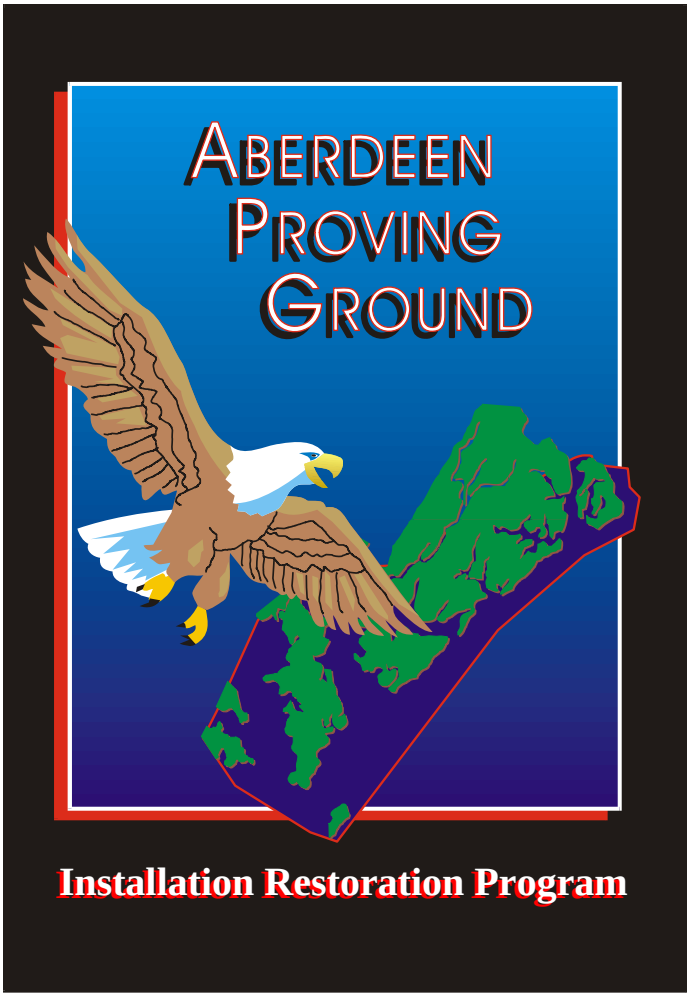

EDGEWOOD AREA – ABERDEEN PROVING GROUND Five-Year Review

Final, October 2008

U.S. Army Garrison
Aberdeen Proving Ground, Maryland

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

December 16, 2008

Colonel Jeffrey Weissman
United States Army
Deputy Installation Commander
Aberdeen Proving Ground, Maryland 21010-5401

Dear Colonel Weissman:

Thank you for submitting the report, *Edgewood Area - Aberdeen Proving Ground Five-Year Review,* dated October 2008 to the EPA for review and concurrence. The report was prepared to fulfill the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121 (c) to review Remedial Actions where hazardous substances remain every five years to assure that human health and the environment are being protected. EPA has reviewed this five-year review report and compared it to EPA's June 2001 guidance document, *Comprehensive Five-Year Review Guidance* (OSWER No. 9355.7-03B-P, EPA 540-R-01-007).

EPA concurs with the Army's recommendation that the following two (2) sites: Bush River Study Area – Cluster 3 Transformer Storage Area; and Lauderick Creek Study Area – Nike Missile Silos, Nike Sanitary Sewer be closed since waste removal has been completed at these sites and the remedial action objectives (RAOs) have been achieved.

EPA concurs with the Army's determination that the remedies for the following sites:

- O-Field – OU 1, OU 2, OU 3;
- J-Field – Soil OU, Groundwater, White Phosphorus Burning Pits;
- Canal Creek Study Area – Bldg. 103 Dump Site, Bldg. 503 Burn Sites, Beach Point,
- East Plume Groundwater, 13 Select Sites, G Street;
- Westwood Study Area – Clusters 2, 6, 10, 14, and 21, Remaining Sites;
- Carroll Island – OU A, OU B;
- Graces Quarters – OU A, OU B;
- Bush River Study Area – Old Bush River Road Dump, Cluster 3 Lead Contaminated Soil Site;
- Lauderick Creek Study Area – Cluster 1 Groundwater, Nike SW Landfill, Other Clusters, Cluster 9 Groundwater;
- Other Edgewood Areas Study Area – Cluster 19 Groundwater;

and the LUC sites are protective of human health and the environment. Furthermore, as part of this five-year review, EPA has evaluated the Government Performance and Results Act (GPRA) measures for the above-listed sites and has determined their status is as follows:

Environmental Indicators

1. Human Health: Current Human Exposure Controlled
2. Groundwater Migration: Groundwater Migration Under Control

Sitewide Ready for Anticipated Use

The Site has not been determined to be Site-Wide Ready for Anticipated Use.

The requirement for this five-year review at APG - Edgewood was triggered by the Remedial Action start date of October 21, 2003. A previous five-year review report was completed and signed by the Army on October 23, 2003. The next five-year review will be due five years from the date of this concurrence letter.

If you have any questions, please contact Ben Mykijewycz, Chief of the NPL/BRAC Federal Facilities Branch, at (215) 814-3351 or Yazmine Yap-Deffler at (215) -814-3369.

Sincerely,

James J. Burke

James J. Burke, Director
Hazardous Site Cleanup Division

cc: Ken Stachiw – APG (DSHE)
John Fairbank – MDE

Five-Year Review Report

Third Five-Year Review Report

for

Edgewood Area

Aberdeen Proving Ground

Harford and Baltimore Counties, Maryland

October, 2008

PREPARED BY:

U.S. Department of the Army
Aberdeen Proving Ground
Maryland

Approved by: Date:

24 OCT 08

JEFFREY S. WEISSMAN
Colonel, US Army
Deputy Installation Commander

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
	Final	

4. TITLE AND SUBTITLE

Edgewood Area - Aberdeen Proving Ground
Five-Year Review

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W91ZLK-04-D-0013

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

General Physics Corporation

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

General Physics Corporation
500 Edgewood Road, Suite 110
Edgewood, Maryland 21040

8. PERFORMING ORGANIZATION REPORT NUMBER

GP-R-123E08002

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Directorate of Safety, Health and Environment
IMNE-APG-SHE-R
Aberdeen Proving Ground, Maryland 21010

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This document is the second Five-Year Review for the Edgewood Area of Aberdeen Proving Ground. All of the sites currently under CERCLA investigation or remediation within the Edgewood Area are included in this review. The Study Areas addressed by this document include O-Field, J-Field, Canal Creek, Westwood, Carroll Island, Graces Quarters, Bush River, Lauderick Creek, and Other Edgewood Areas.

15. SUBJECT TERMS

Five-Year Review, Edgewood Area, Aberdeen Proving Ground

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE		~650	19b. TELEPHONE NUMBER *(Include area code)*

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ACRONYMS & ABBREVIATIONS

AEDB-R	Army Environmental Database – Restoration
AEL	airborne exposure limit
AOC	area of concern
APG	Aberdeen Proving Ground
ARAR	applicable or relevant and appropriate requirement
Army	U.S. Army
AST	aboveground storage tank
AWQC	Ambient Water Quality Criteria
BAT	Best Available Technology
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	constituent of concern
CWM	chemical warfare materiel
DANC	Decontaminating Agent Non-Corrosive
DNAPL	dense, non-aqueous phase liquid
DSERTS	Defense Site Environmental Restoration Tracking System
DSHE	Directorate of Safety, Health and Environment
EOD	explosive ordnance disposal
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
FFA	Federal Facility Agreement
FFS	Focused Feaiblity Study
GAC	granular activated carbon
GIS	geographic information system
GP	General Physics Corporation
GES	groundwater extraction system
GWTF	groundwater treatment facility
HC	smoke generating compounds containing hexachloroethane

HE	high explosives
HHRA	Human Health Risk Assessment
IP	in progress
IRA	interim remedial action
IRP	Installation Restoration Program
LTM	long-term monitoring
LUC	land use controls
MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
O&M	operations and maintenance
OB/OD	open burning / open detonation
OE	ordnance and explosives
OU	operable unit
PAH	polycyclic aromatic hydrocarbons
PBC	performance-based contract
PCB	polychlorinated biphenyls
PIU	permeable infiltration unit
PPE	personal protective equipment
PSB	protective soil blanket
RAB	Restoration Advisory Board
RAO	remedial action objective
RBC	risk-based concentration
RC	Response Complete
RCRA	Resource Conservation and Recovery Act
RD	remedial design
REM	removal action

RG	remedial goal
RI/FS	Remedial Investigation / Feasibility Study
RIP	Remedy in Place
ROD	Record of Decision
SCADA	supervisory control and data acquisition
SOU	soil operable unit
SWMU	solid waste management unit
SVOC	semi-volatile organic compounds
TAL	Target Analyte List
TCL	Target Compound List
TDS	total dissolved solids
TOC	total organic carbon
TI	technical impracticability
TRV	Toxicity Reference Value
USAEHA	U.S. Army Environmental Hygiene Agency
USATEU	U.S. Army Technical Escort Unit
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
UV/OX	ultraviolet/oxidation
UXO	unexploded ordnance
VOC	volatile organic compounds
WRMDF	Westwood Radioactive Material Disposal Facility
WWI	World War I
WWII	World War II

Chemical Name Abbreviations

DCA	1,2-dichloroethane
DCE	dichloroethene
4,4'-DDD	4,4'-dichlorodiphenyldichloroethane
4,4'-DDE	4,4'-dichlorodiphenyldichloroethene
4,4'-DDT	4,4'-dichlorodephenyltrichloroethane
BZ	3-quinuclidinyl benzilate

CC2	2,4,6-trichlorophenyl urea
CG	phosgene
CN	chloroacetophenone
CNS	chloroacetophenone in chloroform
CS	ortho-chlorobenzylidenemalonitrile
Cs-137	cesium-137
CT	carbon tetrachloride
DM	adamsite
GB	Sarin (isopropyl methyl phosphono fluoridate)
GD	pinacolyl methyl phosphono fluoridate
HD	distilled mustard
HMX	cyclotetramethylene tetranitramine
L	lewisite
RDX	cyclotrimethylene trinitramine
TCA	trichloroethane
TCE	trichloroethene
c-DCE	cis-1,2-dichloroethene
t-DCE	trans-1,2-dichloroethene
TeCA	1,1,2,2-tetrachloroethane
TNT	trinitrotoluene
VC	vinyl chloride
VX	o-ethyl s-(2-diisopropylaminoethyl) methylphosphonothiolate
WP	white phosphorus

Units of Measure

ft^2	square foot/feet
gpm	gallons per minute
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
mm	millimeter
pCi/g	picoCuries per gram
µg/l	micrograms per liter

µg/kg	micrograms per kilogram
yd^3	cubic yard(s)

EXECUTIVE SUMMARY

The U.S. Army (Army) has conducted a five-year review of the remedial actions implemented at the Edgewood Area of Aberdeen Proving Ground (APG), Maryland, as required by Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA [a.k.a. Superfund]). This review was conducted from September 2007 through February 2008. The first Edgewood Area five-year review addressed O-Field and was conducted in 1999. Subsequently a joint decision between the U.S. Environmental Protection Agency (USEPA) and the Army was made to place all sites within the Edgewood Area on a consolidated review cycle. Therefore, all of the sites currently under CERCLA investigation or remediation within the Edgewood Area were included in the second (2003) and this review. The USEPA Edgewood Area Superfund Site Identification Number is MD 2210020036.

APG is an approximately 72,500-acre Army installation located in southern Harford and southeastern Baltimore counties, on the western shore of the upper Chesapeake Bay. The installation is bordered to the east and south by the Chesapeake Bay; to the west by Gunpowder Falls State Park, the Crane Power Plant, and residential areas; and to the north by the City of Aberdeen and the towns of Edgewood, Joppatowne, Magnolia, and Perryman. The Bush River divides APG into two areas with the Edgewood Area to the west and the Aberdeen Area east of the river. Established as the Ordnance Proving Ground in 1917, the Aberdeen Area of the installation became a formal military post, designated as APG, in 1919. Traditionally, APG's primary mission involved the testing and development of weapon systems, munitions, vehicles, and a wide variety of military support material. The Edgewood Area (formerly Edgewood Arsenal) was appropriated by presidential proclamation in 1917 and has since been a site of laboratory research, field testing of chemical materiel and munitions, pilot-scale manufacturing, production-scale chemical agent manufacturing, and related test, storage and disposal operations.

During 1984 and 1985, APG was evaluated as a potential National Priorities List (NPL) site. In 1985, the Edgewood Area of APG was proposed for inclusion on the NPL; it was listed in 1990. In 1986, between the time of the proposed listing and the final listing, a Resource Conservation and Recovery Act (RCRA) corrective action permit (MD3-21-002-1355) was issued by the USEPA Region III to address solid waste management units (SWMUs) in the Edgewood and Aberdeen Areas of APG. As required by the RCRA permit, the Army performed a RCRA Facility Assessment (RFA) for the Edgewood Area. The RFA identified sites in the Edgewood Area that were either SWMUs or areas of concern (AOCs) for potential contamination. After the final NPL listing of the Edgewood Area in 1990, further investigations were conducted in accordance with CERCLA under the 1990 Federal Facility Agreement (FFA) with USEPA.

The FFA identified specific Study Areas within the Edgewood Area including O-Field, J-Field, Canal Creek, Westwood, Carroll Island, Graces Quarters, Bush River, and Lauderick Creek. The Edgewood Area SWMUs and AOCs not specifically listed above were grouped and designated the Other Edgewood Areas Study Area. Twenty-two Records of Decision (RODs) have been signed that address 25 Operable Units (OUs) in

the Edgewood Area. Remedial Action Objectives (RAOs), the selected response action, and performance standards are listed in Exhibit 1. Army CERCLA response actions are tracked in the Army Environmental Database – Restoration (AEDB-R). The Edgewood Area sites, their CERCLA status, and corresponding AEDB-R Numbers are listed in Exhibit 2. Recommendations resulting from the 2003 five-year review and follow-up actions are listed in Exhibit 3. Results of this review, i.e., protectiveness statements, recommendations, and follow-up actions, are provided in the following Five-Year Review Summary Forms.

It is recommended that CERCLA Section 121(c) five-year reviews continue to be conducted for the following:

- O-Field – OU 1, OU 2, OU 3;
- J-Field – Soil OU, Groundwater, White Phosphorus Burning Pits;
- Canal Creek Study Area – Bldg. 103 Dump Site, Bldg. 503 Burn Sites, Beach Point, East Plume Groundwater, 13 Select Sites, G Street;
- Westwood Study Area – Clusters 2, 6, 10, 14, and 21, Remaining Sites;
- Carroll Island – OU A, OU B;
- Graces Quarters – OU A, OU B;
- Bush River Study Area – Old Bush River Road Dump, Cluster 3 Lead Contaminated Soil Site;
- Lauderick Creek Study Area – Cluster 1 Groundwater, Nike SW Landfill, Other Clusters, Cluster 9 Groundwater;
- Other Edgewood Areas Study Area – Cluster 19 Groundwater; and
- Sites for which a ROD is signed subsequent to submission of this review and for which CERCLA Section 121(c) trigger criteria apply.

No further CERCLA Section 121(c) five-year review is recommended for the following:

- Bush River Study Area – Cluster 3 Transformer Storage Area; and
- Lauderick Creek Study Area – Nike Missile Silos, Nike Sanitary Sewer.

Waste removal has been completed at these sites.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: APG-EA; O-Field

EPA ID *(from WasteLAN)*: MD2210020036

Region: 3	**State:** MD	**City/County:** Harford County

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☒ Complete

Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** OU 1 – April 1995 OU 2 – September 1998 OU 3 – September 1997

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency U.S. Army

Author name: Cindy Powels

Author title: Project Officer, CERCLA Remedy Review	**Author affiliation:** APG Directorate of Safety, Health & Environment

Review period:** 09 / 05 / 2007 to 10 / 21 / 2008

Date(s) of site inspection: 11 / 13 / 2007, 11 / 19 / 2007

Type of review:

☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☐ 2 (second) ☒ 3 (third) ☐ Other (specify) _____

Triggering action:

☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 10 / 21 / 2003

Due date *(five years after triggering action date)*: 10 / 21 / 2008

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

The Old O-Field RODs did not address vapor intrusion.

Recommendations and Follow-up Actions:

The vapor intrusion pathway cannot be complete as long as remedial activities pursuant to the existing RODs for interim actions are ongoing. Vapor intrusion should be considered in the decision-making process for the final action ROD(s), ESDs, and other decision documents.

Protectiveness Statement(s):

The remedy at OU 1 currently protects human health and the environment because the waste is contained through capture and treatment of contaminants. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

The remedy at OU 2 currently protects human health and the environment because the waste is contained. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

The remedy at OU 3 currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in sediment are demonstrated to be levels that allow for unlimited use and unrestricted exposure. (See recommendations above.)

Other Comments:

None.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: APG-EA; J-Field

EPA ID *(from WasteLAN)*: MD2210020036

Region: 3	**State:** MD	**City/County:** Harford County

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☒ Under Construction ☒ Operating ☒ Complete

Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** Soil OU - October 2001 Groundwater OU - September 2001 White Phosphorus Burning Pits - ___ / ___ / ____

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency U.S. Army

Author name: Cindy Powels

Author title: Project Officer, CERCLA Remedy Review	**Author affiliation:** APG Directorate of Safety, Health & Environment

Review period:** 09 / 05 / 2007 to 10 / 21 / 2008

Date(s) of site inspection: 12 / 18 / 2007

Type of review:

☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:

☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 10 / 21 / 2003

Due date *(five years after triggering action date)*: 10 / 21 / 2008

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

Vapor intrusion was not addressed by the J-Field Groundwater OU ROD.

Recommendations and Follow-up Actions:

Amend the J-Field Groundwater OU LUCs to address vapor intrusion

Protectiveness Statement(s):

The remedy for J-Field Soil OU currently protects human health and the environment because all waste has been contained or removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

The remedy for J-Field Groundwater currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in groundwater are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

The remedy at White Phosphorus Burning Pits is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Other Comments:

None.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: APG-EA; Canal Creek Study Area

EPA ID *(from WasteLAN)*: MD2210020036

Region: 3	**State:** MD	**City/County:** Harford County

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☒ Under Construction ☒ Operating ☒ Complete

Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** Bldg. 103 Landfill - October 1999 Bldg. 503 Burn Sites – October 1999 Beach Point Groundwater - September 1997 East Plume Groundwater - April 2003 DM filling Plant – December 2007

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: EPA State Tribe ***Other Federal Agency*** U.S. Army

Author name: Cindy Powels

Author title: Project Officer, CERCLA Remedy Review	**Author affiliation:** APG Directorate of Safety, Health, & Environment

Review period:** 09 / 05 / 2007 to 10 / 21 / 2008

Date(s) of site inspection: 11 / 9, 13, & 19 / 2007, 12 / 18 / 2007

Type of review:
☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:
☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 10 / 21 / 2003

Due date *(five years after triggering action date)*: 10 / 21 / 2008

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:
Vapor Intrusion has not been addressed by the Canal Creek Study Area RODs.

Recommendations and Follow-up Actions:
Amend the Beach Point Test Site and East Branch Canal Creek Aquifer LUCs to address vapor intrusion..

Complete the study-area wide vapor intrusion evaluation.

Protectiveness Statement(s):

The remedy at Building 103 Dump currently protects human health and the environment because the waste is contained. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

The remedy at Building 503 is protective of human health and the environment because all waste has been removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

The remedy at Beach Point Test Site currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in groundwater are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

The remedy at East Branch Canal Creek Aquifer currently protects human health and the environment because the waste is contained through capture and treatment of contaminants. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure

The remedy for 13 Select Sites currently protects human health and the environment because all waste has been removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

The remedy at G Street is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Other Comments:
One sediment sample (VS-BS-005) collected following excavation at the Brine Sludge Disposal Area in the Westwood Study Area has metal concentrations (arsenic, chromium, copper and zinc) similar to those observed in the RI/FS sediment, but not the high magnesium concentrations characteristic of the brine sludge waste. While this sediment data provides further indication that the excavation remedy was effective in removing the waste at the Westwood Study Area site, its inclusion in the data set for the Canal Creek Study Area West Branch Canal Creek Sediment (EACC5A) is recommended as part of the assessment of impacts to ecological receptors.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: APG-EA; Westwood Study Area

EPA ID *(from WasteLAN)*: MD2210020036

Region: 3	**State:** MD	**City/County:** Harford County

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☒ Under Construction ☐ Operating ☒ Complete

Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** HC Grenade Disposal Pit, WW-90 Drum Dump, WRMDF Western Disposal Area, Brine Sludge Disposal Area, Gas Mask Factory – September 2007 WW-90 Fill Area - ___ / ___ / ____ Hog Point Site - ___ / ___ / ____

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency U.S. Army

Author name: Cindy Powels

Author title: Project Officer, CERCLA Remedy Review	**Author affiliation:** APG Directorate of Safety, Health & Environment

Review period:** 09 / 05 / 2007 to 10 / 21 / 2008

Date(s) of site inspection: 10 / 19 / 2007, 11 / 21 / 2007, 12 / 21 / 2007

Type of review:
☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:
☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 10 / 21 / 2003

Due date *(five years after triggering action date)*: 10 / 21 / 2008

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

None

Recommendations and Follow-up Actions:

None

Protectiveness Statement(s):

The remedy for the Clusters 2, 6, 10, 14, and 21 sites addressed in the ROD signed in 2006 currently protects human health and the environment because all waste has been contained or removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

The remedies at the Remaining Sites (i.e., WW-90 Fill Area and Hog Point Site) are expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Other Comments:

One sediment sample (VS-BS-005) collected following excavation at the Brine Sludge Disposal Area has metal concentrations (arsenic, chromium, copper and zinc) similar to those observed in the RI/FS sediment, but not the high magnesium concentrations characteristic of the brine sludge waste. While this sediment data provides further indication that the excavation remedy was effective in removing the waste at the Westwood Study Area site, its inclusion in the data set for the Canal Creek Study Area West Branch Canal Creek Sediment (EACC5A) is recommended as part of the assessment of impacts to ecological receptors.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: APG-EA; Carroll Island and Graces Quarters

EPA ID *(from WasteLAN)*: MD2210020036

Region: 3	**State:** MD	**City/County:** Baltimore County

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☒ Complete

Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** Carroll Island OU A – October 2006 Graces Quarters OU A – October 2005 Carroll Island / Graces Quarters OU B – September 2007

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency U.S. Army

Author name: Cindy Powels

Author title: Project Officer, CERCLA Remedy Review	**Author affiliation:** APG Directorate of Safety, Health & Environment

Review period:** 09 / 05 / 2007 to 10 / 21 / 2008

Date(s) of site inspection: 11 / 08 / 2007

Type of review:

☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:

☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 10 / 21 / 2003

Due date *(five years after triggering action date)*: 10 / 21 / 2008

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

None

Recommendations and Follow-up Actions:

None

Protectiveness Statement(s):

The remedy at Carroll Island OU A currently protects human health and the environment because the waste has been removed from the site and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

The remedy at Graces Quarters OU A is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedy at Carroll Island / Graces Quarters OU B currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure and shoreline erosion has been mitigated. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. Erosion Controls and LUCs must be maintained and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

Other Comments:

None

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: APG-EA; Bush River Study Area		
EPA ID *(from WasteLAN)*: MD2210020036		
Region: 3	**State:** MD	**City/County:** Harford County

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☒ Under Construction ☐ Operating ☒ Complete

Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** Old Bush River Road Dump – November 2000 Cluster 3 Lead Contaminated Soil – June 2007

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency U.S. Army

Author name: Cindy Powels

Author title: Project Officer, CERCLA Remedy Review	**Author affiliation:** APG Directorate of Safety, Health & Environment

Review period:** 09 / 05 / 2007 to 10 / 21 / 2008

Date(s) of site inspection: 11 / 14 / 2007

Type of review:
☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:
☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 10 / 21 / 2003

Due date *(five years after triggering action date)*: 10 / 21 / 2008

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

None

Recommendations and Follow-up Actions:

None

Protectiveness Statement(s):

The remedy at Old Bush River Road Dump currently protects human health and the environment because the waste is contained. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

The remedy at the Transformer Storage Area is protective of human health and the environment because all waste has been removed.

The remedy at the Lead Contaminated Soil Area currently protects human health and the environment because waste has been treated to action levels, all waste is contained, and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of lead in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

Other Comments:

None

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: APG-EA; Lauderick Creek Study Area

EPA ID *(from WasteLAN)*: MD2210020036

Region: 3	**State:** MD	**City/County:** Harford County

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☒ Under Construction ☒ Operating ☒ Complete

Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** Nike Launch Area Landfill – October 1998 Nike Launch Area Groundwater – October 1999 Cluster 5 Concrete Slab Test Site – December 2005 Nike Control Area Groundwater - ___ / ___ / ____

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency U.S. Army

Author name: Cindy Powels

Author title: Project Officer, CERCLA Remedy Review	**Author affiliation:** APG Directorate of Safety, Health & Environment

Review period:** 09 / 05 / 2007 to 10 / 21 / 2008

Date(s) of site inspection: 10 / 19 & 24 / 2007

Type of review:
☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:
☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 10 / 21 / 2003

Due date *(five years after triggering action date)*: 10 / 21 / 2008

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

Cluster 1 Launch Area Groundwater - Vapor intrusion was not addressed in the ROD.

Recommendations and Follow-up Actions:

Cluster 1 Launch Area Groundwater - Amend LUCs to address vapor intrusion.

Protectiveness Statement(s):

The remedy at Cluster 1, Nike Launch Area Groundwater, is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

The remedy at Cluster 1, Nike SW Landfill, currently protects human health and the environment because the waste is contained. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

The remedy at Cluster 1, Nike Launch Area Silos and Sanitary Sewer, is protective of human health and the environment because all waste has been removed.

The remedy at the Other Clusters currently protects human health and the environment because all waste has been removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

The remedy at Cluster 9, Nike Control Area Groundwater, is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Other Comments:

None

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: APG-EA; Other Edgewood Areas Study Area

EPA ID *(from WasteLAN)*: MD2210020036

Region: 3	**State:** MD	**City/County:** Harford County

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify)

Remediation status (choose all that apply): ☒ Under Construction ☐ Operating ☐ Complete

Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** Cluster 19 Groundwater – ___ / ___ / ____

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency U.S. Army

Author name: Cindy Powels

Author title: Project Officer, CERCLA Remedy Review	**Author affiliation:** APG Directorate of Safety, Health & Environment

Review period:** 09 / 05 / 2007 to 10 / 21 / 2008

Date(s) of site inspection: 10 / 19 / 2007

Type of review:
☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:
☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify)

Triggering action date *(from WasteLAN)*: 10 / 21 / 2003

Due date *(five years after triggering action date)*: 10 / 21 / 2008

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

None

Recommendations and Follow-up Actions:

None

Protectiveness Statement(s):

The remedy for Cluster 19 Groundwater is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Other Comments:

None

EXHIBIT 1

RECORDS OF DECISION

EDGEWOOD AREA 2008 REMEDIES REVIEW

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EXHIBIT 1
RECORDS OF DECISION
EDGEWOOD AREA 2008 REMEDIES REVIEW

Study Area - Operable Unit	CERCLA Status	Remedial Action Objectives	Selected Response Action	Performance Standards
O-Field - OU 1 **Old O-Field Groundwater** **USEPA OU 05**	**Interim ROD, 09 / 27 / 1991** **ESD, 03 / 23 / 2005**	Provide containment of contaminated zones in the water table and upper confined aquifers at Old O-Field; Minimize environmental risks to sensitive aquatic and terrestrial ecosystems in Watson Creek, the Gunpowder River, and surrounding wetlands by reducing or eliminating discharge of contaminated groundwater to these areas; and Control potential human health risks associated with groundwater, surface water, and food-chain exposures that could result from continued contaminant migration in groundwater at Old O-Field.	**Hydraulic Containment - ESD removed pumping from the upper confined aquifer** **Ex Situ Treatment - ESD modified treatment train** **Long-Term monitoring**	1. A groundwater monitoring plan will be developed and implemented during the interim response action to ensure that hydraulic control of the plume of contamination is maintained. 2. A monitoring plan for the effluent from the treatment plant will be developed to ensure that control of the effluent is maintained prior to discharge.
O-Field - OU 2 **Old O-Field Source Area** **USEPA OU 04**	**Interim ROD, 10 / 11 / 1994** **ESD, 9 / 14 / 2005**	Reduce the risk of an accidential release of CWM from the site by minimizing the possibility of a fire at the site; Reduce the likelyhood and effects of an unplanned detonation of ordnance; and Minimize both the likelyhood and potential effects of evaporative release of CWM from a surface or subsurface spill.	**Permeable Infiltration Unit (Cover)** **Air Monitoring System - ESD removed subsurface monitoring** **Sprinkler System - ESD modified use** **Long-Term Monitoring** **Institutional Controls**	1. The subsidence of the field will be monitored to evaluate the stability of Old O-Field and its ability to bear a load. 2. The groundwater extraction and treatment system will be reevaluated to ensure that contaminated groundwater will continue to be captured and treated. 3. Institutional controls will be implemented to limit access to the site, prevent disturbance of the sand layer, and provide long-term maintenance of the PIU. Land use restrictions will also be implemented.
O-Field - OU 3 **Watson Creek** **USEPA OU 06**	**ROD, 09 / 23 / 1997**	Restrict access to the site; Prevent development and disturbance of the site; and Inform workers and the public of the risks.	**Long-Term Monitoring** **Institutional Controls**	1. Institutional controls including access restrictions and land use restrictions will be maintained. 2. Existing physical security measures will be maintained and additional security measures will be implemented. 3. Educational programs will be developed to inform workers andlocal residents of potential hazards. 4. Site conditions will be monitored at least once every five years. 5. Five-year reviews will be conducted.
J-Field - Soil OU **USEPA OU 07**	**ROD, 09 / 27 / 1996** **ESD, April 2001**	Reduce the risk associated with the J-Field SOU by isolating or removing the contaminants.	**In Situ Containment and Limited Disposal** **Erosion Controls** **Long-Term Monitoring** **Institutional Controls**	1. Excavation in the Northern Main Burning Pit and Lead Pushout Area will remove lead to levels below the industrial screening level of 1,000 mg/kg. 2. Excavation in the Northern Main Burning Pits will remove arsenic contamination above 328 mg/kg. 3. The depth of excavation in the Northern and Southern Main Burning Pits will not be less than 2 feet in any area. 4. PCBs in the Southern Main Burning Pit will be excavated to below 25 mg/kg. 5. The PSB, covering the Northern and Southern Main Burning Pits and the Lead Pushout Area, will be a minimum of 2 feet thick in all places. 6. The PSB will be underlain by a geotextile membrane which separates the unexcavated soil from the clean backfill of the PSB. 7. The construction of the PSB will contain a barrier designed to prevent encroachment of burrowing animals. 8. Shoreline protections will be constructed along the J-Field/Chesapeake Bay boundary as part of this interim action. 9. The PSB will be engineered to include an earthen berm to significantly reduce surface runoff from the J-Field SOU toward the marsh. 10. The excavated area will be backfilled with clean soil from an off-site source. Metals contaminated soil will be shipped to a RCRA Subtitle C landfill for stabilization and disposal. PCB contaminated soil will be shipped to a chemical waste landfill if under 40 mg/kg or a TSCA approved incinerator if over 40 mg/kg. Metal scrap and remediation derived waste will be decontaminated and stored for recycling by the Defense Reutilization and Management Office, or disposed off site at an appropriate landfill. 11. The PSB will be monitored in accordance with an approved O&M Plan. ESD. Minimum 2-ft thick PSB placed above soil exceeding RGs acceptable
J-Field - Groundwater **USEPA OU 08**	**ROD, 09 / 27 / 2001** **TI Waiver, 09 / 27 / 2001**	Reduce the contaminant mass in the J-Field surficial aquifer through DNAPL recovery, phytoremediation, and natural processes; Eliminate exposure to groundwater; and Control off-site contaminant migration from the confined aquifer.	**Institutional Controls** **Phytoremediation** **Monitoring of biodegradation processes** **Monitoring of the Confined Aquifer** **Limited DNAPL Recovery** **Abandon/Replace MW JF-51 with possible addition of a supplement to the replacement well**	1. Monitoring of the Surficial Aquifer groundwater within the TI Zone will be conducted to track the progress of the phytoremediation and natural degradaton processes. 2. Monitoring of MCLs and non-zero MCLGs at points outside of the designated TI Zone.
J-Field - White Phosphorus Burning Pits **USEPA OU 18**	**ROD, 09 / 27 / 2007**	Prevent unacceptable exposure to contaminants in soil that would result from residential site use.	**Institutional Controls**	Restriction placed in installation master plan against development and use of property for military family housing, non-military residential housing, elementary and secondary schools, child care facilities and playgrounds.
Canal Creek - Bldg 103 **USEPA OU 01**	**ROD, 09 / 08 / 1995**	Prevent infiltration of water through the dump; Prevent direct contact and inhalation; and Minimize animal intrusion into the dump.	**Cap and Cover System - Sodium Bentonite Geocomposite Mat and Geosynthetic Membrane** **Long-Term Monitoring** **Institutional Controls**	1. Prevent infiltration of water into the Building 103 dump. 2. Prevent direct contact and inhalation of contaminants. 3. Prevent animal intrusion into Building 103 dump. 4. Ensure the cap and cover system will function with minimum maintenance. 5. Promote drainage of surface water, and minimixe erosion of the cap and cover system. 6. Accomodate settling and subsidence so that cap integrity is maintained. 7. Provide for adequate collection/filtration of any gases produced by buried wastes.

EXHIBIT 1
RECORDS OF DECISION
EDGEWOOD AREA 2008 REMEDIES REVIEW

Study Area - Operable Unit	CERCLA Status	Remedial Action Objectives	Selected Response Action	Performance Standards
Canal Creek - Bldg 503 **USEPA OU 03**	**ROD, 04 / 01 / 1996**	Prevent exposure to COCs in excess of RGs, and Decontaminate areas with stressed vegetation.	**Excavation** **Disposal at Bldg 103 Site** **Backfill**	Hexachlorobenzene -- 0.4 mg/kg Hexachloroethane -- 43.0 mg/kg Lead -- 400.0 mg/kg Zinc -- 64,000.0 mg/kg Remove or treat areas with sparse or no vegetation.
Canal Creek - Beach Point **USEPA OU 02**	**ROD, 09 / 24 / 1997** **TI Waiver, 09 / 24 / 1997**	Protect against the risk posed by untreated chemicals in groundwater.	**Institutional Controls** **Long-Term Monitoring**	1. At least one sign will be posted at the Beach Point Test Site, which will state the prohibition of unauthorized excavation and unauthorized groundwater well installation. The exact number of, location of, and wording for the signs will be determined during the workplan development phase and will be approved by USEPA and MDE prior to implementation. 2. A prohibition on all groundwater uses will be imposed. 3. A monitoring plan for the Bush River will be developed and implemented, and will include the sampling and analyses of affected media, such as sediments and surface water. 4. A 5-year review will be conducted in order to evaluate continuing protectiveness of human health and the environment.
Canal Creek - East Plume **USEPA OU 15**	**ROD, 07 / 17 / 2000**	Reduce toxicity, mobility, and volume of chemicals in groundwater	**Groundwater Extraction** **Ex Situ Treatment** **Long-Term Monitoring** **Institutional Controls**	1. Capture and treatment will be continued until chemical-specific ARARs are met in the aquifer unless data from operation and/or supplemental studies demonstrate that achieving these levels is not possible. 2. If ARARs are not achievable, the Army may re-evaluate this remedy and propose a new or changed remedy using the CERCLA process. 3. Prohibition on all uses of untreated groundwater from the East Canal Creek Area Plume will be imposed. 4. Signs that state the prohibition of untreated groundwater use, unauthorized excavation, and unauthorized groundwater well installation will be posted. 5. All site restrictions will be included in APG's GIS which is used in developing APG's Real Property Master Plan. 6. A downgradient monitoring plan for the East Canal Creek Area Plume will be developed and implemented, and will include the sampling and analysis of groundwater. 7. A 5-year review will be conducted to evaluate continuing protectiveness of human health and the environment. 8. The Army shall provide EPA its determination regarding ultimate use or disposal of treated groundwater by 1/2/2001.
Canal Creek - 13 Select Sites **USEPA OU 34**	**ROD, 09 / 26 / 2006**	Prevent ecological exposure to soil containing mean concentrations of COCs in excess of RGs; Prevent residential exposure to hazardous substances in soil that may pose unacceptable risk; and Prevent transport and migration of site COCs to nearby marshes and/or creeks.	**Excavation and Off-Site Disposal at two sites** **Institutional Controls at all 13 sites**	**All Sites** Establish a restriction in the Installation Master Plan prohibiting development and use of the property for future military family housing, elementary and secondary schools, child care facilities, playgrounds, and non-military residential land use until COCs in the soil are detected at levels that allow for unlimited use and unrestricted exposure. **DM Filling Plant, Building 99 Site** Remove soil within the excavation footprints to a minimum depth of 1 ft. Delineation samples will be used to identify the actual limits of the excavation area, with final excavation limits shown on figures in the RD workplan. Excavation will continue until the mean concentration of arsenic is at or below the RG, or a maximum depth of 2 ft has been achieved
Canal Creek - G Street **USEPA OU 14**	**ROD, 09 / 27 / 2007**	Protect future military/industrial workers from unacceptable risk associated with COCs in soil; Reduce the safety hazard from potential UXO/CWM at Burn Residue Disposal Area; Protect ecological communities from unacceptable effects associated with COCs in soil and waste material; and Prevent migration of COCs to downgradient marsh and surface water bodies via surface water runoff.	**Excavation and Off-Site Disposal** **Institutional Controls**	1. Remove Salvage Yard surface soil within the excavation footprint to a depth of 0 to 2 feet bgs. Delineation samples will be used to identify the actual limits of the excavation area. Remove Burn Residue Disposal Area surface soil exceeding RGs outside of the pit footprint to a depth of 0 to 2 feet bgs. Delineation samples will be used to identify the actual limits of the surface soil excavation area. Remove Burn Residue Disposal Area residue material and contaminated soil from the pit area to the full depth of the pit (estimated to be 8 feet bgs) and until confirmation samples are within acceptable risk range. 2. Establish a restriction in the Installation Master Plan prohibiting development and use of the property for future military housing, elementary and secondary schools, child care facilities, playgrounds, and non-military residential land use unti COCs in the soil are detected at levels that allow for unlimited use and unrestricted exposure..
Westwood - Clusters 2, 6, 10, 14, and 21 **USEPA OU 23**	**ROD, 01 / 17 / 2006**	Protect future military/industrial workers from unacceptable risk associated with COCs in waste and soil; Prevent residential exposure to hazardous substances that may pose unacceptable risk; Protect ecological communities from effects associated with COCs in soil; and Eliminate potential for future migration of COCs in waste and soil into adjacent marsh and surface water bodies via surface water runoff.	**Excavation and off-site disposal at five sites** **Institutional Controls at all 26 sites** **NFA at off-shore Gunpowder River area**	**All Sites** Restriction placed in installation master plan against development and use of property for military family housing, non-military residential housing, elementary and secondary schools, child care facilities and playgrounds. **HC Grenade Disposal Site, WW-90 Drum Dump, WRMDF Western Disposal Area** 1. Remove visible waste and visibly contaminated soil. 2. Following remediation and verification sampling, perform a risk screening to evaluate the potential of these sites to pose risk to workers or the environment. **Brine Sludge Disposal Area** 1. Remove visible waste and visibly contaminated soil from the identified remedial area to a depth of at least one foot. 2. Reduce exposure levels for workers to arsenic, chromium, and copper to identified soil RGs **Gas Mask Factory** 1. Remove visible waste and visibly contaminated soil from all identified remedial locations to a depth of at least one foot. 2. Reduce exposure levels for workers to antimony, arsenic, barium, chromium, copper, iron, lead, and mercury to identified soil RGs. 3. Ensure vermivorous bird communities are not significantly impacted by arsenic, copper, lead, or zinc in soil (EPCs less than RGs or post-remedy assessment showing no significant adverse impact). 4. Ensure wildlife communities are not significantly impacted by loss of habitat or availibility of food/prey caused by toxic effects of arsenic, cadmium, copper, lead, and zinc in soil to soil invertebrates or terrestrial plants (EPCs less than RGs or post-remedy assessment showing no or demimimus adverse impact).

EXHIBIT 1
RECORDS OF DECISION
EDGEWOOD AREA 2008 REMEDIES REVIEW

Study Area - Operable Unit	CERCLA Status	Remedial Action Objectives	Selected Response Action	Performance Standards
Westwood - Remaining Westwood Study Area Sites **USEPA OU 40**	**ROD, 09 / 21 / 2007**	Protect future military/industrial workers from unacceptable risk associated with COCs in soil and direct contact with buried waste; Protect ecological communities from unacceptable adverse effects associated with COCs in soil and direct contact with buried waste; and Prevent future leaching of arsenic to groundwater at the Hog Point Site that would result in arsenic exceeding the MCL of 0.01 mg/L in groundwater extracted for potable use.	**Soil Cover at WW-90 Fill Area** **Excavation and off-site disposal at Hog Point Site** **Long-Term Monitoring** **Institutional Controls**	**WW-90 Fill Area** 1. Placement of soil cover material such that existing and new cover soil provide a minimum of four feet of thickness over waste and a minimum cover slope of 4% to facilitate surface water drainage from surface of fill; 2. Stabilization of the toe of the fill, as necessary, to prevent future erosion of cover soil and waste into marsh; 3. Reestablishment of a vegetative cover over the site to minimize erosion of cover soil; and 4. Establish LUC restriction in installation master plan restricting access to the soil cover to protect the integrity of the remedy (in addition to LUCs established by 2005 ROD). **Hog Point Site** 1. Excavate contaminated soil to a minimum depth of one foot in identified hot spots; 2. Reduce EPCs for future workers in Hog Point Area to less than identified RGs; 3. Reduce arsenic EPC for future construction workers in identified hot spot areas to less than 94 mg/kg; 4. Reduce the average arsenic concentration in soil overlying a surficial aquifer groundwater flow path to less than 57 mg/kg; 5 Establish LUC restriction in APG Master Plan preventing installation of groundwater wells for potable water supply (in addition to LUCs established by 2005 ROD); 6. Establish LUC restriction in APG Master Plan requiring characterization of soil prior to use as fill material at a location outside of Hog Point. **Remaining Sites** Accept LUCs established by 2006 ROD as final action.
Carroll Island - OU A Disposal Pits **USEPA OU 09**	**ROD, 09 / 30 / 1996**	Prevent future environmental impacts as a result of the migration of contaminants to areas where humans and environmental receptors may be exposed.	**Hand Excavation and Disposal/Treatment of Excavated Material**	1. The entire volume of waste will be removed from the pits and disposed of in accordance with ARARs. 2. The initial limit of excavation is established by removing all visible waste and debris. 3. Soil excavation will continue until all contaiminated soil is removed. 4. Soil will be considered contaminated if levels exceed: (a) industrial risk-based concentrations for protection of human health or (b) ecological screening criteria and background concentrations, or bioassays show an adverse impact.
Carroll Island/Graces Quarters - OU B **CWM and Hazardous Substances Sites** **USEPA OU 10**	**ROD, 08 / 17 / 2001**	Reduce the potential for direct human contact with CWM and hazardous substances; and Reduce the potential for exposure of human and ecological receptors by reducing the likelyhood of CWM and hazardous substance releases to air and surface water.	**Erosion Controls** **Institutional Controls**	1. Restrict future land use to primary use as a limited Natural Resource Management Area, and secondary use for military/industrial activities. 2. Restrict unauthorized access. 3. Prohibit future land use that is incompatible with and would disrupt the effectiveness of the engineered/constructed shoreline erosion controls.
Graces Quarters - OU A Groundwater **USEPA OU 21**	**ROD, 09 / 30 / 2004**	Prevent exposure to groundwater from the surficial and middle aquifers until such time as constituent concentrations decline below specified levels; and Restore the aquifers' potential for beneficial use by lowering constituent concentrations to acceptable levels that are established as quantitative RAOs.	**In Situ Treatment - Vitamin B_{12}-catalyzed reductive dehalogenation in areas greater than 1 mg/L; MNA at all other locations** **Long-Term Monitoring** **Institutional Controls**	1. Restriction placed in installation master plan against use of groundwater and development and use of property for military housing or non-military residential use; 2. Reduce total CVOC in the treatment area (area where total VOCs exceed 1 mg/L at start) to below 0.1 mg/L within five years; and 3. Restore the aquifer to benificial use (quantitative RAOs) at the conclusion of the MNA portion of the remedy.
Bush River - Cluster 3 OBRRD **USEPA OU 17**	**ROD, 06 / 11 / 1999**	Prevent direct contact with the Dump's soil and waste; Reduce infiltration into the Dump and possible migrationn of contamination; Prevent erosion of surface soil from the Dump to surface water and sediment; Contain any potential risk of detonation of UXO by providing a physical barrier to the release of either chemicals or fragmentation; and Reduce/eliminate risk to ecological receptors.	**Soil Cover** **Long-Term Monitoring**	1. The soil cap will consist of 2 layers, at a minimum depth of 3 feet. The first layer above the surface will be a minimum 3-ft foundation soil layer; the second (top) layer will be a minimum 1/2-ft thick layer of topsoil. 3. Both adjacent streams will be filled and relocated around the slope of the Old Bush River Road Dump. 4. Long-term monitoring will be performed to ensure the long-term performance of the soil cap. 5. A 5-year review will be conducted. 6. Institutional controls will be implemented in the area.
Bush River - Cluster 3 Lead Contaminated Soil Transformer Storage Area **USEPA OU 20**	**ROD, 09 / 29 / 2005**	Prevent ingestion, inhalation, or direct contact with surface soil that contains lead concentrations in excess of RGs; Prevent transport and migration of site contaminants to the adjacent wetlands and streams; and Control future releases of contaminants (i.e., lead) to ensure protection of human health and the environment.	**Excavation and On-Site Reuse** **Institutional Controls**	1. Excavate soil in area above 1,000 mg/kg lead to depth of two feet, verification sampling, clean backfill; 2. Post-remediation Site-wide EPC for surficial soil less than 1,000 mg/kg lead; 3. Post-remediation EPC for subsurface soil (2-4 ft) above 1,000 mg/kg lead to add excavation prohibition to LUCs: 4. Post-remediation configuration around drainage ditch to prclude future transport of lead in soil to Lauderick Creek; 5. Restriction placed in installation master plan against development and use of property for military family housing, non-military residential housing, elementary and secondary schools, child care facilities and playgrounds; and use of groundwater within 500 ft of the site; and 6. Restriction placed in APG excavation permit program requiring personnel notification and proper management of excavated material from excavations greater than 4 ft. 7. Clean Closure removal action at Transformer Storage Area accepted as final action.
Lauderick Creek - Cluster 1 - Groundwater **USEPA OU 11 (former OU 12)**	**ROD, 09 / 27 / 1996** **ESD, October 1998** **ESD, 05 / 09 / 2005**	Prevent human exposure to on-site contaminated groundwater; Prevent off-site migration of contaminated groundwater; and Remediate on-site groundwater to the TCE MCL of 5 u g/L.	**Groundwater Extraction - 2005 ESD implemented MNA in SE plume** **Ex Situ Treatment - 1998 ESD changed treatment technology from reductive dehalogenation to carbon adsorbtion** **Long-Term Monitoring** **Institutional Controls**	1. The contaminant plume of TCE will be contained and treated until the MCL of 5 µg/L is attained within the Former Nike Site and areas affected by this TCE plume. 2. Groundwater monitoring will be conducted to ensure the plume is not migrating and that levels of TCE are being reduced to 5 µg/L. 3. Discharge of the treated water will meet the substantive requirements of the NPDES Permit program.

EXHIBIT 1
RECORDS OF DECISION
EDGEWOOD AREA 2008 REMEDIES REVIEW

Study Area - Operable Unit	CERCLA Status	Remedial Action Objectives	Selected Response Action	Performance Standards
Lauderick Creek - Cluster 1 - Nike SW Landfill **USEPA OU 11**	**ROD, 09 / 27 / 1996**	Prevent the contamination of groundwater or surface water by any potential contaminants of concern that maybe present in the landfill; and Minimize the potential for human contact with the waste.	**Cap and Cover System - Geosynthetic Clay Layer, Synthetic Geomembrane Layer, Drainage Layer, Filter Fabric, Vegetated Soil Cover** **Long-Term Monitoring** **Institutional Controls**	1. The landfill cap will prevent migration of contaminants from the waste to the groundwater. 2. The cap and groundwater will be monitored in accordance with an approved Operation and Maintenance Plan. 3. A five-year review will be conducted.
Lauderick Creek - Cluster 1 - Sanitary Sewer, Missle Silos **USEPA OU 11 (former OU 13)**	**ROD, 09 / 27 / 1996** **No Further Reviews, 10 / 21 / 2003**	Prevent the migration of contamination to groundwater and surface water / sediment.	**Clean and Close in Place**	1. The system will be cleaned by water blasting and filled with an inert material to prevent collapse of the piping system. 2. Sludge, wash water, and any other generated waste will be removed and disposed of or treated in accordance with Federal and state requirements. 3. Accept Missle Silos removal action as final action.
Lauderick Creek - Other Clusters **USEPA OU 22**	**ROD, 08 / 20 / 2004**	Protect future workers and military personnel from hazards associated with waste at the Concrete Slab Test Site; Control the migration of arsenic, barium, cadmium, copper, lead, mercury, nickel, silver, zinc, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT from wastes and soil in the Concrete Slab Test Site to the adjacent Lauderick Creek wetland area; Protect ecological receptors in Lauderick Creek and the associated wetland adjacent tothe Concrete Slab Test Site from risks associated with arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT; Protect terrestrial ecologic receptors from risks associated with barium, cadmium, chromium, copper, lead, silver, zinc, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT; and Prohibit future military family housing and non-military residential land usage.	**Excavation and off-site disposal at Concrete Slab Test Site** **Institutional Controls at all sites**	**All Sites** Military family housing and non-military residential land usage will not be permitted. **Cluster 5 Concrete Slab Test Site** 1. Waste that poses a threat to industrial workers and military personnel, and which is detectable by routinely used ordnance detection equipment, will be removed from the disposal areas. The objective is to remove waste, and not individual subsurface UXO items within the remedial area. 2. The mean concentration of lead in surface soil within the remedial area following remediation will be less than 400 mg/kg.
Lauderick Creek - Cluster 9 Groundwater **USEPA OU 35**	**ROD, 09 / 27 / 2007**	Protect future military/industrial workers from unacceptable risk associated with vapor intrusion into structures; Protect construction workers from unacceptable risk associated with vapors in excavations; Protect future military/industrial workers from unacceptable risk associated with consumption of groundwater from the surficial aquifer; and Restore the surficial aquifer to beneficial uses where practicable, within a reasonable time period given the particular site circumstances.	**Soil Vapor Extraction** **Long-Term Monitoring** **Institutional Controls**	1. Restrictions placed in APG GIS and Real Property Master Plan (in addition to LUCs established by 2004 ROD) requiring all intrusive activities to be performed under an APG approved Health and Safety Plan that addresses direct contact and inhalation risks. Potable use of groundwater will be prohibited. Planning and design of structures at the site will be required to address the potential for vapor intrusion; and 2. Vadose zone vapor concentration reduction of at least 70% in total VOC as measured before and after implementation of the remedial action in vapor probes located between the extraction wells.
Other Edgewood Areas - Cluster 19 Groundwater **USEPA OU 35**	**ROD, 09 / 27 / 2007**	Protect future military/industrial workers from unacceptable risk associated with vapor intrusion into structures; and Protect construction workers from unacceptable risk associated with contact with groundwater and vapors in excavations.	**Institutional Controls** **Long-Term Monitoring**	Restrictions placed in APG GIS and Real Property Master Plan requiring all intrusive activities to be performed under an APG approved Health and Safety Plan that addresses direct contact and inhalation risks. Potable use of groundwater will be prohibited. Planning and design of structures at the site will be required to address the potential for vapor intrusion.

