Department of Energy

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JUL 28 2008

PPPO-02-589-08

Mr. W. Turpin Ballard
U.S. Environmental Protection Agency
Waste Management Division
Federal Facilities Branch
DOE Remedial Section
Region 4
61 Forsyth Street
Atlanta, Georgia 30303

Mr. Edward Winner, FFA Manager
Kentucky Department for Environmental Protection
Division of Waste Management
Frankfort Office Park
14 Reilly Road
Frankfort, Kentucky 40601

Dear Mr. Ballard and Mr. Winner:

TRANSMITTAL OF THE ENGINEERING EVALUATION/COST ANALYSIS FOR THE SOILS OPERABLE UNIT INACTIVE FACILITIES AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE/LX/07-0016&D2)

Enclosed for your review is the certified D2 version of the *Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/LX/07-0016&D2). Also enclosed is an associated Comment Response Summary in response to your comments on the D1 version of the Engineering Evaluation/Cost Analysis (EE/CA) for the Soils Operable Unit Inactive Facilities.

In accordance with the Federal Facility Agreement, the Kentucky Department for Environmental Protection and the U.S. Environmental Protection Agency have a 30-day review period to provide approval of the document.

If you have any questions or require additional information, please contact David Dollins at (270) 441-6819.

Sincerely,

Reinhard Knerr
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:
1. Certification
2. D2 EE/CA for the Soils Operable Unit Inactive Facilities
3. Comment Response Summary to the D1 EE/CA for the Soils Operable Unit Inactive Facilities

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CERTIFICATION

Document Identification: ***Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/LX/07-0016&D2)**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Paducah Remediation Services, LLC
Co-Operator

Tracey L. Duncan
Environmental Restoration/
Environmental Monitoring Manager

7/28/08
Date Signed

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

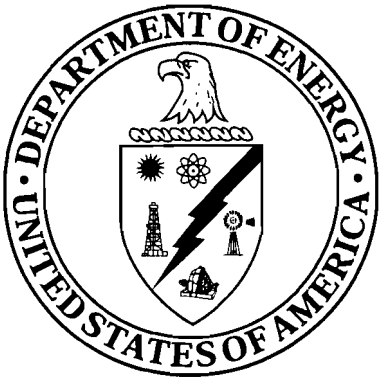
U.S. Department of Energy (DOE)
Owner and Operator

Reinhard Knerr, Paducah Site Lead

7/28/08
Date Signed

DOE/LX/07-0016&D2
Primary Document

Engineering Evaluation/Cost Analysis for Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky



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DOE/LX/07-0016&D2
Primary Document

Engineering Evaluation/Cost Analysis for Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—July 2008

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
PADUCAH REMEDIATION SERVICES, LLC
managing the

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-06EW05001

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PREFACE

This *Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (EE/CA), DOE/LX/07-0016&D2, was prepared to evaluate removal action alternatives associated with the Soils Operable Unit Inactive Facilities in compliance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act. The alternatives considered address contaminants of concern identified and their associated concentration levels located at the C-218 Outdoor Firing Range [Solid Waste Management Unit (SWMU) 181], C-403 Neutralization Tank (SWMU 40), and C-410-B Hydrogen Fluoride Neutralization Lagoon (SWMU 19). The objectives of this report are to (1) describe the environmental conditions supporting the need for a removal action, (2) develop and evaluate alternatives, and (3) recommend the alternative that best meets the removal action objectives. This document provides the basis for development of the Action Memorandum to be issued after receipt and consideration of public comments on the EE/CA.

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CONTENTS

FIGURES

TABLES

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ACRONYMS

ACO	Administrative Consent Order
ALARA	as low as reasonably achievable
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
AWQC	Ambient Water Quality Criteria
BJC	Bechtel Jacobs Company LLC
BMP	best management practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COE	U.S. Army Corps of Engineers
COPC	chemical of potential concern
CSOU	Comprehensive Site Operable Unit
CWA	Clean Water Act
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
EDE	effective dose equivalent
EE/CA	Engineering Evaluation/Cost Analysis
ELCR	excess lifetime cancer risk
EM	Environmental Management
EPA	U. S. Environmental Protection Agency
FFA	Federal Facility Agreement
FR	*Federal Register*
ha	hectare
HF	hydrogen fluoride
HI	hazard index
IEUBK	Integrated Exposure Uptake Biokinetic Model
KAR	Kentucky Administrative Regulations
KDFWR	Kentucky Department of Fish and Wildlife Resources
KOW	Kentucky Ordnance Works
KPDES	Kentucky Pollutant Discharge Elimination System
LMES	Lockheed Martin Energy Systems, Inc.
LLW	low-level waste
MDL	method detection limit
MOU	Memorandum of Understanding
NA	not applicable
NAAQS	National Ambient Air Quality Standards
ND	not detected
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NHANES	National Health and Nutrition Examination Survey
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NSDD	North-South Diversion Ditch
NWP	Nationwide Permit
O&M	operation and maintenance
OU	operable unit
PAH	polycyclic aromatic hydrocarbon compound

PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
PPE	personal protective equipment
PPG	preliminary remediation goal
PRS	Paducah Remediation Services, LLC
RAO	Removal Action Objective
RAWP	Removal Action Work Plan
RCRA	Resource Conservation and Recovery Act
RESRAD	Residual Radioactivity
RfD	reference dose
RGA	Regional Gravel Aquifer
SAP	Sampling and Analysis Plan
SE	Site Evaluation
SF	slope factor
SI	Site Investigation
SMP	Site Management Plan
SVOA	semivolatile organic analysis
SWMU	solid waste management unit
SWOU	Surface Water Operable Unit
T&E	threatened and endangered
TBC	to be considered
TCA	trichloroethane
TCE	Trichloroethene
TEF	toxicity equivalence factor
TSCA	Toxic Substance Control Act of 1976
TSD	Transportation Safety Document
TVA	Tennessee Valley Authority
UCL	upper confidence limit
UCRS	Upper Continental Recharge System
USC	*United States Code*
USEC	United States Enrichment Corporation
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
WAG	waste area grouping
WKWMA	West Kentucky Wildlife Management Area
VOA	volatile organic analysis

EXECUTIVE SUMMARY

The Paducah Gaseous Diffusion Plant (PGDP) is an active uranium enrichment facility owned by the U.S. Department of Energy. PGDP is located in western Kentucky, approximately 10 miles west of Paducah, Kentucky.

The Soils Inactive Facilities Engineering Evaluation/Cost Analysis scope includes evaluating removal at the C-218 Outdoor Firing Range [Solid Waste Management Unit (SWMU) 181], C-403 Neutralization Tank (SWMU 40), and C-410-B Hydrogen Fluoride Neutralization Lagoon (SWMU 19). For the C-218 Firing Range (SWMU 181) this is limited to alternatives that address lead-contaminated soil. For C-403 (SWMU 40) and C-410-B (SWMU 19) this is limited to alternatives that will address contamination within their respective SWMU boundaries (DOE 2007).

The following are the Remedial Action Objectives that have been established for the Soils Operable Unit (OU).

- Control sources early; focus resources at areas that warrant attention in the near term, prioritizing actions within areas to address the greatest risks first.
- Minimize human exposure to contaminants, maximizing the effectiveness of institutional controls.
- Control further migration of contaminated soils.
- Reduce risk from contaminated soil hot spots.
- Reduce the risk, making progress toward the ultimate goal of protecting recreational users and industrial workers from exposure to contaminated soils.

The Removal Action Objectives (RAOs) for this removal action are consistent with the overall Remedial Action Objectives for the Soils OU and are as follows:

- Control current industrial worker exposure to soils, sediment, and/or accumulated rainwater containing hazardous substances, pollutants, or contaminants.
- Identify and control, as needed, off-site migration into multimedia exposure pathways such as surface water and groundwater.

Based on evaluations of the effectiveness, implementability, and cost of each proposed alternative, the preferred alternative identified for this removal action is Alternative 3 – "Excavation and Interim Institutional Controls." This alternative meets all the RAOs for the removal action, is effective, can be implemented, and is the most cost-effective option that meets the specified requirements. Cost of implementation of the recommended alternative (Alternative 3) is estimated to have a present value of $5.7M and an escalated value of $6.1M over a 30-year design life.

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1. INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) documents and describes the evaluation of alternatives to address the potential threat to human health and the environment resulting from the release or potential release of hazardous materials associated with contamination at the C-218 Outdoor Firing Range [Solid Waste Management Unit (SWMU) 181], C-403 Neutralization Tank (SWMU 40), and C-410-B Hydrogen Fluoride (HF) Neutralization Lagoon (SWMU 19). For the C-218 Firing Range (SWMU 181) this is limited to alternatives that address lead-contaminated soil. For C-403 (SWMU 40) and C-410-B (SWMU 19) this is limited to alternatives that will address contamination within their respective SWMU boundaries (DOE 2007). This document was prepared in accordance with the U.S. Environmental Protection Agency's (EPA's) *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (EPA 1993).

1.1 SITE DESCRIPTION AND BACKGROUND

Paducah Gaseous Diffusion Plant (PGDP) is located approximately 10 miles west of Paducah, Kentucky (population approximately 26,000), and 3.5 miles south of the Ohio River in the western part of McCracken County (Figure 1). The plant is on a 3,556-acre U.S. Department of Energy (DOE) site, 748 acres of which are within a fenced security area, 822 acres are located outside the security fence (133 acres are in acquired easements), and the remaining 1,986 acres are licensed to the Commonwealth of Kentucky as part of the West Kentucky Wildlife Management Area (WKWMA). Bordering the PGDP reservation to the northeast, between the plant and the Ohio River, is a Tennessee Valley Authority (TVA) reservation on which the Shawnee Steam Plant is located (Figure 2).

Before the PGDP was built, a munitions-production facility, the Kentucky Ordnance Works (KOW), was operated at the current PGDP location and at an adjoining area southwest of the site. Munitions, including trinitrotoluene, were manufactured and stored at the KOW between 1942 and 1945. The KOW was shut down immediately after World War II. Construction of PGDP was initiated in 1951 and the plant began operations in 1952. Construction was completed and PGDP became fully operational in 1955, supplying enriched uranium for commercial reactors and military defense reactors.

PGDP was operated by Union Carbide Corporation until 1984, when Martin Marietta Energy Systems, Inc. [which later became Lockheed Martin Energy Systems, Inc. (LMES)], was contracted to operate the plant for DOE. On July 1, 1993, DOE leased the plant production/operations facilities to the United States Enrichment Corporation (USEC); however, DOE maintains ownership of the plant and is responsible for environmental restoration and waste management activities. On April 1, 1998, Bechtel Jacobs Company LLC, (BJC) replaced LMES in implementing the Environmental Management (EM) Program at PGDP. On April 23, 2006, Paducah Remediation Services, LLC, (PRS) replaced BJC in implementing the EM Program at PGDP.

PGDP was placed on the National Priorities List (NPL), effective June 30, 1994 [59 *Federal Register (FR)* 27989, May 31, 1994]. A Federal Facility Agreement (FFA) negotiated by DOE, EPA, and the Commonwealth of Kentucky coordinates the requirements of the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at the facility.

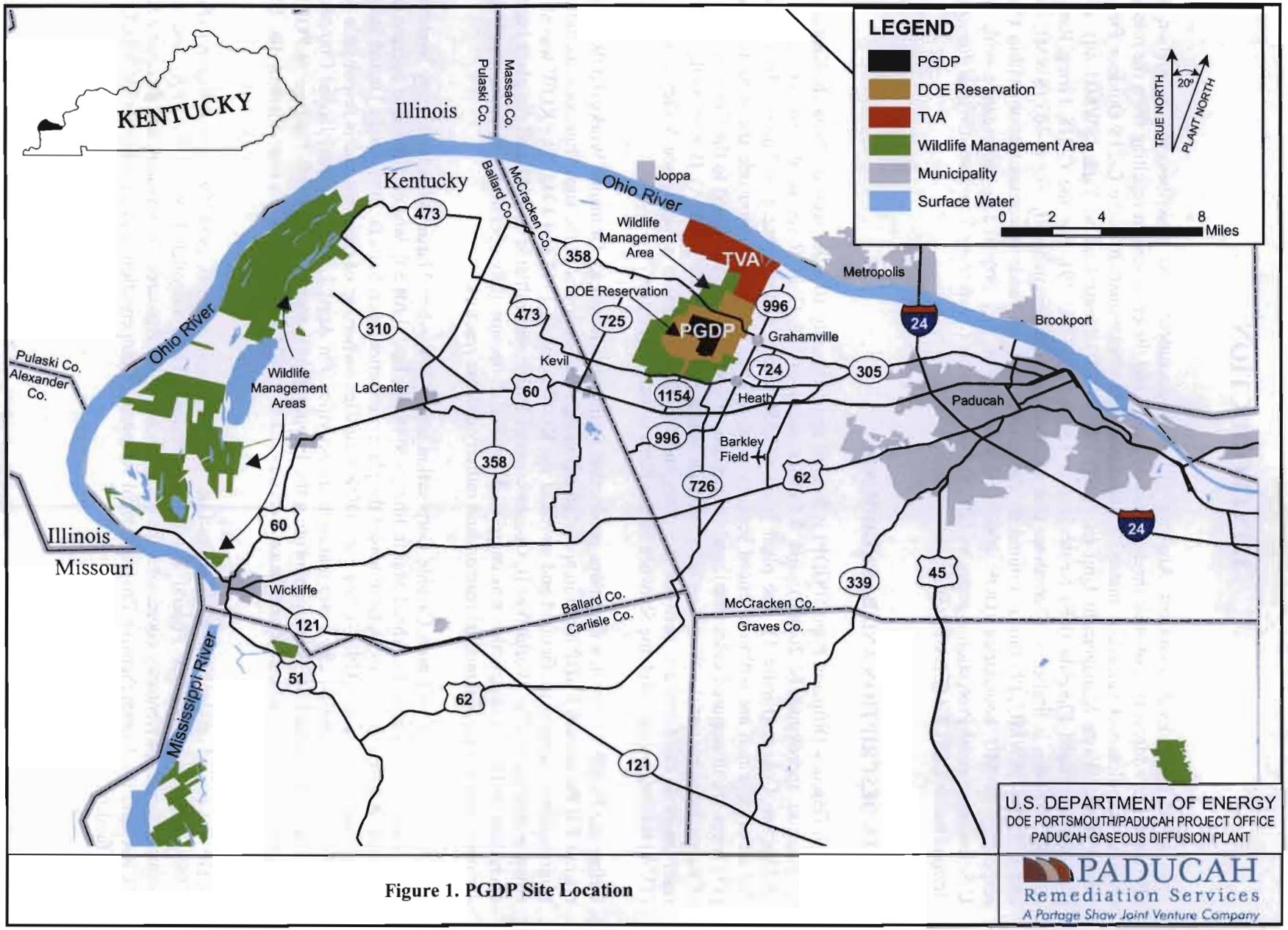

Figure 1. PGDP Site Location

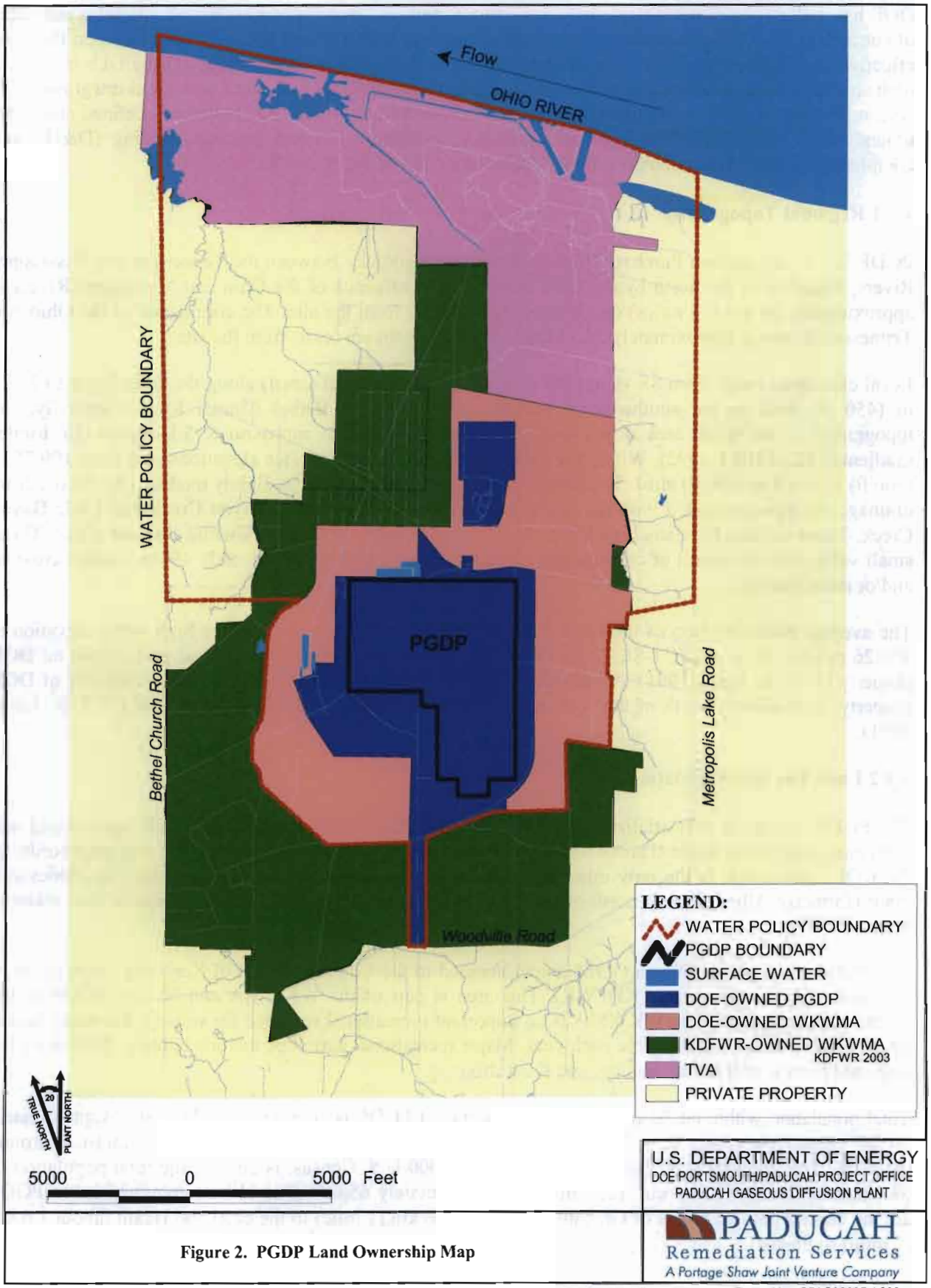

Figure 2. PGDP Land Ownership Map

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DOE has undertaken projects to identify, investigate, and remediate, as necessary, all SWMUs and areas of concern at PGDP. To facilitate the remediation process at PGDP and focus investigations on the most effective and efficient remedial actions, operable units (OUs) have been defined. These OUs consist of both source control units (i.e., units that may contribute contamination to other units) and integrator units (i.e., units that "collect" contamination from source control units). Six OUs have been defined at PGDP: groundwater, surface water, soil, burial grounds, decontamination and decommissioning (D&D), and comprehensive site. This removal action is included as part of the Soils OU.

1.1.1 Regional Topography

PGDP lies in the Jackson Purchase Region of western Kentucky between the Tennessee and Mississippi Rivers, bounded on the north by the Ohio River. The confluence of the Ohio and Mississippi Rivers is approximately 56 km (35 miles) downstream (southwest) from the site. The confluence of the Ohio and Tennessee Rivers is approximately 24.14 km (15 miles) upstream (east) from the site.

Local elevations range from 88.41 m (290 ft) above mean sea level (amsl) along the Ohio River to 137.2 m (450 ft) amsl in the southwestern portion of PGDP near Bethel Church Road. Generally, the topography in the PGDP area slopes toward the Ohio River at an approximate 5.11 m/km (27 ft/mile) gradient (CH2M HILL 1992). Within the plant boundaries, ground surface elevations vary from 109.75 m (360 ft) to 118.9 m (390 ft) amsl. The terrain in the vicinity of the plant is slightly modified by the dendritic drainage systems associated with the two principal streams in the area, Bayou Creek and Little Bayou Creek. These streams have small valleys, which are about 6.09 m (20 ft) below the adjacent plain. These small valleys are the result of construction of plant drainage systems in the early 1950s, natural erosion, and/or maintenance.

The average pool elevation of the Ohio River is 88.41 m (290 ft) amsl, and the high water elevation is 104.26 m (342 ft) amsl (TCT-St. Louis 1991). Approximately 100 small lakes and ponds exist on DOE property (TCT-St. Louis 1991). A marsh covering 66.8 hectares (ha) (165 acres) exists off-site of DOE property, immediately south of the confluence of Bayou Creek and Little Bayou Creek (TCT-St. Louis 1991).

1.1.2 Land Use and Population

The PGDP is heavily industrialized; however, the area surrounding the plant is mostly agricultural and open land, with some forested areas. The TVA's Shawnee Steam Plant, adjacent to the northeast border of the DOE reservation, is the only other major industrial facility in the immediate area. The Honeywell Plant (formerly Allied Signal) north of the Ohio River near Metropolis, Illinois, produces feed material for the PGDP.

The PGDP site includes 804 ha (1,986 acres) licensed to the Commonwealth of Kentucky Department of Fish and Wildlife Resources (KDFWR). This area is part of the WKWMA and borders PGDP to the north, west, and south. The WKWMA is an important recreational resource for western Kentucky and is used by more than 10,000 people each year. Major recreational activities include hunting, field trials for dogs and horses, trail riding, fishing, and skeet shooting.

Total population within an 80.46 km (50-mile) radius of PGDP is approximately 500,000. Approximately 50,000 people live within 16.09 km (10 miles) of PGDP and homes are scattered along rural roads around the plant. The population of Paducah, based on the 2000 U.S. Census, is 26,307; the total population of McCracken County [650.4 km^2 (251 mi^2)] is approximately 65,000. The closest communities to PGDP are the unincorporated towns of Grahamville [about 1.6 km (1 mile) to the east] and Heath [about 1.6 km (1 mile) southeast].

1.1.3 Climate

The climate of the region may be broadly classified as humid-continental. The term "humid" refers to the surplus of precipitation versus evapotranspiration that normally is experienced throughout the year. The "continental" nature of the local climate refers to the dominating influence of the North American landmass. Continental climates typically experience large temperature changes between seasons.

Current and historical meteorological information regarding temperature, precipitation, and wind speed/direction was obtained from the National Oceanic and Atmospheric Administration's National Climatic Data Center. Additional data were obtained from the National Weather Service office at Barkley Regional Airport.

The mean annual temperature for the Paducah area for 2005 was 58.6 °F. The 22-year average monthly temperature is 58.0°F, with the coldest month being January with an average temperature of 35.1 °F and the warmest month being July with an average temperature of 79.2 °F.

The 22-year average monthly precipitation is 10.16 cm (4.00 in.), varying from an average of 6.93 cm (2.73 in.) in August (the monthly average low) to an average of 11.63 cm (4.58 in.) in April (the monthly average high). The total precipitation for 2005 was 95.12 cm (37.45 in.), compared to the normal of 125.07 cm (49.24 in.).

The average mean prevailing wind speed during 2005 was 6.2 mph from the south-southwest. Historically, stronger winds are recorded when the winds are from the southwest.

1.1.4 Geology

PGDP is located in the Jackson Purchase Region of Western Kentucky, which represents the northern tip of the Mississippi Embayment portion of the Coastal Plain. The Jackson Purchase Region is an area of land that includes all of Kentucky west of the Tennessee River. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock. A generalized geologic cross-section for the PGDP site is presented in Figure 3.

Within the Jackson Purchase Region, strata deposited above the Precambrian basement rock attain a maximum thickness of 3,659 m to 4,573 m (12,000 ft to 15,000 ft). Exposed strata in the region range in age from Devonian to Holocene. The Devonian stratum crops out along the western shore of Kentucky Lake. Mississippian carbonates form the nearest outcrop of bedrock and are exposed approximately 14.5 km (9 miles) northwest of PGDP in southern Illinois (Clausen et al. 1992). The Coastal Plain deposits unconformably overlie Mississippian carbonate bedrock and consist of the following: the Tuscaloosa Formation; the sand and clays of the Clayton/McNairy Formations; the Porters Creek Clay; and the Eocene sand and clay deposits (undivided Jackson, Claiborne, and Wilcox Formations). Continental deposits unconformably overlie the Coastal Plain deposits, which are, in turn, covered by loess and/or alluvium.

Relative to the shallow groundwater flow system in the vicinity of the PGDP, the continental deposits and the overlying loess and alluvium are of key importance. The continental deposits locally consist of an upper silt member, with lesser sand and gravel interbeds, and a thick, basal sand and gravel member, which fills a buried river valley. A subcrop of the Porters Creek Clay, located beneath and immediately south of PGDP, marks the south extent of the buried river valley. Fine sand and clay of the McNairy Formation directly underlie the continental deposits. These continental deposits are continuous from beneath the PGDP to beyond the present course of the Ohio River. The general soil map for Ballard and McCracken counties indicates that three soil associations are found within the vicinity of PGDP (USDA

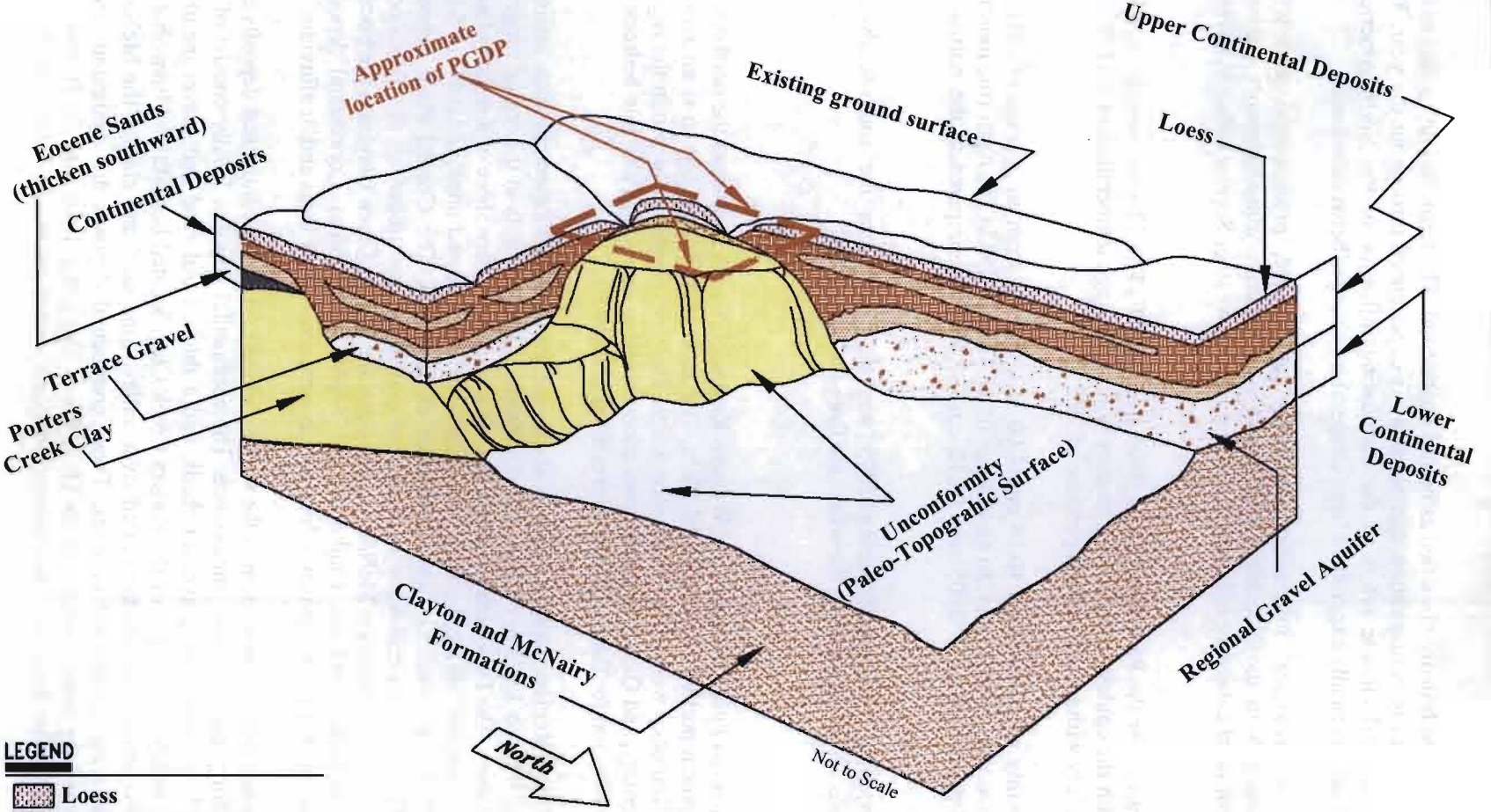

Figure 3. Conceptual Model of the Stratigraphy in the Vicinity of PGDP

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH
Remediation Services
A Portage Shaw Joint Venture Company

1976): the Rosebloom-Wheeling-Dubbs association, the Grenada-Calloway association, and the Calloway-Henry association. The predominant soil association in the vicinity of PGDP is the Calloway-Henry association, which consists of nearly level, somewhat poorly drained to poorly drained, medium-textured soils on upland positions. Several other soil groups also occur in limited areas of the region, including the Grenada, Falaya-Collins, Waverly, Vicksburg, and Loring.

