Department of Energy

Portsmouth/Paducah Project Office
1017 Majestic Drive, Suite 200
Lexington, Kentucky 40513
(859) 219-4000

MAR 0 2 2010

Mr. W. Turpin Ballard
U.S. Environmental Protection Agency, Region 4
Federal Facilities Branch
61 Forsyth Street
Atlanta, Georgia 30303

PPPO-02-393-10

Mr. Edward Winner, FFA Manager
Kentucky Department for Environmental Protection
Division of Waste Management
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601

Dear Mr. Ballard and Mr. Winner:

TRANSMITTAL OF THE D1 PROPOSED REMEDIAL ACTION PLAN FOR TRICHLOROETHENE SOURCES TO THE SOUTHWEST PLUME AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY: (1) SOLID WASTE MANAGEMENT UNIT 1, (2) C-720 BUILDING AREA, AND (3) PART OF SOLID WASTE MANAGEMENT UNIT 102 (DOE/LX/07-2223&D1)

Please find enclosed the certified D1 *Proposed Remedial Action Plan for Trichloroethene Sources to the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky: (1) Solid Waste Management Unit 1, (2) C-720 Building Area, and (3) Part of Solid Waste Management Unit 102* (DOE/LX/07-2223&D1) for your review.

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

Sincerely,

William E. Murphie
Manager
Portsmouth/Paducah Project Office

Enclosure:
D1 PP SW Plume Sources

cc w/enclosure:
AR File/Kevil

e-copy w/enclosure:
ballard.turpin@epa.gov, EPA/Atlanta
brandy.mitchell@prs-llc.net, PRS/Kevil
bryan.clayton@prs-llc.net, PRS/Kevil
christa.turner@ky.gov, KDEP/Frankfort
dave.dollins@lex.doe.gov, PPPO/PAD
dennis.ferrigno@prs-llc.net, PRS/Kevil
edward.winner@ky.gov, KDEP/Frankfort
jana.white@prs-llc.net, PRS/Kevil
janet.miller@lex.doe.gov, PRC/PAD
jeff.carman@prs-llc.net, PRS/Kevil
john.lea@prs-llc.net, PRS/Kevil
msmith@techlawinc.com, TechLaw/Alpharetta
paul.deltete@prs-llc.net, PRS/Kevil
rachel.blumenfeld@lex.doe.gov, PPPO/LEX
reinhard.knerr@lex.doe.gov, PPPO/PAD
todd.butz@prs-llc.net, PRS/Kevil
todd.mullins@ky.gov, KDEP/Frankfort
tufts.jennifer@epa.gov, EPA/Atlanta

CERTIFICATION

Document Identification: ***Proposed Remedial Action Plan for Trichloroethene Sources to the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky: (1) Solid Waste Management Unit 1, (2) C-720 Building Area, and (3) Part of Solid Waste Management Unit 102, DOE/OR/07-2223&D1***

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
Operator

Paul Meltzer, for
Dennis Ferrigno, PM, Site Manager

3/3/10
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

Reinhard Knerr, Paducah Site Lead
Portsmouth/Paducah Project Office

3/3/10
Date Signed

Proposed Remedial Action Plan for Trichloroethene Sources to the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky: (1) Solid Waste Management Unit 1, (2) C-720 Building Area, and (3) Part of Solid Waste Management Unit 102

March 2010

INTRODUCTION

The U.S. Department of Energy (DOE) is conducting cleanup activities at the Paducah Gaseous Diffusion Plant (PGDP), Paducah, Kentucky, to address contamination resulting from past waste-handling and disposal practices at the plant. As part of these cleanup activities, DOE, the U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky's Energy and Environment Cabinet (KEEC) request public review and comment on this Proposed Remedial Action Plan (PRAP) for trichloroethene (TCE) sources to the Southwest Plume. DOE is the lead agency for conducting this action.

As described in the "Site Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky," DOE/LX/07-0185&D2/R1, Annual Revision—FY 2009, March 2009, the Groundwater OU strategy includes a phased approach consisting of the following steps: (1) prevent human exposure to contaminated groundwater; (2) prevent or minimize further migration of contaminant plumes; (3) prevent, reduce, or control contaminant sources contributing to groundwater contamination; and (4) restore the groundwater to its beneficial uses wherever practicable.

Early Groundwater Operable Unit (OU) actions already have been implemented to prevent exposure and to reduce further off-site migration of contaminant plumes. These include the implementation of the DOE Water Policy and construction of and on-going operation of the groundwater treatment systems for the Northwest and Northeast plumes. DOE currently is implementing a remedial action to remove source material from the subsurface near C-400 Building area.

The Groundwater OU scope includes the Southwest Plume TCE sources in subsurface soil at both the Oil Landfarm and the C-720 Building areas.

The Southwest Plume consists of groundwater in the Regional Gravel Aquifer (RGA) contaminated primarily with TCE, a volatile organic compound (VOC), and is located within the DOE property, west of the C-400 Building and south of the larger groundwater contamination area identified as the Northwest Plume (Figure 1). This PRAP presents the Preferred Alternative for remediation of VOCs in the Upper Continental Recharge System (UCRS) subsurface soils at the Solid Waste Management Unit (SWMU) 1 Oil LandFarm and the C-720 Building TCE Spill Northeast and Southeast sites (solid waste management unit 211a and 211b). These sites

CLEARED FOR PUBLIC RELEASE

are sources of contamination to the Southwest Plume. This PRAP also presents the Preferred Alternative for the storm sewer (part of SWMU 102) leading from the C-400 Building area to the Outfall 008 ditch (Figure 2), which was a suspected source of contamination to the Southwest Plume.

The basis for this decision is documented in the "Focused Feasibility Study for the Southwest Groundwater Plume Volatile Organic Compound Sources (Oil Landfarm and C-720 Northeast and Southeast Sites) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky," DOE/LX/07-0186&D2, dated January 2010 (hereafter referred to as the FFS) and the "Site Investigation (SI) Report for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky," DOE/OR/07-2180&D2/R1, dated June 2007 (hereafter referred to as the SI Report). The site investigation determined that the storm sewer was not a source of groundwater contamination and, therefore, no further action is proposed for that area.

