copper, iron, vanadium (subsurface only), total 1,2-dichloroethene (subsurface only), TCE (subsurface only), vinyl chloride (subsurface only), benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and PCB-1260.

2.7.3 Exposure Assessment

The exposure assessment included identifying the following:

- The receptors (e.g., workers) that may be exposed to COPCs
- The exposure pathways (i.e., how the COPCs could reach receptors)
- The magnitude of exposure for these receptors

The potential receptors to OU 2 COPCs in soil include on-installation site workers, off-installation residents, on-site terrestrial ecological receptors, and off-site ecological receptors (via No Name Creek). An exposure pathway is complete only if all four of the following elements occur:

- A COPC is present in the environment.
- A transport mechanism exists for the COPC to reach a receptor exposure point (i.e., through soil, water, or air).
- A potential receptor (current or future) is present at the exposure point.
- A potential exposure route (e.g., ingestion, dermal contact, or inhalation) exists at the exposure point.

TABLE 2-4

SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOILS (0-2 FT)
OPERABLE UNIT 2
Defense Supply Center Richmond
Richmond, Virginia

Chemical	Number of Detections (a)	Number of Analyses (a)	Frequency of Detection (b)	Frequency of Detection ≥ 5%?	Minimum Detected Concentration (mg/kg) (a)	Maximum Detected Concentration (mg/kg) (a)	Industrial Soil Risk-Based Concentration (RBC) (mg/kg) (c)	Maximum Detected Concentration > RBC?	Site Concentrations > Background (d) ?	Direct Contact Soil COPC?
Metals/Inorganics										
Aluminum	15	15	100%	YES	3.58E+03	2.18E+04	1.00E+05 (e)	NO	NA	NO
Arsenic	15	15	100%	YES	4.00E+00	3.00E+01	1.90E+00	YES	YES	**YES**
Barium	15	15	100%	YES	2.00E+01	1.74E+03	2.00E+04	NO	NA	NO
Cadmium	5	15	33%	YES	1.90E+00	5.00E+00	1.00E+02	NO	NA	NO
Chromium	15	15	100%	YES	4.00E+00	7.20E+01	3.10E+02 (f)	NO	NA	NO
Cobalt	1	15	7%	YES	2.00E+01	2.00E+01	2.00E+03 (e)	NO	NA	NO
Copper	15	15	100%	YES	2.50E+00	1.41E+04	4.10E+03	YES	NO	**YES**
Iron	14	15	93%	YES	5.23E+03	3.97E+04	3.10E+04	YES	NO	**YES**
Lead	15	15	100%	YES	2.40E+01	3.80E+02	8.00E+02 (g)	NO	NA	NO
Manganese	15	15	100%	YES	3.00E+01	8.25E+02	2.00E+03	NO	NA	NO
Mercury	13	15	87%	YES	8.00E-02	5.90E-01	3.10E+01 (h)	NO	NA	NO
Nickel	8	15	53%	YES	1.70E+00	1.00E+01	2.00E+03	NO	NA	NO
Selenium	2	15	13%	YES	3.74E-01	1.50E+00	5.10E+02	NO	NA	NO
Silver	4	15	27%	YES	1.00E+00	1.60E+01	5.10E+02	NO	NA	NO
Thallium	1	15	7%	YES	1.20E+00	1.20E+00	7.20E+00	NO	NA	NO
Tin	7	15	47%	YES	4.00E+00	3.80E+01	6.10E+04	NO	NA	NO
Vanadium	15	15	100%	YES	1.00E+01	6.20E+01	1.00E+02	NO	NA	NO
Zinc	15	15	100%	YES	5.00E+00	6.29E+02	3.10E+04	NO	NA	NO
VOCs										
Acetone	7	9	78%	YES	6.10E-03	1.10E-01	9.20E+04	NO	NA	NO
Methylene chloride	7	7	100%	YES	7.60E-03	2.60E-02	3.80E+02	NO	NA	NO
Tetrachloroethene	1	15	7%	YES	1.40E-02	1.40E-02	5.30E+00	NO	NA	NO
Toluene	1	15	7%	YES	1.60E-02	1.60E-02	8.20E+03	NO	NA	NO
trans-1,2-Dichloroethene	1	15	7%	YES	2.00E-01	2.00E-01	2.00E+03	NO	NA	NO
Trichloroethene	1	15	7%	YES	8.40E-02	8.40E-02	7.20E+00	NO	NA	NO
PAHs										
Acenaphthene	4	15	27%	YES	1.90E-01	8.40E+01	6.10E+03	NO	NA	NO
Anthracene	4	15	27%	YES	2.50E-01	7.00E+02	3.10E+04	NO	NA	NO
Benzo(a)anthracene	8	15	53%	YES	4.60E-01	3.60E+02	3.90E+00	YES	NO	**YES**
Benzo(a)pyrene	8	15	53%	YES	3.70E-01	3.40E+02	3.90E-01	YES	NO	**YES**
Benzo(b)fluoranthene	9	15	60%	YES	5.80E-01	5.40E+02	3.90E+00	YES	NO	**YES**
Benzo(ghi)perylene	8	15	53%	YES	5.60E-03	1.90E+02	3.10E+03 (h)	NO	NA	NO
Benzo(k)fluoranthene	7	15	47%	YES	5.80E-01	5.40E+02	3.90E+01	YES	NO	**YES**
Chrysene	8	15	53%	YES	4.70E-01	4.00E+02	3.90E+02	YES	NO	**YES**
Dibenzo(a,h)anthracene	2	15	13%	YES	2.30E-01	7.20E+01	3.90E-01	YES	NO	**YES**
Fluoranthene	8	15	53%	YES	1.00E+00	7.00E+02	4.10E+03	NO	NA	NO
Fluorene	2	15	13%	YES	2.10E-01	8.70E+01	4.10E+03	NO	NA	NO
Indeno((1,2,3-cd)pyrene	7	15	47%	YES	1.90E-01	1.80E+02	3.90E+00	YES	NO	**YES**
Phenanthrene	8	15	53%	YES	5.50E-01	7.00E+02	3.10E+03 (h)	NO	NA	NO
Pyrene	7	15	47%	YES	7.00E-01	9.00E+02	3.10E+03	NO	NA	NO

Source: MACTEC 2006

TABLE 2-4

SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOILS (0-2 FT)
OPERABLE UNIT 2
Defense Supply Center Richmond
Richmond, Virginia

Chemical	Number of Detections (a)	Number of Analyses (a)	Frequency of Detection (b)	Frequency of Detection ≥ 5%?	Minimum Detected Concentration (mg/kg) (a)	Maximum Detected Concentration (mg/kg) (a)	Industrial Soil Risk-Based Concentration (RBC) (mg/kg) (c)		Maximum Detected Concentration > RBC?	Site Concentrations > Background (d) ?	Direct Contact Soil COPC?
SVOCs											
Benzyl alcohol	1	15	7%	YES	2.00E-01	2.00E-01	3.10E+04		NO	NA	NO
bis(2-Ethylhexyl)phthalate	5	15	33%	YES	2.10E-01	3.70E-01	2.00E+02		NO	NA	NO
Dibenzofuran	1	15	7%	YES	5.10E+01	5.10E+01	2.00E+02	(e)	NO	NA	NO
Di-n-octyl phthalate	2	15	13%	YES	3.10E-01	4.60E-01	4.10E+03		NO	NA	NO
Phenol	5	55	9%	YES	4.70E-01	2.40E+00	3.10E+04		NO	NA	NO
Pesticides											
4,4'-DDD	2	15	13%	YES	3.60E-03	1.90E-02	1.20E+01		NO	NA	NO
4,4'-DDE	4	15	27%	YES	2.30E-03	7.90E-02	8.40E+00		NO	NA	NO
4,4'-DDT	2	15	13%	YES	1.10E-02	1.20E-01	8.40E+00		NO	NA	NO
Dieldrin	1	13	8%	YES	1.20E-02	1.20E-02	1.80E-01		NO	NA	NO
Technical Chlordane	1	15	7%	YES	1.50E-01	1.50E-01	8.20E+00	(h)	NO	NA	NO
PCBs											
PCB-1260	1	15	7%	YES	4.70E+01	4.70E+01	1.40E+00		YES	NA	**YES**

Notes:
Bolded chemicals exceed one or more screening criteria

mg/kg Milligrams of chemical per kilogram of soil
RBC Risk-Based Concentration
COPC Constituent of potential concern
PAHs Polycyclic aromatic hydrocarbons
VOCs Volatile organic compounds
SVOCs Semivolatile organic compounds
PCB Polychlorinated biphenyls
NA Not applicable

(a) See MACTEC 2007 for site data.
(b) (No. Detections/ No. Analyses) x 100.
(c) From USEPA (2006).
(d) See MACTEC 2007 for background comparison results.
(e) RBC value listed was obtained from the April 2005 version of the Region 3 RBC table. The constituent has been withdrawn from the current version.
(f) Value for chromium VI used as a surrogate since it is the most conservative value for chromium
(g) From Adult Lead Methodology Frequently Asked Questions, www.epa.gov/superfund/programs/lead/almfaq.htm, April 2004.
(h) Value for mercuric chloride used as a surrogate for mercury; pyrene used a surrogate for benzo(ghi)perylene and phenanthrene; and chlordane used as a surrogate for technical chlordane.

Source: MACTEC 2006

TABLE 2-5

SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE AND SUBSURFACE SOILS (0-10 FT)
OPERABLE UNIT 2
Defense Supply Center Richmond
Richmond, Virginia