Although the soil over most of PGDP may be Henry silt loam with a transition to Calloway, Falaya-Collins, and Vicksburg away from the site, many of the characteristics of the original soil have been lost due to industrial activity that has occurred over the past 45 years. Activities that have disrupted the original soil classifications include filling, mixing, and grading.

1.1.5 Hydrogeology

1.1.5.1 Surface Water

PGDP is located in the western portion of the Ohio River drainage basin, approximately 24 km (15 miles) downstream of the confluence of the Ohio River with the Tennessee River and approximately 56 km (35 miles) upstream of the confluence of the Ohio River with the Mississippi River. Locally, the PGDP is within the drainage areas of the Ohio River, Bayou Creek (also known as Big Bayou Creek), and Little Bayou Creek.[1] Multiple groundwater aquifers underlie PGDP. The shallowest aquifers occur in the Continental Deposits and the McNairy Formation, both of which discharge into the Ohio River north of PGDP. Surface water/groundwater relationships vary significantly across the Soils Operable Unit.

A shallow water table aquifer, with discharge to the area creeks, occurs to the south of PGDP.[2] Under most of PGDP and the adjacent area to the north, large, downward, vertical hydraulic gradients dominate within the shallow groundwater system, and groundwater infiltrates downward to the Regional Gravel Aquifer (RGA) at a depth of approximately 60 ft (see Section 3.6), limiting the amount of groundwater discharge to the ditches of the PGDP and adjacent creeks. During periods of sustained rainfall, infiltrating water accumulates in the shallow soils and develops an increased throughflow system that discharges infiltrating water temporarily to plant ditches and the area creeks. In the vicinity of the Ohio River, where the land surface is approximately 60 ft lower than at PGDP, Bayou and Little Bayou Creeks cut down to near the potentiometric surface of the RGA. In this area, horizontal groundwater gradients predominate within the water table flow system. Gaining reaches in the creeks are found on Bayou Creek south of PGDP and on both creeks north of PGDP near the Ohio River. While there are no springs near PGDP, seeps are present over a limited stretch of Little Bayou Creek near the Ohio River where hydraulic potential within the RGA exceeds the elevation of the creek. *Surface Water to Groundwater Interaction at the Paducah Gaseous Diffusion Plant* (PRS 2007a) discusses the conceptual model for surface water/groundwater interactions at PGDP.

The plant is situated on the divide between the two creeks (Figure 4). Surface flow is east-northeast toward Little Bayou Creek and west-northwest toward Bayou Creek. Bayou Creek is a perennial stream on the western boundary of the plant that flows generally northward, from approximately 2.5 miles south of the plant site to the Ohio River along a 14.5-km (9-mile) course. A 4,820-ha (11,910-acre) drainage basin supplies Bayou Creek. Little Bayou Creek becomes a perennial stream at the east outfalls of PGDP.

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[1] Use designations described in 401 KAR 5:026 for Bayou Creek and Little Bayou Creek are warm water aquatic habitat (WAH), primary contact recreation (PCR), secondary contact recreation (SCR), and domestic water supply (DWS) at Cario, Illinois, which is the location of the nearest downstream public water supply (401 KAR 5:031).

[2] This water table aquifer exists where the top of the Porters Creek Clay occurs near land surface. The water table aquifer is part of the Terrace Gravel flow system (see Section 1.1.4). The Porters Creek Clay is absent under most of PGDP and the adjacent area to the north.

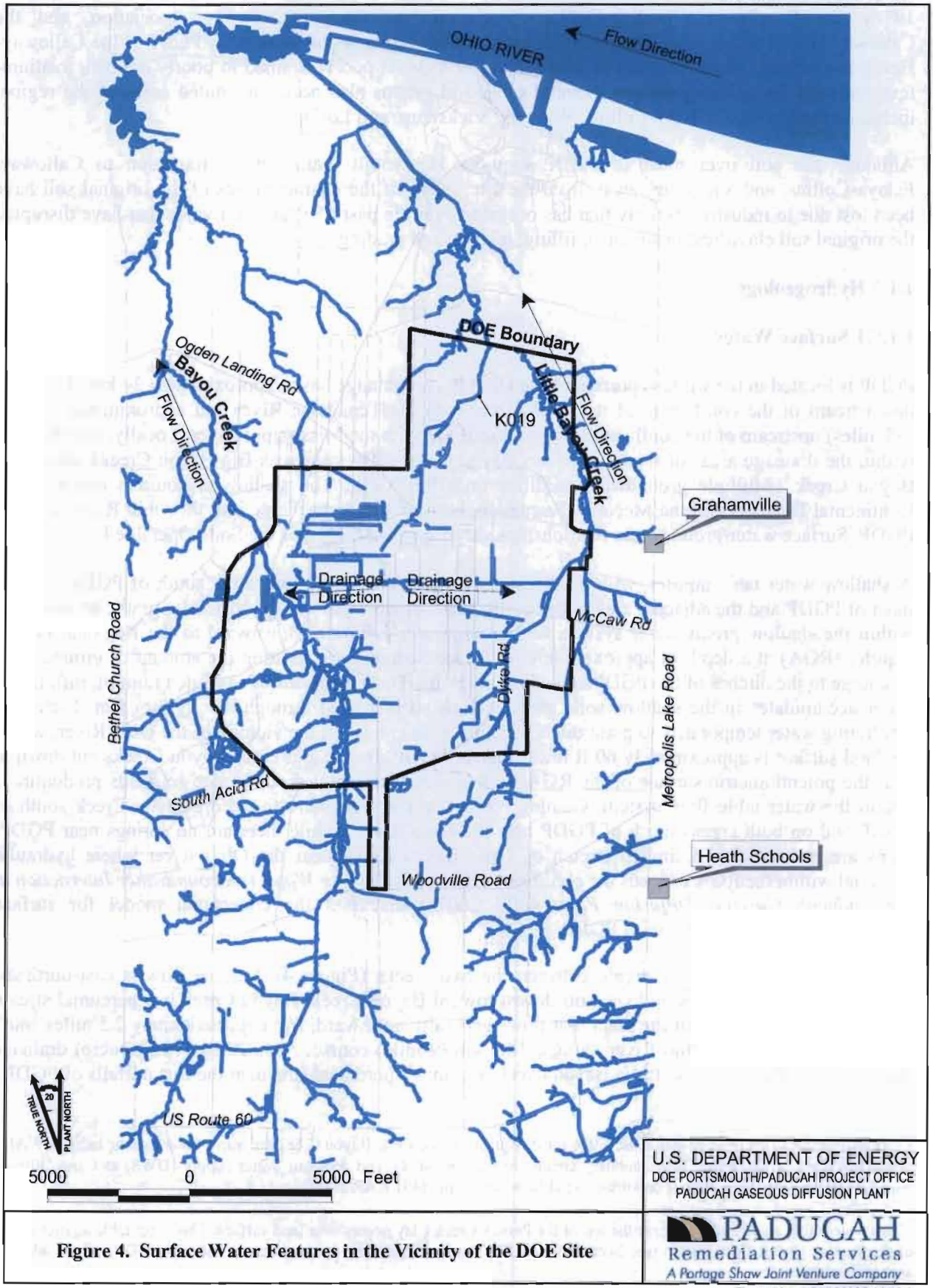

Figure 4. Surface Water Features in the Vicinity of the DOE Site

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The Little Bayou Creek drainage originates within WKWMA and extends northward and joins Bayou Creek near to the Ohio River along a 10.5-km (6.5-mile) course within a 2,400-ha (6,000-acre) drainage basin. Drainage areas for both creeks are generally rural; however, they receive surface drainage from numerous swales that drain residential and commercial properties, including WKWMA, PGDP, and the TVA Shawnee Steam Plant. The confluence of the two creeks is approximately 4.8 km (3 miles) north of the plant site, just upstream of the location at which the combined flow of the creeks discharges into the Ohio River.

Most of the flow within Bayou and Little Bayou Creeks is from process effluents or surface water runoff from PGDP. A network of ditches discharges effluent and surface water runoff from PGDP to the creeks. Plant discharges are monitored at the Kentucky Pollutant Discharge Elimination System (KPDES) outfalls prior to discharge into the creeks. These creeks are monitored at KPDES outfalls for possible contaminant releases from the plant. Outfalls 002, 010, 011, 012, 013, and 018 receive water from the eastern-most portion of the plant and discharge to Little Bayou Creek. Water from the western portion of the plant drains to Bayou Creek through Outfalls 001, 006, 008, 009, 014, 015, 016, and 017. Outfall 004 receives waste water from the C-615 Sewage Treatment Facility and combines with the effluents that lead to Outfall 008. Outfall 019 receives runoff from the C-746-U Landfill located north of PGDP and discharges to the North-South Diversion Ditch (NSDD), which flows to Little Bayou Creek. Outfalls 003, 005, and 007 no longer are permitted or discharging.

1.1.5.2 Groundwater

The discussion is intended to provide the reader with a general overview of the groundwater flow regime for PGDP. The local groundwater flow system at the PGDP site occurs within the sands of the Cretaceous McNairy Formation, Pliocene terrace gravels, Plio-Pleistocene lower continental gravel deposits and upper continental deposits, and Holocene alluvium. Four specific components have been identified for the groundwater flow system and are defined in the following paragraphs.

(1.) **McNairy Flow System.** Formerly called the deep groundwater system, this component consists of the interbedded and interlensing sand, silt, and clay of the Cretaceous McNairy Formation. Sand facies account for 40–50% of the total formation's thickness of approximately 68.6 m (225 ft). Groundwater flow is predominantly north.

(2.) **Terrace Gravel.** This component consists of Pliocene (?)-aged gravel deposits (a question mark indicates uncertain age) and later reworked sand and gravel deposits found at elevations higher than 97.5 m (320 ft) amsl in the southern portion of the plant site; they overlie the Paleocene Porters Creek Clay and Eocene sands. These deposits usually lack sufficient thickness and saturation to constitute an aquifer.

(3.) **Regional Gravel Aquifer.** This component consists of the Quaternary sand and gravel facies of the lower continental deposits and Holocene alluvium found adjacent to the Ohio River and is of sufficient thickness and saturation to constitute an aquifer. These deposits are commonly thicker than the Pliocene (?) gravel deposits, having an average thickness of 9.1 m (30 ft), and range up to 15.24 m (50 ft) along an axis that trends east–west through the plant site. The RGA is the primary local aquifer. Groundwater flow is predominantly north toward the Ohio River.

(4.) **Upper Continental Recharge System (UCRS).** Formerly called the shallow groundwater system, this component consists of the surficial alluvium and upper continental deposits. Sand and gravel lithofacies appear relatively discontinuous in cross-section, but portions may be interconnected. The most prevalent sand and gravel deposits occur at an elevation of approximately 105.2 to 106.9 m (345 to 351 ft) amsl; less prevalent deposits occur at elevations of 102.7 to 103.9 m (337 to 341 ft)

amsl. Groundwater flow is predominantly downward into the RGA from the UCRS, which has a limited horizontal component in the vicinity of PGDP.

1.1.6 Soils

The surficial deposits found in the vicinity of PGDP are Pleistocene to Recent in age and consist of loess and alluvium. Both units are composed of clayey silt or silty clay and range in color from yellowish-brown to brownish-gray or tan, making field differentiation difficult.

The loess (wind-blown) deposits overlie the upper continental deposits over the entire PGDP area. Loess deposition probably occurred in upland areas during all stages of the glaciation that extended into the Ohio and Mississippi River Valleys.

1.1.7 Ecology

The following sections give a brief overview of the terrestrial and aquatic systems at PGDP. A more detailed description, including an identification and discussion of sensitive habitats and threatened and endangered (T&E) species, is contained in the *Investigation of Sensitive Ecological Resources Inside the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CDM 1994) and *Environmental Investigations at the Paducah Gaseous Diffusion Plant and Surrounding Area, McCracken County, Kentucky* (COE 1994a).

1.1.7.1 Terrestrial Systems

The terrestrial component of the PGDP ecosystem includes the plants and animals that use the upland habitats for food, reproduction, and protection. The upland vegetative communities consist primarily of grassland, forest, and thicket habitats with agricultural areas. The main crops grown in the PGDP area include soybeans, corn, tobacco, and sorghum.

Most of PGDP has been cleared of vegetation at some time, and much of the grassland habitat currently is mowed by PGDP personnel. A large percentage of the adjacent WKWMA is managed to promote native prairie vegetation by burning, mowing, and various other techniques. These areas have the greatest potential for restoration and for establishment of a sizeable prairie preserve in the Jackson Purchase area (KSNPC 1991).

Canopy species of the forested areas include oaks, hickories, maples, elms, and sweetgum. Understory species include snowberry, poison ivy, trumpet creeper, Virginia creeper, and Solomon's seal.

Thicket areas consist predominantly of maples, black locust, sumac, persimmon, and forest species in the sapling stage with herbaceous ground cover similar to that of the forest understory.

Wildlife commonly found in the PGDP area consists of species indigenous to open grassland, thicket, and forest habitats. The species documented to occur in the area are discussed in the following paragraphs.

Small mammal surveys conducted on WKWMA documented the presence of southern short-tailed shrew, prairie vole, house mouse, rice rat, and deer mouse (KSNPC 1991). Large mammals commonly present in the area include coyote, eastern cottontail, opossum, groundhog, whitetail deer, raccoon, and gray squirrel.

Typical birds of the area include European starling, cardinal, red-winged blackbird, mourning dove, bobwhite quail, turkey, killdeer, American robin, eastern meadowlark, eastern bluebird, bluejay, red-tail hawk, and great horned owl.

Amphibians and reptiles present include cricket frog, Fowler's toad, common snapping turtle, green tree frog, chorus frog, southern leopard frog, eastern fence lizard, and red-eared slider (KSNPC 1991).

Mist netting activities in the area have captured red bat, little brown bat, Indiana bat, northern long-eared bat, evening bat, and eastern pipistrelle (KSNPC 1991).

1.1.7.2 Aquatic Systems

The aquatic communities in and around the PGDP area that could be impacted by plant discharges include two perennial streams (Bayou Creek and Little Bayou Creek), the NSDD, a marsh located at the confluence of Bayou Creek and Little Bayou Creek, and other smaller drainage areas. The dominant taxa in all surface waters include several species of sunfish, especially bluegill and green sunfish, as well as bass and catfish. Shallow streams, characteristic of the two main area creeks, are dominated by bluegill, green and longear sunfish, and stonerollers.

1.1.7.3 Wetlands and Floodplains

During the 1994 U.S. Army Corps of Engineers (COE) environmental investigations, 11,719 acres of wetlands were found in areas surrounding the PGDP. These investigations identified 1,083 separate wetland areas and grouped them into 16 vegetative cover types encompassing forested, scrub/shrub, and emergent wetlands (COE 1994b). Wetland vegetation consists of species such as sedges, rushes, spikerushes, and various other grasses and forbs in the emergent portions; red maple, sweet gum, oaks, and hickories in the forested portions; and black willow and various other saplings of forested species in the thicket portions.

At the PGDP, three bodies of water cause most area flooding: the Ohio River, Bayou Creek, and Little Bayou Creek. A floodplain analysis performed by COE (1994b) found that much of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams. In addition, this analysis reports that ditches within the plant area can contain the expected 100- and 500-year discharges.

1.2 SOILS OPERABLE UNIT STRATEGY

The Soils OU is one of five media-specific OUs at PGDP being used to evaluate and implement remedial actions. DOE, EPA, and the Commonwealth of Kentucky have agreed upon five media-specific strategic cleanup initiatives as follows [from Site Management Plan (SMP), DOE 2007b]:

- Burial Grounds OU Strategic Initiative,
- D&D OU Strategic Initiative,
- Groundwater OU Strategic Initiative,
- Soils OU Strategic Initiative, and
- Surface Water Operable Unit (SWOU) Strategic Initiative.

These initiatives include taking early actions, as necessary, to prevent and reduce exposure and unacceptable risks. This includes completion of a series of prioritized response actions, ongoing site characterization activities to support future response action decisions, and D&D of the currently operating gaseous diffusion plant once it ceases operation. These initiatives will be followed by Comprehensive Site

Operable Unit (CSOU) evaluation, with implementation of additional and final actions, as needed, to ensure long-term protectiveness. The intended scope, sequence, and timing of the OU initiatives are documented in the SMP (DOE 2007b) and in the FFA (EPA 1998a).

The primary objectives of these initiatives are to protect human health and the environment by taking actions necessary to prevent both on-site and off-site human exposure that presents an unacceptable risk, to provide safe environmental conditions for industrial workers performing ongoing gaseous diffusion plant operations, and to implement actions that provide the greatest opportunities to achieve significant risk reduction before site closure.

For the Soils OU, and consistent with EPA guidance (EPA 1998b; EPA 2005), a phased approach is used to meet the primary objectives. A phased approach is used because the complex soil contamination problems at the site (i.e., ongoing operational activities, multiple sources of contamination, and the potential for a complicated contaminant fate and transport process[3]) prevent PGDP from implementing one comprehensive, cost-effective remedy at this time. Additionally, the phased approach allows the site to use information gained in earlier phases of the cleanup to refine and implement subsequent cleanup objectives and actions.

The phased approach for the Soils OU consists of implementing a series of steps that will meet short-term protection goals, intermediate performance goals, and long-term, final cleanup goals. Sequencing the steps in this manner is consistent with EPA's recommendation to use these goals to accomplish the following EPA objectives (EPA 2005):

- Control sources early; focus resources at areas that warrant attention in the near term, prioritizing actions within areas to address the greatest risks first;
- Minimize human exposure to contaminants, maximizing the effectiveness of institutional controls;
- Control further migration of contaminated soils;
- Reduce risk from contaminated soil; and
- Make progress toward the ultimate goal of protecting recreational users and industrial workers from exposure to contaminated soils.

The following four steps are being used at PGDP to implement the phased approach for the Soils OU [adapted from the SMP (DOE 2007b)]:

(1) Prevent human exposure to contamination presenting an unacceptable risk (short-term protection goal);

(2) Prevent or minimize further off-site migration (intermediate performance goals);

(3) Reduce, control, or minimize contaminated soil contributing to off-site contamination (intermediate performance goals); and

[3] It should be noted that there is minimal migration associated with contaminated soils (i.e., "hot spots"). The primary issue associated with contaminated soils is direct contact risk to the industrial worker. Additional multimedia evaluation (e.g., groundwater, surface water) will be conducted to ensure that all exposure pathways have been adequately assessed to support cleanup decisions.

(4) Evaluate multimedia exposure pathways and select long-term solutions to protect human health and the environment (long-term, final cleanup goals).

In implementing this phased approach, the following Soils OU actions have been implemented to meet the short-term goal of preventing human exposure to contaminated soil hot spots:

- Implementation of on-site institutional controls (1993); and
- Monitoring and posting of radiological areas (ongoing)

The following additional actions have been taken for the Soils OU to meet the intermediate performance goal of reducing, controlling, or minimizing contaminated soil, soil off-site migration, and contributing source areas:

- Removed approximately 5,000 drums of polychlorinated biphenyl- (PCB-) contaminated soils from vaporizer areas in C-337-A (1985 – 1986) and C-333-A (1987);
- Removed various Underground Storage Tanks (USTs) and any associated petroleum-contaminated soils:
  - UST #1 (SWMU 142) containing gasoline, located at C-750-A (1991);
  - UST #2 (SWMU 143) containing diesel fuel, located at C-750-B (1991);
  - UST #3 (SWMU 25) containing used motor oil, located at C-750-C (1993);
  - UST #17 (SWMU 183) containing various petroleum products, located at C-745-K (2002);
  - UST #18 (SWMU 534) containing various petroleum products, located at C-745-K2 and within the footprint of SWMU 193 (2002);
  - UST #5 (SWMU 139) containing diesel fuel, located at C-746-A (2003);
- Removed PCB- and dioxin-contaminated soil at Waste Area Group (WAG) 23 (1997):
- Excavated radiologically contaminated soil associated with concrete rubble piles for AOC 124 under WAG 17 (1997); and
- Treated trichloroethene- (TCE-) contaminated soil at the Cylinder Drop Test Area (SWMU 91) using LASAGNA *in situ* technology (2001)

In addition to the removal actions, the field investigation of WAGs 9 and 11 (DOE 1999a) should be mentioned. This investigation included the sampling and evaluation of potential soil contamination at SWMUs 19, 20, 27, 28, 41, 165, and 170.

Implementation of the Soils OU Inactive Facilities EE/CA is the next step in the phased approach for the Soils OU. The Soils OU Inactive Facilities EE/CA is an interim action consistent with the intermediate performance goal for the Soils OU of reducing, controlling, or minimizing contaminated soil contributing to off-site contamination. Upon completion of Soils OU Inactive Facilities EE/CA, and in keeping with the phased approach, this interim action will be followed by the Soils OU Remedial Investigation and the CSOU (DOE 2007b).

1.3 PREVIOUS INVESTIGATIONS AND RESPONSE ACTIONS

The C-218 Outdoor Firing Range (SWMU 181), C-403 Neutralization Tank (SWMU 40), and C-410-B HF Neutralization Lagoon (SWMU 19) are inactive facilities that supported plant activities associated with various historical plant processes at the PGDP (Figure 5). Each of these inactive facilities has been investigated previously. The contamination associated with each inactive facility originated from plant activities. Table 1 provides a listing of the previous investigations associated with each facility. Detailed descriptions of the investigations are discussed in Section 1.5, "Source, Nature, and Extent of Contamination."

Table 1. Previous Investigations and Response Actions

Facility	Previous Investigations	Response Actions
C-218 Outdoor Firing Range (SWMU 181)	1) Solid Waste Management Unit/Area of Concern Self Assessment Evaluation for Decision Process Report #65 (1994)	None
C-403 Neutralization Tank (SWMU 40)	1) General Site Characterization (1993, 1997, 1998) 2) WAG 6 Remedial Investigation (1998)	None
C-410-B Hydrogen Fluoride Neutralization Lagoon (SWMU 19)	1) Administrative Consent Order (ACO) Phase II Site Investigation (SI) (1991) 2) WAGs 9 & 11 Site Evaluation (SE) (1999)	None

1.4 ANALYTICAL DATA

Analytical data from previous investigations that were representative of current site conditions were utilized in support of this evaluation. Appendix C provides the complete dataset utilized, including data qualifiers.

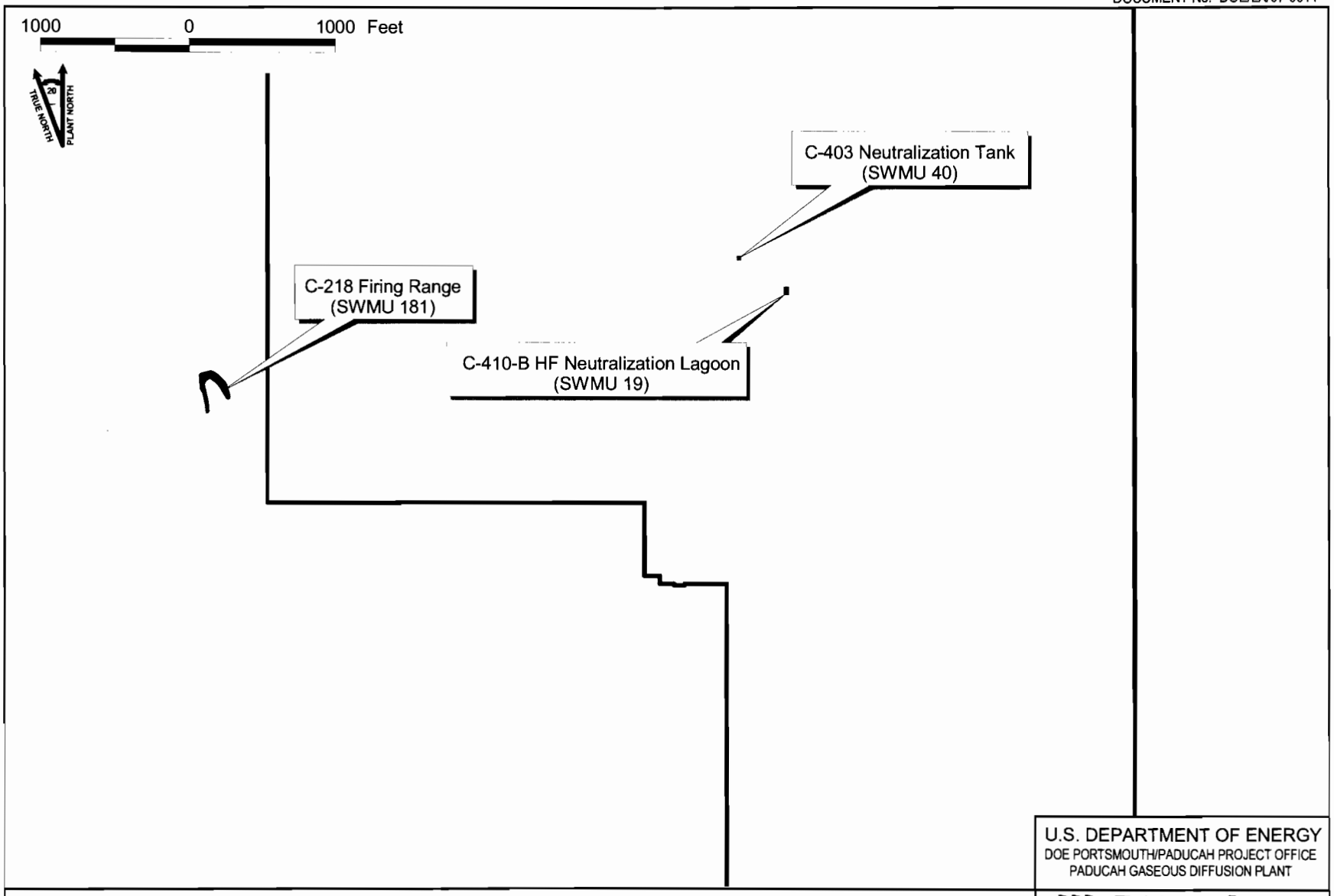

Figure 5. Location of SWMUs 19, 40, and 181

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1.5 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

The source, nature, and extent of the potential chemical contamination present at the C-218 Outdoor Firing Range (SWMU 181), C-403 Neutralization Tank (SWMU 40), and C-410-B HF Neutralization Lagoon (SWMU 19) have been defined by previous investigations (Figure 6 through Figure 8). The identified contamination for each facility was derived from various plant activities conducted at PGDP.

1.5.1 C-218 Outdoor Firing Range (SWMU 181)

The C-218 Firing Range (SWMU 181) is a former outdoor firing range that was in operation from 1985 to 1992. The facility is located immediately west of PGDP on DOE property and consists of a U-shaped soil berm approximately 4.88 m (16 ft) high. Excess excavation material from the East-West Ditch Oil Structure project (Engineering Service Order-13885) completed in 1983, along with possible additional fill material from C-611, was utilized to construct the berm. In 1993, a site characterization of the berm was performed (MMES 1994). The surface soil was sampled for radiological constituents, PCBs, and RCRA bulk metals. Eight sampling locations were chosen at random, resulting in the collection of eight individual and two composite samples. The two composite samples were analyzed for lead. Bulk lead concentrations were 1,774.2 mg/kg to 14,880.0 mg/kg (MMES 1994). The lead results from the two sampled locations [WC-1042 (duplicates) and WC-1043] indicate lead present at concentrations above the background concentration (36 mg/kg) and risk-based action level for the industrial worker (1,250 mg/kg) (DOE 2001). All ten locations were sampled for radionuclides and PCBs. Of the ten locations, total uranium was detected at four (WC-1042, WC-1046, WC-1047, and WC-1049) locations at concentrations below the surface soil background concentration (3.8 pCi/g) and risk-based action level for the industrial worker (171 pCi/g; uranium-238) (DOE 2001). The remaining six locations (WC-1043, WC-1044, WC-1045, WC-1048, WC-1050, and WC-1051) had total uranium below detectable limits for uranium (less than 1.5 pCi/g). PCBs were not detected at any of the ten locations sampled for PCBs. There have been no previous response actions for the C-218 Firing Range; however, based upon historical use, analytical data, and process knowledge, lead is the only chemical of potential concern (COPC) that will be targeted in this removal action. Characterization for other COPCs associated with the source of the berm material is being planned in conjunction with the Soil Pile Project sampling event, and the characterization data will be utilized as part of a follow-up evaluation of the C-218 Firing Range currently scheduled under Soils OU.