The Preferred Alternative of the three alternatives retained for the detailed analysis in the FFS is Alternative 5, In Situ Thermal Source Treatment. The Preferred Alternative consists of a remedial design support investigation, treatment using in situ thermal technology with vapor extraction, off-gas treatment, process monitoring, confirmation sampling, groundwater monitoring, waste management, interim land use controls, and five-year reviews.

This PRAP addresses the potential exposure by receptors to TCE contamination above the maximum contaminant level (MCL) migrating from the Oil Landfarm and the C-720 Building area in the groundwater in the RGA, removes principal threat waste (PTW), prevents excavation worker exposure to VOC contamination in source areas and prevents non-VOC contamination exposure through interim land use controls. Other sources to the Southwest Plume, such as SWMU 4, will be evaluated as part of the Burial Ground OU.

This plan fulfills the public participation requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980; the Resource Conservation and Recovery Act (RCRA) of 1976; and Kentucky Revised Statute 224.01-524 by summarizing the FFS and SI Report and requesting public comments on the Preferred Alternative identified. This PRAP also serves as a "Statement of Basis" for the modification of the Kentucky Hazardous Waste Management Permit, KY8-890-008-982. The Administrative Record for this action is available for review at the DOE Environmental Information Center (see page 15).

*DOE, EPA, and KEEC encourage public review and comment on this proposed Preferred Alternative for addressing the storm sewer leading from the C-400 Building area to the Outfall 008 ditch and the TCE contamination in subsurface soil at the Oil Landfarm and the C-720 Building area. The public comment period for this PRAP is scheduled from **TBD**, 2010, through **TBD**, 2010. The "Responsiveness Summary" section of the Record of Decision (ROD) will address public comments received on this PRAP. Public comments also will become part of the record of modification for the Kentucky Hazardous Waste Management Permit, KY8-890-008-982. The Preferred Alternative represents the recommendation by DOE, subject to public comment. The eventual remedial action selected in the ROD may be different from the Preferred Alternative presented in this document, depending upon public comments. Additional information regarding the public participation process can be found in the "Community Participation" section of this PRAP.*

SITE BACKGROUND

PGDP is located in McCracken County in western Kentucky, about 5.63 km (3.5 miles) south of the Ohio River and approximately 16 km (10 miles) west of the city of Paducah. It is an operating uranium enrichment facility owned by DOE.