EXHIBIT 2

AEDB-R SITE STATUS

EDGEWOOD AREA 2008 REMEDIES REVIEW

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EXHIBIT 2
AEDB-R SITE STATUS
EDGEWOOD AREA 2008 REMEDIES REVIEW

AEDB-R NO.	AEDB-R NAME	RI/FS completed	REM/IRA completed	PBC awarded	ROD signed	RC	RIP	O&M/LTM
EAOF00	**O-FIELD STUDY AREA**							
EAOF01	OLD O-FIELD GWTS-OU1	1990			1991		1995	O&M/LTM
EAOF02	OLD O-FIELD SOURCE AREA-OU2	1994			1994		1998	O&M/LTM
EAOF03	WATSON CREEK SEDIMENT & SW-OU3	1997			1997		1997	LTM
EAOF04	NEW O-FIELD GW AND SOURCE AREA-OU4	IP	2004					
EAJF00	**J-FIELD STUDY AREA**		2001					
EAJF01	WHITE PHOSPHORUS BURNING PIT	2006			2007	2007		LUCs
EAJF02	PROTOTYPE BUILDING	2001	1994		2001	2001		LUCs
EAJF03	CS/CN AREA (RIOT CONTROL BURNING PITS)	2001			2001	2001		LUCs
EAJF04	ROBINS POINT DEMO. GROUND	RCRA				RCRA		
EAJF05	TOXIC BURNING PIT	2001			1996	2001		LTM
EAJF05-A	TBP-SOUTHERN MAIN PITS OVERALL	2001			1996	2001		LTM
EAJF05-B	TBP-SURFICIAL AQUIFER	2001			2001		2001	O&M/LTM
EAJF06	SOUTH BEACH DEMOLITION GROUND	2001			2001	2001		LUCs
EAJF07	SOUTH BEACH TRENCH	2001			2001	2001		LUCs
EAJF08	X1 RUINS SITE SW OF INTERSECTION	2001			2001	2001		LUCs
EAJF09	DRAINAGE GRID-AREA A	2001			2001	2001		LUCs
EAJF10	FORD'S POINT FIRING RANGE-AREA B	2001			2001	2001		LUCs
EAJF11	RUINS SITE NE OF INTERSECTION-AREA C	2001			2001	2001		LUCs
EAJF12	RUINS SITE ACROSS RD FROM WPP (RNS SITE)	2001			2001	2001		LUCs
EAJF13	SWAMP 400' E OF RUINS SITE-AREA D	2001			2001	2001		LUCs
EAJF14	ROBINS POINT TOWER SITE	2001			2001	2001		LUCs
EAJF15	TITANIUM PITS SITE	2001			2001	2001		LUCs
EACC00	**CANAL CREEK STUDY AREA**							
EACC1A-A	RAILROAD YARD-CLUSTER 1A	2005	1994	2005	2006	2006		LUCs
EACC1A-B	G STREET SALVAGE YARD-CLUSTER 1A	2007	1990	2006	2007			
			1996					
EACC1D	DM FILLING PLANT-CLUSTER 1D	2005		2005	2006	2007		LUCs
EACC1E	BUILDING 87 COMPLEX-CLUSTER 1E	IP	1995	2007				
EACC1F-A	BUILDING E5604 AREA-CLUSTER 1F	IP		2007		NFA (RI)		
EACC1F-B	BLDG 80 SERIES SMOKE LABS-CLUSTER 1F	IP		2007		NFA (RI)		
EACC1G-A	BLDG E5185 WWII MTD FILLING PNT-CLU 1G	IP		2007		NFA (RI)		
EACC1G-B	BLDG E5188 WP FILLING PNT-CLUSTER 1G	2006	1995	2005	2006	2006		LUCs
EACC1H-A	1937 MUSTARD DISPOSAL PIT-CLUSTER 1H	IP		2007				
EACC1H-B	WWII CHLORINE PLANT-CLUSTER 1H	IP	1997	2007				
EACC1H-C	BLDG E5483 PROTECT CLOTH LDY-CLUSTER 1H	IP		2007				
EACC1H-D	PHOSGENE PLANT AREA-CLUSTER 1H	IP		2007		NFA (RI)		
EACC1H-E	BLDG 103 AREA CHEM PNT/DUMP SITE-CLU 1H		1992		1995	1999		LTM
EACC1H-F	EXPER CHEM PLANT AREA-CLUSTER 1H	IP		2007				
EACC1H-G	MUSTARD PLANT AREA-CLUSTER 1H	IP		2007				
EACC1I-A	BUILDING 106/107 AREA-CLUSTER 1I	IP		2007				
EACC1I-B	BLDG 113 GAS INST CHAMBER-CLUSTER 1I	IP		2007		NFA (RI)		
EACC1J	LAB TOXIC WASTE DISP PIT-BLDG 30-CL 1	IP		2007				
EACC1K	CANAL CRK MARSH AND LANDFILL-CLUSTER 1K	IP		2007				
EACC1L-A	BLDG 503 SMK MIX BURNING SITES-CLU 1L (burn areas)				1996	1998		
EACC1L-A	BLDG 503 SMK MIX BURNING SITES-CLU 1L (outside burn areas)	IP		2007				
EACC1L-B	BUILDING 503 SMOKE POT PLANT-CLUSTER 1L	IP		2007				
EACC2A	OLD HOSP AND ADMIN AREA-CLUSTER 2A	2006		2005	2006	2006		LUCs
EACC2B	BLDG E5023 WWI WP FILLING PNT-CLU 2B	2006		2005	2006	2006		LUCs
EACC2C	BLDG E5238 CLOTH IMPREG FCLY-CLU 2C	2006		2005	2006	2006		LUCs
EACC2D	LAB TOXIC WASTE DISPOSAL PITS-CLU 2D	IP		2007				
EACC2E	NOBLE ROAD INCINERATORS-CLUSTER 2E	IP		2007				
EACC2F	BLDG 99 (E5032) EXP FILLING PNT-CLU 2F	2005	1998	2005	2006	2007		LUCs
EACC2G	BLDG E5103 PHOTO LAB-CLUSTER 2G	2006		2005	2006	2006		LUCs
EACC2H-A	BLDG 501 FILLING PNT/E5100 LAB-CLU 2H	2006		2005	2006	2006		LUCs
EACC2H-B	WWI SHELL DUMPS-CLUSTER 2H	IP		2007				
EACC2H-C	FILLING PLANTS NO 1&2-CLUSTER 2H	IP		2007				
EACC2I-A	AIRFIELD AREA (WIEDE FIELD)-CLUSTER 2I	2006		2005	2006	2006		LUCs
EACC2I-B	OLD SHOP AND MOTORPOOL AREA-CLUSTER 2I	2006		2005	2006	2006		LUCs
EACC3A	LAB TOXIC WASTE DIS PIT-BLDG E3330-CL 3A	IP	1994	2007				
EACC3B	BUILDING E2100 LABORATORY-CLUSTER 3B	2006		2005	2006	2006		LUCs
EACC3C	BLD E32XX/E3100/3081 MED RESH LABS-CL 3C	IP		2007				
EACC3D	BUILDING E3160 COMPLEX-CLUSTER 3D	IP		2007				
EACC3E	BLDG E3300/E3330 LAB COMPLEX-CLUSTER 3E	IP		2007		NFA (RI)		
EACC3F	BUILDING E35XX AREA-CLUSTER 3F	IP		2007		NFA (RI)		
EACC3G	BLDG E360X/E361X/E362X AREA-CLUSTER 3G	IP		2007				
EACC3H	E3560 TEST CHAMBER COMPLEX-CLUSTER 3H	2006		2005	2006	2006		LUCs
EACC3I	BLDG E3570 ASSEMBLY PLANT-CLUSTER 3I	IP		2007		NFA (RI)		
EACC3J	BLDG E3580 PYROTECH LDG FACILITY-CLU 3J	IP	1991	2007				
			1992					
EACC3K-A	BUILDING E37XX COMPLEX-CLUSTER 3K	IP		2007				
EACC3K-B	B-FIELD KINGS CREEK DUMP CLUSTER 3K	IP		2007				
EACC3L	BLDG E3640 PROCESS LAB-CLUSTER 3L	IP	1995	2007				
EACC3M-A	WASTEWATER TREATMENT AREA-CLUSTER 3M	IP		2007				
EACC3M-B	B-FIELD DECON-DETOX INCINERATOR-CL 3M					RCRA		

EXHIBIT 2
AEDB-R SITE STATUS
EDGEWOOD AREA 2008 REMEDIES REVIEW

AEDB-R NO.	AEDB-R NAME	RI/FS completed	REM/IRA completed	PBC awarded	ROD signed	RC	RIP	O&M/LTM
	CANAL CREEK STUDY AREA (continued)							
EACC3N	BEACH POINT TEST SITE-CLUSTER 3N GROUNDWATER				1997		1997	TI/LTM
EACC3N	BEACH POINT TEST SITE-CLUSTER 3N SOIL	IP	1993	2007				
EACC3O	B-FIELD RANGE AREA-CLUSTER 3O	IP		2007		NFA (RI)		
EACC3P	MOSQUITO TEST GRID AREA-CLUSTER 3P	IP		2007		NFA (RI)		
EACC4A	EAST AREA CC AQUIFER-CLUSTER 4A-A	1998			2000		2003	O&M/LTM
EACC4A-B	WEST AREA CC AQUIFER-CLUSTER4A-B	IP		2007				
EACC5A	CANAL CREEK BED SED.SOURCE AREA CLUST 5A	IP		2007				
EACC5B	KINGS CREEK SEDIMENT PESTICIDE SOURCE AR	IP						
EACC6	HMF/UST REMOVAL/CLOSURE					1999		
EACC7	UNEXPLODED ORDNANCE/CWM	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EAWW00	**WESTWOOD STUDY AREA**							
EAWW00	OFF-SHORE GUNPOWDER RIVER AREA	2005		2005	2006	NFA		
EAWW02-A	MATERIAL STORAGE/RAD TEST SITE	2005		2005	2006	2006		LUCs
EAWW02-B	GROUND SCAR AREA-CLUSTER 2	2005		2005	2006	2006		LUCs
EAWW02-C	OPEN GRAVEL DEPRESSION-CLUSTER 2	2005		2005	2006	2006		LUCs
EAWW02-D	WW-90 DRUM DUMP	2005		2005	2006	2007		LUCs
EAWW02-D	WW-90 FILL AREA	2005		2005	2007	IP		LUCs
EAWW02-D	MOUNDS-CLUSTER 2	2005		2005	2006	2006		LUCs
EAWW02-E	HC GRENADE DISPOSAL SITE	2005		2005	2006	2007		LUCs
EAWW02-E	DISPOSAL/BURN PITS	2005	2000 2001	2005	2006	2006		LUCs
EAWW06	RAD MAT'L DISPOSAL FACILITY/DEMIL SITE	2005	1998	2005	2007	2007		LUCs
EAWW06	RAD MAT'L DISPOSAL FACILITY/WESTERN DISPOSAL AREA	2005		2005	2006	2007		LUCs
EAWW10-A	ROADS END DISPOSAL SITE-CLUSTER 10	2005		2005	2006	2006		LUCs
EAWW10-B	HOG POINT SITE-CLUSTER 10	2005	2006	2005	2007	IP		LUCs
EAWW10-C	PINEY POINT SITE-CLUSTER 10	2005		2005	2006	2006		LUCs
EAWW10-D	LINEAR FEATURES SITE-CLUSTER 10	2005		2005	2006	2006		LUCs
EAWW10-E	IMPOUNDMENT SITE-CLUSTER 10	2005		2005	2006	2006		LUCs
EAWW10-F	WETLAND SITE-CLUSTER 10	2005		2005	2006	2006		LUCs
EAWW14-A	BLDG E-5770 AREA/MAGNOLIA RD RAD. TEST	2005		2005	2006	2006		LUCs
EAWW14-B	BLDG E-5695 AREA-CLUSTER 14	2005		2005	2006	2006		LUCs
EAWW14-C	GAS MASK FACTORY/WWI CHLORINE PLANT/UNKNOWN TANK/CISTERN	2005	1996	2005	2006	2007		LUCs
EAWW14-C	STOKES RD WEST	2005		2005	2006	2006		LUCs
EAWW21-A	SAN DOMINGO ORD. BURIAL PIT-CLUSTER 21	2005		2005	2006	2006		LUCs
EAWW21-B	SAN DOMINGO MUNITIONS PLANT-CLUSTER 21	2005		2005	2006	2006		LUCs
EAWW21-C	BUILDING E5664-CLUSTER 21	2005		2005	2006	2006		LUCs
EAWW21-D	BUILDING E5830 LANDFILL-CLUSTER 21	2005		2005	2006	2006		LUCs
EAWW21-E	WWI CHLORINE PLANT DUMP - CLUSTER 21	2005	1996	2005	2006	2006		LUCs
EAWW21-E	BRINE SLUDGE DISPOSAL AREA	2005		2005	2006	2007		LUCs
EACI00	**CARROLL ISLAND STUDY AREA**		1993 1993 1995 1999					
EACI01-A	BENGIES POINT RD. DUMP-CLUSTER 1	1995			1996	2002		LUCs
EACI01-B	BENGIES POINT ROAD FARM HOUSE-CLUSTER 1	1998			2001	2006		LUCs
EACI01-C	OLD CARROLL ISLAND ROAD DUMP-CLUSTER 1	1995			1996	2002		LUCs
EACI01-D	AOC ASSOCIATED WITH SITE 10-CLUSTER 1	1998			2001	2006		LUCs
EACI02-A	SERVICE AREA-CLUSTER 2	1995			1996	2002		LUCs
EACI02-B	DREDGE SPOIL SITE-CLUSTER 2	1998			2001	2006		LUCs
EACI02-C	WOODS W OF SERV AREA-AOC ASSO W. SITE 13	1995			1996	2002		LUCs
EACI03	EPG DUMP-CLUSTER 3	1995			1996	2002		LUCs
EACI04-A	AERIAL SPRAY GRID-CLUSTER 4	1998			2001	2006		LUCs
EACI04-B	DECONTAMINATION PITS-CLUSTER 4	1995			1996	2002		LUCs
EACI04-C	WOODS WEST OF AERIAL SPRAY GRID	1995			1996	2002		LUCs
EACI04-D	BZ TEST BURN PITS-CLUSTER 4	1995			1996	2002		LUCs
EACI05-A	TEST GRID 1-CLUSTER 5	1998			2001	2006		LUCs
EACI05-B	MAGAZINE AREA-CLUSTER 5	1998			2001	2006		LUCs
EACI05-C	ANIMAL SHELTER-CLUSTER 5	1998			2001	2006		LUCs
EACI05-D	A-SHELTER WDS EAST OF TEST GRID 1-CLU 5	1995			1996	2002		LUCs
EACI05-E	PUSH-B MNDS N & E OF TEST GRID 1-CLU 5	1995			1996	2002		LUCs
EACI06-A	WIND TUNNEL-CLUSTER 6	1998			2001	2006		LUCs
EACI06-B	WOODS SOUTH OF WIND TUNNEL ROAD	1995			1996	2002		LUCs
EACI06-C	UST AT WIND TUNNEL-CLUSTER 6	1998			2001	2006		LUCs
EACI06-D	CS TEST AREA-CLUSTER 6	1998			2001	2006		LUCs
EACI06-E	CS TST AREA MDS-AOC ASSO W. SITE 12-CL 6	1998			2001	2006		LUCs
EACI07-A	VX TEST AREA-CLUSTER 7	1998			2001	2006		LUCs
EACI07-B	TEST GRID 2-CLUSTER 7	1998			2001	2006		LUCs
EACI07-C	HD TEST AREA & AREAS EAST-CLUSTER 7	1998			2001	2006		LUCs
EACI08	DISPOSAL SITE-CLUSTER 8	1995			1996	2002		LUCs

EXHIBIT 2
AEDB-R SITE STATUS
EDGEWOOD AREA 2008 REMEDIES REVIEW

AEDB-R NO.	AEDB-R NAME	RI/FS completed	REM/IRA completed	PBC awarded	ROD signed	RC	RIP	O&M/LTM
EAGQ00	**GRACES QUARTERS STUDY AREA**		1994					
			1995					
			1998					
EAGQ01-A	DISPOSAL AREA-CLUSTER 1	1998			2001	2006		LUCs
EAGQ01-B	GRACES QUARTERS DUMP-CLUSTER 1	1998			2001	2006		LUCs
EAGQ01-C	BUNKERS SITE-CLUSTER 1	1998			2001	2006		LUCs
EAGQ01-D	FEMA SERVICE AREA-CLUSTER 1	1998			2001	2006		LUCs
EAGQ01-E	FEMA BUNKER-CLUSTER 1	1998			2001	2006		LUCs
EAGQ01-F	AOC ASSOCIATED WITH SITE 4	1998			2001	2006		LUCs
EAGQ01-G	HD TEST ANNULI-CLUSTER 1	1998			2001	2006		LUCs
EAGQ01-H	TEST HUTS-CLUSTER 1	1998			2001	2006		LUCs
EAGQ01-I	SECONDARY TEST AREA-CLUSTER 1	1998	1998		2001	2006		LUCs
EAGQ02-A	NORTHERN PERIMETER DUMP-CLUSTER 2	1998			2001	2006		LUCs
EAGQ02-B	S & SW PERIMETER DUMP-CLUSTER 2	1998			2001	2006		LUCs
EAGQ02-C	PRIMARY TEST AREA-CLUSTER 2	1998			2001	2006		LUCs
EAGQ02-D	SURFICIAL AQUIFER-CLUSTER 2	2004		2004	2004		2005	O&M/LTM
EAGQ03-A	SERVICE AREA-CLUSTER 3	1998			2001	2006		LUCs
EAGQ03-B	DUGAWAY PROVING GROUND TEST SITE-CL 3	1998			2001	2006		LUCs
EAGQ03-C	AOC ASSOCIATED WITH SITE 8-CLUSTER 3	1998			2001	2006		LUCs
EAGQ03-D	DISPOSAL MOUNDS AT DUGWAY SITE-CLUSTER 3	1998			2001	2006		LUCs
EAGQ03-E	USTS AT SERVICE AREAS-CLUSTER 3	1998			2001	2006		LUCs
EABR00	**BUSH RIVER STUDY AREA**		1992					
			1997					
EABR03-A	OLD BUSH RIVER ROAD DUMP-CLUSTER 3	1998	1996		1999	2000		LTM
EABR03-B	TRANSFORMER STORAGE-CLUSTER 3	1998	1991	2005	2005	NFA		
EABR03-B	LEAD CONTAMINATED SOIL AREA	2003	2001	2005	2005	2007		LUCs
EABR03-C	SURFICIAL AQUIFER-CLUSTER 3	1998			1999	NFA		
EABR07-A	BOAT CLUB FILL SITE(4)-CLUSTER 7	IP		2005		NFA (RI)		
EABR07-B	BIO-SENSOR FACILITY-CLUSTER 7	IP		2005		NFA (RI)		
EABR11-A	26TH STREET DISPOSAL SITE (1)-CLUSTER 11	IP	1998	2005				
EABR11-B	26TH STREET DISPOSAL SITE (2)-CLUSTER 11	IP		2005				
EABR11-C	22ND STREET LANDFILL-CLUSTER 11	IP		2005				
EABR11-D	BLDG 45-A AMMO RENOVATION FCTY-CLU 11	IP		2005		NFA (RI)		
EABR11-E	CASY INCINERATOR-CLUSTER 11	IP		2005		NFA (RI)		
EABR11-F	SURFICIAL AQUIFER-CLUSTER 11	IP		2005				
EABR11-G	UNDERGROUND STORAGE TANK	IP		2005				
EABR11-H	ADAMSITE STORAGE PIT - CLUSTER 11	IP	1994	2005		NFA (RI)		
EABR11-I	RADIOACTIVE MATERIAL DISPOSAL FACILITY	IP	1995	2005				
			2006					
EABR15-A	KINGS CRK CHEMICAL DISPOSAL SITE CLU 15	IP	1993	2005				
EABR15-B	30TH STREET LF-CLUSTER 15	IP		2005				
EABR15-C	TON CONTAINER STORAGE-CLUSTER 15	IP		2005		NFA (RI)		
EABR15-D	SURFICIAL AQUIFER - CLUSTER 15	IP		2005				
EABR18-A	TAPLER PT DREDGE MATERIAL SITE-CLU 18	IP		2005				
EABR18-B	CHEM MUNITION BURIAL SITE(4)-CLUSTER 18	IP	1999	2005		NFA (RI)		
EABR18-C	IGLOO STORAGE AREAS-CLUSTER 18	IP		2005		NFA (RI)		
EABR18-D	A-FIELD TEST SITE(2)-CLUSTER 18	IP		2005		NFA (RI)		
EABR18-E	BUSH RIVER DOCK(E2396)-CLUSTER 18	IP		2005				
EABR18-F	SURFICIAL AQUIFER - CLUSTER 18	IP		2005				
EABR35-A	MAINTENANCE YARD-CLUSTER 35	IP		2005		NFA (RI)		
EABR35-B	BLDG E2144/2148/2150-CLUSTER 35	IP		2005		NFA (RI)		
EABR36-A	WAREHOUSE STORAGE AREAS-CLUSTER 36	IP		2005		NFA (RI)		
EABR36-B	BLDG 846 WASTE DISPOSAL SITE-CLUSTER 36	IP		2005		NFA (RI)		

EXHIBIT 2
AEDB-R SITE STATUS
EDGEWOOD AREA 2008 REMEDIES REVIEW

AEDB-R NO.	AEDB-R NAME	RI/FS completed	REM/IRA completed	PBC awarded	ROD signed	RC	RIP	O&M/LTM
EALC00	**LAUDERICK CREEK STUDY AREA**		1998					
			2003					
EANS01-A	UNCONFINED GROUNDWATER	1995			1996		2000	O&M/LTM
EANS01-B	CONFINED GROUNDWATER	1995				NFA (RI)		
EANS01-C	LAUNCH AREA SEPTIC SYSTEM	1995			1996	1997		
EANS01	MISSLE SILOS	1995	1994		1996	1996		
EANS01-D	SOUTHWEST LAUNCH LANDFILL	1995	1995		1996	1998		LTM
EANS01-F	UNDERGROUND FUEL TANK (E6871)	1995				NFA (RI)		
EANS01-G	UNDERGROUND FUEL TANKS BARRACKS AREA	1995				NFA (RI)		
EANS01-H	NIKE BARRACKS SEPTIC SYSTEM	1995	1995			NFA (RI)		
EANS01-I	LAUNCH SURFACE DRAINAGE SYSTEM	1995	1994			NFA (RI)		
EANS01-J	BERMS & DISTURBED SOIL AREAS	1995				NFA (RI)		
EANS01-K	SCHOOL FIELD IV	1995	1995			NFA (RI)		
EALC05-B	CONCRETE SLAB TEST AREA-CLUSTER 5	2000	1995		2004	2007		LUCs
EALC05-C	CONCRETE SLAB DUMP AREA 1-CLUSTER 5	2000	1995		2004	2007		LUCs
EALC05-D	CONCRETE SLAB DUMP AREA 2-CLUSTER 5	2000	1995		2004	2007		LUCs
EALC09-A	NIKE CONTROL DRY WELLS(4)-CLUSTER 9	2000			2004	2004		LUCs
EALC09-B	NIKE CNTL SEPTIC TANK/SAND FILTER-CLU 9	2000	2000		2004	2004		LUCs
EALC09-C	NIKE CNTL UNGD FUEL TANK(EXCA)-CLUSTER 9	2000	1994		2004	2004		LUCs
EALC09-D	NIKE EAST WOODS SITE 1-CLUSTER 9	2000	1996		2004	2004		LUCs
EALC09-F	SURFICIAL AQUIFER-CLUSTER 9	2006		2005	2007	2007		LUCs
EALC13-A	SCHOOL FLD NO I TEST AREAS(2)-CLU 13	1999	1995			NFA (RI)		
			1996					
EALC13-B	SCHOOL FIELD NO II DUMPS-CLUSTER 13	1999	1995			NFA (RI)		
			1996					
EALC13-C	UNDERGROUND STORAGE TANKS-CLUSTER 13	1999	1996			NFA (RI)		
EALC13-D	SURFICIAL AQUIFER-CLUSTER 13	IP		2005				
EALC17-A	EAST WOODS DISPOSAL AREA-CLUSTER 17	2000			2004	2004		LUCs
EALC20	SCHOOL FIELD NO III TEST AREA-CLUSTER 20	2000	1995		2004	2004		LUCs
EALC32	GUM POINT DREDGE SPOILS-CLUSTER 32	2000			2004	2004		LUCs
EALC33	MONKS CREEK FARM SITE-CLUSTER 33	2000			2004	2004		LUCs
EAOE00	**OTHER EDGEWOOD AREAS STUDY AREA**		1995					
EAOE04	D-FIELD AERIAL SPRAY GRID-CLUSTER 4	IP	2002					
EAOE08	G-FIELD WASTEWATER TREATMENT AREA-CLU 8	IP						
EAOE12	H-FIELD WASH RACK AND STORAGE AREA-CL 12	IP	1995					
EAOE16	M-FLD MINE-FLD/P-TYPE BLDG. STO AREA C16	IP						
EAOE19	FORT HOYLE TRAINING AREA-CLUSTER 19	IP	1994					
			1997					
EAOE19	FORT HOYLE TRAINING AREA-CLUSTER 19 GROUNDWATER	2006		2005	2007		2008	LTM
EAOE22	L-FLD DEMO AND PROPELL DISP SITE-CLU 22	IP						
EAOE23	I-FIELD JAPANESE BUNKER AREA CLUSTER 23	IP						
EAOE24	M-FLD SOUTHEAST TEST AND BURN AREA CL 24	IP	1994					
EAOE26	M-FLD TUNNELS AND TEST SLAB AREA CLU 26	IP						
EAOE27	M-FIELD PRE-WWII AGENT TEST SITE CLU 27	IP						
EAOE28	H-FIELD CONCRETE TARGET AREA CLUSTER 28	IP						
EAOE29	MAXWELL POINT TEST SITE CLUSTER 29	IP						
EAOE30	C-FIELD MUNITIONS BURIAL SITE CLUSTER 30	IP						
EAOE31	H-FIELD TANK TEST RANGE CLUSTER 31	IP						
EAOE37	D-FLD CHEMICAL AGENT TEST GRID CLU 37	IP						
EAOE38	K-FIELD DEMOLITION FIELD CLUSTER 38	IP						
EAOE39	C-FIELD WASTEWATER SYSTEM CLUSTER 39	IP	1995					
EAOE41	G-FIELD TUNNEL COMPLEX CLUSTER 41	IP						
EAOE42	M-FIELD CLOTHING SHACK AREA CLUSTER 42	IP						
EAOE43	M-FIELD GRENADE RANGE CLUSTER 43	IP						
EAOE44	M-FIELD BOMLET PROJECTOR CLUSTER 44	IP						
EAOE45	E-FLD LEGO POINT IMPACT AREA CLUSTER 45	IP						
EAOE46	E-FIELD DREDGE SPOIL AREA CLUSTER 46	IP						
EAOE49	L-FIELD OLD BUSH RIVER DOCK CLUSTER 49	IP						
EAOE50	G-FIELD TRAINING AREA CLUSTER 50	IP	1992					
EAOE51	K-FIELD PISTOL RANGE CLUSTER 51	IP						
EAOE52	MAXWELL POINT RIFLE RANGE CLUSTER 52	IP						
EAOE53	I-FIELD IMPACT AREA CLUSTER 53	IP						
EAOE54	I-FIELD SMOKE POT BURIAL SITE CLUSTER 54	IP						

EXHIBIT 3

2003 REVIEW RECOMMENDATIONS AND FOLLOW-UP ACTIONS

EDGEWOOD AREA 2008 REMEDIES REVIEW

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EXHIBIT 3
2003 REVIEW RECOMMENDATIONS AND FOLLOW-UP ACTIONS
EDGEWOOD AREA 2008 REMEDIES REVIEW

Study Area - Operable Unit	2003 Review Recommendations	Actions / Progress
O-Field - OU 1 **Old O-Field Groundwater** **USEPA OU 05**	1. Evaluate well maintenance methods with respect to iron fouling problems. 2. Reduce effluent monitoring for chemical parameters to once a month. Eliminate acute toxicity testing. Reduce Chronic toxicity testing to semi-annually. Evaluate chronic toxicity testing to see if it can be eliminated. 3. Evaluate necessity of on-line ventilatory biomonitoring system.	1. Redeveloping active extraction wells on a more regular basis (currently periodically, but recommended for every six months). 2. Recommended changes to effluent, acute, and chronic toxicity testing have been implemented. 3. Still evaluating the necessity of the on-line ventilatory biomonitoring system.
O-Field - OU 2 **Old O-Field Source Area** **USEPA OU 04**	Include in next remedy review	Included in the 2008 review.
O-Field - OU 3 **Watson Creek** **USEPA OU 06**	Include in next remedy review	Included in the 2008 review.
J-Field - Soil OU **USEPA OU 07**	Include in next remedy review	Included in the 2008 review.
J-Field - Groundwater **USEPA OU 08**	Include in next remedy review	Included in the 2008 review.
Canal Creek - Bldg 103 **USEPA OU 01**	1. Continue groundwater monitoring. 2. Continue site inspections and groundhog removal. Evaluate additional deterrents if groundhog burrowing continues.	1. Continued groundwater monitoring. 2. Continued site inspections. Efforts to reduce groundhog intrusion have been sucessful.
Canal Creek - Bldg 503 **USEPA OU 03**	No further remedy reviews	Included in the 2008 review and recommended for further reviews.
Canal Creek - Beach Point **USEPA OU 02**	Include in next remedy review	Included in the 2008 review.
Canal Creek - East Plume **USEPA OU 15**	Include in next remedy review	Included in the 2008 review.
Carroll Island - OU A **Disposal Pits** **USEPA OU 09**	No further remedy reviews	Included in the 2008 review and recommended for further reviews.
Carroll Island/Graces Quarters - OU B **CWM and Hazardous Substances Sites** **USEPA OU 10**	Include in next remedy review	Included in the 2008 review.
Bush River - Cluster 3 **OBRRD** **USEPA OU 17**	Include in next remedy review	Included in the 2008 review.

EXHIBIT 3
2003 REVIEW RECOMMENDATIONS AND FOLLOW-UP ACTIONS
EDGEWOOD AREA 2008 REMEDIES REVIEW

Study Area - Operable Unit	2003 Review Recommendations	Actions / Progress
Lauderick Creek - Cluster 1 - Groundwater USEPA OU 11 (former OU 12)	1. Optimize extraction system. 2. Continue MNA evaluation for SE plume and pursue ESD if results are favorable.	1. Optimization work plan submitted for regulatory review in August 2007, still awaiting comments. Additional primary source characterization in conjunction with optimization studies scheduled for Spring/Summer 2008. 2. ESD for SE plume MNA signed May, 9 2005.
Lauderick Creek - Cluster 1 - Nike SW Landfill USEPA OU 11	Include in next remedy review	Included in the 2008 review.
Lauderick Creek - Cluster 1 - Sanitary Sewer, Missle Silos USEPA OU 11 (former OU 13)	No further remedy reviews	Eliminated from future reviews.

1.0 INTRODUCTION

The U.S. Army (Army) has conducted a five-year review of the remedial actions implemented at the Edgewood Area of Aberdeen Proving Ground (APG), Maryland. The location of APG is shown in Figure 1-1. This review was conducted from September 2007 through February 2008. This report documents the results of the analyses conducted by General Physics Corporation (GP) under Contract No.: W91ZLK-04-D-0013 for the Directorate of Safety, Health and Environment (DSHE) at APG.

1.1 PROJECT OVERVIEW

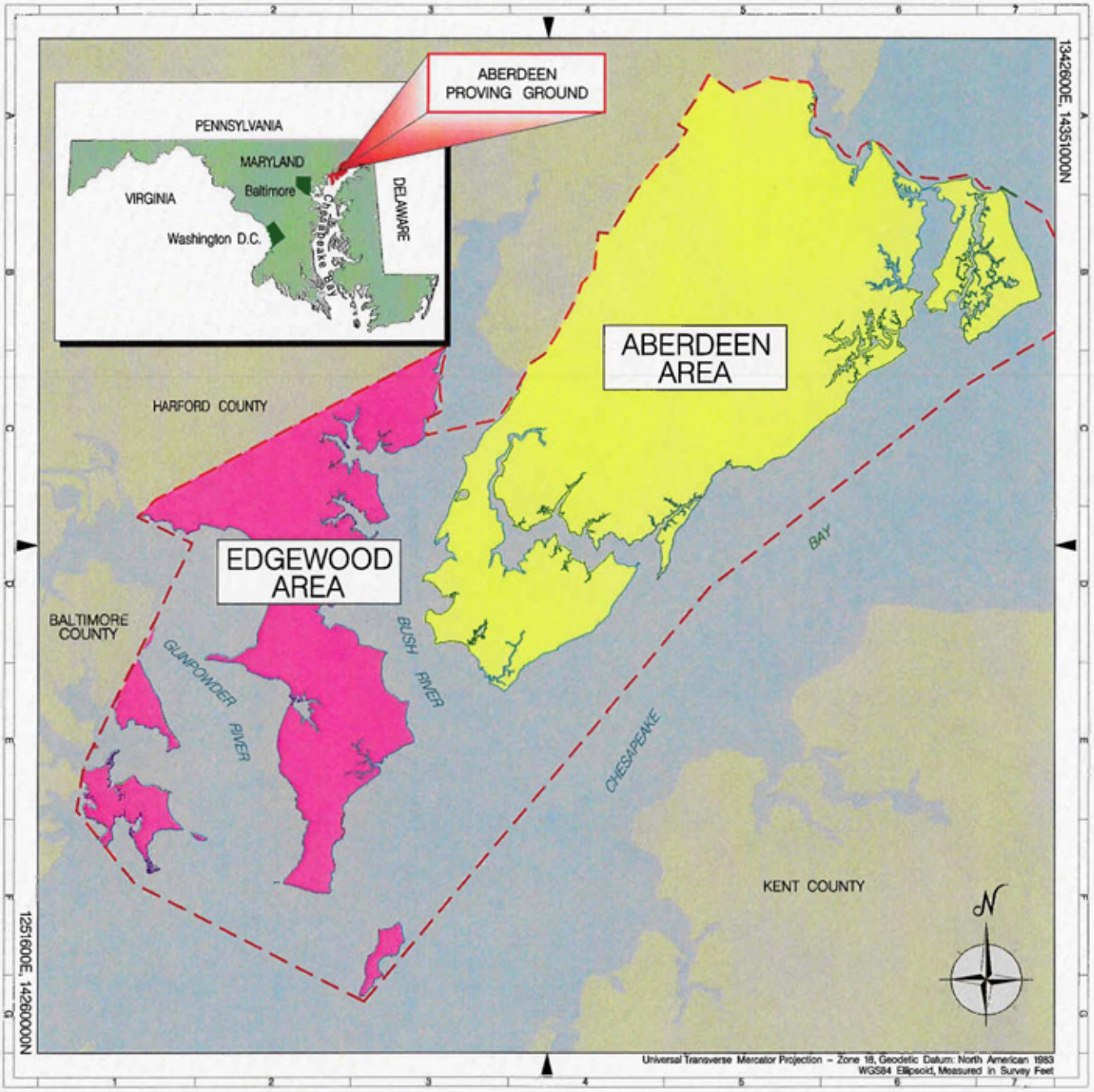
The purpose of a five-year review is to determine whether the remedy at a site is, or is expected to be, protective of human health and the environment. The methods, findings, and conclusions of the five-year review are documented in five-year review reports. In addition, five-year review reports identify issues found during the review, if any, and identify recommendations to address them. The Lead Agency for the remedy (in this case, the Army) must initiate five-year reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA [a.k.a. Superfund]) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 121(c), as amended, states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial actions to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such a review, it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such review.*

This requirement was interpreted further in the NCP (40 Code of Federal Regulations [CFR] 300.430 (f)(4)(ii)) which states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less than every five years after the initiation of the selected remedial action.*

A five-year review of O-Field including Old O-Field Groundwater Operable Unit 1 (OU 1), Old O-Field Source Area (OU 2), Watson Creek Sediment and Surface Water (OU 3), and New O-Field (OU 4) was conducted in 1999. A joint decision between the U.S. Environmental Protection Agency (USEPA) and the Army was made to place all sites in



1400010500 7000 3500 0 7000 14000 28000

GRAPHICAL SCALE
IN FEET (1" = 14000')

1:168000

L E G E N D

- Aberdeen Area
- Edgewood Area
- Installation Boundary
- Water

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TITLE:

GENERAL LOCATION MAP FOR ABERDEEN PROVING GROUND

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	C. HOULIK	11-26-07	1-1

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the Edgewood Area on a consolidated review cycle. Therefore, all of the sites currently under CERCLA investigation or remediation are included in this review. This is the second five-year review for all of the Edgewood Area sites except O-Field. This is the third five-year review of O-Field.

For sites with Records of Decision (RODs), the review includes all elements identified by Guidance (OSWER 9355.7-03B-P).

For sites for which RODs have not been completed (i.e., non-ROD sites), and, therefore, for which a formal CERCLA five-year review is not required by statute, this report reviews the current status of the CERCLA process to provide information on other sites in the Installation Restoration Program (IRP). Since these sites are still in the course of the CERCLA Remedial Investigation/Feasibility Study (RI/FS) process, this five-year review does not provide or imply specifics with respect to the outcome of that process. Remedy determination, and the associated cost and schedule for remedy selection/implementation for non-ROD sites are not addressed in this five-year review. Formal protectiveness statements for non-ROD sites are not included in the protectiveness determination.

Descriptions of each of the sites in this five-year review are found in Sections 2 through 10 of this report.

1.2 EDGEWOOD AREA DESCRIPTION

APG is an approximately 72,500-acre Army installation located in Baltimore and Harford Counties, Maryland, on the western shore of the upper Chesapeake Bay. The installation is bordered to the east and south by the Chesapeake Bay, to the west by Gunpowder Falls State Park, the Crane Power Plant, and residential areas, and to the north by the towns of Joppa, Magnolia, Perryman, and Aberdeen. The Bush River divides APG into two areas with the Edgewood Area to the west and the Aberdeen Area east of the river. This review addresses IRP sites within the Edgewood Area.

The Edgewood Area is listed on the National Priorities List (NPL), which is the USEPA list of hazardous substance sites in the United States that are priorities for long-term remedial evaluation and response. The USEPA Superfund Site Identification Number is MD 2210020036.

APG was established in 1917 as the Ordnance Proving Ground and was designated a formal military post in 1919. Testing of ammunition and materiel and operation of training schools began at APG in 1918. The Edgewood Area (formerly Edgewood Arsenal) has been a center for the development, testing, and manufacture of military-related chemicals since World War I (WWI).

Based upon initial record research and review in the 1970s and early Resource Conservation and Recovery Act (RCRA) activities, a total of over 300 potential Solid Waste Management Units (SWMUs) were identified at the Aberdeen and Edgewood

Areas of APG. The Edgewood Area was listed on the NPL on 21 February 1990. With completion of the Federal Facility Agreement (FFA) in March 1990, the SWMUs and/or areas of concern (AOCs) for potential contamination were grouped into 13 Study Areas, of which nine are located in Edgewood Area and addressed in this report: O-Field, J-Field, Canal Creek, Westwood, Carroll Island, Graces Quarters, Bush River, Lauderick Creek, and Other Edgewood Areas. The locations of these Study Areas are shown in Figure 1-2. Individual SWMUs and AOCs within the Study Areas are tracked in the Army Environmental Database – Restoration (AEDB-R) (formerly Defense Site Environmental Restoration Tracking System [DSERTS]).

In the succeeding years, a wide variety of remedial activities have been conducted with response actions at some sites completed and others still in progress.

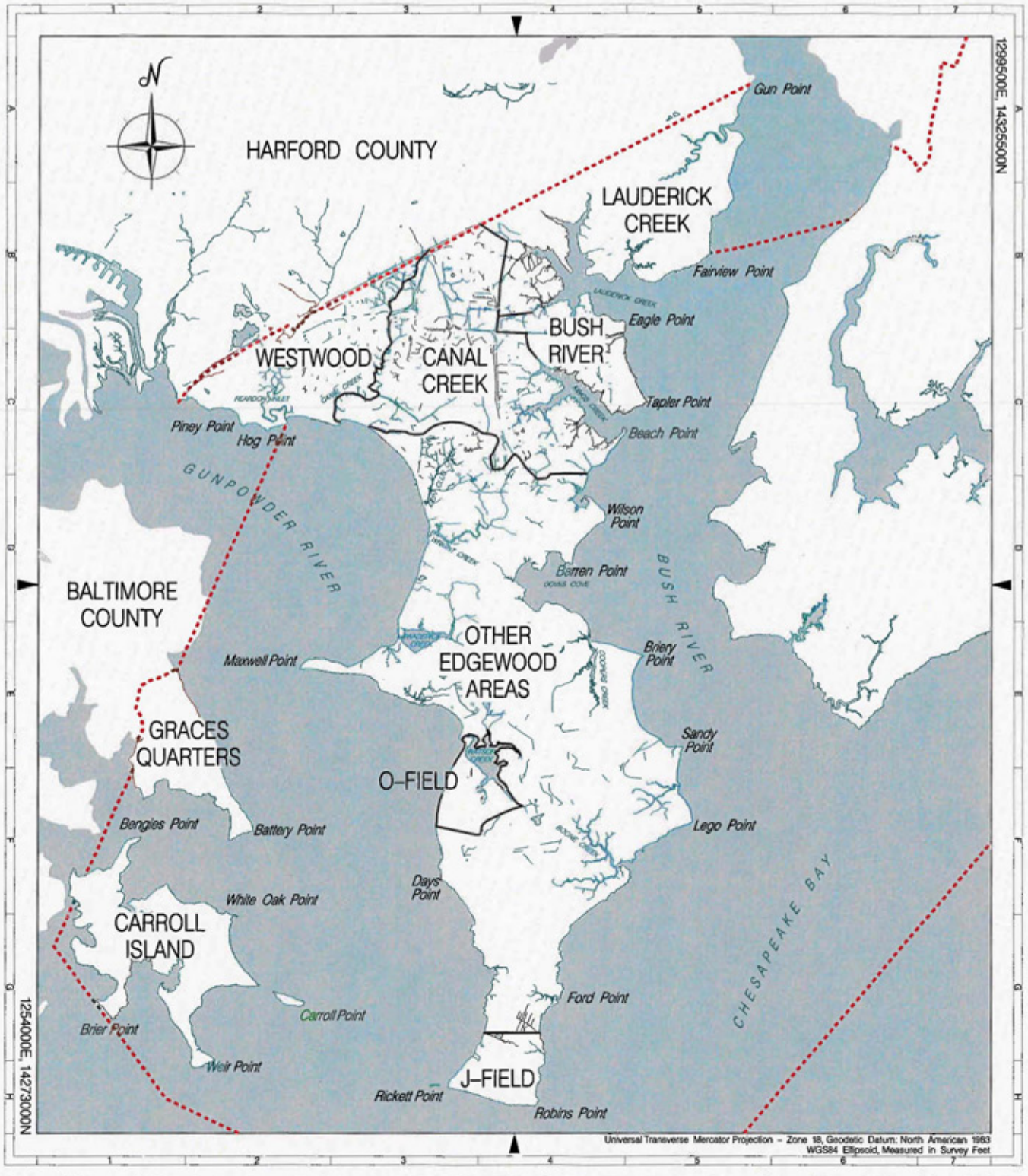
According to CERCLA and the NCP, removal actions are defined to include:

> *the cleanup or removal of released hazardous substances from the environment, such actions as may necessarily be taken in the event of the threat of release of hazardous substances into the environment, such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances, the disposal of removed material, or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release.*

USEPA has categorized removal actions in three ways: emergency, time-critical, and non time-critical. The overall protectiveness of removal actions is evaluated with the final remedy.

In evaluating alternatives for the final remedy the potential performance of each alternative is evaluated in terms of the evaluation criteria required by the NCP. The nine criteria are categorized into one of three groups: threshold criteria, primary balancing criteria, and modifying criteria (Table 1-1). The alternative selected for each site must satisfy the threshold criteria, which are of primary importance. The primary balancing criteria are used to weigh the major tradeoffs among the alternatives, and the modifying criteria are considered in light of the public comments on the Proposed Plan for Remedial Action.

The nine Edgewood Area Study Areas include 235 of the total of 252 APG AEDB-R sites (Exhibit 2). IRP activities since inception of the program in 1976 have resulted in response complete or remedy in place at 125 of the 235 sites. Of those sites, 34 were determined through RI/FS and related activities to pose no risk and, therefore, required no action. Six sites are in operations and maintenance (O&M) and long-term monitoring (LTM), and LTM of environmental media is being conducted at nine. Land Use Controls (LUCs) are in place at 112 AEDB-R sites. LTM of the LUCs ensures they remain protective.



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GRAPHICAL SCALE
IN MILES (1" = 7,000') 1:84,000

L E G E N D

- Water
- Installation Boundary
- Study Area

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TITLE:

ABEDEEN PROVING GROUND, EDGEWOOD AREA, STUDY AREA LOCATIONS

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	C. HOULIK	11-26-07	1-2

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Table 1-1. Remedial Alternative Evaluation Criteria

Threshold Criteria:

- Overall Protection of Human Health and the Environment refers to whether a remedy provides adequate protection against harmful effects. It calls for consideration of how human health or environmental risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) addresses whether a remedy meets all the applicable or relevant and appropriate requirements of Federal and State environmental statutes.

Primary Balancing Criteria:

- Long-Term Effectiveness and Permanence refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment after cleanup goals have been met.

- Reduction of Toxicity, Mobility, or Volume Through Treatment refers to the effectiveness of the treatment technologies in reducing the toxicity, mobility, or volume of contaminants.

- Short-Term Effectiveness refers to the speed with which the remedy achieves protection and to the remedy's potential during construction and implementation to have adverse effects on human health and the environment.

- Implementability refers to the technical and administrative feasibility of a remedy, including the availability of required materials and services.

- Cost includes capital expenditures and operation and maintenance costs.

Modifying Criteria:

- State Acceptance indicates whether the state concurs with, opposes, or has no comment on the preferred alternative based on its review of the RI/FS Reports, Proposed Plan, and public comments.

- Community Acceptance is documented in the ROD following consideration of public comments on the Proposed Plan.

1.3 DESCRIPTION OF REVIEW PROCESS

Under CERCLA 121(c), the Lead Agency is required to review the remedies at CERCLA sites where hazardous substances remain at levels that potentially pose an unacceptable risk. Such reviews must be conducted every five years or may be conducted more frequently if necessary to ensure the protectiveness of the remedy. The remedy review process integrates information taken from decision documents and operational data with the experiences of those responsible for and affected by actions at the site. There are six components to the process: 1) community involvement and notification, 2) document review, 3) data review and analysis, 4) site inspection, 5) interviews and 6) protectiveness determination. Together, the Lead Agency uses these components to assess the remedy's performance, and, ultimately, to determine the protectiveness of that remedy.

Remedies for sites are selected through the CERCLA RI/FS process, which evaluates and selects remedies expected to be protective of human health and the environment. The five-year review process examines the remedy as implemented to determine whether these criteria are being met. The Five-Year Review Report documents the methods, findings, and conclusions of these reviews and presents issues identified during the review with recommendations to address them. The *Comprehensive Five-Year Review Guidance*, OSWER 9355.7-03B-P, dated June 2001 (Guidance) is intended to promote consistent implementation of the five-year review process and is the basis for preparation of this document. The Army also provides guidance for five-year review at IRP sites in Memorandum, SFIM-AEC-ERO, Subject: *Interim Army Guidance for Conducting Five-Year Reviews* (U.S. Army, 2000).

In conducting this five-year review, several steps were carried out. First, all relevant documents were reviewed for each OU within each Study Area. The Administrative Record, as well as information from DSHE Project Officers, were used to compile the appropriate documents. Interviews were conducted with DSHE Project Officers as well as the O&M personnel for those sites with operating treatment systems as part of their remedies. Forms summarizing these interviews are provided in Attachment A of this document. A questionnaire was distributed to all Restoration advisory Board (RAB) members to obtain feedback on the Edgewood Area sites. Mr. Ken Stachiw, Chief of the DSHE Environmental Conservation and Restoration Division and RAB Army Co-Chair, informed the RAB Members at the 25 October 2007 meeting that the five-year review process had been initiated for the Edgewood Area. At the 29 November 2007 meeting, RAB Members were provided with the questionnaires to provide feedback in support of the five-year review process, and Mr. Arlen Crabb, RAB Member, was identified as the RAB point of contact for the review process. Partial transcripts for those portions of the RAB meetings are provided in Attachment B to this document. Mr. Crabb was interviewed on 6 June 2008 (Attachment B). He indicated he had received questionnaires from six community RAB members all of whom were in agreement with the document.

Each of the sites was inspected at least once during the review process. For those sites with a remedy in place, operations, monitoring, and sampling data were reviewed, as well as the site O&M Plan.

As described in the Guidance, the following questions are addressed for each site for which a ROD has been implemented, in order to evaluate remedy protectiveness:

A. Is the remedy functioning as intended by the decision documents?

B. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

C. Has any other information come to light that could call into question the protectiveness of the remedy?

Pertinent to Question B, the potential for human health risk posed by the migration of subsurface contaminants that are both volatile and toxic into inhabited structures (Vapor Intrusion) has received increasing attention since the previous five-year review and was addressed during this review as discussed in Attachment C.

By agreement between the Army and USEPA, AEDB-R sites that have not yet reached the ROD implementation stage were also included in this five-year review. In the case of the non-ROD sites, progress to date is summarized.

1.4 REVIEW TEAM

The five-year review was led by Ms. Cindy Powels, DSHE Project Officer, APG. The following team members assisted in the analysis and/or review:

Team Member	Title	Study Areas
Cindy Powels	Project Officer, DSHE	All
Yazmine Yap-Deffler	Remedial Project Manager, USEPA Region III	All
Frank Vavra	Remedial Project Manager, USEPA Region III	O-Field, Bush River, Carroll Island, Graces Quarters, Westwood, Canal Creek
Heather Njo	Remedial Project Manager, MDE	O-Field, J-Field, Canal Creek, Carroll Island, Graces Quarters, Westwood
Germån Mora	Remedial Project Manager, MDE	Bush River, Lauderick Creek
John Fairbank	Chief, Federal Facilities Division, MDE	All
Curtis DeTore	Section Head, Federal Facilities Division, MDE	Bush River, Lauderick Creek, Other Edgewood Areas
John Wrobel	Project Officer, DSHE	J-Field, Canal Creek
Rurik Loder	Project Officer, DSHE	Bush River, Lauderick Creek, Carroll Island, Graces Quarters
Ruth Golding	Project Officer, DSHE	Other Edgewood Areas

Team Member	Title	Study Areas
Tim Llewellyn	Project Manager, ARCADIS	Graces Quarters
Tim Reese	O&M Manager, EA	Bush River, Lauderick Creek, Carroll Island, Graces Quarters
Len Wrabel	O&M Manager, Mar-Len Environmental	J-Field, Canal Creek
Dennis Donovan	O&M Manager, GP	O-Field, Canal Creek, Lauderick Creek
Jennifer Harris	Project Manager, GP	O-Field, J-Field, Canal Creek
Jennifer Schaefer	Project Manager, GP	Lauderick Creek, Westwood, Other Edgewood Areas
Gary Nemeth	Senior Engineer, GP	Bush River
Tara Weeks	Senior Geologist, GP	O-Field, Canal Creek
Francis Dunkerly	Project Manager, GP	Carroll Island, Graces Quarters
Chuck Houlik	Principal Scientist, GP	All
Karen Thorpe	Program Manager, GP	All

1.5 REPORT FORMAT

This document contains the five-year review information for the Study Areas within Edgewood Area. The review findings are discussed by Study Area as follows:

Section 2 O-Field Study Area
Section 3 J-Field Study Area
Section 4 Canal Creek Study Area
Section 5 Westwood Study Area
Section 6 Carroll Island Study Area
Section 7 Graces Quarters Study Area
Section 8 Bush River Study Area
Section 9 Lauderick Creek Study Area
Section 10 Other Edgewood Areas Study Area

Summary observations and recommendations are provided in Section 11.

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2.0 O-FIELD STUDY AREA

2.1 OVERVIEW

The O-Field Study Area has four OUs corresponding to the AEDB-R numbers as listed in Exhibit 2. The O-Field OUs (located on Figure 2-1) are as follows:

- OU 1: Old O-Field Groundwater
- OU 2: Old O-Field Source Area
- OU 3: Watson Creek Surface Water and Sediment
- OU 4: New O-Field (Source Area and Groundwater) and Other O-Field Areas

To date, RODs for interim actions have been signed for OU 1 and OU 2 and a final action ROD has been signed for OU 3. No ROD has been signed for OU 4. For OU 1, the selected remedy is a groundwater containment remedy, with downgradient extraction, on-site treatment for inorganic and organic contaminants, and surface-water discharge. A Permeable Infiltration Unit (PIU) was selected for OU 2 to reduce the likelihood and impact of a potential explosive event and to reduce vapor releases. For OU 3, the remedy was limited action, including Institutional Controls (access and land-use restrictions), physical security measures, public education programs, long-term monitoring of the site, and five-year reviews.

O-Field was effectively separated into two regions by types of activities and times that testing took place: Old O-Field and New O-Field. Both of these areas contain pits where contaminants and debris were buried. In addition, many hazardous substances or residual materials from testing were burned in open pits at the site after being doused in fuel oil.