1.5.2 C-403 Neutralization Tank (SWMU 40)

The C-403 Neutralization Tank (SWMU 40) is located at the northeast corner of the C-400 Building. The tank is 7.62 m^2 (25 ft^2) by 7.92 m (26 ft) deep, in-ground, and open-topped. It is constructed of concrete and lined with two layers of acid brick. The tank was used for the storage and treatment of acidic, uranium-bearing waste solutions generated during cleaning operations in the C-400 Building until 1957. In 1957, neutralization equipment was installed in the C-400 Building, and the C-403 Neutralization Tank no longer was used to neutralize waste solutions. Although neutralization no longer was carried out at C-403, low-level, uranium-bearing wastewater continued to be discharged to C-403 until 1990. These discharges included uranium hexafluoride cylinder hydrostatic-test water, overflow and runoff from cleaning tanks, discharge from floor drains, and other unknown sources. After 1990, the C-403 Neutralization Tank was removed from service. In 1993, nine water and three sediment samples were collected from the C-403 Neutralization Tank. Analytical results indicated that TCE concentrations in the nine water samples ranged from 17 to 1,300 µg/L and TCE concentrations in the three sediment samples ranged from 35 to 6,700 ug/l (unpublished source referenced in DOE 1997b). During the WAG 6 Remedial Investigation, a water line located near the C-403 tank broke, and water flowed into the tank from one of the still existing fill lines. Approximately 198 m^3 (7,000 ft^3) of water accumulated in the tank.

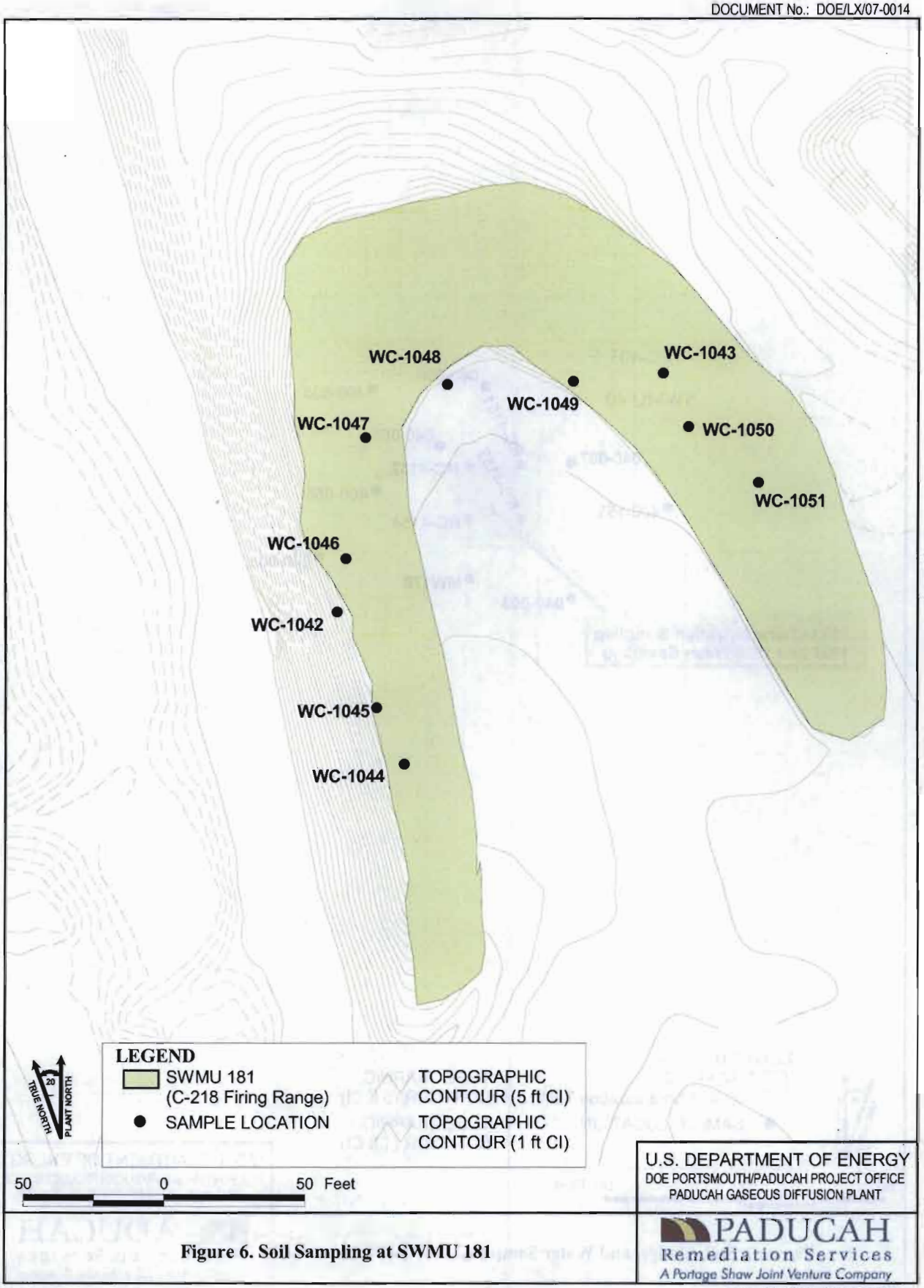

Figure 6. Soil Sampling at SWMU 181

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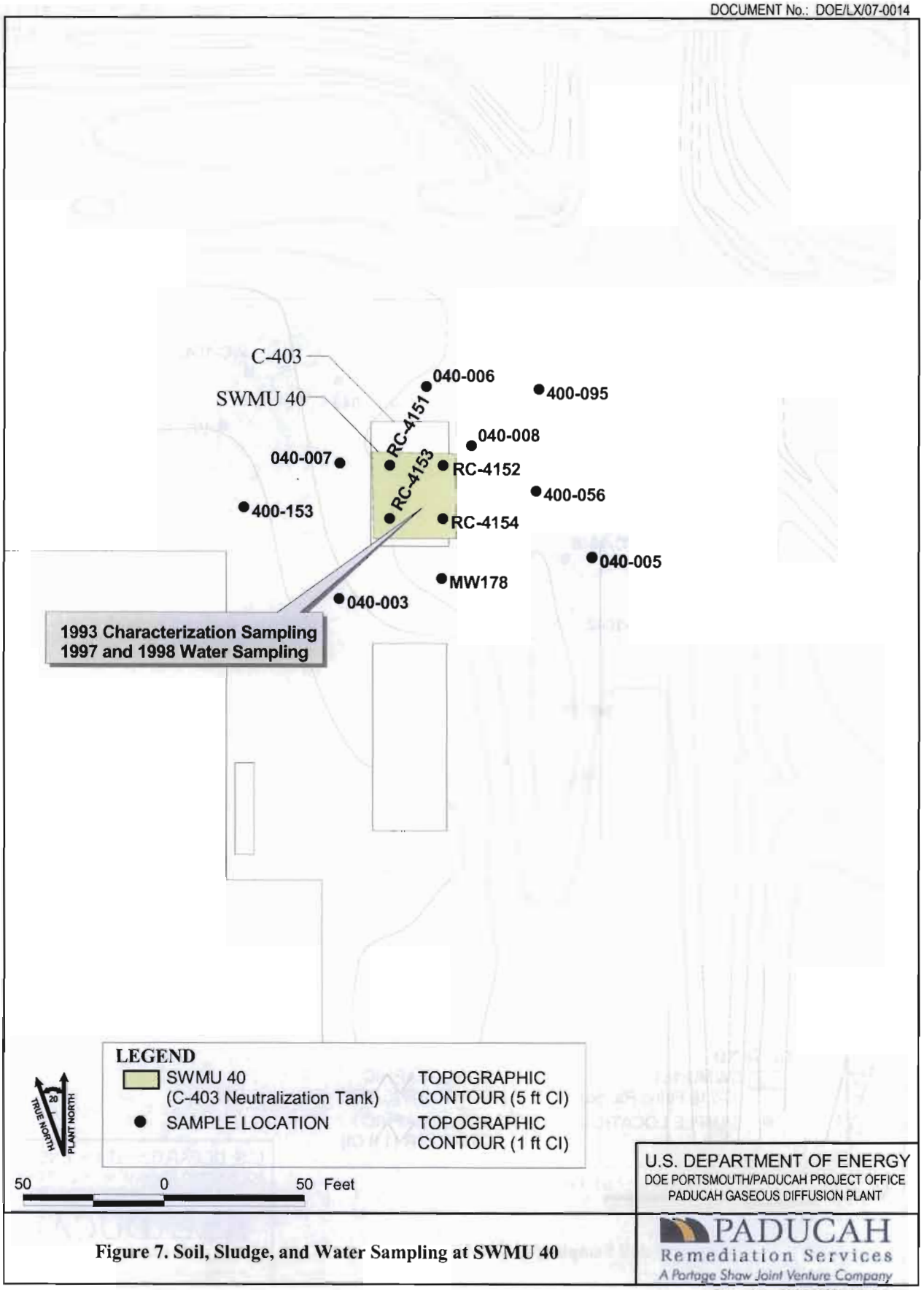

Figure 7. Soil, Sludge, and Water Sampling at SWMU 40

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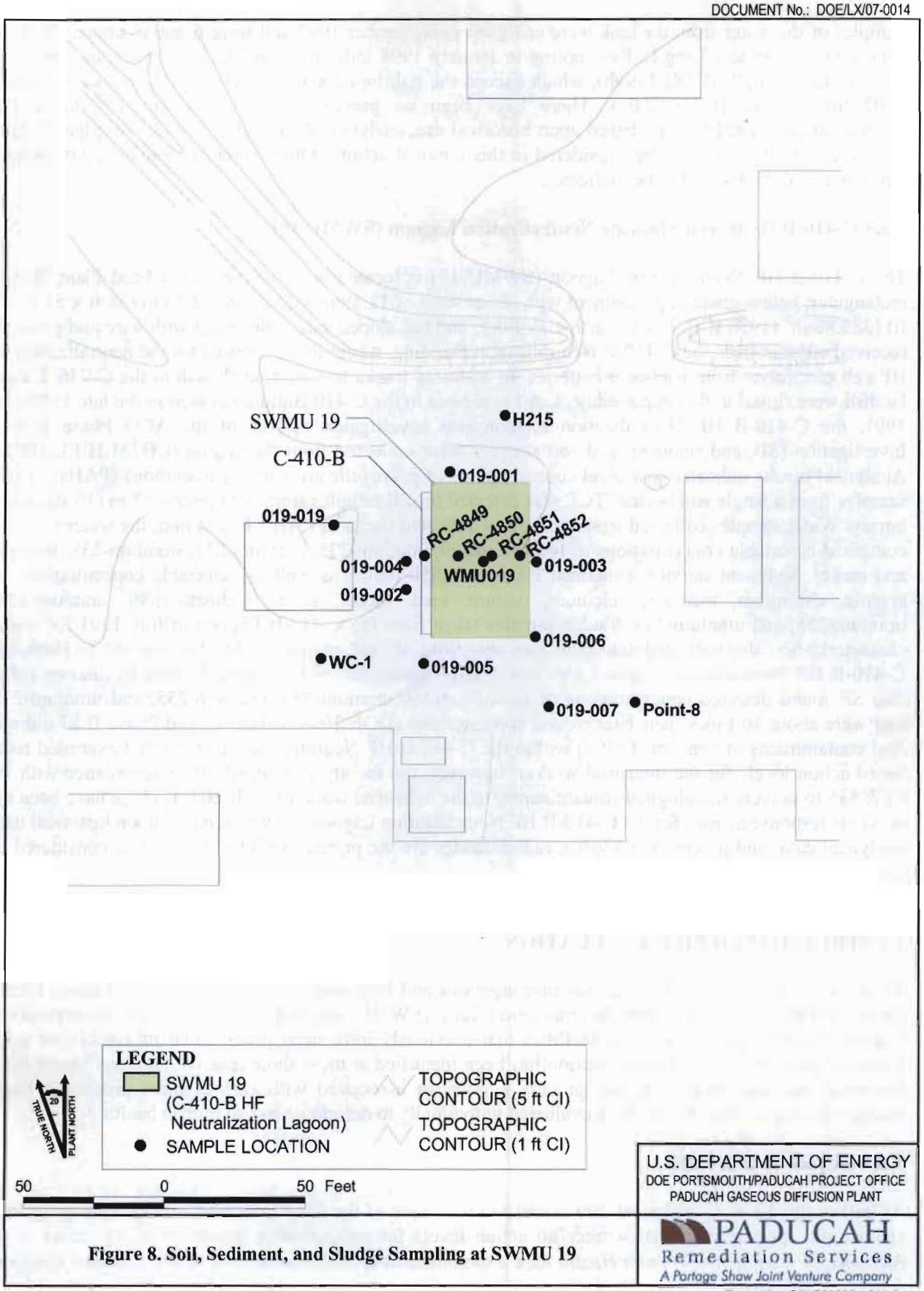

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Figure 8. Soil, Sediment, and Sludge Sampling at SWMU 19

Figure No. C5AC90005sk014r2apr
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Samples of the water from the tank were analyzed in November 1997 and were found to contain TCE at concentrations up to 23 mg/L. Resampling in January 1998 indicated that TCE concentrations in water were up to 5.6 mg/L (DOE 1999b), which exceed the risk-based action levels for the industrial worker (0.02 mg/l; TCE) (DOE 2001). There have been no previous response actions for the C-403 Neutralization Tank; however, based upon historical use, analytical data, and process knowledge, TCE is the primary COPC that will be considered in this removal action. Other potential contaminants include uranium metal, PCBs, and radionuclides.

1.5.3 C-410-B Hydrogen Fluoride Neutralization Lagoon (SWMU 19)

The C-410-B HF Neutralization Lagoon (SWMU 19) is located north of the C-410 Feed Plant. It is a rectangular, below grade impoundment with dimensions of 11.59 m x 15.55 m x 2.13 m (38 ft x 51 ft x 7 ft) [383.88 m^3 (1938 ft^3)]; has an earth-clay floor; and has sloped sides reinforced with wire and grout. It received effluent from the C-410-C Neutralization Building, where lime was used for the neutralization of HF cell electrolyte from lead-acid batteries. In addition, trucks transporting fly ash to the C-746-T inert landfill were rinsed in this impoundment. All processes in the C-410 Building ceased in the late 1970s. In 1991, the C-410-B HF Neutralization Lagoon was investigated as part of the ACO Phase II Site Investigation (SI), and sediment and soil samples were collected from the lagoon (CH2M HILL 1992). Analytical results indicated low-level concentrations of polycyclic aromatic hydrocarbons (PAHs) in soil samples from a single soil boring. TCE was detected in soil samples from the upper 4.57 m (15 ft) of the boring. Water samples collected from the lagoon indicated traces of PAHs. In addition, the water samples contained detectable concentrations of technetium-99, uranium-235, uranium-234, uranium-238, barium, and nickel. Sediment samples contained PAHs at 6,650 µg/kg, as well as detectable concentrations of arsenic, chromium, mercury, selenium, barium, lead, nickel, silver, technetium-99, uranium-234, uranium-235, and uranium-238. Sludge samples taken from the C-410-B Lagoon in July 1991 for waste characterization also indicated detectable concentrations of total uranium and technetium-99. In 1999, the C-410-B HF Neutralization Lagoon was investigated during the WAGs 9 and 11 Site Evaluation (SE). The SE found detected concentrations of technetium-99, uranium-234, uranium-235, and uranium-238 that were about 10 times their background concentration (DOE 1999a). The SE and Phase II SI did not find contaminants of concern (COCs) within the C-410-B HF Neutralization Lagoon that exceeded risk-based action levels for the industrial worker; however, the facility was roped off in accordance with 10 *CFR* 835 to prevent radiological contamination to the industrial worker (DOE 2001). There have been no previous response actions for the C-410-B HF Neutralization Lagoon; however, based upon historical use, analytical data, and process knowledge, radionuclides are the primary COPCs that will be considered in this removal action.

1.6 STREAMLINED RISK EVALUATION

As discussed in Section 1.3, "Previous Investigations and Response Actions," the C-218 Outdoor Firing Range (SWMU 181), the C-403 Neutralization Tank (SWMU 40), and the C-410-B HF Neutralization Lagoon (SWMU 19) are inactive facilities that previously have been investigated in association with historical plant processes. Contamination has been identified at these three inactive facilities based upon historical use, analytical data, and process knowledge associated with various plant processes. Each inactive facility or SWMU has been evaluated individually to determine risk to human health.

1.6.1 Human Health Risk

As part of this EE/CA, analytical data associated with each of the three inactive facilities were compared against site specific industrial worker no action levels for soil/sediment presented in Appendix A of *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous*

Diffusion Plant, Paducah, Kentucky, DOE/OR/07-1506&D1/V1/D2 (DOE 2001). The following are exposure pathways considered for the industrial worker:

- Incidental ingestion of soil/sediment
- Dermal contact with soil/sediment
- Inhalation of particulates emitted from soil/sediment
- External exposure to ionizing radiation emitted from soil/sediment

If the analytical results for an analyte were greater than the specified no action level and above the established background (if available), then the analyte was retained as a COPC for further analysis. If the analytes were not detected during analysis or exhibited a concentration less than the specified no action level or the established background concentration, then the analyte was removed from further consideration as a COPC. The summary of this evaluation is presented in Appendix D. A summary of those analytes that were retained as COPCs for further risk assessment is presented in Table 2 through Table 4.

Table 2. Selected COPCs for Soil/Sludge for C-218 Outdoor Firing Range (SWMU 181)

Analytes Retained as COPCs	Concentration (mg/kg) or (pCi/g)	No Action Level (Industrial Worker) (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No
Lead	1.49E+04	8.00E+02[a]	Yes	3.60E+01	Yes
Thallium[b]	6.63E+01	7.27E-01	Yes	2.10E-01	Yes

[a] Screening level for lead in soil for industrial (current) land use. See Appendix E for details.
[b] Since the removal action associated with C-218 is for lead only, this COPC will be addressed as part of the Soils OU.

Table 3. Selected COPCs for Soil/Sludge for C-403 Neutralization Tank (SWMU 40)

Analytes Retained as COPCs	Concentration	No Action Level (Industrial Worker)	Exceeds No Action Level	Background	Exceeds Background
	(mg/kg) or (pCi/g)	(mg/kg) or (pCi/g)	Yes or No	(mg/kg) or (pCi/g)	Yes or No
Metals (mg/kg)					
Uranium	4.05E+03	2.02E+01	Yes	4.90E+00	Yes
Organic Compounds (mg/kg)					
Total PCBs	1.49E+01	1.99E-01	Yes	NA	NA
Radionuclides (pCi/g)					
Neptunium-237	3.89E+01	2.71E-01	Yes	1.00E-01	Yes
Thorium-230	2.38E+01	1.49E+01	Yes	1.50E+00	Yes
Uranium-235[a]	1.45E+03	3.95E-01	Yes	1.40E-01	Yes

[a] The 25 mrem/yr dose-based limit for uranium-235 is 1.77E+02 pCi/g, which is greater than the no action screening level.
NA= not applicable

Table 4. Selected COPCs for Soil/Sludge for C-410-B HF Neutralization Lagoon (SWMU 19)

Analytes Retained as COPCs	Concentration	No Action Level (Industrial Worker)	Exceeds No Action Level	Background	Exceeds Background
	(mg/kg) or (pCi/g)	(mg/kg) or (pCi/g)	Yes or No	(mg/kg) or (pCi/g)	Yes or No
Metals (mg/kg)					
Silver	7.92E+01	4.11E+01	Yes	2.30E+00	Yes
Uranium	3.67E+01	2.02E+01	Yes	4.90E+00	Yes
Organic Compounds (mg/kg)					
Fluoranthene	1.90E+03	2.21E+02	Yes	NA	NA
Total PAHs [a]	6.86E+00	2.12E-02	Yes	NA	NA
Radionuclides (pCi/g)					
Uranium-234	4.50E+01	1.98E+01	Yes	2.50E+00	Yes
Uranium-235	7.67E-01	3.95E-01	Yes	1.40E-01	Yes
Uranium-238	4.80E+01	1.71E+00	Yes	1.20E+00	Yes

[a] Total PAH is the sum of the concentration of the carcinogenic PAHs multiplied by their toxicity equivalence factor (TEF).
NA= not applicable

The soil/sediment COPCs that exceeded the no action level as well as the background concentrations (if available) for the current industrial worker were lead and thallium at the C-218 Outdoor Firing Range (SWMU 181); uranium, Total PCBs, neptunium-237, thorium-230, and uranium-235 at the C-403 Neutralization Tank (SWMU 40); and silver, uranium, fluoranthene, Total PAHs, uranium-234, uranium-235, and uranium-238 at C-410-B HF Neutralization Lagoon (SWMU 19).

Since the C-403 Neutralization Tank (SWMU 40) and C-410-B HF Neutralization Lagoon (SWMU 19) also are known to contain accumulated rainwater in addition to sludge/sediment, a similar comparison was conducted of the water analytical data against site specific industrial worker no action levels for surface water presented in Appendix A of *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1506&D1/V1/D2 (DOE 2001). The exposure pathway considered for the industrial worker in this scenario was dermal contact with the accumulated rainwater. The summary of this comparison is presented in Appendix D. Those analytes that were retained as COPCs are presented in Table 5 and Table 6. No dose-based COPCs were identified based upon a 25 mrem/yr dose to the industrial worker.

The COPCs that exceeded the no action level for the current industrial worker were cadmium, uranium, endrin, heptachlor epoxide, Aroclor-1260, Total PCBs, toxaphene, and TCE at C-403 Neutralization Tank (SWMU 40) and antimony and lead at C-410-B HF Neutralization Lagoon (SWMU 19). There are no relevant background concentrations available to screen the analytes present in this water.

Table 5. Selected COPCs for Accumulated Rainwater in C-403 Neutralization Tank (SWMU 40)

Analytes Retained as COPCs	Concentration	No Action Level (Industrial Worker)	Exceeds No Action Level	Background	Exceeds Background
	(mg/L) or (pCi/L)	(mg/L) or (pCi/L)	Yes or No	(mg/L) or (pCi/L)	Yes or No
Metals (mg/L)					
Cadmium	2.45E-02	4.57E-03	Yes	NA	NA
Uranium	1.07E+00	4.66E-01	Yes	NA	NA
Organic compounds (mg/L)					
Endrin	2.00E-03	3.43E-04	Yes	NA	NA
Heptachlor Epoxide	1.00E-03	3.68E-05	Yes	NA	NA
Aroclor-1260	8.70E+00	5.24E-05	Yes	NA	NA
Total PCB	1.76E+01	1.65E-04	Yes	NA	NA
Toxaphene	2.00E-02	7.76E-04	Yes	NA	NA
Trichloroethene	1.70E+00	2.18E-02	Yes	NA	NA

NA – not applicable

Table 6. Selected COPCs for Accumulated Rainwater in C-410-B HF Neutralization Lagoon (SWMU 19)

Analytes Retained as COPCs	Concentration[a]	No Action Level (Industrial Worker)	Exceeds No Action Level	Background	Exceeds Background
	(mg/L) or (pCi/L)	(mg/L) or (pCi/L)	Yes or No	(mg/L or (pCi/L)	Yes or No
Metals (mg/L)					
Antimony	1.09E+00	7.31E-03	Yes	NA	NA
Lead	1.65E+00	1.50E-02	Yes	NA	NA

NA – not applicable

1.6.1.1 Human Health Risk Conclusions

Several COPCS were identified in the streamlined risk evaluation. The detected concentrations for these COPCs exceeded no action levels taken from the Risk Methods Document (DOE 2001).

Details concerning the development of cleanup goals for protection of human health are presented in Appendix E. A summary of the final cleanup levels consistent with the preferred alternative is presented in Section 5, "Recommended Removal Action Alternative."

1.7 COMMUNITY PARTICIPATION

Community involvement is a necessary aspect of the CERCLA process. DOE is conducting community relations activities for this project in compliance with 40 *CFR* 300.415(n)(1), (n)(3), and (n)(4), and the community relations plan, *Community Relations Plan Under the Federal Facility Agreement at the U.S. Department of Energy Paducah Gaseous Diffusion Plant* (DOE 2007c).

2. REMOVAL ACTION OBJECTIVES

This section addresses DOE's response authority under CERCLA for removal actions and identifies the scope, purpose, and general Removal Action Objectives (RAOs) for this removal action. Justification for the removal action also is addressed.

2.1 RESPONSE AUTHORITY

PGDP was placed on the NPL in 1994. Pursuant to Section 120 of CERCLA, the PGDP FFA was negotiated and implemented to provide the framework for site CERCLA actions.

Section 104 of CERCLA addresses the mitigation of releases or threatened releases of hazardous substances to the environment through response action. Executive Order 12580, "Superfund Implementation," delegates to DOE the authority for response actions at DOE facilities. As lead agency, DOE is authorized to conduct response measures (e.g., removal actions) under CERCLA.

The National Environmental Policy Act of 1969 (NEPA) requires federal agencies to evaluate and document the effect of their proposed actions on the quality of the human environment. DOE issued a *Secretarial Policy Statement* on NEPA in June of 1994 (DOE 1994), stating that DOE hereafter will rely on the CERCLA process for review of actions to be taken under CERCLA and incorporate NEPA values in CERCLA documents to the extent practicable. Such values may include analysis of socioeconomic, cultural, ecological, and cumulative impacts, as well as environmental justice and land use issues and the impacts of off-site transportation of wastes. NEPA values have been incorporated into this EE/CA in accordance with the Secretarial Policy.

2.2 REMOVAL SCOPE AND PURPOSE

The purpose of this EE/CA is to evaluate alternatives to address the potential threat posed to human health and the environment from the release or potential release of hazardous substances associated with the C-218 Outdoor Firing Range (SWMU 181), C-403 Neutralization Tank (SWMU 40), and C-410-B HF Neutralization Lagoon (SWMU 19).

2.3 REMOVAL ACTION OBJECTIVES

The overall Remedial Action Objectives that have been established for the Soils OU are as follows.

- Control sources early; focus resources at areas that warrant attention in the near term, prioritizing actions within areas to address the greatest risks first.
- Minimize human exposure to contaminants, maximizing the effectiveness of institutional controls.
- Control further migration of contaminated soils.
- Reduce risk from contaminated soil.

- Reduce the risk, making progress toward the ultimate goal of protecting recreational users and industrial workers from exposure to contaminated soils.

The Removal Action Objectives (RAOs) specific for this removal action are consistent with the overall Remedial Action Objectives for the Soils OU and are as follows:

- Control current industrial worker exposure to soils, sediment, and accumulated rainwater containing hazardous substances, pollutants, or contaminants.

- Identify and control, as needed, off-site migration into multimedia exposure pathways such as surface water and groundwater.

Details associated with the development of cleanup goals for protection of human health considered in meeting these RAOs are presented in Appendix E. The human health cleanup goals consider a range of risk and hazard targets consistent with *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2001). A summary of the proposed final cleanup levels that were selected from the cleanup goals and consistent with the RAOs is presented in Section 5, "Recommended Removal Action Alternative." The final cleanup levels will be presented in the Soils OU Inactive Facilities Action Memo and Removal Action Work Plan (RAWP). Once the cleanup levels are determined, the final hot spot areas will be delimited and presented in the Soils OU Action Memo and RAWP.

2.4 JUSTIFICATION FOR THE PROPOSED ACTION

The C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon have been identified as SWMUs under the PGDP FFA due to the potential for actual or threatened releases of hazardous constituents from the site. Risk evaluations of chemicals and compounds in soils indicate that there is a threat to human health greater than the EPA risk range under some scenarios.

3. REMOVAL ACTION TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES

This chapter identifies the applicable representative technologies and alternatives that will be considered for the removal action proposed for the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon. Analyses of the alternatives considered are presented in Section 4.

3.1 TECHNOLOGY IDENTIFICATION AND SCREENING

The alternatives identified and screened in this EE/CA were evaluated based on their ability to meet effectiveness (including RAOs), implementability, and cost. Based on the alternative evaluation, Alternative 3 – "Excavation and Interim Institutional Controls" was chosen as the preferred alternative.

The following alternatives are evaluated in this EE/CA:

1. No Soil Control Measures (No Action);
2. Interim institutional control measures only;
3. Combination of excavation and interim institutional controls (as needed).

A discussion of these alternatives, including their relative effectiveness, feasibility of implementation, and cost, is provided in the following sections.