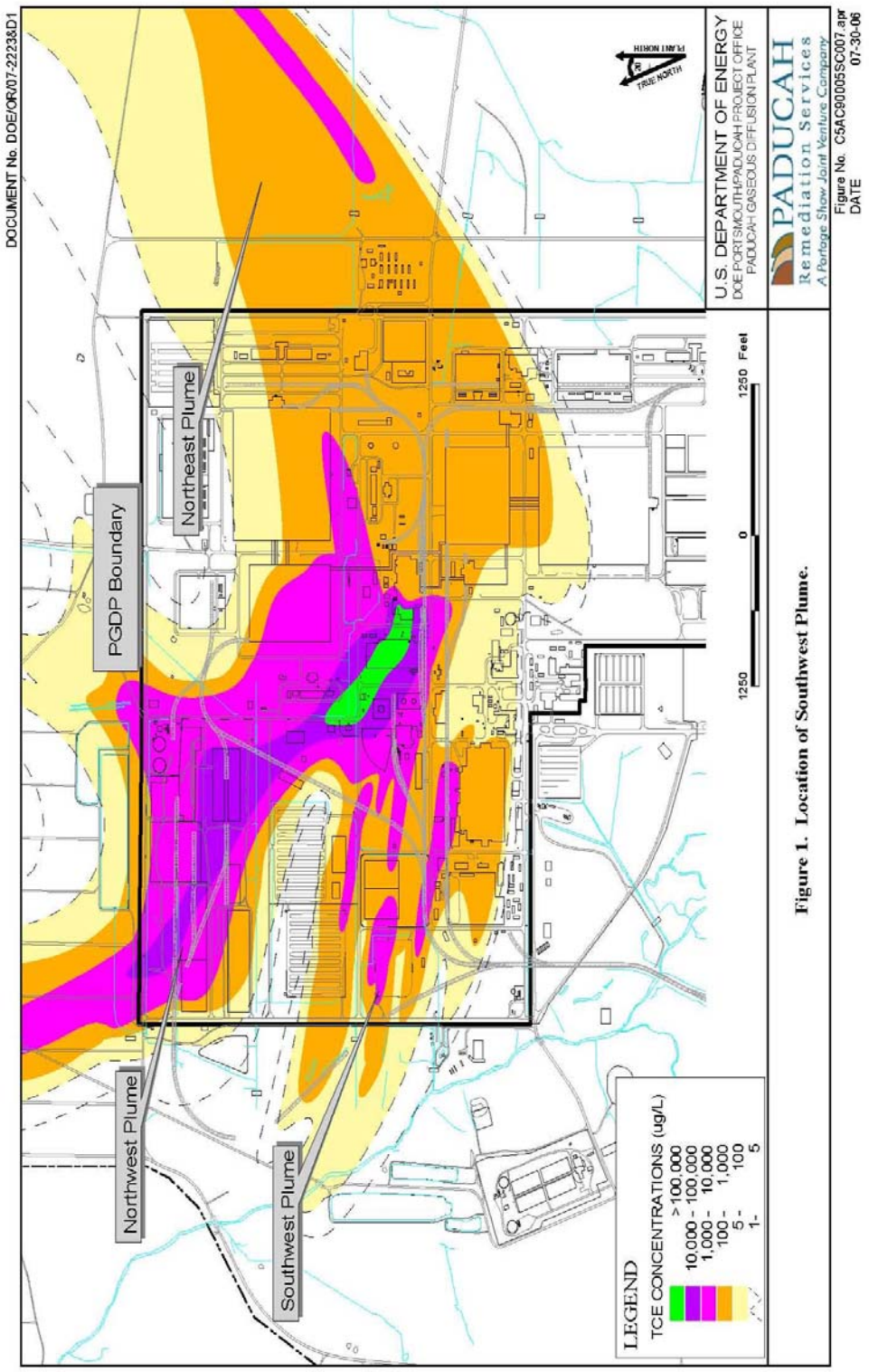

Figure 1. Location of Southwest Plume

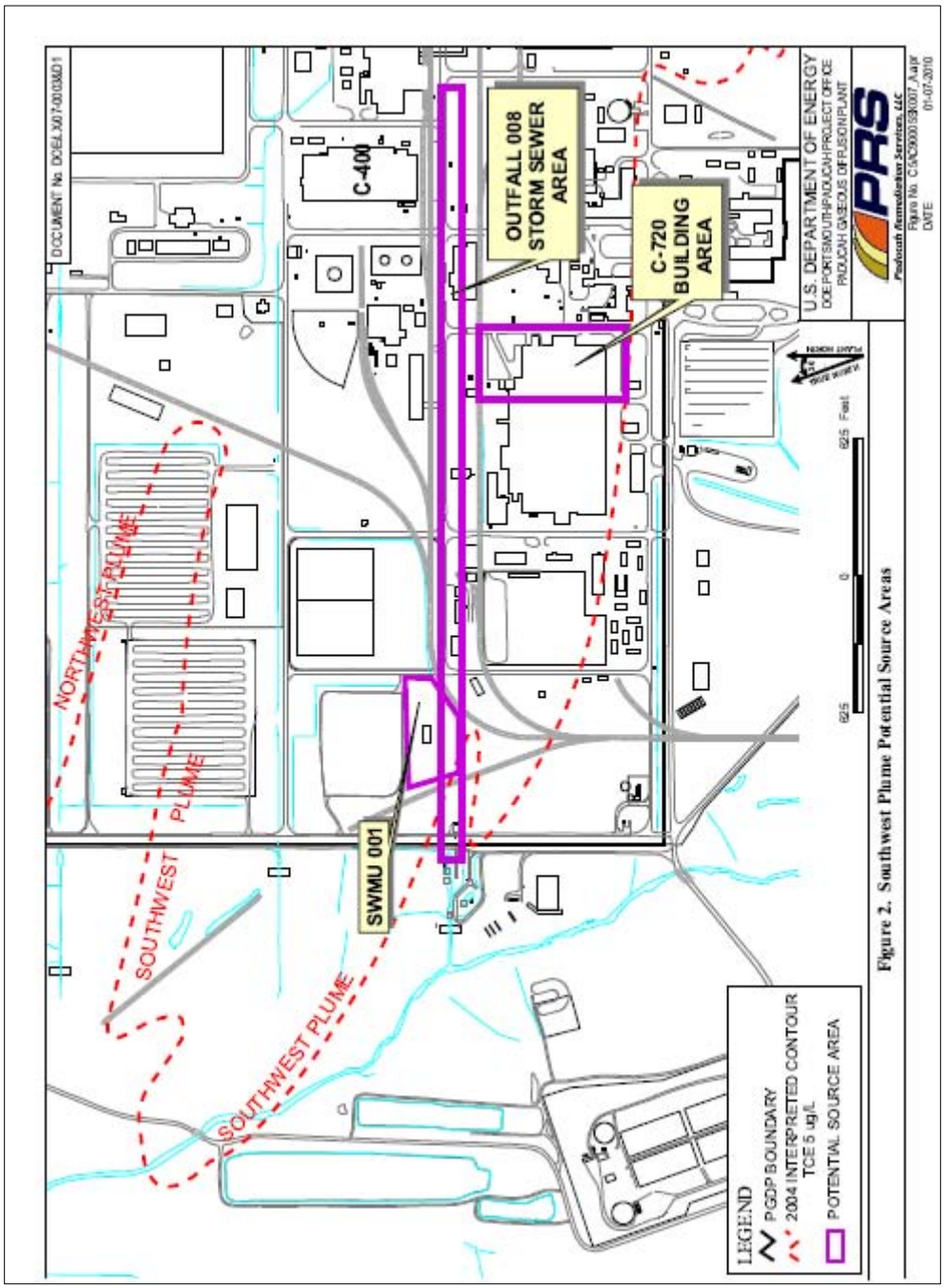

Figure 2. Southwest Plume Potential Source Areas

The Southwest Plume was first identified during the Waste Area Grouping 27 Remedial Investigation (WAG 27 RI) in 1998.[a] Subsequent work to characterize the plume was performed as part of the WAG 3 RI[b] and the Data Gaps Investigation[c] in 2000. In 2004, DOE conducted an SI of the Southwest Plume and potential source areas.[d] As discussed in these reports, the primary contaminant defining the plume is TCE. A feasibility study initially was conducted for the Groundwater OU unit in 2001.[e] The FFS was conducted in 2009 as a component of the Dispute Resolution Agreement for the Southwest Plume SI and to assess alternatives for the source areas addressed in this PRAP.

SWMU 1 Oil Landfarm. SWMU 1 (C-747-C Oil Landfarm) is located in the southwest portion of the plant (Figure 2) and has a total area of approximately 8,947 m^2 (96,300 ft^2 or 2.2 acres). The Oil Landfarm was used from 1973 to 1979 for landfarming of waste oils contaminated with TCE; 1,1,1-trichloroethane; uranium; and polychlorinated biphenyls (PCBs). Soil contaminants remaining at the Oil Landfarm are residuals of the waste oils.

In 1991 and 1992, potential soil and groundwater contamination at the Oil Landfarm was investigated as part of the CERCLA SI, Phase II. Sampling performed in 1996 better defined the PCB and dioxin contamination in surface soils at the unit. In 1998, DOE excavated 23 yd^3 of contaminated surface soils as a non-time-critical removal action. Subsurface soil samples from the WAG 27 RI in 1998 identified a VOC source zone at the Oil Landfarm. No previous remedial actions have been taken to address groundwater or subsurface soils contamination at the Oil Landfarm.