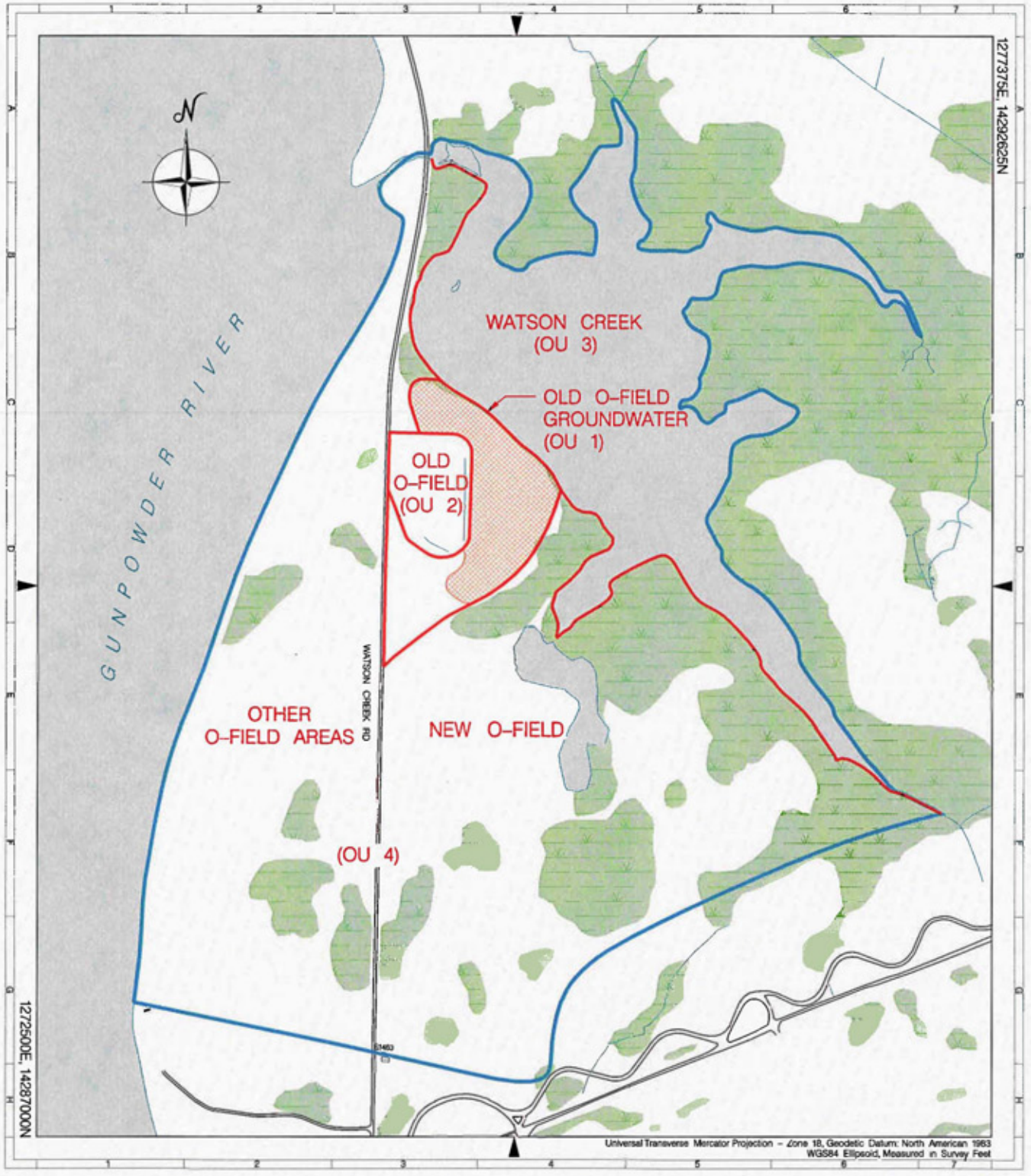
Extensive burn pit residue and construction debris were also pushed out into the marsh located between the New O-Field disposal trenches and Watson Creek. A non-time-critical removal action was conducted to address surface and near-surface wastes and potential unexploded ordnance (UXO) in the push-out area.

2.2 SITE CHRONOLOGY

The first recorded use of O-Field for disposal practices took place in May of 1941; however, there may have been activity at O-Field as early as the late 1930s. During the 1940s and early 1950s, unlined pits and trenches were dug within Old O-Field and used for the disposal of chemical warfare materiel (CWM), munitions, contaminated equipment, and miscellaneous hazardous waste.

2.2.1 Old O-Field

Several decontamination and cleanup operations have been performed at Old O-Field beginning with surface sweeps and demilitarization efforts in 1949 and continuing



750 500 250 0 750 1500

GRAPHICAL SCALE
IN FEET (1" = 750')
1:9000

L E G E N D

- Water
- Road
- Wetland
- Groundwater Plume
- Study Area Boundary
- Operable Unit Boundary

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TITLE:

O-FIELD STUDY AREA
OPERABLE UNITS

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	C. HOULIK	04-02-08	2-1

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through the early 1970s. In 1949, approximately 1,000 barrels of Decontaminating Agent Non-Corrosive (DANC) were applied to the field in an attempt to detoxify mustard that had been scattered over the area by several spontaneous detonations. DANC contains 5% 1,3-dichloro-5,5-dimethylhydantoin (the active decontaminating agent) in 95% 1,1,2,2-tetrachloroethane (TeCA). TeCA and its degradation products have been identified at elevated levels in groundwater at Old O-Field.

In 1953, the field was soaked with fuel oil, ignited, and allowed to burn. Lime (calcium hydroxide) was dispersed onto surrounding trees (using trinitrotoluene [TNT] to disperse the lime) in an effort to neutralize mustard scattered throughout the area and into Watson Creek and the Gunpowder River by previous explosions. Other decontamination efforts involved the use of supertropical bleach (a calcium hypochlorite / calcium hydroxide mixture), lime, and sodium hydroxide to destroy chemical agents at the field. Following this operation, further decontamination and cleanup efforts were limited to removing and securing ordnance items recovered in surface sweeps of the field. The U.S. Army Technical Escort Unit (USATEU) conducted several surface sweeps at Old O-Field from the late 1960s through the early 1970s. During these sweeps, a number of suspect CWM-filled munitions were recovered from Old O-Field. USATEU conducted additional sweeps outside of the fenced area of Old O-Field in the early 1980s. Clearance activities were conducted outside the field by Army contractors during installation of the extraction and monitoring well system and construction of the PIU. Additional surface sweeps were conducted in 2001 and 2003. No disposal of munitions or other hazardous waste appears to have been performed at Old O-Field after 1953.

2.2.2 OU 4

The boundaries for New O-Field were delineated in 1950. New O-Field was reported to contain nine trenches, used for open pit burning and disposal operations from 1950-1961 (Yon et. al., 1978). Based on ground penetrating radar conducted in the early-1990s, a tenth trench is believed to exist just outside the boundary of the surveyed trenches in the main pit area. Two additional open trenches (also referred to as “former burn pits”), lying perpendicular to the covered disposal trenches, were used for burning/ demilitarization activities through the late 1970s, when disposal practices ended at the site.

Two unintentional fires occurred in 1961 and 1997. In 1961, there was an accidental ignition of disposed material, reportedly caused by an unknown laboratory chemical after a heavy downpour of rain. The pit where the ignition occurred was reported to contain 55-gallon drums of acid on dunnage; one 300-gallon tank contaminated with distilled mustard (HD); laboratory samples and waste material consisting of o-ethyl s-(2-diisopropylaminoethyl) methylphosphonothiolate (VX), Sarin (GB), and phosgene (CG), and numerous bottles of miscellaneous laboratory chemicals; GB-contaminated pipe; and, 3-quinuclidinyl benzilate (BZ)-contaminated rags.

The fire in 1997 revealed UXO and surface debris in the push-out area of the New O-Field marsh. Consequently, waste recovery activities were conducted between 2001 and

2004. The waste blanket in the push-out area consisted primarily of ash and pulverized waste, but also contained both reportable (i.e., believed to contain energetics) and non-reportable ordnance items. Soil recovered from the push-out area remains staged on site, due to the presence of residual white phosphorus (WP). Due to the excavation not being backfilled, a 3.6-acre pond was created.

Based on historical records, three additional pits were suspected west of Watson Creek Road in an area now referred to as Other O-Field Areas (south of the current location of the O-Field Groundwater Treatment Facility [GWTF]). It was later determined that two of the three pits were incorrectly interpreted by the initial surveyor and were actually located within the limits of the Old O-Field Source Area. Geophysical surveys and multi-media sampling were performed in 2004; however, there was no evidence of disposal in the vicinity of the third suspected pit.

Table 2-1 presents a brief summary of environmental activities at O-Field.

Table 2-1. O-Field Environmental Activity Chronology

Date	Activity
1977-1978	U.S. Army Environmental Center Environmental Survey
1977	U.S. Army Environmental Hygiene Agency Surface Water Quality and Biological Study
1980	Initial Discovery
1980	Preliminary Assessment
1984	U.S. Geological Survey Hydrogeologic Investigation
1987	Initial Feasibility Study for Old O-Field
1990	Focused Feasibility Study for Groundwater (OU 1)
1990	Edgewood Area Included on the National Priorities List
1990	Federal Facility Agreement
1991	Groundwater and Surface Water Sampling
1991	Record of Decision for Interim Remedial Action at OU 1 (Groundwater)
1993-1996	Watson Creek (OU 3) Sampling Events
1994	Focused Feasibility Study for Source Area (OU 2)
1994	Proposed Plan for OU 2
1994	Record of Decision for Interim Remedial Action at OU 2
1995	Groundwater Extraction, Treatment, and Discharge System Implemented
1995	Draft Final Remedial Investigation Report for the O-Field Study Area (OUs 1 - 4)
1995	LTM Quarterly Groundwater Sampling at Old O-Field Implemented (OU 1)
1997	Focused Feasibility Study - Watson Creek (OU 3)
1997	Proposed Plan for OU 3 (Watson Creek)

1997	Record of Decision (OU 3)
1998	U.S. Environmental Protection Agency Flux Chamber Sampling on Landfill Surface (OU 2)
1999	First Five-Year Review Report
2000	Post-Permeable Infiltration Unit Risk Analysis (OU 2)
1992-2002	New O-Field Remedial Investigation Sampling Events
2001-2004	Removal Action in the push-out area of New O-Field
2002	Final Remedial Investigation Report for the O-Field Study Area (OUs 1 - 4)
2003	Second Five-Year Review Report
2004	LTM Semi-annual Groundwater Sampling at Old O-Field Implemented (OU 1)
2004	Other O-Field Areas Remedial Investigation Sampling Event
2005	Explanation of Significant Differences Signed for OUs 1 and 2
2007	Final Ecological Risk Assessment, Data Evaluation and Risk Characterization for New O-Field (OU 4)
2007	Final Remedial Investigation Addendum for Other O-Field Areas
2007	Perchlorate Sampling at New O-Field (OU 4)
2007	Draft Feasibility Study for New O-Field (OU 4) and Other O-Field Areas

2.3 SITE BACKGROUND

2.3.1 Physical Characteristics

O-Field Study Area is located in the Edgewood Area of APG, on the Gunpowder Neck peninsula (Figure 1-2). O-Field is located within the Atlantic Coastal Plain Physiographic Province. Coastal Plain sedimentary strata at Old O-Field extend to a depth of approximately 80 feet and are subdivided into four hydrostratigraphic units: the water table aquifer, upper confining unit, upper confined aquifer, and lower confining unit. The water table and upper confined aquifers, which are each approximately 10 to 15 feet thick, are separated by a thin, laterally discontinuous clay confining bed. The water table aquifer lies 9 to 15 feet below the ground surface. The presence of contamination in the upper confined aquifer indicates that the confining bed between the water table aquifer and the upper confined aquifer is discontinuous beneath Old O-Field. Deeper aquifers that exist at the site are believed to be uncontaminated.

The water table and upper confined aquifers are recharged by groundwater flowing from the southern portion of Gunpowder Neck and by vertical infiltration of precipitation within the Old O-Field area. A groundwater divide in both aquifers is historically located approximately 300 feet west of Old O-Field; groundwater along the western side of this divide discharges to the Gunpowder River, whereas groundwater along the eastern portion of the divide flows beneath the Old O-Field source area and discharges to Watson Creek. Thus, this divide is important in controlling the distribution of groundwater contamination at the site because it separates the contaminated plume area in both the

water table and upper confined aquifers from uncontaminated groundwater flowing to discharge into the Gunpowder River. Groundwater flow in the aquifers beneath Old O-Field is made additionally complex because of tidal effects from the Gunpowder River and Watson Creek, including lagging and missing tidal cycles in Watson Creek, which are created by the culvert at the creek mouth.

Watson Creek has historically been a habitat for many types of animal and plant life. The culvert construction, temperature fluctuations, and organic content of the water have altered the local environment and have had a negative impact on the wildlife in the creek. The areas surrounding Watson Creek consist of marshlands. Watson Creek has been the natural depository for both Old and New O-Field runoff and groundwater from the site (prior to remedial actions). The maximum elevation in the O-Field source areas is approximately 19 feet.

New O-Field is located south of Old O-Field and east of Watson Creek Road. The geophysical surveys conducted in 1992 indicated the presence of 10 disposal pits that are covered and undisturbed. In addition, two open trenches exist next to the marsh. Areas containing debris, UXO, burn pit push out, and potential CWM have been removed from the perimeter of the New O-Field disposal area. The removal created a 3.6-acre pond where the excavation penetrated the water table.

2.3.2 Land and Resource Use

Old O-Field, located in the northern section of the study area, was used as a disposal area from the 1930s through the 1950s. Old O-Field is contaminated and site access is restricted. New O-Field, located in the southern section of the study area, was used as a destruction, disposal, and training area from the 1950s through the late 1970s.

O-Field is located within a secure section of Edgewood Area where access is restricted. The area is routinely patrolled by guards in land vehicles and boats.

2.3.3 History of Contamination

From 1941 to 1953, Old O-Field was used as a disposal site for chemical-filled/explosive-loaded munitions, contaminated plant equipment, pipes, and tanks. It has been reported that there were also materials buried such as mustard, Lewisite (L), chloroacetophenone (CN), chloroacetophenone in chloroform (CNS), adamsite (DM), munitions-containing explosive charges, munitions filled with WP, and other CWM.

From 1953 to 1961, many other contaminants and debris were disposed at the New O-Field Site. Some examples of materials disposed in pits include explosives, acids, VX, GB, impregnite, mustard, WP-filled shells, ortho-chlorobenzylidenemalonitrile (CS), DM, and CN. The burning of wastes (most likely including chlorinated solvents) was a later disposal practice at New O-Field.

The process of burning was typically used to dispose of the materials and debris contained in the pits at O-Field. A large quantity of fuel oil was spread into the pits before the contents were burned. Burning activities did cause some unexpected explosions, spreading contaminants to the surrounding land and water bodies.

During the 1977-1978 Environmental Survey of Edgewood Area, groundwater contamination and low levels of surface-water contamination were detected in Watson Creek. After a surface-water quality and biological study was conducted by the U.S. Army Environmental Hygiene Agency (USAEHA), it was concluded that the sediment in Watson Creek also contained elevated levels of metals. The metals reported were cadmium, copper, zinc, and low levels of arsenic. In addition, relatively high levels of silver were reported in the surface water. The 1991 Surface Water Sampling Program recorded one detection of the mustard degradation product 1,4-oxathiane.

The New O-Field ecological risk assessment concluded that there was potential risk to ecological receptors from metals, dioxins, and pesticides in the pond created by the push-out area removal action. Subsurface sampling supports that the former burning trenches at New O-Field are a source of metals, volatile organic compounds (VOC), semi-volatile organic compounds (SVOC) – including polycyclic aromatic hydrocarbons (PAH), CWM degradation products, pesticides, and polychlorinated biphenyls (PCB). Many contaminants in groundwater are the same chemicals detected in pond surface water – suggesting that chemicals are being transported from groundwater to the pond. Groundwater also discharges to the marsh, but the principal organic groundwater contaminants have not been detected in Watson Creek.

No significant environmental contamination was found west of Watson Creek Road in the Other O-Field Areas.

2.3.4 Previous Removal Actions

There have been no CERCLA removal actions in the Old O-Field Study Area. A removal action has been completed at the push-out area of New O-Field (Table 2-2). The overall protectiveness of removal actions is evaluated with the final remedy.

Table 2-2. O-Field Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
New O-Field Pushout Area	2001 to 2004	Removal of surface and near-surface debris from the push-out area of the marsh	Recovered 14,400 non-energetic ordnance-related scrap items, 500 reportable ordnance-related items (i.e., items that were intact or thought to contain energetics), 1,500 tons of concrete, 75 tons of bulk steel, and approximately 20,000 cubic yards of soil, ash, and miscellaneous wastes.

2.3.5 Contaminant Media

The contaminant medium for OU 1 is groundwater, and the constituents of concern (COCs) are VOC, CWM degradation products, and metals. At OU 2 the contaminant medium is soil and the COC is CWM. The contaminant medium for OU 3 is sediment, and the COCs are metals and 4,4'-dichlorodiphenyldichloroethene (4,4'-DDE).

The RI/FS for OU 4 is still underway. Definitions of contaminants and contaminant media requiring action have not been established.

2.4 REMEDIAL ACTIONS

2.4.1 Operable Units without RODs

OU 4 is comprised of the groundwater and source areas at New O-Field and the Other O-Field Areas. Of the four OUs at O-Field, this is the only one that has not yet been issued a ROD. It was stated in the 1997 ROD for Watson Creek (OU 3), that the remedy for New O-Field required additional investigation before a decision could be reached.

2.4.2 Operable Units with RODs

Table 2-3 summarizes the remedial actions conducted to date in the O-Field Study Area. The basis for taking action, remedial action objectives (RAOs), selected response, and performance standards are listed in Exhibit 1.

Table 2-3. O-Field Study Area Remedial Action Summary

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
OU 1	ROD – 1991 ESD – 2005	1. Downgradient Extraction with Discharge to Surface Water 2. Circumferential Extraction with Capping and Discharge to Surface Water 3. Circumferential Extraction with Spray Irrigation/Source Flushing 4. Circumferential Extraction with Downgradient Reinjection 5. No Action 6. Minimal Action 7. Chemical Precipitation/Air Stripping/Carbon Adsorption 8. Chemical Precipitation/UV/OX 9. Chemical Precipitation/Powdered Activated Carbon Treatment	Treatment by chemical precipitation in order to remove the inorganic contamination. Following this treatment, an ultraviolet light catalyzed oxidation (UV/OX) system would destroy the organic contaminants. After treatment, the water would be discharged into the Gunpowder River.	Operation of the groundwater extraction and treatment system began in April 1995 and continues to the present. The basis for changes implemented since the ROD were presented in detail in the final Explanation of Significant Differences (ESD) (2005) and are summarized below: The Upper Confined Aquifer is not pumped because extraction was likely to draw contaminants from the Water Table Aquifer into the Upper Confined Aquifer. Aquifer tests at the time of the design indicated that there was a hydraulic connection between the two aquifers. While pumping from the Upper Confined Aquifer would tend to draw contaminants downward, pumping from the Water Table Aquifer only would create a potential upward gradient. Furthermore, a natural upward gradient had been observed. Liquid phase granular activated carbon (GAC) was provided because a major contributor to the high VOC levels was 1,1,2,2-tetrachloroethane, which responds poorly to UV/OX treatment. Operating results prior to the final ESD consistently demonstrated levels for all monitoring parameters well below the discharge criteria. The acute and chronic toxicity testing results also showed no toxicity. As a result, it was proposed that the chemical analysis frequency be reduced to once a month, the acute toxicity testing be eliminated, and the chronic toxicity testing be reduced to semi-annual for an additional 3 years. The ESD also allowed for batch treatment of investigation-derived material from other Study Areas at APG-Edgewood Area.
OU 2	ROD – 1994 ESD - 2005	1. No Action 2. Limited Action 3. Permeable Infiltration Unit (PIU) 4. Foam Cap 5. Multimedia Cap	PIU with air monitoring system and a sprinkler system, institutional controls and land use restrictions.	A PIU was installed in accordance with project specifications between October 1997 and September 1998 to contain and mitigate source contaminants contained within the trenches of the Old O-Field Landfill. A site walkover is performed weekly and topographic survey is performed annually to ascertain if settlement of the PIU has occurred. In addition, the sprinkler system is inspected regularly. The 2005 ESD addressed non-utilization of the subsurface air monitoring system, non-utilization of the surface sprinklers for a treatability study, and addition of a subsurface trickling system.
OU 3	ROD - 1997	1. No Action 2. Limited Action 3. Full-Scale Dredging/Solidification/Landfill 4. “Hot Spot” Removal/Solidification/Landfill 5. Aquatic Phytoremediation	Limited Action, including the following actions: Institutional Controls, Physical Security Measures, Public Education Programs, Long-Term Monitoring of Site Conditions, and Five-Year Reviews	Warning signs were posted at Watson Creek and the PIU. Public education programs included the distribution of literature. Long-term monitoring of Watson Creek sediment is conducted on an annual basis to determine the current environmental condition of site sediment and the effects of contaminants on the resident fish population.

2.4.3 Progress Since Last Five-Year Review

Five-year reviews were conducted for O-Field OUs 1 through 4 in 1999 and 2002. Previous reviews determined that the selected remedies were protective and that remedy components were operating well.

The New O-Field push-out area removal action has been completed. RIs at New O-Field and the Other O-Field Areas have been completed and a draft FS has been prepared.

This five-year review has determined that remedy components with upgrades applied to the system are capable of meeting the remedial action requirements for OUs 1 and 2. The groundwater extraction and treatment system typically meets performance requirements. No deficiencies were identified in institutional controls.

While remedy components continue to function well, the Army is currently evaluating alternatives for a final remedy at OUs 1 and 2.

2.5 FIVE-YEAR REVIEW PROCESS

During the review process, the status of the remedial action at the O-Field site in APG was determined. To accomplish this goal, the O-Field site was visually inspected and available data were reviewed. In addition, the Project Officer, Ms. Cindy Powels, was interviewed on 29 October 2007 to obtain further information regarding the status of the site. The results of this interview are presented in Attachment A of this report.

During the Five-Year Review process, the O-Field site was visited on 13 Nov 2007. GWTF operations personnel were interviewed. Photodocumentation of the site is provided in Attachment D of this document.

Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

2.5.1 Site Inspection

Site inspection checklists, as specified in Guidance, are provided in Attachment E.

2.5.2 Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

2.5.3 Technology Evaluation

Alternative technologies have been evaluated for each site with an implemented ROD for purposes of remedial action optimization. The results of this evaluation are provided in Appendix F. As mentioned previously, the Army's alternatives evaluation for integration

of the remedies for OU 1 and OU 2 into a final action ROD is nearing completion (draft submitted in December 2007). The conclusions from this study will be incorporated into the next version of the draft Five-Year Review.

2.6 FIVE-YEAR REVIEW FINDINGS

Additional information on the review is provided in the following sections.

2.6.1 Groundwater Treatment Plant System Operations

Operation of the groundwater extraction and treatment system began in April 1995 and continues to the present. The extraction well system initially included 12 wells with two more being added in 1997; one of the original wells was replaced in 2000. Extracted water is transferred to four influent holding tanks at the GWTF. The GWTF operates as necessary to treat extracted groundwater, but is currently operated at up to 50 gallons per minute (gpm). The current operating schedule is 5 days a week, 24 hours a day (with an unmanned shift from 8 pm to 7 am, Monday through Friday).

Discussion with operating personnel provided an overview of operations since the GWTF began treating groundwater, with emphasis on modifications to the facility and maintenance issues.

Over the past five years, major improvements to the GWTF have included: refurbishment of the clarifier; replacement of pumps, controls, impellers, dissolved oxygen meters, pH probes and analyzers throughout the plant; addition of pressure transducers to the cartridge filter system; installation of a new National Pollutant Discharge Elimination System (NPDES) autosampler; addition of a static mixer to the hydrogen peroxide injection line for the ultraviolet/oxidation (UV/OX) system; and, major programming updates to automate systems and alarm functions through use of the Supervisory Control and Data Acquisition (SCADA) system. Refurbishment of the clarifier (including removing all interior parts, cleaning, and re-coating for improved erosion and corrosion resistance) and upgrades to the lime mixing system increased throughput by approximately 30 percent. A tour of the GWTF was conducted on 13 November 2007, with emphasis on the recent changes made as previously described.

In November 2007, major upgrades were conducted in the OU 1 well field, including upgrades to the conveyance line to provide secondary containment and leak detection, installation of one new extraction well, and conversion of one monitoring well to an extraction well.

Prior to issuing the Explanation of Significant Differences (ESD) in 2005, approval was obtained from the Maryland Department of the Environment (MDE) to reduce effluent monitoring frequency and eliminate acute toxicity testing. The list of other effluent parameters monitored has remained unchanged.

The following O&M activities are routinely performed to gauge the effectiveness of the GWTF:

- Groundwater Level Measurement (performed weekly). Groundwater levels are measured on a weekly basis. A groundwater flow map is constructed from these data and this information is, in turn, used to determine if a cone of depression is maintained between Watson Creek and the PIU. These combined data are provided to DSHE on a monthly basis in the form of a report.

- Groundwater Sampling (frequency changed from quarterly to semi-annually). Varying numbers of monitoring wells in both the Water Table Aquifer and Upper Confined Aquifer were sampled quarterly from the third quarter 1995 through the fourth quarter of 2003. Sampling frequency was reduced to semi-annual starting in 2004 to the present (events in April and October). A total of 24 water table aquifer wells, 3 upper confined aquifer wells, and 5 surface water locations are now sampled and analyzed for Target Compound List (TCL) VOC, Target Analyte List (TAL) metals, and mustard agent degradation products. Groundwater sample results are compiled, interpreted, and submitted to DSHE in the form of a report.

- NPDES Compliance Sampling (frequency changed to once per month). Samples of influent and effluent groundwater are collected to determine the effectiveness of the GWTF.

As noted in the previous five-year review, iron fouling continues to be a challenge to the extraction system. To optimize groundwater extraction efficiency, the contractor has recommended cleaning and redeveloping the active extraction wells on a semi-annual basis.

Technology Evaluation

The ROD requires the extracted groundwater to be treated by chemical precipitation for metals removal. The most common type of chemical precipitation employed is alkaline precipitation. Most heavy metals have minimum solubility at an alkaline pH range and will precipitate when the pH is adjusted to this range. While a number of alkaline reagents are available, lime is used at the GWTF. It produces precipitated solids that settle well in the clarifier and the sludge produced dewaters well in the filter press. In the course of developing effluent guidelines for metal processing industries, USEPA evaluated various treatment technologies. The technology selected as the Best Available Technology (BAT) was lime precipitation and settling, and the performance of this technology was used as the basis for setting the effluent limitations for the various regulated heavy metals. Therefore, the use of lime for such an application represents BAT and is a sound choice.

Performance at the GWTF is enhanced by lowering the pH after clarification and then filtering the groundwater. This removes residual solids that did not settle and precipitates aluminum which has lower solubility at neutral pH. The metals treatment system has

been very reliable and it consistently produces effluent well below the discharge criteria. It should remain in use as there is no basis for changing to another technology.

The ROD required organics removal by UV/OX. The ESD presented the basis for adding air stripping as needed and GAC to the treatment train. The types and concentrations of organic constituents found during the design and construction of the plant required additional treatment steps to meet the discharge criteria. A major objective in selecting UV/OX was to provide a process that would destroy CWM degradation products on-site rather than transfer these materials to another medium (such as GAC), which would have to be managed and disposed of off-site.

In the revised arrangement, the air stripper was added to reduce the VOC load to the UV/OX when necessary. However in 2003, analysis of the air stripper performance determined that the unit was not reducing influent VOC concentrations significantly and the unit's operational cost was not warranted. Modifications to the UV/OX system including relocation of the hydrogen peroxide injection port and adjustments to injection amounts improved system performance. The air stripper unit, with concurrence of MDE and USEPA, was shutdown and isolated from the treatment train on 07 April 2003 upon completion of the modifications to the UV/OX system. The air stripper is currently in stand-by status at the GWTF in the event future use of unit is deemed necessary. Current plant operations use the UV/OX to destroy the CWM degradation products and VOC, and the GAC to remove the residual VOC (primarily TeCA) that is not completely removed by the UV/OX system. The performance of these units has been very consistent, removing CWM products to below quantitation limits and VOC to an average of 10.7 µg/l.

Results for performance monitoring indicate that the influent concentration of VOC, CWM degradation products, and metals fluctuate over time and are affected by the amount of precipitation infiltrating to the groundwater.

Groundwater Capture

The Old O-Field groundwater extraction and treatment system was installed to provide hydraulic containment of VOC, mustard agent degradation products, and metals present in the water table aquifer. Extraction wells are operated to intercept contaminants emanating from the Old O-Field source areas to prevent the migration of contaminants into the adjacent surface water of Watson Creek. Criteria used to monitor the system performance follow those summarized in USEPA pump and treat guidelines (USEPA, 1994, 1997 and 2001); were detailed in the Revised Groundwater Monitoring Sample and Analyses Plan (ICF Kaiser, 1998); and were revised in the Operable Unit 1 Sampling and Analysis Plan (GP, 2004). The primary criterion of the monitoring program is to demonstrate that the groundwater extraction system is achieving hydraulic containment of the contaminant plume.

The containment monitoring involves: (1) measuring groundwater levels in the site monitoring wells and plotting the groundwater elevation data on site maps to determine

whether the extraction system is influencing groundwater flow adequately to alter hydraulic gradients and to prevent groundwater flow and dissolved contaminant migration into Watson Creek; and (2) conducting groundwater quality monitoring to determine if temporal and spatial variations in contaminant distribution are consistent with hydraulic containment. The containment monitoring activities, therefore, include water level measurements, groundwater sampling and analysis, and pumping rate measurements (USEPA, 1994).

Old O-Field project personnel collect and analyze monitoring data in accordance with the Operable Unit 1 Sampling and Analysis Plan (GP, 2004). Data and analysis relative to hydraulic containment include contour maps of groundwater elevations, contaminant concentration trends, and treatment plant influent and effluent concentrations. The O&M contractor presents the status of hydraulic containment and system performance data in monthly hydraulic containment reports and summarizes the results of groundwater sampling activities in semi-annual groundwater monitoring reports.

Based upon data available for this review, the extraction system overall adequately contains contaminated groundwater emanating from the Old O-Field source area for the majority of operational conditions. Within the last five years, a period of challenged containment conditions existed due to above normal precipitation causing increased groundwater elevations. Record setting amounts of precipitation recorded in 2003 significantly increased groundwater elevations and challenged the extraction system and hydraulic containment conditions. Precipitation recorded at Old O-Field in 2003 included 70.1 inches of rain (normal annual rainfall 41.9 inches) and 58.1 inches of snow (normal annual snowfall 15.2 inches). The continued higher than average precipitation fed the aquifer recharge area, an upland wetland area upgradient of the former disposal site, and significantly increased groundwater elevations from March 2003 to April 2004. Despite the groundwater elevation increase, the extraction system maintained relatively low hydraulic gradients (in the range 0.002 – 0.009) east of the extraction well field during this period.

Operation of the extraction system was modified in June 2003 in response to challenged containment conditions and increased groundwater elevations. A total of six extraction wells located at the north and south ends of the extraction system were shutdown in order to maximize groundwater extraction and control in the area of highest contaminant levels. Seven extraction wells PM-2, EX-3A, PM-3A, EX-8A, EX-4A, MW4-3A, and PM-5 in the northeastern and central eastern portion of the well field remained active at increased pumping rates. This approach maximized the extraction of groundwater from the most contaminated areas in the water table aquifer and resulted in a flattened hydraulic gradient extending from the extraction well system toward Watson Creek.

Above normal precipitation and groundwater elevations continued from 2004 to 2006 (recorded rainfall at Old O-Field GWTF: 2004 - 51.7 inches, 2005 - 45.0 inches, and 2006 – 55.6 inches). Conversely, drought conditions with below average precipitation occurred in 2002 and 2007. The range of fluctuation in groundwater elevations between the 2003 and 2007 is approximately 9 feet west of the PIU, 6.5 feet south of the PIU, and

4.5 feet north of the PIU. The severe changes in infiltrating precipitation and inflowing groundwater to the extraction system provides a constant challenge for system operations and requires variability in extraction and treatment rates to maintain containment. Field activities that included routine replacement of pumps, routine clearing of discharge and suction lines, installation of larger suction lines; and well redevelopment have been implemented to optimize extraction rates. Recent upgrades including larger discharge lines and larger pumps installed in selected extraction wells have increased extraction rates from a maximum of 32 gpm to 56 gpm.

The Old O-Field monitoring well configuration provides adequate lateral and vertical coverage to determine hydraulic containment as specified in the USEPA guidance documents (1997). Review of the water table aquifer contour maps from 2004 to 2007 showed containment of contaminated groundwater with flat to inward gradients sustained between the extraction system and Watson Creek. Seasonal periods of challenged hydraulic containment did occur usually in the late winter and early spring with extremely low hydraulic gradients east of the extraction system averaging 0.002.

Groundwater pumping in the water table aquifer appears to influence the underlying upper confined aquifer as well. Vertical gradient measurements indicate that an upward gradient exists toward the extraction wells and most importantly, the horizontal gradients are essentially flat, indicating low groundwater velocities. The aquifers are interconnected, and pumping of the water table aquifer maintains the upward gradient and limits downward contaminant migration.

The groundwater sampling program which was changed from quarterly to semi-annual in 2004 provides a consistent set of monitoring points located between the extraction wells and Watson Creek. Monitoring well locations sampled north of the PIU indicate low concentrations of contaminants and can be monitored to determine the need for reactivation of the northern extraction wells. The semi-annual sampling events occurring in April and October usually coincide with the seasonal highs and lows in groundwater elevations. Results for VOC, CWM degradation products, and metals from the same set of sampling locations have allowed tracking of contaminant concentration trends that help to determine if changes are necessary in groundwater extraction rates. The majority of the monitoring locations with extensive historical data have shown an overall decrease in contaminant concentrations over time.

Cost

The Treatability Study document for the RI/FS included an O&M cost estimate for the treatment alternative. The estimate for power, chemicals maintenance, and sludge disposal was $180,876 per year. To this cost, $25,000 was added for part-time labor and $99,000 for quarterly monitoring of 15 wells, bringing the total to $304,876 per year. The estimated annual O&M cost stated in the ROD was $466,650 per year.

For the previous five-year review, the actual cost was reported at an average of $1,600,000 per year. The system that was ultimately constructed is more complex than

was contemplated at the RI/FS stage, and the operating protocols are much more involved than was contemplated at the RI/FS stage, likely accounting for a significant part of the increased costs.

Over the past five year period, the actual cost dropped to approximately $1,200,000 per year – including $1,000,000 for the O&M contract (labor, materials, and equipment, including sampling and analytical services), $70,000 for subcontract services (biomonitoring, waste disposal, etc.), $50,000 for corrective maintenance and capital improvements, and $80,000 for base support. Although the GWTF is currently treating a larger volume of water than originally anticipated, O&M cost reductions have been achieved through plant automations, placing the air stripper on stand-by status, a reduction from three manned shifts to two per day, and a reduction in sampling frequency.

2.6.2 OU 2 Permeable Infiltration Unit Operations

The PIU was designed to mitigate hazards posed by the presence of surface and subsurface munitions at the Old O-Field site to human health and the environment.

Specific objectives of the PIU include the following:
- Cover residual wastes to preclude ordnance exposure.
- Restrict the availability of air to surface and subsurface of Old O-Field to reduce the potential for white phosphorus ignition.
- Reduce the concentration of CWM vapors released from the subsurface.
- Stabilize the surface of Old O-Field and prevent human and animal contact with contaminated soil and windblown dust.
- Reduce the shock applied to the top of the PIU by attenuating or distributing impulses through the sand layer components of the structure.
- Provide an early warning system and a means to control a release of CWM or non-CWM VOC vapors.
- Establish a vapor barrier via downward percolation of precipitation through subsurface fill (construction of a permeable cap promotes the development of an elevated groundwater level that will aid in lowering the risk of WP ignition).

Field work was initiated in October 1997 and construction of the PIU was completed in May 1998. The PIU was constructed as a non-traditional landfill cover comprised of the following components that are described in ascending order of construction:

- Initial sand layer.
- Synthetic geogrid material.
- Auxiliary subsurface trickling system.
- Subsurface air monitoring system.
- Final sand layer.
- Erosion control layers (permeable erosion control fabric and gravel cover layer).
- Surface sprinkler system.

Other construction work elements included the installation of a pump house and a water storage tank. These features were installed between October 1997 and September 1998.

The original design did not include the synthetic geogrid. The design was modified to incorporate the geogrid to eliminate the need for hydraulic compaction. Hydraulic compaction would have required the use of a significant quantity of water that was not readily available and would have added approximately six months to the construction schedule.

The following O&M activities are routinely performed to ensure the structural integrity and gauge the effectiveness of the PIU:

- Visual Inspection (performed weekly). A site walk is performed by the contractor retained by DSHE to maintain and operate the facility. The purpose of the site walk is to look for visual indication of settlement of the PIU and erosion washouts along the side slopes.

- Topographic Survey (performed annually). A topographic survey is performed annually to ascertain if settlement of the PIU has occurred.

- Sprinkler Inspection (performed monthly). A visual inspection of the sprinkler system is performed monthly.

- Sprinkler Test (performed quarterly). The sprinklers are tested quarterly to confirm operation in the event of an emergency (except in the winter, when the system is drained to prevent freezing).

Technology Evaluation

The PIU was designed to be a self-healing cover and is performing as intended. As waste materials in the landfill degrade and collapse, areas of subsidence are observed. Repairs to the sand cover resulting from subsidence were conducted in April 2003, December 2003, July 2004, and October 2005.

Cost

The estimated annual operating cost presented in the ROD for the PIU was $269,000. For the previous five-year review, the annual O&M cost for OU2 was reported as $230,000 – including $140,000 for labor, $4,000 for utilities, $26,000 for subcontract services, $30,000 for materials and supplies, and $30,000 for equipment. The average for the past five year period was approximately $84,000 for labor, materials, and supplies; however, air monitoring costs were reported at an average of $133,000 per year – bringing the total average cost for O&M to $217,000. The Army is currently evaluating alternatives to the existing, labor-intensive, real-time air monitoring system, as part of the final remedy evaluation for Old O-Field (OUs 1 and 2).

2.6.3 OU 3 Watson Creek Sediment

Watson Creek is located in a restricted section of the proving ground. Access to the restricted area is limited to properly cleared personnel or individuals in an escorted capacity. A wide variety of physical security countermeasures to include barrier systems, sensors and random patrols by law enforcement personnel are in place to prevent unauthorized access. Prior to the previous five-year review in 2002, warning signs designed to keep visitors from potential hazards were installed at the culvert that separates Watson Creek from the Gunpowder River, at strategic locations around the perimeter of Watson Creek, and around the periphery of the PIU. A public education program comprised of the distribution of literature informing workers and the public of risks associated with Watson Creek is performed annually by APG.

LTM of Watson Creek sediment is required by the ROD for OU 3. Sampling and analysis is required at least once every five years prior to the five-year remedy review. During the initial years of LTM, from 1999 through 2004, sampling and analysis was accomplished annually. During these years, the minimum/baseline work involved collection of sediment samples from 12 locations within the Creek once each year with analysis for TAL metals and TCL pesticides. During 1999 and 2004 sediment bioassays were performed, and for those sediment samples, analysis for the full suite of TAL/TCL constituents was accomplished. During 2003, two rounds of sediment sampling and analysis were accomplished, immediately prior to and following a hurricane event with flooding of the Watson Creek area. During 2004, the monitoring was substantially expanded to include collection and analysis of sediment pore water, as well as two surface water sampling events, and sediment bioassay.

The principal findings from the 1999 through 2004 LTM work were that:

- The COCs in sediment (arsenic, copper, mercury, silver, zinc, and 4,4-DDE) do not pose risk to benthic organisms.
- The concentrations of COCs in sediment are not increasing.
- Storm events involving water flow over Watson Creek Road from the Gunpowder River into Watson Creek do not pose risk to ecological receptors by disturbing contaminated sediment.
- While the concentration of mercury in Watson Creek sediment is slightly higher than background, the mercury in Watson Creek sediment does not appear to bioaccumulate to the extent that it poses unacceptable risk to either populations of higher trophic level fish or to humans through consumption of fish.

Based on the results of LTM for 1999 through 2004, the LTM was revised to be performed once every five years, preceding the five-year remedy review. Sediment samples were collected in 2007 from the same 12 locations within Watson Creek that were sampled during the 1999 through 2004 period. Samples were analyzed for TAL metals and TCL pesticides.

All sediment sampling and analysis results for 2007 are consistent with LTM data from the 1999 through 2004 period, except for the concentration of copper in the sample from location WC-03. The copper concentration in this sample, 794 milligrams/kilogram (mg/kg), was substantially higher than copper concentrations observed in any other sediment samples collected from Watson Creek during previous LTM or prior RI/FS sampling and analysis. It is uncertain if this laboratory result is representative of the copper concentration in sediment at this location, or is an anomaly.

Cost

The Focused Feasibilty Study (FFS) and ROD for Watson Creek present an annual cost of $46,000 for the selected remedy. The current O&M cost as provided by DSHE is $25,000 per year in which LTM sampling and analysis is performed, representing a substantial reduction in cost from the original estimate. However, at this point, all institutional controls and public education programs have been implemented and warning signs and fences have been installed. The current LTM cost assumes collection and analysis of 12 sediment samples.

2.7 TECHNICAL ASSESSMENT

The results of the technical assessment, in accordance with Guidance, are summarized in Tables 2-4 through 2-6. Only sites with implemented RODs are included in this evaluation. These include OU 1 (groundwater at Old O-Field), OU 2 (Old O-Field Source Area), and OU 3 (Watson Creek surface water and sediment).

Recommendations regarding all OUs are included in Subsection 2.8.

Table 2-4. O-Field Study Area Technical Assessment: OU 1

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents?	☒ **Yes**	☐ **No**
▪ **Remedial Action Performance**		
Groundwater Containment Remedy	Y	The remedy has been implemented in accordance with the ROD, as modified by the ESD. Groundwater capture is maintained.
▪ **System Operations/O&M**		
Groundwater Extraction System (GES) and Groundwater Treatment Facility (GWTF)	Y	LTM and O&M are ongoing and conducted in accordance with the ROD, as modified by the ESD. The remedy has performed as intended in achieving hydraulic control of the plume of contamination, restricting its movement toward Watson Creek. The GWTF performs better in removing contaminants than the discharge criteria established by MDE. O&M procedures appear satisfactory to keep the remedy functioning as intended. System performance data, including cost information, are included in Subsection 2.6.1.
▪ **Opportunities for Optimization**		
GES and GWTF	Y	Significant upgrades have been made recently to the GES, including replacement of the entire conveyance line, installation of one new extraction well, and conversion of an existing monitoring well to an extraction well. The GWTF is performing well; however, the major components of the treatment train are aging. Capital improvements will be required to sustain the current performance. Potential upgrades to the existing equipment (e.g., changes to the lime delivery system) may help to reduce labor/material demands and ultimately reduce O&M costs.
▪ **Early Indicators of Potential Issues**		
GES and GWTF	N	There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
Old O-Field Site	Y	The site is located in a restricted area of the Installation, with access limited to badged or escorted personnel.

Table 2-4. O-Field Study Area Technical Assessment: OU 1 (continued)

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	The Safe Drinking Water Act Maximum Contaminant Levels (MCLs) for arsenic and chloroform changed between ROD completion in 1991 and the five-year review in 2002. No significant changes have been made to the list of MCLs since 2002. Changes in Standards for protection of human health do not substantively affect the conclusions of the original risk assessment nor the remedy selected.
TBC guidance for protection of ecological receptors	Y	The 1991 preliminary risk assessment indicated that the maximum concentrations of a number of metals in nearby Watson Creek surface water exceeded Ambient Water Quality Criteria (AWQC) for the Protection of Aquatic Life. AWQC on which this assessment were based were evaluated to determine if criteria may have changed and what effect that may have on the current risk. Some minor changes have occurred to State and Federal AWQC. However, none of these changes substantively affect the original conclusions of the risk assessment or the remedy selected.
▪ **Changes in Exposure Pathways**		
Ecological Receptors	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Human Health	Y	The Army and regulators have identified vapor intrusion as a new potential exposure pathway (see Attachment C). However due to remedial activities, future construction is not anticipated. All other exposure pathways and receptors remain unchanged.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
Old O-Field Groundwater	N	Although changes have been made to some of the COC toxicity values, the COCs are removed from the treated water prior to discharge to concentrations below those required for discharge, so the remedy is protective.
▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	ERA methods have changed since the ROD was signed in 1991. However, none of the changes substantively affect the original conclusions of the risk assessment.
Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed since the ROD was signed in 1991. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
Old O-Field Groundwater	Y	The remedy protects human health and the environment from the risks associated with groundwater contamination, by capturing the groundwater prior to discharge into Watson Creek.

Table 2-4. O-Field Study Area Technical Assessment: OU 1 (continued)

Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
Old O-Field Groundwater	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
Old O-Field Groundwater	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
Old O-Field Groundwater	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 2-5. O-Field Study Area Technical Assessment: OU 2

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Permeable Infiltration Unit (PIU) – Source Area	Y	The remedy has been implemented in accordance with the ROD, as modified by the ESD.
▪ **System Operations/O&M**		
PIU	Y	LTM and O&M are ongoing and conducted in accordance with the ROD, as modified by the ESD.
▪ **Opportunities for Optimization**		
PIU	N	At this time, no optimization opportunities have been identified for OU 2. However, the Army is currently developing an Alternatives Evaluation for integration of the remedies at OU 1 and OU 2, in support of a final remedy.
▪ **Early Indicators of Potential Issues**		
PIU	N	There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
Old O-Field Site	Y	LUCs have been implemented in accordance with the ROD. The site is also located in a restricted area of the Installation, with access limited to badged or escorted personnel. The Source Area is also fenced.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	Army Airborne Exposure Limits (AELs) have been updated since the ROD was signed in 1994. However, the new lower standards do not affect the remedy selected or the type of real-time air monitoring device currently used.
TBC guidance for protection of ecological receptors	Y	USEPA Region III released soil screening guidance after construction of the PIU. However, this new guidance does not affect the original conclusions of the risk assessment or the remedy selected.
▪ **Changes in Exposure Pathways**		
Ecological Receptors	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Human Health	Y	The Army and regulators have identified vapor intrusion as a new potential exposure pathway (see Attachment C). However due to land use restrictions in this area, future construction over the Source Area is not anticipated. All other exposure pathways and receptors remain unchanged.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
Old O-Field Source Area	N	Although changes have been made to some of the COC toxicity values, the PIU prevents exposure to the contaminated soils.

Table 2-5. O-Field Study Area Technical Assessment: OU 2 (continued)

▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	A traditional quantitative ERA was not conducted for OU 2, due to the unique nature of the site. The ROD assumed that the risks associated with exposure to media within the fenced portion of Old O-Field would be mitigated through the installation of the PIU. Although risk assessment methods have changed since the ROD was signed in 1994, none of the changes substantively affect the original conclusions of the risk assessment or the remedy selected.
Human Health Risk Assessment (HHRA)	Y	A traditional quantitative HHRA was not conducted for OU 2, due to the unique nature of the site. The ROD assumed that the risks associated with exposure to media within the fenced portion of Old O-Field would be mitigated through the installation of the PIU. Although risk assessment methods have changed since the ROD was signed in 1994, none of the changes substantively affect the original conclusions of the risk assessment or the remedy selected.
▪ **Expected progress towards meeting RAOs**		
Old O-Field Source Area	Y	The remedy protects human health and the environment from exposure to CWM, munitions, and other waste materials in the Source Area.
Has any other information come to light that could call into question the protectiveness of the remedy?		☐ **Yes** ☒ **No**
▪ **Ecological risk assessment**		
Old O-Field Source Area	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
Old O-Field Source Area	N	No changes have been identified in site conditions since the emplacement of the remedy.
▪ **Other information that could call into question the remedy protectiveness**		
Old O-Field Source Area	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 2-6. O-Field Study Area Technical Assessment: OU 3

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Watson Creek Sediment	Y	LTM activities have been conducted in accordance with the ROD.
▪ **System Operations/O&M**		
Watson Creek Sediment	NA	
▪ **Opportunities for Optimization**		
Watson Creek Sediment	Y	LTM frequency has been reduced (consistent with the ROD) and may no longer be necessary.
▪ **Early Indicators of Potential Issues**		
Watson Creek Sediment		There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
Watson Creek Sediment	Y	LUCs have been implemented in accordance with the ROD. The site is also located in a restricted area of the Installation, with access limited to badged or escorted personnel.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	N/A	The remedy was not based on human health; therefore, this question is not applicable.
TBC guidance for protection of ecological receptors	Y	There have been changes to screening levels for ecological receptors in sediment since the ROD was signed in 1997. However, none of these changes substantively affect the original conclusions of the risk assessment or the remedy selected.
▪ **Changes in Exposure Pathways**		
Ecological Receptors	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Human Health	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
Watson Creek Sediment	N	Concentrations of sediment COCs have not increased, nor has the distribution of COCs changed from historical conditions.
▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	ERA methods have changed since the ROD was signed in 1997. However, none of the changes substantively affect the original conclusions of the risk assessment.

Table 2-6. O-Field Study Area Technical Assessment: OU 3 (continued)

Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed since the ROD was signed in 1997. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
Watson Creek Sediment	Y	The remedy protects human health and the environment through institutional controls and long-term monitoring.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
Watson Creek Sediment	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
Watson Creek Sediment	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
Watson Creek Sediment	N	No additional information that could call into question the remedy protectiveness has been identified.

2.7.1 Opportunities for Optimization

The following items are recommended for implementation or additional evaluation to document rationale/justification before implementation:

- OU 1 – Evaluate continued use of the on-line ventilatory biomonitoring system. Issues that need to be considered include: (1) fish sensitivity to the principal COCs (heavy metals and VOC) at the required discharge limits; (2) fish sensitivity to parameters that can and are being monitored and recorded, such as pH, temperature, and dissolved oxygen; and (3) many alarms in the past have been related to power failures and managing the control water rather than improperly treated effluent. Based on these issues, this system may not be justified beyond academic interest.

- OU 2 - Evaluate the need for real-time air monitoring. O&M of the current system is time-consuming and expensive. Based on over a decade of air monitoring data, analyses of explosive risks, and stable conditions within the landfill (aside from occasional subsidence events), real-time monitoring is no longer warranted. Alternative monitoring strategies are under evaluation in the Alternatives Analysis for the final action ROD.

- OU 3 – Re-evaluate the long-term monitoring program for Watson Creek. It is recommended that supplemental sampling and analysis be performed to evaluate the anomalous copper analytical result. Assuming no finding of ecological risk associated with copper in sediment, current concentrations of constituents in sediment do not warrant continued remedial action pursuant to the OU 3 ROD RAOs. Ongoing monitoring under the interim action RODs (and the final action ROD will) address the potential for future impact to the creek. Hazards associated with UXO in Watson Creek will continue to be managed by the APG Installation Safety Program.

2.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

Since the last five-year review, USEPA has been placing more emphasis on assessment and remedial action to address the exposure pathway of vapor intrusion into structures. Volatile and toxic substances are COCs at Old O-Field. The footprint of concern for vapor intrusion is under the source area (OU 2) PIU and the groundwater extraction and monitoring field (OU 1). Buildings that would be inhabited on a regular basis cannot be placed on the permeable infiltration unit and are precluded by remedial activities in the extraction and monitoring field. The GWTF is outside the footprint of concern. The vapor intrusion pathway cannot be complete as long as remedial activities pursuant to the existing RODs for interim actions are ongoing. Vapor intrusion should be considered in the decision-making process for the final action ROD(s), ESDs, and other decision documents.

During the course of this five-year review, no other issues that impact protectiveness were discovered relating to the O-Field Study Area.

2.9 PROTECTIVENESS STATEMENT(S)

2.9.1 OU 1

The remedy at OU 1 currently protects human health and the environment because the waste is contained through capture and treatment of contaminants. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

2.9.2 OU 2

The remedy at OU 2 currently protects human health and the environment because the waste is contained. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

2.9.3 OU 3

The remedy at OU 3 currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in sediment are demonstrated to be levels that allow for unlimited use and unrestricted exposure. (See Sections 2.6.3 and 2.7.1.)

2.9.4 Remaining Areas

Removal Actions have been conducted at sites in this Study Area to address specific issues. These Removal Actions met their objectives and therefore provided reduction in risk. A formal Protectiveness Statement for these sites cannot be made until the RI/FS/ROD/RA process is completed.

2.10 NEXT REVIEW

Final RODs for Old O-Field (OUs 1 & 2) and New O-Field/Other O-Field Areas (OU 4) are anticipated in FY09; therefore, it is recommended that a five-year review be conducted in 2013 for all four O-Field OUs (OU 1, OU 2, OU 3, and OU 4).

3.0 J-FIELD STUDY AREA

3.1 OVERVIEW

The J-Field Study Area, located at the southern tip of the Gunpowder Neck Peninsula (Figure 1-2), consists of seventeen AEDB-R sites (listed in Exhibit 2). All of these sites, with the exception of Robbins Point Demolition Ground (EAJF04) – an active RCRA site, have been addressed under one of three RODs:

- J-Field Soil OU (SOU)
- J-Field Groundwater
- White Phosphorus Burning Pits

An RI was conducted for the J-Field Study Area from 1994 through 1998. The findings of this investigation were described in the *Remedial Investigation Report for J-Field* (June 1998). Based upon preliminary RI investigation results, an interim ROD was developed in 1996 for the J-Field SOU, which included the Toxic Burn Pits and Southern Main Pits. This ROD specified removal of contaminated soil followed by placement of a soil cover and erosion controls for a portion of the J-Field shoreline. The SOU ROD was amended by an ESD in 2001, to remove the requirement for further excavation.