3.2 DEVELOPMENT OF ALTERNATIVES

This EE/CA provides a description of the alternatives being considered for reducing human health risk from direct contact with contaminated soils associated with the C-218 Outdoor Firing Range, and contaminated soils/sediment and accumulated rainwater associated with C-403 Neutralization Tank and C-410-B HF Neutralization Lagoon. The alternatives developed in this EE/CA serve as the basis for the preparation, analysis, and comparison of cost estimates for implementation of the alternatives. The specific methods employed in implementing selected controls, would be defined prior to implementation. The action would be consistent with this EE/CA and the Action Memorandum to be issued following public comment on this EE/CA.

3.2.1 No Action Alternative – Alternative 1

Under the No Aetion Alternative (Alternative 1), there would be no change to the current configuration of the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon. No additional controls would be implemented to mitigate the threat of contaminant migration within these systems or the threat of exposure to human and environmental receptors by contaminant releases. Requirements for evaluation of the No Action Alternative are presented in EPA guidance for CERCLA response actions (EPA 1999).

3.2.2 Interim Institutional Controls—Alternative 2

Interim institutional controls (Alternative 2) include administrative policies and exclusion or barrier type controls implemented to reduce the risk of exposure to contaminated soils and accumulated rainwater, prior to selection of the remedial action and pending the selection of additional response actions. Alternative 2 is the implementation of interim institutional controls to reduce the potential of human exposure. These controls include methods of excluding facility personnel and the public from known contamination areas; communicating hazards; monitoring areas for contamination or contaminant mobility; and implementing additional requirements for personal protective equipment (PPE). Interim institutional controls may be either short-term or long-term depending on site characteristics.

The specific type of interim institutional control implemented would be dependent on the specific physical and chemical characteristics of the hazard. For example, contaminated soils within the C-218 Firing Range may require different controls than contaminated soils and accumulated rainwater identified within C-403 Neutralization Tank and C-410-B HF Neutralization Lagoon. Interim institutional controls do not completely eliminate issues of contaminant transport, endpoints, or exposure. Removal of contaminated soils or accumulated rainwater would not occur under Alternative 2, and the risk of human contact with contaminated soil and accumulated rainwater is reduced, but not completely eliminated. The following are interim institutional controls evaluated under Alternative 2:

- Hazard postings,
- Appropriate PPE requirements,
- Additional radiological survey and other monitoring requirements,
- Fencing,
- Exclusion zones, and
- Long-term environmental monitoring.

Since the risk to human health associated with C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon is due to direct contact (see Appendix E), the institutional control of exclusion fencing and hazard posting combined with long-term monitoring (i.e., applicable parameters to monitor whether contaminant migration at levels of concern is occurring) was selected as the institutional control alternative for the detailed analysis that is summarized in Section 4, "Analysis of Alternatives."

3.2.3 Excavation and Interim Institutional Controls—Alternative 3

Alternative 3 would implement excavation and removal of areas of known contamination (i.e., soil/sediment and accumulated rainwater) that were identified in Section 1.6, "Streamlined Risk Evaluation" and Appendix E, "Cleanup Goals." During implementation of this alternative, one or more engineered controls to prevent transport of contaminated soil/sediments and accumulated rainwater would be required. Interim institutional controls, such as exclusion zones and fencing, also would be utilized as needed during implementation of Alternative 3. After completion of the removal action, and upon verification that the alternative action objectives were achieved (including site restoration), engineering and interim institutional controls would be evaluated and discontinued as appropriate.

Unlike Alternatives 1and 2, Alternative 3 would reduce the risk of exposure to human receptors by removing known sources of contamination. This alternative assumes a low probability of future contamination discovery in areas where removal actions have occurred.

4. ANALYSIS OF ALTERNATIVES

To determine the relative performance of the proposed technologies, the alternatives discussed in Section 3 were evaluated against three criteria specified by the EPA, including compliance with applicable or relevant and appropriate requirements (ARARs). NEPA values not normally considered in CERCLA documentation also are considered relative to each of the alternatives. Section 4.1 provides a brief description of the evaluation criteria. Analyses of each individual alternative, based on these criteria, are presented in Section 4.2. A comparison of the alternatives is included in Section 4.3.

4.1 ANALYSIS CRITERIA

The EPA *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA 1993) contains three criteria for the evaluation of removal action alternatives. These criteria are effectiveness, implementability, and cost.

Effectiveness evaluates the protectiveness of the removal action and its achievement of the RAOs. Criteria for considering effectiveness include the following.

- RAOs – assess each alternative's ability to meet the project RAOs.

- Overall Protection of Human Health and the Environment – assess how each alternative achieves adequate protection and describe how the alternative would reduce, control, or eliminate risks at the site through treatment, engineering controls, or interim institutional controls.

- Long-Term Effectiveness and Permanence – assess the ability of the alternative technologies to reduce the potential risk posed by the contamination. These criteria address the magnitude of residual risks at the site after the removal efforts are complete, the adequacy and reliability of in-place controls, and long-term environmental and cumulative effects.

- Short-Term Effectiveness – assess any threats to site workers and the effectiveness and reliability of protective measures that would be taken during the removal action.

For implementability, the following three factors were used to assess how realistic a removal alternative is in practice: (1) technical feasibility, (2) administrative feasibility, and (3) resource availability. Criteria for considering implementability include the following:

- Ability to Construct and Operate Technologies – construction and operating complexities are presented. Some operational complexities could include the frequency or complexity of equipment maintenance or controls, the need for raw materials, the need for a large technical staff, and the effects to the environment.

- Availability and Reliability of Technologies – each alternative is evaluated to determine if technologies or services are obtainable, are mature enough to implement, and have been used under similar conditions for similar wastes.

- Availability of Treatment, Storage, and Disposal Services and Capacity – it must be determined whether treatment, storage, and disposal capacity, equipment, personnel, services, materials, and

other resources necessary to implement an alternative would be available in time to maintain the removal schedule.

Finally, the alternative is evaluated to determine costs. These are the criteria for considering cost:

- Capital costs – these are comprised of the expenditures associated with construction, equipment and materials, land and building, relocation and transportation, analytical and treatment services, disposal services, engineering and design, legal fees, mobilization and demobilization, and contingencies.

- Operation and Maintenance (O&M) – these costs are comprised of labor and materials to support a routine or defined plan to maintain an institutional control such as performing inspections, replacing signs, repairing fencing, collecting samples for a monitoring program, and preparing reports to document that the maintenance has occurred or presenting results of the monitoring sampling.

4.1.1 Applicable or Relevant and Appropriate Requirements

In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan, on-site removal actions conducted under CERCLA are required to attain ARARs to the extent practicable, considering the scope and urgency of the action. ARARs include only federal and state environmental or facility siting laws/regulations; they do not include occupational safety or worker radiation protection requirements. Additionally, per 40 *CFR* § 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies [to be considered (TBC) category].

ARARs typically are divided into three categories: (1) location-specific, (2) chemical-specific, and (3) action-specific. Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., floodplains or historic districts). Chemical-specific ARARs provide health- or risk-based concentration limits or discharge limitations in various environmental media (i.e., surface water, groundwater, soil, or air) for specific hazardous substances, pollutants, or contaminants. Action-specific ARARs include operation, performance, and design of the preferred alternative based on waste types and/or media to be addressed and removal/remedial activities to be implemented.

TBC information also may be used in developing and evaluating removal action alternatives. In the absence of ARARs, TBC information consisting of advisories, criteria, or guidance, such as DOE Orders, may be useful in determining cleanup levels that are protective of human health and the environment. A list of potential ARARs/TBCs has been identified to address the alternatives proposed in this EE/CA and is included as Appendix A.

When DOE proposes a response action, Section XXI of the FFA requires that DOE identify each state and federal permit that otherwise would have been required in the absence of CERCLA Section 121(e)(1) and the National Contingency Plan. Such permits are identified in Tables A-1, A-2, and A-3 of Appendix A. DOE also must identify the standards, requirements, criteria, or limitations necessary to obtain such permits and provide an explanation of how the proposed action will meet the standards, requirements, criteria, or limitations identified. The evaluation determined that the otherwise required permits may include KPDES; RCRA Treatment, Storage, and Disposal Facility; and Solid Waste Landfill permits. In addition, a permit from the U.S. Fish and Wildlife Service (USFWS) otherwise may be required in the likely event that the selected alternative affects the "taking" of migratory birds and such taking cannot be mitigated. PGDP currently operates under KPDES Permit No. KY0004049, Hazardous Waste Facility Operating Permit No. KY8-890-008-982, and Solid Waste Permit No. 073-00014/073-00015/073-00045, which define the applicable standards, requirements, criteria, or limitations. Upon final selection of an alternative, the USFWS migratory bird list will be reviewed and/or a field survey conducted to determine

which species occur or are likely to occur on DOE property and the impact of the alternative on those species. The RAWP will further discuss how the substantive requirements specific for the selected alternative will be satisfied.

DOE also determined that if the selected alternative has the potential to impact waters of the United States (including wetlands) and this cannot be avoided, compliance with the substantive TBC requirements of the Nationwide Permits (NWPs) discussed herein may be required. Wetlands will be delineated, as necessary prior to the removal action. Specifically, excavating or backfilling in a water body or wetland and building a temporary or permanent road across a water body or wetland otherwise may require the additional permits such as the following:

- Backfilling an excavation and excavation of hazardous sediments in a water body or in a wetland would require a combination of the following:
  - NWP 38 – Cleanup of Hazardous and Toxic Waste,
  - NWP 18 – Minor Discharges,
- Construction of a temporary access road across a water body or wetland would require
  - NWP 33 – Temporary Construction Access.
- Construction of a permanent access road across a water body or wetland would require
  - NWP 14 – Linear Transportation Projects.

Under the NWP program, a prospective permittee must comply with the NWP general conditions, as appropriate, contained in Part II of the March 12, 2007, *FR* (Volume 72, Number 47). The NWP general conditions that may be TCB requirements for implementation of the selected Removal Action alternative pertain to, but are not limited to, the following:

- Suitable material
- Fills within 100-year floodplains
- Equipment
- Soil erosion and sediment controls
- Removal of temporary fills
- Proper maintenance
- Wild and scenic rivers
- Endangered species
- Historic properties
- Designated critical resource waters
- Mitigation
- Water quality
- Regional and case-by-case conditions
- Use of multiple nationwide permits

In addition to the general NWP requirements, specific TBC requirements of NWPs may address any of the following:

- The loss of waters of the United States exceeding 1/10 acre;

- Discharge or the volume of area excavated that exceeds 10 yd^3 below the plane of the ordinary high water mark or the high tide line;

- Discharges in a special aquatic site, including wetlands;

- Requirements for a restoration plan showing how all temporary fills and structures will be removed and the area restored to pre-project conditions.

Applicability of the general and specific standards, requirements, criteria, or limitations of NWPs will be delineated in the RAWP after final alternative selection. Requirements will be implemented as part of this removal action.

Implementation of the selected alternative will comply with the ARARs/TBCs criteria specified in Appendix A, to the extent practicable. Activities conducted on-site must comply with the substantive but not administrative requirements of ARARs. Administrative requirements include applying for permits, recordkeeping, consultation and reporting. Activities conducted off-site must comply with both the substantive and administrative requirements of applicable laws. Required measures will be incorporated into the design phase and implemented during the construction and operation phases of the removal action. Additional discussion of pertinent ARARs is set forth in Section 4.2 for each alternative, including the No Action Alternative.

4.1.2 NEPA Values

The following NEPA values, not normally addressed by CERCLA documentation, also are considered in this EE/CA to the extent practicable, consistent with DOE policy (DOE 1994):

- Land use
- Air quality and noise
- Geology and soils
- Water resources
- Wetlands and floodplains
- Ecological resources
- T&E species
- Migratory birds
- Cultural resources
- Socioeconomics, including environmental justice and transportation

The action alternatives analyzed in this EE/CA would have no identified short-term or long-term impacts on geological resources, T&E species, migratory birds, cultural resources, or socioeconomics. Upon final selection of the alternative, the absence of any short- and long-term impacts to these values, including T&E species, migratory birds, and cultural resources, will be verified. Short- or long-term impacts would be managed, to the extent practicable, through compliance with ARARs/TBCs.

No long-term impacts to air quality or noise would result from implementation of any of the action alternatives. Interim institutional controls, engineering controls, and removal actions should not result in generation of air pollutants above regulatory limits, and noise levels should be similar to current background levels.

None of the action alternatives would have any impacts on geology and construction activities would have only short-term impacts on soils. Site clearing, excavation, grading, and contouring would alter the topography of the area where the removal actions are located, but the geologic formations underlying those sites should not be affected. Construction would disturb existing soils, and some topsoil might be removed in the process. Soil erosion impacts during construction would be mitigated through the use of best management practice (BMP) control measures (e.g., covers and silt fences). No conversion of prime farmland soils is expected to occur. Any alternative that would create disturbances also would include restoration to these areas.

Carrying capacity calculations that have been performed indicate that all the drainage ditches will contain the 100-year and 500-year flood discharges associated with Little Bayou Creek and Bayou Creek (COE 1994c). If during the design phase of a removal action, it is determined that wetlands and/or floodplains would be impacted, compliance with ARARs/TBCs for floodplain/wetlands activities would be followed.

No archaeological resources have been identified within the vicinity of the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon. All three facilities are located in areas where previous ground disturbance activities have occurred.

No historical resources have been identified in the vicinity of the C-218 Outdoor Firing Range. The C-403 Neutralization Tank (Kentucky Survey #MCN-142) and the C-410 Feed Plant (Kentucky Survey #MCN-148), which includes the C-410-B HF Neutralization Lagoon, are designated as facilities that are eligible for listing in the PGDP Historic District (BJC 2006a). The C-403 Neutralization Tank and the C-410-B HF Neutralization Lagoon are documented with survey forms and photographs in the Cultural Resources Survey (BJC 2006b). Since the two facilities are ancillary facilities, additional mitigation measures beyond the current documented survey forms and photography are not needed, consistent with Section 4.3 of the Cultural Resources Management Plan (BJC 2006a), which has been approved by the Kentucky State Historic Preservation Officer.

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires agencies to identify and address disproportionately high and adverse human health or environmental effects their activities may have on minority and low-income populations. No census tracts near the site include a higher proportion of minorities than the national average. Therefore, there would be no disproportionate or adverse environmental justice impacts to any minority or low-income populations.

No long-term or short-term adverse transportation impacts are expected to result from implementation of action alternatives. During construction activities there would be a slight increase in the volume of truck traffic in the vicinity of the C-218 Firing Range, but the affected roads are capable of handling the additional truck traffic.

Additional discussion of pertinent NEPA values is set forth in Section 4.2 for each alternative including the No Action Alternative.

4.2 ANALYSIS OF INDIVIDUAL ALTERNATIVES

Analysis of each alternative is provided in the following sections.

4.2.1 Alternative 1—No Action Alternative

The No Action Alternative is considered the least protective of the alternatives presented in Section 3. Because none of the EE/CA RAOs are achieved by implementation of the No Action Alternative, it is considered the least effective of all of the alternatives presented.

4.2.1.1 Effectiveness

The No Action alternative would be ineffective in meeting any of the RAOs stated in Section 3. The alternative would not provide for overall protection of human health or the environment because the potential for on-site worker contact with contaminated soil/sediment and accumulated rainwater would not be addressed. Comparison to the effectiveness criteria follows.

- **RAOs**—The alternative does not achieve any of the project RAOs.
- **Overall Protection of Human Health and the Environment**—The alternative does not provide for protection of human health and the environment since no action is taken. As a result, the alternative is not protective.
- **Long-Term Effectiveness and Permanence**—The alternative has no long-term effectiveness.
- **Short-Term Effectiveness**—The alternative does not provide for short-term control measures to protect industrial workers.
- **Compliance with ARARs**—This is discussed in Section 4.2.1.4.

There is no overall effectiveness rating of the No Action Alternative.

4.2.1.2 Implementability

The No Action alternative ranks high in ease of implementation since implementation requires no further resources, and technical feasibility is not a consideration. Because of DOE policy and state and federal law, however, the No Action Alternative is not considered to be administratively feasible.

4.2.1.3 Cost

There would be no cost for implementing the No Action Alternative.

4.2.1.4 Compliance with ARARs

The No Action Alternative would not comply with ARARs.

4.2.1.5 NEPA Values

Under the No Action Alternative, short- and long-term impacts may occur to the following NEPA values identified in Section 4.1.

- Soils
- Water resources
- Ecological resources

Soils in and around the PGDP may be impacted as contaminated soils are redistributed from existing contamination areas by surface water runoff into areas previously uncontaminated. Similarly, water resources may be impacted as contaminants are mobilized by surface water runoff and transported to Bayou Creek. Ecological resources in the Bayou Creek may be impacted as terrestrial and aquatic biota is exposed to contaminated media.

4.2.2 Alternative 2—Interim Institutional Controls

The interim institutional controls identified for analysis under this EE/CA are exclusion fencing and hazard posting in combination with long-term monitoring (i.e., applicable parameters to monitor whether contaminant migration at levels of concern is occurring). Fencing is a control intended to exclude unauthorized personnel from entry into a contaminated area. Hazard postings are intended to warn site workers of the hazard and provide direction should access to the area be required. In the case of routine maintenance activities, additional contingency controls such as PPE, radiological surveying, or environmental monitoring may be required as short-term institutional controls while the maintenance activity is being performed. Long-term monitoring for applicable parameters will be performed to ensure that contaminant migration does not occur.

4.2.2.1 Effectiveness

Implementation of interim institutional controls would achieve the RAOs identified in Section 2.3. Implementation of interim institutional controls would decrease the risk of human exposure through exclusion or other interim institutional means. Interim institutional controls alone, however, would not control contaminant sources, nor would they control the potential for contaminant migration. Additionally, interim institutional controls would prevent entry by those who do not adhere to the control (e.g., the intentional trespasser). A discussion of the alternative effectiveness criteria follows.

- **RAOs**—The alternative only partially achieves the project RAOs and therefore is rated low.
- **Overall Protection of Human Health and the Environment**—The alternative provides for limited protection of human health by controlling access to the contamination, but does not remove contamination. As a result, this alternative is rated moderate.
- **Long-Term Effectiveness and Permanence**—The alternative has limited long-term effectiveness since it does not remove contamination or control migration. As a result, this alternative is rated low.
- **Short-Term effectiveness**—The alternative provides for limited short-term control measures to protect industrial workers and its effectiveness therefore is considered moderate.
- **Compliance with ARARs**—This is discussed in Section 4.2.2.4.

The overall effectiveness rating of Alternative 2 is low to moderate.

4.2.2.2 Implementability

Alternative 2 would require a relatively low effort to implement. The interim institutional controls identified in this section can be rapidly implemented with a minimum amount of planning or supporting work. These controls include installation of exclusion fencing and hazard postings. Long-term monitoring would require more effort to implement. Plans [sampling and analysis plans (SAPs), site specific health and safety plans, O&M plans, etc.] would need to be prepared and approved. Additional personnel and

training may be required. The following discussion evaluates the implementability criteria for Alternative 2.

- **Ability to Construct and Operate Technologies**—The resources required to implement interim institutional controls such as fencing and hazard postings are considered minimal. There would be a slight increase in demands on staff for inspection and maintenance activities and long-term monitoring; there would be minimal needs for raw materials; implementation of controls would not require complex operating technologies; and the effects to the environment due to alternative implementation would be minimal. The ranking for this criterion is high.

- **Availability and Reliability of Technologies**—The technology is proven and readily available to implement interim institutional controls. The ranking for this criterion is high.

- **Availability of Treatment, Storage, and Disposal Services and Capacity**—This alternative does not require treatment, storage, or disposal services, and the criterion does not apply.

The overall implementability ranking of Alternative 2 is high.

4.2.2.3 Cost

The estimated capital cost for the various interim institutional controls associated with Alternative 2 is $119,696, with an additional estimated O&M cost of $50,918 (see Appendix B, Table B.1). Because the costs are low relative to other alternatives, the cost ranking for Alternative 2 is high.

4.2.2.4 Compliance with ARARs

Implementation of interim institutional controls would comply to the extent practicable with ARARs in Appendix A.

4.2.2.5 NEPA Values

Similar to the No Action Alternative, short- and long-term impacts may occur to the following NEPA values identified in Section 4.1 by implementation of Alternative 2.

- Soils
- Water resources
- Ecological resources

Soils in and around the PGDP may be impacted as contaminated soils are redistributed from existing contamination areas by surface water runoff into areas previously uncontaminated. Similarly, water resources may be impacted as contaminants are mobilized by surface water runoff and transported to Bayou Creek. Ecological resources in Bayou Creek may be impacted as terrestrial and aquatic biota are exposed to contaminated media.

These impacts to NEPA values may occur because interim institutional controls alone will not remove contaminated soils from the environment.

4.2.3 Alternative 3—Excavation and Interim Institutional Controls

Alternative 3 would implement removal actions in the contaminated areas that were identified in Section 1.6, "Streamlined Risk Evaluation" in order to meet cleanup goals discussed in Appendix E, "Cleanup

Goals," and implement exclusion fencing and hazard postings as needed to minimize direct contact with contaminated soil and accumulated rainwater. Excavation of the contaminated area will eliminate the risk of human receptors contacting contaminated soils and accumulated rainwater. Fencing is a control intended to exclude unauthorized personnel from entry into the contaminated area and will adequately manage future risk of residual contamination. Hazard postings are intended to warn site workers of the hazard and provide direction should access to the area be required. During excavation activities, additional contingency controls such as small stormwater retention areas, silt fencing, or rock check dams may be temporarily required as localized engineering controls. Installation of these temporary controls is dependent upon the site conditions at the time of excavation. After excavation of the contaminated area is complete, samples would be collected for verification purposes (SWMU 181) and for characterization purposes (SWMU 19 and SWMU 40). Upon verification that the alternative action objectives were achieved (including site restoration), localized engineering controls would be evaluated and discontinued as appropriate. In the case of routine maintenance activities, a different set of contingency controls such as PPE, radiological surveying, or environmental monitoring may be required as short-term institutional controls while the maintenance activity is being performed. Because the contaminated area will be removed, no long-term monitoring for contaminant migration will be required.

4.2.3.1 Effectiveness

Implementation of excavation (including removal of accumulated rainwater, as appropriate) in combination with exclusion fencing and hazard posting outlined in Alternative 3 would achieve all of the RAOs identified in Section 2.3. This alternative provides for a complete level of protectiveness for industrial workers. The RAOs are satisfied by this alternative. The combination of excavation (including removal of accumulated rainwater, as appropriate) with interim institutional controls, as needed, not only removes the contamination, but also adequately manages future risk of any residual contamination. Under Alternative 3, contaminated soil/sediment and accumulated rainwater would be removed from the environment. The risk to industrial workers from direct contact with contaminated soil/ sediment or accumulated rainwater would be permanently reduced and contamination would be permanently eliminated. A discussion of the alternative effectiveness criteria follows.

- **RAOs**—The alternative achieves the project RAOs and therefore is rated high.
- **Overall Protection of Human Health and the Environment**—The alternative provides for a high level of overall protection of human health and the environment since the contaminated soil/sediment and accumulated rainwater are removed. As a result, this alternative is rated high.
- **Long-Term Effectiveness and Permanence**—The alternative has high long-term effectiveness and permanent solutions since the contaminated soil/sediment and accumulated rainwater are removed. As a result, this alternative is rated high.
- **Short-Term Effectiveness**—The alternative provides for short-term control measures to protect industrial workers and its effectiveness therefore is considered high.
- **Compliance with ARARs**—This is discussed in Section 4.2.3.4.

The overall effectiveness rating of Alternative 3 is high.

4.2.3.2 Implementability

Alternative 3 would require a level of implementation effort greater than the previous alternatives (Alternatives 1and 2). Excavation of the contaminated area, along with removal of accumulated rainwater

(if applicable) will require engineering plans, specifications, bid packages, and other documents. The interim institutional controls identified in this section can be implemented rapidly with a minimum amount of planning or supporting work. These controls include installation of exclusion fencing and hazard postings as needed to minimize direct contact with contaminated soil and accumulated rainwater. Additional personnel and training may be required. The following discussion evaluates the implementability criteria for Alternative 3.

- **Ability to Construct and Operate Technologies**—The resources required to implement excavation of the contaminated area are readily available and the provision of construction support is available locally. There would be an increase in demands on engineering and scientific staff for the design and development of engineering plans, specifications, bid packages, and other documents. Operating technologies for most sediment and stormwater engineering controls are not complex and may be implemented with a minimal amount of engineering and hydrologic analysis. Environmental impacts due to alternative implementation typically would be minor. The resources required to construct interim institutional controls such as fencing and hazard postings also are considered minimal. There would be a slight increase in demands on staff for inspection and maintenance activities and long-term monitoring; there would be minimal needs for raw materials; implementation of controls would not require complex operating technologies; and the effects to the environment due to alternative implementation would be minimal. The ranking for this criterion is high.

- **Availability and Reliability of Technologies**—The technology is proven and readily available to implement excavation activities and interim institutional controls. The ranking for this criterion is high.

- **Availability of Treatment, Storage, and Disposal Services and Capacity**—Excavation activities (including accumulated rainwater removal as appropriate) would require treatment, storage, and disposal services. It is expected that these services would be provided by existing PGDP facilities or appropriate off-site disposal facilities. The ranking for this criterion is moderate.

The overall implementability ranking of Alternative 3 is high.

4.2.3.3 Cost

The estimated capital cost for the excavation and interim institutional controls (as needed) associated with Alternative 3 is $5,527,738 with an additional estimated O&M cost of $5,000 (see Appendix B, Table B.2). Because the costs are comparable to implementation of complex engineering controls, the cost ranking for Alternative 3 is moderate to high.

4.2.3.4 Compliance with ARARs

Implementation of Alternative 3 would comply to the extent practicable with ARARs as listed in Appendix A.

Impacts to wetlands, critical habitat, migratory birds, floodplains, streams, and/or aquatic habitat would be determined during the design phase of an excavation and removal of contaminated soil/sediment and accumulated rainwater. Required measures for compliance with the location-specific ARARs/TBCs to the extent practicable would be incorporated into the design phase and implemented during the construction and operation phases of the excavation and removal action. For example, the only sensitive resource located in close proximity to the removal areas is the nesting habitat for the Indiana bat. During the nesting season (spring and summer), the Indiana bat may inhabit deciduous trees with greater than a 3

inch diameter at breast height. If this critical habitat cannot be protected through avoidance during spring and summer, the lost habitat will be replaced to ensure no net loss or adverse modification of the resource.

All action-specific ARARs listed in Appendix A are applicable for the implementation of Alternative 3. Compliance with ARARs/TBCs would be followed to the extent practicable. Required measures that will be incorporated into the design phase and implemented during the construction and operation phases of Alternative 3 include, but are not limited to, the following:

- Excavation and removal activities will be conducted in a manner that will limit fugitive dust emissions and will provide sedimentation controls, thereby limiting potential impacts due to airborne particulates and suspended solid loading.

- Soil and other waste materials generated as a result of this excavation and removal of contaminated media will be characterized properly and disposed of in accordance with the substantive provisions of ARARs/TBCs in Appendix A for low-level wastes (LLW), RCRA, and PCB waste. All on-site management of such materials also will be conducted in accordance with the substantive provisions of ARARs/TBCs. In the preamble to the *FR* Notice for the 1998 PCB Disposal Amendment, EPA discussed the applicability of 40 *CFR* § 761.61, which provides cleanup and disposal options for PCB remediation waste, as an applicable ARAR and stated: "EPA anticipates that today's rule will be a potential ARAR at CERCLA sites where PCBs are present. EPA would expect that CERCLA cleanups typically would comply with the substantive requirements of one of the three options [self-implementing, performance-based, or risk-based] provided by 761.61, upon completion of the cleanups. This decision would not be made by the facility, but in the remedy selection process" 63 *FR* 35407 (June 29, 1998).

- DOE will perform disposal [in accordance with 40 *CFR* § 761.61(a)(5)(v)] of soil and other waste materials containing equal to or less than 49 ppm PCBs at the C-746-U solid waste landfill. The Environmental Performance Standard in 401 Kentucky Administrative Regulations (*KAR*) 47:030, Section 8, and Condition Number T-66 of Solid Waste Permit No. 073-00014/073-00015/073-00045 currently allow such disposal. Compliance with the performance standard and solid waste permit condition will not pose an unreasonable risk of injury to human health or the environment. PCB-contaminated soils and solids requiring off-site disposal (greater than 49 ppm) will be disposed of at Energy*Solutions* in Clive, Utah, or the Nevada Test Site under their current coordinated approval in accordance with 40 *CFR* § 761.61(b). An alternate facility (facilities) for disposal of solid PCB remediation waste may be used if the receiving facility also is a performance based facility under 40 *CFR* § 761.61(b). Liquid PCB remediation waste will be disposed of at the Toxic Substances Control Act (TSCA) incinerator in Oak Ridge, Tennessee, in accordance with 40 *CFR* § 761.61(b)(1). An alternate facility (facilities) for the decontamination/disposal of liquid PCB remediation waste may be used in accordance with 40 CFR § 761.61(a)(5)(iv).