Chemical	Number of Detections (a)	Number of Analyses (a)	Frequency of Detection (b)	Frequency of Detection ≥ 5%?	Minimum Detected Concentration (mg/kg) (a)	Maximum Detected Concentration (mg/kg) (a)	Industrial Soil Risk-Based Concentration (RBC) (mg/kg) (c)	Maximum Detected Concentration > RBC?	Site Concentrations > Background (d) ?	Direct Contact Soil COPC?
Metals/Inorganics										
Aluminum	45	45	100%	YES	2.55E+03	1.28E+05	1.00E+05 (e)	YES	NO	**YES**
Antimony	2	56	4%	NO	6.00E-01	7.00E-01	NA	NA	NA	NO
Arsenic	48	56	86%	YES	2.30E-01	4.10E+01	1.90E+00	YES	YES	**YES**
Barium	40	47	85%	YES	9.50E+00	1.74E+03	2.00E+04	NO	NA	NO
Beryllium	16	56	29%	YES	1.57E-01	1.10E+00	2.00E+02	NO	NA	NO
Cadmium	18	55	33%	YES	4.00E-01	8.00E+00	1.00E+02	NO	NA	NO
Chromium	54	56	96%	YES	1.40E+00	1.22E+02	3.10E+02 (f)	NO	NA	NO
Chromium (VI)	2	42	5%	YES	3.00E-01	4.00E-01	3.10E+02	NO	NA	NO
Cobalt	10	46	22%	YES	1.02E+00	2.00E+01	2.00E+03 (e)	NO	NA	NO
Copper	43	56	77%	YES	1.02E+00	1.41E+04	4.10E+03	YES	NO	**YES**
Cyanide	1	49	2%	NO	1.00E+00	1.00E+00	NA	NA	NA	NO
Iron	45	46	98%	YES	1.15E+03	7.65E+04	3.10E+04	YES	NO	**YES**
Lead	54	56	96%	YES	2.40E+00	3.80E+02	8.00E+02 (g)	NO	NA	NO
Manganese	45	46	98%	YES	3.00E+00	3.34E+03	2.00E+04	NO	NA	NO
Mercury	39	56	70%	YES	2.10E-03	5.90E-01	3.10E+01 (h)	NO	NA	NO
Molybdenum	1	1	100%	YES	3.96E-01	3.96E-01	5.10E+02	NO	NA	NO
Nickel	23	56	41%	YES	1.00E+00	3.40E+01	2.00E+03	NO	NA	NO
Selenium	11	56	20%	YES	1.00E-01	1.50E+00	5.10E+02	NO	NA	NO
Silver	10	55	18%	YES	4.50E-01	1.60E+01	5.10E+02	NO	NA	NO
Thallium	2	57	4%	NO	1.20E+00	1.20E+01	NA	NA	NA	NO
Tin	13	32	41%	YES	4.00E+00	3.80E+01	6.10E+04	NO	NA	NO
Vanadium	46	46	100%	YES	3.40E+00	3.89E+02	1.00E+02	YES	NO	**YES**
Zinc	56	56	100%	YES	1.00E+00	6.29E+02	3.10E+04	NO	NA	NO
VOCs										
1,1,1-Trichloroethane	1	55	2%	NO	3.43E+00	3.43E+00	NA	NA	NA	NO
1,1,2-Trichloroethane	1	8	13%	YES	2.49E-01	2.49E-01	5.00E+01	NO	NA	NO
1,2,4-Trichlorobenzene	1	50	2%	NO	2.39E-01	2.39E-01	NA	NA	NA	NO
1,2-Dichlorobenzene	3	57	5%	YES	1.18E-01	1.80E+01	9.20E+03	NO	NA	NO
1,2-Dichloroethane	1	58	2%	NO	3.43E-01	3.43E-01	NA	NA	NA	NO
1,2-Dichloroethene, total	2	11	18%	YES	1.92E+00	9.40E+00	9.20E+02	NO	NA	**YES (i)**
trans-1,2-Dichloroethene	2	48	4%	NO	2.00E-01	5.50E-01	NA	NA	NA	NO
1,3-Dichlorobenzene	1	57	2%	NO	1.19E+00	1.19E+00	NA	NA	NA	NO
1,4-Dichlorobenzene	3	57	5%	YES	7.80E-01	9.20E+01	1.20E+02	NO	NA	NO
2-Butanone	9	47	19%	YES	3.30E-03	1.40E+01	6.10E+04	NO	NA	NO
2-Hexanone	1	45	2%	NO	7.00E-03	7.00E-03	NA	NA	NA	NO
4-Methyl-2-pentanone	1	48	2%	NO	6.20E+00	6.20E+00	NA	NA	NA	NO
Acetone	22	29	76%	YES	2.60E-03	4.57E+00	9.20E+04	NO	NA	NO
Benzene	1	55	2%	NO	2.41E-01	2.41E-01	NA	NA	NA	NO
Carbon Disulfide	1	49	2%	NO	4.40E-03	4.40E-03	NA	NA	NA	NO
Carbon Tetrachloride	1	54	2%	NO	1.14E+01	1.14E+01	NA	NA	NA	NO
Chlorobenzene	4	57	7%	YES	5.10E-02	2.26E+01	2.00E+03	NO	NA	NO

Source: MACTEC 2006

TABLE 2-5

SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE AND SUBSURFACE SOILS (0-10 FT)
OPERABLE UNIT 2
Defense Supply Center Richmond
Richmond, Virginia

Chemical	Number of Detections (a)	Number of Analyses (a)	Frequency of Detection (b)	Frequency of Detection ≥ 5%?	Minimum Detected Concentration (mg/kg) (a)	Maximum Detected Concentration (mg/kg) (a)	Industrial Soil Risk-Based Concentration (RBC) (mg/kg) (c)		Maximum Detected Concentration > RBC?	Site Concentrations > Background (d) ?	Direct Contact Soil COPC?
Chloroform	2	58	3%	NO	1.00E-03	1.40E+01	NA		NA	NA	NO
Ethylbenzene	5	57	9%	YES	4.75E-03	2.54E+00	1.00E+04		NO	NA	NO
Methylene chloride	22	37	59%	YES	4.68E-03	1.80E+00	3.80E+02		NO	NA	NO
p-Isopropyltoluene	1	2	50%	YES	1.20E-03	1.20E-03	1.00E+03	(h)	NO	NA	NO
Tetrachloroethene	4	57	7%	YES	5.67E-03	2.84E+00	5.30E+00		NO	NA	NO
Toluene	11	57	19%	YES	1.00E-03	6.60E+01	8.20E+03		NO	NA	NO
Trichloroethene	6	57	11%	YES	2.97E-03	5.34E+01	7.20E+00		YES	NA	**YES**
Vinyl chloride	1	57	2%	NO	3.00E-03	3.00E-03	4.00E+00		NO	NA	**YES (i)**
m,p-Xylene	3	6	50%	YES	1.28E-02	4.60E+00	2.00E+04	(h)	NO	NA	NO
o-Xylene	3	6	50%	YES	5.63E-03	2.35E+00	2.00E+04	(h)	NO	NA	NO
Xylenes, total	1	39	3%	NO	1.60E-02	1.60E-02	NA		NA	NA	NO
PAHs											
Acenaphthene	10	53	19%	YES	1.90E-01	9.30E+01	6.10E+03		NO	NA	NO
Acenaphthylene	2	55	4%	NO	8.27E-02	7.79E-01	NA		NA	NA	NO
Anthracene	13	55	24%	YES	2.50E-01	7.00E+02	3.10E+04		NO	NA	NO
Benzo(a)anthracene	18	55	33%	YES	4.60E-01	3.60E+02	3.90E+00		YES	NA	**YES**
Benzo(a)pyrene	17	55	31%	YES	3.70E-01	3.40E+02	3.90E-01		YES	NA	**YES**
Benzo(b)fluoranthene	20	55	36%	YES	5.80E-01	5.40E+02	3.90E+00		YES	NA	**YES**
Benzo(ghi)perylene	14	55	25%	YES	5.60E-03	1.90E+02	3.10E+03	(h)	NO	NA	NO
Benzo(k)fluoranthene	14	55	25%	YES	5.80E-01	5.40E+02	3.90E+01		YES	NA	**YES**
Carbazole	3	6	50%	YES	3.06E-01	7.95E+00	1.40E+02		NO	NA	NO
Chrysene	19	55	35%	YES	2.80E-01	4.00E+02	3.90E+02		YES	NA	**YES**
Dibenzo(a,h)anthracene	8	55	15%	YES	1.80E-01	7.20E+01	3.90E-01		YES	NA	**YES**
Fluoranthene	21	55	38%	YES	1.54E-01	7.00E+02	4.10E+03		NO	NA	NO
Fluorene	11	55	20%	YES	1.80E-01	8.70E+01	4.10E+03		NO	NA	NO
Indeno((1,2,3-cd)pyrene	15	55	27%	YES	1.90E-01	1.80E+02	3.90E+00		YES	NA	**YES**
2-Methylnaphthalene	3	45	7%	YES	7.08E+00	3.93E+02	4.10E+02		NO	NA	NO
Naphthalene	7	55	13%	YES	7.90E-02	5.32E+01	2.00E+03		NO	NA	NO
Phenanthrene	21	55	38%	YES	1.35E-01	7.00E+02	3.10E+03	(h)	NO	NA	NO
Pyrene	20	55	36%	YES	1.16E-01	9.00E+02	3.10E+03		NO	NA	NO
SVOCs											
2,4-Dichlorophenol	1	6	17%	YES	7.46E-01	7.46E-01	3.10E+02		NO	NA	NO
2,4-Dimethylphenol	2	55	4%	NO	1.43E+00	7.40E+00	NA		NA	NA	NO
2-Methylphenol	1	45	2%	NO	7.84E-01	7.84E-01	NA		NA	NA	NO
4-Methylphenol	3	46	7%	YES	6.53E-02	3.17E+00	5.10E+02		NO	NA	NO
Benzyl alcohol	1	39	3%	NO	2.00E-01	2.00E-01	NA		NA	NA	NO
bis(2-Ethylhexyl)phthalate	10	55	18%	YES	1.20E-02	1.16E+00	2.00E+02		NO	NA	NO
Dibenzofuran	7	47	15%	YES	1.40E-01	5.31E+01	2.00E+02	(e)	NO	NA	NO
Di-n-butyl phthalate	6	55	11%	YES	4.95E-01	4.00E+00	1.00E+04		NO	NA	NO
Di-n-octyl phthalate	3	55	5%	YES	2.00E-01	4.60E-01	4.10E+03	(e)	NO	NA	NO
Phenol	5	55	9%	YES	4.70E-01	2.40E+00	3.10E+04		NO	NA	NO

Source: MACTEC 2006

TABLE 2-5

SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE AND SUBSURFACE SOILS (0-10 FT)
OPERABLE UNIT 2
Defense Supply Center Richmond
Richmond, Virginia

Chemical	Number of Detections (a)	Number of Analyses (a)	Frequency of Detection (b)	Frequency of Detection ≥ 5%?	Minimum Detected Concentration (mg/kg) (a)	Maximum Detected Concentration (mg/kg) (a)	Industrial Soil Risk-Based Concentration (RBC) (mg/kg) (c)	Maximum Detected Concentration > RBC?	Site Concentrations > Background (d) ?	Direct Contact Soil COPC?
Pesticides										
4,4'-DDD	8	55	15%	YES	2.10E-03	5.26E-01	1.20E+01	NO	NA	NO
4,4'-DDE	8	55	15%	YES	2.20E-03	7.90E-02	8.40E+00	NO	NA	NO
4,4'-DDT	4	55	7%	YES	1.10E-02	1.20E-01	8.40E+00	NO	NA	NO
Dieldrin	2	53	4%	NO	1.30E-03	1.20E-02	NA	NA	NA	NO
Technical Chlordane	1	46	2%	NO	1.50E-01	1.50E-01	NA	NA	NA	NO
PCBs										
PCB-1260	1	50	2%	NO	4.70E+01	4.70E+01	1.40E+00	YES	NA	**YES (j)**
Petroleum Hydrocarbons										
Diesel Fuel	9	26	35%	YES	6.40E+00	4.86E+03	NA	NA	NA	NA
Heavy Oil	7	26	27%	YES	6.82E+01	1.23E+04	NA	NA	NA	NA
Total Petroleum Hydrocarbons	11	45	24%	YES	1.00E+00	1.55E+02	NA	NA	NA	NA
Total Unknown Hydrocarbons	4	26	15%	YES	3.74E+01	7.01E+01	NA	NA	NA	NA

Notes:
Bolded chemicals exceed one or more screening criteria

mg/kg	Milligrams of chemical per kilogram of soil
RBC	Risk-Based Concentration
COPC	Constituent of potential concern
PAHs	Polycyclic aromatic hydrocarbons
VOCs	Volatile organic compounds
SVOCs	Semivolatile organic compounds
PCB	Polychlorinated biphenyls
NA	Not applicable

(a) See MACTEC 2007 for site data.
(b) (No. Detections/ No. Analyses) x 100.
(c) From USEPA (2006).
(d) See MACTEC 2007 for background comparison results.
(e) RBC value listed was obtained from the April 2005 version of the Region 3 RBC table. The constituent has been withdrawn from the current version.
(f) Value for chromium VI used as a surrogate since it is the most conservative value for chromium.
(g) From Adult Lead Methodology Frequently Asked Questions, www.epa.gov/superfund/programs/lead/almfaq.htm, April 2004.
(h) Value for mercuric chloride used as a surrogate for mercury; cumene used as a surrogate for p-isopropyltoluene; total xylene used as a surrogate for m,p- and o-xylene; pyrene used a surrogate for benzo(ghi)perylene and phenanthrene.
(i) Total 1,2-dichloroethene and vinyl chloride are infrequently detected, but were selected as COPCs because they are potential break-down products of trichloroethene.
(j) Although PCB-1260 was detected at a very low frequency, it is included as a COPC because of its toxicity.