Groundwater data indicated that residual, dense, non-aqueous phase liquid (DNAPL) could be present in the Surficial Aquifer. DNAPL removal and remediation to maximum MCLs were shown to be technically impracticable in a Technical Impracticability (TI) Evaluation. As part of the TI Evaluation, an Alternative Remedial Strategy was developed to provide protectiveness at the J-Field Study Area. This Alternative Remedial Strategy called for establishing institutional controls, continuing the phytoremediation demonstration and extending the phytoremediation zone, monitoring the natural processes, and extending the monitoring of the Confined Aquifer. The Alternative Remedial Strategy also addressed Confined Aquifer Well JF-51, which was to be abandoned and replaced, and specified free phase DNAPL recovery in the area around temporary Geoprobe® well GP-53. The Final ROD, signed in September 2001, addressed the Surficial Aquifer, the Confined Aquifer, and remaining soil areas [aside from the two active sites, the White Phosphorus Burning Pits and Robbins Point Demolition Ground].

After the White Phosphorus Burning Pits area was closed to emergency disposal operations in 2001, a RI/FS was initiated for the site. In 2004/2005, slightly elevated metals were found in soil and slightly elevated VOC were detected in groundwater. The risk assessments concluded that there were no potential unacceptable risks for human or ecological receptors for a military/industrial land use scenario. However, based on blood level modeling, lead posed a potential risk to hypothetical future child residents. Trichloroethene (TCE) concentrations in groundwater also posed a potential risk to a hypothetical future resident. However, it was determined that the groundwater contamination did not constitute a plume, but instead was present in isolated hot spots.

These hot spots were determined not to cause a threat to the environment and no unacceptable ecological risks were identified. The Final ROD for the White Phosphorus Burning Pits, signed in September 2007, specified that existing LUCs continue and additional LUCs preventing future military family housing, elementary and secondary schools, child care facilities, playgrounds, and non-military residential land use be implemented.

3.2 SITE CHRONOLOGY

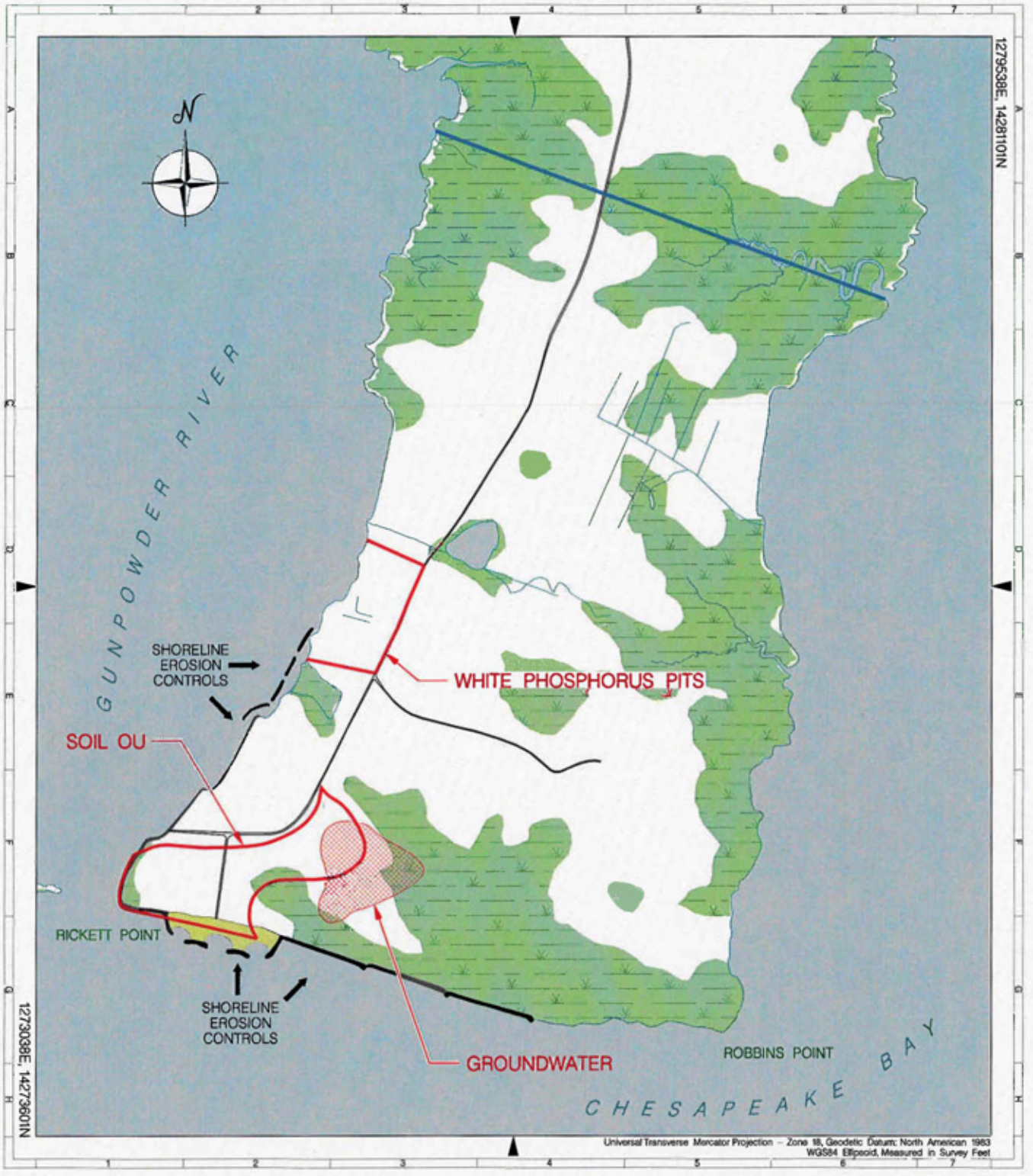
According to terrain maps available from the time period prior to World War II (WWII), some areas of J-Field were cleared between the years 1920-1930. It has also been documented that J-Field was used for the testing of High Explosives (HE) and munitions during WWII as well as for the thermal decontamination of chemical munitions. In addition, open pits were used to detonate or burn CWM and HE. Limited testing of chemical agents occurred at J-Field from 1946-1971; however, open-air testing of chemical agents was halted in 1969.

Since 1980, J-Field has had only limited use. Limited areas remain as active emergency open detonation locations at J-Field.

As noted, three RODS have been written for the J-Field area. In September 1996, a ROD was written for the J-Field SOU. This OU consists of the two main burn pits (Northern Main Burn Pit and Southern Main Burn Pit) as well as the Push-out Area. A second ROD covering the Surficial Aquifer and remaining sites was signed in September 2001. The third ROD, covering the White Phosphorus Burning Pits, was signed in September 2007. The J-Field sites are shown on Figure 3-1.

The SOU ROD was implemented in 1998, and construction of the Protective Soil Blanket (PSB) was completed in 2001. The 2-foot minimum excavation depth specified in the ROD was achieved; however, the levels of arsenic and lead in the soil had not been reduced to the intended cleanup performance standards. UXO and other hazardous materials were encountered in the soil. As a result, further excavation was carried out by hand in Level B Personal Protective Equipment (PPE). It was determined that although some contaminants remained at levels above their action levels, additional removal would not enhance the protectiveness of the remedy. An ESD was developed in 2001 to modify the remedy to state that additional excavation would not be conducted. The PSB was constructed as specified in the 1996 ROD. The purpose of the PSB was to protect human health and the environment from potentially harmful effects of contact with the soil at the site. Groundwater monitoring and LUCs, implemented in response to the 2001 and 2007 RODs, will provide additional protection of human health and the environment.

Table 3-1 lists the dates of important events occurring within the J-Field Study Area.



1000 750 500 250 0 500 1000 2000

GRAPHICAL SCALE
IN FEET (1" = 1000')

1:12000

L E G E N D

- Water
- Road
- Wetland
- Study Area Boundary
- Operable Unit Boundary
- Groundwater Plume

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TITLE:

J-FIELD STUDY AREA OPERABLE UNITS

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	C. HOULIK	02-26-08	3-1

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Table 3-1. J-Field Site Activity Chronology

Date	Activity
1977-1978	Environmental Contamination Survey
1983	Munitions Disposal Study
1989	RCRA Facility Assessment
1987-1992	Hydrological Assessment, Phase I
1989	Monitor Wells Installed in First Confined Aquifer
1990	Edgewood Area included on the National Priorities List
1990	Federal Facility Agreement
1991-1996	Remedial Investigation Activities
1992	Characterization and Interim Remediation
1992	Hydrological Assessment, Phase II
1992	Sediment Sampling Study
1993-present	Surface Water Sampling
1994	Piezometer Installation and Sampling
1994	Toxic Pits Pilot Remediation Study
1994	Drum Removal from Prototype Building
1994-1996	Ecological Risk Assessment
1994-1997	Aquatic Toxicity Evaluation
1995	Deep Drilling
1996	Record of Decision for Soil OU
1996	Well Installation and Sampling
1997-2000	Natural Attenuation Study
1997-present	Phytoremediation Remedy
1997-1999	Honeybee Biomonitoring Program
1998-present	Groundwater Level Monitoring Study
1998-1999	Hydrogen Release Compound Treatability Study
1998-1999	Vacuum Vaporizer Well Technology Treatability Study
1998-2001	1996 Record of Decision Implementation
1998-1999	Shoreline Erosion Controls
1999	Cone of Depression Located in Center of Phytoremediation Area
1999	Biosolids Investigation
1999	Borehole Geophysical Investigation
2000	Confined Aquifer Wells Abandonment and Replacement
2000	Geochemical Evaluation of Arsenic and Lead Mobility
2000	Sampling for Products of Combustion
2000	Surficial Aquifer Feasibility Study
2001	Time Critical Removal Action
2001	Proposed Plan and Record of Decision for Groundwater
2001	Explanation of Significant Differences for Soil OU
2002 - 2007	Shoreline Post-Construction Surveys
2003	Remedial Action Completion Report – Soil OU
2004	LTM/O&M Plan for the J-Field Study Area
2004 - 2005	Remedial Investigation at White Phosphorus Burning Pits
2007	LTM Annual Report (Year 1) and Biomonitoring Report
2007	Focused Feasibility Study, Proposed Plan, and Record of Decision for White Phosphorus Burning Pits
2007 - present	Deciduous forest planted at White Phosphorus Burning Pits

3.3 SITE BACKGROUND

3.3.1 Physical Characteristics

J-Field is located at the southern end of the Gunpowder Neck peninsula (Figure 1-2). The J-Field Surficial Aquifer contains a contaminated groundwater plume in the Toxic Burn Pits area. At J-Field, there are four primary hydrostratigraphic units classified in descending order from ground surface as: (1) Surficial Aquifer, (2) Confining Unit, (3) First-Confined Aquifer, and (4) Undifferentiated Semi-confined to Confined Aquifer Unit.

The flow of the groundwater in the Surficial Aquifer can be classified as having an east to southwest direction. The groundwater discharges to the surrounding freshwater marshes. The source of the VOC plume, the former Toxic Burn Pits, resides on a local topographic high. This area contributes groundwater recharge to the Surficial Aquifer. Due to seasonal variations in the water table, groundwater levels vary by approximately 3 feet. Short-term shifts in the hydraulic gradient and flow direction can be attributed to these fluctuations in the water table.

More than 100 feet of Quaternary fluvial and estuarine sedimentary deposits as well as older geologic formations underlie the J-Field site. The maximum elevation at J-Field is approximately 10 feet, resulting in a nearly flat area. In addition, J-Field contains many marsh areas with plants such as common reed and cattail. Forests dominate the remaining areas at J-Field. Yellow poplar and deciduous trees are common in the non-marshy areas. There are open areas with upland grasses along the western shore of J-Field (ICF Kaiser Engineers, 1996).

The J-Field shoreline area consists of a low upland bank along approximately 1,000 feet of its westernmost portion. Marsh dominates the remaining portion of the project shoreline with two pond areas, known as Little Pond and Big Pond, in the vicinity. Big Pond has significant habitat value as a brackish to freshwater floating bog. Historically, and prior to ROD implementation, shoreline erosion in this area proceeded at a rate of approximately 2.5 to 3 feet per year, and threatened not only the unique marsh habitat associated with Big Pond, but also the buried ordnance and remediation sites located at J-Field. To alleviate and reduce erosion impacts in this area in accordance with the J-Field SOU ROD, the J-Field Shoreline Protection Plan was implemented in fall 1998, including a stabilization system protecting the affected shoreline from Ricketts Point to the eastern edge of Big Pond. This stabilization system serves to protect the freshwater marsh habitat, Big Pond, and J-Field. The construction project consisted of 1,400 feet of intermittent stone revetments and 900 feet of headland breakwaters, spurs, beach fill (sand), and marsh plantings spanning approximately 2,800 feet of the shoreline area.

The J-Field Study Area is located in a restricted region of the Edgewood Area. APG physical security measures have been implemented to prevent unauthorized personnel from entering and to increase security at the site. Additional institutional controls were added under the 2001 and 2007 J-Field Study Area RODs.

3.3.2 Land and Resource Use

Edgewood Area has been a center for the development, testing, and manufacture of CWM since WWI. However, little is known about the land use of J-Field prior to WWII. Evidence of cleared areas suggests that some sections of J-Field may have been used for testing activities during this time period.

During WWII, J-Field was used for testing HE and munitions, and for thermal decontamination of chemical munitions. Chemical agents, chemical wastes, and HE were burned or detonated in open pits. Extensive use of the burn pits took place during the 1940s to 1960s and some additional use of the pits continued into the 1970s (ICF Kaiser Engineers, 1996).

J-Field has had only limited use since 1980. Current activities are conducted in accordance with applicable regulations. The only area at J-Field that remains active for open burning / open detonation (OB/OD) operations is Robbins Point. This area is maintained and will be closed (as appropriate) when its use is no longer required for APG's mission.

The groundwater from the J-Field site is not currently used and no plans exist for future groundwater use. Restrictions on groundwater use from the Surficial Aquifer and Upper Confined Aquifer (unless the untreated water meets applicable standards and criteria) have been implemented under the 2001 ROD and 2004 LUC Implementation Plan for J-Field.

3.3.3 History of Contamination

Chemicals historically disposed at J-Field include nerve agents (such as VX), blister agents, riot control agents, WP, and chlorinated solvents, as well as drummed chemical wastes generated by research laboratories, process laboratories, pilot plants, and machine and maintenance shops (Argonne, 1998). Between 1946 and 1971, limited testing of chemical agents continued at J-Field. Open-air testing of chemical agents stopped in 1969. Heavy metals; petroleum related compounds; chlorinated methanes, ethanes, ethenes; PCB; and pesticides were reported at the J-Field SOU.

3.3.4 Previous Removal Actions

Previous removal actions at J-Field are listed in Table 3-2. The overall protectiveness of the removal actions is evaluated with the final remedy.

3.3.5 Contaminant Media

The contaminated media at J-Field include groundwater and soil. The groundwater COCs are primarily VOC; whereas, the COCs for soil (SOU and White Phosphorus Burning Pits) are metals such as arsenic and lead.

Table 3-2. J-Field Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
Drum Removal Action	1994	Corrective Action Phase I; Removal of drums.	Removal of four drums with unknown contents from Prototype Building and construction of erosion controls.
Time-Critical Removal Action	May to October 2001	Remove/excavate surface debris and metallic anomalies and level existing piles/mounds to the surrounding area ground elevations. Need for Time Critical Removal Action determined when controlled burn of phragmites at J-Field revealed the mounded areas.	Total surface area cleared was approximately 26 acres. Six unexploded ordnance/ordnance and explosives (UXO/OE) items were discovered and turned over to USATEU for disposal. USATEU discovered and removed 297 AN-M50 incendiary magnesium bomblets. Recovered non-hazardous OE scrap and non-OE scrap-related debris (total of 119,140 lbs) sent for disposal. In addition, 22,500 lbs of concrete material were removed from the Phase IV area.

3.4 REMEDIAL ACTIONS

3.4.1 Operable Units

Table 3-3 summarizes the remedial actions conducted to date in the J-Field Study Area. The basis for taking action (RAOs), selected response, and performance standards are listed in Exhibit 1.

3.4.2 Progress Since Last Five-Year Review

The White Phosphorus Burning Pits ROD has been signed and is under implementation.

Table 3-3. J-Field Study Area Remedial Action Summary

Functional Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
Soil OU	ROD – 1996 ESD – 2001	1. No Action 2. In Situ Containment and Limited Disposal 3. Removal and Short Term Storage 4. Removal, Off-Site Treatment, and Limited Disposal 5. Removal, Off-Site Treatment, and Disposal	In Situ Containment and Limited Disposal Erosion Controls	The selected remedy was implemented from 1998-1999. An ESD was signed to change the remedy. The ESD explained that the specified levels of arsenic and lead were not reached before excavation was stopped because the presence of large amounts of UXO and CWM made further excavation more difficult than originally expected. (Remedial costs would have been increased by a factor of 6 to 10.) Although some contamination above Action Levels remained, it was determined that additional removal would not enhance the protectiveness of the remedy. In Fall 2001, the PSB was constructed in accordance with the Interim ROD/ESD.
Groundwater	ROD – 2001 TI Waiver – 2001	1. No Action 2. Institutional Controls 3. Phytoremediation with Institutional Controls 4. Monitored Natural Attenuation (MNA) with Institutional Controls and Phytoremediation 5. Integrated Remedial System: In Situ Source Area Treatment Using Groundwater Circulation Wells, MNA, and Phytoremediation 6. Integrated Remedial System: Source Area Treatment Using Groundwater Pumping, Transport, and Off-Site Treatment of Groundwater, MNA, and Phytoremediation	Institutional Controls Phytoremediation Monitoring of biodegradation processes Abandonment and replacement of confined aquifer well JF-51 Possible addition of a supplement to the replacement well for JF-51 Monitoring of the Confined Aquifer Limited recovery of DNAPL.	The selected remedy has been implemented. Phytoremediation trees were planted in Fall 2001, with additional trees planted in 2002 - 2007 (as needed). The LTM/O&M Plan was finalized in 2004. LTM activities began in 2006, with the first annual report issued in 2007.
White Phosphorus Burning Pits	ROD – 2007	1. No Action 2. Land-Use Controls (LUCs) 3. In-Situ Containment, Soil Blanket* 5. Excavation and Off-Site Disposal	LUCs Five-Year Reviews	LUCs will be implemented to prevent future military family housing, elementary and secondary schools, child care facilities, playgrounds, and non-military residential land use. LUCs will be maintained until the concentrations of hazardous substances in the soil and groundwater are reduced to levels that allow for unlimited use and unrestricted exposure. If this site is subsequently remediated to allow for unlimited use and unrestricted exposure, LUCs will no longer be required.

* Alternative 4 (In-Situ Containment – RCRA cap with LUCs) was not discussed in the Proposed Plan or ROD because it was eliminated from consideration during the Alternatives Analysis section of the Focused FS.

3.5 FIVE-YEAR REVIEW PROCESS

During the review process, the status of the remedial actions at the J-Field Study Area in APG was determined. To accomplish this goal, the J-Field site was visually inspected and available data were reviewed. In addition, the site Project Officer was interviewed in order to obtain further information regarding the status of the site. Input was also obtained from MDE and the RAB.

The Project Officer for the J-Field site, Mr. John Wrobel, was interviewed on 29 October 2007. The results of this interview are summarized in Attachment A. The J-Field site inspection was conducted on 18 December 2007 and 13 May 2008. Photodocumentation is provided in Attachment D to this document.

Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

3.6 FIVE-YEAR REVIEW FINDINGS

3.6.1 Site Inspection

A site inspection was conducted at J-Field on 18 December 2007 and 13 May 2008. Site inspection checklists are provided in Attachment E.

3.6.2 Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

3.6.3 Technology Evaluation

Alternative technologies have been evaluated for each site with an implemented ROD for purposes of remedial action optimization. A summary of these technologies is presented in Attachment F of this document.

The J-Field Surficial Aquifer exhibits both tight soil conditions and the likely presence of DNAPL, as supported by the demonstration presented in the TI waiver. This constraint has been shown to fundamentally limit the ability to apply in situ treatment technologies because of the difficulty in achieving transport of material through the aquifer. The previous pumping test and treatability tests using groundwater circulation wells and in situ bioremediation additives (Hydrogen Release Compound) showed that, even though the technologies themselves may have some use for the COCs, hydrogeologic conditions limited their effectiveness. Many of the emerging technologies for VOC in groundwater, summarized in Attachment F, would have this same limitation.

The 2006 LTM report concluded, "Because the phytoremediation grove is still relatively young, the full impact of the trees on water levels may not be fully known at this time.

Analysis of groundwater data collected in 2006 indicates that seasonal plume containment by the phytoremediation system occurs within the Surficial Aquifer. It was noted, however, that the mature forests nearby appear to have a greater effect on the water table than does the phytoremediation grove. As the young trees mature, a larger impact will likely be seen from the plantation."

Attachment F also discusses some technologies being evaluated for further investigation and, possibly, recovery of DNAPL. The J-Field TI Waiver suggested that, where such DNAPL may exist, it was likely in the form of non-mobile, sorbed residual within the soil rather than as mobile, free phase material amenable to collection. During the first round of LTM in 2006, the two source area wells (JFRW-1 and JFRW-2), were evaluated for the presence of DNAPL based on visual inspection and testing with Red Oil-O (hydrophobic dye). Well JFRW-2 was the only well that gave any indication of DNAPL presence, but it was not in a measurable amount. Therefore, the results from the 2006 LTM event support the earlier hypothesis in the TI Evaluation that DNAPL recovery is unlikely to be successful.

Finally, past experience at J-Field has demonstrated the issues associated with efforts to excavate material from the site and the possible presence of UXO/CWM is a significant barrier to further invasive remediation of the site. As summarized in Attachment F, the resolution of these uncertainties in terms of the ability to identify and discriminate UXO/CWM in the deeper subsurface is not likely to be achievable in the near future.

3.7 TECHNICAL ASSESSMENT

The results of the technical assessment, in accordance with Guidance, are included in Tables 3-4 through 3-6. Recommendations are included in Subsection 3.8.

3.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

Volatile and toxic substances are COCs in J-Field groundwater and vapor intrusion was not addressed in the Groundwater OU ROD. The vapor intrusion pathway is adequately addressed by the White Phosphorus Burning Pits ROD. There are no existing buildings that are inhabited on a regular basis. It is recommended the J-Field LUCs for the Groundwater OU be amended to address vapor intrusion.

During the course of this five-year review, no other issues that impact protectiveness were discovered relating to the J-Field Study Area.

Table 3-4. J-Field Study Area Technical Assessment: Soil Operable Unit – Toxic Burn Pits

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
J-Field SOU – Toxic Burn Pit Excavation and Protective Soil Blanket (PSB)	Y	The remedy has been implemented in accordance with the ROD, as modified by the ESD. The PSB provides additional protection of human health and the environment, by preventing exposure to contaminated soil.
▪ **System Operations/O&M**		
	Y	LTM and O&M are ongoing and conducted in accordance with the ROD, as modified by the ESD. Routine maintenance of the PSB includes inspection for signs of disturbance or animal intrusion.
▪ **Opportunities for Optimization**		
	N	At this time, no optimization opportunities have been identified for the J-Field SOU.
▪ **Early Indicators of Potential Issues**		
	N	There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs have been implemented in accordance with the ROD. The site is also located in a restricted area of the Installation, with access limited to badged or escorted personnel.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	There are no promulgated standards for soil. To-be-considered guidance such as USEPA Risk-Based Concentrations has been updated since the ROD was signed; however, the new guidance does not affect the original conclusions of the risk assessment or the remedy selected.
TBC guidance for protection of ecological receptors	Y	USEPA Region III released soil screening guidance after construction of the PSB. However, this new guidance does not affect the original conclusions of the risk assessment or the remedy selected.
▪ **Changes in Exposure Pathways**		
Ecological Receptors	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Human Health	Y	The Army and regulators have identified vapor intrusion as a new potential exposure pathway (see Attachment C). However due to land use restrictions in this area, future construction in the vicinity of the PSB is not anticipated. All other exposure pathways and receptors remain unchanged.

Table 3-4. J-Field Study Area Technical Assessment: Soil Operable Unit – Toxic Burn Pits (continued)

▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	Although changes have been made to some of the COC toxicity values, exposure to the contaminated media has been prevented through the construction of the PSB.
▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	ERA methods have changed since the ROD was signed in 1996. However, none of the changes substantively affect the original conclusions of the risk assessment.
Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed since the ROD was signed in 1996. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
	Y	The remedy protects human health and the environment from the risks associated with exposure to soil containing elevated concentrations of arsenic, lead, and PCB.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 3-5. J-Field Study Area Technical Assessment: Groundwater

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
J-Field Groundwater	Y	The remedy has been implemented in accordance with the ROD. The LUCs implemented as part of the remedy provide protection of human health and the environment, by restricting groundwater use.
▪ **System Operations/O&M**		
	Y	LTM and O&M are ongoing and conducted in accordance with the ROD. The cones of depression and flow reversals observed during water level monitoring suggest that the phytoremediation plantation is providing hydraulic containment of the VOC plume during the growing season (except during periods of significant precipitation). LTM results from 2006 confirm the presence of DNAPL; however, recovery efforts are unlikely to be successful due to site hydrogeological conditions. Overall, the LTM results suggest that the alternative remedial system is protective of human health and the environment.
▪ **Opportunities for Optimization**		
	N	At this time, no optimization opportunities have been identified for the J-Field groundwater.
▪ **Early Indicators of Potential Issues**		
	N	There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs, including groundwater use restrictions, have been implemented in accordance with the ROD. The site is also located in a restricted area of the Installation, with access limited to badged or escorted personnel.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	A TI waiver was approved prior to signature of the groundwater ROD. Thus, changes to MCLs have no affect on the original conclusions of the TI evaluation or remedy selected.
TBC guidance for protection of ecological receptors	NA	There are no promulgated standards for protection of ecological risk associated with groundwater.
▪ **Changes in Exposure Pathways**		
Ecological Receptors	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Human Health	Y	Modification of LUCs to address vapor is recommended (see Attachment C.)

Table 3-5. J-Field Study Area Technical Assessment: Groundwater (continued)

▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	Although changes have been made to some of the COC toxicity values, the LUCs mitigate exposure so the remedy is protective.
▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	There have been no significant changes to ERA methods since ROD signature in 2001.
Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed since the ROD was signed in 2001. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
	Y	The remedy protects human health and the environment from the risks associated with groundwater contamination.
Has any other information come to light that could call into question the protectiveness of the remedy?		☐ **Yes** ☒ **No**
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 3-6. J-Field Study Area Technical Assessment: White Phosphorus Burning Pits Area

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
White Phosphorus Burning Pits	Y	The remedy has been implemented in accordance with the ROD. The LUCs implemented as part of the remedy provide protection of human health through restrictions on residential land use. The results of the Ecological Risk Assessment (ERA) suggest no risk to ecological receptors at this site.
▪ **System Operations/O&M**		
	NA	The remedy selected for the White Phosphorus Burning Pits area does not include any ongoing O&M.
▪ **Opportunities for Optimization**		
	N	At this time, no optimization opportunities have been identified for the J-Field groundwater.
▪ **Early Indicators of Potential Issues**		
	N	There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs have been implemented in accordance with the ROD (remedial action completion report in preparation). The site is also located in a restricted area of the Installation, with access limited to badged or escorted personnel.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	NA	The ROD for this site was signed in September 2007. Since that date, there have been no changes to the standards for protection of human health.
TBC guidance for protection of ecological receptors	NA	The ROD for this site was signed in September 2007. Since that date, there have been no changes to the standards for protection of human health.
▪ **Changes in Exposure Pathways**		
Ecological Receptors	NA	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Human Health	NA	There have been no changes in exposure pathways for human health, since the ROD was signed
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	NA	There have been no changes in toxicity or other contaminant characteristics since the ROD was signed in September 2007.

Table 3-6. J-Field Study Area Technical Assessment: White Phosphorus Burning Pits Area (continued)

▪ **Changes in Risk Assessment Methods**		
ERA	NA	There have been no significant changes to ERA methods since ROD signature in September 2007.
Human Health Risk Assessment (HHRA)	NA	There have been no significant changes to HHRA methods since ROD signature in September 2007.
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been achieved. The remedy protects human health by preventing residential land use.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

3.9 PROTECTIVENESS STATEMENT(S)

The remedies for the J-Field Study Area have been implemented in accordance with the RODs signed in 1996 (as amended by the 2001 ESD), 2001, and 2007. All three remedies are protective of human health and the environment.

3.9.1 Soil OU

The remedy for J-Field SOU currently protects human health and the environment because all waste has been contained or removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

3.9.2 Groundwater

The remedy for J-Field Groundwater currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in groundwater are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

3.9.3 White Phosphorus Burning Pits

The remedy at White Phosphorus Burning Pits is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

3.10 NEXT REVIEW

It is recommended that the next five-year review for all three J-Field Study Area OUs be conducted in 2013.

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4.0 CANAL CREEK STUDY AREA

4.1 OVERVIEW

The Canal Creek Study Area has eleven OUs corresponding to the AEDB-R sites as listed in Exhibit 2. The Canal Creek OUs are as follows:

OUs with RODs	Non-ROD OUs
Building 103 Dump	Canal Creek Source Areas
Building 503 Burn Sites	West Branch Canal Creek Aquifer
Beach Point Test Site	Canal Creek Marsh and Landfill
East Branch Canal Creek Aquifer	Canal Creek Sediment
13 Select Sites	Kings Creek Sediment
G-Street Salvage Yard	

The non-RODs OUs are a current management tool that may change as the decision-making process evolves. Figure 4-1 shows the locations of the OUs with signed RODs within the Canal Creek Study Area[1].

The ROD for interim remedial action at the Building 103 Dump was signed in September 1995. The selected remedy included a cap with a geosynthetic membrane and clay barrier. The cap has been constructed and LTM/O&M is underway.

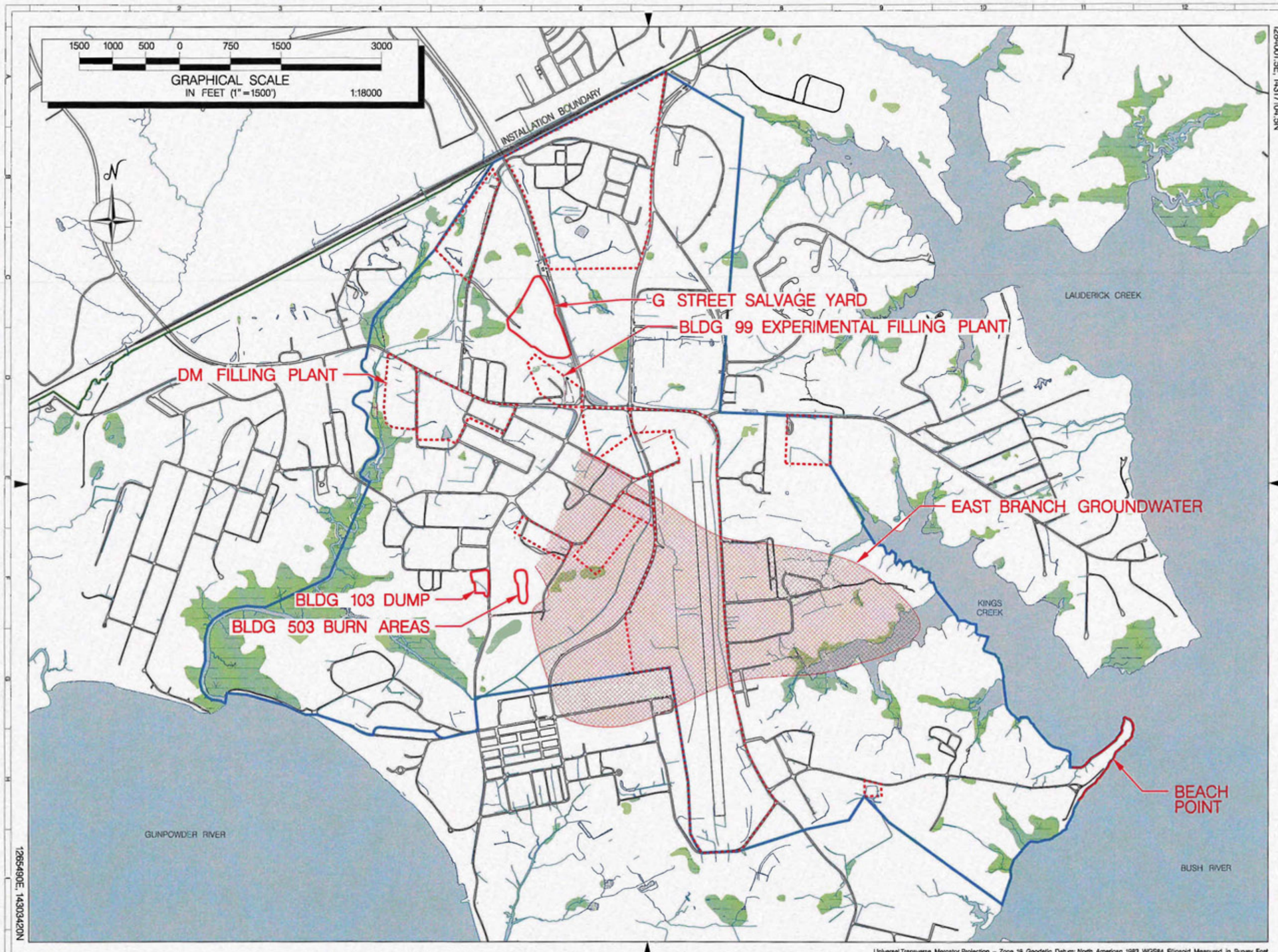
The Building 503 Burn Sites Soil has a ROD for interim action signed in April 1996, which identified excavation and disposal of contaminated soil and ash as the selected remedy. This ROD has been implemented. The ash from the Building 503 area was excavated and placed in the Building 103 Dump prior to and as part of construction of the Building 103 Dump containment system.

The ROD for the peninsula portion of the Beach Point Test Site was signed in September 1997. The selected remedy for this site included LUC and LTM. A TI Waiver was signed with the ROD, demonstrating the impracticability of removing DNAPL from the groundwater and remediating groundwater to concentrations below MCLs at the Beach Point site. LTM is underway for this site.

The ROD for the East Branch Canal Creek Aquifer, signed in July 2000, specified groundwater extraction/treatment with LUC and natural processes in the downgradient portion of the plume. The extraction and treatment system began operation in April 2003 and is currently in the O&M/LTM phase.

The ROD for 13 Select Sites signed in September 2006 established LUCs for all thirteen sites. Excavation and off-site disposal was also selected for two of the sites. As of

[1] In the interests of clarity and conciseness, sites for which the ROD specifies only institutional controls are not shown on maps throughout this document.



L E G E N D

- Road
- Water
- Wetland
- Structure
- Installation Boundary
- Canal Creek Study Area
- 13 Select Site Boundaries
- Site Boundaries
- Groundwater Plume

500 Edgewood Road, Suite 110
Edgewood, MD 21040
(410) 676-8835
www.gpworldwide.com
GENERAL PHYSICS CORPORATION

TITLE:

CANAL CREEK RECORD OF DECISION SITES

CARTOGRAPHER:	APPROVED BY:
B. JOYCE	C. HOULIK
DATE:	FIGURE:
11-30-07	4-1

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December 2007, the LUCs are in place and the arsenic-contaminated soil has been removed from the two action sites. All of the soil removed from the DM Filling Plant has been transported off-site for disposal. The excavated soil at the Building 99 site has been retained on site at APG, due to the presence of residual WP-contamination.

A ROD was signed for the G-Street Salvage Yard in September 2007 that specified excavation and off-site disposal of contaminated soil and waste materials. The Remedial Design and Site Safety Submittal were approved in fall 2007. UXO clearance activities began in November 2007.

4.2 SITE CHRONOLOGY

The Canal Creek Study Area has been utilized since WWI for the development, testing, and manufacturing of CWM. Current land use includes research and development, supply and storage, open space, outdoor recreation, administration, airfield, and industrial. A chronology of CERCLA activities at this Study Area is listed in Table 4-1.

Table 4-1. Canal Creek Site Environmental Activity

Date	Activity
1976 – 1979	U.S. Army Environmental Center Environmental Study
1977	U.S. Army Environmental Hygiene Agency (USAEHA) Surface Water Quality and Biological Study
1983 – 1984	Maryland State Health Department Sampling of Groundwater Wells
1985	U.S. Geological Survey Groundwater Contamination Study Initiated
1985	USAEHA Study on Biological Effects of Pollutants in Creeks
1986	USAEHA Study on Biological Effects of Pollutants in Sediment
1986	U.S. Geological Survey Canal Creek Study
1986	RCRA Permit Issued
1986	Hydrogeologic Assessment of SWMUs
1988	U.S. Geological Survey Soil Sampling and Analyses
1989	RCRA Facility Assessment
1989	Remedial Investigation (Phase I)
1989 – 1991	Preliminary Baseline Risk Assessment
1990	Edgewood Area Placed on National Priorities List
1990	Removal Action at G-Street Salvage Yard
1990 - 1996	Building 87 Pilot Plant Complex Decommissioning
1991	Removal Action at Building E3580 Drum Rack
1991 – 1993	Additional sampling to support Human Health Risk Assessment

Date	Activity
1992	Remediation Feasibility Assessment for Building E5625
1992	BBC Tank Removal
1992	Removal Action at Buildings Associated with Former Wound Ballistics Program
1992	Soil Excavation at Building E3580 Drainage Swales
1992 – 1996	Innovative Technologies Evaluation – Canal Creek Aquifer
1992 – 1996	U.S. Geological Survey Groundwater and Wetland Study
1993	Removal Action at Former Drum Rack Area
1993	Building 503 Burn Sites Feasibility Study
1994	Building 103 Dump Feasibility Study
1994	Delineation of Toxic Disposal Pits
1994	Underground Storage Tank (UST) Removal at WWII Railroad Yard
1994 – 1995	Groundwater Sampling for Metals
1995	E5625 Sumps Closure
1995	E5188 WP Scrubber Tower Removal
1995	Standby Well Closure
1995	Baseline Risk Assessment
1996	Building 103 Dump Interim ROD
1995	Soil Sampling at Experimental Plants Dumps
1995	Sump Closure at Building E3640
1996	Building 503 Burn Sites ROD
1996	U.S. Geological Survey Freshwater Wetland Studies
1996	Remedial Investigation (Phase II)
1996	Surface and Subsurface Hydrogeology Studies
1996	Beach Point Focused Feasibility Study
1996	Installation of temporary soil cover at G-Street Salvage Yard
1997	Beach Point Technical Impracticability Waiver and ROD
1997	WWII Experimental Chlorine Plant Dump Sites Removal Action
1997	Lewisite Sump Closure
1998	Building 99 (E5032) Building Removal
1998-2000	Hazardous Material Facility Removals
1998	Canal Creek Aquifer Feasibility Study
1999	Beach Point Remedy Implementation

Date	Activity
2000	Canal Creek Aquifer East Plume ROD
2001	Final Remedial Action Report – Building 103 Dump
2003	Building E5185 Canal Creek Mustard Tank Investigation Closeout Report
2003	Phase II Remedial Investigation Report, IRP Sites 2, 6, and 46
2004	Interim Remedial Action Completion Report, East Canal Creek Area Plume, Canal Creek Aquifer
2004	Remedial Action Report, Building 503 Smoke Plant
2004	Three Sites in Canal Creek Ecological Risk Assessment, Data Evaluation and Risk Characterization
2004	Draft Feasibility Study for West Canal Creek Area Groundwater
2004-2006	Biomat Design, Installation, and Direct Injection Pilot Test at Seep 3-4W
2004-2006	Canal Creek Potential Source Definition Study Field Efforts and Screening Level Ecological Risk Assessments
2005	Remedial Investigation/Feasibility Study for the Building 99 Site
2005	Remedial Investigation for Ten Potential No Further Action Sites
2005	Human Health Risk Assessment for the No Further Action Sites
2005	Feasibility Study for Three Sites
2005	Perchlorate Sampling in Groundwater and Surface Water
2006	Ecological Risk Assessment for Selected Sites
2006	ROD for 13 Select Sites in the Canal Creek Study Area
2006	Remedial Investigation Report for Thirty-Five Remaining Soil Sites, Volume I: Northwest Region and Volume II: Southwest Region
2006	West Canal Creek Area Phytoremediation Pilot Test Report
2007	Remedial Investigation Report for Thirty-Five Remaining Soil Sites, Volume III: East Region and Volume IV: Kings Creek Industrial Area
2007	Remedial Design for 13 Select Sites
2007	Remedial Action at the Former Building 99 and DM Filling Plant Sites
2007	G-Street Salvage Yard ROD, Remedial Design, and Site Safety Submittal
2007	Final Human Health Risk Assessment for the Proposed Remedial Action Sites

4.3 SITE BACKGROUND

4.3.1 Physical Characteristics

The Canal Creek Study Area is a ~700-acre parcel located in the northern portion of the Edgewood Area bordered by the Westwood Study Area on the west, the Bush River and

Lauderick Creek Study Areas on the east, and Other Edgewood Areas to the south (Figure 1-2). The upland developed area is flat lying with site improvements separated by maintained lawns and some wooded areas. The developed area is surrounded by wooded areas, marshes, and open water. Canal Creek encompasses ~3 nautical miles of open water and ~115 acres of wetland. The two main tributary branches of Canal Creek (East Branch and West Branch) flow from the north to the southwest and converge to form the main stem of Canal Creek that flows to the Gunpowder River to the west of the Study Area.

The groundwater system at the Canal Creek Study Area is comprised of the Surficial Aquifer, the Upper Confining Unit, the Canal Creek Aquifer, the Lower Confining Unit, and the Lower Confined Aquifer. The Canal Creek Aquifer is confined over most of the Study Area. Its confining layer thins in the up-dip (northwest) direction as the result of erosional disconformities and the aquifer subcrops the recent marsh and creek sediment of the West Branch Canal Creek. There is also an erosional window (paleochannel) in the confining layer beneath the East Branch Canal Creek where the Canal Creek Aquifer subcrops the Surficial Aquifer. The groundwater hydraulic divide (located west of the paleochannel) separates the aquifer into a local flow system discharging to the West Branch Canal Creek and a regional, confined flow system with a gradient to the southeast. The Surficial Aquifer is thin to absent over most of the area west of the hydraulic divide.

4.3.2 Land and Resource Use

The Edgewood Area has been a center for the development, testing, and manufacture of CWM since WWI with industrial activities concentrated in the Canal Creek Study Area. These activities include chemical manufacturing and storage, munitions filling, protective clothing treatment, medical and chemical research, vehicle maintenance, sewage treatment, aviation and transportation, and open-air testing. Portions of the Study Area were also used for disposal of chemicals, munitions, and other wastes. Past waste disposal practices (which were common and acceptable at the time of operation but are no longer being conducted) included landfilling in marshes and unlined pits, discharging untreated chemicals and wastes through sewage systems into streams, and burning chemicals and wastes on the ground. These past activities resulted in environmental contamination, including chemicals in the soil, groundwater, surface water, and sediment. In many of the contaminated areas, several probable sources for the COCs existed in close proximity, including buildings in which past manufacturing, munitions filling, or research activities took place; land disposal areas; leaky sewer lines and sewer discharge points; and, various support facilities such as machine shops and the airfield.

4.3.3 Building 103 Dump

4.3.3.1 Physical Characteristics

The Building 103 dump was a grassy area, located at the intersection of Hoadley and Williams Roads in the old chemical plants area. Geophysical surveys conducted in 1994

suggested that the dump was approximately 1.9 acres in size and 19 feet deep; however, based on interpretation of historical aerial photos the dump appeared to extend beneath the parking lot to the west/southwest and Building E5422 to the south. The dump was originally a sand borrow pit that was excavated over a two to three year period starting in 1917. In the 1920s, the pit was reportedly used for disposal of scrap, miscellaneous waste materials, chemicals, and possible ordnance. The pit was subsequently filled, then covered during a general cleanup that occurred in April 1937.

4.3.3.2 Land and Resource Use

Wastes historically disposed at the Building 103 Dump may include debris, waste chemicals, UXO, and vehicles. Disposal activities began after WWI and continued into the late 1930s or early 1940s. Afterward, the area was occasionally used for open burning to remove the insulation from scrap copper wire. This area is no longer used. LUC restrict access to the site and prohibit activities that would impact the landfill cap and drainage system.

4.3.3.3 History of Contamination

There are no specific records of disposal practices at the Building 103 Dump; however, wastes such as excess chemicals, UXO, and debris were most likely disposed at the site. In 1992, 50 gallons of sludge consisting primarily of α-bromobenzyl cyanide were removed from an underground storage tank (UST) at the Building 103 Dump; the UST was filled and left in place.

4.3.3.4 Contaminant Media

The contaminant medium at the Building 103 Dump is soil. Contaminants include iron; manganese; benzene; chloroform; methylene chloride; TeCA; 1,2-dichloroethane (DCA); TCE; trans-1,2-dichloroethene (t-DCE); and, vinyl chloride (VC). The cap system mitigates percolation through the landfill contents into the groundwater. Groundwater sampling is conducted annually to monitor the contaminated groundwater underlying the site.

4.3.4 Building 503 Burn Sites

4.3.4.1 Physical Characteristics

The Building 503 (E5265) Smoke Pilot Plant Burn Sites consisted of two irregularly shaped ash-covered areas. The North Burn Site was approximately 10,540 square feet (ft^2), and the South Burn Site was about 2,160 ft^2. The ash has been removed and the areas are now vegetated.

4.3.4.2 Land and Resource Use

The Building 503 Smoke Pilot Plant was built during WWI to be used as a large-caliber shell-filling plant. The plant was later used for production of smoke munitions. Open burning began at the North Burn Site in 1943 and then at the South Burn Site in 1951. The use of both burn sites ended in 1975.

Building 503 is currently used as a smoke munitions research and development facility, but this process is known to produce little waste. The Burn Sites are currently not in use. The interim remedial action at the site is complete. The ROD has a periodic review requirement to determine the effectiveness of this interim remedy and whether further remedial actions are necessary. This is implemented through completion of the ongoing RI/FS and the Edgewood Area Five-Year Reviews.

4.3.4.3 History of Contamination

The Building 503 Burn Sites were used for both disposal and testing activities for more than 30 years. Open burning probably was used mainly for the disposal of off-specification mixtures. Also, wastes that were produced during the shell-filling process were collected and burned at the sites. In addition to disposal, the burn sites were used for testing of various munitions. Smoke munitions, which were tested at the sites, produced a fine mist of particles that spread in the air. Other components to the munitions such as fuses and grenade spoons were often left at the burn sites. Contaminants that were detected in the soil at the burn pits included hexachlorobenzene, hexachloroethane, lead, and zinc. As noted in the Building 503 Burn Sites Completion Report, arsenic and mirex were added to the list of COCs during design of the action. Contaminants above action levels were removed during remedial actions conducted under the ROD.

4.3.4.4 Contaminant Media

The contaminant medium at the Building 503 Burn Sites was soil and the contaminants were hexachlorobenzene, hexachloroethane, lead, zinc, arsenic, and mirex.

4.3.5 Beach Point

4.3.5.1 Physical Characteristics

Beach Point comprises approximately 6.9 acres and is a peninsula at the intersection of the Bush River and Kings Creek. While the Bush River is sometimes used for recreational purposes, Kings Creek is closed to the public.

Northern Beach Point is a marshy area with vegetation. Drainage swales and erosional gullies are located along the Kings Creek shoreline. Steep erosional surfaces exist along the shorelines with drops of approximately 8 to 12 feet. The remaining area of Beach Point has slight relief, with elevations ranging from 0 feet at the shore to 14 feet near the

center of the area. Along Bush River, it was a practice to deposit construction debris on the shore prior to regulations concerning shoreline erosion control, which bar this activity.

The Beach Point peninsula geology consists of sand and silt deposits for up to 65 feet under the ground surface. The level of groundwater in the Surficial Aquifer is known to fluctuate due to changing tides and other factors. The Upper Confining Unit separating the Surficial Aquifer and underlying Canal Creek Aquifer is approximately 80 to 100 feet thick under Beach Point. On the northwest side and neck of the Beach Point peninsula, low conductivity silt deposits tend to lessen the spread of contamination from these regions. The eastern and southeastern sections of Beach Point, however, are known to have higher conductivity sand deposits.

4.3.5.2 Land and Resource Use

The site history is one of development and testing, along with some material storage. A variety of chemical products were in use during active operations at Beach Point. Operations conducted at the Beach Point Test Site have included fire suppression testing of liquid rocket fuels, pyrotechnic testing, and clothing impregnation activities, as well as small-scale chemical storage and waste water treatment.

The site contains a gravel access road, an office trailer, seven concrete building pads, and a steel rocket fuel fire suppression burn pan. The remainder of the site is grass- and shrub-covered and partially forested with several species of deciduous hardwoods. A marshy, vegetated area occupies the northernmost portion of the peninsula and a portion of the Kings Creek shoreline. LUC were implemented as part of the ROD which prohibit all uses of groundwater at Beach Point.

4.3.5.3 History of Contamination

Two mobile process plants, designated M1 and M2, were located at Beach Point. Another semi-permanent plant was reportedly located near the center of the Beach Point site, situated on a large concrete pad. A solvent-based process and the Impregnite 2,4,6-trichlorophenyl urea (CC2) were used at the M1 plant. CC2 was used as the protective agent in clothing that would shield soldiers from blister gas. The solvent used at the M1 plant was TeCA, which was recovered and recycled by the plant. In addition, the plant used a chlorinated paraffin binder to hold the CC2 within the clothing. The M1 plant's capacity was approximately 3,000 pounds of clothing impregnation every 24 hours. In contrast, a mixture of the Impregnite XXCC3, polyvinyl alcohol, chlorinated paraffin, dye, and water was used at the M2 plant. The XXCC3 Impregnite was composed of 10 parts CC2 to 1 part zinc oxide.

Some forms of testing also occurred at Beach Point. In Northern Beach Point, fire and vapor suppression methods were tested for liquid rocket fuels from 1963 until 1964. Propellants, such as hydrazine and red fuming nitric acid were mixed with an oxidizer, such as nitrogen tetroxide, for this process. The mixing procedure would produce flames,

which were then suppressed. Some explosive compounds, such as TNT, tetryl, cyclotrimethylene trinitramine (RDX), and cyclotetramethylene tetranitramine (HMX) were also tested at Northern Beach Point in the 1970s.

Chemical warfare agents, including nerve agents, were previously stored in Building E3990 at Northern Beach Point. Test firing of 4.2-inch mortars occurred during the 1940s and smoke generator fog oil was stored at Southern Beach Point.

4.3.5.4 Contaminant Media

Contaminant media identified in the site investigation at Beach Point included subsurface soil, surface soil, sediment, and groundwater. Although various contaminants were identified at the site, the 1995 Baseline Risk Assessment found no risk to human health or the environment from the sediment, soil, groundwater, or surface water.

Contaminants in the groundwater included aluminum; antimony; arsenic; barium; beryllium; cadmium; calcium; chromium; cobalt; copper; iron; lead; magnesium; manganese; mercury; nickel; potassium; silver; sodium; vanadium; zinc; acetone; bis(2-ethylhexyl)phthalate; carbon disulfide; carbon tetrachloride (CT); chlorobenzene; chloromethane; chloroform, dichloroethene (DCE); di-n-butyl phthalate; methylene chloride; TeCA; trichloroethane (TCA); and, TCE.

A TI Waiver was issued for the Beach Point site due to the presence of DNAPL at the site. It was determined that the remediation of DNAPL to acceptable levels would be extremely cost-prohibitive and difficult because adequate technologies are not yet available for this type of removal process given the physical constraints at the site. The 1997 ROD for the Beach Point site specified LUC coupled with LTM.

4.3.6 East Branch Canal Creek Aquifer

4.3.6.1 Physical Characteristics

The Canal Creek Aquifer (Section 4.3.1) was divided into eastern and western plumes for investigation purposes. As of December 2007, only the East Branch Canal Creek Aquifer plume is covered under a completed ROD. The East Branch Canal Creek Aquifer plume occurs east of the hydraulic divide, originating where the Canal Creek Aquifer and Surficial Aquifer are in hydraulic communication and extending southeastward into the regional, confined flow system.

4.3.6.2 Land and Resource Use

As discussed in Section 4.3.2, APG's historical industrial and associated waste management activities were centered in the Canal Creek Study Area. Most buildings were used for several different purposes throughout their history, and historical records of manufacturing and disposal practices are incomplete. The East Canal Creek Area is

currently used for a variety of industrial and administrative functions supporting the military mission of APG. These uses are expected to continue for the foreseeable future.

In 1942, wells were drilled into the Canal Creek Aquifer to supply water to the APG industrial facilities. In 1968, these wells were converted for use as a standby water source during water shortages. The wells were shut down in 1984 at the direction of MDE because of the chemicals in the water. Some of the wells were abandoned prior to 1989, and the six production wells were abandoned in 1995. Historical production from these wells caused past groundwater flow directions to differ from ambient conditions and contributed to the shape of the plumes.

LUC, implemented under the 2000 ROD, prohibit drinking water well installation and restrict withdrawal or use of groundwater without treatment.

4.3.6.3 History of Contamination

The contamination of the Canal Creek Aquifer was a result of the industrial activities that occurred at the Canal Creek Study Area such as research, manufacturing, and testing. Disposal areas were also located at the Study Area to support the industrial activities. Other possible sources of VOC contamination include previous manufacturing, filling, and research activities; leaky sewer lines and sewer discharge points; and, support facilities.