- Any wastes transferred off-site or transported in commerce along public rights-of-way must meet the requirements summarized on Appendix A, depending on the type of waste (e.g., RCRA, PCB, or LLW). These include packaging, labeling, marking, manifesting, and placarding requirements for hazardous materials at 49 *CFR* §§ 170–180 *et seq*. Transport of wastes along roads within the PGDP site that are not accessible to the public would not be considered "in commerce."

- In addition, CERCLA Section 121(d)(3) provides that the off-site transfer of any hazardous substance, pollutant, or contaminant generated during CERCLA response actions be sent to a treatment, storage, or disposal facility that complies with applicable federal and state laws and has been approved by the EPA for acceptance of CERCLA waste (see also the "Off-Site Rule" at 40 *CFR*

§ 300.440 *et seq.*). Accordingly, DOE will verify with the appropriate EPA regional contact that any needed off-site facility is acceptable for receipt of CERCLA wastes before transfer.

4.2.3.5 NEPA Values

No long-term and minor short-term impacts to land use would occur under Alternative 3. Land surrounding the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon is designated as industrial within the DOE "buffer zone.". Land use of the immediate area surrounding the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon currently is governed by interim institutional controls that restrict access to these areas. It is assumed that these controls would remain in place under Alternative 3; thus, land use would remain unchanged.

Short-term impacts may occur to the following NEPA values identified in Section 4.1 by implementation of Alternative 3.

- Air quality and noise
- Wetlands and floodplains
- Soils
- Water resources
- Ecological resources

Excavation activities would require heavy construction. There would be minor short-term impacts to air quality and noise resulting from Alternative 3 during construction activities. Air quality impacts would include emissions from vehicle and equipment exhaust and fugitive dust from vehicle traffic and disturbance of soils. Site preparation and construction activities would be short-term, sporadic, and localized (except for emissions from vehicles of construction workers and transport of construction materials and equipment). Fugitive dust from excavation and earthwork activities would be noticeable on-site and in the immediate vicinity. Dispersion would decrease concentrations of pollutants in the ambient air as distance from the construction site increased. The use of control measures (i.e., covers and water or chemical dust suppressants) would minimize fugitive dust emissions. No exceedances of primary or secondary National Ambient Air Quality Standards (NAAQS) would be expected.

Increased noise levels from the transport and use of construction equipment in the immediate vicinity of construction also would be short-term, sporadic, and localized. Noise levels already are slightly elevated in the vicinity of the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon because of their location within or close proximity to the industrialized portion of PGDP. No sensitive noise receptors (e.g., residences) are located near the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon; thus, no noise impacts would occur. Construction or operational activities, including excavation, dredging, or road building, may impact wetlands or regulatory floodways. If, during the design phase of the removal action, it is determined that wetlands and/or floodplains would be impacted, ARARs/TBCs requirements for floodplain/wetlands would be implemented to the extent practicable and mitigate short- or long-term impacts.

Alternative 3 would have short-term impacts on soils. Site clearing, excavation, grading, and contouring would alter the topography of the area where the removal actions are located, but the geologic formations underlying those sites should not be affected. Construction would disturb existing soils, and some topsoil might be removed in the process. Soil erosion impacts during construction would be mitigated through the use of control measures (e.g., covers and silt fences). No conversion of prime farmland soils is expected to occur. Site restoration would be performed at the conclusion of this alternative to minimize the impacts to the areas disturbed during implementation.

Short-term impacts to water resources may result from localized construction activity, especially in the areas immediately surrounding the C-218 Firing Range, which is adjacent to Bayou Creek. These impacts typically would occur in the form of stormwater runoff from the construction site resulting in elevated levels of suspended solids. Silt fencing and other construction BMPs would be used to minimize short-term impacts to water quality.

Short-term negative impacts to ecological resources are likely to occur during construction activities associated with Alternative 3. The existing vegetation that provides habitat and food to plants and animals would be eliminated in the vicinity of the work site. Site preparation activities and excavation also could cause the direct loss of some less mobile wildlife located at the construction site, while other wildlife could be displaced from the cleared areas.

4.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

The following sections present a comparison of the proposed removal action alternatives based on effectiveness, implementability, and cost criteria. A summary of the alternative comparisons is shown in Table 7.

4.3.1 Effectiveness

Alternative 1, the No-Action Alternative is considered the least protective of all of the alternatives considered. Alternative 1 does not meet project RAOs, nor does it provide for overall protection of human health and the environment. Direct contact risk at the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon is not eliminated or controlled by Alternative 1. There is no overall effectiveness associated with Alternative 1.

Alternative 2 provides for limited protection against direct contact with the contamination area for on-site workers. The RAOs are partially satisfied by this alternative. Implementation of interim institutional controls would decrease the risk of human exposure through exclusion or other institutional means. Interim institutional controls alone would not control contaminant sources nor would they control the potential for contaminant migration, since the contaminated areas are not removed. Interim institutional controls would not prevent entry by those who do not adhere to the control (e.g., the intentional trespasser) and, as a result, are only partially protective of human health and the environment. The effectiveness of Alternative 2 is ranked as low to moderate.

Alternative 3 provides for excavation of contamination from the C-218 Outdoor Firing Range and excavation of contamination and removal of accumulated rainwater (if applicable) from the C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon. This alternative provides for a complete level of protectiveness for industrial workers. The RAOs are satisfied by this alternative. The combination of excavation (including removal of accumulated rainwater, as appropriate) with interim institutional controls not only removes the contamination, but also adequately manages future risk of any residual contamination. Under Alternative 3, contamination areas would be removed from the environment. The risk to industrial workers from direct contact with soil/sediment and surface water would be permanently reduced and the contamination area would be permanently eliminated. All project RAOs are achieved by this alternative and its effectiveness is ranked high.

Table 7. Removal Action Alternative Comparisons

Criteria	Alternative 1. No Action Alternative	Alternative 2. Interim Institutional Controls	Alternative 3. Combination of Excavation and Interim Institutional Controls
Effectiveness			
RAOs	Does not meet RAOs.	Partially meets RAOs.	Meets RAOs.
Overall Protection of Human Health and the Environment	Not protective.	Moderate.	High.
Long-term Effectiveness and Permanence	Not effective.	Low.	High.
Short-term Effectiveness	No short-term effectiveness.	Moderate.	High.
Overall Effectiveness	None.	Low to moderate.	High.
Implementability			
Ability to Construct and Operate Technologies	Not applicable.	High. Minimal construction and operating effort.	High. Standard construction techniques and minimal operator effort.
Availability and Reliability of Technologies	Not applicable.	High. Technology is readily available.	High. Technology is readily available.
Availability of Treatment, Storage, and Disposal Services and Capacity	Not applicable.	Not applicable.	Moderate. Will require waste storage and disposal.
Overall Implementability	Not applicable.	High. Easily implemented.	High. Easily implemented.
Cost			
Capital Cost	Not applicable.	$119,696	$5,527,738
O&M Cost	Not applicable.	$50,918	$5,000
Present Value Total Cost with 30-year O&M	Not applicable.	$1,647,233	$5,677,738
Escalated Total Cost with 30-year O&M	Not applicable.	$2,547,617	$6,066,922

4.3.2 Implementability

Alternative 1, the No Action alternative ranks high in ease of implementation since implementation requires no further resources and technical feasibility is not a consideration. Because of DOE policy and state and federal law, however, the No Action Alternative is not considered to be administratively feasible.

Alternative 2 would require a relatively low effort to implement. The interim institutional controls identified in this section can be rapidly implemented with a minimum amount of planning or supporting work. These controls include installation of exclusion fencing and hazard postings. Long-term monitoring would require more effort to implement. Plans (SAPs, site specific health and safety plans, O&M plans, etc.) would need to be prepared and approved. Additional personnel and training may be required.

Alternative 3 would require a level of implementation effort greater than the previous alternatives (Alternatives 1 and 2). Excavation of the contaminated area (including removal of accumulated rainwater as appropriate) will require engineering plans, specifications, bid packages, and other documents. The interim institutional controls identified in this section can be rapidly implemented with a minimum amount of planning or supporting work. These controls include installation of exclusion fencing and hazard postings as needed to minimize direct contact with contaminated soil and accumulated rainwater. Additional personnel and training may be required.

4.3.3 Cost

Estimated action alternative costs are presented in Appendix B, Tables B.1 through B.2. In order to estimate and compare the relative magnitude of cost for each action alternative, assumptions were made regarding the types of controls implemented, the amount of long-term monitoring and O&M required, and the quantities of waste removed. All alternatives assume a 30-year design life. These assumptions for the cost model are presented below.

Alternative 2. Interim institutional control measures only.

- Installation of exclusion fencing and hazard posting for the C-218 Outdoor Firing Range, C-403 Neutralization Tank, and C-410-B HF Neutralization Lagoon.
- Inspection and maintenance of fencing and hazard postings.
- Long-term monitoring for applicable parameters until D&D of the plant to ensure that contaminant migration does not occur.

Alternative 3. Combination of excavation (including the removal of accumulated rainwater as appropriate) and interim institutional controls (as needed).

- Excavation and off-site disposal of contamination areas (i.e., "hot spots") – approximately 165,493 ft^3 of soil (C-218 Outdoor Firing Range: 120,000 ft^3; C-403 Neutralization Tank: 36,981 ft^3; and C-410-B HF Neutralization Lagoon: 8,512 ft^3); including the removal of approximately 100,000 gallons of accumulated rainwater (C-403 Neutralization Tank: 75,000 gallons and C-410-B HF Neutralization Lagoon: 25,000 gallons).
- Restoration (i.e., backfill with clean soil, reseeding, etc.) of disturbed acreage.
- Engineered sediment controls and temporary fencing during implementation (BMPs).
- Verification soil sampling during excavation (limited to lead at the C-218 Firing Range)
- Collection of soil characterization samples at SWMU 19 and SWMU 40 prior to restoration, for use in future CERCLA actions (e.g., Groundwater OU, Soils OU, CSOU, etc.).

- Continued inspection and maintenance during and after excavation and restoration.
- No long-term monitoring for contaminant migration.

As shown in the accompanying economic analysis, the initial capital investment (capital cost) is most expensive for Alternative 3 and least expensive for Alternative 2.

If it is determined through the CERCLA review process that the proposed final cleanup levels presented in Section 5, "Recommended Removal Action Alternative," require modification, then the impacts to the contaminated area will need to be reevaluated to determine if the selected alternative still is correct. The cost associated with excavation and disposal is most significantly impacted by the size of the contaminated area.

5. RECOMMENDED REMOVAL ACTION ALTERNATIVE

Based on the comparative analysis, Alternative 3 - "Excavation and Interim Institutional Controls," is the recommended removal action alternative. The evaluation included consideration of effectiveness, implementability, cost, and whether the alternative meets RAOs. Under this alternative, C-403 Neutralization Tank (SWMU 40) and C-410-B HF Neutralization Lagoon (SWMU 19) will be removed to their respective SWMU boundaries; therefore, cleanup levels for these inactive facilities are not applicable. For the C-218 Firing Range (SWMU 181), only a cleanup level for lead is presented since the focus of this removal action is lead contaminated soil at SWMU 181. The cleanup goals for lead at the C-218 Firing Range (SWMU 181) under alternative 3 are presented in Table 8. Methods to validate the achievement of the cleanup levels will be presented in the RAWP.

Table 8. Cleanup Levels Based on Carcinogenic Risk and Hazard

	Background (mg/kg or pCi/g)	Risk-Derived Cleanup Goal (mg/kg)	Industrial Hazard-Derived Cleanup Goal (mg/kg)	Recreational Hazard-Derived Cleanup Goal (mg/kg)	Selected Cleanup Level (mg/kg)
Soils and Sediment					
Lead	36	-	800[a]	1420[b]	800[c]

[a] An updated screening level for soil lead at industrial sites of 800 parts per million is based on a recent analysis of the combined phases of the National Health and Nutrition Examination Survey (NHANES III) that chose a cleanup goal protective for all subpopulations (EPA 2007).
[b] Cleanup goal for lead in soil derived using the Integrated Exposure Uptake Biokinetic Model (IEUBK) (EPA 1994).
[c] Cleanup level for lead in soil was evaluated for industrial (current) land use and recreational (future) land use; defaulting to the industrial no action level of 800 mg/kg as the more protective.

The following summarizes the selected cleanup levels presented in Table 8 and the impact to the three respective inactive facilities.

- **C-218 Firing Range (SWMU 181):** Reduce the lead concentration within the facility "hot spot" below 800 mg/kg. It currently is estimated that this will result in the "hot spot" excavation of approximately 3,398 m^3 (120,000 ft^3) of contaminated soil. Further evaluation of the firing range for other COPCs will be deferred to the Soils OU.

- **C-403 Neutralization Tank (SWMU 40):**

  — **Soil/Sediment:** To achieve risk reduction, SWMU 40 within its defined boundaries will be removed. Defined boundaries of SWMU 40 extend no further than 3 ft on each side of or 3 ft from the bottom of the tank. This will result in the removal of approximately 1,048 m^3 (36,981 ft^3) of soil, sediment, concrete, and brick, which includes the tank and its defined area.

  — **Accumulated Rainwater:** To achieve risk reduction, accumulated rainwater estimated at approximately 283,906 L (75,000 gal) will be pumped from the tank and properly stored and disposed of prior to excavation of the tank and surrounding soil.

- **C-410 B HF Neutralization Lagoon (SWMU 19):**

— **Soil/Sediment:** While radionuclides are not shown to exceed an excess lifetime cancer risk (ELCR) of 1E-05, the C-410-B HF Neutralization Lagoon contains radionuclides that are approximately 10 times their background concentration (DOE 1999a) and the facility has been roped off and posted in accordance with 10 *CFR* 835 to prevent radiological contamination to the industrial worker (DOE 2001). As a result, to achieve risk reduction, SWMU 19 within its defined boundaries will be removed. Defined boundaries of SWMU 19 extend no further than 3 ft on each side of or 3 ft from the bottom of the lagoon. This will result in the removal of approximately 241 m^3 (8,512 ft^3) of sludge, concrete, and soil, which includes the lagoon structure and its defined area, as well as approximately 94,635 L (25,000 gal) of water (see below).

— **Accumulated Rainwater:** To achieve risk reduction, accumulated rainwater estimated at approximately 94,633 L (25,000 gals) will be pumped from the lagoon and properly stored and disposed of prior to excavation of the lagoon and surrounding soil.

Based on the evaluation, this alternative meets all the RAOs for the removal action, is effective, and can be implemented. Alternative 3 is the most cost-effective option that meets the requirements of effectiveness, implementability, and RAOs. In addition, a "no further action" will be achieved for SWMU 19 and SWMU 40 since they will be completely removed. For SWMU 181, a "no further action" will be achieved for lead and further evaluation of a "no further action" for other possible COPCs will be evaluated as part of the Soils OU.

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APPENDIX A

POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE/TO BE CONSIDERED REQUIREMENTS

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Table A.1 Summary of Location-Specific ARARs/TBCs for Soils Operable Unit

Standards, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
Protection of Wetlands	10 *CFR* Part 1022; 40 *CFR* § 230.10 (c)	Activities must avoid or minimize impacts to wetlands to preserve and enhance their natural and beneficial value. If wetland resources are not avoided, measures must be taken to address ecologically sensitive areas and mitigate adverse effects. Such measures may include minimum grading requirements, runoff controls, design, and construction considerations. Discharges of dredge and fill material for which there is no practicable alternative may be conducted provided that the substantive requirements of (general) NWPs (TBCs 14, 18, 33, and/or 38) are met.	The substantive requirements are applicable if impacts to wetlands cannot be avoided during implementation. As referenced in Section 4.1.1, NWPs otherwise would be required in the absence of CERCLA Section 121(e)(1) and the National Contingency Plan.
Protection of Aquatic Ecosystems	40 *CFR* § 230.10 (a) & (d)	Places restrictions on discharge of dredge and fill materials into waters of the United States that will minimize potential adverse impacts on the discharge on the aquatic ecosystem. Discharges of dredge and fill material for which there is no practicable alternative may be conducted provided that the substantive requirements of (general) NWPs (TBCs 14, 18, 33, and/or 38) are met.	The substantive requirements are applicable because of the close proximity of Bayou Creek. As referenced in Section 4.1.1, NWPs otherwise would be required in the absence of CERCLA Section 121(e)(1) and the National Contingency Plan.

67

Table A.1 Summary of Location-Specific ARARs/TBCs for Soils Operable Unit (Continued)

Standards, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
Nationwide Permit Program	33 *CFR* § 330.5	NWPs are a type of general permit issued by the Corps of Engineers and are designed to regulate, with little if any delay or paperwork, certain activities having minimal impacts. NWPs can be issued to satisfy the permit requirements of Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act, Section 103 of the Marine Protection, Research, and Sanctuaries Act, or some combination thereof.	Unless impacts to wetlands or aquatic ecosystems are avoided or an alternative is selected that does not impact wetlands or aquatic ecosystems, compliance with the substantive TBC requirements of NWPs 14, 18, 33, and/or 38 would be required as follows: 1. Backfilling an excavation and excavation of hazardous sediments in a water body or wetland would require a combination of NWP 38 – Cleanup of Hazardous and Toxic Waste, and NWP 18 – Minor Discharges. 2. Construction of a temporary access road across a water body or wetland would require NWP 33 – Temporary Construction Access. 3. Construction of a permanent access road across a water body or wetland would require NWP 14 – Linear Transportation Projects. These substantive TBC requirements will be delineated in the RAWP after final alternative selection. As referenced in Section 4.1.1, NWPs otherwise would be required in the absence of CERCLA Section 121(e)(1) and the National Contingency Plan.

Table A.1 Summary of Location-Specific ARARs/TBCs for Soils Operable Unit (Continued)

Standards, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
Endangered Species Act	16 *USC* 1531 *et seq.* § 7(a)(2); 50 *CFR* Part 402	Actions that jeopardize the existence of listed species or result in the destruction or adverse modification of critical habitat must be avoided or reasonable and prudent mitigation measures must be taken.	The substantive requirements are applicable because critical habitat for T&E species is present near PGDP outside the industrialized area. The requirements will be met through avoidance of critical habitat or mitigation measures.
Migratory Bird Treaty Act	16 *USC* 703-711; 50 *CFR* Part 21	Prohibits killing, unlawful taking, possession, and sale of almost all species of native birds in the U.S.	The substantive requirements are applicable because migratory birds frequent PGDP. As referenced in Section 4.1.1, permits otherwise may be required if migratory birds are taken (i.e., taking cannot be avoided) in the absence of CERCLA Section 121(e)(1) and the National Contingency Plan.
Memorandum of Agreement - Migratory Bird Treaty Act	Executive Order 13186	Under a Memorandum of Understanding signed between DOE and the U.S. Fish and Wildlife Service (USFWS) DOE shall: • Avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions; • Restore and enhance the habitats of migratory birds, as practicable; • Prevent or abate the pollution or detrimental alteration of the environment for the benefit of migratory birds, as practicable; • Identify where unintentional uptake likely will result from agency actions and develop standards and/or practices to minimize such unintentional take; and • Obtain permits if required for the taking of migratory	Should the selected alternative impact migratory birds, substantive TBC requirements such as scheduling construction time around nesting seasons, or controlling airborne pollution will be delineated in the RAWP.

Table A.1 Summary of Location-Specific ARARs/TBCs for Soils Operable Unit (Continued)

Standards, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
		birds.	
Protection of Water Resources and Floodplain Management	10 *CFR* Part 1022; 401 *KAR* 4:060, Section 4	Protects floodplains and streams by regulating fill, deposits, obstructions, excavation, or storage of materials or structures that may adversely affect the floodway, stream channel, or drainage capability of a stream or flowing body of water.	The substantive requirements are applicable because the close proximity of Bayou Creek. If encroachments cannot be avoided, the substantive requirements for uses of regulatory floodway will be met by ensuring that the encroachments shall have "no impact" or not result in any increase in flood levels during occurrence of the base flood discharge. Dredging or other removal of material from between the stream banks and the regulatory floodway may be conducted if disposal of the dredged material is outside of the floodway and does not result in increases in flood elevations.

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
USFWS = U.S. Fish and Wildlife Service
KAR = *Kentucky Administrative Regulation*
MOU = Memorandum of Understanding
NEPA = National Environmental Policy Act
NWP = Nationwide Permit
PGDP = Paducah Gaseous Diffusion Plant
RAWP = Removal Action Work Plan
T&E = threatened and endangered species
TBC = to be considered
USC = *United States Code*

Table A.2 Summary of Action-Specific ARARs/TBCs for the Soils Operable Unit

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
Kentucky Water Quality Criteria • Designated Uses of Surface Water • Surface Water Standards • KPDES Program	401 *KAR* 5:026; 401 *KAR* 5:031, Sections 1 – 7, excluding Section 2(1)(g) and Section 3(3)(d); KPDES Permit KY0004049; 401 *KAR* 5:055, Section 1; 401 *KAR* 5:070, Section 4	KPDES Program provides designated uses of surface waters and physical and chemical-specific numeric standards for pollutants discharged or found in surface waters and in domestic water supplies. The KPDES program requires a permit to discharge pollutants from a point source into waters of the Commonwealth. Compliance with the KPDES program requirements constitutes compliance with the operational permit requirements of 401 *KAR* 5:005 and requirements related to the operational permit.	The substantive standards of the regulations are applicable and implemented through the TBC effluent limits in the KPDES permit. BMPs will be implemented to control storm water and sedimentation runoff. As referenced in Section 4.1.1, a KPDES permit would be required in the absence of CERCLA Section 121(e)(1) and the National Contingency Plan.

Table A.2 Summary of Action-Specific ARARs/TBCs for the Soils Operable Unit (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
Fugitive Dust Emissions during Site Preparation and Construction Activities	401 *KAR* 63:010	Precautions must be taken to prevent particulate matter from becoming airborne. Such precautions must be incorporated into the planning and design of activities and include actions such as these: • Wetting or adding chemicals to control dust from construction activities; • Using materials such as asphalt or concrete (or other suitable chemicals/fixing agents) on roads or material stockpiles to prevent fugitive emissions; and • Using covers on trucks when transporting materials to and from the construction site(s). This requirement specifies that, for on-site construction activities, no visible emissions may occur at the PGDP fence line.	The substantive requirements are applicable and will be met through the use of appropriate dust control practices identified during the design/planning phase.
Toxic Emissions and National Emission Standards for Hazardous Air Pollutants	401 *KAR* 63:020, Section 3; 40 *CFR* § 61.92	No owner or operator shall allow any affected facility to emit potentially hazardous matter or toxic substances in such quantities or duration as to be harmful to the health and welfare of humans, animals, and plants. The radiological dose to the most exposed member of the public resulting from sitewide radionuclide emissions to the atmosphere must not exceed 10 mrem/year.	The substantive requirements are applicable. Based on preliminary evaluation of similar removal actions at the PGDP, it is anticipated that emissions will not exceed the *KAR* or NESHAPS limits. Verification modeling will be conducted and the results presented in the RAWP.
Radiation Protection of the Public and the Environment	DOE Order 5400.5(II)(1)(a) and (2)	Except under unusual circumstances, the exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an EDE greater than 100 mrem.	The substantive requirements are TBC and activities necessary to comply will be incorporated into the design/planning phase.

Table A.2 Summary of Action-Specific ARARs/TBCs for the Soils Operable Unit (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
		The ALARA process shall be implemented for all DOE activities and facilities that cause public doses.	
Toxic Substances Control Act	40 *CFR* § 761.61(c)	TSCA provides for risk-based cleanup of PCBs when the method will not pose an unreasonable risk of injury to health or the environment.	The substantive requirements are applicable if the selected alternative includes removal to the proposed PCB risk-based levels. Activities necessary to comply will be incorporated into the design/planning phase.
Public Dose Limits	DOE Order 5400.5 II(1)(b)	The public dose limits apply to doses from exposures to radiation sources and radioactive materials released to the atmosphere from routine DOE activities, including remedial actions.	The substantive requirements are TBC during implementation of the preferred alternative. Exposure limits from materials released to the atmosphere will not be exceeded through the use of any necessary dust control practices identified during the design/planning phase.
Management and Control of Radioactive Materials in Liquid Discharges	DOE Order 5400.5, Chapter II(3)(a)	At the point of discharge from the conduit to the environment, control must be imposed on liquid releases to protect resources such as land, surface water, groundwater, and the related ecosystems from undue contamination.	The substantive requirements are TBC because of the potential for discharges of radioactive material in liquid discharges. Activities necessary to comply will be incorporated into the design/planning phase.
Low-Level Waste Management	DOE Order 435.1 and DOE M. 435.1-1	Provides DOE requirements for characterization, packaging, certification, and disposal of LLW, mixed LLW, and TSCA-contaminated LLW waste.	The substantive requirements are TBC and will be implemented through the characterization and appropriate management of LLW wastes generated. Waste management will be predicated upon waste characterization and will comply with the substantive requirements associated with

Table A.2 Summary of Action-Specific ARARs/TBCs for the Soils Operable Unit (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
			LLW management
Hazardous Waste Management	401 *KAR* 30–34 and 37	All wastes or environmental media containing wastes must be characterized to determine whether the waste also is a hazardous. If it is determined that a waste is a hazardous waste or that environmental media contain a hazardous waste subject to the *KAR* regulations, requirements of the *KAR* are applicable.	The substantive requirements are applicable on-site and compliance will be ensured through the characterization and appropriate management of hazardous wastes and environmental media generated. Waste management will be predicated upon waste characterization and will comply with all substantive requirements associated with on-site hazardous waste management, as appropriate. Hazardous waste sent off-site will be managed in accordance with the substantive and administrative requirements of applicable regulations. For contained-in/no-longer-contaminated-with determinations, the waste will be characterized to apply the TCE/TCA contained-in/no-longer-contaminated levels of 39.2 ppm TCE in solids and 0.081 ppm TCE in water to media and debris generated by this action. The characterization plan will be subject to regulator review and approval under the procedures outlined in the FFA. The characterization results will be compared against the contained-in, health-based levels listed above, and a contained-in determination will be made. Land Disposal Restrictions apply to media and debris that no longer contain or are no longer contaminated with RCRA regulated waste.

Table A.2 Summary of Action-Specific ARARs/TBCs for the Soils Operable Unit (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
			As referenced in Section 4.1.1, a Treatment, Storage, and Disposal permit would be required in the absence of CERCLA Section 121(e)(1) and the National Contingency Plan.
PCB Waste Management	40 *CFR* Part 761;	General TSCA requirements for the management of PCB wastes or items include the following: • Management of waste and material; • Characterization of PCB-containing materials; • Labeling and storage for disposal; • Manifest completion for shipment off-site; • Decontamination of affected equipment or items; and • Disposal of PCB wastes. Or	The substantive requirements are applicable if PCBs are identified as regulated under 40 *CFR* Part 761. Activities necessary to comply with these ARARs shall be incorporated into the RAWP. For up to 180-days, PCB remediation wastes will be managed/stored in risk-based storage instead of storage meeting 40
	40 *CFR* § 761.65(b); Or 40 *CFR* § 761.61 (a)(5)(iv)	In addition, TSCA provides for risk-based storage of PCBs when the method will not pose an unreasonable risk of injury to health or the environment. Any person disposing of liquid PCB remediation waste shall either: 1) decontaminate the waste to the levels specified in 40 *CFR* § 761.79(b)(1) or (b)(2), or 2) dispose of the waste in accordance with requirements for performance based standards or risk-based approval.	*CFR* § 761.61(b) requirements. Such wastes will be stored up to 180-days in drums, B-12 boxes, B-25 boxes, Intermodal containers, and/or Sealand containers, provided that the containers are sealed when not adding/removing materials. Storing PCB Remediation wastes in this manner (which will be further detailed in the RAWP) provides a level of protectiveness that is similar to storing PCB remediation wastes in piles under 40 *CFR* § 761.65(c)(9).
Disposal of PCB Remediation Waste	40 *CFR* § 761.61 (a), (b), and (c)	Provides requirements and options for disposing of PCB remediation waste. Options include methods for	The substantive requirements are relevant and appropriate. DOE will perform on-site risk-

Table A.2 Summary of Action-Specific ARARs/TBCs for the Soils Operable Unit (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
		performance based, risk-based, and coordinated approval disposal.	based cleanup; however, wastes containing equal to or less than 49 ppm PCBs will be disposed of on-site at the C-746-U solid waste landfill pursuant to substantive requirements of 40 *CFR* § 761.61(a)(5)(v). The Environmental Performance Standard in 401 *KAR* 47:030, Section 8 and referenced in Condition Number T-66 of Solid Waste Permit No. 073-00014/073-00015/073-00045 currently allow such disposal. PCB remediation waste above 49 ppm will be disposed off-site at Energy*Solutions* in Clive, Utah, or the Nevada Test Site under a current coordinated approval in accordance with 40 *CFR* § 761.61(b). An alternate facility (facilities) for disposal of solid PCB remediation waste may be used if the receiving facility is a performance-based facility under 40 *CFR* § 761.61(b) such as the Oak Ridge TSCA Incinerator or an approved risk-based disposal facility as allowed in 40 *CFR* § 761.61(c). PCB waste disposed of off-site will be managed in accordance with the substantive and administrative requirements of applicable regulations. As referenced in Section 4.1.1, a Solid Waste Landfill permit would be required in the absence of CERCLA Section 121(e)(1) and the National Contingency Plan.