SWMU 211 C-720 Building area. The C-720 Building area is located in the southwest portion of PGDP (Figure 2) and occupies an area of approximately 82,962 m^2 (893,000 ft^2 or 20.5 acres). It has been used since the early 1950s (and still is active) for fabrication, assembly, cleaning, and repair of process equipment. Most areas adjacent to the C-720 Building are covered by concrete and asphalt pavement. Any areas not covered are small (less than 19 m^2 or 200 ft^2) and widely spaced. The C-720 Building area was identified as a possible source of TCE contamination during the Phase IV Groundwater Investigation.[f]

The WAG 27 RI identified five areas of subsurface soil contamination (primarily by VOCs) around the perimeter of the C-720 Building, including the area previously known as the C-720 TCE Spill Site—Northeast (SWMU 211). The Southwest Plume SI further investigated and confirmed the extent of the two primary areas of subsurface soil contamination located at the northeast and southeast corners of the building.

Subsurface soil contamination found to the northeast of the C-720 Building is believed to have been a result of routine equipment cleaning and rinsing with solvents. The source of VOC contamination found to the southeast of the C-720 Building is uncertain, but may have originated from spills. Receiving and storage facilities are located in the southeast corner of the C-720 Building. No previous remedial actions have been taken to address soil and groundwater contamination at the C-720 Building area.

Storm Sewer Leading from C-400 to Outfall 008. Rainfall runoff at the south end of the C-400 Building drains through a storm water sewer line

---

[a] *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1777&D2, June 1999.

[b] *Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1895&D1, July 2000.

[c] *Data Report for the Sitewide Remedial Evaluation for Source Areas Contributing to Off-Site Groundwater Contamination at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1845/D1, January 2000.

[d] *Site Investigation Report for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2180&D2, June 2007.

[e] *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1857/D2, August 2001.

[f] *Northeast Plume Preliminary Characterization Summary Report*, DOE/OR/07-1339&D2, July 1995.

system to the Outfall 008 ditch on the west side of the plant (Figure 2). During a 1997 RI of the area around the C-400 Cleaning Building, VOC contamination of subsurface soils was identified near two of the lateral lines that feed into the main storm sewer. The TCE that leaked from the C-400 area to the surrounding soils has been identified as a source of groundwater contamination. Additionally, there was a possibility that some of the TCE was transported down the lateral lines to the main storm sewer (then west toward Outfall 008), encountered a breach in the storm sewer, and leaked to the surrounding soils to become a source of TCE to the Southwest Plume. No previous remedial actions have been taken in the area of the storm sewer extending from C-400 to the Outfall 008 ditch.

SITE CHARACTERISTICS

Each of the three areas has flat topography, with elevations ranging from approximately 112.8 to 115.5 m (370 to 379 ft) above mean sea level (amsl). The Oil Landfarm is grass covered and is bordered by drainage ditches on the north, south, and west sides. Storm water runoff from the Oil Landfarm flows to these perimeter ditches, which discharge via the Outfall 008 ditch to Bayou Creek. Most of the ground surface surrounding the C-720 Building area is covered by concrete, asphalt, or gravel. Drainage from the C-720 Building area is via a storm sewer that discharges through Outfalls 008 and 009 to Bayou Creek. Groundcover over the storm sewer extending from the C-400 Building to the Outfall 008 ditch varies from predominately gravel and pavement on the east half to mostly grass on the west half of this segment of the storm sewer. The subsurface geology and hydrogeology of the three areas are similar. A sequence of silt and clay layers, with interbedded sand and gravel lenses, occurs to an average depth of 16.8 to 18.3 m (55 to 60 ft) below ground surface. These units comprise the UCRS. At the Oil Landfarm, the depth to the water table in the UCRS averages approximately 4.26 m (14 ft), but can be as shallow as 2.13 m (7 ft) due to seasonal variability. In the C-720 Building Area, the depth to water in the UCRS ranges from 1.83 to 13.7 m (6 to 45 ft) below surface with an average of 8.8 m (29 ft).

The RGA, a highly permeable layer of gravelly sand or chert gravel, typically extends with top at approximately 16.8 to 18.3 m (55 to 60 ft) deep to a base as much as 32.0 m (105 ft) deep. In the area of the Oil Landfarm and the C-720 Building, the RGA is approximately 9.1-m (30-ft) thick.

Water within the UCRS tends to flow downward to the RGA. Groundwater flow in the RGA in the Southwest Plume below PGDP generally is to the west-northwest. Information collected from all site investigations in the area of the downgradient Southwest Plume does not indicate that the Southwest Plume has migrated beyond the DOE property line, which is 914 m (3,000 ft) and 1,460 m (4,789 ft) west of the Oil Landfarm and the C-720 Building area, respectively. From the DOE property line, the distance within the Southwest Plume flow path to the first point of discharge to surface water (near the Ohio River) is approximately 6.4 km (4.0 miles).

Nature and Extent of Contamination

The following section presents summaries of the investigation of the Oil Landfarm, the C-720 Building area, and the storm sewer leading from C-400 to the Outfall 008 ditch and the nature and extent of TCE soil contamination found at each. More detailed information is in the SI Report.

SWMU 1 Oil Landfarm. TCE soil contamination at the Oil Landfarm underlies an area of approximately 809 m^2 (8,700 ft^2/0.2 acres) throughout the thickness of the UCRS, to a depth of approximately 16.8 m (55 ft). Of the 108 soil analyses for the Oil Landfarm, 71 analyses report detected levels of TCE (0.008 to 439 mg/kg). Average TCE concentrations within the source zone vary from 5.74 mg/kg at 15.2 to 16.8 m (50 to 55 ft) deep to 110.8 mg/kg at 3.0 to 6.1 m (10 to 20 ft) deep. The total TCE remaining in the soils of the Oil Landfarm source zone is approximately 187 L (49 gal).