4.3.6.4 Contaminant Media

The primary contaminants in groundwater are VOC, especially chlorinated VOC; such as TeCA, TCE, DCE, VC, CT, and chloroform. Arsenic, iron, and manganese were also listed as east plume contaminants in the ROD. The 2000 ROD specified extraction and treatment of groundwater within the Canal Creek Aquifer in the East Canal Creek Area.

4.3.7 Thirteen Select Sites

During supplemental RI efforts (conducted as part of the Potential Source Definition Study), ten potential "No Further Action" (NFA) sites were identified. These ten sites included: Building E5188 WP Filling Plant (EACC1G-B); Old Hospital and Administration Area (EACC2A); Building E5023 WP Filling Plant (EACC2B); Building E5238 Clothing Impregnation Facility (EACC2C); Building E5103 Photographic Laboratory (EACC2G); Building 501 Filling Plant/Building 5100 Laboratory (EACC2H-A); Weide Airfield Area (EACC2I-A); Old Shop and Motor Pool Area (EACC2I-B); Building E2100 Laboratory (EACC3B); and, Building E3560 Test Chamber Complex (EACC3H). The NFA sites were later grouped with the DM Filling Plant (EACC1D), WWII Railroad Yard and Maintenance Shop (EACC1A-A), and Former Building 99 (EACC2F) for Proposed Plan and ROD development.

While the ten NFA sites warranted no action under an industrial land use scenario, there were a few COCs in soil (primarily metals) that posed risks to hypothetical future child

residents. As a result, LUC were also required for those sites. Two of the additional sites merited remedial action based on potential risks to ecological receptors and LUC based on potential risks to hypothetical future child residents; while, the third required LUC only.

4.3.7.1 Physical Characteristics

The upland, developed portion of the Canal Creek Study Area is flat lying with site improvements separated by maintained lawns and some wooded areas. The developed area is surrounded by wooded areas, marshes, and open water.

The thirteen sites addressed by the 2006 ROD overlie the Canal Creek Aquifer on both sides of the groundwater divide (i.e., lying in either the East or West Canal Creek Areas).

4.3.7.2 Land and Resource Use

The Canal Creek Study Area has been utilized since WWI for the development, testing, and manufacturing of military-related chemicals and agents. Since the end of WWII, the chemical manufacturing activities were scaled down and many of the plants were abandoned or converted to pilot-scale chemical manufacturing facilities. Until the 1970s, most of the buildings in the Study Area discharged liquid wastes to the West or East Branches of Canal Creek. Current land use includes research and development, supply and storage, open space, outdoor recreation, administration, airfield, and industrial.

The WWII Railroad Yard consisted of a locomotive storage and maintenance barn, storage shed, and several railroad sidings used to store rail cars filled with supplies.

The DM Filling Plant was used for DM manufacturing and filling activities during the late 1940s. In the 1950s and 1960s, the facility was sporadically used for a variety of operations involving irritant or colored smoke mixing or manufacturing, bomb loading, Napalm B mixing, and charcoal impregnation and blending. The area is not currently used.

Building 99 was built during WWI and was used for incendiary bomb filling. It was converted to a pilot filling plant during WWII for the development of a WP filling process. The building was used for both wet and dry WP filling in addition to WP/mustard mixture filling and triethyl aluminum filling. All filling operations at Building 99 ended in 1981. The building was demolished in February 1998 and the sumps were closed and filled. Currently, the area is vacant and inactive.

4.3.7.3 History of Contamination

The contamination is a result of the industrial activities that occurred at the Canal Creek Study Area such as research, manufacturing, and testing.

The WWII Railroad Yard was used from WWII to the 1960s for temporary parking of railroad cars waiting to be loaded, unloaded, or transported off site. Building E5762, the former Railroad Maintenance Shop, was used during this time for repair and routine maintenance of railroad equipment. Wastewater from Building E5762 drained to a septic tank that discharged to a surface ditch leading to the headwaters of the West Branch Canal Creek. Building E5762 was demolished in 2003. Building E5760, the only remaining building on site, was used for storage of miscellaneous materials used in the Maintenance Shop.

The DM Filling Plant was used for Adamsite (DM, an arsenic-containing CWM) manufacturing and filling activities during the late 1940s. The facility was occasionally used during the 1950s and 1960s for activities that included the manufacture or mixing of irritant or colored smokes, munitions filling, Napalm B mixing, and charcoal impregnation and blending. Wastewater from the E56xx-series buildings drained to chemical sewers with outfalls that lead to the wooded marsh area between the filling plant and the West Branch of Canal Creek. During the 1970s, the buildings were connected to the sanitary sewer system and discharge to the marsh ended. Beginning in 1973, several of the buildings were used for storage and as general-purpose labs. This site includes seven buildings most of which have been abandoned.

Building 99 was used for both wet and dry WP filling operations. In addition, WP/mustard mixture filling and triethyl aluminum filling, as well as thickening of mustard with methylmethacrylate polymer, occurred. Originally, the building contained only a chemical/storm sewer. It was also connected to a sanitary sewer system during WWII.

4.3.7.4 Contaminant Media

Surface soil and sediment were the primary contaminated media at the sites. Although these sites pose no unacceptable risks to human health from site-related contaminants under an industrial land-use scenario, there is potential for unacceptable risks to hypothetical future residents (due primarily to elevated metals) resulting in the need for LUC.

The ERAs also suggest potential for risk to ecological receptors. Arsenic was the principal ecological-risk driver at both the DM Filling Plant and Building 99 Site, whereas, 4,4'-dichlorodiphenyltrichloroethane (DDT) was the ecological-risk driver at the WWII Railroad Yard.

Sampling within the 10 additional LUC sites revealed slightly elevated concentrations of PAH, pesticides, and metals. Arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene were the only chemicals detected in excess of industrial soil risk-based concentrations (RBCs).. There were no unacceptable risks identified for human health (under an industrial land-use scenario) or for ecological receptors. However, the risk assessments indicated the potential for unacceptable risks to hypothetical future child residents based on exposure to soil at these sites.

4.3.8 G-Street Salvage Yard

Limited removal actions were conducted at the G-Street Salvage Yard in 1990 to remove surface debris and debris found in mounds in the project area. VX and bomblets were encountered during past site activities. A temporary soil cover was placed over a portion of the site in 1996 as part of a CERCLA Removal Action. The ROD for remediation of the G-Street Salvage Yard was signed in September 2007.

4.3.8.1 Physical Characteristics

The G-Street area is located in the northernmost portion of the upland, developed area near the facility boundary. The site is surrounded by wooded areas.

4.3.8.2 Land and Resource Use

This site was initially used during the WWI era as a railroad yard. In 1941, when new on-post railways were constructed to support plant activities, the railroad yard at G-Street was abandoned. Use of the site as a salvage yard reportedly began in the 1940s and continued through the late-1960s. Historical records also suggest that the area may have been used as a disposal site for miscellaneous materials and waste prior to that time. In recent years, the site has been used for storage of bulk road construction materials. The area around the salvage yard has also been used to a limited extent for troop training.

4.3.8.3 History of Contamination

The G-Street Salvage Yard was used from WWII to the late 1960s. The Salvage Yard was used to handle and process junk and salvageable items. There is no information indicating that the salvage yard was used for the disposal of hazardous materials. From 1972 until 1978, fire training activities occurred at the site. Each use of the fire training pit involved two burns, each using 200-300 gallons of fuel, usually diesel or JP-4. The recent uses of the area include storage of bulk and construction materials and some troop training. Based upon observations from a removal action in 1991, some materials from J-Field or O-Field may have been taken to G Street in the past. Residue originating from burning pit disposal operations in New O-Field and J-Field was encountered during the removal activities in the Burn Residue Disposal Area.

4.3.8.4 Contaminant Media

The contaminant medium for the Salvage Yard Soil Area is soil, and the COCs are metals, PAH, PCB, pesticides, and dioxins/furans. The contaminant media for the Burn Residue Disposal Area are waste and soil, and the COCs are metals, PCB, pesticides, and CWM/UXO.

4.3.9 Non-ROD OUs

4.3.9.1 Canal Creek Source Areas

Thirty-five AEDB-R sites comprise the Canal Creek Source Areas OU. Four geographic groupings of these sites were defined for purpose of the RI/FS (Northwest Region, Southwest Region, East Region, and Kings Creek Industrial Area). These sites consist of defined areas of disposal and soil contamination. The current and future land use is industrial. The dominant habitat is maintained lawn. Contaminants exceeding acceptable risk levels for industrial receptors included Target Analytes (primarily arsenic and mercury), PAH (primarily benzo[a]pyrene), dieldrin, and Aroclor 1254. The Draft RI Report (submitted in four volumes) is currently under review.

This OU is included in the performance-based contract (PBC) awarded in 2007 that scheduled response complete for 13 sites by September 2008 and the remaining 22 sites by September 2009.

4.3.9.2 West Branch Canal Creek Aquifer

The Canal Creek Aquifer (Section 4.3.1) was divided into eastern and western plumes for study. The West Branch Canal Creek Aquifer plume occurs west of the groundwater hydraulic divide in the local flow system discharging to the West Branch Canal Creek. The Surficial Aquifer is thin to absent over most of the area west of the hydraulic divide. As discussed above, the primary contaminants in groundwater are chlorinated VOC such as TeCA, TCE, DCE, VC, CT, and chloroform. Benzene, antimony, beryllium, iron, manganese, and thallium were also listed as west plume COCs in the east plume ROD.

This OU is included in the PBC awarded in 2007 that scheduled remedy in place by September 2009.

4.3.9.3 Canal Creek Marsh and Landfill

Canal Creek encompasses ~3 nautical miles of open water and ~115 acres of wetland. Wetland acreage was substantially larger prior to the historic landfilling for site development and waste disposal. Historical landfilling operations eliminated most of the marsh area on the East Branch. Filling of wetlands also occurred in an area on the west side of the West Branch at the southern end of the WWI chlorine plant, and along the east side of the lower West Branch where the WWII chlorine plant was built. Numerous point-source discharges active during WWI and WWII manufacturing also impacted the Canal Creek marshes. Contaminant levels, toxicity, and UXO/CWM hazard likely increase with depth in the sediment column beneath the marshes. At the marsh surface most mercury is present in non-methylated forms, and most metals are present in non-bioavailable forms.

This OU is included in the PBC awarded in 2007 that scheduled remedy in place by September 2009.

4.3.9.4 Canal Creek Sediment

Canal Creek encompasses ~3 nautical miles of open water and ~115 acres of wetland. Wetland acreage was substantially larger prior to the historic landfilling for site development and waste disposal. Numerous point-source discharges active during WWI and WWII manufacturing also impacted Canal Creek. Contaminant levels, toxicity, and UXO/CWM hazard likely increase with depth in the sediment column beneath the creek.

This OU is included in the PBC awarded in 2007 that scheduled remedy in place by September 2010.

4.3.9.5 Kings Creek Sediment

Sediment samples have been collected throughout Kings Creek. 4,4'-Dichlorodiphenyl dichloroethane (4,4'-DDD) detections in the sediment indicated the possible presence of a pesticide source in the creek bed; however, the location of this source has not been determined. Silver and mercury concentrations consistently exceed available Toxicity Reference Value (TRV) levels. In addition, UXO is present.

This OU is included in a task awarded in 2006, with a scheduled remedy in place by September 2010.

4.3.10 Previous Removal Actions

Previous removal actions are listed in Table 4-2. The overall protectiveness of removal actions is evaluated with the final remedy.

Table 4-2. Canal Creek Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
G-Street Salvage Yard	1990	Debris, including scrap metal, asbestos, wood, concrete, pipe, and drums of a tar-like substance, was removed from the G-Street Salvage Yard. All of the material was recycled or disposed of according to federal, state, local, and APG regulations.	UXO, CWM removed.
Building E3580 Drum Rack	1991	Removal and disposal of PCB-contaminated soil	Action completed

Removal Action	Date	Goal	Results
Building 103 Dump	1992	Removal of 500 gallons of α−bromobenzyl cyanide from UST	UST remained in place; contents removed.
Buildings Associated with Former Wound Ballistics Program	1992	Source definition, decontamination, and removal	UXO clearance, demolition of 4 buildings, asbestos removed from Building E3170A, and Building E3170A relocated.
Building 103 Dump Site	1992	Fence installation	Action completed
Building E3580 Drainage Swales	1992	Soil excavation	Action completed
Drum Rack Area at Beach Point	1993	Removal of four overpacked drums containing fog oil, 500-gallon aboveground storage tank (AST)	Action completed
Toxic Disposal Pits	1994	Delineation of extent of suspected former disposal pits and marking of locations with signs and stakes	Action completed
WWII Railroad Yard	1994	UST removal	Action completed
Scrubber Tower Building E5188	1995	Removal of scrubber tower	Action completed
Wells and well houses	1995	Removal of 6 wells and well houses	This closure was required by MDE to prevent APG from pumping contaminated groundwater.
Building E5625 and E5633 Sumps	1995	Removal of sump contents and closure of sumps	Action completed
Building 87 Complex Sumps	1995	Removal and disposal of water and sludge from chemical wastewater sumps	Action completed
Experimental Plants Dumps	1995	Soil sampling to determine the extent of contamination and excavation and disposal of contaminated soil and surface material	Action completed
Building E3640	1995	Sump closure	Action completed
G-Street Salvage Yard	1996	Temporary soil cover installation	Action completed
WWII Experimental Chlorine Plant Dump	1997	Removal of potentially contaminated material	Action completed

Removal Action	Date	Goal	Results
Lewisite sump	1997	Removal of sump, tank, and contents of both (sediment and water)	Action completed
Building 99 (E5032)	1998	Removal of building	Action completed
Hazardous Material Facilities	1998-1999	Removal of Hazardous Material Facilities	Action completed
E3640 Process Laboratory Complex	2007	Removal of building and surrounding structures	Action completed
Experimental Chemical Plants Area	2007	Removal of buildings	Action underway

4.4 REMEDIAL ACTIONS

4.4.1 Operable Units with RODs

Table 4-3 summarizes the remedial actions conducted to date in the Canal Creek Study Area. The basis for taking action, RAOs, selected response, and performance standards are listed in Exhibit 1.

4.4.2 Progress Since Last Five-Year Review

The East Branch Canal Creek Aquifer ROD has been implemented. The 13 Select Sites ROD was signed and has been implemented. The G-Street Salvage Yard ROD has been signed and is the early stages of implementation.

4.5 FIVE-YEAR REVIEW PROCESS

During the review process, an objective was to determine the status of the remedial action at the Canal Creek Study Area in APG. To accomplish this goal, the Study Area was visually inspected and any available data were reviewed. In addition, the Project Officer was interviewed to obtain further information regarding the status of the site. Input also was obtained from MDE.

The Project Officer for the Canal Creek site, Mr. John Wrobel, was interviewed on 29 October 2007. The results of this interview are presented in Attachment A to this report.

Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

Table 4-3. Canal Creek Study Area Remedial Action Summary

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
Building 103 Dump	ROD, 1996	1. No Action 2. Cap and cover system using off-site clay. 3. Cap and cover system using sodium bentonite geocomposite liner. 4. Cap and cover system using a geosynthetic membrane. 5. Cap and cover system using off-site clay and geosynthetic membrane. 6. Cap and cover system using sodium bentonite geocomposite liner and geosynthetic membrane.	Sodium Bentonite Geocomposite Mat and Geosynthetic Membrane	The Building 103 Dump selected remedy was completed in 1999. Before the cap and cover system was installed, however, the excavated soil and ash from the Building 503 Burn Sites was moved to the Building 103 Dump and placed in the foundation layer of the Building 103 Dump cap.
Building 503 Burn Sites	ROD, 1996	1. No Action 2. In Situ Vitrification 3. Excavation, Stabilization, and On-site Disposal 4. Excavation, Off-site Treatment, and Off-site Disposal	Excavation, Disposal at Building 103 Dump, Backfill	The Building 503 Burn Sites selected remedy was implemented as described in the ROD in 1997 and 1998.
Beach Point Test Site	ROD, 1997 TI Waiver, 1997	1. No Action 2. Institutional Controls and LTM	Institutional Controls and LTM	The Beach Point Test Site selected remedy has been implemented as described in the ROD.

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
East Branch Canal Creek Aquifer	ROD, 2000	1. No Action 2. Monitored Natural Attenuation (MNA) with LUCs 3. Groundwater Extraction/ Treatment with MNA and LUCs	Groundwater Extraction/ Treatment with MNA and LUCs	The selected remedy has been implemented as described in the ROD.
13 Select Sites	ROD, 2006	<u>WWII RR Yard</u> 1. No Action 2. Stream Diversion, Excavation, and Off-Site Disposal 3. LUCs Only <u>DM Filling Plant</u> 1. No Action 2. Excavation with Off-Site Disposal and Cleaning/ Closing the Rotoclone Sump 3. Phytoremediation and Cleaning/Closing the Rotoclone Sump <u>Bldg 99</u> 1. No Action 2. Excavation, and Off-Site Disposal 3. Excavation and On-Site Reuse 4. Phytoremediation	LUCs only at WWII Railroad Yard and 10 Additional Sites; Excavation, Off-Site Disposal, and LUCs at DM Filling Plant and Bldg 99	LUCs have been implemented for all thirteen sites, as described in the ROD. Arsenic-contaminated soil has been removed from both the DM Filling Plant and Building 99 Sites. Excavated soil from the DM Filling Plant was disposed off-site, as specified in the ROD. Excavated soil from Building 99 remains on site, pending resolution of WP-related disposal issues.

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
13 Select Sites (continued)	ROD, 2006	10 Additional Sites 1. No Action 2. LUCs		
G-Street Salvage Yard	ROD, 2007	Salvage Yard Soil Area 1. No Action 2. Institutional Controls 3. Low-Permeability Cover 4. RCRA Cap 5. Excavation and Off-Site Disposal Burn Residue Disposal Area 1. No Action 2. Improve and Extend Existing Cover 3. Excavation and Off-Site Disposal	Excavation and Off-Site Disposal Institutional Controls	The Remedial Design and Site Safety Submittals were approved in 2007. As of December 2007, initial site activities are underway.

4.6 FIVE-YEAR REVIEW FINDINGS

4.6.1 Site Inspection

Site inspections were conducted at the Canal Creek Study Area sites from 13 November through 18 December 2007. Photodocumentation of the site visits is provided in Attachment D to this document. Site inspection checklists, as specified in Guidance, are provided in Attachment E. Major findings of the site inspection are described below.

4.6.1.2 Building 103 Dump

The Building 103 Dump was inspected on 19 November 2007. The cap appears to be in good condition, with adequate vegetative cover. Noticeable damage from animal intrusion was not in evidence. All drains are properly working.

The LTM program for the Building 103 Dump includes groundwater and indoor air sampling. Groundwater wells located upgradient and downgradient of the cap are sampled on an annual basis and analyzed for VOC, metals, radionuclides, explosives, and chemical agent degradation products. Indoor air samples are collected in Building E5427 (adjacent to the landfill), once every other year using SUMMA canisters.

Technology Evaluation

The cover at the Building 103 Dump consists of the following layers (from bottom to top): excavated soil/ash from the Building 503 Soil Operable Unit; 2 feet of clean backfill (graded to achieve a 4% slope); bentonite geocomposite mat; geosynthetic membrane; drainage layer; compacted cobble/animal intrusion barrier; and, 2 feet final soil and vegetative layer. Fencing and warning signs have also been constructed, to minimize disturbance of the cover system.

According to the O&M contractor, there have been no recent animal intrusion issues. During annual groundwater sampling in March 2007, TCE, chromium, and iron were detected above MCLs. Chloroform was also detected in one well, but the detection was below the MCL for total trihalomethanes.

Overall, the cover system is working as designed. Groundwater monitoring conducted in accordance with MDE landfill requirements suggests the presence of low-level VOC and slightly elevated metals. The shallow groundwater underlying this site will ultimately be addressed by a separate ROD for the West Branch Canal Creek Area.

Cost

The estimated annual operating cost presented in the ROD for the Building 103 Dump was $4,730 per year; however, this cost does not appear to include LTM.

The actual cost per year for O&M/LTM (from FY03 through FY06) was $100,000. In FY07, the annual O&M/LTM cost was reduced to $50,000. These cost savings are due to negotiated reductions in the monitoring program: i) carbon sampling has been reduced to every other year; ii) water levels are now being conducted annually (versus monthly in previous years); and, iii) indoor air samples are collected once every other year. Groundwater samples are collected and analyzed on an annual basis and the cover is formally inspected on a quarterly basis (with informal visual inspections every month). The cover is mowed approximately seven times a year.

The Army estimates that maintenance costs could be reduced to approximately $18,000 per year, once groundwater monitoring requirements have been satisfied.

4.6.1.3 Beach Point Test Site

The Beach Point Test Site was inspected on 18 December 2007. The remedy for this site involves LUC and LTM of site conditions. [NOTE: Groundwater ARARs were waived for this site under an approved TI waiver.]

The warning sign posted at the entrance to the site is in good condition. The road leading to the end of the peninsula is still in good condition; however, water was observed in low points.

Technology Evaluation

The RI for Beach Point identified DNAPL beneath the Beach Point peninsula. The primary COCs were TeCA and TCE, with historical maximum groundwater detections of 35,900 micrograms/liter (µg/l) and 4,640 µg/l, respectively. The LTM program includes annual collection of sediment and surface water samples from 15 locations, and groundwater samples from three monitoring wells. Six of the surface water/sediment sampling locations are in the Bush River immediately adjacent to the area of highest VOC concentrations in the groundwater, where the contaminant plume likely extends under the Bush River, and where discharge of VOC to sediment and surface water is most likely. Nine additional locations in the Bush River and Kings Creek surrounding Beach Point are sampled to assess possible discharge outside of the immediately adjacent area.

The 2006 groundwater concentrations were consistent with historical data. No detectable COCs were present in surface water, but there were 11 detections in sediment. Preliminary data for 2007 suggest the presence of toluene at 5.1 micrograms/kilogram (µg/kg) and 2-butanone (19 µg/kg) in sample locations SE3N010 and SE3N011, respectively. Historically, these two samples have contained no detectable levels of VOC. These data are being reviewed for accuracy and will be addressed in LTM Annual Report Number 8.

Overall, the results from the first nine years of sampling and analysis events at Beach Point are inconclusive as to whether contamination is being released to the sediment due to discharge from the Beach Point groundwater plume. Future sampling at times of

highest potential for discharge, as indicated by water level monitoring, will provide data for further assessment.

The concentrations of chlorinated VOCs that have been detected in the sediment and surface water during the post-ROD monitoring do not exceed USEPA Region III Biological Technical Assistance Group Screening Levels or the USEPA National Recommended Water Quality Criteria.

Cost

The annual LTM cost was estimated at $68,640 per year in the Beach Point ROD. This cost assumed collection of 10 surface water and 10 sediment samples. Sampling frequency was reduced from quarterly to annually in 2000 and the current LTM program includes the collection of 15 surface water/sediment samples and 3 groundwater samples, at an annual cost of $16,000.

4.6.1.4 East Branch Canal Creek Aquifer

The East Branch Canal Creek Aquifer GWTF has been operating since April 2003. The GWTF was inspected on 13 November 2007. According to interviews with the Plant Operations Manager, extensive upgrades have been made to the GWTF over the past few years, including:

- Replacement of the extraction well control systems;
- Upgrades to the Programmable Logic Controller for the well field and plant;
- Replacement of the lime and aluminum sulfate systems;
- Replacement of pumps and controllers (throughout the plant);
- Addition of dessicant breathers and expansion chambers to all pumps;
- Addition of a separate control panel to control the discharge recirculation valves;
- Addition of an influent flowmeter;
- Replacement of the acid injection system and piping;
- Replacement of all steam systems;
- Upgrades to the air dryer system;
- Upgrades to the mechanical hoist system;
- Upgrades to freeze protection (heat tracing and insulation);
- Enclosure of pH systems;
- Replacement of piping beneath clarifier with stainless steel; and,
- Addition of pressure transducers to the resin system.

The O&M contractor is also currently testing a potential replacement for the original Ambersorb resin, which is no longer commercially available (discussed in detail below).

Short-term monitoring groundwater sampling events were conducted in August 2003 and January 2004. LTM has been underway since February 2004 with two groundwater sampling events completed in July 2005 and October 2007. During the two initial LTM events, eight extraction wells and 28 monitoring wells were sampled. Samples from the

extraction wells were analyzed for TCL VOC, TAL metals (total), methane (dissolved), alkalinity, hardness, and total dissolved solids (TDS); while, the samples from the monitoring wells were analyzed for only TCL VOC and TAL metals (total). Six monitoring wells were also sampled for Monitored Natural Attenuation (MNA) parameters including ferrous iron, sulfate, chloride, dissolved gases (oxygen, carbon dioxide, methane, ethane, and ethene), oxidation-reduction potential, and total organic carbon (TOC).

The size of the main body of the plume, defined by the 100 µg/l total VOC boundary, has not changed significantly since startup of the extraction system. Groundwater sampling has indicated that VOC concentrations up gradient of the main body of the plume are stable or have decreased slightly. In general VOC concentration levels within the main body of the plume are stable or declining. Groundwater samples collected from monitoring well CC-029B (in the western portion of the main body of the plume) prior to extraction well startup and through the short-term monitoring period indicated increasing total VOC concentrations due primarily to increasing TCE concentrations. The extraction system was operating at 250 gpm during the short-term monitoring period. Subsequently the extraction system was operated at approximately 200 gpm (initial operational design). LTM groundwater samples collected from CC-029B following the extraction rate reduction show total VOC concentrations decreasing.

MNA monitoring results confirm natural attenuation is occurring via dilution, hydro-halo-elimination, and reductive dehalogenation under mostly sulfate reducing conditions.

Groundwater elevations are collected at a minimum on a quarterly basis from 68 monitoring wells and eight extraction wells. Groundwater elevation data indicate that when fully active, the extraction system induces an inward gradient to capture the 100 µg/l target VOC area.

Technology Evaluation

An innovative (at the time) synthetic adsorption media (Ambersorb 563) was selected as a cost-effective alternative to traditional GAC for TeCA (as well as the other VOC) removal, based on the results of a treatability study. Other innovative technologies evaluated for VOC removal during the treatability study included assisted ultraviolet peroxidation (CAV-OX® cavitation) and low-profile air stripping. Both vapor and liquid phase VOC polishing was tested using the Ambersorb 563 resin.

During construction of the GWTF, the resin manufacturer announced that Ambersorb 563 would no longer be commercially available. Therefore, a surplus of Ambersorb 563 resin was purchased to replace attrition losses. During the first year of operation, physical degradation of the Ambersorb 563 within the treatment vessels was observed. Although the removal efficiency for the target VOC was not impacted by the physical degradation of the resin, flow dynamics and efficiency were significantly affected. Efforts were made to remove fines and improve the performance of the existing system; however, the stock of Ambersorb 563 is nearing exhaustion.

As a result, the O&M contractor has been evaluating potential options for replacement of the Ambersorb 563 resin. Two potential replacement resins have been identified:

- Dowex L493: similar size range to Ambersorb 563 (0.3 to 0.8 millimeter [mm] bead size)
- Dowex L503: larger than Ambersorb 563 and Dowex L493, (approximately 1 mm bead size)

A treatability study was conducted to compare the performance of the two resins to Ambersorb 563 for adsorption of target VOC, regeneration, and physical durability. Based on removal and regeneration efficiency, Dowex L503 was selected for testing in one of the vessels at the GWTF. Based on preliminary testing, the new resin successfully removes the primary compounds (TeCA and TCE), but is challenged by the breakdown products (cis- and t-1,2-DCE and VC). Although the vendor suggests that treatment will improve over successive regenerations, the O&M contractor is currently evaluating other options for replacement of the resin system.

Cost

The total capital cost in the ROD for the East Branch Canal Creek Aquifer was $3,912,000. The estimated annual O&M cost in the ROD was $712,000. Actual costs for O&M since operation began in 2003, range from $715,000 to $913,000 per year (including disposal and LTM costs). Additional funding has been requested for a greenhouse enclosure over the process equipment (approximately $750,000) and for increased influent storage (cost to-be-determined).

4.6.1.5 13 Select Sites

The two active remediation sites were inspected on 19 November 2007 and 18 December 2007. At the time of the first inspection, all of the excavations at the DM Filling Plant were restored with two feet of clean fill and approximately 3-4 inches of grass cover. The Building 99 excavation remained open, with orange construction fencing. The excavated soil also remained staged on site (due to the presence of residual WP).

On 18 December 2007, the remediation contractor was observed backfilling the Building 99 excavation. Although the contractor is planning to hydroseed, it is unlikely that any growth will occur during the winter season. As a result, the site will be straw mulched and tacked for stabilization.

Technology Evaluation

The ROD specified residential LUC for all 13 of the 2006 ROD sites, along with excavation and off-site disposal at the DM Filling Plant and Building 99. Remedial activities at the latter two sites began in August 2007. The excavated soil at the DM Filling Plant was hauled off-site by APG's waste contractor in mid-September 2007.

Unfortunately, due to the presence of residual WP, the Building 99 soil could not immediately be transported off-site. As mentioned previously, this soil remains on site pending resolution of the WP issues.

Due to safety hazards, WP-contaminated soil is traditionally packed wet in drums and shipped off-site for incineration. However, disposing of approximately 500 cubic yards (yd^3) of soil in this manner is cost-prohibitive (estimated at approximately $4.2 million, compared to the total capital cost of $750,000 estimated in the ROD). The Army is planning to transport and temporarily store the WP-contaminated soil at the New O-Field Site until final disposition is resolved and an ESD can be written to amend the ROD. In retrospect, the DSHE Project Officer (Mr. John Wrobel) preferred selection of the phytoremediation alternative for the former Building 99 Site.

Cost

The total capital cost estimated in the ROD for the 13 Select Sites was $750,000. This cost assumed excavation and off-site non-hazardous disposal of approximately 473 yd^3 (in situ volume, prior to excavation and expansion) of arsenic-contaminated soil. The final volume of soil removed from the two active sites, based on post-excavation surveys, is approximately 735 yd^3. The total amount awarded to the remediation contractor for development and implementation of the ROD was approximately $600,000 (not including APG waste disposal costs).

4.6.1.6 G-Street Salvage Yard

The ROD for G-Street was signed in September 2007. A suspect GB-bomblet was encountered in late-November 2007, during the initial UXO clearance of the site. As a result, the site was shut down pending analysis of the munition contents. [Due to safety reasons, a site inspection was not conducted at the G-Street Salvage Yard.]

The explosive ordnance disposal (EOD) team is expected to resume UXO clearance operations in early-January 2008, with the full-scale remedial action anticipated to begin in May 2008. The field work is tentatively scheduled for completion by February 2009, with the draft Remedial Action Completion Report anticipated in August 2009 and project closeout in November 2009.

4.6.1.7 Non-ROD Sites

Investigations of the following sites are still on-going: Canal Creek Source Areas, West Branch Canal Creek Aquifer, Canal Creek Marsh and Landfill, Canal Creek Sediment, and Kings Creek Sediment. The FS, Proposed Plans, and ROD documents for these sites will be completed under tasks awarded in FY06 and FY07.

Formal site inspections of these individual sites were not conducted; however, the entire Study Area was toured on 18 December 2007. During the site tour, it was observed that several old abandoned buildings within sites EACC1H-F (Experimental Chemical Plants)

and EACC3L (Building 3640 Process Laboratory) have been demolished. Conditions at the other sites do not appear to have changed from those reported in their respective RI reports.

4.6.2 Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

4.6.3 Technology Evaluation

Alternative technologies have been evaluated for each site with an implemented ROD for purposes of remedial action optimization. In the case of the Canal Creek Study Area, alternative technologies have been considered for the Building 103 Dump, Beach Point, 13 Sites, and G-Street. The Building 503 Dump was not included in this evaluation since no waste remains in place at this site. The ROD for the East Branch Canal Creek Aquifer selected an innovative groundwater treatment technology, using resin adsorption for VOC removal. However, other technologies which could potentially be applied to the East Branch Canal Creek Aquifer were also evaluated as part of this report. A summary of these technologies is presented in Attachment F to this document.

Attachment F includes technologies being evaluated for further investigation and, possibly, recovery of DNAPL. The Beach Point TI Waiver indicates DNAPL may exist, including in the near offshore areas. The ability to recover DNAPL in such areas is presently very limited and likely to remain so in the near future.

4.7 TECHNICAL ASSESSMENT

The results of the technical assessment for the other Canal Creek Study Area sites are included in Tables 4-4 through 4-9, in accordance with Guidance. Only sites for which CERCLA five-year review trigger criteria apply are included in this evaluation. Recommendations regarding all sites are included in Subsection 4.8.

4.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

Vapor intrusion was not addressed in the Beach Point Test Site ROD. There are no existing buildings that are inhabited on a regular basis. It is recommended the Beach Point LUCs be amended to address vapor intrusion.

Vapor intrusion was not addressed in the East Branch Canal Creek Aquifer OU ROD. There are existing buildings in this OU. Over most of its extent the East Branch Canal Creek Aquifer is confined and too deep to be of concern for vapor intrusion. The area of potential concern is where the confining unit is absent and the aquifer is shallow. The buildings in this area were screened with the USEPA's screening-level vapor intrusion model (Appendix C). Commercial/industrial worker exposure assumptions were used.

All but five of the buildings had modeled carcinogenic risk within the target range for CERCLA remedial actions. All non-carcinogenic hazard quotients were modeled less than one. None of the five buildings with carcinogenic risk modeled above 1E-04 are occupied full time (i.e., risk would be modeled lower with part-time exposure assumptions). Based on building use, buildings E4040, E4060, and E4081 were selected for further evaluation. These buildings are included in the ongoing Canal Creek study-area-wide vapor intrusion study. It is recommended the East Branch Canal Creek Aquifer LUCs be amended to address vapor intrusion.

During the course of this five-year review, no other issues that impact protectiveness were discovered relating to the Canal Creek Study Area.

4.9 PROTECTIVENESS STATEMENT(S)

4.9.1 Building 103 Dump

The remedy at Building 103 Dump currently protects human health and the environment because the waste is contained. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

4.9.2 Building 503 Burn Sites

The interim remedy at Building 503 currently protects human health and the environment because all waste has been removed to action levels. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. The RI/FS and ROD for final action must be completed and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

4.9.3 Beach Point Test Site

The remedy for Beach Point Test Site currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in groundwater are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

4.9.4 East Branch Canal Creek Aquifer

The remedy at East Branch Canal Creek Aquifer currently protects human health and the environment because the contamination is contained through capture and treatment of groundwater. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the plume must continue and LTM

Table 4-4. Canal Creek Study Area Technical Assessment: Building 103 Dump

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Building 103 Dump	Y	The remedy has been implemented in accordance with the ROD.
▪ **System Operations/O&M**		
	Y	LTM and O&M are ongoing and conducted in accordance with the ROD.
▪ **Opportunities for Optimization**		
	N	At this time, no optimization opportunities have been identified for the Building 103 Dump Site.
▪ **Early Indicators of Potential Issues**		
	N	There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUC have been implemented in accordance with the ROD. Fencing and warning signs are in place and in good condition.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs Used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	USEPA Region III released soil screening guidance after construction of the Bldg 103 cap. However, this new guidance does not affect the original conclusions of the risk assessment or the remedy selected.
TBC guidance for protection of ecological receptors	Y	Same as above.
▪ **Changes in Exposure Pathways**		
	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Vapor Intrusion	Y	The Army and regulators have identified vapor intrusion as a new potential exposure pathway (see Attachment C). However due to land use restrictions in this area, future construction over the Building 103 Dump Site is not anticipated. Indoor air samples are collected within an adjacent building, every other year.

Table 4-4. Canal Creek Study Area Technical Assessment: Building 103 Dump (continued)

▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	Y	Although changes have been made to some of the COC toxicity values since the ROD was signed in 1995, they do not affect the original conclusions of the risk assessment or the remedy selected.
▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	ERA methods have changed since the ROD was signed in 1995. However, none of the changes substantively affect the original conclusions of the risk assessment.
Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed since the ROD was signed in 1995. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been achieved. The remedy protects human health by preventing residential land use.
Has any other information come to light that could call into question the protectiveness of the remedy?		☐ **Yes** ☒ **No**
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 4-5. Canal Creek Study Area Technical Assessment: Building 503 Burn Sites

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Building 503 Burn Sites	Y	Remedial construction activities were conducted in accordance with the ROD and remedial design.
▪ **System Operations/O&M**		
	Y	Because all waste was removed during ROD implementation, there are no O&M activities associated with the Building 503 Dump.
▪ **Opportunities for Optimization**		
	N	Because there are no ongoing O&M activities, there are no optimization opportunities.
▪ **Early Indicators of Potential Issues**		
	N	There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	The ROD has a periodic review requirement to determine the effectiveness of this interim remedy and whether further remedial actions are necessary. This is implemented through completion of the ongoing RI/FS and the Edgewood Area Five-Year Reviews.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	The interim remedy addressed principal threat wastes. The final remedy will be based on standards and TBC current at the time of the ROD for final action
TBC guidance for protection of ecological receptors	Y	Same as above.
▪ **Changes in Exposure Pathways**		
	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Vapor Intrusion	Y	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	Y	No contaminants above action levels remain in place at the Building 503 Burn Sites.

Table 4-5. Canal Creek Study Area Technical Assessment: Building 503 Burn Sites (continued)

▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	All waste has been removed.
Human Health Risk Assessment (HHRA)	Y	All waste has been removed.
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been achieved.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 4-6. Canal Creek Study Area Technical Assessment: Beach Point Test Site

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Beach Point Test Site	Y	The remedy has been implemented in accordance with the ROD.
▪ **System Operations/O&M**		
	Y	LTM and LUC are being implemented in accordance with the ROD.
▪ **Opportunities for Optimization**		
	Y	As there is no discernable impact to surface water and sediment LTM frequency can be reduced.
▪ **Early Indicators of Potential Issues**		
		There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
		LUC have been implemented in accordance with the ROD. There is no fencing at this site; however, a warning sign is in place and in good condition.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	A TI Waiver was approved prior to signature of the groundwater ROD. Thus, changes to MCLs have no affect on the original conclusions of the TI Evaluation or remedy selected.
TBC guidance for protection of ecological receptors	NA	There are no promulgated standards for protection of ecological risk associated with groundwater.
▪ **Changes in Exposure Pathways**		
	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Vapor Intrusion	N	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	Although changes have been made to some of the COC toxicity values, the LUC mitigate exposure so the remedy is protective.

Table 4-6. Canal Creek Study Area Technical Assessment: Beach Point Test Site (continued)

▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	ERA methods have changed since the ROD was signed in 1997. However, none of the changes substantively affect the original conclusions of the risk assessment.
Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed since the ROD was signed in 1997. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
	Y	The remedy protects human health and the environment from the risks associated with groundwater contamination.
Has any other information come to light that could call into question the protectiveness of the remedy?		☐ **Yes** ☒ **No**
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 4-7. Canal Creek Study Area Technical Assessment: East Branch Canal Creek Aquifer

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
East Branch Canal Creek Aquifer	Y	The remedy has been implemented in accordance with the ROD.
▪ **System Operations/O&M**		
	Y	LTM and O&M are ongoing and conducted in accordance with the ROD.
▪ **Opportunities for Optimization**		
	Y	The O&M Contractor is currently evaluating potential replacements for the Ambersorb 563 resin, which is no longer commercially available. Other future capital improvements include installation of a greenhouse enclosure over the process equipment and construction of a tank farm.
▪ **Early Indicators of Potential Issues**		
	Y	There are several issues associated with the Ambersorb resin that the Army and O&M contractor are currently working together to resolve.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUC have been implemented in accordance with the ROD.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	N	
TBC guidance for protection of ecological receptors	NA	
▪ **Changes in Exposure Pathways**		
	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Vapor Intrusion	Y	Modification of LUC to address this potential pathway is recommended (see Attachment C).
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	Although changes have been made to some of the COC toxicity values, the COCs are removed from the treated water prior to discharge so the remedy is protective.

Table 4-7. Canal Creek Study Area Technical Assessment: East Branch Canal Creek Aquifer (continued)

▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	Y	ERA methods have not changed since the ROD was signed in 2000.
Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed slightly since the ROD was signed in 2000. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
	Y	The remedy protects human health and the environment from the risks associated with groundwater contamination.
Has any other information come to light that could call into question the protectiveness of the remedy?		☐ **Yes** ☒ **No**
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 4-8. Canal Creek Study Area Technical Assessment: 13 Select Sites

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
13 Select Sites	Y	Remedy implemented in accordance with the ROD.
▪ **System Operations/O&M**		
	NA	
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	Y	There is a potential remedy issue associated with the Building 99 Site, because the excavated soil cannot be transported off-site due to the presence of residual WP in the soil. The Army and O&M contractor are currently working to resolve this issue.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUC have been implemented in accordance with the ROD.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	N	There have been no significant changes to the standards for protection of human health since the ROD for 13 Sites was signed in 2006.
TBC guidance for protection of ecological receptors	N	Same as above.
▪ **Changes in Exposure Pathways**		
	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Vapor Intrusion	N	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	There have been no significant changes in toxicity or contaminant characteristics since the ROD was signed.
▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	N	ERA methods have not changed since the ROD was signed.
Human Health Risk Assessment (HHRA)	N	HHRA methods have not changed since the ROD was signed.
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been achieved.

Table 4-8. Canal Creek Study Area Technical Assessment: 13 Select Sites (continued)

Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 4-9. Canal Creek Study Area Technical Assessment: G-Street Salvage Yard

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☐ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
G-Street Salvage Yard	NA	The ROD for G-Street was signed in September 2007, but has not been implemented yet.
▪ **System Operations/O&M**		
	NA	
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	Y	UXO/CWM safety issues are being addressed by standard protocol.
▪ **Implementation of Institutional Controls and Other Measures**		
	NA	Same as above.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	N	There have been no significant changes to the standards for protection of human health since the ROD for G-Street was signed in 2007.
TBC guidance for protection of ecological receptors	N	Same as above.
▪ **Changes in Exposure Pathways**		
	NA	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
Vapor Intrusion	N	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	There have been no significant changes in toxicity or contaminant characteristics since the ROD was signed in 2007.
▪ **Changes in Risk Assessment Methods**		
Ecological Risk Assessment (ERA)	N	ERA methods have not changed since the ROD was signed in 2007.
Human Health Risk Assessment (HHRA)	N	HHRA methods have not changed since the ROD was signed in 2007.

Table 4-9. Canal Creek Study Area Technical Assessment: G-Street Salvage Yard (continued)

▪ **Expected progress towards meeting RAOs**		
	NA	The ROD for G-Street was signed in September 2007, but has not been implemented yet.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

4.9.5 13 Select Sites

The remedy for 13 Select Sites currently protects human health and the environment because all waste has been removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

4.9.6 G-Street Salvage Yard

The remedy at G-Street Salvage Yard is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

4.9.7 Non-ROD Sites

Several removal actions have been conducted at sites throughout Canal Creek Study Area to address specific issues. These removal actions met their specific objectives and therefore provided reductions in risk. A formal Protectiveness Statement for these sites cannot be made until the RI/FS/ROD/RA process is completed.

4.10 NEXT REVIEW

It is recommended that a five-year review be conducted in 2013 for the Building 103 Dump Site, Building 503 Burn Sites, Beach Point, East Canal Creek Aquifer Groundwater, 13 Select Sites, G-Street and any OUs for which a ROD is signed prior to 2013 and for which CERCLA five-year review trigger criteria apply.

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5.0 WESTWOOD STUDY AREA

5.1 OVERVIEW

The Westwood Study Area, located in the extreme northwestern portion of the Edgewood Area of APG (Figure 5-1), consists of 26 AEDB-R sites (listed in Exhibit 2) grouped into five geographical areas termed "Clusters" for investigation purposes. All of these sites have been addressed under one of two RODs for the entire Study Area.

An RI was conducted for the Westwood Study Area from 1994 through 1998. The findings of this investigation are described in the *Remedial Investigation Report for the Westwood Study Area* (April 2005). FS field investigations, completed from 2001 through the spring of 2004, provided supplemental data to the RI to further evaluate remedial alternatives at the Hog Point Site, WWI Chlorine Plant/Gas Mask Factory/Stokes Road East Site[1], Brine Sludge Disposal Area, HC Grenade Disposal Site, WW-90 Drum Dump, WW-90 Fill Area, and Westwood Radioactive Material Disposal Facility (WRMDF) Western Disposal Area. The Westwood Study Area FS Report was also published in April 2005.

The first Westwood Study Area ROD signed in January 2006 imposed Institutional Controls preventing future military family housing, elementary and secondary schools, child care facilities, playgrounds, and nonmilitary residential land use at all 26 on-shore AEDB-R sites and declared No Action for the off-shore Gunpowder River Area. Excavation and Off-Site Disposal was the selected remedy for waste and contaminated soils at the HC Grenade Disposal Site, WW-90 Drum Dump, WRMDF Western Disposal Area, Brine Sludge Disposal Area, and the Gas Mask Factory. This ROD has been implemented. As of December 2007, the LUCs are in place and waste and contaminated soil from the five Action Sites have been removed and transported off-site for disposal at an approved facility. No O&M (to include LTM) is required for these sites.

The second Westwood Study Area ROD signed in September 2007 addressed the remaining four sites and groundwater located within the WSA. The selected remedies included excavation of contaminated soil and LUCs at the Hog Point Site (to include Cluster 10 Surficial Aquifer), an earthen cover and LUCs at the WW-90 Fill Area, and No Further Action at the WRMDF, Demilitarization Site, and Westwood groundwater. The Institutional Controls imposed by the 2006 ROD were accepted as the final action at all remaining sites. Draft remedial designs for the WW-90 Fill Area and Hog Point Site are currently under review by APG and the regulatory agencies.

5.2 SITE CHRONOLOGY

The Westwood Study Area has been utilized since WWI for a variety of military training and testing activities, material storage, manufacturing, munition assembly, and waste disposal activities. Current land use includes supply and storage, open space, outdoor

[1] Referred to as the Gas Mask Factory for the remainder of this section.

WRMDF WESTERN DISPOSAL AREA

WW-90 DRUM DUMP

WW-90 FILL AREA

CLUSTER 6

WRMDF / DEMILITARIZATION SITE

CLUSTER 14

CLUSTER 2

HC GRENADE DISPOSAL SITE

CLUSTER 21

WWI CHLORINE PLANT / GAS MASK FACTORY & STOKES ROAD EAST SITE

Piney Point

CLUSTER 10

Reardon Inlet

BRINE SLUDGE DISPOSAL AREA

HOG POINT SITE

Canal Creek

Hog Point

N

GUNPOWDER RIVER

1271374.3E,1431544.7N

1263885.4E,1430422.6N

Universal Transverse Mercator Projection – Zone 18, Geodetic Datum: North American 1983, WGS84 Ellipsoid, Measured in Survey Feet

LEGEND

- Road
- Aberdeen Proving Ground Boundary
- Cluster Boundary
- Water
- Wetland
- Site Boundary

800 600 400 200 0 400 800 1600

GRAPHICAL SCALE
IN FEET (1" = 800')

1:9600

TITLE:

WESTWOOD STUDY AREA CLUSTERS

500 Edgewood Road, Suite 110 (410) 676-8835
Edgewood, MD 21040 www.gpworldwide.com

CARTOGRAPHER:	APPROVED BY:
B. JOYCE	C. HOULIK
DATE:	FIGURE:
08-05-08	5-1

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recreation, administration, and industrial. Table 5-1 lists a chronology of CERCLA activities occurring within the Westwood Study Area.

Table 5-1. Westwood Environmental Chronology

Date	Activity
1989	RCRA Facility Assessment, Edgewood Area of APG
1990	Edgewood Area of APG included on the National Priorities List
1994-2004	Remedial Investigation and Feasibility Study Activities
1996	Removal Action – WWI Chlorine Plant Dump Site
1996	Removal Action – Stokes Road East Site
1998	Removal Action – Westwood Radioactive Material Disposal Facility (WRMDF)
1999	Groundwater Flow Model
2000	Removal Action – Grenade/Incendiary Disposal Pits A, B, C
2001	Removal Action – Grenade/Incendiary Disposal Pit D
2001	Underground Tank System Closure – Building E5695 Area, E5770 Area, and E5803 Area
2005	Remedial Investigation and Feasibility Study Reports
2006	Record of Decision for Remedial Action at Clusters 2, 6, 10, 14, and 21
2006	Remedial Design for Clusters 2, 6, 10, 14, and 21 (for the five Action Sites)
2006-2007	2006 Record of Decision Implementation
2006	Removal Action – Hog Point Site Area A
2007	Record of Decision for Remedial Action at the Remaining Sites

5.3 SITE BACKGROUND

5.3.1 Physical Characteristics

The Westwood Study Area covers approximately 850 acres in the extreme northwestern portion of the Edgewood Area of APG, as shown in Figure 1-2. It is bounded on the west by the Gunpowder River and on the east by the West Branch of Canal Creek. Reardon Inlet, consisting of a marsh and stream, physically divides the Study Area (Figure 5-1). The site is relatively flat, with a maximum elevation of 45 ft above msl. The Study Area consists of freshwater and estuarine wetlands, upland forests, fields, roads, buildings, permitted SWMUs, and designated hunting and fishing areas.

The Westwood Study Area is comprised of an unconfined or semi-confined surficial aquifer which terminates vertically at a clay confining unit. A paleochannel roughly trending north to south along the wetlands of Reardon Inlet hydraulically divides the Westwood surficial aquifer into eastern and western units.

There is no hydraulic communication (route of migration) between the surficial aquifers east and west of the inlet. In a similar manner, Canal Creek and the West Branch of Canal Creek comprise a discharge divide between the surficial aquifers at the Westwood Study Area and the Canal Creek Study Area. The lower confined aquifer, comprised mainly of silty sand to fine, well-sorted sand, averages approximately 20 feet thick throughout the Westwood Study Area. Shallow groundwater flow within the Study Area typically conforms to the topography forming a radial pattern, beginning off-post and traveling on-post and outward towards Canal Creek, the Gunpowder River, and Reardon Inlet. Groundwater flow direction in the confined aquifer is south from off-post through the Westwood Study Area to the Gunpowder River.

In support of the risk assessment and RI/FS process a groundwater model for the Westwood Study Area A and nearby off-post area was developed to assess the potential for groundwater in the surficial and confined aquifers to migrate off-post (northward) across the Installation boundary in response to hypothetical future pumping. The groundwater flow model was applied to existing conditions and seven hypothetical future pumping scenarios to determine under what conditions a flow reversal would be created at the Installation boundary. The modeling results for each pumping scenario indicated that a flow reversal at the Installation boundary would never occur in the surficial aquifer. It was found that production levels in excess of 400,000 gallons per day would be required to create a flow reversal at the Installation boundary in a confined aquifer.

5.3.2 Land and Resource Use

The Westwood Study Area has been used by the Army for testing, training, material storage, munitions assembly, waste disposal, and radiological waste handling and storage.

The area west of Reardon Inlet was historically used as the former Westwood Range Area. This portion was not included in the original acquisition of Edgewood Area and consisted of private property until 1942 when it was acquired by the Army. The Westwood Range Area included range areas for incendiary and white phosphorus munitions testing and static testing of white phosphorus bombs and grenades, as well as a flame thrower range. The area was used from the post-WWII era until the early 1970s for testing and training activities involving mustard agent, mustard agent decontamination, and sealed source radiological and high-explosive munitions. In addition, demilitarization of explosive components and radiological waste processing and storage took place in the area west of Reardon Inlet.

From 1918 through the 1970s, the area east of Reardon Inlet contained training areas, offices, laboratories, manufacturing facilities, and warehouses. Testing activities included testing of fuel thickener, radiological vulnerability, and radiological waste concentration testing. From the 1940s through the 1960s, some buildings housed manufacturing facilities for production of protective equipment, metal and woodworking fabrication shops, storage areas, equipment maintenance shops, and nuclear physics and chemical laboratories. The WWI Chlorine Plant and Gas Mask Factory comprised 40 acres of the area east of Reardon Inlet. The San Domingo Munitions Assembly Plant,

which was built in the area during WWII, included several buildings that were used for painting, cleaning, and assembling ordnance components already filled with chemicals. Production ended in the mid-1960s.

The Army currently uses the Westwood Study Area for military/industrial land use activities. West of Reardon Inlet is open space, east of Reardon Inlet is used for RCRA permitted hazardous waste storage, research and development, and commercial warehousing. A portion of the Study Area north of Magnolia Road is leased to Harford County for solid waste incineration. According to the APG Land Use Plan, planned future use of the Westwood Study Area is for open space and military training west of Reardon Inlet and military/industrial east of Reardon Inlet.

5.3.3 Clusters 2, 6, 10, 14, and 21 Sites

The ROD for the Clusters 2, 6, 10, 14, and 21 Sites, signed in January 2006, selected LUC preventing future residential land use at all 26 on-shore AEDB-R sites, "No Action" for the Off-Shore Gunpowder River Area, and Excavation and Off-Site Disposal for the HC Grenade Disposal Site, WW-90 Drum Dump, WRMDF Western Disposal Area, Brine Sludge Disposal Area, and the Gas Mask Factory. As of December 2007, the LUC is in place and waste and contaminated soil from the five Action Sites have been removed and transported off-site for disposal at an approved facility. All five sites are straw mulched and tacked for stabilization during the winter season. Final site restoration will be completed once vegetation returns to each site.