Table A.2 Summary of Action-Specific ARARs/TBCs for the Soils Operable Unit (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
Disposal of Waste with Residual Radioactive Material Off-Site	DOE Order 5400.5(II)(5)(c) (6) and 5400.5(IV)(5)(a)	If residual radioactive material is released to a non-DOE or non-NRC licensed facility, the waste must achieve authorized limits equal to the specific guidelines derived from the basic dose limit using DOE/CH-8901a (or equivalent) in accordance with DOE Order 5400.5 (IV)(4)(a) before that release. Authorized limits shall be consistent with limits and guidelines established by other applicable federal and state laws.	The substantive requirements are TBC prior to the release of residual radioactive material to a non-DOE or non-NRC licensed facility for disposal.
Disposal of Waste with Residual Radioactive Material in the C-746-U Landfill	DOE Order 5400.5(IV)(5)(a)	Disposal of residual radioactive material must achieve the authorized limits equal to the specific guidelines derived from the basic dose limit using DOE/CH-8901a (or equivalent) in accordance with DOE Order 5400.5 (IV)(4)(a).	The substantive requirements are TBC for waste with residual radioactive materials disposed on-site in the C-746-U Landfill. The substantive requirements will be met through compliance with the already established authorized limits for the C-746-U Landfill.
Transportation of Hazardous Materials (RCRA, PCB and Radioactive) Off-Site	49 *CFR* Part 171; 40 *CFR* § 761.207; 401 *KAR* Chapters 32 and 34	Provides requirements for marking, labeling, placarding, packaging, manifesting, emergency response, obtaining an identification number, use of transporters, recordkeeping, etc., when transporting or offering to transport hazardous materials, including hazardous, radioactive, and PCB waste in commerce.	Hazardous material offered for transportation off-site will be conducted in accordance with the administrative and substantive requirements of the applicable hazardous materials regulations.
Transportation of Hazardous Materials (RCRA, PCB and Radioactive) On-Site	DOE Order 460.1B	Provides requirements for identification, packaging, control, etc., for on-site transfer or movement of hazardous materials at PGDP per the *Transportation Safety Document for On-Site Transport within the Paducah Gaseous Diffusion Plant,* PRS-WSD-0661, (TSD)(PRS 2007b).	The substantive requirements are TBC for on-site transfer or movement of hazardous materials (RCRA, PCB and radioactive).

Table A.2 Summary of Action-Specific ARARs/TBCs for the Soils Operable Unit (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comments
Transportation of LLW	DOE Order 435.1 and DOE M 435.1-1	Provides requirements for packaging and transporting LLW.	The substantive requirements are TBC during the labeling, packaging, and transportation of low-level waste that may be generated during implementation.

ALARA = as low as reasonably achievable
ARAR = applicable or relevant and appropriate requirement
AWQC = Ambient Water Quality Criteria
BMP = best management practice
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = *Code of Federal Regulations*
CWA = Clean Water Act
DOE = U.S. Department of Energy
EDE = effective dose equivalent
FFA = Federal Facility Agreement
KAR = Kentucky Administrative Regulation
KPDES = Kentucky Pollutant Discharge Elimination System
LLW = low-level waste
mrem = millirem
NESHAPS = National Emission Standards for Hazardous Air Pollutants
NRC = Nuclear Regulatory Commission
PCB = polychlorinated biphenyl
PGDP = Paducah Gaseous Diffusion Plant
RAWP = Removal Action Work Plan
RCRA = Resource Conservation and Recovery Act
SAP = Sampling and Analysis Plan
TBC = to be considered
TCA = trichloroethane
TCE = trichloroethene
TSCA = Toxic Substances Control Act
TSD = Transportation Safety Document

96

APPENDIX B

COST ESTIMATE AND CONCEPTUAL DESIGN

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Table B.1 Alternative 2 – Interim Institutional Controls Cost Analysis

Alternative 2 Cost Analysis						
Cost Item	***Description***	***Extended Description***	***Quantity***	***Unit***	***Unit Cost ($)***	***Extended Cost ($)***
1	**Project Management**		80	Hrs	77.2	6176.0
2	**Project Planning**					
	2.1 Procedures	Work Package	100	Hrs	64.40	6,440.0
	2.2 Plans	Site specific Health and Safety Plan and Sampling and Analysis Plan	50	Hrs	64.40	3,220.0
	2.3 Design	Fencing and signage specifications	60	Hrs	60.66	3,642.0
3	**Execution**					
	3.1 HP Support	Construction subcontractor support	40	Hrs	46.37	1,856.0
	3.2 Superintendent	Construction subcontractor support	80	Hrs	54.57	4,368.0
	3.3 HSO	Construction subcontractor support	80	Hrs	60.66	4,856.0
4	**Administration**					
	4.1 Procurement	Supplies, bid packages	32	Hrs	27.60	883.2
	4.2 Contracting	Subcontract	40	Hrs	27.60	1,104.0
	4.3 Other Administrative Adders	Assumes 5% of capital	1	L.S.	4,784.4	4,784.4
5	**Site Prep**					
	5.1 Clear and Grub	2-man crew Cut and chip trees, clear brush, area needed for fence installation only	0.5	Acres	6,000.0	3,000.0
	5.2 Utility Locate		8	Hrs.	37.40	299.2
6	**Security Fencing**	Installed cost, 8 foot, 6 gauge, galvanized chain link, 3 strand barbed wire, 2 inch posts at 10 foot O.C.	1,464	L.F.	37.40	54,753.6
7	**Gate**	20 foot x 8 foot, 6 gauge, galvanized chain link, 3 strand barbed wire	3	Ea.	1,290.0	3,870.0

8/1

Table B.1 Alternative 2 – Interim Institutional Controls Cost Analysis (Continued)

Alternative 2 Cost Analysis						
Cost Item	***Description***	***Extended Description***	***Quantity***	***Unit***	***Unit Cost ($)***	***Extended Cost ($)***
8	**Signage**	Hazard postings	1	L.S.	500.0	500.0
9	**Other Adders**	Tax, overhead, fringe, etc. @ 20% of capital	1	L.S.	19,943.3	19,943.3
		Subtotal Capital				***119,695.7***
10	**O&M**					
	10.1 Tarps	20 mil, woven reinforced, fire retardant	2	Ea.	1,710.0	3,420.0
	10.2 Materials	Miscellaneous materials/supplies	1	L.S.	1,800.00	1,800.0
	10.3 Installation	Labor (framing and installation)	1	L.S.	6,300.0	6,300.0
	10.4 Maintenance and Inspections	Fencing and postings	1	L.S.	5,000.0	5,000.0
	10.5 Sampling @ SWMU 40 (C-403)					
	10.5.1 Sampling labor		8	Hrs	37.21	297.7
	10.5.2 Analytical	Semiannual sampling of monitoring wells for environmental surveillance parameters (MW178 and MW341)	4	Events	850.00	3,400.0
	10.5.3 Sample Shipping	6 coolers/yr.	2	Ea.	750.00	1,500.0
	10.5.4 Env. Compliance	Data interpretation and annual reporting	80	Hrs.	64.40	5,152.0
	10.6 Sampling @ SWMU 19 (C-410)					
	10.6.1 Sampling labor		4	Hrs	37.21	148.8
	10.6.2 Analytical	Semiannual sampling of monitoring wells for environmental surveillance and groundwater quality parameters (MW260)	2	Events	850.00	1,700.0
	10.6.3 Sample Shipping	6 coolers/yr.	2	Ea.	750.00	1,500.0
	10.6.4 Env. Compliance	Data interpretation and annual reporting	80	Hrs	64.40	5,152.0

Table B.1 Alternative 2 – Interim Institutional Controls Cost Analysis (Continued)

Alternative 2 Cost Analysis						
Cost Item	***Description***	***Extended Description***	***Quantity***	***Unit***	***Unit Cost ($)***	***Extended Cost ($)***
	10.7 Sampling @ SWMU 181 (C-218)					
	10.7.1 Sampling labor	Quarterly sampling of surface water at Bayou Creek for environmental surveillance parameters (C-746-K-5 and S-31)	16	Hrs	37.21	595.4
	10.7.2 Analytical		8	Events	850.00	6,800.0
	10.7.3 Sample Shipping	6 coolers/yr.	4	Ea.	750.00	3,000.0
	10.7.4 Env. Compliance	Data interpretation and annual reporting	80	Hrs	64.40	5,152.0
		Subtotal O&M				***50,917.9***
		Grand Total				***170,613.6***
		Cost/Benefit Analysis				
		Capital Cost (2006$)				119,695.7
		Annual Cost (O&M) (2006$)				50,917.9
		Design Life (yrs)				30.0
		Present Value Total Cost with 30-year O&M (2006$)				1,647,232.7
		Escalated Total Cost with 30-year O&M				2,547,617.1

Table B.2 Alternative 3 – Excavation and Interim Institutional Controls Cost Analysis

Alternative 3 Cost Analysis							
Cost Item	***Description***		***Extended Description***	***Quantity***	***Unit***	***Unit Cost ($)***	***Extended Cost ($)***
1	**Project Management**			1,000	Hrs	77.20	77,200.0
2	**Project planning**						
	2.1 Procedures		Site security and control	400	Hrs	64.40	25,760.0
	2.2 Plans		Site specific HASP and SAP	480	Hrs	64.40	30,912.0
	2.3 Design		Design, specifications, bid package	800	Hrs	60.66	48,560.0
3	**Execution**						
	3.1 HP Support		Construction subcontractor support	880	Hrs	46.37	40,832.0
	3.2 Superintendent		Construction subcontractor support	960	Hrs	54.57	52,416.0
	3.3 HSO		Construction subcontractor support	880	Hrs	60.66	53,416.0
4	**Administration**						
	4.1 Procurement		Supplies, bid packages	180	Hrs	27.57	4,968.0
	4.2 Contracting		Subcontract	180	Hrs	27.57	4,968.0
	4.3 Other Administrative Adders		Assumes 5% of capital	1	L.S.	219,354.67	219,354.7
5	**Mobe/Demobe**						
	5.1		Portable toilet, assume 4-month rental	4	Month	300.00	1,200.0
	5.2		Office trailer	4	Month	500.00	2,000.0
6	**Decontamination**						
	6.1 Decon pad			1	L.S.	600.00	600.0
	6.2 Decon water treatment			5,000	Gallons	1.30	6,500.0
	6.3 Decon water storage drums			100	Drums	50.60	5,060.0
	6.4 PPE		3 persons, 90 days	270	Ea.	33.80	9,126.0
	6.5 Decon equipment		Pressure washer	1	Ea.	400.00	400.0
7	**Site Prep**						
	7.1 Survey		2-man crew	6	Day	720.00	4,320.0
	7.2 Clear and Grub			1.5	Acres	6,000.00	9.000.0
	7.3 Utility locate			24	Hrs	37.40	897.6
8	**Excavation**						
	8.1 Shoring		Sheet piling @ C-403 only	5,200	Ft^2	30.00	156,000.0
	8.2 Load and Haul		All three subunits in plan	6,130	Yd^3	65.00	398,450.0

Table B.2 Alternative 3 – Excavation and Interim Institutional Controls Cost Analysis (Continued)

Alternative 3 Cost Analysis							
Cost Item	***Description***		***Extended Description***	***Quantity***	***Unit***	***Unit Cost ($)***	***Extended Cost ($)***
9	**Remove Contaminated Liquid**		105,000 gallons				
	9.1 Pumping		105,000 gallons	1	L.S.	2,400.00	2,400.0
	9.2 Transportation		Tanker Truck	24	Trip	4,271.00	102,504.0
	9.3 Treatment		EnviroCare incinerator	209,000	Lbs.	1.20	250,800.0
			TSCA incinerator	Remainder	Lbs.	0.0	0.0
10	**Backfill**						
	10.1 Select fill			3,200	Yd^2	15.00	48,000.0
	10.2 Compact			40	Hrs.	7.20	288.0
	10.3 Install geotextile		20 mil, woven	19,000	Ft^2	0.90	17,100.0
11	**Waste Disposal**						
	11.1 Off-site Transportation		Disposal volumes include swell and excess material; total @ 165,493 ft^3				
		C-218	See 11.2				0.0
		C-403	2000 ft^3 gondola @ 36,981 ft^3	19	Railcar	15,631.00	296,989.0
		C-410	2000 ft^3 gondola @ 8,512 ft^3	5	Railcar	15,631.00	78,155.0
	11.2 Treatment/Disposal						
		C-218	Assumes macroencapsulation; includes trucks, transport, treatment, and disposal*	6,366	Tons	181.0	1,152,246.0
		C-403	No treatment; disposal as mixed low-level waste	36,981	Ft^3	23.0	850,563.0
		C-410	No treatment; disposal as low-level waste	8,512	Ft^3	16.87	143,597.4
12	**Removal Action Labor**						
	12.1 Labor		Foreman	720	Hrs	40.00	28,800.0
	12.2 Labor		Operator	720	Hrs	36.00	25,920.0
	21.3 Labor		Laborer	720	Hrs	27.50	19,800.0

*If a more effective/efficient disposal alternative is available, it will be presented in the RAWP.

Table B.2 Alternative 3 – Excavation and Interim Institutional Controls Cost Analysis (Continued)

Alternative 3 Cost Analysis							
Cost Item	***Description***		***Extended Description***	***Quantity***	***Unit***	***Unit Cost ($)***	***Extended Cost ($)***
13	**Embankment Stabilization and Site Restoration**						
	13.1 Revegetation		Fertilize, mulch, seed	2	Acre	1,500.00	3,000.0
	13.2 Contour		Cat D-6 or equivalent, 6.0 acres	6	Hrs	65.00	390.0
	13.3 Silt fence		Installed cost, adverse conditions	2,000	L.F.	0.32	640.0
	13.4 Erosion Control Matting		Stapled polypropylene mesh for embankment stabilization	3,000	Yd^2	1.80	5,520.0
	13.5 Rip-rap small		5 to 20 lb angular rock for embankment stabilization	2,500	Yd^3	75.00	187,500.0
	13.6 Labor		Foreman	140	Hrs	40.00	5,600.0
	13.7 Labor		Operator	140	Hrs	36.00	5,040.0
	13.8 Labor		Laborer	140	Hrs	27.50	3,850.0
	13.9 Backhoe		Cat 420 or equivalent	80	Hrs	59.00	4,720.0
	13.10 Bobcat		Cat 277 or equivalent	80	Hrs	45.00	3,600.0
14	**Temporary Fencing**		Installed, barricade safety fence (orange, woven polypropylene), ultraviolet stabilized pre-posts, 10 ft O.C.	1,830	L.F.	1.43	2,616.9
15	**Signage**		Hazard postings	3	L.S.	500.00	1,500.0
16	**Verification Sampling**		Verification				
	16.1 Sampling labor			160	Hrs	37.21	5,953.6
	16.2 Samples	C-218	Waste characterization and verification sampling (TCLP metals, total metals)	104	Ea.	271.00	28,184.0
	16.3 Samples	C-403	Waste characterization and post removal sampling (VOAs, SVOAs, PCB, TCLP metals, Rad suite)	48	Ea.	1742.00	83,616.0
	16.4 Samples	C-410	Waste characterization and post removal sampling (VOAs, SVOAs, PCB, TCLP metals, total metals, Rad suite)	41	Ea.	1835.00	75,235.0
	16.5 Sample shipping		10 coolers for 193 samples @ 20 samples/cooler	10	Ea.	750.00	7,500.0
	16.6 Env. Compliance		Data interpretation and reporting	200	Hrs	64.40	12,880.0
17	**Other Adders**		Tax, overhead, fringe, etc. @ 20 % of capital	1	L.S.	681,737.70	921,289.6
			Subtotal Capital				***5,527,737.8***

Table B.2 Alternative 3 – Excavation and Interim Institutional Controls Cost Analysis (Continued)

Alternative 3 Cost Analysis							
Cost Item	***Description***		***Extended Description***	***Quantity***	***Unit***	***Unit Cost ($)***	***Extended Cost ($)***
18	**O&M**						
	18.1 Maintenance		Fencing, postings, repair restoration	1	L.S.	5,000.0	5,000.0
			Subtotal O&M				***5,000.0***
			Grand Total				***5,532,737.8***
			Cost/Benefit Analysis				
			Capital Cost (2006$)				***5,527,737.8***
			Annual Cost (O&M) (2006$)				5,000.0
			Design Life (yrs)				30.0
			Present Value Total Cost with 30-year O&M (2006$)				5,677,737.80
			Escalated Total Cost with 30-year O&M				6,066,921.90

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APPENDIX C

ANALYTICAL DATA
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APPENDIX C

ANALYTICAL DATA

Engineering Evaluation/Cost Analysis
for Soils Operable Unit Inactive Facilities at the
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky
DOE/LX/07-0016&D2

Appendix C
ANALYTICAL DATA

APPENDIX D

ACTION LEVEL COMPARISON AND CHEMICAL OF POTENTIAL CONCERN SELECTION

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Table D.1. Action Level Comparison for Soil/Sludge for C-218 Outdoor Firing Range (SWMU 181)

Analyte	Concentration Detected (mg/kg) or (pCi/g)	No Action Level (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No	Selected as COPC Yes or No
Metals (mg/kg)						
Antimony	ND	NA	NA	NA	NA	No
Arsenic	7.50E+00	5.23E-01	Yes	12	No	No
Barium	1.16E+02	2.29E+02	No	NA	NA	No
Cadmium	5.00E+00	2.13E+01	No	NA	NA	No
Chromium	3.22E+01	3.56E+02	No	NA	NA	No
Lead	1.49E+04	4.00E+02	Yes	3.60E+01	Yes	Yes
Mercury	2.00E-01	1.00E+05	No	NA	NA	No
Nickel	1.19E+01	2.42E+02	No	NA	NA	No
Selenium	5.00E-01	9.49E+01	No	NA	NA	No
Silver	2.39E+01	4.11E+01	No	2.30E+00	Yes	No
Thallium	6.63E+01	7.27E-01	Yes	2.10E-01	Yes	Yes
Uranium	1.80E+00	2.02E+01	No	NA	NA	No
Organic Compounds (mg/kg)						
PCB, Total	1.00E-01	1.99E-01	**No**	NA	NA	No
Radionuclides (pCi/g)						
Americium-241	ND	NA	NA	NA	NA	No
Cesium-137	ND	NA	NA	NA	NA	No
Cobalt-60	ND	NA	NA	NA	NA	No
Neptunium-237	ND	NA	NA	NA	NA	No
Plutonium-239	ND	NA	NA	NA	NA	No
Technetium-99	1.70E+01	3.62E+02	No	NA	NA	No
Thorium-230	ND	NA	NA	NA	NA	No

ND = not detected
NA = not applicable

Table D.2. Action Level Comparison for Soil/Sludge for C-403 Neutralization Tank (SWMU 40)

Analyte	Concentration Detected (mg/kg) or (pCi/g)	No Action Level (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No	Selected as COPC Yes or No
Metals (mg/kg)						
Arsenic	ND	NA	NA	NA	NA	No
Barium	ND	NA	NA	NA	NA	No
Cadmium	2.84E-01	2.13E+01	No	NA	NA	No
Lead	ND	NA	NA	NA	NA	No
Mercury	ND	NA	NA	NA	NA	No
Nickel	1.63E+01	2.42E+02	No	NA	NA	No
Selenium	ND	NA	NA	NA	NA	No
Silver	ND	NA	NA	NA	NA	No
Thallium	ND	NA	NA	NA	NA	No
Uranium	4.05E+03	2.02E+01	Yes	4.9E+00	Yes	Yes
Organic Compounds (mg/kg)						
Benzene	ND	NA	NA	NA	NA	No
2-Butanone	ND	NA	NA	NA	NA	No
Carbon Tetrachloride	ND	NA	NA	NA	NA	No
Chlorobenzene	ND	NA	NA	NA	NA	No
Chloroform	ND	NA	NA	NA	NA	No
Chromium	ND	NA	NA	NA	NA	No
1,2-Dichlorobenzene	ND	NA	NA	NA	NA	No
1,4-Dichlorobenzene	ND	NA	NA	NA	NA	No
1,2-Dichloroethane	ND	NA	NA	NA	NA	No
1,1-Dichloroethene	ND	NA	NA	NA	NA	No
2,4-Dinitrotoluene	ND	NA	NA	NA	NA	No
Endrin	ND	NA	NA	NA	NA	No
Heptachlor Epoxide	ND	NA	NA	NA	NA	No
Hexachlorobenzene	ND	NA	NA	NA	NA	No
Hexachlorobutadiene	ND	NA	NA	NA	NA	No
Hexachloroethane	ND	NA	NA	NA	NA	No
Methoxychlor	ND	NA	NA	NA	NA	No
2-Methylphenol	ND	NA	NA	NA	NA	No
Nitrobenzene	ND	NA	NA	NA	NA	No
Pentachlorophenol	ND	NA	NA	NA	NA	No
Pyridine	ND	NA	NA	NA	NA	No
Toxaphene	ND	NA	NA	NA	NA	No
Trichloroethene	ND	NA	NA	NA	NA	No
2,4,5-Trichlorophenol	ND	NA	NA	NA	NA	No
2,4,6-Trichlorophenol	ND	NA	NA	NA	NA	No
PCB, Total	1.49E+01	1.99E-01	Yes	NA	NA	Yes

Table D.2. Action Level Comparison for C-403 Neutralization Tank Soil/Sludge (SWMU 40) (Continued)

Analyte	Concentration Detected (mg/kg) or (pCi/g)	No Action Level (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No	Selected as COPC Yes or No
Radionuclides (pCi/g)						
Neptunium-237	3.89E+01	2.71E-01	Yes	1.0E-01	Yes	Yes
Plutonium-239/240	2.19E+00	1.15E+01	No	2.50E-02	Yes	No
Technetium-99	2.30E+01	3.62E+02	No	NA	NA	No
Thorium-230	2.38E+01	1.49E+01	Yes	1.5E+00	Yes	Yes
Uranium-235	1.45E+03	3.95E-01	Yes	1.40E_01	Yes	Yes

ND = not detected
NA = not applicable

Table D.3. Action Level Comparison for Soil/Sludge for C-410-B HF Neutralization Lagoon (SWMU 19)

Analyte	Concentration Detected (mg/kg) or (pCi/g)	No Action Level (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No	Selected as COPC Yes or No
Metals (mg/kg)						
Antimony	ND	NA	NA	NA	NA	No
Arsenic	8.37E+00	5.23E-01	Yes	1.20E+01	No	No
Barium	1.06E+02	2.29E+02	No	NA	NA	No
Benzene	6.00E-03	1.13E+00	No	NA	NA	No
Aluminum	9.01E+03	4.64E+03	Yes	1.30E+04	No	No
Beryllium	7.30E-01	9.48E-01	No	NA	NA	No
Cadmium	5.70E+00	2.13E+01	No	NA	NA	No
Calcium	8.74E+04	NA	NA	NA	NA	No
Cobalt	7.79E+00	1.92E+03	No	NA	NA	No
Copper	1.78E+02	4.93E+02	No	NA	NA	No
Chromium	1.73E+01	3.56E+02	No	NA	NA	No
Iron	1.34E+04	2.07E+03	Yes	2.80E+04	No	No
Lead	1.71E+01	4.00E+02	No	NA	NA	No
Magnesium	3.47E+03	NA	NA	NA	NA	No
Manganese	3.37E+02	4.52E+01	Yes	1.50E+03	No	No
Mercury	3.10E-01	1.00E+05	No	NA	NA	No
Nickel	5.27E+01	2.42E+02	No	NA	NA	No
Potassium	9.91E+02	NA	NA	NA	NA	No
Selenium	1.20E+00	9.49E+01	No	NA	NA	No
Silver	7.92E+01	4.11E+01	Yes	2.30E+00	Yes	Yes
Sodium	8.88E+02	NA	NA	NA	NA	No
Thallium	5.48E-01	7.27E-01	No	NA	NA	No
Uranium	3.67E+01	2.02E+01	Yes	4.90E+00	Yes	Yes
Vanadium	2.39E+01	3.32E+00	Yes	3.80E+01	No	No
Zinc	8.59E+01	2.73E+03	No	NA	NA	No
Organic Compounds (mg/kg)						
Acenaphthylene	ND	NA	NA	NA	NA	No
Acetone	4.39E-02	3.58E+02	No	NA	NA	No
Aldrin	ND	NA	NA	NA	NA	No
Alpha Chlordane	9.70E-02	2.08E+00	No	NA	NA	No
Anthracene	1.40E+00	3.79E+03	No	NA	NA	No
1,2-Benzenedicarboxylic Acid	2.43E-01	1.12E+04	No	NA	NA	No
Benzenemethanol	ND	NA	NA	NA	NA	No
Benzo(ghi)perylene	ND	NA	NA	NA	NA	No
Benzoic Acid	ND	NA	NA	NA	NA	No

Table D.3. Action Level Comparison for Soil/Sludge for C-410-B HF Neutralization Lagoon (SWMU 19) (Continued)

Analyte	Concentration Detected (mg/kg) or (pCi/g)	No Action Level (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No	Selected as COPC Yes or No
Bis(2-chloroisopropyl) ether	ND	NA	NA	NA	NA	No
Bis(2-ethylhexyl)phthalate	9.20E-01	8.84E+00	No	NA	NA	No
Bromodichloromethane	ND	NA	NA	NA	NA	No
Bromoform	ND	NA	NA	NA	NA	No
Bromomethane	ND	NA	NA	NA	NA	No
4-Bromophenyl phenyl ether	ND	NA	NA	NA	NA	No
2-Butanone	ND	NA	NA	NA	NA	No
Butyl benzyl phthalate	2.70E+00	2.71E+03	No	NA	NA	No
Carbon disulfide	ND	NA	NA	NA	NA	No
Carbon Tetrachloride	ND	NA	NA	NA	NA	No
4-Chlorobenzenamine	ND	NA	NA	NA	NA	No
Chlorobenzene	ND	NA	NA	NA	NA	No
Chloroethane	ND	NA	NA	NA	NA	No
Chloroform	ND	NA	NA	NA	NA	No
Chloromethane	ND	NA	NA	NA	NA	No
4-Chloro-3-methylphenol	ND	NA	NA	NA	NA	No
4-Chlorophenyl phenyl ether	ND	NA	NA	NA	NA	No
2-Chloronaphthalene	ND	NA	NA	NA	NA	No
2-Chlorophenol	ND	NA	NA	NA	NA	No
cis-1,3-Dichloropropene	ND	NA	NA	NA	NA	No
Cyanide	ND	NA	NA	NA	NA	No
4,4'-DDD	ND	NA	NA	NA	NA	No
4,4'-DDE	ND	NA	NA	NA	NA	No
4,4'-DDT	3.20E-02	3.59E+00	No	NA	NA	No
Dibenzofuran	ND	NA	NA	NA	NA	No
Dibromochloromethane	ND	NA	NA	NA	NA	No
1,2-Dichlorobenzene	ND	NA	NA	NA	NA	No
1,3-Dichlorobenzene	ND	NA	NA	NA	NA	No
1,4-Dichlorobenzene	ND	NA	NA	NA	NA	No
3,3-Dichlorobenzidine	ND	NA	NA	NA	NA	No
1,1-Dichloroethane	ND	NA	NA	NA	NA	No
1,2-Dichloroethane	ND	NA	NA	NA	NA	No
1,1-Dichloroethene	ND	NA	NA	NA	NA	No
1,2-Dichloroethene	ND	NA	NA	NA	NA	No
2.4-Dichloropheno	ND	NA	NA	NA	NA	No

Table D.3. Action Level Comparison for Soil/Sludge for C-410-B HF Neutralization Lagoon (SWMU 19) (Continued)