SWMU 211-A and B C-720 Building Area. The primary area of TCE contamination in the soils around the perimeter of the C-720 Building is in the parking lot located southeast of the C-720 Building. These contaminated soils underlie an area of approximately 4,572 m^2 (15,000 ft^2/0.3

acres) to a depth of approximately 18.3 m (60 ft). Average TCE concentrations within the source zone vary from 0.10 mg/kg at 15.2 to 18.4 m (50 to 60 ft) deep to 11.9 mg/kg at 6.1 to 9.2 m (20 to 30 ft) deep. The total TCE remaining in the soils of the C-720 Building area source zone is approximately 76 L (20 gal).

Storm Sewer Leading from C-400 to Outfall 008. Both the camera inspection of 910 m (2,986 ft) of the storm sewer and the soil sample analyses for the storm sewer line leading from the C-400 Building to the Outfall 008 ditch confirm that the integrity of the storm sewer remains intact. TCE levels in the soil samples were nondetectable (less than 0.001 mg/kg) to 0.220 mg/kg. The SI determined that the storm sewer is not a source of TCE to the Southwest Plume.

The nature and extent assessments in the Southwest Plume SI indicate that TCE is present at the Oil Landfarm and the C-720 Building area as isolated droplets dispersed in the soil of the UCRS. These zones of isolated droplets of TCE are in the upper 18.3 m (60 ft) of soils. Groundwater samples taken from the RGA beneath SWMU 1 and the C-720 area, as part of WAG 27 RI and the SI, also contained TCE.

SCOPE AND ROLE OF THE RESPONSE ACTION

The Groundwater OU is one of five media-specific OUs at PGDP being used to evaluate and implement remedial actions. For these OUs, DOE, EPA, and the KEEC have agreed upon five strategic cleanup initiatives, as discussed in the Site Management Plan:

- Groundwater OU Strategic Initiative,
- Burial Grounds OU Strategic Initiative,
- Surface Water OU Strategic Initiative,
- Soils OU Strategic Initiative, and
- Decontamination and Decommissioning OU Strategic Initiative.

The VOC source areas addressed in this proposed action (Oil Landfarm, C-720 Building Area, and Storm Sewer) are assigned to the Groundwater OU at PGDP. The Groundwater OU is being implemented in a phased approach consisting of sequenced remedial and removal actions designed to accomplish the following goals:

(1) Prevent human exposure to contaminated groundwater;

(2) Prevent or minimize further migration of contaminant plumes;

(3) Prevent, reduce, or control contaminant sources contributing to groundwater contamination; and

(4) Restore the groundwater to its beneficial uses, wherever practicable.

This remedial action upon implementation will support goals 2, 3, and 4 of the Groundwater OU remedial goals. These goals are supported by reducing source areas and removing PTW that results in groundwater contamination.

Remedial alternatives were developed in the FFS in support of a final action for VOCs in the UCRS subsurface soils, which is to mitigate the migration of VOCs from the Oil Landfarm and the C-720 Building Area to the Southwest Plume and to treat or remove PTW. Based on results from the Southwest Plume SI, the Storm Sewer no longer is considered a source of TCE contamination to the Southwest Plume. Risks posed by direct contact with contaminated surface soil or sediment at the Oil Landfarm and C-720 Building Area or remaining risks from potential use of contaminated groundwater will be addressed later as part of the decisions for the Surface Water, Soils, or Groundwater OUs. Non-VOC soil contamination at the source areas will be addressed by the Soils OU, as described in the 2009 Site Management Plan. Groundwater contamination will be addressed through the Dissolved-Phase Plumes Remedial Action. Interim land use controls will be applied to control the exposure to contaminated soil until the other OUs complete their actions.

SUMMARY OF SITE RISKS

This section of the PRAP presents a summary of the baseline risk assessment performed in the Southwest Plume SI. The human health and ecological risk posed by the site determine whether a remedial action is warranted. This summary describes the risk to human health and the environment by the VOC contamination found at the Southwest Plume source areas that will be addressed by the proposed action. This discussion is presented in two subsections: human health risks and ecological risks.

Human Health Risks

There are currently restrictions in place that prevent human exposure to site contaminants, except during monitoring activities; therefore, there is no current risk. In the baseline human health risk assessment, it was assumed these restrictions were not in place. The baseline human health risk assessment considered both the current and several potential future uses of each of the Southwest Plume source areas and areas to which contaminants from the source may migrate.

Risks calculated for consumption of groundwater drawn from the RGA by a hypothetical resident exceeded the lower limit of EPA's acceptable cancer risk range and/or the noncancer hazard index value for each of the three source areas and for the area of the Southwest Plume. Priority contaminants of concern (COCs) (i.e., contaminants with a noncancer hazard index (HI) equal to or greater than 1 or an excess cancer lifetime risk greater than the upper limit of EPA's acceptable cancer risk range) at the locations were as follows.

- Oil Landfarm—arsenic, iron, manganese, chloroform, *cis*-1,2-DCE, and TCE.
- C-720—arsenic, iron, manganese, nickel, 1,1-DCE, *cis*-1,2-DCE, and TCE.
- Storm Sewer—None.

Risks to a hypothetical resident from use of contaminated groundwater migrating from source areas and drawn from wells completed in the RGA at the SWMU boundary exceeded the lower limit of EPA's acceptable cancer risk range and/or the noncancer HI value. C-720 Building area has the largest risk followed by the Oil Landfarm. The Storm Sewer was determined not to be a source of TCE contamination to the Southwest Plume.

For the modeled points of exposure, the COCs for Oil Landfarm are TCE; *cis*-1,2-DCE; *trans*-1,2-DCE; and VC. The COCs for the C-720 Building area are TCE; *cis*-1,2- DCE; and VC. Of these, only TCE has a HI greater than 1 or an estimated life time cancer risk above the upper limit of EPA's acceptable cancer risk range and is, therefore, a "priority COC" for contaminant migration at Oil Landfarm. The C-720 Building does not have any "priority COCs." Based on the previous and current modeling results, neither metals nor radionuclides are COCs for contaminant migration from the sources at the C-720 area or Oil Landfarm.

Risks to a hypothetical resident from the inhalation of volatiles as a result of vapor intrusion into home basements exceeded the lower limit of EPA's acceptable cancer risk range and/or the noncancer HI value from the source at the C-720 area and Oil Landfarm.