Given the current and future land use discussed above in Section 2.6, the following receptors and potentially complete exposure pathways were evaluated for COPCs identified in the HHBRA:

- On-site Current Outdoor Industrial Worker
  - Incidental ingestion of shallow soil via direct contact
  - Dermal contact with shallow soil via direct contact
  - Inhalation of fugitive dusts derived from shallow soil
- On-site Future Outdoor Industrial Worker
  - Incidental ingestion of surficial and subsurface soil via direct contact
  - Dermal contact with surficial and subsurface soil via direct contact
  - Inhalation of fugitive dusts derived from surficial and subsurface soil
  - Inhalation of volatile emissions from surficial and subsurface soil
- On-site Future Construction Worker
  - Incidental ingestion of surficial and subsurface soil via direct contact
  - Dermal contact with surficial and subsurface soil via direct contact
  - Inhalation of fugitive dusts derived from surficial and subsurface soil
  - Inhalation of volatile emissions from surficial and subsurface soil
- On-site Future Indoor Industrial Worker
  - Inhalation of vapors from volatile compounds in the soil due to indoor vapor intrusion

While current industrial workers are assumed to have direct contact with surface soils only, future conditions may allow for mixing of subsurface and surface soils during construction and/or regrading. Therefore, future on-site receptors are assumed to be exposed to both subsurface and surface soils. There are no current on-site construction workers or significant exposure pathways to off-installation residential receptors. The nearest off-installation residents are located to the south and east of the OU in Rayon Park. Data from the No Name Creek Monitoring and Creeks HHBRA (MACTEC, 2005b, 2005c) indicate no significant migration of soil COPCs off-installation via surface water and no significant risks to off-installation human receptors via this pathway.

The on-site industrial worker receptor was conservatively assumed to work outdoors for the full 8-hour workday because any time spent indoors would reduce the time spent in contact with soil COPCs. Two inhalation pathways were included that consider the potential for volatilization from soil to outdoor air and vapor intrusion into an indoor work space were assessed because volatile COPCs are present in subsurface soil. Groundwater COPCs and exposure pathways were not evaluated in OU 2 because the groundwater underlying OU 2 soils will be addressed as part of the OU 6 HHBRA.

Evaluating exposure for potentially complete exposure pathways requires the development of an exposure-point concentration (EPC), the COPC concentration to which someone may be exposed. For this assessment, the EPC was either based on the 95 percent upper confidence limit (95UCL) of the mean or the maximum detected concentration, whichever was lower. For the statistical computations (i.e., 95UCL), a concentration equal to one-half the method detection limit was used when COPCs were not detected.

EPCs were calculated for each indirect pathway. Indirect pathways, such as inhalation of volatile emissions from soil, involve at least one media transfer step. The Johnson and Ettinger vapor intrusion model was used to estimate VOC concentrations in indoor air for the future on-site industrial worker pathway. The VDEQ Voluntary Remediation Program trench model was used to estimate EPCs for VOCs in air for future construction workers in a trench.

Exposure doses were estimated in milligrams of constituent per kilogram of body weight per day of exposure (mg/kg-day). For example, the number of milligrams of a constituent entering the body could be calculated via an air inhalation rate multiplied by the constituent concentration in the air. The exposure doses were estimated using default values for input parameters. Default values are intended to be conservative and therefore are likely to overestimate actual exposure.

2.7.4 Toxicity Assessment

The toxicity assessment describes the potential adverse health effects associated with exposure to COPCs. Noncarcinogenic effects are characterized by a reference dose (RfD), which is a threshold below which no harmful health effects are anticipated. USEPA establishes RfDs for ingestion and inhalation routes (dermal toxicity is based on the oral RfD) using a margin of safety to protect sensitive individuals. RfDs are derived from human epidemiological studies or subchronic animal studies from which extrapolations are made to humans using uncertainty factors (UFs). The UF helps to ensure that the extrapolation of experimental data does not underestimate the potential for noncarcinogenic effects to occur in humans.

Carcinogens are classified into Groups A through E by USEPA, based on the weight-of-evidence about a particular chemical causing human cancer. Group A represents known human carcinogens, while Group E chemicals are noncarcinogenic. Carcinogenicity is quantified with a slope factor (SF), or the cancer risk per unit daily intake of the chemical, expressed in $(mg/kg\text{-}day)^{-1}$. The SF represents the 95UCL of the slope of the dose-response curve. The SF multiplied by the exposure dose equals the upper-bound risk estimate of developing cancer from COPC exposure. "Upper-bound" refers to a conservative risk estimate calculated from the cancer SF to ensure that actual cancer risks are not underestimated. As in the RfD, UFs built into these SFs allow for the extrapolation of subchronic animal studies to chronic human exposures.

2.7.5 Human Risk Characterization

The risk characterization combines toxicity and exposure assessment information. The risk characterization estimates quantitative carcinogenic risk and noncarcinogenic hazards for each COPC, exposure route, and receptor.

The quantitative measure of noncarcinogenic effects is the hazard quotient (HQ). HQs for individual chemicals, equal to the exposure dose divided by the RfD, are summed to give a combined (multi-chemical) hazard index (HI) for COPCs affecting the same target organ (e.g., the liver). For the OU 2 updated HHBRA, HQs were conservatively summed for all COPCs, regardless of target organ. If the HI for all noncarcinogens does not exceed 1, then no chronic health effects are expected. If the HI is greater than 1, adverse health effects are possible.

For carcinogens, risk is the probability that an individual will develop cancer over a lifetime as a result of exposure to a carcinogen (USEPA, 1989). In the OU 2 HHBRA, the risks presented by individual carcinogenic COPCs were added. The NCP at 40 CFR 300.430(e)(2)(i)(A)(*2*) establishes an acceptable excess cancer risk range of 1×10^{-4} (a 1 in 10,000 chance of developing cancer) to 1×10^{-6} (a 1 in a million chance) for CERCLA sites. In general, cancer risks greater than 1×10^{-4} should be considered in a risk management evaluation, and cancer risks less than 1×10^{-6} do not warrant further attention.

For chemicals with non-carcinogenic effects, the HIs for all receptors are equivalent to or less than the 1, the departure value required by the NCP at 40 CFR 300.430(e)(2)(i)(A)(*1*). For chemicals with carcinogenic effects, the results are summarized below and in **Table 2-6**:

TABLE 2-6

RISK CHARACTERIZATION SUMMARY
UPDATED HHBRA
OPERABLE UNIT 2
Defense Supply Center Richmond
Richmond, Virginia

Current Outdoor Industrial Worker	Hazard Index	Excess Cancer Risk
Soil Ingestion	0.3	9.E-04
Dermal Soil Contact	0.03	8.E-04
Fugitive Dust Inhalation	NA	5.E-08
TOTALS	**0.4**	**2.E-03**

Future Outdoor Industrial Worker	Hazard Index	Excess Cancer Risk
Soil Ingestion	0.3	2.E-04
Dermal Soil Contact	0.2	2.E-04
Fugitive Dust Inhalation	0.003	2.E-08
Inhalation of Volatile Compounds	0.06	5.E-05
TOTALS	**0.5**	**4.E-04**

Future Construction Worker	Hazard Index	Excess Cancer Risk
Soil Ingestion	1	1.E-05
Dermal Soil Contact	0.3	5.E-06
Fugitive Dust Inhalation	NA	6.E-08
Inhalation of Volatile Compounds	0.06	1.E-06
TOTALS	**1**	**2.E-05**

Future Indoor Industrial Worker	Hazard Index	Excess Cancer Risk
Inhalation of VOCs	0.0001	3.E-08
TOTALS	**0.0001**	**3.E-08**

Source: MACTEC 2006

- The cumulative excess cancer risk for the current outdoor industrial worker is estimated to be 2×10^{-3}.
- The cumulative excess cancer risk for the future outdoor industrial worker is estimated to be 4×10^{-4}
- The cumulative risk for the future construction worker is 2×10^{-5}.
- The cumulative risk value for future indoor industrial workers potentially exposed to soil vapors in indoor air is 3×10^{-8}.

The cumulative risk for current and future outdoor industrial workers exceeds 1×10^{-4}, the acceptable risk allowed under the NCP. The majority of the risk for the current outdoor industrial worker is associated with direct contact with four carcinogenic PAHs (benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and benzo(a)anthracene). The remainder of the exceedance is associated with arsenic, two PAHs (benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene), and PCB-1260. The majority of the risk for the future outdoor industrial worker is associated with benzo(a)pyrene. The remainder of the exceedance is associated with trichloroethene and four PAHs (benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene). The risk associated with surface soil exposures exceeds that for mixed horizon soils (0 to 10 feet), indicating the majority of the estimated risk is associated with soil constituents within the top 2 feet of ground surface.

The conservative nature of the estimated risks outweighs any uncertainties that may underestimate risks; thus, the final risk estimates are likely higher than the actual risk posed by direct exposure to COPCs at OU 2.

2.7.6 COCs

Those COPCs with an associated cancer risk above 10^{-5} were identified as soil COCs. The COCs in surface soil include arsenic, six carcinogenic PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene), and PCB-1260. Six COCs in subsurface soil include trichloroethene and five carcinogenic PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene). Most of the risk for the current and future outdoor industrial worker was associated with benzo(a)pyrene. The remainder of the excess cancer risk was associated with the other carcinogenic PAHs, namely benzo(a)anthracene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene. Risk-based remediation goals for these soil COCs are presented in **Table 2-7**.

2.7.7 Ecological Risk Considerations

OU 2 is in a developed and industrialized area of the installation and has been designated for industrial use for many years. This area provides limited ecological habitat. OU 2 is fenced and completely grass-covered or paved. The grassed area is mowed on a routine basis, and this maintenance will continue in the future. Therefore, the introduction of additional ecological species is unlikely to occur (MACTEC, 2007). However, there is a potential for some ecological receptors to be at OU 2 in its current condition. The COC concentrations at OU 2 exceed soil ecological screening values. DSCR, USEPA and VDEQ determined that the proposed remedy should address this potential ecological risk.

2.7.8 Human Health and Ecological Risk Characterization of No Name Creek

Monitoring water and sediment quality for No Name Creek adjacent to the installation and areas downgradient of OU 2 was conducted from November 2001 to April 2004 (MACTEC, 2005c). The overall purpose of the monitoring program was to evaluate whether conditions at the installation were affecting ecological receptors in the creeks. The abundance of aquatic organisms and changes in environmental conditions over the monitoring period were evaluated. During each monitoring event, co-located surface water, sediment, and benthic macroinvertebrate samples were collected for analysis; selected physical/chemical parameters were measured *in situ*; and creek habitat assessments were performed.

Analytical data for the No Name Creek monitoring program indicated no adverse ecological effects from the installation; the downstream benthic community was representative of the available habitat in the creek.