5.3.3.1 Physical Characteristics

WW-90 Drum Dump - The WW-90 Drum Dump lies just southeast of the intersection of Westwood and Piney Point Roads. This site occupied less than 0.2-acres along the north side of a steep drainage ravine that carries surface water runoff to Reardon Inlet. Geophysical investigations identified anomalous areas of subsurface metallic material within the wooded upland portion of the site, and along the north ridge of the drainage ravine. Partially exposed drums existed on the northern slope and at the base of the drainage ravine.

HC Grenade Disposal Site - The HC Grenade Disposal Site is located west of Reardon Inlet and east of Piney Point Road, opposite the entrance to the Westwood Debris Landfill within a dense upland forest of secondary growth hardwoods. The site sits on the north bank and base of a narrow drainage swale that originates near Piney Point Road and widens as it gently slopes to a marsh area that discharges eastward to Reardon Inlet. Waste material comprised of HC[2] smoke and rifle grenade fragments existed within a 2,400 ft^2 area along the north bank and within the stream bed of the swale.

The swale within which the waste was disposed was approximately 6 feet deep with steeply sloping sidewalls. The elevation at the top of the north bank was 24 feet above

[2] HC designates smoke generating compounds containing hexachloroethane.

msl and dropped to 18 feet above msl at the base of the drainage ravine, within the stream bed. The drainage ravine receives surface water and stormwater runoff from overland flow originating at the Debris Landfill.

WRMDF Western Disposal Area - The WRMDF Western Disposal Area lies just south of the Installation boundary and north of Westwood Road. The 0.2-acre site lies at the western edge of an open clearing, on the east bank of a natural drainage channel that carries runoff from the nearby off-post area southward to Reardon Inlet. The majority of the subsurface magnetic anomalies within the disposal area were on the steep slope of the drainage channel. A narrow drainage ditch trending east to west cuts through waste material within the disposal site, terminating at the drainage channel. The ground surface throughout the eastern portion of the Western Disposal Area is relatively level at 16 to 18 feet above msl. At the western and southern portions of the site, topography descends steeply from the top of the slope down to the base of the drainage channel.

Gas Mask Factory – The Gas Mask Factory is an 8.75-acre area, situated adjacent to the east sides of Hanlon and Stokes Roads. The Gas Mask Factory contained twelve dump areas, labeled A through L, scattered throughout the wooded area east of former Building 708, adjacent to the West Branch of Canal Creek marsh. With the exception of Dump E, the waste material within each dump site was exposed at the surface and contained the same type of waste material (decayed gas mask filter canisters, burned metal, glass lenses, Whetlerite/charcoal fines). At Dump E, soil containing possible Whetlerite material was spread or graded just under the topsoil layer. An area of elevated lead concentrations in surface soil within a drainage pathway running west to east through the central portion of the site was referred to as the drainage area.

Brine Sludge Disposal Area - The Brine Sludge Disposal Area lies adjacent to the southern edge of the WWI Chlorine Plant Dump, within a wooded area just north of the West Branch of Canal Creek. At this location, a 3,430 ft^2 area of white crumbly material (suspected of being the remains of brine sludge from chlorine manufacture) existed on a slope down to the edge of the Canal Creek marsh. At the Brine Sludge Disposal Area, topography descended quickly from the edge of the visible waste area down to the marsh edge. Runoff in the area of the brine sludge disposal is directly to the marsh edge of the West Branch of Canal Creek.

5.3.3.2 Land and Resource Use

WW-90 Drum Dump - There are no specific records of disposal practices at the WW-90 Drum Dump. Aerial photography showed ground disturbance and clearance within the WW-90 Drum Dump area beginning in the late 1950s. The U.S. Army may have used this site for the disposal of wastes generated during military training and demilitarization operations conducted within the Westwood Range during the 1950s and 1960s. This area is no longer used.

HC Grenade Disposal Site - There are no specific records of disposal practices at the HC Grenade Disposal Site. The site is located within the former Westwood Range area

and disposal is believed to have occurred during the time testing of grenades was accomplished in the area west of Piney Point Road, from the 1940s until the 1960s. This area is no longer used.

WRMDF Western Disposal Area - The open clearing east of the Western Disposal Site was originally a farm site prior to WWII, was briefly used for demilitarization operations after WWII, and then from the late 1940s or early 1950s until circa 1964 was the location of an operation involving repacking of radioactive waste for off-site disposal (i.e., the Westwood Radioactive Material Disposal Facility). Since 1964 the area has remained unused.

Gas Mask Factory – The Gas Mask Factory occupied some of the facilities previously part of the WWI Chlorine Plant after operations ceased following WWI. After WWI the Chlorine Plant Cell Building #2 (Building 708) was converted to a gas mask and filter factory. In 1942, Building 713 (E5680) was constructed to produce gas masks for horses and screen Whetlerite. The principal waste of mask and filter production was from the screening of charcoal and Whetlerite. Whetlerite is activated charcoal impregnated with silver, copper, and chromium used in gas mask canisters to improve protection against some chemical agents. During the screening process, a portion of the materials were lost as fines. These screening wastes would have been disposed of by dumping near the plant, probably east of the primary buildings for these operations, Buildings 708, 721, and 713. In the early to mid 1960s, the remaining mask and filter production operations in the plant were moved to Building 84 (E5604). Both buildings were demolished in either the late 1960s or early 1970s**.** Currently, the area is predominantly wooded and inactive.

Brine Sludge Disposal Area - To the north of this site was the location of the former WWI Chlorine Plant salt storage and treatment facility (Building 706). This building was dismantled in the late 1930s. Brine sludge from the WWI Chlorine Plant was reportedly dumped or discharged to the marsh area to the southeast of the plant.

5.3.3.3 History of Contamination

WW-90 Drum Dump - Remediation activities to remove the waste material at the WW-90 Drum Dump ended in July 2006. The waste at the site consisted of metal debris, drum remnants, drum lids, metal cable, ammunition boxes, broken glass etc. During excavation, ordnance items (including projectiles, mortars, incendiary bombs, and a Chemical Agent Identification Set ampoule determined to contain phosgene) were found beneath the drum waste. Approximately 400 yd^3 of waste and soil were removed from this area and disposed of as non-hazardous material. The waste depth ranged from 3 to 8 feet below ground surface. Constituents detected in post-remedy soil and sediment include naturally-occurring metals, trace levels of several pesticide compounds, a phthalate compound, PAH, VOC, and explosive-related compounds nitrobenzene and 2,4-dinitrotoluene. Residual concentrations of constituents remaining in soil at the WW-90 Drum Dump do not pose unacceptable risk to human health or the environment. The

remediation at the WW-90 Drum Dump was effective in removing waste, and all performance standards have been achieved.

HC Grenade Disposal Site - Waste recovery operations at the HC Grenade Disposal Site concluded in August 2006. The waste and contaminated soil at the site consisted of residential waste (broken dishes, bottles, broken glass), and rusted grenade fragments (HC Smoke and Rifle Grenade). Approximately 100 yd^3 of waste and soil were removed from this area and disposed of as non-hazardous material. The waste depth ranged from 1 to 2 feet below ground surface. Constituents detected in post-remedy soil include naturally-occurring metals, trace levels of several pesticide compounds, phthalate compounds, a PAH, several VOC, and explosive-related compounds nitrobenzene and perchlorate. Residual concentrations of constituents in soil at the HC Grenade Disposal Site do not pose unacceptable risk to human health or the environment. The remediation at the HC Grenade Disposal Site was effective in removing waste, and all performance standards have been achieved.

WRMDF Western Disposal Area - Approximately 990 yd^3 of cesium-137 (Cs-137) contaminated soil, 440 linear feet of piping, and underground septic and wastewater system components were removed from the WRMDF in 1998. The removal action resulted in the release of the WRMDF from the Nuclear Regulatory Commission (NRC) license. The NRC cleanup level for Cs-137 under this removal action was 15 picoCuries per gram (pCi/g).

Supplemental soil and sediment sampling during the FS identified the presence of a small area (approximately 20 feet in diameter and beneath 2 feet of water) of Cs-137 contamination in sediment at the former headwall for the WRMDF wastewater discharge line. Cesium-137 activity levels in sediment at the former headwall were found as high as 189 pCi/g. The NRC was consulted about the remaining levels of Cs-137 and found that the site meets the criterion in 10 CFR 20.1402 for release without further remediation.

Remediation of the WRMDF Western Disposal Area finished in July 2006. The waste and contaminated soil at the site consisted of miscellaneous building debris (i.e. concrete, brick, terra cotta tile, etc.), industrial waste (metal cable, steel rail, gears, etc.), and household waste (plates, shoes, metal cans, bottles etc). During the course of removal operations a 5,000-gallon UST was identified within the removal area. The analytical results indicated that the tank was filled with water that did not contain constituents at levels that would pose a hazard to human health or the environment. The UST was emptied and removed from the ground and placed in the staging area for off-site disposal. Approximately 200 yd^3 of material were removed from this area and disposed of as non-hazardous material. The waste depth ranged from 1 to 3 feet below ground surface. Constituents detected in post-remedy soil include naturally-occurring metals, trace levels of several pesticide compounds, a PAH, and a VOC. Residual concentrations of these constituents in soil at the WRMDF Western Disposal Area do not pose unacceptable risk to human health or the environment. The remediation at the WRMDF Western Disposal Area was effective in removing waste, and all performance standards have been achieved.

Gas Mask Factory – An October 1996 removal action recovered a large amount of surface material (partially decayed drums, glass bottles, decayed gas mask cartridges, concrete and brick rubble, dried paint, etc.) within Dump Area B (i.e., Stokes Road East Site). However, soil mixed with possible Whetlerite material remained at the completion of removal activities.

Remediation involving the excavation and removal of contaminated soil and waste at the 13 areas within the Gas Mask Factory concluded in May 2006. Approximately 2,250 yd^3 were disposed as non-hazardous waste material and 50 yd^3 were disposed as hazardous waste material. Waste removed from the 13 areas within the Gas Mask Factory site consisted of soil mixed with Whetlerite, paint, metal, gas mask components (lenses, gaskets, buckles, filters), and graphite rods, as well as building materials (terra cotta, brick and concrete). The excavation remedy removed all of the soil with the highest levels of contamination, leaving only low concentrations in a few small areas. No samples of soil that remains at the site have any detections of arsenic, barium, chromium, copper, iron, mercury or zinc higher than worker or ecological RAOs. Only a small number of samples have antimony, cadmium or lead concentrations higher than the RAOs, all in different areas, and limited to small areas. The remediation at the Gas Mask Factory was effective in removing waste and contaminated soil, and performance standards for constituent concentrations in soil have been achieved.

Brine Sludge Disposal Area - Waste removal and excavation operations at the Brine Sludge Disposal Area ended in May 2006. The waste and contaminated soil at the site consisted of white crumbly powder (brine sludge residue) and miscellaneous building debris such as metal hinges, bolts, sheet metal, cans, etc. During the course of excavation two 4lb incendiary bombs and a pressurized gas cylinder that was ¾ full of a nitrogen and oxygen compound were also identified. Approximately 200 yd^3 of waste and contaminated soil were removed from this site and disposed of as non-hazardous material. The waste depth ranged from 1 to 2 feet below ground surface. The remediation at the Brine Sludge Disposal Area was effective in removing waste and contaminated soil, and performance standards for constituent concentrations in soil have been achieved.

5.3.3.4 Contaminant Media

WW-90 Drum Dump, HC Grenade Disposal Site, and WRMDF Western Disposal Area - The contaminant medium at each of the three sites was soil. These three sites were identified late in the RI/FS process when risk assessment for human health had been completed and the ERA was in the latter stages of completion. Thus, the sites did not have identified COCs in soil prior to the remedy selection process. Due to the small size of each site, the substantial cost of additional characterization and risk assessment, and given that military wastes were disposed at the sites (creating more potential for unacceptable risk) the ROD established that the best means of assessing risk associated with these sites was to excavate and dispose of waste and soil directly underlying waste, and then perform verification sampling and analysis. The verification sampling and

analysis was used to assess risks associated with any residual contamination in environmental media and verify that the remedy was adequate and protective.

Gas Mask Factory – Soil was the primary contaminated medium at the Gas Mask Factory Site. The final industrial worker soil COCs listed in the ROD for the Gas Mask Factory are antimony, barium, chromium, copper, iron, lead and mercury. The final ecological soil COCs listed in the ROD are cadmium, copper, lead and zinc.

Brine Sludge Disposal Area – The contaminant medium at the Brine Sludge Disposal Area was soil. The final industrial worker COCs were arsenic, chromium, and copper and the final ecological COCs were arsenic, cadmium and copper.

LUC Sites - Sampling within the 26 LUC sites revealed only sporadic and isolated detections of constituents above background levels. Concentrations of metals were detected in sediment and soil associated with some of these sites. Since there were no unacceptable risks identified for human health (under an industrial land-use scenario) or for ecological receptors, remedial action at these sites was not warranted. However, the risk assessments indicated at least some sites have metals concentrations in soil above background levels that would pose unacceptable risk to hypothetical future residents. Furthermore, because the data quality objectives were developed based on future military/industrial land usage, the number and spatial distribution of soil samples, while appropriate for that land usage, are not sufficient to conclude that there are not unidentified hot spot areas that could pose unacceptable risk to hypothetical future residents. Consequently, LUCs preventing future residential land use were implemented.

5.3.4 Remaining Sites

The ROD for the WW-90 Fill Area and Hog Point Site, signed in September 2007, selected remediation of the sites by placement of an earthen (i.e., soil) cover and excavation and off-site disposal, respectively. Elements of the selected remedy for the WW-90 Fill Area will consist of: construction of a soil cover to provide a minimum four feet thickness over waste and a minimum cover slope of 4 percent to facilitate surface drainage from the surface of the fill; stabilization of the fill area toe, as necessary, to prevent future erosion of cover soil and waste into the marsh; re-vegetation of the soil cover; and implementation of LUCs to prevent excavation into the WW-90 Fill Area soil cover. The selected remedy for the Hog Point Site will involve: removal and off-site disposal of approximately 4,300 yd^3 of contaminated soil; backfill and re-vegetation of the remedial areas; and implementation of LUCs to prevent potable use of surficial aquifer groundwater at Hog Point (i.e., Cluster 10 Surficial Aquifer) and require sampling and analysis of soil prior to any transport out of the Hog Point area for use as fill material.

5.3.4.1 Physical Characteristics

WW-90 Fill Area - The WW-90 Fill Area comprises approximately 0.7 acres and lies south of Westwood Road and monitoring well WW-90, just adjacent to the upper portion

of the Reardon Inlet marsh. The WW-90 Fill Area begins approximately 50 feet south of Westwood Road. The central portion of the WW-90 Fill Area is predominately open, grassy field. A small grove of pine trees and a drainage swale exist west of the WW-90 Fill Area. The marshes of Reardon Inlet border the eastern side of the site. The open field portion of the fill area transitions to scrub-shrub wetland vegetation and marsh sediments to the south, which terminates at Reardon Inlet. The ground surface is generally uneven throughout the central portion of the site, with some evidence of small animal burrows and small demolition debris items visible at the surface. There is no evidence of erosion during the approximately 40 years since operation of the site, and no visual evidence of subsidence. A usable groundwater aquifer does not exist at the WW-90 Fill Area. No aquifer immediately underlies the landfill, and the surficial aquifer upgradient of the site is a Class III aquifer due to low permeability.

Hog Point Site - The Hog Point Site is a 10-acre area on the southernmost portion of the Westwood Study Area, west of Reardon Inlet. The site is bounded to the north and south by Reardon Inlet and the Gunpowder River, respectively. The central portion of the Hog Point Site is predominately open, grassy field. To the north, Reardon Inlet contains estuarine subtidal, unconsolidated bottom wetlands. The Gunpowder River borders Hog Point to the south. Presently, the only building structure still remaining at the Hog Point Site is the explosives barricade (T5980). Unimproved gravel roads run through the central and southern portions of the site. The shoreline on the western side of Hog Point is armored against erosion with boulder-sized demolition material, comprised mostly of large concrete slabs. A local topographic high, with an elevation of 24 feet above msl, is located along Hog Point Road, northwest of the road's junction with another gravel road. The land surface slowly descends from the topographic high towards Reardon Inlet to the northeast and the Gunpowder River to the southwest and southeast. The steepest slopes are on the Gunpowder River shoreline just south of former Building E5975 and the former demilitarization area. Portions of this shoreline are nearly vertical.

The surficial aquifer in Cluster 10 is divided into two hydraulically connected water-bearing sections. An upper, water bearing section is present in the north and in the middle of the cluster (i.e., northern and western portions of Hog Point Site). A 10- to 15-foot thick silty-clay confining layer separates this upper, water-bearing section from a much thicker, lower water-bearing section, slowing vertical infiltration from the western and middle parts of the cluster. This confining layer is breached by a paleochannel near Reardon Inlet, accelerating vertical infiltration in the eastern half of the cluster (i.e., eastern portion of Hog Point) towards the mouth of Reardon Inlet. Surface runoff, as well as any potential site-related contamination, can infiltrate through the vadose and saturated zones quickly in this portion of the cluster.

5.3.4.2 Land and Resource Use

WW-90 Fill Area - The fill area was discovered during a 1999 UXO surface sweep of the area within a ¼-mile of the Installation boundary. Aerial photographs indicate activity at the site began in the early 1960s and concluded by the early 1970s. Although

no disposal records exist, filling during this time would have included sanitary, industrial, and military waste.

Hog Point Site - The U.S. Army used the portion of the Westwood Range Area near Hog Point during the post-WWII period until the early 1970s for a variety of demilitarization, testing and training activities, mostly by the USATEU. This work included mustard contamination/decontamination testing, demilitarization, sealed-source radiological defense training, and training of USATEU personnel. This entire area was also used during the WWII era, beginning in 1943, by the Chemical Warfare School as a gas mask obstacle course. Aerial photographs and Installation maps indicate approximately 10 to 12 structures were built in the area from the 1950s to early 1960s. Most structures were used for storage and offices, but some were also used for testing and training purposes.

5.3.4.3 History of Contamination

WW-90 Fill Area - No documentation exists as a record of what was historically disposed at the WW-90 Fill Area. The areal extent of the fill area is based on a combination of geophysics, topography, test digs, site inspection and engineering surveys. The existing soil cover thickness ranges from less than one foot to four feet, with an average thickness of one foot in most locations over the fill material. The waste material recovered during FS test dig efforts is a mix of household, military, and construction debris.

Hog Point Site – The contamination at the Hog Point Site is the result of historical training activities that occurred at the site such as mustard contamination/ decontamination testing, demilitarization of munitions, and obstacle course training. RI/FS results identified two areas within the Hog Point Site (Areas A and B) containing elevated levels of several metals in surface and shallow subsurface soil samples and three areas (Areas C through E) with elevated concentrations of only arsenic in surface and subsurface soil. The estimated total area of potentially contaminated soil within the site is approximately 30,000 ft^2.

In December 2006, approximately 190 yd^3 of metals contaminated soil and waste material were removed from Area A to a depth of two feet. The verification data show that most of the contaminated soil was removed from the site. A small area immediately outside the excavation, estimated at less than one-tenth of an acre in size, has elevated levels of zinc, cadmium, and lead. The concentrations of these three metals do not pose a threat to industrial workers or wildlife, but could possibly pose toxic effects to soil invertebrates. Because the size of the area with residual metals is small and because industrial workers and wildlife are not threatened, there is no need for further remediation at Area A.

Sustained arsenic concentrations (0.015 mg/l) in groundwater slightly above the MCL of 0.010 mg/l were detected south of Hog Point Road in shallow groundwater, within and downgradient of historical demilitarization operations and elevated levels of arsenic in surface soil.

5.3.4.4 Contaminant Media

WW-90 Fill Area - The contaminant medium for the WW-90 Fill Area is soil. The WW-90 Fill Area was identified late in the RI/FS process when risk assessment for human health had been completed and the ERA was in the latter stages of completion. While the WW-90 Fill Area was not addressed in the RI/Baseline Risk Assessment (BRA), remedial evaluation of the site was included in the FS, using an approach similar to the USEPA presumptive remedy approach (i.e., source containment) for military landfills. A preliminary risk assessment for the WW-90 Fill Area concluded the only potential risk associated with the site is through direct contact with potentially hazardous and other industrial wastes as a result of inadvertent human excavation into the fill material, with subsequent exposure of human or ecological receptors. A risk management decision was made to proceed with the recommended remedy of a soil cover at the WW-90 Fill Area rather than to conduct further characterization and risk assessment that would not likely alter the remedial outcome.

The BRA found no unacceptable risk to human health and ecological receptors from exposure to sediment and surface water of the Reardon Inlet drainage basin surrounding the fill area, with the results of supplemental March 2006 sediment sampling and analysis supporting that conclusion. The 2007 ROD specified continued annual monitoring of sediment adjacent to the WW-90 Fill Area, to begin upon completion of the soil cover.

Hog Point Site – Soil and groundwater are the contaminant media for the Hog Point Site. At the Hog Point Site, the primary COCs in soil are antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, and zinc and the primary COC in groundwater is arsenic. The metals contamination at the Hog Point Site poses a potential threat to future workers and military personnel. These metals also pose a potential risk to terrestrial ecological receptors

5.3.5 Previous Removal Actions

Previous removal actions are listed in Table 5-2. The overall protectiveness of removal actions is evaluated with the final remedy.

Table 5-2. Westwood Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
WWI Chlorine Plant Dump Site	1996	Removal of contaminated soil and surface debris	Completed April 1996. Material removed included several concrete blocks, a large UST which was apparently excavated from another part of the installation and disposed of at the dump, 10-ounces of suspect two-cycle oil and insecticide within a 55-gallon drum, one 55-gallon drum of tar-like substance, several metal drums, wood, an abandoned canvas and plastic tent with metal and wood poles, and miscellaneous building materials.
Stokes Road East Drum Site	1996	Removal of contaminated surface material and drums	Completed October 1996. Materials removed include concrete, gas mask components, metal, drums, and asphalt.
Westwood Radioactive Material Disposal Facility	1998	Removal of soil, piping, and underground equipment from septic system	Completed September 1998. Removed 990 yd^3 of soil, 440 linear feet of piping, septic tank equipment, and building demolition material. Site released from the NRC license.
Grenade/Incendiary Disposal/Burn Pits (A, B, C)	2000	Removal of fused smoke grenades, pieces of incendiaries, metallic items, and slag	Completed March 2000. Items recovered include fused but unfilled smoke grenades, pieces of incendiaries, nonenergetic metallic items, and slag.
Grenade/Incendiary Disposal/Burn Pit D	2001	Removal of grenade/incendiary components, metallic items and slag	Completed November 2001. Items recovered included an empty unfuzed artillery simulator, grenade/incendiary components, molten slag, rust flakes.
Hog Point Site – Area A	2006	Removal of metals contaminated soil	Completed December 2006. Removed 190 yd^3 of contaminated soil and waste to a depth of 2 feet.

5.4 REMEDIAL ACTIONS

5.4.1 Operable Units with RODs

Table 5-3 summarizes the remedial actions conducted to date in the Westwood Study Area. The basis for taking action, RAOs, selected response, and performance standards are listed in Exhibit 1.

5.4.2 Progress Since Last Five-Year Review

The ROD signed in January 2006 has been implemented. The ROD for the remaining Westwood Study Area sites was signed in September 2007 and is in the early stages of implementation (i.e., Remedial Design stage).

5.5 FIVE-YEAR REVIEW PROCESS

An objective of the review process was to determine the status of the remedial actions at the Westwood Study Area. To accomplish this goal, the study area was visually inspected and available data were reviewed. In addition, the Westwood Study Area Project Officer was interviewed in order to obtain further information regarding the status of the site. MDE also provided input.

The Project Officer for the Westwood Study Area, Ms. Cindy Powels, was interviewed on 16 October 2007. Attachment A to this report presents of the results of this interview.

Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

Table 5-3. Westwood Study Area Remedial Action Summary

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
Clusters 2, 6, 10, 14, and 21	ROD, 2006	Active Remediation Sites 1. No Action 2. Excavation and Off-Site Disposal. 3. Excavation and Off-Site Disposal (except contaminated drainage) at Gas Mask Factory Only. LUC Sites 1. No Action 2. Institutional Controls.	Active Remediation Sites Excavation and Off-Site Disposal. LUC Sites Institutional Controls. Off-Shore Gunpowder River Area No Action	The selected remedy for the Active Remediation Sites and LUCs for all sites have been implemented, as described in the ROD.

Table 5-3. Westwood Study Area Remedial Action Summary (continued)

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
Remaining Sites	ROD, 2007	WW-90 Fill Area 1. No Action 2. Impermeable RCRA Cap 3. Earthen Cover 4. Excavation Hog Point Site (to include the Cluster 10 Surficial Aquifer) 1. No Action 2. Excavation of Contaminated Soil 3. Consolidation and Capping of Contaminated Soil 4. Phytoremediation of Arsenic-Contaminated Soil with Excavation of Waste and Soil Contaminated with Other Constituents 5. In Situ Treatment of Arsenic-Contaminated Soil with Excavation of Waste and Soil Contaminated with Other Constituents	WW-90 Fill Area Earthen Cover Institutional Controls LTM Hog Point Site (to include the Cluster 10 Surficial Aquifer) Excavation of Contaminated Soil Institutional Controls Groundwater LTM	The Remedial Designs for the WW-90 Fill Area and Hog Point Site have been drafted and are in various stages of the APG and regulatory agency review process. Implementation of both selected remedies is expected by September 08.

5.6 FIVE-YEAR REVIEW FINDINGS

5.6.1 Site Inspection

Site inspections were conducted at the Westwood Study Area sites on 19 October 2007, 30 November 2007, and 21 December 2007. Photodocumentation of the site visits is provided in Attachment D to this document. Site inspection checklists, as specified in the USEPA Guidance, are provided in Attachment E. Major findings of the site inspections are described below.

5.6.1.1 Clusters 2, 6, 10, 14, and 21 Sites

Four of the five Active Remediation Sites were inspected on 19 October 2007 and 21 December 2007. The HC Grenade Disposal Site was inspected on 10 October 2007 and 30 November 2007. At the time of the first inspection, all waste and contaminated soil at the five sites had been recovered in accordance with the ROD requirements and the Remedial Action Work Plan. All of the sites except the Gas Mask Factory and HC Grenade Disposal Site still required restoration with clean fill and vegetation. Final grading and stabilization activities were still required at Gas Mask Factory Area A and the Cistern; however, the remainder of the site is restored with vegetative cover. Re-vegetation of the HC Grenade Disposal Site is slow due the steep banks of the excavation area. On 30 November 2007, placement of new jute matting on the slopes of the HC Grenade Disposal Site occurred to facilitate site stabilization and revegetation. By 21 December 2007, the excavations at Brine Sludge Disposal Area, WRMDF Western Disposal Area, and WW-90 Drum Dump were backfilled to a proper grade. Although it is unlikely that any vegetative growth will occur during the winter season, these three sites and the re-graded Area A and Cistern at the Gas Mask Factory were hydroseeded, then straw mulched and tacked for stabilization.

Technology Evaluation

The ROD signed in January 2006 specified residential LUC for 26 of the Westwood Study Area sites, along with excavation and off-site disposal at the Gas Mask Factory, Brine Sludge Disposal Area, WRMDF Western Disposal Area, WW-90 Drum Dump, and HC Grenade Disposal Site. Implementation of the remedy for each Active Remediation Sites is complete and effective in the protection of human health and the environment.

Cost

The total capital cost estimated in the ROD for Clusters 2, 6, 19, 14, and 21 was $1,987,000. This cost assumed excavation and off-site nonhazardous disposal of approximately 3,800 yd^3 (ex-situ volume) of waste and contaminated soil from all five Active Remediation Sites. The final volume of soil removed from the five active sites, based on post-excavation surveys, is approximately 3,400 yd^3. The total amount awarded to the remediation contractor for development and implementation of the ROD was approximately $841,000 (not including APG waste disposal costs).

5.6.1.2 Remaining Sites

The ROD signed in September 2007 selected an earthen cover remedy with LUCs, O&M, and sediment LTM for the WW-90 Fill Area and excavation of contaminated soil remedy with LUCs and groundwater LTM for the Hog Point Site. Site inspections of the WW-90 Fill Area and Hog Point Site were conducted on 19 October 2007. Remedial Designs for both sites are expected to be approved in early 2008, with full-scale remedial action at the WW-90 Fill Area anticipated to begin in Spring 2008. Due to the presence of a bald eagle nest in the vicinity of the Hog Point Site, remedial action of the site did not begin until 15 June 2008 when access restrictions for entering the nesting area were lifted.

5.6.2 Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

5.6.3 Technology Evaluation

Alternative technologies have been evaluated for each site with an implemented ROD for purposes of remedial action optimization. A summary of these technologies is presented in Attachment F to this document.

The nature of the remedies at the WW-90 Drum Dump, HC Grenade Disposal Site, WRMDF Western Disposal Area, Gas Mask Factory, and Brine Sludge Disposal Site indicates that optimization via such technologies is not relevant to these remedies. Since construction is complete at these five sites, optimization opportunities would likely be constrained to modified methods of maintenance and monitoring if determined to be necessary during the remedy review process, rather than implementation.

5.7 TECHNICAL ASSESSMENT

The results of the technical assessment for the Westwood Study Area sites are included in Tables 5-4 and 5-5, in accordance with USEPA Guidance. Recommendations regarding the Westwood Study Area sites are included in Subsection 5.8.

Table 5-4. Westwood Study Area Technical Assessment: Clusters 2, 6, 10, 14, and 21

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Five Active Remediation Sites 26 LUC Sites. No Action at Off-Shore Gunpowder River Area	Y	The remedy has been implemented in accordance with the ROD.
▪ **System Operations/O&M**		
	NA	.
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	N	
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUC has been implemented in accordance with the ROD.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	N	There have been no significant changes to the standards for protection of human health since the ROD was signed.
TBC guidance for protection of ecological receptors	N	Same as above for ecological receptors.
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	N	See Attachment C.
	N	No significant changes in site setting have occurred based on the site visits and interview with the DSHE Project Officer.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	There have been no changes in toxicity or contaminant characteristics since the ROD was signed in January 2006.
▪ **Changes in Risk Assessment Methods**		
Human Health Risk Assessment (HHRA)	N	HHRA methods changed slightly since the ROD was signed in January 2006. However, none of the changes substantively affect the original conclusions of the risk assessment.
Ecological Risk Assessment (ERA)	N	ERA methods have not changed since the ROD was signed in January 2006.
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been met.

Table 5-4. Westwood Study Area Technical Assessment: Clusters 2, 6, 10, 14, and 21 (continued)

Has any other information come to light that could call into question the protectiveness of the remedy?	☐ **Yes**	☒ **No**
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 5-5. Westwood Study Area Technical Assessment: Remaining Sites

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☐ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Remaining Sites	NA	The ROD for the Remaining Sites was signed in September 2007, but selected remedies for the WW-90 Fill Area and Hog Point Site have not been implemented yet. The ROD identified No Further Action for the remaining sites addressed in this ROD.
▪ **System Operations/O&M**		
	NA	.
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	N	
▪ **Implementation of Institutional Controls and Other Measures**		
	NA	
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	N	There have been no significant changes to the standards for protection of human health since the ROD was signed in September 2007.
TBC guidance for protection of ecological receptors	N	Same as above for ecological receptors.
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	N	See Attachment C.
	N	No significant changes in site setting have occurred based on the site visits and interview with the DSHE Project Officer.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	There have been no changes in toxicity or contaminant characteristics since the ROD was signed in September 2007.
▪ **Changes in Risk Assessment Methods**		
Human Health Risk Assessment (HHRA)	N	HHRA methods changed slightly since the ROD was signed in September 2007. However, none of the changes substantively affect the original conclusions of the risk assessment.
Ecological Risk Assessment (ERA)	N	ERA methods have not changed since the ROD was signed in September 2007.

Table 5-5. Westwood Study Area Technical Assessment: Remaining Sites (continued)

▪ **Expected progress towards meeting RAOs**		
	NA	The ROD for the Remaining Sites was signed in September 2007, but selected remedies for the WW-90 Fill Area and Hog Point Site have not been implemented yet.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

5.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

During the course of this five-year review, no issues that impact protectiveness were discovered relating to the Westwood Study Area.

5.9 PROTECTIVENESS STATEMENT(S)

5.9.1 Clusters 2, 6, 10, 14, and 21 Sites

The remedy for the Clusters 2, 6, 10, 14, and 21 sites addressed in the ROD signed in 2006 currently protects human health and the environment because all waste has been contained or removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedies to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

5.9.2 Remaining Sites

The remedies at the Remaining Sites (i.e., WW-90 Fill Area and Hog Point Site) are expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

5.10 NEXT REVIEW

It is recommended that a five-year review be conducted in 2013 for all sites in the Westwood Study Area.

6.0 CARROLL ISLAND STUDY AREA

6.1 OVERVIEW

The Carroll Island Study Area has two OUs corresponding to the AEDB-R sites as listed in Exhibit 2. Thirteen disposal pits comprise OU A while OU B addresses the entire island. There was concern of possible migration of hazardous substances due to Carroll Island's high water table, frequent flooding, and shoreline erosion. In addition, not all of the wastes associated with former activities on Carroll Island could be located or identified because of the large amount of wetlands and the dense vegetation on the island. The ROD for OU A was signed in 1996. Hand excavation of waste in the disposal pits and segregation and disposal or treatment of the excavated waste was the selected remedy. The ROD for OU B was signed in 2001. Public Access Controls, Land Use Restrictions, and Erosion Controls were the selected remedy.

6.2 SITE CHRONOLOGY

The Carroll Island Study Area has been utilized since WWII for the testing of CWM and military training. Current land use includes military training and open space. A chronology of CERCLA activities at this Study Area is listed in Table 6-1.

Table 6-1. Carroll Island Environmental Activity Chronology

Date	Activity
1975	CWM Testing Facilities Decommissioned
1977	U.S. Army Toxic and Hazardous Materials Agency begins fieldwork at site
1986	RCRA Facility Investigation
1989	USGS Hydrogeologic Assessment
1989	RCRA Facility Assessment
1990	Edgewood Area Listed on National Priorities List
1991-1993	Remedial Investigation
1992-1995	Phase I Archaeological Surveys
1993	Lower Island Disposal Area – Removed Contents of Open Pit
1993	Wind Tunnel Test Facility Removal Action
1995	Removal Action at Wind Tunnel Test Facility
Dec 1995	Focused Feasibility Study for OU A
Jul 1996	Proposed Plan for OU A
Nov 1996	Record of Decision OU A
1997-2001	Remedial Action Construction OU A
Feb 1998	Combined Feasibility Study Carroll Island and Graces Quarters OU B
1999	Sump Removal Action at Abandoned Wastewater Treatment Plant

Apr 2000	Proposed Plan OU B
Aug 2001	Record of Decision OU B
2002-2006	Remedial Action Construction OU B
Dec 2005	Remedial Action Report OU A
Sep 2007	Remedial Action Report OU B

6.3 SITE BACKGROUND

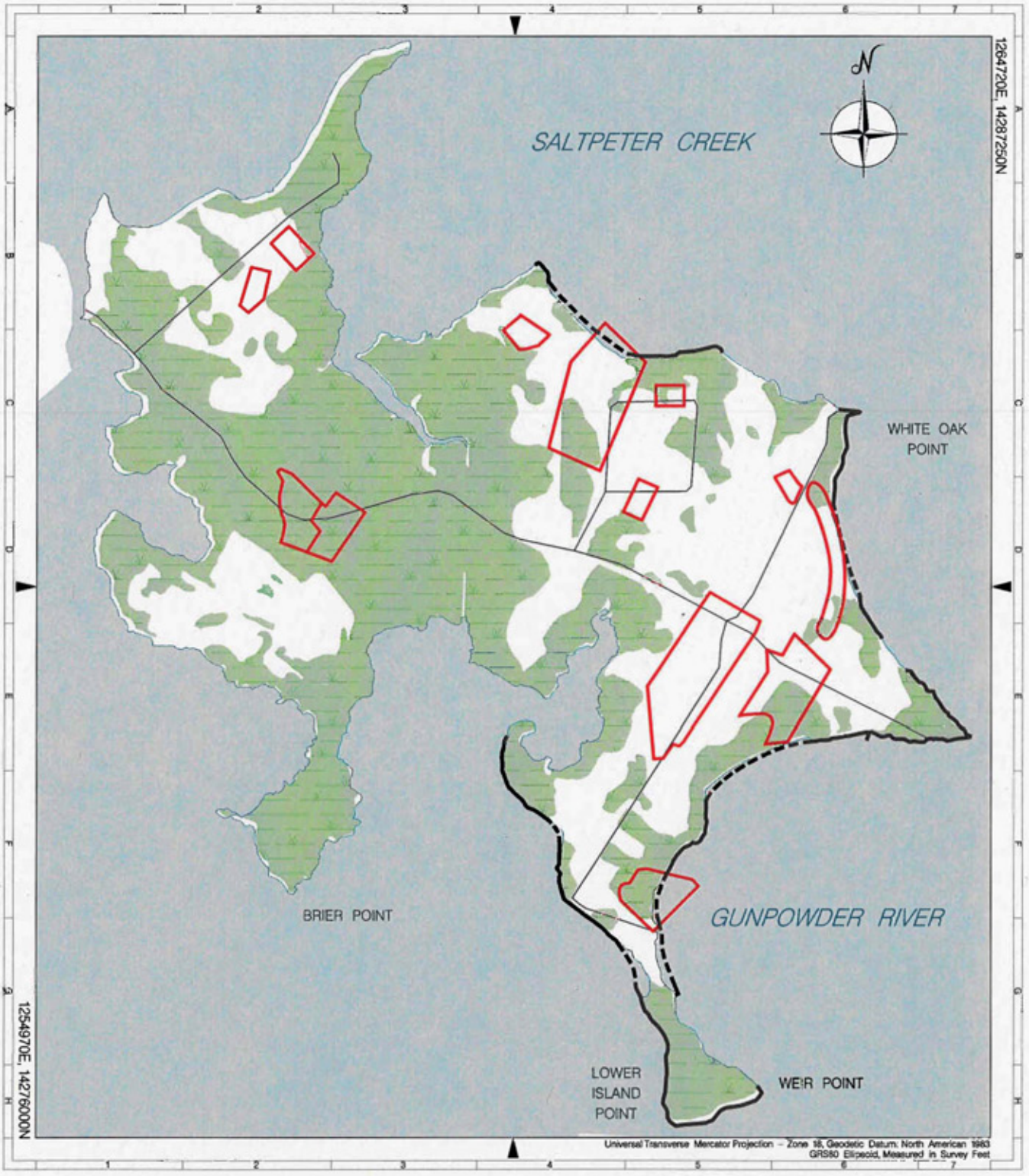
6.3.1 Physical Characteristics

Carroll Island is surrounded by the Gunpowder River, Saltpeter Creek, Seneca Creek, and the Chesapeake Bay as seen in Figure 1-2. Of its ~855 acres, ~659 are classified as wetlands, with the remainder consisting of upland forest and ephemeral ponds. The highest elevation on Carroll Island is 13 ft above msl, and most of the island is less than 10 ft above msl. Due to its low elevation, Carroll Island is marked by a shallow water table, frequent flooding, and shoreline erosion problems. These erosion and flooding problems led to concern over the possible spread of contamination on Carroll Island or to surrounding waterways. The disposal pits (OU A) were located throughout the island, as seen in Figure 6-1.

6.3.2 Land and Resource Use

Carroll Island was obtained by the Army in 1918, during the acquisition of the Edgewood Area, but there is no evidence of military use until 1944. From 1944 until 1971, it was used as an impact area, mainly for the testing of HE and WP-filled rounds. Chemical agents and chemical ordnance, including mustard, were also tested on Carroll Island from the 1940s through 1971, although only non-lethal chemicals were tested from 1969 through 1971. Chemical agents tested at Carroll Island included all standard CWM as well as some experimental chemicals, and may have included biological simulants. Agents known to have been tested at Carroll Island include HE, WP, mustard, BZ, CS, and VX. Detailed records are available only from 1964 through 1971. The CWM testing facilities were decommissioned in 1975.

Military training activities are currently conducted on the island and will most likely continue in the future. The Carroll Island site is a designated natural area, with a single road and bridge leading to the island. Access is strictly controlled.



1500 1000 500 0 750 1500 3000

GRAPHICAL SCALE
IN FEET (1" = 1500')

L E G E N D

- Water
- Wetland
- Road
- Site Boundary
- Shoreline Erosion Controls

500 Edgewood Road, Suite 110
Edgewood, MD 21040
(410) 676-8835
www.gpworldwide.com

TITLE:

CARROLL ISLAND DISPOSAL PITS

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	C. HOULIK	08-05-08	6-1

i:\Edgewood Graphics\GEOGRAPHICS\5 Year Rod Review\Carroll Island.dgn

6.3.3 History of Contamination

Wastes from the testing activities that occurred on the island were dumped or buried at various locations. Explosive items or objects containing CWM were decontaminated by agents such as supertropical bleach and DANC.

The large areas of wetlands and dense vegetation on the island have made locating and identifying all of the wastes on the island impossible. Potential contaminants include CWM, SVOC, pesticides, PCB, radioisotopes, and inorganic analytes. Debris, including munitions, munitions fragments, and scrap, has been found.

6.3.4 Previous Removal Actions

Previous removal actions are listed in Table 6-2. The overall protectiveness of removal actions is evaluated with the final remedy.

Table 6-2. Carroll Island Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
Lower Island Disposal Area	1993	Removal of contents of an open pit	Contents removed. Pit lined, backfilled, and delineated with metal posts.
Wind Tunnel Test Facility	1993	Removal of aboveground portion of facility	Building removed. Equipment and structures disassembled, cut, stored, sampled, decontaminated, treated, released, and recycled as scrap metal.
Wind Tunnel Test Facility	1995	Removal of 250-gal UST that had been used to store coolant	Liquid pumped out. UST excavated, removed, cleaned, cut up, and recycled as scrap metal. Excavated area filled with gravel. Excavated soil spread on surface of gravel.
Abandoned Wastewater Treatment Plant	1999	Removal of sediment and water from sump	Contents removed. Sump dewatered, sediments removed and high pressure washed. Outgoing lines plugged, and sump backfilled.

6.3.5 Contaminant Media

The contaminant medium for Carroll Island OU A is soil and the COCs are CWM, CWM degradation products, UXO, buried wastes, and buried metal. The contaminant medium for OU B is soil and the COCs are UXO and CWM.

6.4 REMEDIAL ACTIONS

6.4.1 Operable Units with RODs

Table 6-3 summarizes the remedial actions conducted to date in the Carroll Island Study Area. The basis for taking action, RAOs, selected response, and performance standards are listed in Exhibit 1.

6.4.2 Progress Since Last Five-Year Review

Progress since the last five-year review includes completion of pre-design activities for OUB to include the collection and analysis of water levels, wind data, design wave conditions, topography, and geotechnical data. The Design Plan for OUB was completed in 2003. Remedial construction commenced in the Fall 2002 and was completed in the Summer 2006. The Remedial Action Report was signed by the USEPA in September 2007.

6.5 FIVE-YEAR REVIEW PROCESS

During the review process the status of the remedial action at the Carroll Island site in APG was determined. To accomplish this goal, the Carroll Island site was visually inspected with DSHE representatives and available data were reviewed. In addition, the Project Officer was interviewed to obtain further information regarding the status of the site. Input was also received from the MDE and the RAB.

The Project Officer for the Carroll Island site, Mr. Rurik Loder, was interviewed on 7 November 2007. The results of this interview are presented in Attachment A.

During the Five-Year Review process, the Carroll Island site was visited on 8 November 2007. Photographic documentation of this site visit is provided in Attachment D of this document.

Comments from MDE pertaining to work conducted at the Carroll Island Study Area were received on 06 December 2007 and are provided in Attachment J of this document.

Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

6.6 FIVE-YEAR REVIEW FINDINGS

6.6.1 Site Inspection

A site inspection was conducted on 08 November 2007. Site inspection checklists, as specified in Guidance, are provided in Attachment E to this document.

Table 6-3. Carroll Island Study Area Remedial Action Summary

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
OU A	ROD – 1996	1. No Action 2. Hand Excavation and Disposal/Treatment of Excavated Material 3. Conventional Excavation in an Armored Filtered Air Shelter and Disposal/Treatment of Excavated Material 4. Telerobotic Excavation in an Armored Filtered Air Shelter and Disposal/Treatment of Excavated Material	Hand Excavation and Disposal/Treatment of Excavated Material	The Carroll Island OU A selected remedy has been implemented as described in the ROD.
OU B	ROD – 2001	1. No Action 2. Public Access Controls with Land Use Restrictions and Erosion Controls	Public Access Controls with Land Use Restrictions and Erosion Controls	The Carroll Island OU B selected remedy has been implemented as described in the ROD. All removal actions were declared final actions under this ROD.

6.6.2 Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

6.6.3 Technology Evaluation

Alternative technologies have been evaluated for each site with an implemented ROD for purposes of remedial action optimization. A summary of these technologies is presented in Attachment F of this document.

6.7 TECHNICAL ASSESSMENT

The results of the OU A and OU B technical assessment, in accordance with Guidance, are summarized in Table 6-4.

6.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

At present no issues have been identified with the IRP process at Carroll Island.

6.9 PROTECTIVENESS STATEMENT(S)

6.9.1 OU A

The remedy at OU A currently protects human health and the environment because the waste has been removed from the site and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

6.9.2 OU B

The remedy for OU B currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure and shoreline erosion has been mitigated. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. Erosion Controls and LUCs must be maintained and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

6.10 NEXT REVIEW

It is recommended that a five-year review be conducted in 2013 for Carroll Island OU A and OU B.

Table 6-4. Carroll Island Study Area Technical Assessment

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ Yes ☐ No		
▪ **Remedial Action Performance**		
	Y	Disposal pit wastes have been removed. Shoreline Stabilization is in place, along with LUCs preventing exposure to UXO and CWM.
▪ **System Operations/O&M**		
	NA	.
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	N	
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs have been implemented in accordance with the ROD. The site is also located in a restricted area of the Installation, with access limited to badged or escorted personnel.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ Yes ☐ No		
▪ **Changes in Standards and TBC**		
	NA	
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	N	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	NA	
▪ **Changes in Risk Assessment Methods**		
	NA	
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been met

Table 6-4. Carroll Island Study Area Technical Assessment (continued)

Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

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7.0 GRACES QUARTERS STUDY AREA

7.1 OVERVIEW

The Graces Quarters Study Area has two OUs corresponding to the AEDB-R sites as listed in Exhibit 2. OU A addresses contaminated groundwater while OU B addresses the entire peninsula. Potential migration of hazardous substances was an issue due to Graces Quarters' high water table, frequent flooding, and shoreline erosion. In addition, not all of the wastes associated with former activities at Graces Quarters could be located or identified because of the large amount of wetlands and the dense vegetation at the site. The ROD for OU A was signed in 2006. In-situ treatment of the groundwater was the selected remedy. In 2001, Public Access Controls, Land Use Restrictions, and Erosion Controls were chosen as the selected remedy for OU B.

7.2 SITE CHRONOLOGY

The Graces Quarters Study Area has been utilized since WWII for the testing of CWM and military training. Current land use includes military training and open space. A chronology of CERCLA activities at this Study Area is listed in Table 7-1.

Table 7-1. Graces Quarters Environmental Activity Chronology

Date	Activity
1977	USATHAMA Begins Fieldwork at Site
1986	RCRA Facility Investigation
1989	RCRA Facility Assessment
1990	Edgewood Area Listed on NPL
1992-1996	Phase I Archaeological Surveys
1992-1996	Remedial Investigation Field Activities
1993-1994	Removal Action at Burial Pits
1993-1995	Removal Action at Graces Quarters Service Area
1994	Installation of Fence and Warning Signs
1995	Removal Action at Test Site Perimeter Dumps
1996	Draft Remedial Investigation Report
1997	Engineering Evaluation / Cost Analysis for the Secondary Test Area
1997	Extensive Soil Sampling
Feb 1998	Remedial Investigation Report
Mar 1998	Combined Feasibility Study for Carroll Island and Graces Quarters OU B
1998	Decision Document for Soil Removal at the Secondary Test Area
1998	Removal Action at Secondary Test Area
Apr. 2000	Proposed Plan OU B

Aug 2001	Record of Decision OU B
2002-2006	Remedial Action Construction OU B
Feb 2004	Feasibility Study OU A
Apr 2004	Proposed Plan OU A
Sep 2004	Record of Decision OU A
Jan 2006	Final Remedial Design, OU A
Feb 2006	Remedial System Construction Completion Report, OU A
Jun 2006	Land Use Control Remedial Design, OU A
Sep 2007	Remedial Action Report OU B

7.3 SITE BACKGROUND

7.3.1 Physical Characteristics

Graces Quarters is located on a peninsula that is approximately 1 mile north of Carroll Island, as seen in Figure 1-2. Of its 414 acres, 151 are classified as wetlands. The area is surrounded by the Gunpowder River to the east, Saltpeter Creek to the south, Dundee Creek to the west, and the Hammerman Area of Gunpowder State Park to the north (Figure 7-1). The maximum elevation at Graces Quarters is approximately 40 feet above msl, and the study area consists mainly of tidal and non-tidal wetlands, open fields, and wooded areas.

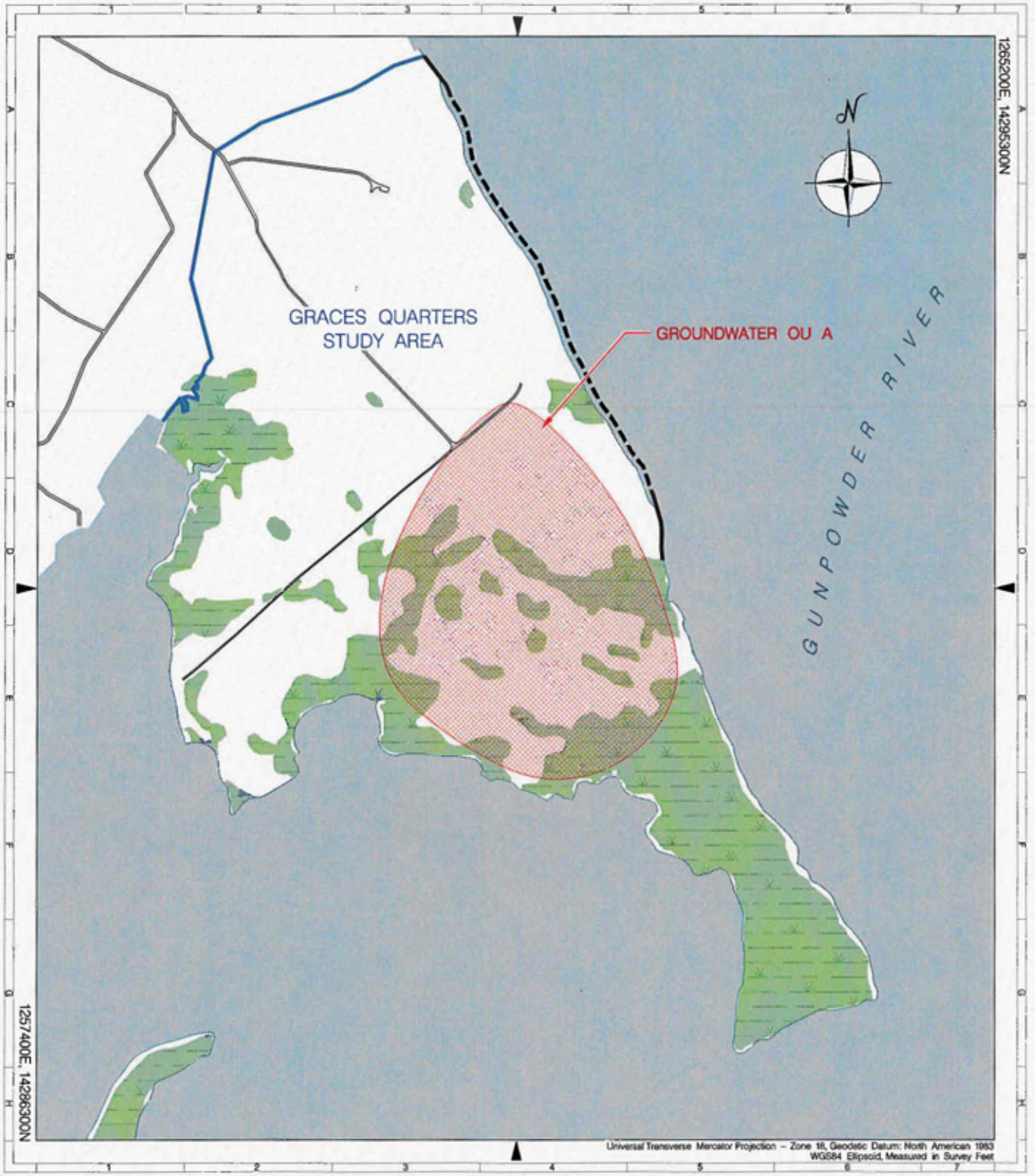
7.3.2 Land and Resource Use

Graces Quarters was acquired by the Army in 1918, along with the rest of the Edgewood Area. However, there is no evidence of any military operation occurring on the site until 1944. From the 1940s until 1971, Graces Quarters was used as an impact area and firing point for mortar fire toward M-Field, as well as a testing area for chemical agents and chemical ordnance. The mortar fire consisted mainly of HE and WP-filled rounds.