Ecological Risks

A screening ecological risk assessment indicated that no ecological impacts were likely to occur from exposure to the VOC sources areas addressed by this PRAP. This was based upon the location of the contamination being addressed (i.e., in the subsurface and for C-720 source areas that are below significant cover such as a building or cement pad), the relatively small size of the contaminant source areas, and the industrial nature of the units. Additionally, fate and transport modeling predicted that the maximum concentration of TCE in groundwater from the Oil Landfarm and the C-720 Building area for a setting near the Ohio River, which is the first location where discharge is likely to surface, would be less than 1 µg/L for both sources as predicted by modeling.

REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAOs) describe what the proposed site cleanup is expected to accomplish. The RAOs for Oil Landfarm and the C-720 Building area are to do the following:

(1) Treat and/or remove the PTW consistent with the National Contingency Plan (NCP).

(2a) Prevent exposure to VOC contamination in the source areas that will cause an unacceptable risk to excavation workers (< 10 ft).

(2b) Prevent exposure to non-VOC contamination and residual VOC contamination through interim land use controls within the Southwest Plume source areas (i.e., SWMU 1, SWMU 211-A, and SWMU 211-B) pending remedy selection as part of the Soils OU and the Groundwater OU.

(3) Reduce VOC migration from contaminated subsurface soils in the treatment areas at the Oil Landfarm and C-720 Northeast and Southeast Sites so that contaminants migrating from the treatment areas do not result in the exceedance of MCLs in underlying RGA groundwater.

Two types of remediation goals (RG) were developed to support the RAOs. Worker protection RGs are VOC concentrations in soils present at depths of 0-10 ft that would meet RAO #2a. Groundwater protection RGs are VOC concentrations in subsurface soils that would meet RAO #3. Alternatives were evaluated with respect to their effectiveness at attaining RGs and meeting the RAOs based on previous source removal demonstrations at PGDP; literature reports of previous actions at other sites; modeling of VOCs to determine exceedances of MCLs; and engineering judgment. A discussion of the RG development and application is contained in the FFS.

SUMMARY OF ALTERNATIVES

The following five remedial alternatives were assessed for application to the Southwest Plume source areas at the Oil Landfarm and the C-720 Building area. The SI determined that the storm sewer is not a source of TCE to the Southwest Plume; therefore, no alternatives were developed to address the soil surrounding the storm sewer.

- Alternative 1: No Action.

- Alternative 2: *In Situ* Bioremediation and interim land use controls. This alternative consists of a remedial design support investigation to refine the extent of VOC contaminant and determine *in situ* bioremediation parameters, injection of electron donor into the UCRS saturated zones of the source areas, soil and groundwater monitoring, waste management, confirmatory sampling, and interim land use controls.

- Alternative 3: Source Removal and *Ex Situ* Thermal Treatment. This alternative consists of a remedial design support investigation, excavating source area soils contaminated with VOCs above the RGs, treating excavated soils, confirmatory sampling of treated soils for VOCs, and backfilling with treated soil or other approved fill.

- Alternative 4: Soil Vapor Extraction Source Treatment, Containment, and Interim Land Use Controls. This alternative consists of a remedial design support investigation, hydrofracturing in the UCRS to increase vapor recovery rates, containment cap to reduce and control surface water infiltration, recharge controls, dual-phase soil vapor extraction, treatment of recovered vapor, co-produced groundwater treatment, treated groundwater discharge to an outfall, groundwater sampling and monitoring, confirmation sampling, waste management, and interim land use controls.

- Alternative 5: In Situ Thermal Treatment and Interim Land Use Controls. This alternative consists of a remedial design support investigation, treatment using in situ thermal technology with vapor extraction, treatment of recovered vapor and groundwater, process monitoring, confirmation sampling,

WHAT IS RISK AND HOW IS IT CALCULATED?

A CERCLA human health risk assessment estimates "baseline risk." This is an estimate of the likelihood of health problems occurring under current and expected future use if no cleanup action is taken at a site. To estimate the baseline risk at a CERCLA site, a four-step process is followed.

Step 1: Analyze Contamination
Step 2: Estimate Exposure
Step 3: Assess Potential Health Dangers
Step 4: Characterize Site Risk

In Step 1, the risk assessor looks at the concentrations of contaminants found at a site, as well as at past scientific studies on the effects these contaminants have had on people (or animals, when human health studies are unavailable). Comparisons between site-specific concentrations and concentrations reported in past studies enable the risk assessor to determine which contaminants are most likely to pose the greatest threat to human health.

In Step 2, the risk assessor considers the different ways that people might be exposed to the contaminants identified in Step 1, the concentrations that people might be exposed to, and the potential frequency and duration of exposure. Using this information, the risk assessor calculates dose from a "reasonable maximum exposure" (RME) scenario, which represents an estimate of the highest level of human exposure that reasonably could be expected to occur within a given time period.

In Step 3, the risk assessor uses the information from Step 2, combined with the information of the toxicity of each chemical, to assess potential health risks. Two types of risk are considered: cancer risk and noncancer risk. The likelihood of any kind of cancer resulting from a CERCLA site generally is expressed as an upper bound probability: for example, a "1 in 10,000 chance." In other words, for every 10,000 people exposed under the RME scenario, one extra cancer *may* occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than normally would be expected from all other causes. For noncancer health effects, the risk assessor calculates a "hazard index." The key concept for noncancer health effects is that a "threshold level" (measured as a hazard index of 1) exists; below this level, noncancer health effects are not expected.

In Step 4, the risk assessor determines whether the site risks are great enough to cause unacceptable health problems for people exposed at or near a site. To do this, the risk assessor combines and summarizes the risk results for the individual chemicals and routes of exposure within the RME scenario and compares the resulting scenario risk estimates to the generally acceptable risk range for site-related exposures.

WHAT ARE THE "CONTAMINANTS OF CONCERN"?