A conservative HHBRA was performed for chemicals in No Name Creek surface water (MACTEC, 2005b). The purpose of the HHBRA was to assess potential health risks to off-installation residents (recreational child and adult) from 10 COPCs in surface water that may be linked to historical installation activities. The ten surface water COPCs included seven inorganic compounds (aluminum, arsenic, iron, lead, manganese, thallium, and vanadium), one VOC

TABLE 2-7

RISK-BASED REMEDIATION GOALS FOR SURFACE AND SUBSURFACE SOILS
FOR OPERABLE UNIT 2 - AREA 50 LANDFILL
Defense Supply Center Richmond
Richmond, Virginia

Current Industrial Worker	**Estimated Risk by Exposure Pathway**				**Surface Soil HHBRA EPC**	**Surface Soil Risk-Based Remediation Goal (10-5)**
	Ingestion	**Inhalation**	**Dermal Contact**	**Totals**		
Arsenic	1.E-05	1.E-08	2.E-06	1.E-05	2.0E+01	1.8.E+01
Benzo(a)anthracene	6.E-05	NA	5.E-05	1.E-04	2.7E+02	2.3.E+01
Benzo(a)pyrene	6.E-04	4.E-08	5.E-04	1.E-03	2.5E+02	2.3.E+00
Benzo(b)fluoranthene	9.E-05	NA	8.E-05	2.E-04	4.0E+02	2.3.E+01
Benzo(k)fluoranthene	9.E-06	NA	8.E-06	2.E-05	4.0E+02	2.3.E+02
Dibenzo(a,h)anthracene	1.E-04	NA	1.E-04	2.E-04	5.3E+01	2.3.E+00
Indeno(1,2,3-cd)pyrene	3.E-05	NA	3.E-05	6.E-05	1.3E+02	2.3.E+01
PCB- 1260	2.E-05	3.E-09	2.E-05	4.E-05	3.4E+01	8.3.E+00
TOTALS	**9.E-04**	**5.E-08**	**8.E-04**	**2.E-03**		

Future Industrial Worker	**Estimated Risk by Exposure Pathway**				**Subsurface Soil HHBRA EPC**	**Subsurface Soil Risk-Based Remediation Goal (10-5)**
	Ingestion	**Inhalation**	**Dermal Contact**	**Totals**		
Benzo(a)anthracene	1.E-05	NA	1.E-05	2.E-05	5.1E+01	2.3.E+01
Benzo(a)pyrene	1.E-04	7.E-09	9.E-05	2.E-04	4.7E+01	2.3.E+00
Benzo(b)fluoranthene	3.E-05	NA	2.E-05	5.E-05	1.1E+02	2.3.E+01
Dibenzo(a,h)anthracene	2.E-05	NA	2.E-05	5.E-05	1.1E+01	2.3.E+00
Indeno(1,2,3-cd)pyrene	6.E-06	NA	5.E-06	1.E-05	2.5E+01	2.3.E+01
Trichloroethene	8.E-07	5.E-05	2.E-07	5.E-05	1.2E+01	2.5.E+00
TOTALS	**2.E-04**	**5.E-05**	**2.E-04**	**4.E-04**		

Notes:
EPC Exposure Point Concentrations from the HHBRA
HHBRA Human Health Baseline Risk Assessment

Source: MACTEC 2006

(vinyl chloride), and two PAHs (styrene and chrysene). The HHBRA results showed that the surface water concentrations of these 10 COPCs yielded noncarcinogenic HIs of less than 1 (HI of 0.2) for children and adults. The total excess cancer risk was 1×10^{-5}, which is within the acceptable range of 10^{-4} to 10^{-6} under the NCP. The carcinogenic risk was associated with arsenic and vinyl chloride, which were infrequently detected in surface water samples. The risk estimates were conservative and potentially overstated the actual risk. Therefore, off-installation human receptors are not at unacceptable risk from exposure to chemicals currently found in No Name Creek water. The potential for continuing discharges of impacted groundwater to No Name Creek will be further considered in the OU 6 HHBRA.

2.7.9 Basis for Action

The updated OU 2 HHBRA indicated that further action is necessary to protect the health of onsite workers. Potential unacceptable site hazards were found for current and future outdoor workers who might come into contact with carcinogenic PAHs in soils.

2.8 Remedial Action Objectives

The primary goal of a response action is to protect human health and the environment from exposure to COCs that could potentially cause adverse effects. Remedial action objectives (RAOs) are the response action completion criteria that can be practicably achieved to ensure reliable protection of human health and the environment within a reasonable time. Factors considered during the selection of RAOs include COCs and affected media of concern, ARARs, and current and future exposure pathways.

RAOs for OU 2 are to:

- Prevent human ingestion of, direct contact with, and inhalation of volatile emissions and fugitive dusts from impacted soils (primarily for workers).
- Be compatible with actions that may be taken as the remedy for OU 6 to reduce constituent migration to groundwater.
- Prevent exposure to OE hazards.

The RAOs for OU 2 focus on the protection of human health, namely current and future outdoor workers, who may be harmed through direct contact with COCs in soils.

2.9 Description of Alternatives

Remedial alternatives were initially developed for soils at OU 2 during the 1999 FFS (Law, 1999). The RAOs were developed based on the nature and extent of COCs and the risk assessment for a residential scenario. The RAOs were selected to prevent human ingestion of, direct contact with, and inhalation of fugitive dusts from impacted soils; prevent constituent migration to groundwater; and prevent exposure to OE hazards.

The primary remedial objective identified in the FFS (Law, 1999) was preventing exposure to impacted soils and OE to protect human health and the environment. An additional goal was the mitigation of potential groundwater impacts or reduction of soil constituents leaching to groundwater. Alternatives were screened for overall protectiveness of human health and the environment, compliance with ARARs, long-term and short-term effectiveness, reduction of toxicity mobility and volume, implementability, and cost.

- Alternative 1: No action
- Alternative 2: Institutional controls
- Alternative 6A: Capping (soil cover) with storm sewer rehabilitation, institutional controls/land use controls (LUCs), and source removal of free product and saturated soils
- Alternative 6B: Capping (clay cover) with storm sewer rehabilitation, institutional controls/LUCs, and source removal of free product and saturated soils

A comparative analysis was performed for each alternative and documented in the FFS. Comments received from the Commonwealth of Virginia on the FFS indicated preference for a clay cap. Alternative 6B was preferred with capping (clay cover), storm sewer rehabilitation, source removal of free product and free-product-saturated soils, implementation of selected institutional controls/LUCs, and long-term groundwater monitoring.

As described above, Alternative 6B was selected for implementation based on the FFS. During the remedial action planning meeting conducted at DSCR in August 2000, a revised remedy was proposed to address COCs but also to minimize risk from OE upon implementation. The revised alternative included:

- Institutional controls
- Surface grading to promote drainage (potential fill)

- Monitoring requirements to evaluate constituent migration
- Storm sewer rehabilitation
- Maintenance of access restrictions (fencing)

This revised remedy was presented in the 2001 Final Technical Memorandum (Law, 2001). The most significant changes included re-evaluation of the free product/saturated soil removal action and elimination of the clay cap. The removal action was re-evaluated to better weigh the risk associated with exposure to OE that would be significant with any intrusive activity against the benefit of the source removal and because free product or significant dissolved-phase fuel contamination has not been observed in the OU 2 and downgradient monitoring wells during numerous sampling efforts conducted from 2001 to 2007. The clay cap was rejected upon re-evaluation based on the following rationale:

- A portion of the OU 2 waste is below the water table and could potentially contribute to downgradient groundwater contamination, thus negating the advantages of a low permeability clay cover.
- The RAOs would be met if the remedial alternative was changed to include storm sewer rehabilitation, surface grading, and institutional controls/LUCs. Long-term groundwater monitoring would be required to evaluate the RA's effectiveness.
- Surface grading would include placing a soil cover sloped to drain precipitation off the cover and to reduce infiltration to the landfilled area.

Rehabilitating the storm sewer system at OU 2 was included because cracks and leaks in this system could affect mobility of chemicals in OU 2 soil. During the last quarter of 2004 and the first quarter of 2005, USACE undertook storm sewer rehabilitation using the fold-and-form method as part of a DSCR installation-wide compliance program (MACTEC, 2007). **Figure 2-19** depicts the storm sewer lines rehabilitated in the OU 2 vicinity. Cracks in the existing brick manholes were sealed with a cement/epoxy spray sealer to reduce infiltration.

Based on the results of the field activities, revised HHBRA, conceptual site model, and storm sewer rehabilitation efforts, a modification to Alternative 6A defined in the FFS was recommended (MACTEC, 2007). The modified Alternative 6A is defined with the following components:

- A soil cover that provides a grade to promote surface runoff and that has a minimum thickness of 6 inches

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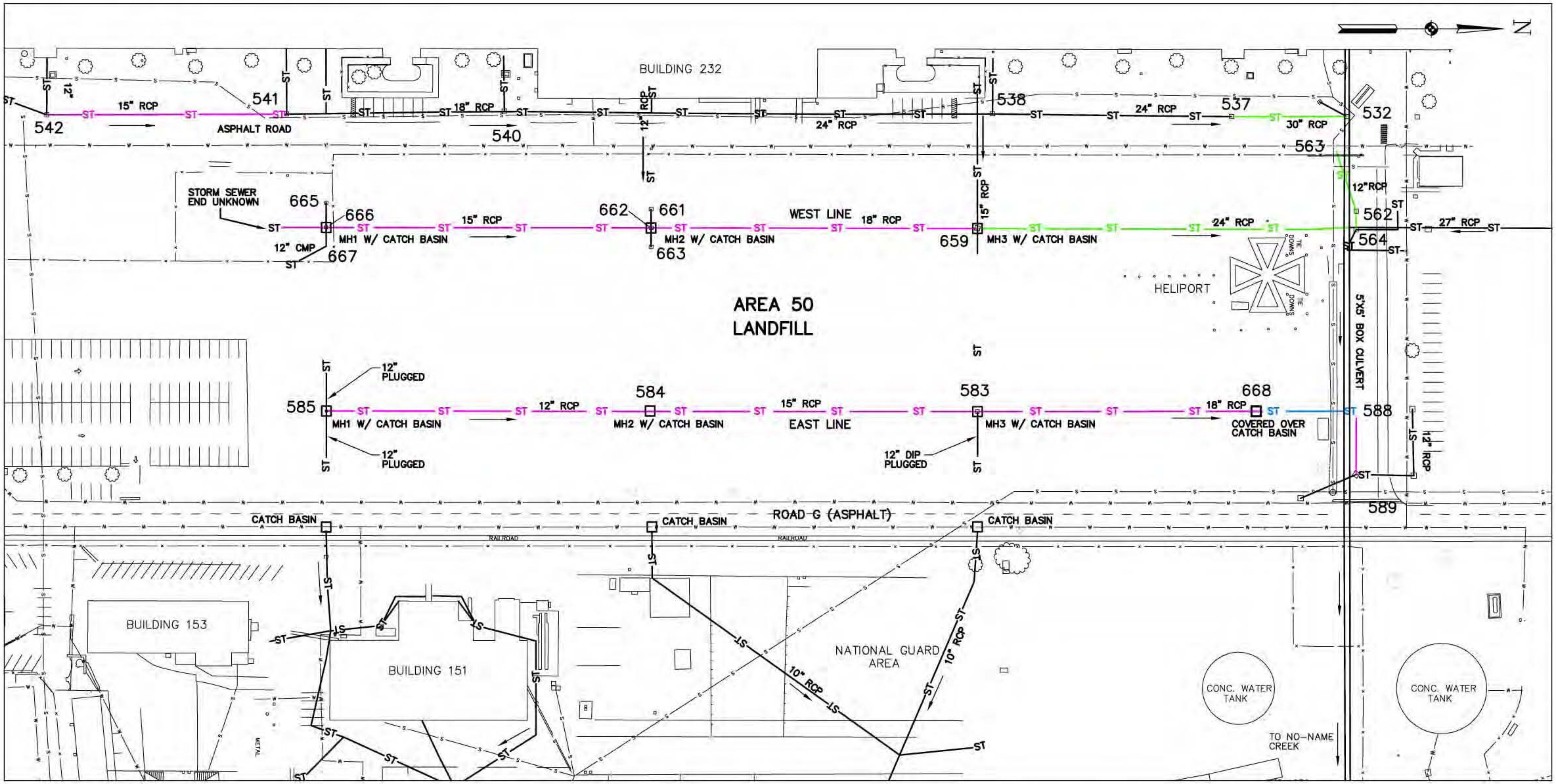

LEGEND

—ST—	STORM SEWER
—ST— (magenta)	LINED BY PVC FOLD AND FORM METHOD
—ST— (green)	INTERNAL SPOT REPAIRED
—ST— (blue)	TEST AND SEAL
	SANITARY SEWER
	WATER LINE
	FENCE
○	SHRUB OR TREE
□	MANHOLE

RCP = REINFORCED CONCRETE PIPE
DIP = DUCTILE IRON PIPE
MH = MANHOLE

0 100 200
SCALE IN FEET

NOTE: STORM SEWER REHABILITATION PERFORMED BY AIR POWER UNDER CONTRACT TO COE.