Analyte	Concentration Detected (mg/kg) or (pCi/g)	No Action Level (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No	Selected as COPC Yes or No
1,2-Dichloropropane	ND	NA	NA	NA	NA	No
trans-1,3-Dichloropropene	ND	NA	NA	NA	NA	No
Dieldrin	ND	NA	NA	NA	NA	No
Diethyl phthalate	ND	NA	NA	NA	NA	No
2,4-Dimethylphenol	ND	NA	NA	NA	NA	No
Di-n-butyl phthalate	1.62E+00	2.13E+03	No	NA	NA	No
Di-n-octylphthalate	ND	NA	NA	NA	NA	No
2,4-Dinitrophenol	ND	NA	NA	NA	NA	No
2,4-Dinitrotoluene	ND	NA	NA	NA	NA	No
2,6-Dinitrotoluene	ND	NA	NA	NA	NA	No
Endosulfan I	ND	NA	NA	NA	NA	No
Endosulfan II	ND	NA	NA	NA	NA	No
Endosulfan sulfate	ND	NA	NA	NA	NA	No
Endrin	ND	NA	NA	NA	NA	No
Endrin ketone	ND	NA	NA	NA	NA	No
Ethylbenzene	ND	NA	NA	NA	NA	No
Fluoranthene	1.90E+03	2.21E+02	Yes	NA	NA	Yes
Fluorene	3.30E-01	3.39E+02	No	NA	NA	No
Heptachlor	ND	NA	NA	NA	NA	No
Heptachlor Epoxide	ND	NA	NA	NA	NA	No
Hexachlorobenzene	ND	NA	NA	NA	NA	No
Hexachlorobutadiene	ND	NA	NA	NA	NA	No
Hexachlorocyclopentadiene	ND	NA	NA	NA	NA	No
Hexachloroethane	ND	NA	NA	NA	NA	No
2-Hexanone	ND	NA	NA	NA	NA	No
Isophorone	ND	NA	NA	NA	NA	No
Lindane	ND	NA	NA	NA	NA	No
Methoxychlor	ND	NA	NA	NA	NA	No
2-Methyl-4,6-dinitrophenol	ND	NA	NA	NA	NA	No
4-Methyl-2-pentanone	ND	NA	NA	NA	NA	No
2-Methylnaphthalene	ND	NA	NA	NA	NA	No
2-Methylphenol	ND	NA	NA	NA	NA	No
4-Methylphenol	ND	NA	NA	NA	NA	No
Methylene chloride	ND	NA	NA	NA	NA	No
Naphthalene	1.10E+00	2.36E+01	No	NA	NA	No
Nitrobenzene	ND	NA	NA	NA	NA	No

Table D.3. Action Level Comparison for Soil/Sludge for C-410-B HF Neutralization Lagoon (SWMU 19) (Continued)

Analyte	Concentration Detected (mg/kg) or (pCi/g)	No Action Level (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No	Selected as COPC Yes or No
2-Nitrobenzenamine	ND	NA	NA	NA	NA	No
3-Nitrobenzenamine	ND	NA	NA	NA	NA	No
4-Nitrobenzenamine	ND	NA	NA	NA	NA	No
2-Nitrophenol	ND	NA	NA	NA	NA	No
4-Nitrophenol	ND	NA	NA	NA	NA	No
N-Nitroso-di-n-propylamine	ND	NA	NA	NA	NA	No
N-Nitrosodiphenylamine	ND	NA	NA	NA	NA	No
Pentachlorophenol	ND	NA	NA	NA	NA	No
Phenanthrene	1.89E+00	NA	NA	NA	NA	No
Phenol	5.60E-02	1.16E+04	No	NA	NA	No
Pyrene	1.79E+00	1.65E+02	No	NA	NA	No
Styrene	ND	NA	NA	NA	NA	No
1,1,2,2-Tetrachloroethane	ND	NA	NA	NA	NA	No
Tetrachloroethene	ND	NA	NA	NA	NA	No
Toluene	ND	NA	NA	NA	NA	No
Toxaphene	ND	NA	NA	NA	NA	No
1,2,4-Trichlorobenzene	ND	NA	NA	NA	NA	No
1,1,1-Trichloroethane	ND	NA	NA	NA	NA	No
1,1,2-Trichloroethane	ND	NA	NA	NA	NA	No
Trichloroethene	ND	NA	NA	NA	NA	No
2,4,5-Trichlorophenol	ND	NA	NA	NA	NA	No
2,4,6-Trichlorophenol	ND	NA	NA	NA	NA	No
Vinyl acetate	ND	NA	NA	NA	NA	No
Vinyl chloride	ND	NA	NA	NA	NA	No
Xylene, total	ND	NA	NA	NA	NA	No
PCB, Total	ND	NA	NA	NA	NA	No
PAHs	6.86E+00	2.12E-02	Yes	NA	NA	Yes
Radionuclides (pCi/g)						
Americium-241	1.70E-01	5.16E+00	No	NA	NA	No
Cesium-137	3.73E-02	8.58E-02	No	NA	NA	No
Cobalt-60	1.60E-02	1.77E-02	No	NA	NA	No
Neptunium-237	ND	NA	NA	NA	NA	No
Plutonium-238	ND	NA	NA	NA	NA	No
Plutonium-239	ND	NA	NA	NA	NA	No
Technetium-99	5.07E+01	3.62E+02	No	NA	NA	No
Thorium-230	8.90E-01	1.49E+01	No	NA	NA	No
Thorium-232	7.90E-01	1.35E+01	No	NA	NA	No

Table D.3. Action Level Comparison for Soil/Sludge for C-410-B HF Neutralization Lagoon (SWMU 19) (Continued)

Analyte	Concentration Detected (mg/kg) or (pCi/g)	No Action Level (mg/kg) or (pCi/g)	Exceeds No Action Level Yes or No	Background (mg/kg) or (pCi/g)	Exceeds Background Yes or No	Selected as COPC Yes or No
Uranium-234	4.50E+01	1.98E+01	Yes	2.50E+00	Yes	Yes
Uranium-235	7.67E-01	3.95E-01	Yes	1.40E-01	Yes	Yes
Uranium-238	4.80E+01	1.71E+00	Yes	1.20E+00	Yes	Yes

ND = not detected
NA = not applicable

Table D.4 Action Level Comparison for Accumulated Rainwater in C-403 Neutralization Tank (SWMU 40)

Analyte	Concentration Detected (mg/L) or (pCi/L)	No Action Level (mg/L) or (pCi/L)	Exceeds No Action Level Yes or No	Background (mg/L) or (pCi/L)	Exceeds Background Yes or No	Selected as COPC Yes or No
Metals (mg/L)						
Arsenic	ND	NA	NA	NA	NA	No
Barium	1.20E+00	4.48E+00	No	NA	NA	No
Cadmium	2.40E-02	4.57E-03	Yes	NA	NA	Yes
Chromium	1.90E-04	6.86E+00	No	NA	NA	No
Lead	ND	NA	NA	NA	NA	No
Mercury	ND	NA	NA	NA	NA	No
Nickel	3.90E+00	4.94E+00	No	NA	NA	No
Selenium	9.50E-02	2.01E+00	No	NA	NA	No
Silver	ND	NA	NA	NA	NA	No
Uranium	1.07E+00	4.66E-01	Yes	NA	NA	Yes
Organic Compounds (mg/L)						
1,2-Dichlorobenzene	ND	NA	NA	NA	NA	No
1,2-Dichloroethane	ND	NA	NA	NA	NA	No
1,4-Dichlorobenzene	ND	NA	NA	NA	NA	No
2,4,5-Trichlorophenol	ND	NA	NA	NA	NA	No
2,4,6-Trichlorophenol	ND	NA	NA	NA	NA	No
2,4-D	ND	NA	NA	NA	NA	No
2,4-Dinitrotoluene	ND	NA	NA	NA	NA	No
2-Butanone	ND	NA	NA	NA	NA	No
2-Methylphenol	ND	NA	NA	NA	NA	No
4-Methylphenol	ND	NA	NA	NA	NA	No
Benzene	ND	NA	NA	NA	NA	No
Carbon Tetrachloride	ND	NA	NA	NA	NA	No
Chlorobenzene	ND	NA	NA	NA	NA	No
Chloroform	ND	NA	NA	NA	NA	No
Endrin	2.00E-03	3.43E-04	Yes	NA	NA	Yes
Heptachlor Epoxide	1.00E-03	3.68E-05	Yes	NA	NA	Yes
Hexachlorobenzene	ND	NA	NA	NA	NA	No
Hexachlorobutadiene	ND	NA	NA	NA	NA	No
Hexachloroethane	ND	NA	NA	NA	NA	No
Methoxychlor	1.00E-02	1.14E-01	No	NA	NA	No
Nitrobenzene	ND	NA	NA	NA	NA	No
Aroclor-1260	8.70E+00	5.24E-05	Yes	NA	NA	Yes
Aroclor-1268	8.90E+00	NA	NA	NA	NA	No
PCB-TOTAL	1.76E+01	1.65E-04	Yes	NA	NA	Yes
Pentachlorophenol	ND	NA	NA	NA	NA	No
Pentachlorophenol	ND	NA	NA	NA	NA	No
Pyridine	ND	NA	NA	NA	NA	No

Table D.4 Action Level Comparison for Accumulated Rainwater in C-403 Neutralization Tank (SWMU 40) (Continued)

Analyte	Concentration Detected (mg/L) or (pCi/L)	No Action Level (mg/L) or (pCi/L)	Exceeds No Action Level Yes or No	Background (mg/L) or (pCi/L)	Exceeds Background Yes or No	Selected as COPC Yes or No
Toxaphene	2.00E-02	7.76E-04	Yes	NA	NA	Yes
Trichloroethene	1.70E+00	2.18E-02	Yes	NA	NA	Yes
Radionuclides (pCi/L)						
Pu-239	1.80E-03	NA	NA	NA	NA	No
Np-237	2.88E-02	NA	NA	NA	NA	No
Tc-99	1.80E-02	NA	NA	NA	NA	No
Th-230	1.76E-02	NA	NA	NA	NA	No

ND = not detected
NA = not applicable

Table D.5 Action Level Comparison for Accumulated Rainwater in C-410-B HF Neutralization Lagoon (SWMU 19)

Analyte	Concentration Detected (mg/L) or (pCi/L)	No Action Level (mg/L) or (pCi/L)	Exceeds No Action Level Yes or No	Background (mg/L) or (pCi/L)	Exceeds Background Yes or No	Selected as COPC Yes or No
Metals (mg/L)						
Antimony	1.09E+00	7.31E-03	Yes	NA	NA	Yes
Arsenic	ND	NA	NA	NA	NA	No
Barium	4.69E-02	4.48E+00	No	NA	NA	No
Beryllium	ND	NA	NA	NA	NA	No
Cadmium	ND	NA	NA	NA	NA	No
Calcium	3.92E+01	NA	NA	NA	NA	No
Chromium	3.31E+00	6.86E+00	No	NA	NA	No
Copper	1.35E-02	1.01E+01	No	NA	NA	No
Iron	2.73E-01	4.11E+01	No	NA	NA	No
Lead	1.65E+00	1.50E-02	Yes	NA	NA	Yes
Magnesium	1.12E+00	NA	NA	NA	NA	No
Mercury	ND	NA	NA	NA	NA	No
Nickel	8.43E-01	4.94E+00	No	NA	NA	No
Potassium	1.21E+00	NA	NA	NA	NA	No
Selenium	1.10E-03	2.01E+00	No	NA	NA	No
Silver	ND	NA	NA	NA	NA	No
Sodium	1.40E+00	NA	NA	NA	NA	No
Thallium	ND	NA	NA	NA	NA	No
Vanadium	ND	NA	NA	NA	NA	No
Zinc	8.62E-02	5.48E+01	No	NA	NA	No
Organics (mg/L)						
1,1,1-Trichloroethane	1.00E-03	1.69E+00	No	NA	NA	No
1,1,2,2-Tetrachloroethane	ND	NA	NA	NA	NA	No
1,1,2-Trichloroethane	ND	NA	NA	NA	NA	No
1,1-Dichloroethane	ND	NA	NA	NA	NA	No
1,2,4-Trichlorobenzene	ND	NA	NA	NA	NA	No
1,2-Dichlorobenzene	ND	NA	NA	NA	NA	No
1,2-Dichloroethane	ND	NA	NA	NA	NA	No
1,2-Dichloropropane	ND	NA	NA	NA	NA	No
1,4-Dichlorobenzene	ND	NA	NA	NA	NA	No
2,4,5-Trichlorophenol	ND	NA	NA	NA	NA	No
2,4-Dimethylphenol	ND	NA	NA	NA	NA	No
2,4-Dinitrotoluene	ND	NA	NA	NA	NA	No
2-Butanone	ND	NA	NA	NA	NA	No
2-Chloronaphthalene	ND	NA	NA	NA	NA	No
2-Chlorophenol	2.00E-03	6.93E-02	No	NA	NA	No

Table D.5 Action Level Comparison for Accumulated Rainwater in C-410-B HF Neutralization Lagoon (SWMU 19) (Continued)

Analyte	Concentration Detected (mg/L) or (pCi/L)	No Action Level (mg/L) or (pCi/L)	Exceeds No Action Level Yes or No	Background (mg/L) or (pCi/L)	Exceeds Background Yes or No	Selected as COPC Yes or No
2-Hexanone	ND	NA	NA	NA	NA	No
2-Methyl-4,6-dinitrophenol	ND	NA	NA	NA	NA	No
2-Methylnaphthalene	ND	NA	NA	NA	NA	No
2-Methylphenol	ND	NA	NA	NA	NA	No
2-Nitrobenzenamine	ND	NA	NA	NA	NA	No
2-Nitrophenol	ND	NA	NA	NA	NA	No
3,3'-Dichlorobenzidine	ND	NA	NA	NA	NA	No
3-Nitrobenzenamine	ND	NA	NA	NA	NA	No
4,4'-DDT	ND	NA	NA	NA	NA	No
4-Bromophenyl phenyl ether	ND	NA	NA	NA	NA	No
4-Chloro-3-methylphenol	2.00E-03	NA	NA	NA	NA	No
4-Chlorobenzenamine	ND	NA	NA	NA	NA	No
4-Chlorophenyl phenyl ether	ND	NA	NA	NA	NA	No
4-Methyl-2-pentanone	ND	NA	NA	NA	NA	No
4-Methylphenol	ND	NA	NA	NA	NA	No
4-Nitrobenzenamine	5.00E-02	NA	NA	NA	NA	No
4-Nitrophenol	ND	NA	NA	NA	NA	No
Acenaphthene	ND	NA	NA	NA	NA	No
Acenaphthylene	ND	NA	NA	NA	NA	No
Acetone	ND	NA	NA	NA	NA	No
Aldrin	ND	NA	NA	NA	NA	No
alpha-BHC	ND	NA	NA	NA	NA	No
alpha-Chlordane	ND	NA	NA	NA	NA	No
4-Chlorobenzenamine	ND	NA	NA	NA	NA	No
4-Chlorophenyl phenyl ether	ND	NA	NA	NA	NA	No
4-Methyl-2-pentanone	ND	NA	NA	NA	NA	No
4-Methylphenol	ND	NA	NA	NA	NA	No
4-Nitrobenzenamine	ND	NA	NA	NA	NA	No
4-Nitrophenol	ND	NA	NA	NA	NA	No
Acenaphthene	ND	NA	NA	NA	NA	No
Acenaphthylene	ND	NA	NA	NA	NA	No
Acetone	ND	NA	NA	NA	NA	No
Aldrin	ND	NA	NA	NA	NA	No
alpha-BHC	ND	NA	NA	NA	NA	No

Table D.5 Action Level Comparison for Accumulated Rainwater in C-410-B HF Neutralization Lagoon (SWMU 19) (Continued)

Analyte	Concentration Detected (mg/L) or (pCi/L)	No Action Level (mg/L) or (pCi/L)	Exceeds No Action Level Yes or No	Background (mg/L) or (pCi/L)	Exceeds Background Yes or No	Selected as COPC Yes or No
alpha-Chlordane	ND	NA	NA	NA	NA	No
Anthracene	ND	NA	NA	NA	NA	No
Benz(a)anthracene	ND	NA	NA	NA	NA	No
Benzene	ND	NA	NA	NA	NA	No
Benzenemethanol	ND	NA	NA	NA	NA	No
Benzo(a)pyrene	ND	NA	NA	NA	NA	No
Benzo(b)fluoranthene	ND	NA	NA	NA	NA	No
Benzo(ghi)perylene	ND	NA	NA	NA	NA	No
Benzo(k)fluoranthene	ND	NA	NA	NA	NA	No
Benzoic acid	ND	NA	NA	NA	NA	No
beta-BHC	ND	NA	NA	NA	NA	No
Bis(2-chloroethoxy)methane	ND	NA	NA	NA	NA	No
Bis(2-chloroethyl) ether	ND	NA	NA	NA	NA	No
Bis(2-chloroisopropyl) ether	ND	NA	NA	NA	NA	No
Bis(2-ethylhexyl)phthalate	1.00E-03	1.51E-02	No	NA	NA	No
Bromodichloromethane	ND	NA	NA	NA	NA	No
Bromoform	ND	NA	NA	NA	NA	No
Bromomethane	ND	NA	NA	NA	NA	No
Butyl benzyl phthalate	ND	NA	NA	NA	NA	No
Carbon disulfide	3.90E-02	2.40E+00	No	NA	NA	No
Carbon tetrachloride	ND	NA	NA	NA	NA	No
Chlorobenzene	ND	NA	NA	NA	NA	No
Chloroethane	ND	NA	NA	NA	NA	No
Chloroform	ND	NA	NA	NA	NA	No
Chloromethane	ND	NA	NA	NA	NA	No
Chrysene	ND	NA	NA	NA	NA	No
cis-1,3-Dichloropropene	ND	NA	NA	NA	NA	No
Cyanide	ND	NA	NA	NA	NA	No
delta-BHC	ND	NA	NA	NA	NA	No
Dibenz(a,h)anthracene	ND	NA	NA	NA	NA	No
Isophorone	ND	NA	NA	NA	NA	No
Lindane	ND	NA	NA	NA	NA	No
Methoxychlor	ND	NA	NA	NA	NA	No
Methylene chloride	ND	NA	NA	NA	NA	No
Naphthalene	ND	NA	NA	NA	NA	No
Nitrobenzene	ND	NA	NA	NA	NA	No

Table D.5 Action Level Comparison for Accumulated Rainwater in C-410-B HF Neutralization Lagoon (SWMU 19) (Continued)

Analyte	Concentration Detected (mg/L) or (pCi/L)	No Action Level (mg/L) or (pCi/L)	Exceeds No Action Level Yes or No	Background (mg/L) or (pCi/L)	Exceeds Background Yes or No	Selected as COPC Yes or No
N-Nitroso-di-n-propylamine	ND	NA	NA	NA	NA	No
N-Nitrosodiphenylamine	ND	NA	NA	NA	NA	No
Aroclor -1016	ND	NA	NA	NA	NA	No
Aroclor -1221	ND	NA	NA	NA	NA	No
Aroclor -1232	ND	NA	NA	NA	NA	No
Aroclor -1242	ND	NA	NA	NA	NA	No
Aroclor -1248	ND	NA	NA	NA	NA	No
Aroclor -1254	ND	NA	NA	NA	NA	No
Aroclor -1260	ND	NA	NA	NA	NA	No
Pentachlorophenol	ND	NA	NA	NA	NA	No
Phenanthrene	ND	NA	NA	NA	NA	No
Phenol	ND	NA	NA	NA	NA	No
Pyrene	5.00E-03	2.66E-02	No	NA	NA	No
Styrene	ND	NA	NA	NA	NA	No
Tetrachloroethene	ND	NA	NA	NA	NA	No
Toluene	ND	NA	NA	NA	NA	No
Total Xylene	ND	NA	NA	NA	NA	No
Toxaphene	ND	NA	NA	NA	NA	No
trans-1,3-Dichloropropene	ND	NA	NA	NA	NA	No
Trichloroethene	ND	NA	NA	NA	NA	No
Vinyl acetate	ND	NA	NA	NA	NA	No
Vinyl chloride	ND	NA	NA	NA	NA	No
Radionuclides (pCi/L)						
Neptunium-237	ND	NA	NA	NA	NA	No
Plutonium-239	ND	NA	NA	NA	NA	No
Technetium-99	6.90E+02	NA	NA	NA	NA	No
Thorium-230	1.50E-01	NA	NA	NA	NA	No
Uranium-238	2.10E+02	NA	NA	NA	NA	No

ND = not detected
NA = not applicable

Table D.6 Dose Action Level Comparison for Soil/Sludge

Analyte	Concentration Detected (pCi/L)	Dose Based Screening Level 25 mrem/yr	Dose Based Screening Level[a] 15 mrem/yr	Exceeds Dose Based Screening Level Yes or No
C-218 Outdoor Firing Range (SWMU 181)-Soil/Sediment				
Technetium-99	1.70E+01	6.06E+05	3.64E+05	No
C-403 Neutralization Tank (SWMU 40)-Soil/Sediment				
Neptunium-237	3.89E+01	9.75E+01	5.85E+01	No
Plutonium-239	2.19E+00	5.63E+02	3.74E+02	No
Technetium-99	2.30E+01	6.06E+05	3.64E+05	No
Thorium-230	2.38E+01	3.51E+03	2.11E+03	No
Uranium-235	1.45E+03	1.77E+02	1.06E+02	Yes
C-410-B HF Neutralization Lagoon (SWMU 19)-Soil/Sediment				
Americium-241	1.70E-01	4.67E+02	2.80E+02	No
Cesium-137	3.73E-02	4.01E+01	2.41E+01	No
Cobalt-60	1.60E-02	8.45E+00	5.07E+00	No
Neptunium-237	ND	9.75E+01	5.85E+01	NA
Plutonium-238	ND	6.24E+02	3.74E+02	NA
Plutonium-239	ND	5.63E+02	3.38E+02	NA
Technetium-99	5.07E+01	6.06E+05	3.64E+05	No
Thorium-230	8.90E-01	8.01E+00	2.11E+03	No
Thorium-232	7.90E-01	7.52E+02	4.35E+02	No
Uranium-234	4.50E+01	6.88E+03	4.13E+03	No
Uranium-235	7.67E-01	1.77E+02	1.06E+02	No
Uranium-238	4.80E+01	8.80E+02	5.28E+02	No

[a] Dose-based screening level at 15 mrem/yr is included for comparison purposes only.

Table D.7 Dose Action Level Comparison for Accumulated Rainwater

Analyte	Concentration Detected (pCi/L)	Dose Based Screening Level 25 mrem/yr	Dose Based Screening Level[a] 15 mrem/yr	Exceeds Dose Based Screening Level Yes or No
C-403 Neutralization Tank (SWMU 40)- Accumulated Rainwater				
Plutonium-239	1.80E-03	NA	NA	NA
Neptunium-237	2.88E-02	NA	NA	NA
Technetium-99	1.80E-02	NA	NA	NA
Thorium-230	1.76E-02	NA	NA	NA
C-410-B HF Neutralization Lagoon (SWMU 19)- Accumulated Rainwater				
Neptunium-237	ND	NA	NA	NA
Plutonium-239	ND	NA	NA	NA
Technetium-99	6.90E+02	NA	NA	NA
Thorium-230	1.50E-01	NA	NA	NA
Uranium-238	2.10E+02	NA	NA	NA

[a] Dose-based screening level at 15 mrem/yr is included for comparison purposes only.

APPENDIX E

CLEANUP GOALS

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E.1 CLEANUP GOALS

Several COPCs were identified in Section 1.6, "Streamlined Risk Evaluation" The detected concentrations for these COPCs exceeded no action levels taken from the Risk Methods Document (DOE 2001), and it was determined that unacceptable human health risks could exist at each of the three inactive facilities. Based on the comparative analysis from Section 4, "Analysis of Alternatives," Alternative 3 - "Excavation and Interim Institutional Controls," was the recommended removal action alternative. Under this alternative, C-403 Neutralization Tank (SWMU 40) and C-410-B HF Neutralization Lagoon (SWMU 19) will be removed to their respective SWMU boundaries; therefore, cleanup levels for these inactive facilities are not applicable. For the C-218 Firing Range (SWMU 181), the focus of the removal action is lead contaminated soil. As a result, cleanup goals for lead at the C-218 Firing Range (SWMU 181) were developed. Appendix E is included to give the risk manager the details associated with the development of the cleanup goals for the C-218 Outdoor Firing Range (SWMU 181) and a summary of the final cleanup levels that were selected consistent with the preferred alternative presented in Section 5, "Recommended Removal Action Alternative." It provides the rationale and backup information that supports the final cleanup levels necessary to meet set regulatory limits, dose, hazard, and risk levels.

E.1.1 Lead Exposure

Adverse effects on neurological development have been manifested from lead ingestion, especially among children. At the C-218 Outdoor Firing Range (SWMU 181), the lead concentration was measured at 14,880 mg/kg in one sample, which is one to two orders of magnitude above EPA guidelines for lead at commercial/industrial areas in soil (EPA 2003a). While no published risk factors are available for lead, EPA recommends a screening level for soil lead at commercial/industrial (i.e., nonresidential) sites of 800 mg/kg based on an analysis of the combined phases of the National Health and Nutrition Examination Survey (NHANES III) using the Adult Lead Model that provided a cleanup goal protective of adult workers (EPA 2007). The C-218 Outdoor Firing Range is located in area that is designated for industrial use, based on current land use associated with plant operations and the lease agreement with USEC. As a result, the screening level of 800 mg/kg from the EPA guidance document has been selected as the cleanup level for the current land use scenario.

While the selection of 800 mg/kg satisfies the primary objective of this removal action to reduce current risks to the industrial worker, consideration should be given to the location of the C-218 Firing Range and planning assumptions in the SMP that indicate recreational use reasonably could be expected in the future for this area once the plant ceases operation. Currently, there is no published EPA guidance documenting cleanup levels that correspond to a recreational use; however, EPA guidance does allow for a site-specific value to be calculated using the Integrated Exposure Uptake Biokinetic Model (IEUBK) (EPA 1994; EPA 2003b). In order to obtain a cleanup level appropriate for recreational use, this model was utilized to calculate a site-specific lead preliminary remediation goal (PRG) based on intermittent exposures to a recreational receptor. The recreational receptor was assumed to spend 42 days during the summer months and an additional 18 days over the fall/winter during hunting season. The combined exposure to the recreational receptor over the two seasons resulted in a total of 60 days per 8 months (i.e., 1.7 days per week). Time-weighted soil concentrations for input into the IEUBK were developed using a mean background value of 17 mg/kg for off-site exposure and varying on-site concentrations. Different values for the weighted soil concentration were run through the model iteratively to develop a PRG that met the EPA target of less than 5% probability of exceeding the 10 ug/dl blood lead level (EPA 2003b). The updated values for lead residue in food from the 2001 Food and Drug Administration Total Diet Study were used in the model, and the tap water concentration was modified to the mean background value for dissolved lead in RGA groundwater (9.8 ug/L). For the recommended scenario of the summer and fall

exposures combined, the site-specific PRG for lead in soil is 1,420 mg/kg for recreational use. This PRG represents an acceptable mean concentration in soil at the site.

The calculated site-specific cleanup level of 1,420 mg/kg for lead in soil for recreational use is higher than the EPA recommended screening level of 800 mg/kg lead in soil for the industrial land use scenario. As a result, the 800 mg/kg screening level has been selected as the cleanup level protective of both industrial and recreational exposures for this removal action. The selection of 800 mg/kg provides a basis for a no further action under the current and future land use scenarios.

E.1.2 Lead Modeling

The EPA lead model IEUBKWin32, version 1.0.264, was used to calculate a lead PRG based on intermittent exposures to a recreational receptor for 42 days of exposure over the summer months and an additional 18 days of exposure for the same receptor over the fall/winter months during hunting season. The combined exposure over the two seasons is 60 days per 8 months (1.7 days per week). Time-weighted soil concentrations for input into IEUBK were developed using 17 mg/kg (mean background value) for the off-site exposure and varying on-site concentrations to develop a PRG. The updated values for lead residue in food from the 2001 Food and Drug Administration Total Diet Study were used in the model, and the tap water concentration was changed to the mean background value for dissolved lead in RGA groundwater (9.8 ug/L). For the recommended scenario of the summer and fall exposures combined, the PRG is 1,420 mg/kg lead in site soil. This PRG represents an acceptable mean concentration in soil at the site.

The output from the model using a soil concentration of 1,420 mg/kg lead in site soil is shown in Table E.1. A probability distribution for this modeling run is illustrated in Figure E.1.

Table E.1 Calculated Blood Lead and Lead Uptakes

Age (Years)	Air[1] (ug/day)	Diet[2] (ug/day)	Water[3] (ug/day)	Soil+Dust[4] (ug/day)	Total (ug/day)	Blood Lead Concentration (ug/dL)
.5-1	0.021	1.422	0.882	6.854	9.179	4.9
1-2	0.034	1.148	2.164	10.681	14.027	5.8
2-3	0.062	1.287	2.286	10.850	14.485	5.4
3-4	0.067	1.247	2.365	11.011	14.690	5.1
4-5	0.067	1.221	2.521	8.380	12.188	4.3
5-6	0.093	1.295	2.686	7.619	11.693	3.7
6-7	0.093	1.421	2.747	7.236	11.498	3.3

[1] Daily intake of lead through inhalation (IEUBK default value).
[2] Daily intake of lead from food (2001 Food and Drug Administration Total Diet Study Values.
[3] Daily intake of lead from water (based on PGDP mean concentration of lead in filtered RGA water of 9.8 ug/L).
[4] Daily intake of lead from soil and dust combined based on weighted soil concentration of 17 mg/kg in off-site soil and 1,420 mg/kg in on-site soil.