DOE has identified several contaminants of concern (COCs) in subsurface soil and groundwater at the three locations. However, fate and transport modeling, combined with sampling of groundwater in the Southwest Plume, confirmed that TCE is the primary groundwater COC for potential exposure by receptors. Discussions of the fate and transport modeling and the other COCs are in Appendices F and G, respectively, of the Southwest Plume Site Investigation Report, DOE/OR/07-2180&D2.

TCE is a halogenated organic compound used in the past at PGDP for a variety of purposes. Exposure to this compound has been associated with deleterious health effects in humans, including anemia, skin rashes, liver conditions, and urinary tract disorders. Based on laboratory studies, TCE is considered a probable human carcinogen. Over time, TCE naturally degrades to other organic compounds, including 1,2-dichloroethene and vinyl chloride. TCE currently is not used at the PGDP.

groundwater discharge to an outfall, monitoring, waste management, and interim land use controls. Additionally, groundwater protection measures described in the A*ction Memorandum for the Water Policy at the Paducah Gaseous Diffusion Plant* protects residents from the risks associated with contaminated groundwater.

Groundwater monitoring included in Alternatives 2, 4, and 5 will continue until groundwater VOC levels are reduced to levels acceptable for beneficial use of the groundwater which is alternative dependent. Contamination above levels that would prevent unrestricted use would remain on-site during and for a specific time period after active implementation of alternatives 2, 4, and 5 and would require CERCLA mandated five-year reviews.

A screening evaluation of all five alternatives was conducted, which resulted in the elimination of Alternatives 2 and 3 from a detailed analysis. Alternative 2 was screened from further consideration because VOC reduction was less certain than for Alternatives 4 or 5, with roughly similar cost and implementability. Alternative 3 was screened from further consideration because it is much less technically implementable and much more expensive than any other alternative.

EVALUATION OF ALTERNATIVES AND THE PREFERRED ALTERNATIVE

The Preferred Alternative is Alternative 5, *In Situ* Thermal Treatment and Interim Land Use Controls. A remedial design support investigation would be performed to further characterize the Oil Landfarm and the C-720 Northeast and Southeast Sites in support of the treatment system design. Treatment of the sites would be conducted using *in situ* thermal technology for approximately one year. System shutdown criteria would be established in the remedial design/remedial action work plan and would incorporate lessons learned from the C-400 Electrical Resistive Heating project.[g] Electrodes would be placed in the soil and a low-frequency electrical energy would be applied in arrays to heat the soils. The VOCs in the soil would be vaporized and the vapor would be recovered through wells. The VOCs then would be removed from the vapor using granular activated carbon. The treatment processes would be monitored daily to evaluate effectiveness of the system. After treatment is complete, confirmatory sampling of the treatment area would be conducted to determine post-treatment TCE soil concentrations and site restoration would be conducted. Monitoring of the groundwater in the RGA would be conducted and reported in the five-year reviews and provided to the Groundwater OU project. Interim land use controls would be implemented to prevent exposure to contaminated soils. The cost of the Preferred Alternative is $21.5 million.

The following discussion summarizes the comparison of alternatives in the context of the threshold and balancing criteria (see page 14).

Overall Protection of Human Health and the Environment

Protection of human health and the environment would be afforded by the removal of VOC contaminant mass, monitoring, and implementation of interim land use controls for Alternatives 4 and 5. Alternative 1 (no action) would not meet this threshold criterion because no action would be implemented to reliably reduce exposures and attain RGs in a reasonable time frame.

Compliance with ARARs

Alternatives 4 and 5 are compliant with location- and action-specific applicable or relevant and appropriate requirements (ARARs). There are no chemical-specific ARARs. Alternative 1 would not meet the threshold criteria.

[g]ROD for Interim Remedial Action for the GWOU for the Volatile Organic Compound Contamination at the C-400 Cleaning Building at the PGDP, Paducah, Kentucky, DOE/OR/07-2150&D2/R2, July 2005.

Long-Term Effectiveness and Permanence

Alternative 5 would provide the best long-term effectiveness and permanence, since it leaves the least residual contamination, which allows groundwater protection RGs to be attained and RAOs met at the C-720 Northeast and Southeast Sites in about 29 years and 52 years at the Oil Landfarm. Alternative 4 would rank behind Alternative 5 because it is expected to leave 10% more residual contamination. Alternatives 4's long-term cover maintenance and recharge controls will be required at all sites after completion of soil vapor extraction for about 70 years to meet the RAOs. Alternative 1 would provide no long-term effectiveness or permanence. Attainment of RGs would take in excess of 100 years, which is not expected to be a reasonable time frame.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 5 would accomplish the greatest reduction of toxicity, mobility, and volume (estimated at 98%) in one year using *in situ* thermal technology. Alternative 4 would accomplish less reduction of VOC mass (estimated at 90%) during its active operational period of 2 to 5 years. The reduction, however, in VOC mobility, through capping and recharge controls, during and after completion of Soil Vapor Extraction operations, would allow the RAOs to be met during the potential 5-year time period. The cap and recharge controls must be maintained in order to continue to attain the RAOs. Alternative 1 would not implement treatment and would reduce VOC concentrations only through natural processes.

Short-Term Effectiveness

Alternative 5 has the highest short-term effectiveness, because it would attain RGs in the least time without the use of supplementary actions. Alternative 5 would attain groundwater protection RGs and RAOs in about 29 years at the C-720 Northeast and Southeast Sites and would require up to 52 years at the Oil Landfarm. Alternative 4 would attain the RAOs in its 2-5 year active operational time only when combined with continuous capping and recharge controls. Without the long-term cover maintenance and recharge controls, monitoring would be required for about 70 years at both sites, until RGs in soil were attained. Alternative 1 has the lowest short-term effectiveness, because it would require the longest time for attainment of RGs.

No added risks to the public or the environment would result from implementing any of the alternatives. All worker risks and hazards could be mitigated by worker protection programs, which would increase the cost and complexity of the alternatives.