SOURCE: ELECTRONIC FILE PROVIDED BY ANDERSON AND ASSOCIATES MARCH 1994.

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

DEFENSE SUPPLY CENTER RICHMOND
RICHMOND, VA

OU 2 RECORD OF DECISION

STORM SEWER REHABILITATION LOCATIONS

PREPARED BY:
CHECKED BY:
PROJECT NO:

FIGURE NUMBER: 2-19

- Institutional controls in the form of LUCs, including maintenance of access restrictions (fencing)

Since the storm sewer rehabilitation has been accomplished, further discussion of remedial alternatives below focuses on the soil remedy components. The following paragraphs contain brief descriptions of each alternative.

2.9.1 Alternative 1

CERCLA requires that "No Action" be evaluated to establish a baseline for comparison to other remedial alternatives. No action will leave the contaminated soils in place without measures to prevent exposure. The only cost considered in this alternative was for the five-year reviews. The estimated present worth (PW) costs were based on a 20-year period (4 five-year reviews).

Estimated Capital Cost:	$ 0
Estimated Five-year Review Cost:	$10,500 each
Estimated Total PW Cost:	$26,171

2.9.2 Alternative 2

Land Use Controls (LUCs) include institutional controls and maintenance of existing site access restrictions and industrial land uses to limit direct contact by humans to site COCs. While the DLA is present at DSCR, OU 2 land use will remain industrial until conditions allow for unlimited use and unrestricted exposure. Institutional controls include legal restrictions that would be attached to the property deed at the time of transfer, thus preventing certain future land and groundwater uses under any future property ownership. The estimated capital costs cover placement of property deed restrictions and development of outdoor worker health and safety plans. O&M costs cover fence maintenance, annual site inspections, legal services, and four five-year reviews over 20 years. The total PW costs are summarized below.

Estimated Capital Cost:	$ 21,250
Estimated Annual O&M Cost:	$ 10,500
Estimated PW Cost for 20 yrs O&M:	$130,853
Estimated Total PW Cost:	$152,103

2.9.3 Alternative 6A

Alternative 6A involves removal of source material, including saturated soils, OEs, and free-phase product prior to constructing a vegetative soil cover over the remaining impacted soil and putting LUCs in place. The soil cover would have a minimum thickness of 6 inches and will provide a grade to promote surface runoff. Maintenance activities for this alternative include maintaining the vegetative cover and fencing. Routine inspections would verify that the cover is intact (i.e., no signs of excessive soil erosion, animal burrowing, or stressed vegetation) and that LUCs are effective at preventing unauthorized site entry and intrusive work. The results of these inspections would be compiled into annual reports.

The estimated capital costs cover source material removal, design and construction of the soil cover, and putting LUCs into place. O&M costs include soil cover and fencing maintenance, annual inspections, legal services, and four five-year reviews over 20 years. The total PW costs are summarized below.

Estimated Capital Cost:	$1,600,000
Estimated Annual O&M Cost:	$ 24,450
Estimated PW Cost for 20 yrs O&M:	$ 300,000
Estimated Total PW Cost:	$1,900,000

2.9.4 Alternative 6B

Alternative 6B is similar to 6A, except that a constructed clay cover with low permeability soil characteristics would be placed over the remaining impacted soils at OU 2. The resulting thickness of the clay layer, grading, and maintenance work would be the same as that for Alternative 6A. The source removal and LUCs would also be included in Alternative 6B, as in Alternative 6A. The estimated total PW costs are similar to those for Alternative 6A.

Estimated Capital Cost:	$1,700,000
Estimated Annual O&M Cost:	$ 24,450
Estimated PW Cost for 20 yrs O&M:	$ 300,000
Estimated Total PW Cost:	$2,000,000

2.9.5 Modified Alternative 6A

Modified Alternative 6A includes the same components as Alternative 6 except that it does not include removal of source materials from OU 2 prior to construction of a soil cover. The capital costs would be less than either Alternative 6A or 6B because excavation, transportation, and off-site disposal of the source material would not occur under this alternative. The estimated total PW cost is summarized below.

Estimated Capital Cost:	$1,200,000
Estimated Annual O&M Cost:	$ 24,450
Estimated PW Cost for 20 yrs O&M:	$ 300,000
Estimated Total PW Cost:	$1,500,000

2.10 Comparative Analysis of Alternatives

The remedial action alternatives were evaluated using nine criteria to compare alternatives and select an appropriate remedy, as required by the NCP at 40 CFR Section 300.430(e)(9)(iii). These criteria fall into three groups: threshold criteria, balancing criteria, and modifying criteria. The threshold criteria must be met for an alternative to be eligible for selection. The balancing criteria are used to compare the relative strengths and weaknesses of alternatives. The modifying criteria are taken into account after public and regulatory comments are received to evaluate acceptance.

The threshold criteria are:

- Overall protection of human health and the environment and how an alternative reduces potential risk.
- Compliance with ARARs or justification for a waiver.

Primary balancing criteria are:

- Long-term effectiveness and permanence with respect to risk, the adequacy and reliability of controls, and the ability to achieve the RAOs.
- Reduction of toxicity, mobility, or volume. The statutory preference is for alternatives that employ treatment. This criterion also includes the irreversibility of the treatment and the type and quantity of residuals.
- Short-term effectiveness relative to protection of workers and the community during implementation of the alternative and the environmental impacts from implementing the alternative.
- Implementability, as measured relative to the technical and administrative feasibility as well as the availability of necessary goods and services.
- Cost, which includes the PW of capital and O&M costs. Estimated costs are expected to provide an accuracy of plus 50 percent to minus 30 percent.

Additional NCP modifying criteria include regulatory agency acceptance and community acceptance, which were addressed based on comments received on the FFS, Proposed Plan, and during the public meeting. DSCR's response to public comments received on the Proposed Plan is provided in the Responsiveness Summary (Section 3.0). State acceptance is documented by a letter of concurrence with the Final ROD, which is included in the Administrative Record for this site.

The comparison of remedial alternatives using the nine evaluation criteria required by the NCP is provided below and summarized in **Table 2-8**.

2.10.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is the primary objective of remedial action. Alternative 1 does not satisfy the protectiveness criterion since it does not limit exposure or provide monitoring to confirm that conditions remain protective. Alternative 2 limits exposure through LUCs but does not fully mitigate potential risks to current and future outdoor workers from direct contact with soil COCs. Alternatives 6A, 6B, and Modified 6A are protective of human health and the environment through the use of LUCs and a soil cover barrier preventing direct contact with COCs in soils.

2.10.2 Compliance with ARARs

As shown in **Table 2-9**, there are no chemical- or location-specific ARARs for OU 2. No action-specific ARARs were identified for Alternatives 1 and 2. Alternatives 6A, Modified 6A and 6B will comply with action-specific ARARs such as RCRA closure requirements and Virginia regulations (solid waste management regulations and hazardous waste regulations).

2.10.3 Long-Term Effectiveness and Permanence

Alternative 1 is not effective in the long-term because exposure to soils above industrial RBCs is not restricted. While Alternative 2 (LUCs) may be effective at reducing risk through site access and use restrictions, it does not reduce exposure to fugitive dusts from impacted soils and so is not fully effective. Alternatives 6A (including Modified 6A) and 6B offer long-term effectiveness through the use of a cover that eliminates human contact with COCs via ingestion, direct contact and inhalation of volatile emissions and fugitive dust from impacted soils.

TABLE 2-8

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 2 - AREA 50 LANDFILL
Defense Supply Center Richmond
Richmond, Virginia

	Alternatives	**Evaluation Criteria**								
		Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, and Volume Through Treatment**	**Short-term Effectiveness**	**Implementability**	**Costs**	**State Acceptance**	**Community Acceptance**
1.	No Action	Not protective	No Applicable ARARs	Not effective	No reduction because no treatment	Because there is no action, there are no short-term risks to workers or the community during construction.	Easy to implement because there are no actions except 5-year reviews.	No costs	Does not provide assurance that human health and the environment are protected.	Does not provide assurance that human health and the environment are protected.
2.	Institutional Controls	Not protective	No Applicable ARARs	Not effective	No reduction because no treatment	Land use controls and deed restrictions in the event of property transfer provide immediate prohibition against contact with onsite soils.	Institutional controls are easy to implement.	$150,000	ICs alone may not satisfy state ARARs.	ICs alone may not satisfy community that this remedial alternative is sufficiently protective of human health and the environment.
6A.	Soil cover, storm sewer rehabilitation, institutional controls, and source removal of free-product and saturated soils	Will be effective in protection of human health and the environment: landfilled materials left in place	Compliant with ARARs	Effective	No reduction because no treatment	Unacceptable short-term risks related to onsite construction and likelihood of encountering ordnance and explosives.	Construction of soil cover is moderately easy to implement. ICs easy to implement. Removal of free-product and saturated soils difficult and hazardous to implement. Storm sewer rehabilitation has been completed.	$1,900,000	The combination of technologies provided in this alternative will satisfy state ARARs	The combination of technologies provided in this alternative is expected to satisfy the community that this alternative is sufficiently protective of human health and the environment.
6B.	Clay cover, storm sewer rehabilitation, institutional controls, and source removal of free-product and saturated soils	Will be effective in protection of human health and the environment: landfilled materials left in place	Compliant with ARARs	Effective	No reduction because no treatment	Unacceptable short-term risks related to onsite construction and likelihood of encountering ordnance and explosives.	Construction of clay cover is moderately easy to implement. ICs easy to implement. Removal of free-product and saturated soils difficult and hazardous to implement. Storm sewer rehabilitation has been completed.	$2,000,000	The combination of technologies provided in this alternative will satisfy state ARARs	The combination of technologies provided in this alternative is expected to satisfy the community that this alternative is sufficiently protective of human health and the environment.
Modified 6A.	Soil cover, institutional controls	Will be effective in protection of human health and the environment: landfilled materials left in place	Compliant with ARARs	Effective	No reduction because no treatment	Acceptable short-term risks.	Construction of soil cover is moderately easy to implement. ICs easy to implement. Storm sewer rehabilitation has been completed.	$1,500,000	The combination of technologies provided in this alternative will satisfy state ARARs	The combination of technologies provided in this alternative is expected to satisfy the community that this alternative is sufficiently protective of human health and the environment.

Notes:
ARARs Applicable or Relevant and Appropriate Requirements
ICs Institutional Controls
For purposes of comparison of costs, complete excavation and off-site disposal is estimated to be on the order of magnitude of $13 million.