Although Graces Quarters has access controls in place, the surrounding water bodies are used for recreational activities including boating and fishing. Graces Quarters is currently used for military training activities.

7.3.3 History of Contamination

The CWM tested at Graces Quarters included common stockpile agents and experimental chemicals, such as pinacolyl methyl phosphono fluoridate (GD), VX, CS, HD, and GB. Biological simulants were also tested. Detailed records of testing activities exist only



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GRAPHICAL SCALE
IN FEET (1" = 1200') 1:14400

L E G E N D

Water
Wetland
Groundwater Plume
Road
Study Area Boundary
Shoreline Erosion Controls

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TITLE:

GRACES QUARTERS STUDY AREA

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	C. HOULIK	02-26-08	7-1

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from 1964 through 1971. From 1969 until 1971, only non-lethal chemical materials were tested at Graces Quarters. Waste from the testing activities was placed in dumpsites or burial pits.

The large area composed of wetlands and dense vegetation at the Graces Quarters Study Area has made locating and identifying all of the wastes possibly remaining at the site impossible. Possible contaminants include CWM, SVOC, pesticides, PCB, radio-isotopes, and inorganic analytes. Debris, including munitions, munitions fragments, and scrap, has been found.

7.3.4 Previous Removal Actions

Previous removal actions are listed in Table 7-2. The overall protectiveness of removal actions is evaluated with the final remedy.

Table 7-2. Graces Quarters Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
Graces Quarters Service Area	1993-1995	Removal of Quonset hut and 2 USTs containing gasoline and diesel fuel	Quonset Hut dismantled, placed in plastic-lined wooden crates, and thermally treated at Edgewood. Two USTs were removed, sampled, tested, pumped out, transported off-post, punctured, and removed from use.
Burial Pits	1993-1994	Removal of wastes in pits	Four pits excavated, soil/ materials removed, pits lined and backfilled, and gravel access road installed.
Secondary Test Area	1998	Removal of soil containing elevated concentrations of lead	Approximately 4 yd^3 of lead-contaminated soil removed.
Test Site Perimeter Dumps	1995	Removal of contaminated surface material	Surface debris removed and placed in plastic-lined wooden boxes, shipped to decon/detox facility, and thermally treated for final disposal.

7.3.5 Contaminant Media

The contaminant medium for Graces Quarters OU A is groundwater and the COCs are VOC, primarily TeCA, CT, TCE, PCE, and CF. The contaminant medium at OU B is soil and the COCs are UXO and CWM.

7.4 REMEDIAL ACTIONS

7.4.1 Operable Units with RODs

Table 7-3 summarizes the remedial actions conducted to date in the Graces Quarters Study Area. The basis for taking action, RAOs, selected response, and performance standards are listed in Exhibit 1.

7.4.2 Progress Since Last Five-Year Review

The OU A ROD has been implemented and the OU B ROD is construction complete.

7.5 FIVE-YEAR REVIEW PROCESS

During the review process, the status of the remedial action at the Graces Quarters site in APG was determined. To accomplish this goal, the Graces Quarters site was visually inspected and any available data were reviewed. In addition, the Project Officer was interviewed in order to obtain further information regarding the status of the site.

The Project Officer for the Graces Quarters site, Mr. Rurik Loder, was interviewed on 30 October and 07 November 2007. The results of the interviews are presented in Attachment A.

During the Five-Year Review process, the Graces Quarters site was inspected on 08 November 2007 and 25 February 2008. Photographic documentation is provided in Attachment D of this document.

Comments from MDE were received on 06 December 2007 and are provided in Attachment J of this document. Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

7.6 FIVE-YEAR REVIEW FINDINGS

7.6.1 Site Inspection

Site inspections were conducted on 08 November 2007 and 25 February 2008. Site inspection checklists, as specified in the USEPA Guidance, are provided in Attachment E.

7.6.2 Document and Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

Table 7-3. Graces Quarters Study Area Remedial Action Summary

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
OU A	ROD 2004	1. No Action 2. LTM and Institutional Controls 3. In Situ Treatment - Vitamin B_{12}-catalyzed reductive dehalogenation in areas greater than 1 mg/L (both aquifers); MNA at all other locations 4. In Situ Treatment - Vitamin B_{12}-catalyzed reductive dehalogenation in areas greater than 1 mg/L (both aquifers); pump and treat at all other locations 5. In Situ Treatment - Vitamin B_{12}-catalyzed reductive dehalogenation in areas greater than 1 mg/L (surficial aquifer); pump and treat at all other locations 6. In Situ Treatment - Vitamin B_{12}-catalyzed reductive dehalogenation in areas greater than 0.1 mg/L (both aquifers); MNA at all other locations 7. Pump and treat at all locations 8. Pump and treat in areas greater than 1 mg/L (both aquifers); LTM at all other locations 9. Six-phase heating in areas greater than 1 mg/L (surficial aquifer); pump and treat at all other locations	In Situ Treatment - Vitamin B_{12}-catalyzed reductive dehalogenation in areas greater than 1 mg/L; MNA at all other locations Long-Term Monitoring Institutional Controls	The Graces Quarters OU A selected remedy is under implementation as described in the ROD. Full-scale remedy installed and operational in October 2005. 20 amendment injection events conducted between October 2005 and March 2007. Performance and compliance monitoring conducted in accordance with the remedial design.
OU B	ROD 2001	1. No Action 2. Public Access Controls with Land Use Restrictions	Public Access Controls with Land Use Restrictions Erosion Controls	The Graces Quarters OU B selected remedy has been implemented as described in the ROD. All removal actions were declared final actions under this ROD.

7.6.3 Technology Evaluation

Alternative technologies have been evaluated for each site with an implemented ROD for purposes of remedial action optimization. A summary of these technologies is presented in Attachment F of this document.

Because the OU A remedy is in progress and is progressing toward meeting the RAOs, evaluation of alternative technologies is not warranted at this time. Adjustments and opportunities for optimization of the remedy in progress are evaluated regularly.

7.7 TECHNICAL ASSESSMENT

The results of the technical assessment, in accordance with USEPA Guidance, are summarized in Tables 7-4 and 7-5.

7.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

At the time of this review, no issues have been identified with the IRP process at Graces Quarters.

7.9 PROTECTIVENESS STATEMENT(S)

7.9.1 OU A

The remedy at OU A is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

7.9.2 OU B

The remedy for OU B currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure and shoreline erosion has been mitigated. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. Erosion Controls and LUCs must be maintained and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

7.10 NEXT REVIEW

It is recommended that a five-year review be conducted in 2013 for Graces Quarters OU A and OU B.

Table 7-4. Graces Quarters Study Area Technical Assessment: OU A

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Graces Quarters Groundwater	Y	Remedy performance evaluated in Second Annual O&M Report.
▪ **System Operations/O&M**		
	Y	System operation performance evaluated in Second Annual O&M Report.
▪ **Opportunities for Optimization**		
	Y	Recirculation wells in the middle aquifer have been reconfigured to increase remedy effectiveness. Further possibilities for optimization are evaluated regularly.
▪ **Early Indicators of Potential Issues**		
	N	None.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs have been implemented in accordance with the ROD. The site is also located in a restricted area of the Installation, with access limited to badged or escorted personnel.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs Used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
	Y	No significant changes have been made to the list of MCLs since 2002. Changes in Standards for protection of human health do not substantively affect the conclusions of the original risk assessment nor the remedy selected.
▪ **Changes in Exposure Pathways**		
	N	There has been no change in the land use at the site; therefore exposure pathways remain the same.
Vapor Intrusion	N	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	Although changes have been made to some of the COC values, the COCs in the treated water are recycled for further treatment so the remedy is protective.
▪ **Changes in Risk Assessment Methods**		
	N	There have been no changes to the risk assessment methods that would affect the protectiveness of the remedy.
▪ **Expected progress towards meeting RAOs**		
	Y	Remedy is meeting performance standards, as described in Second Annual Report

Table 7-4. Graces Quarters Study Area Technical Assessment: OU A (continued)

Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 7-5. Graces Quarters Study Area Technical Assessment: OU B

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
	Y	Shoreline Stabilization in place, along with LUCs preventing exposure to UXO and CWM.
▪ **System Operations/O&M**		
	NA	
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	N	None.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs have been implemented in accordance with the ROD. The site is also located in a restricted area of the Installation, with access limited to badged or escorted personnel.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs Used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
	NA	
▪ **Changes in Exposure Pathways**		
	N	There has been no change in the land use at the site; therefore exposure pathways remain the same.
Vapor Intrusion	N	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	
▪ **Changes in Risk Assessment Methods**		
	N	
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been met

Table 7-5. Graces Quarters Study Area Technical Assessment: OU B (continued)

Has any other information come to light that could call into question the protectiveness of the remedy?	☐ **Yes**	☒ **No**
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

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8.0 BUSH RIVER STUDY AREA

8.1 OVERVIEW

The Bush River Study Area contains seven geographical clusters of sites numbered 3, 7, 11, 15, 18, 35, and 36[1] (Figure 8-1). Site status by AEDB-R number is listed in Exhibit 2. For RI/FS purposes, the Bush River Study Area is divided into three areas of investigation: Northern Bush River, Southern Bush River, and Cluster 3. At the time of this Five-Year Review, two RODs have been completed for sites in the Bush River Study Area, for actions at the Old Bush River Road Dump and the Cluster 3 Lead-Contaminated Soil Area.

The Old Bush River Road Dump, Lead Contaminated Soil Area, and Transformer Storage Area comprise Cluster 3. The Old Bush River Road Dump ROD, signed in 1999, selected a soil cover as the remedy. This remedy was designed to reduce the migration of contaminants by reducing infiltration, stabilizing the soil to prevent erosion, and containing the explosion of 4.2-inch chemical mortar shells that may be buried in the dump. The second Cluster 3 ROD, signed in 2005, selected excavation and on-site reuse, with ex-situ treatment as necessary, for the Lead Contaminated Soil Area and accepted the removal action as the final action for the Transformer Storage Area.

OUs have not been established for the Northern Bush River Area since the Draft RI identified no sites that warrant further CERCLA action.

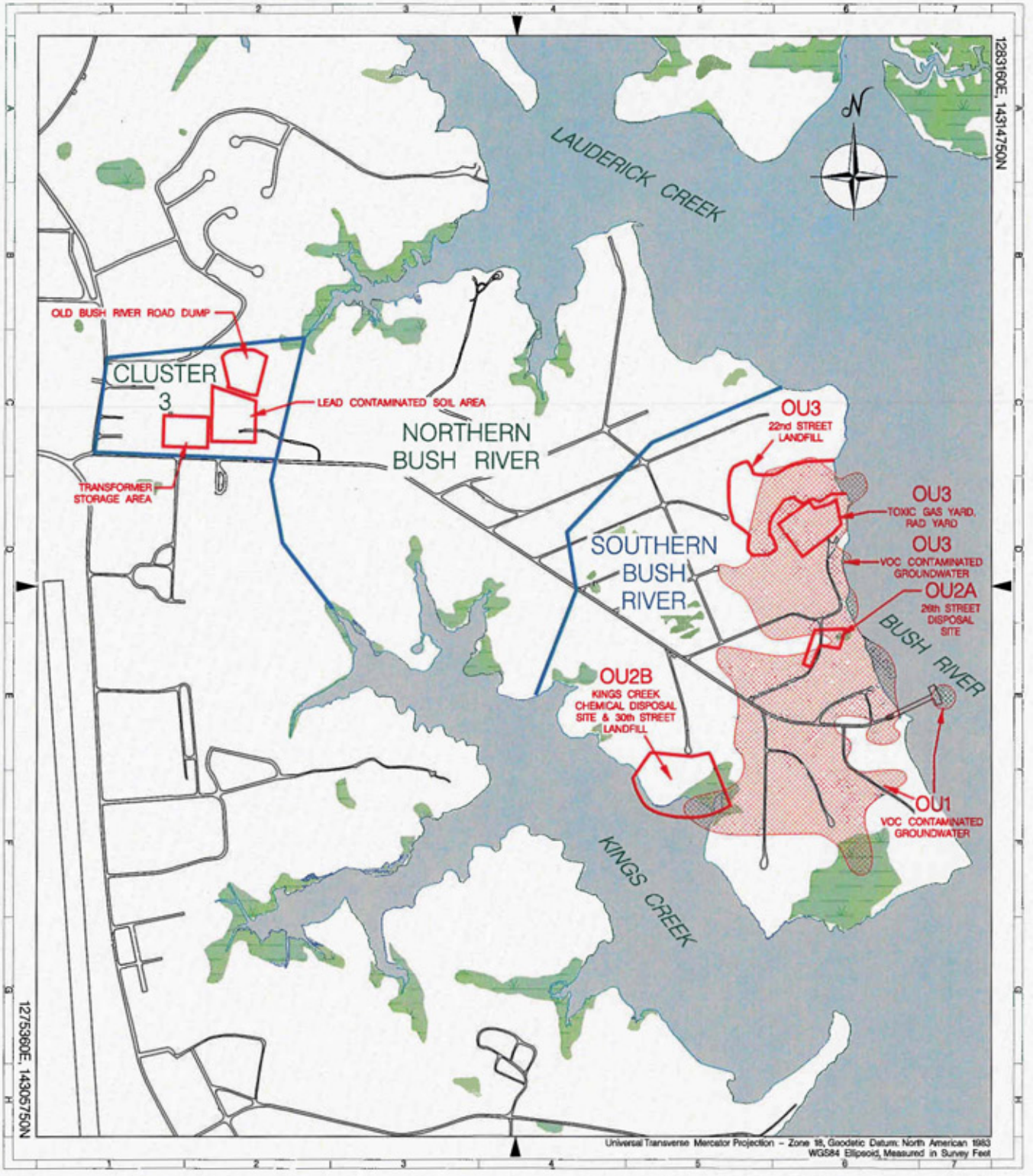
For purposes of completing FSs the Southern Bush River Area has been divided into the following OUs:

- OU 1: Surficial Aquifer Groundwater (southern and eastern plumes and Bush River Dock);
- OU 2A: 26th Street Disposal Site;
- OU 2B: Kings Creek Chemical Disposal Site, and 30th Street Landfill; and
- OU 3: Toxic Gas Yard / RAD Yard and 22nd Street Landfill (including the Surficial Aquifer northern plume).

8.2 SITE CHRONOLOGY

The Bush River Study Area has been utilized since WWI for military training and the testing and storage of CWM. Current land use includes supply, storage and industrial. A chronology of CERCLA activities at this Study Area is listed in Table 8-1.

[1] Former Cluster 55 has been incorporated into Cluster 36.



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GRAPHICAL SCALE
IN FEET (1" = 1200')

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L E G E N D

Roads
Water
Site Boundary
Wetland
Investigation Area
Groundwater Plume

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www.gpworldwide.com

TITLE:

BUSH RIVER STUDY AREA

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	C. HOULIK	11-30-07	8-1

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Table 8-1. Bush River Study Area Site Activity

Date	Activity
1989	RCRA Facility Assessment
1990	Edgewood Area Included on the National Priorities List
1990	Federal Facility Agreement
1990	Remedial Investigation Initiated at Cluster 3
1991	Transformer Storage Area Removal Action
1992	Removal Action at Kings Creek Chemical Disposal Site
1992-1995	Investigation & Removal Action at Adamsite Storage Vaults
1995	Investigation at Bldg E2364 of Radioactive Storage Facility
1996	Bush River Study Area Wetlands Delineation Report
1996	Removal of Potentially Contaminated Surface Debris
1997	Focused Feasibility Study Data Report
1997	Focused Feasibility Study Data Report Addendum for Cluster 3, Site 3
1998	Cluster 3 Remedial Investigation Report
1998	Feasibility Study for Cluster 3, Old Bush River Road Dump
1998	Proposed Plan for Cluster 3, Site 3, Old Bush River Road Dump
1998	Record of Decision, Old Bush River Road Dump
1993-1998	Removal Action at 26th Street Disposal Site
1999	Removal Action at Chemical Munitions Burial Site
1999	Removal Actions at Burn and Mask Disposal Sites
2000	Old Bush River Road Dump Record of Decision Implementation
2000	Removal Action at Bldg E2620 Waste Dumps
2001	Removal Action at Cluster 3 – Binary Canisters
2002	Remedial Investigation Report for Southern Bush River
2003	Remedial Investigation Report for Northern Bush River
2003	Removal Action at Kings Creek Chemical Disposal Site
2004 - 2007	Removal Action at Bush River Radioactive Material Disposal Facility

8.3 SITE BACKGROUND

8.3.1 Physical Characteristics

The Bush River Study Area covers ~500-acres on a peninsula located in the northeastern portion of the Edgewood Area, and is bounded on the north by Lauderick Creek, on the east and south by the Bush River, and on the southwest by Kings Creek (Figure 1-2). The study area has low relief, sloping gradually to the south with elevations in the area ranging from zero to 25 feet above msl. The Study Area consists of a mixture of wetlands, upland forests, fields, buildings, and roads.

The Bush River Study Area contains three aquifers, which are separated by confining units: the Surficial Aquifer, the Canal Creek Aquifer, and the Lower Confined Aquifer.

8.3.2 Land and Resource Use

By 1918, the Bush River Study Area was being used for training and test activities as well as for CWM storage and waste disposal. During WWI and WWII, the area served as a storage and transshipment depot for chemical-filled munitions and included a large dock for off- and on-loading of CWM.

The southern portion of the peninsula, designated as A-Field, was the location of activities such as artillery firing, training, and testing. It also housed smoke and incendiary munitions testing facilities.

The lower two-thirds of the peninsula have been used in the past for the storage of chemical agents and materials needed for various operations in Edgewood Area. It is currently used to store hazardous wastes and materials in preparation for off-site disposal. Mustard agent was stored in bulk and later demilitarized at the secured area.

8.3.3 Old Bush River Road Dump

8.3.3.1 Physical Characteristics

The Old Bush River Road Dump is located in the northeastern part of Cluster 3, encompassing 1.56 acres, in a drainage area of Lauderick Creek. The Surficial Aquifer is thin and does not extend under the Old Bush River Road Dump. The upper confining unit, composed of silt and clay, is continuous beneath the Old Bush River Road Dump

8.3.3.2 Land and Resource Use

Historical aerial photographs illustrate that the site was active as a dump from 1929 through the early 1940s. The last disposal activities at the Dump most likely occurred during the late 1940s or early 1950s.

8.3.3.3 History of Contamination

No documentation exists as a record of what was historically disposed at the Old Bush River Road Dump. There is potential for the presence of hazardous materials at the site. Inspections have indicated that wastes were pushed out toward Lauderick Creek, not all wastes were covered, and burning occurred at the site.

8.3.3.4 Contaminant Media

The contaminant medium for the Old Bush River Road Dump is soil, and the COCs are metals and UXO.

8.3.4 Lead Contaminated Soil Area and Transformer Storage Area

8.3.4.1 Physical Characteristics

The Lead Contaminated Soil Area and Transformer Storage Area are located in relatively flat terrain south (up gradient) of the Old Bush River Road Dump.

8.3.4.2 Land and Resource Use

The Lead Contaminated Soil Area is a part of the former installation operations facilities yard, and was likely the site of waste lead acid battery storage. The Transformer Storage Area was used to store both PCB-containing transformers and non-PCB-containing (serviceable) transformers from approximately 1964 to 1989.

8.3.4.3 History of Contamination

Two former burn areas that were sparsely vegetated and contained discolored soil were found to contain elevated levels of lead. A 15,000-gallon UST and associated appurtenances were removed from the Transformer Storage Area in 1991.

8.3.4.4 Contaminant Media

The contaminant medium for the Lead Contaminated Soil Area is soil, and the COC is lead.

8.3.5 Non-ROD OUs

8.3.5.1 Southern Bush River OU 1

Southern Bush River OU 1 consists of the VOC plumes in the surficial aquifer in the southern portion of the Southern Bush River Area and the VOC in offshore water-bearing sand lenses at the Bush River Dock. Three separable areas comprise OU 1; the Southern Plume, the Eastern Plume, and the Dock Area.

Since 1918, the 240-acre Southern Bush River Area has been used for training, test activities, waste disposal, and CWM storage under a military-industrial land use setting. Materials stored include chemical warfare agents, WP, munitions, contaminated soil and wastewater, and decontamination agents containing chlorinated solvents. The Bush River Dock served as a shipping and receiving point for materials from 1918 to the 1960s, and consisted of a T-shaped pier situated perpendicular to the Bush River. The primary sources of solvent release were related to the decontamination of materials contaminated with chemical warfare agents and storage/leakage of materials containing chlorinated solvents, resulting in VOC migration to the surficial aquifer and offshore water-bearing units. From the 1930s until circa the 1960s, these past storage and handling activities involving chlorinated solvents have resulted in two plumes of chlorinated VOC within the surficial aquifer in the southern portion of the Southern Bush River Area. A small, localized VOC area lies below organic silt within water-bearing sand lenses directly off the end of the Bush River Dock.

This OU is included in the PBC awarded in 2005 that schedules remedy in place by March 2009.

8.3.5.2 Southern Bush River OU 2

The 26th Street Disposal Site (OU 2A) consists of two disposal areas separated by 26th Street. The disposal area located west of the road is ~300 by ~50 feet, and is located within a natural drainage ditch. Disposal activities on the west side of 26th Street may have begun as early as WWI and continued until the 1960s or 1970s. Much of the disposal included the burning of off-spec and unserviceable gas mask containers within a designated pit/ditch. The canisters were commonly burned inside of their wooden-box packaging leaving behind residue and metal remnants (e.g., canisters and box hinges) that eventually filled the pit/ditch. A thin soil cover overlies the burned residue and metal remnants. The western portion of the 26th Street Disposal Site has an average ground surface elevation between 12 and 15 feet above msl, which gently slopes east toward the Bush River.

East of 26th Street was a ~100- to 150-foot diameter disposal area. Although the beginning of activities in this portion of the site is unknown, some disposal may have occurred as late as the 1970s. Early field inspections identified waste such as empty solvent drums, scrap metal, and medical/biological laboratory waste throughout different portions of the disposal area. This section of the site was addressed by a removal action. It presently consists of an excavation covered with geotextile fabric delineated by plastic fencing and warning signs. A small palustrine wetland area exists east of the excavation. This palustrine wetland area drains east into the Bush River by means of a drainage culvert.

Two adjacent sites on the north shore of Kings Creek comprise OU 2B. The Kings Creek Chemical Disposal Site is a ~3.2-acre area. The date the site was first used for CWM disposal/storage is unknown. The earliest available historical aerial photographs from 1929 indicate disposal activities already occurring at the site. The types of material found at the site suggest activity occurred during the 1920s and 1930s with first use probably occurring sometime between 1919 and 1922. Field inspections of the site indicate that open burning and drum storage were the primary methods employed. Undocumented conversations with Bush River Study Area personnel suggest that disposal activities concluded during the late 1930s or early 1940s.

Several removal actions have been conducted at this site to remove surface waste and debris, to remove UXO from the shoreline area, to remove laboratory waste in a shallow burial trench along the shoreline, and to stabilize the shoreline. Currently, the site is predominately vegetated but includes a small open area where burning occurred; two areas where drums containing chemical material had been stacked and burned; pieces of corroded scrap metal from the disposal operations; and shoreline stabilization structures along Kings Creek. Existing data compiled for the site suggest that wide-scale burial of material did not occur in the area. Average ground surface elevation ranges between four to seven feet above msl and gently slopes toward Kings Creek. A small drainage ditch exists within the central portion of the site carrying surface water runoff from upstream of the site into Kings Creek.

The 30th Street Landfill is approximately two acres in size. Historically, the western boundary of the 30th Street Landfill has been depicted as overlapping the eastern boundary of the Kings Creek Chemical Disposal Site. In reality, however, the area of overlap is occupied by mounds of construction/demolition debris that separate the OU 2B sites. Historical aerial photography indicates activity within the landfill occurred during the late 1960s and/or 1970s. Visual inspections of the site revealed building demolition debris, including small amounts of concrete and steam radiators within the marsh area adjacent to the creek. The 30th Street Landfill was created by dumping and push out of waste into a wetland along the shoreline of Kings Creek. The volume of waste disposed was small, with the surface not substantially higher than the level of water in Kings Creek, and the site remains an estuarine (brackish), tidal wetland. Average land surface elevation is ~2 feet above msl. Virtually all of the landfill waste is covered by marsh vegetation and lies in the saturated, organic creek/marsh sediment.

This OU is included in the PBC awarded in 2005. The time to achieve response complete will be dependent on funding schedules and regulatory approvals of RI/FS and decision documents.

8.3.5.3 Southern Bush River OU 3

OU 3 consists of the 22nd Street Landfill (~8.0 acres), the Ton-Container Steamout Site and Bush River Radioactive Material Disposal Facility (including the former Toxic Gas Yard and referred to as the TGY/RAD Yard), and the VOC-contaminated groundwater in the northern portion of the Southern Bush River Area. The 22nd Street Landfill lies to the

north of the TGY/RAD Yard. The landfill occupies a former marsh area. Two drainage swales/streams are located at the landfill, one along the north side and one through the middle of the fill. Both flow to the east and discharge into the Bush River.

The average ground surface elevation at the 22nd Street Landfill is approximately five feet above msl. Information on operating procedures or the final cover thickness of the area is unknown. Visual inspection of the landfill suggests the cover thickness is approximately one to two feet or less, and eroded in areas exposing the underlying fill materials. Leachate seeps within the landfill and erosion along the shoreline have been observed during low tide. A sump constructed with concrete blocks and concrete/dirt mounds lie at the edge of the current marsh area in the southeastern part of the landfill. The sump had received wastewater from the valve pit associated with the liquid waste concentrator building in the RAD Yard. The TGY/RAD Yard lies south of the landfill and average ground surface elevation is approximately 12 feet above msl sloping to the east toward Bush River where the shoreline elevation is approximately 2.5 feet above msl. Radioactive contaminants have been addressed by a Removal Action.

The historical activities that were the primary source of VOC are the Ton-Container Steamout Site at the Toxic Gas Yard, the 22nd Street Landfill, and CWM storage activities in and around the Toxic Gas Yard and the former Chemical Agent Storage Yard. VOC released in the storage areas was likely related to decontamination activities.

This OU is included in the PBC awarded in 2005. The time to achieve response complete will be dependent funding schedules and regulatory approvals of RI/FS and decision documents.

8.3.6 Previous Removal Actions

Previous removal actions are listed in Table 8-2. The overall protectiveness of removal actions is evaluated with the final remedy.

8.4 REMEDIAL ACTIONS

8.4.1 Operable Units with RODs

Table 8-3 summarizes the remedial actions conducted to date in the Bush River Study Area. The basis for taking action (RAOs), selected response, and performance standards are listed in Exhibit 1.

8.4.2 Remaining Sites

Draft RI reports for the Southern Bush River Area and Northern Bush River Area were submitted in 1997 and 2002, respectively. While FSs are underway for the Southern Bush River OUs, regulatory review of the draft RIs has not been completed.

Table 8-2. Bush River Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
Transformer Storage Area	1991	Removal of a 15,000-gal UST, sump, and concrete pad	Action completed.
E1372 Site	1992	Interim remediation of PCB-contaminated soil, and tank removal	Action completed.
Kings Creek Chemical Disposal Site	1993	Removal of contaminated surface material, drums, and spilled material	Action completed.
Adamsite Storage Vaults	1994	Removal of arsenic-contaminated soil	Action completed.
Radioactive Storage Facility	1995	Removal of contaminated water and sediment from two in-ground concrete sumps	Action completed.
Old Bush River Road Dump	1996	Fence installation	Action completed.
Bush River Area	1997	Removal of potentially contaminated surface material	Action completed.
26th Street Disposal Site	1998	Removal of gas cylinders and the disposal of debris and contaminated waste	Action completed.
Chemical Munitions Burial Site	1999	Removal of mercury contaminated soil	Action completed.
Cluster 3	2001	Removal of empty binary canisters	Action completed.
Kings Creek Chemical Disposal Site	2003 & 2006	Excavation of laboratory waste in burial trench along shoreline, and stabilization of the Chemical Disposal Site and 30th Street Landfill shoreline.	Action completed.
Radioactive Waste Management Facility	2004 - 2007	Remove radioactively contaminated equipment, structural material, wastewater lines and soil, with removal of the site from the radiological license.	Action Completed
Radioactive Waste Management Facility	2004 - 2008	Removal of sufficient arsenic-contaminated soil such that risk to future industrial workers is reduced to an acceptable level.	Evaluation of potential risk posed by remaining arsenic in soil underway.

Table 8-3. Bush River Study Area Remedial Action Summary

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
Old Bush River Road Dump	ROD, 1998	1. No Action 2. Composite Cap 3. Soil Cover 4. Vegetative Barrier Cap	Soil Cover	The selected remedy has been implemented as described in the ROD.
Lead Contaminated Soil Area Transformer Storage Area	ROD,2005	Lead Contaminated Soil Area 1. No Action 2. Institutional Controls 3. Excavation and Off-site Disposal 4. Excavation, Stabilization (as needed) and On-site Disposal 5. Containment (capping) 6. Phytoremediation	Lead Contaminated Soil Area Excavation, Stabilization (as needed) and On-site Disposal	The selected remedy has been implemented as described in the ROD. The clean-closure removal action at the Transformer Storage Area was accepted as the final action

8.4.3 Progress Since Last Five-Year Review

The second Cluster 3 ROD that, together with the first, addresses all sites in Cluster 3 has been signed and implemented.

8.5 FIVE-YEAR REVIEW PROCESS

During the review process, the status of the remedial actions at the Bush River Study Area sites in APG was determined. To accomplish this goal, the sites were visually inspected and any available data were reviewed. In addition, the site officer was interviewed in order to obtain further information regarding the status of the site. Input was also received from MDE and a member of the RAB.

The site officer for the Bush River Study Area sites, Mr. Rurik Loder, was interviewed on 17 October 2007. The results of this interview are presented in Attachment A to this report.

Comments from MDE pertaining to work conducted at the Bush River Study Area were received on 6 December 2007 and are provided in Attachment J to this document.

Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

8.6 FIVE-YEAR REVIEW FINDINGS

8.6.1 Site Inspection

A site inspection was conducted on 14 November 2007. Results of the site inspection are presented in the Site Inspection Checklist (Attachment E).

8.6.2 Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

8.6.3 Technology Evaluation

Alternative technologies have been evaluated for each site with an implemented ROD for purposes of remedial action optimization. A summary of these technologies is presented in Attachment F of this document.

The nature of the Remedy at Old Bush River Road Dump and the Lead-Contaminated Soil Area indicates that optimization via such technologies is not relevant to these remedies. Since construction is complete, optimization opportunities for the Old Bush River Road Dump would likely be constrained to modified methods of maintenance and/or monitoring rather than implementation. However, some or all of these technologies can be considered in developing remedies for the remaining operable units.

8.7 TECHNICAL ASSESSMENT

The results of the technical assessment, in accordance with Guidance, are included in Tables 8-4 and 8-5. Only sites with implemented RODs are included in this evaluation. Recommendations regarding all OUs are included in Subsection 8.8.

8.7.1 Opportunities for Optimization

It has been determined that toxicity in sediment downgradient of Old Bush River Road Dump (and the Lead-Contaminated Soil Area) results from naturally occurring ammonia. With remedies in place at both the Old Bush River Road Dump and the Lead-Contaminated Soil Area, there is no reason to expect that metals concentrations in down-gradient sediment would increase or pose unacceptable risk.

The frequency of LTM at the Old Bush River Road Dump can be reduced to once every five years, preceding the remedy review.

Table 8-4. Bush River Study Area Technical Assessment: Old Bush River Road Dump

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Old Bush River Road Dump	Y	Soil cover in place, no unacceptable risk to ecological receptors downstream in Lauderick Creek.
▪ **System Operations/O&M**		
	Y	Soil cover being maintained such that erosion does not occur.
▪ **Opportunities for Optimization**		
	Y	Observed toxicity has been due to naturally-occuring ammonia, and not constituents of potential concern. Frequency of LTM can be reduced.
▪ **Early Indicators of Potential Issues**		
	NA	
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs have been implemented in accordance with the ROD. The site is fenced with locking gates to restrict access to the site.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
	NA	
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	N	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	NA	
▪ **Changes in Risk Assessment Methods**		
	NA	
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been met.

Table 8-4. Bush River Study Area Technical Assessment: Old Bush River Road Dump (continued)

Has any other information come to light that could call into question the protectiveness of the remedy?	☐ **Yes**	☒ **No**
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 8-5. Bush River Study Area Technical Assessment: Lead Contaminated Soil Area

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Lead Contaminated Soil Area	Y	Clean soil cover in place, along with LUCs preventing exposure to subsurface soil.
▪ **System Operations/O&M**		
	Y	With LUCs in place, long-term O&M will not be necessary after vegetation cover is fully established.
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	N	
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs have been implemented in accordance with the ROD.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
	N	
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	N	See Attachment C.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	
▪ **Changes in Risk Assessment Methods**		
	N	
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been met.

Table 8-5. Bush River Study Area Technical Assessment: Lead Contaminated Soil Area (continued)

Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

8.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

Since the last five-year review, USEPA has been placing more emphasis on assessment and remedial action to address the exposure pathway of vapor intrusion into structures. At Cluster 3, where sites are already under ROD, there are very low concentrations of VOC in the Canal Creek aquifer, with the source being upgradient in the Canal Creek Study Area. In the Cluster 3 area, the Canal Creek Aquifer is overlain by 20 feet of low permeability clay, and vapor intrusion is not expected to be a complete exposure pathway. In the Southern Bush River area, several plumes of VOC exist in groundwater. Although some structures exist in the areas where the plumes are located, at the present time none of the structures are routinely occupied. When future remedies are selected, the potential for vapor intrusion into structures should be addressed.

During the course of this five-year review, no other issues that impact protectiveness were discovered relating to the Bush River Study Area.

8.9 PROTECTIVENESS STATEMENT(S)

8.9.1 Old Bush River Road Dump

The remedy at Old Bush River Road Dump currently protects human health and the environment because the waste is contained. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

8.9.2 Transformer Storage Area

The remedy at the Transformer Storage Area is protective of human health and the environment because all waste has been removed.

8.9.3 Lead Contaminated Soil Area

The remedy at the Lead Contaminated Soil Area currently protects human health and the environment because waste has been treated to action levels, all waste is contained, and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of lead in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

8.9.4 Remaining Areas

Several Removal Actions have been conducted at sites in this Study Area to address specific issues. These Removal Actions met their specific objectives and therefore

provided reduction in risk. A formal Protectiveness Statement for these sites cannot be made until the RI/FS/ROD/RA process is completed.

8.10 NEXT REVIEW

It is recommended that a five-year review be conducted in 2013 for Old Bush River Road Dump, the Lead Contaminated Soil Area, and any OUs for which a ROD is signed prior to 2013 and for which CERCLA five-year review trigger criteria apply.

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9.0 LAUDERICK CREEK STUDY AREA

9.1 OVERVIEW

The Lauderick Creek Study Area, located in the extreme northeastern portion of the Edgewood Area of APG (Figure 1-2), consists of 27 AEDB-R sites (as listed in Exhibit 2) grouped into eight geographical areas termed "Clusters" and numbered 1, 5, 9, 13, 17, 20, 32, and 33. All of these sites, with the exception of four sites within the Cluster 13 area (EALC13-A, -B,-C, and –D), are addressed under one of three RODs:

- Cluster 1, Former Nike Missile Site
- Other Lauderick Creek Clusters (5, 9, 17, 20, 32, and 33)
- Cluster 9 Groundwater

The Cluster 1 ROD, signed in September 1996, identified remedial actions for three contaminated areas and media at the Nike Missile Launch Site. Extraction (amended by the 2005 ESD to implement MNA in the southeastern portion of the plume) and treatment by reductive dehalogenation (amended by the 1998 ESD to use carbon adsorption) was chosen as the selected remedy for groundwater. A composite cap was selected for the Nike SW Landfill. The selected remedy for the Launch Area Sanitary Sewer System was cleaning and closure of the system in place. Finally, the ROD declared no further action was warranted for the Nike Missile Silos. The removal action involving the removal and disposal off-site of lead-contaminated water from the six silos, followed by filling of the silos with concrete was accepted as the final action.

Clusters 5, 9, 17, 20, 32, and 33 were addressed in a ROD signed in August 2004. This ROD selected excavation and off-site disposal for the Concrete Slab Test Site and institutional controls for all sites. However, remedy selection for groundwater at Cluster 9 was deferred.

The ROD for the Cluster 9 groundwater, signed in September 2007, specified soil vapor extraction. The selected remedy for this site also includes LUCs and LTM.

The RI/FS process is still underway for the remaining four sites within the Lauderick Creek Study Area, all associated with Cluster 13. A Draft TI Evaluation, completed in July 2006 for the groundwater at Cluster 13, will be finalized as an appendix in the Cluster 13 FS Report anticipated for completion during 2008.

9.2 SITE CHRONOLOGY

The Lauderick Creek Study Area served as a military training and munitions impact area for the U.S. Army Chemical School from 1920 until 1951. Active from approximately 1954 to 1973, the Nike Missile Battery consisted of separate Control (Cluster 9), Launch, and Barracks (Cluster 1) areas. Current land use is for military training. A chronology of CERCLA activities at this Study Area is listed in Table 9-1.

Table 9-1. Lauderick Creek Environmental Activity Chronology

Date	Activity
1986	RCRA Facility Investigation, Nike Missile Battery
1989	RCRA Facility Assessment, Edgewood Area of APG
1990	Edgewood Area of APG included on the National Priorities List
1990 - 1995	Cluster 1 Remedial Investigation and Feasibility Study Activities
1994	Underground Storage Tank Removal Action at Cluster 9
1994	Remediation of Six Nike Missile Silos (Cluster 1)
1994	Removal Action at Discharge Pipe and Chlorination Building (Cluster 1)
1995	Cluster 1 Nike Site Remedial Investigation/Feasibility Study Report
1995	Removal of metal drums, munition containers, and metal material at School Field IV and Frog Road Mounds (Cluster 1)
1995	Removal of Barracks Area Discharge Pipe and Chlorination Building (Cluster 1)
1995	Removal of 14 55-gallon drums from surface of Launch SW Landfill (Cluster 1)
1995	Removal of surface materials (Cluster 13 and Cluster 20)
1995	Concrete Slab Test Site Removal Action (Cluster 5)
1996	Cluster 1 Proposed Plan
1996	Removal Action at Cluster 13
1996	Cluster 1 Record of Decision
1997	Removal of 1,000-gallon petroleum UST located approximately 50 feet north of Building E6891
1998	CWM Removal Action
1998	Cluster 1 Explanation of Significant Difference to change groundwater treatment technology from reductive dehalogenation to liquid phase adsorption.
1998	Cluster 1 Nike Site Sanitary Sewer System Abandonment Technical Report
1998	Cluster 1 Launch Southwest Landfill Remedial Design Report
1998	Cluster 1 Nike Southwest Landfill Cap Completion
1999	Remedial Investigation Report – Cluster 13
2000	Began full-time operation of the Cluster 1 Nike Site Groundwater Treatment Plant
2000	Removal of Nike Control Septic Tank/Sand Filter (Cluster 9)
2000	Remedial Investigation Report – Clusters 5, 9, 17, 20, 32, 33
2000	Cluster 1 Nike Site Plume Migration Study
2001	Feasibility Study Report – Cluster 5 Concrete Slab Test Site
2001	Proposed Plan – Clusters 5, 9, 17, 2, 32, 33

Table 9-1. Lauderick Creek Site Activity Chronology (continued)

Date	Activity
2000 - 2002	UXO Removal Action along Northern Boundary
2002	Former Nike Site Southeast Area Phase III Monitored Natural Attenuation Study Report
2004	Record of Decision – Clusters 5, 9, 17, 2, 32, 33
2005	Cluster 1 Explanation of Significant Difference implementing monitored natural attenuation in southeastern portion of plume
2005	Cluster 5 Concrete Slab Test Site – Remediation Complete
2006	Cluster 13 Draft Technical Impracticability Evaluation
2006	Cluster 9 Control Area Surficial Aquifer Feasibility Study Report
2007	Proposed Plan – Cluster 9 Groundwater
2007	Cluster 5 Concrete Slab Test Site – Remedial Action Completion Report
2007	Record of Decision – Cluster 9 Groundwater

9.3 SITE BACKGROUND

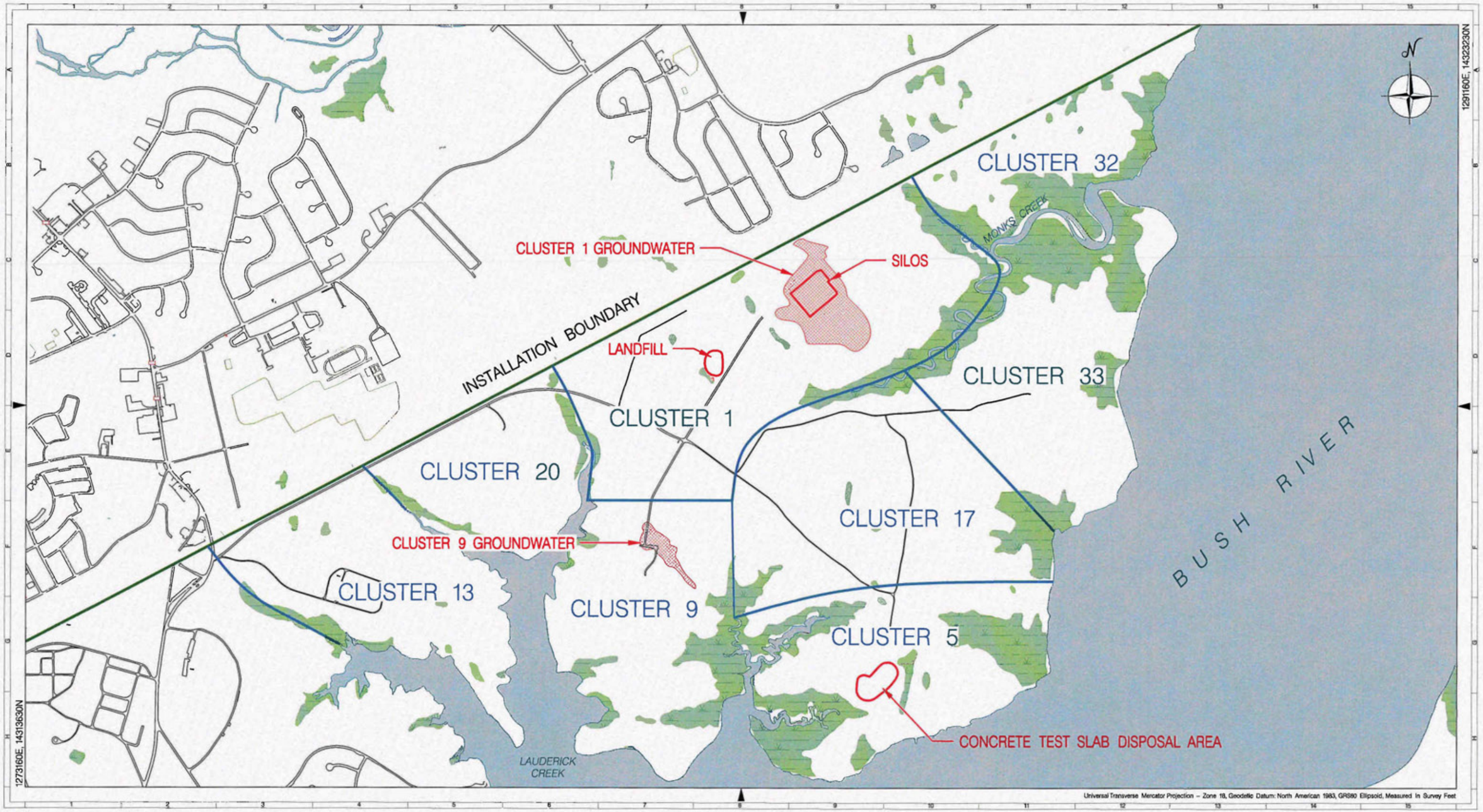
9.3.1 Physical Characteristics

The Lauderick Creek Study Area covers approximately 1,340 acres in the extreme northeastern portion of the Edgewood Area (Figure 9-1). It lies south of the Amtrak/Conrail railroad lines and east of the Canal Creek Study Area. The Study Area is bounded by the Installation boundary to the north, by the Bush River to the east, and by Lauderick Creek to the west and south. Elevations range from 1 to 40 feet above msl. The vegetation at the Lauderick Creek Study Area includes wetlands, upland forests, and fields.

9.3.2 Land and Resource Use

Along with the rest of Edgewood Area, the Lauderick Creek Study Area was acquired by the Army in 1917. Use of the Lauderick Creek Study Area as a training facility for the U.S. Army Chemical Warfare School continued from 1920 until 1951. It was the primary chemical ordnance training area at APG. The Nike Missile Battery was active from approximately 1954 to 1973.

Currently, the Lauderick Creek Study Area is used by the Maryland National Guard for light infantry training. This use is expected to continue into the future.



LEGEND

- Installation Boundary
- Road
- Cluster Boundary
- Wetland
- Water
- Groundwater Plume
- Site Boundary

1200 900 600 300 0 600 1200 2400

GRAPHICAL SCALE
IN FEET (1" = 1200')

1:14400

TITLE:

LAUDERICK CREEK STUDY AREA CLUSTERS

500 Edgewood Road, Suite 110 (410) 676-8835
Edgewood, MD 21040 www.gpworldwide.com

CARTOGRAPHER:	APPROVED BY:
B. JOYCE	C. HOULIK
DATE: 11-30-07	FIGURE: 9-1

F:\Edgewood Graphics\GEOGRAPHICS\5 Year Rod Review\Lauderick Creek.dgn

9.3.3 Cluster 1

9.3.3.1 Physical Characteristics

Cluster 1 consists of ~300 acres of forest, open fields, and wetlands. The maximum elevation at the site is 40 feet above msl. Terrain consists of subtly rolling flatlands separated by shallow swales and a tributary to Lauderick Creek and Monks Creek. Two predominant groundwater aquifers exist in the vicinity of Cluster 1: the surficial aquifer and the confined aquifer. The surficial aquifer consists of 25 to 40 feet of unconsolidated sand and gravel. This aquifer is approximately 25 feet thick along the northern boundary of APG and thickens toward the south-southeast. Beneath the former missile silos the aquifer is approximately 40 feet thick. Further to the southeast, the surficial aquifer divides into two units separated by thickening strata of peat and clay. The entire surficial aquifer is underlain by 15 to 50 feet of clay that forms the boundary between the semi-confined surficial aquifer and the deeper confined unit.

9.3.3.2 Land and Resource Use

The Nike Missile Battery was used from 1954 through 1973 for the deployment of anti-aircraft missiles. The site consisted of three separate areas: the missile silo area where the missiles were assembled, stored, and maintained within six silos; the barracks area used as living quarters and office space; and the Control Area (referred to as Cluster 9).

9.3.3.3 History of Contamination

Two types of missiles were deployed at the Nike Missile Battery: Nike Ajax and Nike Hercules. The Ajax was armed with a HE warhead and the Hercules with a HE or nuclear warhead. All missiles were removed from the silos in 1973 when the site was decommissioned. In 1993, lead-contaminated water from the six silos was removed and each silo was filled with concrete as part of a removal action.

Three contaminated areas were identified at Cluster 1 due to past activities: groundwater in the Surficial Aquifer, the Nike Southwest Landfill, and sludge in the Launch Area Sanitary Sewer. The extent of the VOC plume encompasses a ground surface area of approximately 27 acres. Field investigations identified the former Missile Maintenance Area as a potential source area for the VOC plume. The Southwest Landfill is approximately 275 feet long by 175 feet wide and has an average depth of 8 feet. These areas are shown in Figure 9-1.

9.3.3.4 Contaminant Media

VOC contamination, primarily TCE, was identified in groundwater in the Surficial Aquifer. The Nike Southwest Landfill contains construction debris and asbestos waste. The soil and groundwater at the landfill are not contaminated. The Launch Area Sanitary Sewer System was determined to contain a small amount of sludge contaminated with

metals, VOC, and pesticides. The contaminant medium in the Nike Missile Silos was water and the COC was lead

9.3.4 Clusters 5, 9, 17, 20, 32, and 33

The "Other Lauderick Creek Clusters" consist of the Cluster 5 Concrete Slab Test Site, Cluster 9 Nike Missile Battery Control Area, Cluster 17 East Woods Disposal Areas, Cluster 20 School Field III, Cluster 32 Gum Point Dredge Spoil Area, and Cluster 33 Monks Creek Farm Site.

9.3.4.1 Physical Characteristics

This portion of the Lauderick Creek Study Area contains forest, field, and wetland habitats that support varieties of wildlife species and vegetation. Tulip poplar, oak, maple, sweet gum, and pine trees dominate secondary growth forest vegetation. Shrubs and native grasses are found in the open fields. The majority of the wetlands in the area are estuarine emergent marsh environments. Estuarine emergent species include phragmites, cordgrass, three squares, and rushes. Wetland ecology also includes small areas of palustrine forest and emergent marsh environments. Palustrine forested areas contain oak, tulip poplar, pine, red maple, and sweet gum. Wetland plants common to the palustrine emergent areas include phragmites, cattails, and rushes.

9.3.4.2 Land and Resource Use

A significant portion of the Other Lauderick Creek Clusters area served as a training area for the U.S. Army Chemical School from 1920 until 1951. The Army designated portions of the area as School Fields I through IX. Training activities in the School Fields included the firing of chemical ordnance such as grenades, Livens projectiles, Stokes mortar rounds, and 4.2-inch mortar rounds; identification of chemical agents and decontamination of personnel, vehicles, and related equipment; clothing impregnation and laundering; and handling and servicing of chemical warfare equipment, such as bulk storage containers. Training also included instruction, and possibly field practice, in the disposal of chemical agents, chemical ordnance, and chemical agent-contaminated material. Other field operations involved the use of conventional materials, such as gasoline and diesel fuel for vehicles, heating fuels, and small-scale disposal operations involving burning of waste.

9.3.4.3 History of Contamination

Ordnance testing and associated waste disposal activities at the Cluster 5 Concrete Slab Test Site were performed within the Concrete Slab Test Area, Concrete Slab Dump Area 1, and Concrete Slab Dump Area 2. The U.S. Army Chemical School used the site for testing of incendiary munitions and pyrotechnic and flamethrower projects. These testing activities continued through the 1950s and 1960s, and possibly into the early 1970s. Field inspections showed that wastes from the test activities were dumped adjacent to the concrete slab. A removal action conducted in 1994 and 1995 recovered several non-

ordnance/non-explosive wastes from the Cluster 5 Concrete Slab Test Site. Materials removed included vehicle fuel tanks, empty drums, and fuel tank remnants.

9.3.4.4 Contaminant Media

The contaminant medium is soil and the COCs are aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, magnesium, mercury, nickel, potassium, selenium, silver, vanadium, zinc, PAH, and pesticides.

9.3.5 Cluster 9, Groundwater

9.3.5.1 Physical Characteristics

Cluster 9, centered on the former Nike Control Area, occupies approximately 120 acres, lying within the central portion of the Lauderick Creek Study Area encompassing the broad peninsula containing the VOC plume in the Surficial Aquifer. Cluster 9 currently consists of a developed area with two buildings, paved areas, and a gravel road surrounded by open grassy fields that lead to wooded areas. Two tributaries of Lauderick Creek surround Cluster 9 to the east and west, with Lauderick Creek itself bordering on the south. Average elevation at Cluster 9 is 15 feet above msl. Groundwater beneath Cluster 9 occurs within a relatively shallow unconfined aquifer system. The surficial aquifer can be broadly divided into an upper section averaging 10 feet in thickness and a lower section averaging 25 feet in thickness, with laterally discontinuous silt and clay layers separating the sections.

9.3.5.2 Land and Resource Use

Active from approximately 1954 to 1973, the Nike Missile Battery consisted of separate control, launch, and barracks areas. The Control Area contained radar, electronic, and communications equipment necessary for target tracking, missile launch, and missile guidance.

9.3.5.3 History of Contamination

Solvents used in maintenance of electronic and communications equipment are the likely source of VOC in the surficial aquifer. Results of soil vapor and subsurface soil sampling indicate a vadose-zone VOC source area corresponding to an area of dark-stained soil observed on a late 1960s aerial photograph. Depth to groundwater in the source area averages 18 feet. The approximately 0.2-acre VOC source area contributes to an approximately 3-acre groundwater plume within the Cluster 9 area.

9.3.5.4 Contaminant Media

The contaminant media are soil and groundwater and the COCs are VOC, primarily TCE, TCA, and degradation products.

9.3.6 Non-ROD OUs

9.3.6.1 Cluster 13

Cluster 13 is a peninsula located in the western part of the Lauderick Creek Study Area (Figure 9-1). Currently, Cluster 13 is predominantly forest, with some open grassy fields.

The historical activities that released chlorinated solvents, primarily TeCA, to the environment occurred during the period from the early 1920s to the early 1950s, with most of the release occurring during WWII. Sporadic occurrences of DNAPL throughout the surficial aquifer constitute sources of dissolved VOC. The plume of dissolved solvents in groundwater is in steady state conditions, i.e., not expanding, and is undergoing intrinsic bioremediation in the sediment column beneath the wetlands and tributaries of Lauderick Creek. Without remediation of the DNAPL zones, the Cluster 13 dissolved plume will likely persist for the foreseeable future. Considering these factors, a TI Evaluation was prepared as part of the FS of remedial alternatives for the surficial aquifer at Cluster 13 underway.