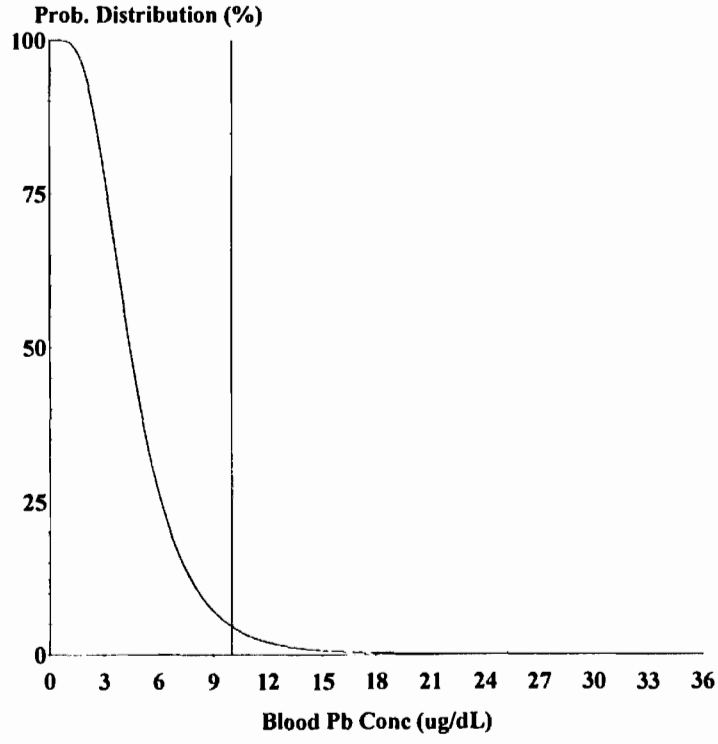

Figure E.1 Probability Distribution Graph for a Lead Concentration in Soil at C-218 Firing Range (SWMU 181) of 1,420 mg/kg

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Comment Response Summary

for the

Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

(DOE/LX/07-0016&D1 issued March 2008)

Regulatory Review – May 2008

Prepared for
U.S. Department of Energy
Office of Environmental Management

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
U.S. Environmental Protection Agency – May 27, 2008			
1.	General	As stated in the document SWMUs 19 and 40 will be excavated, and although not mentioned, we assume will be backfilled thereafter. EPA views the remediation for these SWMUs more as a final action rather than an interim action given the type of remediation necessary. The scenario of revisiting these sites at some point in the future is not time or cost effective and probably unlikely. The RAOs listed in the Executive Summary should be fulfilled with this remedial action and not delayed until some time in the future, especially with respect to controlling source areas and protecting groundwater and surface water. Therefore the COPCs selected and the cleanup goals derived should be done so with the intent that this remedial action is final.	Under the proposed EE/CA, SWMU 19 and SWMU 40 are targeted for excavation and will be backfilled as part of site restoration (See Section 4.3.3 page 42); therefore, within the boundaries of the SWMU a "no further action" will be achieved. Additional text has been added to the report to clarify this action.
2.	Executive Summary	The purpose of the Remedial Action Objectives (RAOs) described in the EE/CA is to address the short-term and intermediate goals which include: • Minimize human exposure to contaminants, maximizing the effectiveness of institutional controls; • Control further migration of contaminated soils; • Make progress toward the ultimate goal of protecting recreational users and industrial workers from exposure to contaminated soils. The document falls short in meeting these RAOs for these reasons: 1. The selected cleanup level for PCBs is 32 mg/kg (Table E.4), which is based on industrial use, does not minimize human exposure. PCBs are not listed as a COPC because concentrations detected did not exceed 32 mg/kg. PCBs should be included as COPCs. 2. The PCB cleanup goal (32 mg/kg) calculation assumed present day conditions to an industrial worker rather than future risk to an industrial worker. The difference in assumptions between present day versus a future risk scenario is an exposure frequency of 14 days/year versus 250 days/year and a duration of 25 versus 50 years. The cleanup goal is not protective for future industrial use exposure.	As discussed in response to EPA Comment #1, under the proposed EE/CA, complete removal of SWMU 19 and SWMU 40 is being addressed by this action; therefore, cleanup goals for COPCs are not required for these facilities and have been removed from the EE/CA. For SWMU 181, the lead based screening criteria of 800 mg/kg has been utilized as the cleanup level. The screening level for lead in soil was evaluated for commercial/industrial (current) land use and recreational (future) land use exposure scenarios, defaulting to the commercial/industrial no action level of 800 mg/kg as protective for both industrial and recreational exposures. Additional text has been added to clarify the use of the 800 mg/kg and how the site-specific recreational value was calculated.

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
		3. Storm events can move soils off-site to the creeks. Soils that contain PCB concentrations become a source to recreational users and to habitat off-site. The selected cleanup goal for PCBs should be 10 mg/kg (or 10 ppm) for these reasons: • The goal is consistent with EPA *Guidance on Remedial Actions at Superfund Sites with PCB Contamination* [OSWER Dir.No. 9355.4-01 August 1990] which recommends PCB levels should generally be within the range of 10 to 25 ppm at sites in industrial areas. • The goal of 10 ppm is an established cleanup goal for similar CERCLA sites with industrial use at other DOE facilities. • A cleanup goal of 10 mg/kg will prevent revisiting soil remedial action in the future. • The cleanup goal will be protective of present day and future industrial use workers. • The cleanup goal will address sources to recreational users and habitats as soil migrates off-site.	
3.	Section 1.2 Page 1	The Soils Operable Unit Strategy and objectives are stated as protecting human health, both on-site and off-site. Discussion of ecological protection should be included. In addition, the references to the 2006 SMP with respect to the OU initiatives may not be accurate considering EPA's comments on the 2007 SMP and suggested revision for much of the "strategic" language for use in the 2008 SMP. Consider rewording consistent with EPA's suggested language or deleting any unnecessary reference to the SMP.	The text discussing the primary objective for the Soils Operable Unit (OU) has been modified to include ecological protection and the sentence reads as follows: "The primary objectives of these initiatives are to **protect human health and the environment** by taking actions necessary to prevent both on-site and off-site human exposure that presents an unacceptable risk, to provide safe environmental conditions for industrial workers performing ongoing gaseous diffusion plant operations, and to implement actions that provide the greatest opportunities to achieve significant risk reduction before site closure." 2) The reference to the OU initiatives is consistent with the

118

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
			latest version of the SMP (FY 2007) and consistent with the recent set of comments received from EPA. The reference section and callouts have been revised to reference the FY 2007 SMP.
4.	Section 1.5.2 Page 19	C-403 Neutralization Tank (SWMU 40). The section indicates that sediment samples were collected from the tank, but these locations are not plotted on Figure 7. The text also discusses the high concentrations of TCE detected in sediment (6,700 ug/kg) and water in the tank (21,000 ug/L) and later states that "...TCE is the primary COPC that will be considered in this removal action." However, these concentrations are not reflected in Table 3 - The Selected COPCs for SWMU 40 or any tables in Appendix D or E. All sampling locations should be plotted on the map, sampling results should be included in the tables, and TCE should be retained as a COPC. In the discussion for C-403 of the nature, source, and extent of contamination, there is no mention of the radionuclides that are COCs, and confirmed in Table 2 - Np-237 [2 orders of magnitude over it's NAL], and U-235 [4 orders of magnitude over it's NAL]. The radionuclides should be discussed in the text.	The discussion in the text of the high concentrations of TCE detected in sediment and water in the tank are from an unpublished source and the information is referenced in the WAG 6 RI Report. More detail is given regarding these concentrations in the WAG 6 RI Work Plan. These data were collected from within the tank, and, as a result, they were omitted from Figure 7. Figure 7 has been revised to include samples collected from within the tank and the title of the figure has been changed to reflect the addition of these samples. The electronic data available from this 1993 characterization event are included on the CD. The reader has been referenced to the WAG 6 Work Plan instead of the WAG 6 RI Report, with a notation that the information is from an unpublished report to be used only for process knowledge. The following text has been added to the C-403 Neutralization Tank (SWMU 40) discussion: "Other potential contaminants include uranium metal, PCBs, and radionuclides."
5.	Section 1.5.3 Page 19	C-410-B Hydrogen Fluoride Neutralization Lagoon (SWMU19). The text indicates that sediment and soil samples were collected from the lagoon in 1992. These results are not provided in the tables, nor are the sample locations plotted on Figure 8. The results should be provided.	The sediment and soil samples collected from the lagoon as part of the ACO Phase II Site Investigation are from the locations WMU019 and H215. H215 is included on the figure. WMU019 is listed in Paducah OREIS as a sediment sample and was not included on Figure 8 because the figure shows "Soil Sampling at SWMU 19." The figure title has been revised and WMU019 added. Additionally, RC-4849, RC-4850, RC-4851, and RC-4852, which are listed in Paducah OREIS as sludge samples, have been included on the figure.

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
			These data are available on the CD and are included in the tables.
6.	Section 1.6.1 Page 20	The dose-based screening level of 25 rnrem/yr should not be listed here without also the risk-based criteria used [1E-05 - 1st indication is on P. 44, Table 8, Footnote b] given also, to keep in mind the EPAOSWER Directive 9200.4-18. The explanation of the risk-based criteria alongside the dose-based criteria should be discussed in Section 1.5.2, not just included as a footnote. The risk-based criteria is the determining factor as noted in Table 2 and 8, as would be expected since 25 rnrem/yr is approximately 5E-4 risk equivalent.	Text concerning the dose-based screening level of 25 mrem/yr has been removed. Text originally was added for clarification purposes; however, upon further review, we understand that the text is confusing and the text has been deleted.
7.	Section 1.6; Table 4 Page 21.	Selected COPCs for soil/sludge for SWMU 19. The table shows the total concentration for total PAHs to be 6.86 mg/kg. However Table D.3 (Action Level Comparison for Soil/Sludge for SWMU 19) shows the concentration detected for Fluoranthene as 1,900 mg/kg. This discrepancy should be corrected for Table 4 and Table E.4. PAHs should be retained as COPCs based on concentrations provided in Table D.3.	The apparent discrepancy has been corrected with the addition of a footnote to Table 4. This footnote explains the calculation for Total PAHs, which is the sum of the concentration of the carcinogenic PAHs multiplied by their TEF. Flouranthene is a noncarcinogen, which is not included in this calculation.
8.	Section 1.6.1.1	This section states, "No action levels for the current industrial worker were estimated based on a 14-day per year exposure frequency, making it more representative of possible future site risks that would be applicable to the three inactive facilities. Future industrial workers spending 8 hours per day, 250 days per year, for 25 years, as the Methods Document directs, in one or more of the three inactive facilities is not realistic." The proposed actions will be based upon protecting the current industrial receptor only. While the future industrial scenario default assumptions may well be unrealistic, the text does not provide a rationale to support this claim. It would also reasonable to anticipate a variety of future circumstances in which future industrial exposure duration could exceed 14 days per year. The proposed actions should consider the possibility of a more conservative industrial exposure scenario.	As discussed in response to EPA Comment #1, under the proposed EE/CA, complete removal of SWMU 19 and SWMU 40 is being addressed by this action; therefore, cleanup goals for COPCs are not required for these facilities and have been removed from the EE/CA. For SWMU 181, the lead based screening criteria of 800 mg/kg has been utilized as the cleanup level. The screening level for lead in soil was evaluated for commercial/industrial (current) land use and recreational (future) land use exposure scenarios, defaulting to the commercial/industrial no action level of 800 mg/kg as protective for both industrial and recreational exposures. Additional text has been added to clarify the use of the 800 mg/kg and how the site-specific recreational value was calculated.

12 b

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
9.	Section 3.2.3 Page 27	The text states that "long-term monitoring and other long-term interim institutional controls may be required after a source is successfully removed...". Long-term monitoring would be an additional component to the alternative and not included as part of institutional controls. If this remedial action is treated as final, as stated above, long-term monitoring would not be necessary.	The sentence, "Long-term monitoring and other long-term interim institutional controls may be required after a source is successfully removed and restoration is completed" has been removed.
10.	Section 4.2.3.4 Page 38.	The quotation in the second bullet of EPA's expectation from the 1998 PCB Disposal Rule in the Federal Register is not completely accurate. Please include the phrase "the substantive requirements of' after the words "comply with".	Text has been modified to include the phrase "the substantive requirements of" and the sentence now reads as follows: "EPA anticipates that today's rule will be a potential ARAR at CERCLA sites where PCBs are present. EPA would expect that CERCLA cleanups typically would comply with **the substantive requirements of** one of the three options [self-implementing, performance-based, or risk-based] provided by 761.61, upon completion of the cleanups. This decision would not be made by the facility, but in the remedy selection process."
11.	Section 5; C-403 Page 45	It would be better to say "reduce the U-235 concentration *below the risk derived cleanup goal* of 60.2 pCi/g". It may be inappropriate to state it here in this document, but it should be recognized that with remedial techniques and little added cost, associated with the ALARA principle [As Low As Reasonably Achievable], the removal will hopefully reduce U235 levels far below the cleanup goal, perhaps closer to the uncontrolled industrial level.	Since C-403 and its defined boundaries are targeted for complete excavation, cleanup goals no longer apply for this action. Removal of the SWMU and its defined boundaries will permanently reduce current worker industrial exposure and eliminate a potential source of contamination to surface water or groundwater. As a result, text for this section has been modified as follows: "To achieve risk reduction, SWMU 40 within its defined boundaries will be removed. Defined boundaries of SWMU 40 extend no further than 3 ft on each side of or 3 ft from the bottom of the tank. This will result in the removal of approximately 1,048 m^3 (36,981 ft^3) of soil, sediment, concrete, and brick, which includes the tank and its defined area. Samples will be collected at the SWMU boundary to determine if additional action may be warranted under another OU (i.e., Groundwater OU, Soils OU, CSOU, etc.)."

121

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
12.	Appendix A	Overall the list of ARARs and TBCs on the table appears comprehensive. The format of the table, especially the inclusion of the end column is a bit unusual, and EPA recommends using the format used in previous CERCLA documents at this facility. Consider adding the DOE Order 5400.5(IV)(4)(a) guidelines for residual radioactive material in soils, in particular the requirements for 'hot spots' as TBC in the Chemical-specific table. Also, in the event that the PCB cleanup level of 10 ppm is utilized for this action and is based in part of EPA's *Guidance on Remedial Actions at Superfund Sites with PCB Contamination* [OSWER Dir.No. 9355.4-01 August 1990] then add reference as TBC in the Chemical-specific table.	1) The format of the table has been modified to delete the end column. 2) Since DOE Order 5400.5 (IV)(4)(a) specifically applies at the time property is released, it is not appropriate to add this guideline to the Chemical-Specific ARAR/TBC table since the removal is an interim action and property will not be released and will remain under DOE control. Reference to this order is appropriate for the waste disposal portion of the project and the order is referenced under the Action-Specific ARAR/TBC portion of the table. No changes have been made to the text of the document based on this comment. 3) PCB cleanup levels have been removed from the document and, as a result, the suggested language was not incorporated.
13.	Appendix E; Section E.1.1 Page E-3	This explanation of the risk-based criteria alongside the dose-based criteria should be discussed in the early part of the report, i.e. in Section 1.5.2. The text should be clear that the criteria that 'drives' the cleanup goal for the radionuclides, also meets the EPA OSWER Directive of staying within the 1E-6 to 1E-4 risk range.	Since cleanup goals for COPCs are not required for these facilities, this text no longer applies and has been removed from the EE/CA.
14.	Appendix E, Section E.1.4.1 Page E-6	This section recommends that cleaning up PAH contamination should be deferred to the Comprehensive Sitewide Operable Unit due to widespread nature of PAHs and their continuing sources (e.g., motorized vehicles, asphalt paving, etc.). EPA has been involved is at least two extensive studies at large federal facilities in Region 4 that have sought to link anthropogenic sources to environmental PAH contamination. Neither of these studies was able to establish a statistical correlation. EPA does not concur with the recommendation to defer clean-up of PAHs based on this rationale. Subsequent sections that state, "PAHs currently are not considered as part of this EE/CA," should be revised.	Since cleanup goals for COPCs are not required for these facilities, this text no longer applies and has been removed from the EE/CA.
15.	Appendix E; Table E.4	As stated above, the selected cleanup level for this interim action of 32 mg/kg for PCBs (as an average) in soils and sediments is not acceptable to EPA. This concentration is likely too high for ecological protection and inconsistent with	As discussed in response to EPA Comment #1, under the proposed EE/CA, complete removal of SWMU 19 and SWMU 40 is being addressed by this action; therefore,

122

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
	Page E-7	the 10 ppm PCB cleanup level recommended in EPA guidance and established at other DOE sites for industrial areas. The ecological risk assessment will help clarify what is an acceptable concentration of PCBs. Concerning the PCBs, an average concentration of 32 mg/kg in the sediments indicates that some areas will be at a higher concentration than this, indicating that the area could still serve as a source of PCB contamination at concentrations of ecological concern for the watercourse downstream of the "remediated" area.	cleanup goals for COPCs are not required for these facilities and have been removed from the EE/CA. For SWMU 181, the lead based screening criteria of 800 mg/kg has been utilized as the cleanup level. The screening level for lead in soil was evaluated for commercial/industrial (current) land use and recreational (future) land use exposure scenarios, defaulting to the commercial/industrial no action level of 800 mg/kg as protective for both industrial and recreational exposures. Additional text has been added to the document to clarify the use of the 800 mg/kg and how the site-specific recreational value was calculated.
Kentucky Department for Environmental Protection—Division of Hazardous Waste – May 28, 2008			
1.	General	KDWM believes many of the issues identified in the following comments could have been avoided if these three inactive facilities were scoped with the parties to the FFA, prior to the issuance of the D1.	Thank you. Scoping is an ongoing process and we look to continue scoping the project as we respond to your comments.

123

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
2.	General	Employing the "current industrial worker" scenario to all three SWMUs is clearly unsupportable. The exposure parameters for this receptor were first presented in association with the on-site ditches and the North-South Diversion Ditch in the SWOU. KDWM rejected the scenario in relation to the SWOU documents because the exposure timeframe fails to consider that the same worker will be exposed to multiple SWMUs and the cumulative exposure across the SWMUs would sum to an exposure period greater than the 14 days. DOE insisted upon using this exposure period for the SWOU on-site emphasizing the point that a worker would not spend more than 14 days within the ditches per year, that is, the exposure period only applied to the ditches. KDWM emphasized that the same employees could not be exposed to other units and that records of entrance to these areas be maintained. Remove the 14 day exposure period and use the default exposure period in the agreed upon Risk Methods Document, or schedule a meeting between the three parties to set an exposure period supported by available site records. Best professional judgment is insufficient support for setting an exposure period, especially when the timeframe presented strikes a reasonable person as ostensibly doubtful.	As discussed in response to EPA Comment #1, under the proposed EE/CA, complete removal of SWMU 19 and SWMU 40 is being addressed by this action; therefore, cleanup goals for COPCs are not required for these facilities and have been removed from the EE/CA. For SWMU 181, the lead based screening criteria of 800 mg/kg has been utilized as the cleanup level. The screening level for lead in soil was evaluated for commercial/industrial (current) land use and recreational (future) land use exposure scenarios, defaulting to the commercial/industrial no action level of 800 mg/kg as protective for both industrial and recreational exposures. Additional text has been added to clarify the use of the 800 mg/kg and how the site-specific recreational value was calculated.
3.	General	According to the SMP (2008), SWMU 181 is located where recreational land use is recognized as the Reasonably Acceptable Future Land Use, yet in this EE/CA it is assumed industrial. This discrepancy must be resolved.	DOE agrees that the latest version of the SMP indicates that the C-218 Firing Range is listed as recreational under the reasonably acceptable land use scenario and has modified the document accordingly.
4.	Section 1.1.1 - Regional Topography; 2nd paragraph, last sentence Page 4	There is no mention of historical channeling activities. Please revise the sentence to reflect the construction influence.	An additional sentence has been added to discuss historical channeling activities and the construction influence. New text is as follows: "These small valleys are the result of construction of plant drainage systems in the early 1950s, natural erosion, and/or periodic dredging to remove obstructions that collect in turns and tight corners of the streams."
5.	Section 1.1.5.1 - Surface Water; 2nd paragraph	Please add a sentence explaining why some of the outfalls are not mentioned (003, 004, 005, 007).	Additional text has been added to the paragraph to discuss Outfalls 003, 004, 005, and 007. Information regarding these outfalls is listed below:

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
	Page 9		• Outfall 004 receives waste water from the C-615 Sewage Treatment Facility and combines with the effluents that lead to Outfall 008. • Outfall 019 receives runoff from the C-746-U Landfill located north of PGDP and discharges to the North-South Diversion Ditch (NSDD), which flows to Little Bayou Creek. • Outfalls 003, 005, and 007 no longer are active. 1. Outfall 003 was located at Section 3 of the NSDD and monitored effluent from Section 1 and Section 2 of the NSDD prior to its eventual discharge to Little Bayou Creek. 2. Outfall 005 monitored the C-611 Sludge Lagoon prior to discharge to Bayou Creek. 3. Outfall 007, located at C-611, monitored effluents prior to discharge to Bayou Creek. Outfall 007 has been replaced with a septic tank and leach field and Outfall 007 no longer exists.
6.	Section 1.5.1 – C -218 Outdoor Firing Range (SWMU 181) Pages 15 and 19	KDWM has obtained information alleging the C-218 soil berm was constructed of sediment originating from the C-611 Sludge Lagoon. A function of this lagoon is to allow Ohio River sediment to settle out. Periodically the sediment was dredged and piled to the east of the C-611 Sludge Lagoon. This information was recently shared with DOE and PRS informally as 'AOI 30' on April 17, 2008, and formally on April 25, 2008. Revise to include narrative that mentions the alleged source of the soil berm material and any impact that may have on the chemicals of potential concern (COPCs) being considered for this removal action.	Additional narrative has been added to describe the source of the soil that makes up the C-218 Firing Range along with the strategy for identification of chemicals of potential concern related to the source of the soil.

125

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
7.	Table 2 - Selected COPCs for Soil/sludge for C-218; footnote *a* Page 21	Revise the document to reflect cleanup levels consistent with KDWM General Comment #3. The reasonable anticipated land use in the SMP leads KDWM to assert that 400 mg/Kg is an appropriate clean-up value.	DOE agrees that the latest version of the SMP indicates that the C-218 Firing Range is listed as "recreational" under the reasonably acceptable land use scenario and has modified the document accordingly. DOE also recognizes that if the reasonably acceptable future land use scenario is "recreational" that the calculation and presentation of a site-specific recreational value would be appropriate.
8.	Section 1.6.1.1 - Human Health Risk Conclusions; 1st paragraph, 3rd and last sentence Page 23	Eight hours a day, 250 days per year, for 25 years are the values agreed upon in the Risk Methods document for an industrial worker. The Risk Methods document does not distinguish between a "current" or "future" industrial worker. Therefore, any deviation from the 250 days scenario must have adequate documentation and administrative controls in place to substantiate a lower exposure scenario. The proposed 14-day per year exposure was not accompanied by adequate justification. It also does not appear to consider cumulative exposures at other facilities associated with the Paducah Gaseous Diffusion Plant. If a worker spent the proposed 14-day exposure at these three inactive facilities and then moved on to the next group of facilities with a similar exposure period, would the worker be in danger of being over exposed? In other words, what is to prevent a current or future worker from complying with multiple exposure limits at various facilities and subsequently receiving an unacceptable exposure? State and provide documentation (professional judgment as sole support will be considered insufficient) proving that this scenario is not occurring and will not occur, and arrange to negotiate an appropriate exposure period with the three parties to the FFA.	As discussed in response to EPA Comment #1, under the proposed EE/CA, complete removal of SWMU 19 and SWMU 40 is being addressed by this action; therefore, cleanup goals for COPCs are not required for these facilities and have been removed from the EE/CA. For SWMU 181, the lead based screening criteria of 800 mg/kg has been utilized as the cleanup level. The screening level for lead in soil was evaluated for commercial/industrial (current) land use and recreational (future) land use exposure scenarios, defaulting to the commercial/industrial no action level of 800 mg/kg as protective for both industrial and recreational exposures. Additional text has been added to clarify the use of the 800 mg/kg and how the site-specific recreational value was calculated.
9.	Section 4.2.3.1 - Effectiveness, 3rd bullet - Long-Term Effectiveness and Permanence Page 36	How can the long-term effectiveness and performance rate high when final cleanup numbers are not proposed? Revise the document to restore some credibility to these ratings.	Long-term effectiveness and permanence are rated high since the contaminated soil/sediment and accumulated rainwater are completely removed from SWMU 19 and SWMU 40 to their defined boundaries. For SWMU 181, the lead based screening criteria of 800 mg/kg is protective for both industrial and recreational exposures scenarios. No changes have been made to the text of the document based on this comment.

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
10.	Section 4.3.3 - Cost; 1st bullet, last sentence Page 45	Considering the cost of maintaining institutional controls, it may be more cost effective to complete a removal with one mobilization instead of deferring portions of SWMU 181 to a further evaluation in the Soils Operable Unit? Therefore, provide the cost analysis for an additional alternative exploring a "no further action" for SWMU 181 in the D2 version of Engineering Evaluation/Cost Analysis for Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant.	The current cost analysis assumes that for SWMU 181, the lead based screening criteria of 800 mg/kg is protective for both industrial and recreational exposures scenarios. Since this is an interim action for lead only, other COPCs will be addressed during Soils OU. As a result, provision of a cost estimate is not required based upon current project scope. No changes have been made to the text of the document based on this comment.
11.	Section 4.3.3 – Cost; 2nd bullet, last sentence Page 45	KDWM was not provided with the information to substantiate the following suggestion; however, it may be more cost effective over time, if a complete removal of contaminants were undertaken with one mobilization instead of deferring portions of SWMU 40 to a further evaluation in the Comprehensive Site Operable Unit? Additionally, DOE has not made the case for recontamination or infrastructure considerations to support a deferral to the CSOU. Provide an alternative to remove contamination to "no further action" levels.	As discussed in response to EPA Comment #1, under the proposed EE/CA, complete removal of SWMU 40 is being addressed by this action; therefore, the cost provided is that for a "no further action." No changes have been made to the text of the document based on this comment.
12.	Section 4.3.3 – Cost; 3rd bullet, last sentence Page 45	Provide an alternative to remove contamination at SWMU 19 to "no further action" levels. As was the case with SWMU 40, DOE has not made the case for recontamination or infrastructure considerations to support a deferral to the CSOU.	As discussed in response to EPA Comment #1, under the proposed EE/CA, complete removal of SWMU 19 is being addressed by this action; therefore, the cost provided is that for a "no further action." No changes have been made to the text of the document based on this comment.
13.	Appendix B - Cost Estimate and Conceptual Design	Provide the cost analysis of an additional alternative exploring a "no further action" of SWMUs 19, 40, and 181 in the D2 version of Engineering Evaluation/Cost Analysis for Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant.	As discussed in response to EPA Comment #1, under the proposed EE/CA, complete removal of SWMU 19 and SWMU 40 is being addressed by this action; therefore, the cost provided is that for a "no further action." For SWMU 181, the current cost analysis assumes that the lead based screening criteria of 800 mg/kg is protective for both industrial and recreational exposures scenarios. Since this is an interim action for lead only, other COPCs will be addressed during Soils OU. As a result, provision of a cost

COMMENT RESPONSE SUMMARY
for the
Engineering Evaluation/Cost Analysis for the Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-0016&D1

Comment Number	§/Page/¶	Comment	Response
			estimate is not required based upon current project scope. No changes have been made to the text of the document based on this comment.
14.	Appendix E.1.2.1 - Industrial Worker; 1st paragraph, 3rd sentence Page E-3	Provide the "process knowledge" documentation associated with actual work performed at the PGDP. Would the industrial worker be completing any other work during the year that could differ from the process knowledge documentation you will provide?	Since SWMU 19 and SWMU 40 and their defined boundaries are targeted for complete removal, cleanup levels have been removed from the document (i.e., cleanup goals were based upon site-specific exposure assumptions). For SWMU 181, the lead based screening criteria of 800 mg/kg has been utilized as the cleanup level. The screening level for lead in soil was evaluated for commercial/industrial (current) land use and recreational (future) land use exposure scenarios, defaulting to the commercial/industrial no action level of 800 mg/kg as protective for both industrial and recreational exposures. Additional text has been added to the document to clarify the use of the 800 mg/kg and how the site-specific recreational value was calculated.

126