Source: MACTEC 2006

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TABLE 2-9

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
AND TO-BE-CONSIDERED CRITERIA (TBCs) FOR SOILS
OPERABLE UNIT 2 – AREA 50 LANDFILL
Defense Supply Center Richmond
Richmond, Virginia

TYPE OF ARAR	ARARs	TBC REQUIREMENTS
Chemical-Specific	None Identified	USEPA Region III Industrial Risk-based Criteria
Location-Specific	None Identified	None Identified
Action-Specific		
Alternative 1: No Action	None identified	None identified
Alternative 2: LUCs	None identified	None identified
Alternatives 6A, 6B, Modified 6A: Containment/ Capping	RCRA - Closure Requirements (40 CFR 264 Subpart G; VHWMR 9 VAC 20-60-740, et seq.)	
	VA Storm water Management Regulations (4 VAC 3-20-10, et seq.)	
	VA Storm water Management Act (Code of VA § 10.1-603.1 et. seq.)	
	VA Erosion and Sediment Control Regulations (Code of VA § 10.1-560, et seq.)	
	VA Erosion and Sediment Control Regulations (4 VAC 50-30-10, et seq.)	
	VA Standards of Performance for Visible Emissions and Fugitive Dust/ Emissions [Rule 5-1] (9 VAC 5-50-60, et seq.)	
	VA Closure and Post Closure Requirements (VHWMR 9 VAC 20-60-800, et seq.)	
Grading	VA Stormwater Management Regulations (4 VAC 30-20-10, et seq.)	None identified
	VA Erosion and Sediment Control Regulations (4 VAC 50-30-10, et seq.)	
	VA Stormwater Management Act (Code of VA § 10.1-603.1 et. seq.)	
	VA Erosion and Sediment Control Law (Code of VA § 10.1-560, et seq.)	
	VA Standards of Performance for Visible Emissions and Fugitive Dust/ Emissions [Rule 5-1] (9 VAC 5-50-60, et seq.)	

RCRA = Resource Conservation and Recovery Act
Source: MACTEC 2006

2.10.4 Reduction in Toxicity, Mobility or Volume

Treatment is not provided by any alternative developed and evaluated for OU 2. Therefore, constituent toxicity and volume remain unchanged. Alternatives 1 and 2 do not reduce the mobility of COCs. Alternatives 6A, 6B, and Modified 6A reduce the mobility of COCs through the use of a soil cover.

2.10.5 Short-Term Effectiveness

Short-term effectiveness evaluates risk to on-site workers and the nearby community during remedial action implementation. Alternatives 1 and 2 do not involve construction activities that might expose workers and surrounding community to short-term risks from site contaminants. Alternatives 6A and 6B may present unacceptable risks related to on-site construction (during source removal) and the likelihood of encountering OE materials. Modified Alternative 6A presents less short-term risks than Alternatives 6A and 6B because it does not include source removal.

2.10.6 Implementability

Alternatives 1 and 2 are the simplest to implement. No construction, specialized equipment, or materials are necessary. LUCs involved in Alternatives 2, 6A, 6B, and Modified 6A require some coordination with USEPA, VDEQ, and local/county agencies. Alternatives 6A and 6B are implementable, although removal of free product and saturated soils could be difficult and unsafe due to the risk of encountering OE materials. Modified Alternative 6A is more implementable than Alternatives 6A and 6B because it does not include source removals.

2.10.7 Cost

The cost comparison of alternatives is based on total PW including capital and O&M costs. PW costs were calculated using a 5 percent annual discount rate. A 20-year O&M period was assumed for all alternatives for comparison purposes. Alternatives 1 and 2 are the least expensive; Alternatives 6A and 6B are the most expensive. The cost of modified Alternative 6A is more moderate than the original set of alternatives considered in the 1999 FFS.

Alternative 1:	Total PW Cost	=	$ 26,171
Alternative 2:	Total PW Cost	=	$ 152,103
Alternative 6A:	Total PW Cost	=	$1,900,000

Alternative 6B:	Total PW Cost	=	$2,000,000
Modified 6A:	Total PW Cost	=	$1,500,000

2.10.8 State and Community Acceptance

Alternatives 1 and 2 do not offer protectiveness and do not prevent potential harmful exposure. Therefore, Alternatives 1 and 2 are not preferred. USEPA and the VDEQ support Modified Alternative 6A because it meets the threshold criteria (protectiveness and compliance with ARARs), is more cost effective and does not have the short-term risks posed by excavation and removal of source material under Alternatives 6A and 6B.

Community acceptance of the preferred alternative is based on comments received during the public comment period for the Proposed Plan. No written comments were received during the public comment period.

2.11 Principle-Threat Waste

A principal-threat waste is highly toxic or highly mobile source materials that cannot be reliably contained (USEPA, 1991a). Principal-threat wastes present a significant threat—well in excess of 10^{-3} excess cancer risk, or 1 extra cancer incident in 1,000 people exposed—to public health or the environment should exposure occur; treatment is typically evaluated for these types of wastes. Taking into account the conservative nature of the HHBRA, the OU 2 source materials do not constitute principal-threat wastes, and the mobile COCs are being addressed as part of OU 6 groundwater and OU9 interim remedial action. A soil cover over these source materials eliminates short-term risks associated with any excavation that might disturb the OEs.

2.12 Selected Remedy

Based on the evaluation of alternatives, DLA, DSCR, and USEPA, with concurrence from VDEQ, have selected Modified Alternative 6A as the remedy for OU 2 soils. The selected remedy meets the OU-specific RAOs (outlined in Section 1.0) and is consistent with the current and future industrial use of the installation. This remedy will also protect any potential ecological receptors at OU 2 because the soil cover will act as a barrier to separate contaminated soil from any ecological receptors. Modified Alternative 6A consists of the following components:

- A soil cover that provides a grade to promote surface runoff and that has a minimum thickness of 6 inches
- LUCs, including land and groundwater use restrictions, pre-construction assessments, and maintenance of access restrictions (fencing), soil cover, and storm sewer system crossing the site.

2.12.1 Soil Cover

A soil layer with a minimum thickness of 6 inches will be placed over the landfill. The soil cover will be sloped to promote drainage of surface water runoff. Sufficient soil fill will be placed near the center of the landfill to create a high point to promote drainage to the perimeter or towards the storm sewer system. DSCR will ensure that the design and installation of the OU 2 soil cover will not impede upcoming remediation activities for the groundwater underneath OU 2 (OU 6 groundwater). Additional soil cover design considerations are discussed below.

2.12.1.1 Storm Water Evaluation

As part of the design effort, storm water conveyance will be evaluated for a 25-year, 24-hour storm. The proposed design will include run-on controls to minimize flow onto the closed landfill and runoff controls to collect and route storm water. Additional evaluations will be conducted to determine potential impacts of the soil cover to storm water flow. These evaluations will focus on minimizing downstream impacts.

2.12.1.2 Erosion and Sediment Control

An Erosion and Sediment Control Plan will be developed and implemented to comply with regulatory requirements during construction. As part of the final surface, a vegetative layer will play an important role in controlling erosion.

2.12.1.3 Post-closure Care

Following construction, a Post-closure Care Plan will be developed for long-term OU maintenance. The plan will include a program of regular inspections and maintenance, and groundwater monitoring. Examples of components that may be included in the inspections are the final surface, settlement monitoring points, the stormwater drainage system, and the entrance fencing and gates. The groundwater monitoring will be performed as part of the OU 6 activities.

Routine maintenance such as erosion repair and mowing will help to evaluate the current condition and maintain the remedy's effectiveness.

2.12.1.4 Land Use Controls

As part of the Modified Alternative 6A remedy, LUCs—any engineered restriction or administrative action (e.g., fencing, secured gate, property deed restrictions, signage, review boards)—will be in place to limit human exposure to COCs by restricting resource (land and/or groundwater) use.

As RODs for each OU are finalized, the DSCR Environmental Land Use Control Implementation Plan (LUCIP) for the entire installation is amended. Within 21 days of ROD signature, DLA and DSCR will propose a deadline for submission of the Environmental LUCIP updated to include OU 2 for USEPA and VDEQ review. The draft updated LUCIP will be submitted by no more than 90 days after finalization of this ROD. The specific OU 2 LUCs will be outlined in an individual appendix of the Environmental LUCIP.

LUCs for OU 2 will include:

- Land use restricted to industrial uses and restriction of groundwater use as a drinking water source
- Intrusive activity restrictions and signage
- Fencing, soil cover, and storm sewer maintenance and inspection
- Property transfer deed restrictions in the event of transfer of the property out of the ownership, custody or control of DLA
- Pre-construction assessments and reviews

Land use will be solely for industrial purposes until conditions allow for unlimited use and unrestricted exposure to soil. Groundwater use has been prohibited throughout the county in accordance with county ordinances (Code, County of Chesterfield, Virginia Chapter 18 Section 18-60).

Annual inspections will be conducted to assess the integrity of the soil cover, fencing, signage, and storm sewer system, and the effectiveness of the institutional controls in place. The annual inspections will describe deficiencies or violations and proposed measures or corrective actions taken or required. In the unlikely event of a failure of the LUCs, DSCR will take appropriate corrective action.

LUCs will be attached to the property deed to restrict groundwater use and prohibit residential development and land use for schools or childcare facilities, should the property change ownership in the future. DLA retains sole responsibility for remedy integrity, including LUCs, in accordance with this ROD and the subsequent LUCIP, even if the agency transfers procedural responsibilities to another party by contract, property transfer agreement, or other means.

2.12.2 Expected Outcomes

Land use at OU 2 will remain industrial through the use of LUCs. The soil cover will be designed and constructed and the site maintained to meet the:

- Threshold criteria of protecting human health and the environment and complying with ARARs, and
- RAOs of preventing exposure to soil COCs and OEs and being compatible with actions to reduce constituent migration to groundwater.

As required by CERCLA Section 121(c), five-year reviews will be conducted to ensure that the remedy remains protective of human health and the environment until site conditions allow for unlimited use and unrestricted exposure.

2.12.3 Five-Year Review Process

In accordance with CERCLA Section 121(c) and 40 CFR 300.430(f)(4)(ii), performance of the selected remedy will be evaluated every five years. The five-year reviews will assess protectiveness of the remedy and will serve as justification for amendment of this ROD if human health is not being effectively protected. Five-year reviews are required where hazardous substances remain on-site at concentrations that do not allow for unlimited use and unrestricted exposure. DSCR will document these reviews in the Administrative Record.

2.12.4 Post-ROD Documents

In accordance with the FFA, within 21 days of the signature of this ROD, DSCR will submit a schedule for post-ROD documents to be submitted to USEPA and VDEQ. The following post-ROD documents will be submitted:

- Environmental LUCIP update (new appendix)
- Remedial Design documents for the Soil Cover at OU 2
- Remedial Action Completion Report
- Annual Land Use Controls Reports
- CERCLA Five-Year Reviews

2.13 Statutory Determinations

2.13.1 Statutory Requirements

This section discusses how the selected remedy meets the statutory requirements of CERCLA Section 121. Specifically, a remedy should:

- Protect human health and the environment.
- Comply with ARARs (unless a waiver is justified).
- Be cost-effective.
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.
- Satisfy the preference for treatment as a principal element to reduce toxicity, mobility or volume, or explain why treatment is not needed.

2.13.2 Protection of Human Health and the Environment

The principal threat to human health is ingestion of, direct contact with, and inhalation of volatile emissions and fugitive dusts from impacted soils containing COCs. The Modified Alternative 6A includes a soil cover and LUCs to prevent exposure to COCs. The future use for OU 2 will remain industrial. OU 2 is in the direct flight path for the heliport; therefore, the surface will remain a grassed field. This soil layer and grass cover will be maintained to prevent direct soil contact or the generation of fugitive dust. Intrusive activities impacting the integrity of the soil cover will be prohibited by LUCs. Construction or utility workers performing intrusive work in the vicinity of OU 2 will be required to follow protective health and safety protocols with measures to prevent harmful exposures to COCs or OEs that might be related to past Area 50 landfill waste disposal activity. Therefore, the modified Alternative 6A will effectively protect human health.