This OU is included in the PBC awarded in 2005 that schedules remedy in place by February 2009.

9.3.7 Previous Removal Actions

Previous removal actions are listed in Table 9-2. The overall protectiveness of removal actions is evaluated with the final remedy.

9.4 REMEDIAL ACTIONS

9.4.1 Operable Units with RODs

Table 9-3 summarizes the remedial actions conducted to date in the Lauderick Creek Study Area. The basis for taking action, RAOs, selected response, and performance standards are listed in Exhibit 1.

9.4.2 Non-ROD Sites

The Cluster 1 RI recommended no further action at all other AEDB-R sites in Cluster 1. Based on the draft FS, the Army, USEPA, and MDE decided to conduct a TI Evaluation for Cluster 13 groundwater. Revisions to the Draft TI Evaluation and FS are underway to evaluate remedial alternatives for the Cluster 13 surficial aquifer.

Table 9-2. Lauderick Creek Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
Cluster 1 Launch Area Missile Silos	1994	Remove water contaminated with lead and fill with inert material.	Action complete.
Cluster 1 Discharge Pipe and Chlorination Building	1994	Stop water discharging from the Barracks Area septic system to Lauderick Creek, excavate the pipe, and demolish the building.	Action complete.
Cluster 9	1994	Removal of USTs	Action complete.
Cluster 1 School Field IV	1995	Remove potentially contaminated materials such as drums, cans, and munitions containers.	Action complete.
Cluster 5 Concrete Slab Test Site	1995	Remove construction debris, scrap metal, and drums	Action Complete
Cluster 1 Nike Southwest Landfill	1995	Remove Fourteen 55-gallon drums.	Action complete.
Cluster 13	1996	Remove one UST	Action complete.
Cluster 9	2000	Removal of Nike Control Area septic tank/sand filter	Action Complete.
Cluster 5	1997	Remove a 1,000-gallon petroleum UST located approximately 50 ft north of Building E6891.	Action complete.
Cluster 13	1995	Remove 25 tons of potentially contaminated surface material	Action complete.
Cluster 20	1994-95	Remove potentially contaminated surface material	Action complete.
Lauderick Creek Study Area	1998	Remove potentially contaminated debris from 1-mile wide area	Action complete.
Northern Boundary Removal Action	2000-2003	Remove CWM/UXO within the ¼-mile wide project site in the northern boundary Lauderick Creek Area.	Action complete.

Table 9-3 Lauderick Creek Study Area Remedial Action Summary

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
Cluster 1 Nike Launch Area Groundwater	ROD, 1996 ESD, 1998 ESD, 2005	1. No Action 2. Treatment in sequencing batch reactors 3. Treatment by UV/OX 4. Treatment in Place Using Reductive Dehalogenation 5. Treatment by Aboveground Reductive Dehologenation 6. Treatment by Air Stripping	Extraction and Treatment by Aboveground RD 1998 ESD modified treatment system, to liquid phase granular activated carbon (GAC). 2005 ESD implemented MNA rather than extraction in the southeastern portion of the plume.	The Selected Remedy has been implemented as described in the ROD and ESD documents.
Cluster 1 Nike SW Landfill	ROD, 1996	1. No Action 2. Installation of a Composite Cap 3. Conventional Excavation of Landfill Contents in an Armored, Filtered-Air Shelter and Off-Site Disposal of Excavated Waste 4. Telerobotic Excavation of Landfill Contents in an Armored, Filtered-Air Shelter and Off-Site Disposal of Excavated Waste	Installation of a Composite Cap	The Selected Remedy has been implemented as described in the ROD.
Cluster 1 Launch Area Sanitary Sewer Sludge Nike Missile Silos	ROD, 1996	1. No Action 2. Clean and Close Sanitary Sewer in Place 3. Clean and Excavate the Sanitary Sewer System	Clean and Close Sanitary Sewer in Place.	The Selected Remedy has been implemented as described in the ROD. This ROD accepted the Nike Missile Silos removal action as the final action.

Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
Other Clusters	ROD, 2004	Concrete Slab Test Site 1. No Action 2. Remove Surface Waste, Construct Soil Cover and Implement LUCs 3. Remove Waste 4. LUCs and Monitoring All Sites 1. No Action 2. Institutional Controls	Concrete Slab Test Site Remove Waste All Sites Institutional Controls	The Selected Remedy has been implemented as described in the ROD. However , ~250 yd^3 of WP-impacted soil remains on site awaiting final disposition.
Cluster 9 Groundwater	ROD, 2007	1. No Action 2. Hydraulic Containment 3. Biosparging 4. Soil Vapor Extraction 5. Air Stripping/Soil Vapor Extraction	Soil Vapor Extraction Institutional Controls	Implementation of the Selected Remedy is underway. The Remedial Design has been drafted and the Soil Vapor Extraction system is expected to be operational by April 2008.

9.4.3 Progress Since Last Five-Year Review

Construction of the cap and cover system for the Nike Southwest Landfill was completed in 1998. O&M and LTM activities at the site are underway.

At the time of the previous five-year review an MNA evaluation was underway and it was recommended that MNA be implemented if demonstrated. An ESD to the Cluster 1 Nike Site 1996 ROD, signed on May 9, 2005, implemented MNA as the remedy for the southeastern portion of the groundwater plume instead of extraction and treatment

Regulatory comments on an Optimization Work Plan for the Cluster 1 Nike Launch Area Groundwater Treatment System were received in November 2007. Additional characterization of the primary TCE source area in the vicinity of the well NMB-07 in conjunction with treatment system optimization studies is scheduled for Spring 2008 upon approval of the Work Plan.

The Other Lauderick Creek Clusters ROD was signed in August 2004, with implementation completed by December 2005 at the Cluster 5 Concrete Slab Test Site. LTM activities at the site are underway.

The Cluster 9 Groundwater ROD was signed in September 2007 and implementation is underway.

9.5 FIVE-YEAR REVIEW PROCESS

An objective of the review process was to determine the status of the remedial actions at the Lauderick Creek Study Area. To accomplish this goal, the Lauderick Creek Study Area was visually inspected and any available data were reviewed.

The Project Officer for the Lauderick Creek Study Area, Mr. Rurik Loder, was interviewed in 18 October 2007. Attachment A to this report presents the results of this interview.

Comments from MDE were received on 06 December 2007 and are provided in Attachment J of this document.

Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

9.6 FIVE YEAR REVIEW FINDINGS

9.6.1 Site Inspection

Site inspections were conducted at the Lauderick Creek Study Area sites on 19 October 2007. Photodocumentation of the site visits is provided in Attachment D to this

document. Site inspection checklists, as specified in the USEPA Guidance, are provided in Attachment E. Since the Cluster 9 remedy is in the design phase, no Site Inspection Checklist was completed. However, no changes in site conditions were observed at Cluster 9. Major findings of the site inspections are described on the following pages.

9.6.1.1 Cluster 1 Launch Area Groundwater

The Cluster 1 Nike Launch Area GWTF began operation in January 2000. The GWTF was inspected on 19 October 2007. According to an interview with the Plant Operations Manager, no extensive upgrades have been made to the GWTF since system start-up. LTM has been underway since system start-up. Groundwater samples are collected on a quarterly basis from the eight extraction wells, six sentry wells, and system influent, intermediate, and effluent streams and analyzed for TCE. Within the southeastern portion of the plume, five monitoring wells are also sampled on an annual basis for TCL VOC, and MNA parameters including, dissolved gases (, methane, ethane, ethene, carbon dioxide nitrogen, and oxygen), anions (chloride, ferrous iron, sulfate), TOC, and alkalinity. Groundwater elevations are collected on a quarterly basis from 89 monitoring wells and eight extraction wells.

Inspection of the treatment building noted the extraction system pipelines and valves were in good condition and well-labeled. A revision to the weekly operating schedule for extraction well W107 (i.e., operating one day per week) provides a satisfactory response to the system's iron-fouling problem noted during the last five-year review. The building was well-maintained and organized, with an up-to-date O&M manual, as-built drawings, and maintenance logs readily available on-site. Treated process water is discharged southeast of the treatment building into an existing drainage swale that flows toward the marsh area of Monks Creek.

Technology Evaluation

Pre-design investigations determined the extent of the TCE plume encompassed a ground surface area of approximately 27 acres within the Nike Site. The extraction and treatment system is designed to strategically target TCE in groundwater at three geographic areas of the former Nike Missile Battery: the Northern Boundary Area, the former Missile Maintenance and Fueling/Defueling Area, and the Southeast Area. An ESD to implement MNA as the remedy for the Southeast Area plume was signed on 9 May 2005.

The groundwater treatment system is comprised of an eight-well extraction system, a GAC treatment system, and a SCADA system. The extraction system pumps contaminated groundwater from the surficial aquifer to the treatment system. Organic contaminants are adsorbed onto the activated carbon within dual, in-series carbon vessels, and the treated groundwater is discharged into the natural drainage network of the site. A main programmable logic controller automates the extraction, treatment, and discharge of groundwater using a network of sensors and controllers. The Nike GWTF pumps and treats an average of 300,000 gallons per week, consistently running at an annual average

efficiency of 93 percent. Approximately 138 million gallons of contaminated groundwater has been treated over the life of the plant, up through the week of 19 October 2007.

Overall, the GWTF is operating as designed. The size of the plume, defined by the 5 µg/L TCE boundary, has decreased significantly since startup of the extraction system. The groundwater analytical data from LTM activities indicate that TCE levels in the sentry wells and extraction wells located in several areas of historic contamination have decreased below the MCL and the detection limit, indicating that the TCE plume is being removed and the residual contaminants are being diluted by clean water from the aquifer. The results of two years of MNA studies within the Southeast Area continue to provide supporting evidence that the natural attenuation processes are reducing TCE concentrations in the southeastern source area and preventing potential receptor exposure to TCE concentrations above regulatory levels protective of human health and the environment. Groundwater elevation data indicate that the groundwater extraction system is effectively creating an inward gradient to capture groundwater in the areas of the TCE contamination. Groundwater flow across the Installation Boundary continues to be reversed, toward the boundary extraction wells.

An evaluation of potential remedial alternatives to expedite degradation of the TCE contaminated groundwater within the primary source area near well NMB-07B is planned for 2008. Further characterization of the primary source area near NMB07B will be conducted in early 2008 to aid in the development of feasible alternatives. A ramp-down exit strategy for the remainder of the plume area (i.e., possible reduction in wellfield pumping operations and frequency of groundwater monitoring) will also be developed.

Cost

The estimated annual O&M cost in the ROD was $84,000. Actual costs for O&M during this five-year review period ranged from $103,000 to $165,000 per year (including disposal and LTM costs). The increase in actual O&M costs from the estimated annual ROD cost is related to the change in treatment technology from reductive dehalogenation specified in the 1996 ROD to carbon adsorption specified in the 1998 ESD to the ROD. Annual costs increased again for FY06 and FY07 with the addition of groundwater LTM to evaluate the natural attenuation remedy for the Southeast Area.

9.6.1.2 Nike Southwest Landfill

The Cluster 1 Nike Southwest Landfill was inspected on 19 October 2007. The cap appears to be in good condition, with adequate vegetative cover. Damage to the cover into the sand layer due to animal intrusion was noticed in at least eight locations within the eastern portion of the site. In addition, the presence of sweet gum and red maple saplings was noted along the perimeter edges of the landfill cover, with individual species scattered across the remainder of the cover. Multiflora rose was also observed at the site. According to an interview with the DSHE Project Officer, plans are in place to mow the

cover by the end of 2007 and in the future, once every two years to prevent woody species growth. Fence surrounding the site was in good condition, with proper signs.

The LTM program for the Cluster 1 Nike Southwest Landfill consists of annual groundwater sampling at three monitoring wells. Groundwater wells located upgradient and downgradient of the cap are sampled on an annual basis and analyzed for TCL VOC, TCL SVOC, TCL pesticides and PCB, TAL metals, total cyanide, explosives, total sulfur, and thiodiglycol. O&M activities for the site include quarterly inspections and maintenance of the cap, and annual replacement of carbon filters on two gas vents.

Technology Evaluation

Completion of the impermeable cap over the Nike Southwest Landfill occurred in 1998. The cap consists of a geocomposite gas vent layer, a geosynthetic clay liner, a 40-millimeter linear low-density polyethylene geomembrane, and a geocomposite drainage layer. Above the geosynthetic components are 18 inches of drainage sand and 6 inches of vegetative soil.

LTM results show no discernable impacts to groundwater from buried waste at the site. Overall, the cap and cover system remedy for the Nike Southwest Landfill is effective and functioning as designed.

Cost

The estimated annual operating cost (including LTM) presented in the ROD for the Nike Southwest Landfill was $29,000. The actual cost per year for O&M/LTM ranged from $51,000 in FY03 to $15,000 in FY07. The increase in the O&M/LTM cost for FY03 was for the re-vegetation of the landfill cover with warm season grasses. In FY06, the annual O&M/LTM cost was reduced to $15,000 per year. These cost savings are due to negotiated reductions in the monitoring program cost by the O&M contractor, along with replacement of the carbon filters on the gas vents instead of the annual collection and analysis of two gas vent air samples each year.

9.6.1.3 Cluster 5 Concrete Slab Test Area

The Cluster 5 Concrete Slab Test Site was inspected on 19 October 2007. Excavation and disposal of all waste material from the site was completed in 2005 and the Remedial Action Completion Report was signed in August 2007. Remedial areas at the site are stabilized and well vegetated. No erosion was identified. A small pile of soil (approximately 250 yd^3) containing residual amounts of WP remains on the concrete slab awaiting final disposition by APG. The soil pile is vegetated with no signs of erosion.

The LTM program for the Cluster 5 Concrete Slab Test Area consists of sediment sampling and sediment toxicity tests. Three sediment samples downgradient of the test slab and one background reference sediment sample are collected on an annual basis and

analyzed for TCL and TAL analytes, TOC, total phosphorus, total nitrogen, ammonia, fluoride, chloride, sulfate and sulfide, acid volatile sulfide, simultaneously extracted metals, and herbicide special list. In addition, 28-day chronic toxicity tests are run on the samples.

Technology Evaluation

The Other Lauderick Creek Clusters ROD signed in August 2004 specified excavation of wastes and soil hot spots and disposal of excavated material as the selected remedy for the Cluster 5 Concrete Test Slab. Two years of sediment monitoring at the site have identified no constituent releases from soil to downgradient Lauderick Creek sediment. Data results for 2006 sediment samples identified only pesticides and metals (such as lead) above ecological risk screening levels and the local background reference sample. Results of sediment toxicity testing indicated sediments at the site did not have an impact on amphipod survival or reproduction, but did show statistically significant affects on growth at two locations. Naturally occurring levels of ammonia at the site may be causing this toxicity.

Implementation of the remedy for this site is complete and effective in the protection of human health and the environment.

As mentioned previously, due to the presence of WP, a small pile of soil remains on-site at the Cluster 5 Concrete Slab Test Site pending resolution of the white phosphorus issues. Due to safety hazards during transportation, disposal of this soil off-site for incineration is cost-prohibitive. Alternatives for the final disposition of the soil are being evaluated by the Army.

Cost

The total capital cost estimated in the ROD for the Other Lauderick Creek Clusters was $1,712,000. This cost assumed excavation of waste and soil hot spots and off-site disposal from the Cluster 5 Concrete Slab Test Site. The total amount awarded to the remediation contractor for development and implementation of the ROD was approximately $1,030,000 (not including APG waste disposal costs).

The estimated annual LTM cost presented in the ROD for the Cluster 5 Concrete Slab Test Site was $7,800. The actual cost per year for LTM was $21,000 in FY06 and $18,000 in FY07. The increase in the actual LTM costs for the site compared to the ROD estimate was due to the addition of sediment toxicity tests to the LTM program for the site. The ROD estimate did not include toxicity studies.

9.6.1.4 Cluster 9 Groundwater

The ROD for the Cluster 9 Groundwater was signed in September 2007. The ROD selected soil vapor extraction, groundwater LTM, and LUCs for the site. The vapor

intrusion pathway is addressed in this ROD. A site inspection of the Cluster 9 Groundwater area was conducted on 19 October 2007. Preparation of the draft Remedial Design is underway and the soil vapor extraction system is expected to be operational during fiscal 2008.

9.6.1.5 Non-ROD Sites

The last remaining non-ROD site within the Lauderick Creek Study Area is Cluster 13 and associated groundwater. This site was not inspected since implementation of a remedy has not yet occurred. A working copy of the FS Report will be submitted for regulatory review in early 2008. A draft TI Evaluation (an FS appendix) has been provided to the regulatory agencies.

9.6.2 Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

9.6.3 Technology Evaluation

Alternative technologies have been evaluated for each site with an implemented ROD for purposes of remedial action implementation. A summary of these technologies is presented in Attachment F to this document. However, some or all of these technologies can be considered in developing a remedy for the remaining Lauderick Creek Study Area OU (i.e., Cluster 13). The Cluster 13 TI Evaluation indicates that DNAPL may exist throughout the aquifer. Attachment F includes technologies being evaluated for further investigation and, possibly, recovery of DNAPL that should be considered during development of the Cluster 13 FS.

The nature of the remedy at the Nike Southwest Landfill and the Cluster 5 Concrete Slab Test Site indicates that optimization via such technologies is not relevant to these remedies. Since construction is complete at these two sites, optimization opportunities would likely be constrained to modified methods of maintenance and/or monitoring rather than implementation.

9.7 TECHNICAL ASSESSMENT

The results of the technical assessment for the Lauderick Creek Study Area sites, in accordance with USEPA Guidance, are included in Tables 9-4 through 9-7. Only sites with implemented RODs are included in this evaluation. Recommendations regarding all OUs are included in Subsection 9.8.

Table 9-4.

Lauderick Creek Study Area Technical Assessment: Cluster 1 Groundwater

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Cluster 1 Launch Area Groundwater	Y	Remedy implemented in accordance with the ROD.
▪ **System Operations/O&M**		
	Y	LTM/O&M conducted in accordance with the ROD.
▪ **Opportunities for Optimization**		
	Y	The O&M Contractor is currently evaluating potential alternatives for accelerating remediation of the primary TCE source area, as well as reducing the LTM frequency and optimizing the well field extraction processes.
▪ **Early Indicators of Potential Issues**		
	N	
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs implemented in accordance with the ROD.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Ecological TBC	NA	
Human-Health Standards	N	
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	Y	Modification of LUC to address this potential pathway is recommended (See Attachment C).
	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	
▪ **Changes in Risk Assessment Methods**		
Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed since the ROD was signed in 1996. However, none of the changes substantively affect the original conclusions of the risk assessment.
Ecological Risk Assessment (ERA)	Y	ERA methods have changed since the ROD was signed in 1996. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
	Y	The remedy protects human health and the environment from the risks associated with groundwater contamination.

Table 9-4. Lauderick Creek Study Area Technical Assessment: Cluster 1 Groundwater (continued)

Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 9-5.

Lauderick Creek Study Area Technical Assessment: Nike SW Landfill

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Nike Southwest Landfill	Y	The remedy has been implemented in accordance with the ROD.
▪ **System Operations/O&M**		
	Y	LTM and O&M are ongoing and conducted in accordance with the ROD.
▪ **Opportunities for Optimization**		
	Y	Five years of monitoring show no discernable impacts to groundwater from buried waste. Groundwater LTM frequency can be reduced.
▪ **Early Indicators of Potential Issues**		
	Y	Evidence of small animal intrusion into the cover may indicate a potential cover integrity issue in the future, if not repaired.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUCs have been implemented in accordance with the ROD. Fencing and warning signs are in place and in good condition.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	USEPA Region III released soil screening guidance after construction of the Nike Southwest Landfill cap. However, this new guidance does not affect the original conclusions of the risk assessment or the remedy selected.
TBC guidance for protection of ecological receptors	Y	Same as above.
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	N	See Attachment C.
	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	Y	Although changes have been made to some of the COC toxicity values since the ROD was signed in 1996, they do not affect the original conclusion of the risk assessment or the remedy selected.

Table 9-5.

Lauderick Creek Study Area Technical Assessment: Nike SW Landfill (continued)

▪ **Changes in Risk Assessment Methods**		
Human Health Risk Assessment (HHRA)	Y	HHRA methods have changed since the ROD was signed in 1996. However, none of the changes substantively affect the original conclusions of the risk assessment.
Ecological Risk Assessment (ERA)	Y	ERA methods have changed since the ROD was signed in 1996. However, none of the changes substantively affect the original conclusions of the risk assessment.
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been met.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 9-6.

Lauderick Creek Study Area Technical Assessment: Other Clusters

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Other Lauderick Creek Clusters	Y	The remedy has been implemented in accordance with the ROD.
▪ **System Operations/O&M**		
	Y	No active O&M at site. LTM is ongoing and conducted in accordance with the ROD.
▪ **Opportunities for Optimization**		
	Y	Two years of sediment monitoring at the Cluster 5 Concrete Slab Test Site have shown no impacts to sediments for constituent releases in soil. Sediment toxicity studies are ineffective at the site due to the interference of naturally occurring levels of ammonia in sediment and its affect on amphipods. Sediment LTM frequency can be reduced and sediment toxicity studies eliminated.
▪ **Early Indicators of Potential Issues**		
	N	There are no early indicators of potential remedy issues.
▪ **Implementation of Institutional Controls and Other Measures**		
	Y	LUC have been implemented in accordance with the ROD.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	Y	There have been no significant changes to the standards for protection of human health since the ROD was signed in August 2004.
TBC guidance for protection of ecological receptors	Y	Same as above.
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	N	See Attachment C.
	N	No significant changes in site setting have occurred based on the site visit and interview with the DSHE Project Officer.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	Y	Athough changes have been made to some of the COC toxicity values since the ROD was signed in 2004, they do not affect the original conclusions of the risk assessment or the remedy selected.

Table 9-6.

Lauderick Creek Study Area Technical Assessment: Other Clusters (continued)

▪ **Changes in Risk Assessment Methods**		
Human Health Risk Assessment (HHRA)	N	HHRA methods changed slightly since the ROD was signed in August 2004. However, none of the changes substantively affect the original conclusions of the risk assessment.
Ecological Risk Assessment (ERA)	N	ERA methods have not changed since the ROD was signed in 2004.
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs have been met.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

Table 9-7.

Lauderick Creek Study Area Technical Assessment: Cluster 9 Groundwater

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☐ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
Cluster 9 Groundwater	NA	The ROD for the Cluster 9 Groundwater was signed in September 2007, but has not been implemented yet.
▪ **System Operations/O&M**		
	NA	.
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	N	
▪ **Implementation of Institutional Controls and Other Measures**		
	NA	Same as above.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
Standards for protection of human health	N	There have been no significant changes to the standards for protection of human health since the ROD was signed in September 2007.
TBC guidance for protection of ecological receptors	N	Same as above.
▪ **Changes in Exposure Pathways**		
Vapor Intrusion	Y	Vapor intrusion pathway addressed in this ROD.
	NA	No significant changes in the site setting have occurred based on the site visit and interview with the DSHE Project Officer.
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	There have been no significant changes in toxicity or contaminant characteristics since the ROD was signed in September 2007.
▪ **Changes in Risk Assessment Methods**		
Human Health Risk Assessment (HHRA)	N	HHRA methods have not changed since the ROD was signed in September 2007.
Ecological Risk Assessment (ERA)	N	ERA methods have not changed since the ROD was signed in 2007.

Table 9-7.

Lauderick Creek Study Area Technical Assessment: Cluster 9 Groundwater (continued)

▪ **Expected progress towards meeting RAOs**		
	NA	The ROD for the Cluster 9 Groundwater was signed in September 2007, but has not been implemented yet.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	N	No additional data have been collected since the emplacement of the remedy that would question the protectiveness of the remedy.
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

9.7.1 Opportunities for Optimization

9.7.1.1 Nike Southwest Landfill

Five years of annual LTM have identified no discernible impact to groundwater from buried waste. LTM frequency can be reduced.

9.7.1.2 Cluster 5 Concrete Slab Test Site

Two years of monitoring have identified no discernible impacts to Lauderick Creek sediment from soil at the site. It is suspected that toxicity in sediment downgradient of the test site results from naturally occurring levels of ammonia and therefore, LTM is ineffective. With a remedy in place at this site, there is no reason to expect that metals concentrations in downgradient sediment would increase or pose unacceptable risk. LTM frequency can be reduced and eliminating toxicity testing should be considered

9.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

Vapor intrusion was not addressed in the Lauderick Creek Cluster 1 ROD. The existing buildings are a storage shed and the groundwater treatment plant. The treatment plant includes office space however, due to its primary function, the building is properly ventilated. It is recommended the Cluster 1 Groundwater LUCs be amended to address vapor intrusion.

During the course of this five-year review, no other issues that impact protectiveness were discovered relating to the Lauderick Creek Study Area.

9.9 PROTECTIVENESS STATEMENT(S)

9.9.1 Nike Launch Area Groundwater

The remedy at Cluster 1, Nike Launch Area Groundwater currently protects human health and the environment because the contamination is contained through capture and treatment of groundwater. However, for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the plume must continue, LUCs must be maintained, and LTM and five-year reviews conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

9.9.2 Nike Southwest Landfill

The remedy at Cluster 1, Nike SW Landfill, currently protects human health and the environment because the waste is contained. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Containment of the waste must continue, LUCs must be maintained, and LTM and five-year reviews

conducted until site conditions are demonstrated to allow for unlimited use and unrestricted exposure.

9.9.3 Nike Launch Area Silos and Sanitary Sewer

The remedy at Cluster 1, Nike Launch Area Silos and Sanitary Sewer, is protective of human health and the environment because all waste has been removed.

9.9.4 Other Lauderick Creek Clusters

The remedy for the Other Lauderick Creek Clusters currently protects human health and the environment because all waste has been removed to action levels and LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of COCs in soil are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

9.9.5 Cluster 9 Groundwater

The remedy at Cluster 9, Nike Control Area Groundwater, is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

9.9.6 Non-ROD Sites

RI/FS investigations are ongoing at Cluster 13. A formal Protectiveness Statement for this site cannot be made until the RI/FS/ROD/RA process is completed.

9.10 NEXT REVIEW

It is recommended that a five-year review be conducted in 2013 for the Cluster 1 Nike Launch Area Groundwater, Nike Southwest Landfill, the Other Lauderick Creek Clusters, Cluster 9 Groundwater, and any OUs for which a ROD is signed prior to 2013 and for which CERCLA five-year review trigger criteria apply.

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10.0 OTHER EDGEWOOD AREAS STUDY AREA

10.1 OVERVIEW

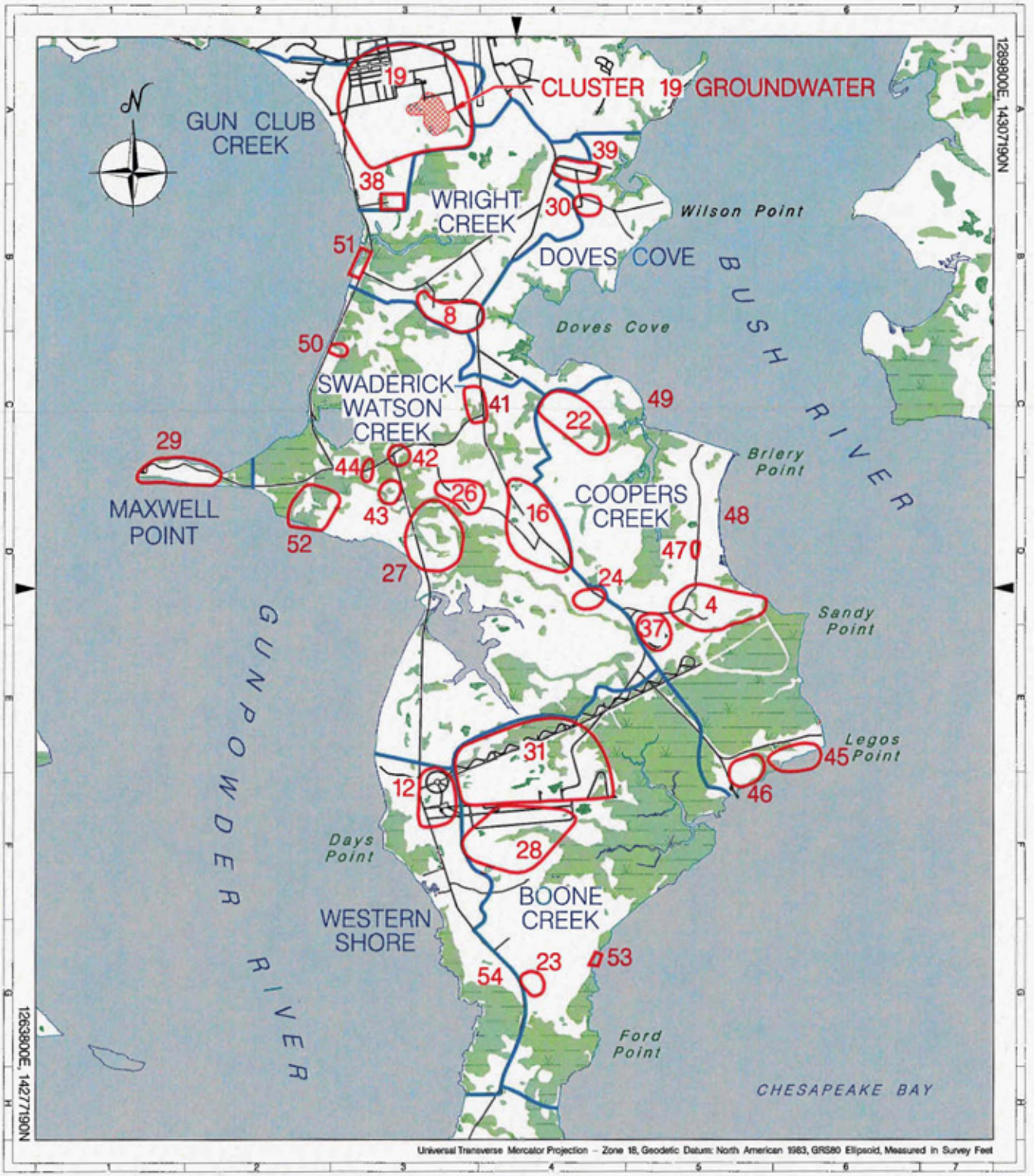
APG initially grouped the Other Edgewood Areas Study Area SWMUs and AOCs into clusters of sites for investigation purposes. Site status by AEDB-R number is listed in Exhibit 2. Because of the very large size of the Study Area and the need for an integrated approach, the currently planned prioritization and subdivision of the Study Area for site investigation work considers the program priorities, as well as the technical considerations. This organization results in eight Investigation Areas containing the 31 Clusters of sites within 14 watershed/drainage areas of the Study Area.

Figure 10-1 displays the locations of the Other Edgewood Areas Investigation Areas and Clusters. Each of the eight Investigation Areas contain from one to three watersheds, and in only a few instances is a small portion of a watershed area not grouped with the main portion of that Investigation Area. This organization should minimize the extent to which potential contaminant source areas from the sites within a Cluster are separated into multiple Investigation Areas. Because the primary unit of subdivision is watershed/drainage areas, the names of the Investigation Areas are based on the name of the principal watershed within the Investigation Area. The eight Investigation Areas are: Gun Club Creek, Wright Creek, Doves Cove, Maxwell Point, Swaderick-Watson Creek, Coopers Creek, Western Shore, and Boone Creek (including Pooles Island).

A ROD for Cluster 19 Groundwater in the Gun Club Creek Investigation Area was signed in 2007. The selected response was LUCs and LTM and has been implemented. All of the other SWMUs and/or AOCs within the Investigation Areas are awaiting completion of the media sampling and risk assessments under an RI.

10.2 SITE CHRONOLOGY

An RI has been initiated in all of the 31 Clusters at the Other Edgewood Areas Study Area. Activities that have been completed include historical document and aerial photograph reviews; x-ray fluorescent soil screening and soil gas surveys; installation of direct push points and groundwater monitoring wells; groundwater, soil, sediment, and surface water sampling; site characterization and removal actions; groundwater natural attenuation studies; geophysical and geotechnical investigations, and construction of shoreline stabilization structures. Table 10-1 lists the dates of important events which have occurred within the Other Edgewood Areas.



4000 3000 2000 1000 0 2000 4000 8000

GRAPHICAL SCALE
IN FEET (1" = 4000')

1:48000

L E G E N D

Roads
Water
Cluster Locations
Wetlands
Investigation Area

500 Edgewood Rd., Suite 110
Edgewood, MD 21040
(410) 676-8835
www.gpworldwide.com

TITLE:

OTHER EDGEWOOD AREAS INVESTIGATION AREAS AND CLUSTERS

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	C. HOULIK	11-30-07	10-1

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Table 10-1. Other Edgewood Areas Site Activity Chronology

Date	Activity
1989	Resource Conservation and Recovery Act Facility Assessment completed
1990	Edgewood Area of APG listed on USEPA National Priorities List
1991	Remedial Investigation sampling and analysis commenced
1992	Removal action at Wright Creek G-Field Drum Disposal Site (EAOE08)
1994	Removal action at Gun Club Creek Drum and Junk Dump Site Area 2 (EAOE19)
1995	Removal action at Doves Cove C-Field Septic System Sites (EAOE30 and EAOE39)
1997	Removal action at Gun Club Creek Bldg. E4585 Demolition Debris Site (EAOE19)
1999	Strategic Plan divides Other Edgewood Areas into eight Investigation Areas for RIs
2002	Time critical removal action at Coopers Creek D-Field Shoreline Area (EAOE04)
2004	Time critical removal action to stabilize D-Field shoreline
2004	Site characterization at Maxwell Point Smoke Generator Debris Site (EAOE29)
2004	Site characterization at Gun Club Creek Drum and Junk Dump Sites (EAOE19) and K-Field Demolition Ground (EAOE38)
2005	Removal action at Boone Creek I-Field Japanese Bunkers A and F (EAOE23)
2005	Draft-Final Screening-Level Ecological Risk Assessment for the Gun Club Creek Investigation Area (EAOE19 and EAOE38) completed
2005	Final Baseline Human Health Risk Assessment for the Gun Club Creek Investigation Area (EAOE19 and EAOE38) completed
2006	RI/FS Report for Cluster 19 Groundwater (EAOE19) finalized
2006	Draft Screening-Level Ecological Risk Assessment for the Doves Cove Investigation Area (EAOE30 and EAOE39) completed
2006	Final Baseline Human Health Risk Assessment for the Doves Cove Investigation Area (EAOE30 and EAOE39) completed
2006	Draft Screening-Level Ecological Risk Assessment for the Wright Creek Investigation Area (EAOE08 and EAOE51) completed
2006	Shoreline stabilization of Coopers Creek D-Field Shoreline Area (EAOE04) completed
2006	Draft Screening-Level Ecological Risk Assessment for the Western Shore Investigation Area (EAOE12) completed
2007	Draft Baseline Human Health Risk Assessment for the Wright Creek Investigation Area (EAOE08 and EAOE51) completed
2007	Draft Baseline Human Health Risk Assessment for the Western Shore Investigation Area (EAOE12) completed
2007	Seeding for re-vegetation of D-Field shoreline completed
2007	ROD and draft Remedial Design for Cluster 19 Groundwater (EAOE19) completed

10.3 SITE BACKGROUND

10.3.1 Physical Characteristics

The Other Edgewood Areas Study Area is the largest geographically (approximately 5,087 acres), comprising more area than the rest of the Edgewood Area study areas combined. The Other Edgewood Areas contain approximately 167 sites located on the Gunpowder Neck, which is 6 miles long and ½ to 2 miles wide, as seen in Figure 1-2. The Gunpowder Neck is largely undeveloped with restricted access and limited usage as military test ranges.

The terrain of Other Edgewood Areas Study Area ranges from sea level to approximately 40 feet above msl. Surface water runoff drains to the Bush River, Gunpowder River, Chesapeake Bay, or to tributary creeks. The creeks and rivers are relatively large and contain numerous marsh areas.

10.3.2 Land and Resource Use

Other Edgewood Areas Study Area has been used to support the research and testing of chemical weapons and conventional ordnance at APG. Activities included laboratory research and development, testing, and pilot- and full-scale manufacture of both conventional ordnance and innovative chemical warfare agents.

Testing and training activities included the use of chemical weapons in trench, bunker, and tunnel warfare, various delivery methods of CWM including bombing and aerial spraying, and CWM identification and decontamination. In addition, support activities, such as pistol/rifle ranges, prototype buildings, bunkers, munitions disposal areas, and waste disposal sites, have been identified.

10.3.3 History of Contamination

Contamination at Other Edgewood Areas Study Area is a result of the previous testing, training, and support activities that have occurred. These activities included aerial spraying, munitions assembly, armored vehicle weapons systems testing, CWM storage, bombing of targets, burning of chemicals and contaminated materials to destroy and/or decontaminate, testing of rocket-powered sleds, and open air testing of CWM.

10.3.4 Previous Removal Actions

Previous removal actions at Other Edgewood Areas Study Area are listed in Table 10-2. The overall protectiveness of removal actions will be evaluated with the final remedy.

Table 10-2. Other Edgewood Areas Study Area Previous Removal Actions

Removal Action	Date	Goal	Results
Wright Creek G-Field Drum Disposal Site (EAOE08)	1992	Removal of surface debris (including more than 80 drums) & small wooden shed	Action Complete.
Gun Club Creek Drum and Junk Dump Site (EAOE19)	1994	Removal of approximately 40 empty drums from Area 2	Action complete.
Doves Cove C-Field Septic System Sites (EAOE30 and EAOE39)	1995	Removal of soil contaminated with PCB (C-Field 1) and beryllium (C-Field 2) and contents of two septic tanks	Action Complete.
Gun Club Creek Rod & Gun Club Bldg. E4585 Demolition Debris Site (EAOE19)	1997	Removal of potentially contaminated material from building demolition on site surface.	Action Complete.
Coopers Creek D-Field Shoreline Area (EAOE04)	2002	Time Critical removal of UXO exposed by shoreline erosion	Action Complete.
Maxwell Point Smoke Generator Debris Site (EAOE29)	2004	Removal of smoke generator debris and soil contaminated with metals.	Action Complete
Gun Club Creek Drum and Junk Dump Sites (EAOE19) and K-Field Demolition Ground (EAOE38)	2004	Site characterization resulting in removal of all surface waste material and contaminated soil, and sampling at 11 areas.	No subsequent contamination noted.
Boone Creek I-Field Japanese Bunkers (EAOE23)	2005	Removal of potentially contaminated material from Bunkers A and F.	Action Complete.
Coopers Creek D-Field Shoreline Area (EAOE04)	2004-2007	UXO removal and Shoreline stabilization along Bush River.	Action Complete.

10.3.5 Contaminant Media

The eight Investigation Areas of the Study Area are in the RI phase and, with one exception, definitions of contaminants and contaminant media requiring action have not been established.

The Gun Club Creek Investigation Area RI is ongoing; however this investigation has delineated a plume of VOC and its source area in shallow groundwater at Cluster 19. The absence of other sources to groundwater at Cluster 19 has been documented and APG identified Cluster 19 groundwater as a separate OU for remedial response. Other environmental media at Cluster 19 will be addressed with completion of the Gun Club Creek Investigation Area RI.

The shallow groundwater at Cluster 19 contains three parent VOC (TeCA, TCE, and tetrachloroethene), and five other VOC that are likely degradation products of the parent VOC. The shallow groundwater is contained laterally by surrounding, interfingered silt and clay and vertically by the underlying 50+ feet-thick clay confining unit. No chlorinated VOC have been detected in downgradient groundwater, surface water, sediment, or sediment pore water sampling locations. The VOC-bearing sand stringers thin and become discontinuous to the west, south, and east, where plume migration is inhibited by silt and clay.

This groundwater poses no threat to an aquifer, surface water, or sediment. The Army, USEPA, and MDE have determined that the shallow saturated zone conforms to the USEPA Class III and MDE Type III groundwater classification (USEPA, 1984, 1988; Code of Maryland Regulations 26.08.02.09B). This groundwater is not capable of providing water supply and therefore does not warrant protection or restoration to beneficial use as a source or potential source of drinking water.

10.4 REMEDIAL ACTIONS

10.4.1 Functional Operable Units

For planning purposes, APG has divided all of the Other Edgewood Areas Study Area AEDB-R sites into eight Investigation Areas containing 31 Clusters of sites (Figure 10-1) within the 14 watershed/drainage areas of the Study Area. With one exception these sites are in the RI phase and remedial actions have not as yet been selected.

Table 10-3 summarizes the response actions conducted to date in the Other Edgewood Areas Study Area. The basis for taking action (RAOs), selected response, and performance standards are listed in Exhibit 1.

Table 10-3. Other Edgewood Areas Study Area Response Action Summary

Functional Operable Unit	CERCLA Status	Alternatives Evaluated	Selected Remedy	Implementation
Cluster 19 Groundwater	ROD – 09/27/2007	1. No Action 2. LUCs and LTM	LUCs and LTM	The LUCs are in place and the remedial action completion report is in preparation. The first LTM groundwater monitoring report is scheduled for the fall of 2009. The first LUC monitoring report is scheduled for 2010.

10.4.2 Progress Since Last Five-Year Review

Substantial progress has been made at all Investigation Areas in site characterization, contaminant assessment, and the conduct of baseline human health and screening-level ecological risk assessments since the first five-year review for the Other Edgewood Areas Study Area. One ROD has been signed and implemented.

10.5 FIVE-YEAR REVIEW PROCESS

During the review process, the status of the remedial action at the Other Edgewood Areas Study Area site in APG was determined. To accomplish this goal, the Other Edgewood Areas Study Area site was visually inspected and any available data were reviewed. In addition, the Project Officer was interviewed to obtain further information regarding the status of the site. Input was also received from the MDE.

The Project Officer for the Other Edgewood Areas Study Area site, Ms. Ruth Golding, was interviewed on 5 November 2007. The results of this interview are presented in Attachment A.

During the Five-Year Review process, the Other Edgewood Areas Study Area site inspection was conducted on 22 October 2007.

Comments from MDE pertaining to work conducted at Other Edgewood Areas Study Area were received on 30 November 2007 and are provided in Attachment J of this document. The MDE has requested that the Army address a munitions burial pit "in the vicinity of H-Field." APG will confer with MDE to ascertain whether this comment concerns the H-Field Munitions Disposal (EAOE28) Site (see Section 10.6.3) and ensure the sites of concern to MDE are addressed in completing the RI/FS.

Program-wide comments were solicited from the RAB in November 2007. Community participation is summarized in Attachment B of this document.

10.6 FIVE-YEAR REVIEW FINDINGS

10.6.1 Site Inspection

A site inspection was conducted on 22 October 2007. Since the Cluster 19 remedy was in the design phase, no Site Inspection Checklist was completed. However, no changes in site conditions were observed at Cluster 19.

10.6.2 Data Review

Information from the above sources and the documents listed in Attachment G were compiled and reviewed by the project team.

10.6.3 Technology Evaluation

With one exception, sites at the Other Edgewood Areas Study Area are currently in the RI phase, and contaminant types, media, and site risks have not been fully defined. At present, it is not possible to fully evaluate technologies for consideration at these sites. Based upon preliminary information, however, some Other Edgewood Areas Study Area sites may exhibit contaminant scenarios similar to those at other Edgewood Area sites, and the lessons being learned at those sites will assist in defining the remedial approach for the Other Edgewood Areas Study Area.

For Cluster 19 Groundwater there is potential for human health risk and no potential for ecological risk. There are uncertainties associated with the potential for human health risk posed by VOC vapors, and extensive and expensive additional study would be required to make a definitive determination of risk. Therefore, a risk management decision was made to proceed with LUCs rather than to conduct further vapor intrusion risk assessment that would not likely alter the response outcome.

Localized sections of the Edgewood Area shoreline exhibit signs of erosion and accretion. For example, the former Wright Creek K-Field Pistol Range (EAOE51) lost over 20 feet of shoreline in 2003.

At D-Field and other Study Areas, such as J-Field and Carroll Island, shoreline erosion controls were used as components of CERCLA actions to minimize the potential for waste migration to surface water. Such alternatives could be evaluated for other Other Edgewood Areas Study Area sites if studies document high erosion rates in areas of potential former waste disposal.

As with other Study Areas, UXO/CWM threats may exist throughout Other Edgewood Areas Study Area. For example, a removal action was conducted for the D-Field Shoreline and during site characterization at the Cluster 19 Douglas Road Munitions Disposal Site to remove UXO exposed by erosion. Scheduled site characterization activities will result in the removal of UXO items during sampling underneath the H-Field Munitions Disposal Site (EAOE28) and I-Field Munitions Disposal Site (EAOE23).

10.7 TECHNICAL ASSESSMENT

The results of the technical assessment, in accordance with EPA Guidance, are summarized in Table 10-4. Only sites with implemented RODs are included in this evaluation, i.e., Cluster 19 Groundwater.

10.8 ISSUES IDENTIFIED AND RECOMMENDATIONS

During the course of this five-year review, no issues that impact protectiveness were discovered relating to the Other Edgewood Areas Study Area.

Table 10-4. Other Edgewood Areas Technical Assessment: Cluster 19 Groundwater

Assessment Criteria	Y/N/NA	Comments
Is the Remedy functioning as intended by the Decision Documents? ☒ **Yes** ☐ **No**		
▪ **Remedial Action Performance**		
	Y	The remedy is being implemented in accordance with the ROD and RD
▪ **System Operations/O&M**		
	NA	
▪ **Opportunities for Optimization**		
	NA	
▪ **Early Indicators of Potential Issues**		
	N	There are no indicators of potential remedy problems.
▪ **Implementation of Institutional Controls and Other Measures**		
	N	LUCs have been implemented in accordance with the ROD and RD.
Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid? ☒ **Yes** ☐ **No**		
▪ **Changes in Standards and TBC**		
	N	
▪ **Changes in Exposure Pathways**		
	N	No significant changes in site setting and land use based on site visit and interview with DSHE Project Officer (Attachment A)
▪ **Changes in Toxicity and Other Contaminant Characteristics**		
	N	
▪ **Changes in Risk Assessment Methods**		
	N	
▪ **Expected progress towards meeting RAOs**		
	Y	RAOs will have been met with implementation of LUCs.
Has any other information come to light that could call into question the protectiveness of the remedy? ☐ **Yes** ☒ **No**		
▪ **Ecological risk assessment**		
	NA	
▪ **Natural disaster impacts**		
	N	No changes have been identified in site conditions since the ROD was signed.
▪ **Other information that could call into question the remedy protectiveness**		
	N	No additional information that could call into question the remedy protectiveness has been identified.

10.9 PROTECTIVENESS STATEMENT(S)

10.9.1 Cluster 19 Groundwater

The remedy for Cluster 19 Groundwater currently protects human health and the environment because LUCs prevent site activities that would result in unacceptable exposure. However, in order for the remedy to be protective in the long-term the following actions need to be taken to ensure protectiveness. LUCs must be maintained and LTM and five-year reviews conducted until the levels of VOC in groundwater are demonstrated to be levels that allow for unlimited use and unrestricted exposure.

10.9.2 Remaining Areas

Several removal actions have been conducted at sites in this Study Area to address specific issues. These removal actions met their specific objectives and therefore provided reduction in risk. A formal Protectiveness Statement for these sites cannot be made until the RI/FS/ROD/RA process is completed.

10.10 NEXT REVIEW

It is recommended that a five-year review be conducted in 2013 for Cluster 19 Groundwater and any OUs for which a ROD is signed prior to 2013 and for which CERCLA five-year review trigger criteria apply.

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11.0 SUMMARY OF OBSERVATIONS

11.1 GENERAL

This Five-Year Review has individually considered sites in each of the Edgewood Area study areas defined under the IRP. Assessments of the protectiveness of the remedies in each study area are provided in the respective sections of this report. Issues potentially impacting protectiveness are listed in Table 11-1 and recommendations are summarized in Table 11-2.

11.2 INSTITUTIONAL CONTROLS

Many of the individual sites at Edgewood Area employ access controls. Concern over the adequacy of existing controls was expressed by the community during the previous review. The Army, USEPA, and MDE have made substantial progress in formalizing and documenting the protocols for institutional controls, LUCs in particular. Standard ROD and remedial design text for LUC implementation and maintenance acceptable to all stakeholders has been developed.

11.3 REMEDIAL INVESTIGATION AND MANAGEMENT TECHNOLOGIES

11.3.1 Overall Remedial Technologies

Review of technologies under consideration by DSHE and of the available literature on emerging technologies indicates that APG is doing a good job of identifying and evaluating technologies. Many of the individual IRP sites exhibit similar contaminants (i.e., chlorinated VOC in groundwater). At the various sites, DSHE has evaluated and is evaluating a wide range of technologies to address the risk posed by these constituents. Information developed on the various sites is disseminated for consideration at other sites, both informally among project officers and via DSHE's periodic program review meetings. The selection of remedial approaches is based upon site-specific contaminant distribution, geologic and hydrogeologic conditions, and technology availability at the time of remedy selection.

11.3.2 Shoreline Erosion

Several sites at Edgewood Area may exhibit erosion in areas where potential wastes may remain both on shore and underwater near the shoreline. Examples to date where shoreline stabilization has been implemented indicate that constructed erosion barriers are performing well in mitigating this threat.

11.3.3 Long-Term Monitoring

LTM of remaining contaminants is a common component of Edgewood Area remedies. In general, the monitoring program begins with a groundwater monitoring frequency of

Table 11-1 Issues

Issues	Affects Protectiveness (Y/N)	
	Current	**Future**
Vapor intrusion is not adequately addressed by the following RODs:		
O-Field OU 1 – Old O-Field Groundwater	N	Y
O-Field OU 2 – Old O-Field Source Area	N	Y
J-Field – Groundwater	N	Y
Canal Creek – Bldg. 103 Dump	Y	Y
Canal Creek – Beach Point	N	Y
Canal Creek – East Plume	Y	Y
Lauderick Creek – Cluster 1 Groundwater	N	Y

Table 11-2 Recommendations and Follow-up Actions

Recommendations/ Follow-up Actions *	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	**Future**
Ensure future decision documents for O-Field OUs 1 and 2 address vapor intrusion.	Cindy Powels	AEC	ongoing	N	Y
Revise J-Field LUCs to address vapor intrusion.	John Wrobel	AEC	4th Qtr. FY09	N	Y
Complete Canal Creek Study Area vapor intrusion evaluation.	John Wrobel	USEPA	2nd Qtr. FY10	See below.	See below.
Continue monitoring Bldg. E5427. Include in study area wide evaluation.	John Wrobel	AEC	2nd Qtr. FY10	Y	Y
Revise Beach Point LUCs to address vapor intrusion.	John Wrobel	AEC	4th Qtr. FY09	N	Y
Revise Canal Creek East Plume LUCs to address vapor intrusion. Complete evaluation of existing buildings. Include in study area wide evaluation.	John Wrobel	AEC	2nd Qtr. FY10	Y	Y
Revise Cluster 1 LUCs to address vapor intrusion.	Rurik Loder	AEC	4th Qtr. FY10	N	Y

*See Attachment C.

quarterly. Although quarterly monitoring is often a reasonable starting point and has some regulatory basis (for example, RCRA closure/postclosure typically uses quarterly monitoring) site-specific conditions such as groundwater velocity may warrant either more or less frequent monitoring. More frequent monitoring may be required in cases where groundwater velocities are high enough for measurable migration to occur in the short term; typically not the case in the Edgewood Area. Less frequent monitoring may be sufficiently protective and more cost effective in situations where groundwater velocities are very low as is typical in the Edgewood Area. LTM frequency has been adjusted at several sites during the past five years. It is recommended that DSHE continue to evaluate actual groundwater velocities where appropriate and that monitoring frequencies be established considering these site-specific conditions.

11.4 FUTURE CERCLA FIVE-YEAR REVIEWS

An additional CERCLA Section 121(c) five-year review is recommended for the following:

- O-Field – OU 1, OU 2, OU 3;
- J-Field – Soil OU, Groundwater, White Phosphorus Burning Pits;
- Canal Creek Study Area – Bldg. 103 Dump Site, Bldg. 503 Burn Sites, Beach Point, East Plume Groundwater, 13 Select Sites, G Street;
- Westwood Study Area – Clusters 2, 6, 10, 14, and 21; Remaining Sites;
- Carroll Island – OU A, OU B;
- Graces Quarters – OU A, OU B;
- Bush River Study Area – Old Bush River Road Dump, Cluster 3 Lead Contaminated Soil;
- Lauderick Creek Study Area – Cluster 1 Groundwater, Nike SW Landfill, Other Clusters, Cluster 9 Groundwater;
- Other Edgewood Areas Study Area – Cluster 19 Groundwater; and
- Sites for which a ROD is signed subsequent to submission of this review and for which CERCLA Section 121(c) trigger criteria apply.

No further CERCLA Section 121(c) five-year review is recommended for the following:

- Bush River Study Area – Cluster 3 Transformer Storage Area; and
- Lauderick Creek Study Area – Nike Missile Silos, Nike Sanitary Sewer.

Waste removal has been completed at these sites.