As discussed previously in Section 2.7, OU 2 is in a developed and industrialized area of the installation and has been designated for industrial use for many years. This area provides limited ecological habitat. OU 2 is fenced and completely grass-covered or paved. The grassed area is mowed on a routine basis, and this maintenance will continue in the future. Therefore, the introduction of additional ecological species is unlikely to occur (MACTEC, 2007). However, there is a potential for some ecological receptors to be at OU 2 in its current condition. The COC concentrations at OU 2 exceed soil ecological screening values. The selected remedy of a soil cover will eliminate this potential risk.

2.13.3 Compliance with ARARs

Table 2-9 lists the ARARs and criteria to-be-considered (TBCs) for the OU 2 soils. TBCs are criteria that can be used to help develop risk-based cleanup objectives in the absence of chemical-specific ARARs. TBCs are not enforceable standards. The remedy will comply with all ARARs.

2.13.4 Cost-Effectiveness

As discussed above in Section 2.10.7, Modified Alternative 6A is the most cost-effective alternative that meets:

- Both threshold criteria of protectiveness and compliance with ARARs
- The three RAOs for OU 2.

For comparison purposes, the cost estimates for each alternative assumed a 20-year O&M period, a 5 percent discount rate on annual O&M costs, and a 25 percent contingency on capital costs.

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

Modified Alternative 6A complies with CERCLA guidance concerning presumptive remedies for military solid waste disposal sites. CERCLA guidance calls for a cover system and use of institutional controls as the presumptive remedy for these types of CERCLA sites. This remedy is considered compliant with this statutory requirement to use permanent solutions and alternative treatment technologies to the maximum extent practicable.

2.13.6 Preference for Treatment as a Principal Element

Treatment is not a principal element of Modified Alternative 6A because treatment of the soil COCs would render the remedy cost-ineffective; however, as mentioned above, this alternative complies with CERCLA guidance concerning presumptive remedies for military solid waste disposal sites..

2.13.7 Five-Year Review Requirements

As long as concentration of soil COCs and source materials preclude unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the response action to ensure that the remedy is, or will be, protective of human health and the environment. Protectiveness reviews will be conducted no less frequently than every five years thereafter, until site conditions provide for unlimited use and unrestricted exposure, or review requirements are otherwise terminated by statutory amendment.

2.14 Documentation of Significant Changes

There are no significant changes in the selected remedy from the description of Modified Alternative 6A presented in the Proposed Plan.

3 RESPONSIVENESS SUMMARY

The purpose of this responsiveness summary is to document public comments on the OU 2 proposed remedy. A public meeting was held on 10 December 2007, at the Bensley Community Center in Richmond, Virginia. The meeting was attended by DLA, USEPA Region 3, VDEQ, DSCR, members of the Restoration Advisory Board, and several community members. A list of community members who signed the attendance log is provided in Appendix A. Questions raised during the public meeting and the associated responses are also provided in Appendix A in the public meeting transcript.

3.1 Stakeholder Comments and Lead Agency Responses

No written questions were received during the public meeting or the 45-day comment period (5 November to 21 December 2007).

3.2 Technical and Legal Issues

No technical or legal issues are outstanding. No issues that would potentially impede remediation were identified.

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APPENDIX A: Public Meeting Attendees and Transcript

DEFENSE SUPPLY CENTER

RICHMOND, VIRGINIA

PUBLIC HEARING

IN RE:

Operable Unit (OU) 2

Proposed Plan

Monday, December 10, 2007

8:00 p.m.

at the Bensley Park and Community Center

2900 Drewry's Bluff Road

Richmond, Virginia 23237

CRANE-SNEAD & ASSOCIATES, INC.

4914 Fitzhugh Avenue, Suite 203

Richmond, Virginia 23230

Tel. No. (804) 355-4335

MR. LEEPER: I want to welcome you tonight and call this meeting to order. This is the OU 2 Proposed Plan meeting. I'm glad everybody was able to come out tonight.

What we're going to do is go through the introductions, and Steve’s going to do the Proposed Plan and then have a short break and then questions from the public. Then we'll adjourn, and if there are any questions afterwards, you can talk to any of us who work at the Center. When we get to the break, all the information is in the back there, and we've got some handouts and fact sheets. Don Mayer brought in some Proposed Plan posters, so you can take a look at and read over that. Don Mayer is with Earth Tech and works out of the Richmond office, and he does a great deal of work for us here, and it's excellent to have him on the team. Like I've said many times before, the team is really good, and Don is part of that team. You know these two characters right here, no introduction needed but for you, Mr. Howard, Medford Howard, the court reporter who is taking the notes for us tonight. Jack Potosnak is with EPA and Jim Cutler. Everyone knows Mr. Carrell, the Site Director. He'll be up here in just a little bit. So, we've got the introductions out of the way. Now, I'll read what I have to read to you.

Good evening, thank you for taking the time to participate in this important public process. In a moment you will have an opportunity to look at the exhibits and talk to the staff before we get started. If not, there'll be another opportunity this evening. My name is Mark Leeper; I'm the moderator for tonight's meeting for the Defense Supply Center's Operable Unit 2 Proposed Plan. My job tonight is to make sure that we cover the agenda topics and everybody gets a fair opportunity to voice their concerns and their questions.

At this time I'd like to introduce Steve Edlavitch, Program Manager and Charles Carrell, the Site Director. We also have Kim Turner, who handles public affairs.

The purpose of this meeting tonight is to present the Proposed Remedial Plans for Operable Unit 2. In a few moments you will hear the presentation. I'm going to ask that you hold your questions until our comment and question time. You are encouraged to offer comments and ask questions about the Proposed Plan and other alternatives. One of my roles this evening is to ensure that everybody who wants to provide a formal comment on or ask a question about the Proposed Plan and the alternative is allowed that opportunity. I'm also responsible for keeping us on topic and on schedule, which is a no-fun business. I'd like to ask everyone to observe a few basic ground rules. Also, in the back, you'll find the ground rules, but they're also on a sheet that you can take with you.

The meeting therefore has three purposes: To exchange information about the OU Proposed Plan, answer your questions about the Proposed Plan, and to hear and receive your comments. Let's go through tonight's agenda so everyone will understand the process and the ground rules. First, we'll open the discussion in the exhibition area, which will be open throughout the meeting. The poster and the fact sheets are presented there. Second, consists of my remarks and presentation, and then Charles Carrell will come up and you'll hear the Proposed Plan presentation by Steve; and after that, we'll take a short break. After the presentation you'll have an opportunity to ask questions regarding the presentation and make any formal comments. We'll adjourn, and then subject experts will be available to talk to you if you have additional questions after that.

During the question and answer period, if you wish to ask a question or get a comment, we ask that you fill out a speaker card. We'll get about five or six, so we know it's going to be a fun night. We also have a lot more in the back if you need them. Please give the card to me or the person at the reception table, and he will give them to me. I will recognize the speaker during the question and answer period in the order that I receive them. I want to emphasize that the question and answer session is not a debate. There will be no response to a comment. If an answer is available to your question, it will be given, and speakers are allowed up to four minutes each, if you wish to comment. I urge you to make your comments concise and to the point. If you have a longer written statement please feel free to summarize your comments early and submit the written document in its entirety. If you believe you'll need more time than is allowed, let me know, and I'll be pleased to provide additional time after everyone has their first opportunity. Also, if you prefer to have me read your comment or question rather than you speak, please let me know when I call your name. You may submit your comments by leaving them at the table. The comments can also be mailed.

That's it for the agenda and the meeting format and the manner in which comments may be made. Are there any questions at this time?

Thank you for your cooperation in making this a productive meeting, and we look forward to your participation. Now, Mr. Charles Carrell.

MR. CARRELL: First of all, thanks for coming, and Janet, we appreciate your help, and of course Jack and Jim, we really appreciate the support you have provided and other activities that we're talking about here at DSCR.

DSCR composes about 600 acres owned by the U. S. Army and operated by the Defense Logistics Agency, and its primary mission is to provide aviation support and logistic services to America’s war fighters. Just as a matter of record, the county government personnel and contract personnel employ about 3,000 people on the Center, including DSCR and all its entities. That's a significant impact to the economy of Chesterfield County and the surrounding areas.

Next chart. It was added to the National Priorities List, which is the government's version of the Superfund, in 1978. It wasn't until 1990 that we had a facilities agreement between DLA and the Environmental

Protection Agency and the Virginia Department of Environmental Quality. It established DLA as the lead agency and organized what we refer to as an Operable Unit, into 13 Operable Units. At the time soil contamination and groundwater and the pumping creek system, and we've made good progress over the years, as far as records of decisions, and we’re moving down towards the end of the road, as far as records of decision. We should have those in place shortly.

Next slide. This shows you where the OU 2 is, this is the map, and it's right here. If you've been on the Center, it's the area in front of what we call Building 54, that's fenced in. It's a sizable piece of land, and approximately 13 acres.

This is just a listing of the Operable Units. It involves soil contamination, impacted soil from a former landfill, area 50. It's 13 acres, between the Open Storage Area and the National Guard Area. Landfill activities took place in the late 50's and early 70's. Proposed plan presents the Preferred Remedial Alternative for these OUs, and Steve will go over those in detail.

MR. LEEPER: We have everything, all our materials on the table back here, but before we get started, let's take about a five-minute break, and you can look at the poster and grab a fact sheet, and we'll get started at about 7:30, and Steve will make a presentation.

NOTE: Break time; whereupon, the hearing reconvenes, viz:

MR. EDLAVITCH: Good evening, everyone. I'm Steve Edlavitch, and I'm the Project Manager here at the DSCR. Tonight we're going to talk about the Proposed Plan for Operable Unit 2. As you know, we're in this CERCLA process, and the lead agency offers a Proposed Remedial Action Plan as to how they want to go about cleaning up this site, and then the public has a window through which they can learn about it or comment on it. We're in that process right now. As far as CERCLA, that's the Superfund Statute, and it works in these stages here, as shown here on the slide. The Proposed Plan comes after the investigational phases, which is a remedial investigation FS. Once the feasibility study is completed, we move into the Proposed Plan.

Here we are at the Proposed Plan stage of the cleanup process. When we finish this, we'll go on and write the record of decision, which you know about, and the remedial design and remedial action and so forth.

Tonight we're going to talk about OU 2. Charles mentioned its location. It's in the center of the facility. It's a 13-acre landfill that was filled in the late '50's through the '70's, so that's the location, No Name Creek and James River.

The OU 2 is a 13-acre area in the central part of DSCR. The landfill operations took place in the late '50's and ended in the '90's. It seems like, according to aerial records, where we got a lot of our investigational data, they moved from the northern area in the late '50's and moved into the central part and eventually towards the southern part of area 50. It was completed in the 1970's. After that, it was eventually filled in and graded and seeded, as of 1975. When the Army began the environmental investigation it became designated as OU 2. OU 2 is obviously the contents in the soil there. We know basically what's in there is discarded chemical containers, scrap metal, construction debris, and ordnance and explosives. We know that, somewhat from the aerial photography and somewhat from talking to people who worked here since the late '50's. Also, from what I'm going to talk about next, which is from the experimental trenches they dug to find out more about what the contents were.

Just like I mentioned, in the '80's, when the remedial investigation began by the U. S. Army Environmental Hygiene Agency, there were some borings done in the landfill area, and they found things like rubber, cinder block, coal ash and slag, bits of wood, scrap metal, glass, rubber, brick, asphalt, concrete and wires. I think you'll find that this type of debris is found at 90 percent of the military installations that have landfills like this. This is DSCR's version of it.

Through this investigation in the '80's they found soil stained and saturated with fuel oil were observed in some trenches. That will tell you more about the content of the landfill. As for some of the borings and what were the things they discovered, such as PCBs and PAHs and VOCs. PCBs are the things that are in the electrical transformers, and PAHs are the result of partially combusted fuel oils and things like that, and the VOCs we talk about a lot are like solvents or metal solvents.

A little bit more about the investigations. Water level data and observations during the trenching efforts show that the lower portion of the landfill waste is below the water table. Basically, we have this landfill that's in the ground, but the water table, I'll try to draw a figure here. Let's say this is the refuse here, and the water table is actually in the bottom, and that's not like a traditional. A new landfill constructed after 1988 when the new regulations came in are built like this. They have a sloped cover, and the refuse is put in here, and then there's a liner to catch the leachate, and there are usually wells in here to pump out the leachate collection system, and then it's above the water table. But, we don't have that case here. It was filled before the new regulations, and that's an important point. There are storm sewers that run north and south within the OU 2 area.

Another important thing is groundwater. In the public meeting tonight we're talking bout OU 2, which is everything above the groundwater table. We're going to talk about OU 6 and the actual, we'll talk about that in the coming years when we present the results of the feasibility study for OU 6. Tonight we're just talking about the unsaturated content OU 2.

As you know, for each Operable Unit we have to do risk assessments which assess the current and future risks at the site and then measure it against the EPA given requirements. Cumulative carcinogenic risks for current and future outdoor industrial workers exceeds the acceptable risks allowed by EPA. Those are what's driving the remediation of the site, current and future outdoor industrial workers that could have the potential to be exposed to contaminants which are above certain EPA criteria. Non-carcinogenic risks for all receptors is less than EPA's targeted risk range. That means some of these analytes are not above the EPA criteria, so that they don't present a risk to, potential risk to workers. The majority of the risks that we talked about here for the current and future outdoor workers is associated with direct contact with the PAHs. The PAHs are found right near the surface, for whatever reason.

Ecological risks, as you know, we have to assess human health and the environment when we clean up these sites. There is not a lot of potential for ecological risks at this site, because the area, OU 2, is fenced and grass-covered, and the grass is mowed. It doesn't provide a great habitat for anything. We do not anticipate a lot of animals getting in there and potentially have an impact. However, after some discussion with the EPA and the regulatory agencies, we all agree there is some small potential for ecological impact in the future. The remedy that we'll be discussing does take into effect the potential for ecological risk. Everybody agrees that the remedy should address the potential for ecological risk in the future.

We also have to look at No Name Creek, and that's the creek that could potentially be impacted by the landfill materials. We did a three-year creek study, and we talked about that before in this forum. Basically, the three-year creek study showed that there was no risk in the actual creek and there were abundant feces present in No Name Creek after testing the sediment and surface water in the Bensley environment.

After all this remedial investigation, we came up with the following contaminants of concern. These are contaminants that were present in such abundance that they exceeded a certain risk level, and what we found for OU 2 is that arsenic, these PAHs which I won't name, and PCBs are the contaminants of concern in the surface soil. In the subsurface soil, and basically surface soil is zero to two feet, and sub-surface soil is zero to ten feet, and that's how that works. Once you go a little bit deeper you find trichlorethene and these PAHs presents an unacceptable risk, and that's what we need to address in our remedy.

After you decide what the contaminants of concern are and how someone could be affected by the COCs, then we have to come up with a remedial action objective, and that's called RAOs. Here is what we came away with. Prevent human ingestion of, direct contact with, and inhalation of volatile emissions and fugitive dusts from impacted soils, primarily for workers. That's a goal of the remediation. Be compatible with actions to reduce constituent migration to groundwater. Basically we talked about how OU-2 is just the unsaturated material. We want to do a remedy that's going to be compatible with future actions to mediate the groundwater. These folks have worked diligently in that remedial action objective. Another objective is to prevent exposure to OE hazards and that means coming in contact with the ordnance and explosives at this site.

Remedial alternative evaluated in a technical memorandum published in 2006 were no action, which is the CERCLA requirement, and requires that we evaluate no action as a baseline for other alternatives. Alternative 2, institutional controls. Then you jump to 6A and 6B, and that's because through evolution of the remedial alternatives, basically two through five were not selected to undergo further evaluation, because they were deemed not necessary. You're left with 1, 2 and 6A. 6A is a soil cover with storm sewer rehabilitation, land use controls and source removal of free product and saturated soils. The soil cover we've been talking about. The land use controls, those are things like deed restrictions and fencing and engineering controls, and those are devices to keep folks away from the contamination. Source removal of free product was dropped from the alternatives because basically it's not in a dissolved state, like if you changed the oil in your car, how that affects the soil. Alternative 6B is a clay cover with storm sewer rehabilitation, land use controls and source removal of free product and saturated soils.

Then there was an additional alternative called Modified Alternative 6A, that was soil cover and land use controls. 6A evolved because of a few things that happened in subsequent investigations. The Corps of Engineers basically sealed the storm sewer in 2005, not as part of a remediation project, but they were doing it across the Center, so they've lined the storm sewers in that area, which sort of took on a part of these alternatives out, so that's why we came up with a Modified Alternative 6A. We also found in our monitoring well network around the landfill that we didn't see any of this free product that was seen during some of the trenching exercises. We don't think that's going to be a future impact to the groundwater. It was only found in the landfill, and it's not moving downgrade.

After all of that we have to evaluate the alternative based on land criteria for CERCLA. I'm going to talk about that in a minute. Basically what DLA proposed, their Proposed Alternative, and the following issues came up during the selection of alternatives. Presence of waste materials below the water table would negate the benefit provided by an impervious clay cover. We talked about the clay there before. Because we know that the water table is within the landfill, it would really negate the benefit of a clay cover. The clay cover might stop some of the rainfall infiltrating, but you're still left with this condition where the groundwater is continuing to move this way and continues to leach groundwater through the landfill.

Free product and saturated soil removal action was re-evaluated. Risk associated with exposure to ordnance and explosives during digging activities. It sort of screens out the free product removal because of the short-term risk that would be present for a construction worker going in to remove those. The ordnance presents an unacceptable risk.

There was a storm sewer lining project completed by the Army Corps of Engineers in 2005, and here are the nine criteria how we evaluated that: Protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reductions in toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; cost; regulatory agency support; and community acceptance. When working through this evaluation criteria as documented in this technical memorandum, we found the soil cover for most surface water runoff to be the best alternative, Modified 6A. It would have a minimum thickness of six inches. So the soil cover, instead of like a clay or geosynthetic liner, would provide the best benefit for the site.

Land use controls, including restriction of groundwater use as a drinking water source, fencing, signs, property transfer deed restrictions and pre-construction assessments and reviews. The land use controls we talked about before. They seem to go along with all the remedies nowadays and mostly engineering and administrative techniques we use to keep people away from the contamination. Of course, requirement for a five-year review.

What are the advantages of the Modified 6A Alternative? It meets all the Remedial Action Objectives, provides protection of human health and the environment, protection of potential ecological receptors, reduces mobility of the contaminants, because the sloped cover will prevent some leaching through the reduction of precipitation moving through the refuse, expected to meet ARARs, applicable relevant appropriate requirements. Its straightforward to implement. If we get into these dig-and-haul situations, it becomes very complex to avoid the explosive hazards. If you're digging and hauling and you start getting into the groundwater, if you go to the beach and dig a hole in the sand and you reach the water table, you'll notice that it will start caving in on you, and that would be a difficulty during construction. If you try to dig and haul out of this material, it's difficult. It is a cost-effective alternative and expected to have agency and community acceptance.

Community Participation. The DSCR has a monthly Restoration Advisory Board meeting, and there was also a newspaper notice on Proposed Plan published on November 4, 2007. The Proposed Plan is still available for review in the Administrative Record, if you go to *adminrec.com*. Public comment period is from November 5, 2007 to December 21, 2007. If your correspondence is date-stamped by the 21st, then we'd have to address it. Additional opportunity is this public meeting you're at tonight for us to address some of your comments.

What's next? After we finish the Proposed Plan, if it's agreed and moved forward, then we'll go into the record of decision where we're creating a legally binding document to describe the cleanup activities that are going on. That's our discussion about OU-2 and the Proposed Plan. Now we go to the next step.

MR. LEEPER: Do we have any questions? We passed out two cards. If there are no more questions we can open up time for comments. Some of the questions have already been answered.

UNIDENTIFIED FEMALE: I think you should answer them out loud.

MR. LEEPER: Question Number 1, what type of explosives could be present in the area OU-2?

MR. EDLAVITCH: I think it's essentially in this Proposed Plan.

MR. LEEPER: Going from memory and the trenching reports, what they found, I believe, is mostly shell casings which are empty, 9 millimeters, some recoilless rifle shells and some of these JATO bottles, jet-assisted takeoff bottles.

MR. EDLAVITCH: The trenching effort field personnel noted, trenching work also uncovered OE items, 40 millimeter, grenades, 90 millimeter recoilless rifle rounds and the JATO bottles.

UNIDENTIFIED FEMALE: Okay, so the grenades were exploded or non-exploded?

MR. EDLAVITCH: Just says grenades.

UNIDENTIFIED FEMALE: Okay.

UNIDENTIFIED MALE: One of those 40 millimeter shells, like the M-79 potentially armed.

UNIDENTIFIED FEMALE: There are still some potential explosives in there?

MR. LEEPER: Something that would prohibit us from coming in there and digging the stuff up, potentially dangerous. Does that answer your question?

Question Number 2, what impact will occur if the storm sewers are not rehabilitated?

MR. EDLAVITCH: Like I said, there is landfill content that is in the groundwater, so there is a potential for leaching of landfill contaminants into the storm sewers. The Army Corps of Engineers did a lining of those storm sewers in 2005, so that should prevent the leaching from getting into the storm sewer system.

UNIDENTIFIED FEMALE: 6A, you have to fix the storm sewers, and if they relined them, what were you going to do differently in 6A that you're not doing in 6B?

MR. LEEPER: As far as the sewers go, I believe the liners would not have been installed, I believe we would have had to replace the sewers.

MR. CARRELL: When we did the storm sewer repair, as long as you can flush down the storm sewer with the water and other things, there was some storm sewer damage, and we replaced certain parts of it. The liner seemed to be very effective and a better way of doing it. You don't have to do all this digging to get to it. They're the yellow liners.

MR. LEEPER: With the storm sewer you have concrete, and over time that develops cracks, and there's potential to leach storm water into the sewers that go into No Name Creek, but it's a thick vinyl composite liner that goes inside, and they blow it up to fill it out, and then they heat it up so it adheres to the inside of the concrete so it seals the sewer.

All right, any other questions?

Thank you so much for participating; glad to have you here. That concludes our OU-2 Proposed Plan briefing. If anyone travels this holiday, please be safe, and then we'll see you next year. I believe the next meeting is January 14th, and we'll have a couple of issues to discuss. Again, thank you for coming.

PROCEEDINGS CONCLUDED.

CERTIFICATE OF THE COURT REPORTER

I, Medford W. Howard, was the court reporter who took down and transcribed the proceedings in the matter of the Public Hearing in re: Operable Unit (OU) 2 - Proposed Plan, on Monday, December 10, 2007 at 8:00 p.m. at the Bensley Park and Community Center, 2900 Drewry's Bluff Road, Richmond, Virginia.

I certify this transcript is true and correct to the best of my ability.

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Medford W. Howard