Implementability

All aspects of Alternatives 1, 4, and 5 are implementable; however, Alternatives 4 and 5 contain some technical challenges. Implementation challenges associated with Alternative 5 include the technical complexity of the alternative and relatively few vendors offering the technology, but these constraints can be managed. The technology has successfully been implemented at PGDP in a field treatability study and is underway with full-scale treatment at a similar source area. Alternative 4 challenges include implementation in an area with tight soil requiring fracturing and a long period of cover and recharge maintenance (70 years) relative to Alternative 5, which reduces the overall implementability of Alternative 4.

Cost

The estimated life-cycle costs were calculated and are presented as escalated values in fiscal year 2009 dollars for capital, operating and maintenance, and periodic costs for each alternative. Alternative 1 has no cost. The estimated cost of Alternative 4 is $24.5 million, and the estimated cost of Alternative 5 is $21.5 million.

Summary of Preferred Alternative

The preferred alternative is *In Situ* Thermal Treatment/Alternative 5. Alternative 5 meets the RAOs. RAO #1 would be met by removal of the PTW as vapor and destroying it *ex situ*. RAO #2a would be met by removing VOCs to levels within EPA's generally acceptable cancer risk range for

site-related exposures of 1E-04 to 1E-06 and also supported by interim land use controls. RAO #2b would be met by implementing interim land use controls. RAO #3 would be met by reducing VOC soil concentrations to groundwater protection RGs through a combination of active remediation and attenuation. Groundwater modeling results indicate that after completion of the one year of active remedial treatment, residual VOC mass will still leach to groundwater in the RGA and result in above TCE MCL concentrations at both sites. After 29 years of continued attenuation TCE concentrations in the RGA groundwater will be below MCL levels at the C-720 Northeast and Southeast Sites. It will require 52 years of continued attenuation to reduce TCE leaching from the soil to below the MCL at the Oil Landfarm.

Alternative 5 meets the threshold criteria (Overall protection of human health and the environment and compliance with ARARs) and provides the best balance of tradeoffs among the alternatives with respect to the balancing and modifying criteria for remedy selection. Alternative 5 would provide the best long-term effectiveness and permanence because it results in the least amount of residual contamination subsequent to treatment as compared to the other alternatives. Alternative 5 also would accomplish the greatest reduction in toxicity, mobility, and volume through treatment. The highest short-term effectiveness would be accomplished by Alternative 5 because the RAOs would be reached in 52 years and risks to workers can be managed. The implementability challenges of Alternative 5 can be managed. The cost of Alternative 5 is estimated at $21.5M, which is lower than Alternative 4 ($24.5M).

Completion criteria for discontinuing heating will be based on two parameters which is consistent with the Interim Remedial Action of the Volatile Organic Compound Contamination at the C-400 Cleaning Building. The parameters will be stabilization of heating in the subsurface and stabilization of TCE contaminant recovery. Specific parameters and values will be defined for completion criteria and will be stated in the ROD and quantified in the Remedial Action Work Plan.

No Further Action alternative is appropriate for the storm sewer leading from the C-400 Building area to the Outfall 008 ditch because it is not contributing TCE to the Southwest Plume.

KEEC and EPA concur with the remedial action selected in this PRAP. This document also serves as a Statement of Basis as discussed in the Introduction Section where the requirements fulfilled by the PRAP are discussed. The Preferred Alternative can change in response to public comment or new information.

Based on information currently available, DOE believes that the Preferred Alternative meets the threshold criteria and provides the best balance of trade-offs among the other alternatives with respect to the balancing criteria. The DOE expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element of the remedy.

COMMUNITY PARTICIPATION

Community involvement is a critical aspect of the cleanup process at PGDP. DOE, EPA, and the KEEC encourage the public to read and comment on this PRAP. The Preferred Alternative discussed in this document represents a preliminary decision that is subject to public comment. A Notice of Availability will be published in *The Paducah Sun* announcing the 45-day public review period for this document. The public comment period for this PRAP is scheduled from **TBD** through **TBD**, 2010.

A public meeting will be conducted if requested in writing. All public comments at the meeting will be recorded. The Kentucky Department for Environmental Protection, Division of Waste Management, will conduct a public hearing following the public meeting, if requested. A hearing is a formal gathering during which public comments are recorded officially by a hearing officer (to be designated by the KEEC), as

required by RCRA and Kentucky hazardous waste regulations. Written requests for a public hearing should state the issues to be discussed.

If either a meeting or a hearing is requested, a notice will appear in *The Paducah Sun*. To request a public meeting and/or submit comments on this PRAP, please contact the Paducah DOE Site Office, P.O. Box 1410, Paducah, KY 42001, phone (270) 441-6800. To request a public hearing and/or submit comments on this "Statement of Basis," please contact Tony Hatton, Kentucky Department for Environmental Protection, Division of Waste Management, 14 Reilly Road, Frankfort, KY 40601, phone (502) 564-6716.

CRITERIA FOR REMEDIAL ALTERNATIVES EVALUATION

Nine criteria developed by the EPA are used to compare alternatives and select a cleanup plan or remedy that meets the statutory goals of protecting human health and the environment, maintaining protection over time, and minimizing contamination. These nine criteria make up the assessment process regulated under CERCLA Section 121 and regulations promulgated in the NCP and are the standard criteria used for all Superfund sites. The following list highlights these nine criteria and some questions that must considered in selecting a final cleanup plan. More detailed definitions are contained in Section 4 of the FFS.

Threshold Criteria

1. **Overall protection of human health and the environment:** Will the alternative protect human health and plant and animal life on and near the area? The chosen cleanup plan must meet this criterion.
2. **Compliance with applicable or relevant and appropriate requirements (ARARs):** Does the alternative meet all pertinent federal and state environmental statutes, regulations, and requirements? The chosen cleanup plan must meet this criterion.

Balancing Criteria

3. **Long-term effectiveness and permanence:** How reliable will the alternative be at long-term protection of human health and the environment? Is contamination likely to present a potential risk again?
4. **Reduction of toxicity, mobility, or volume through treatment:** Does the alternative incorporate treatment to reduce the harmful effects of the contaminants, their ability to spread, and the amount of contaminated material present?
5. **Short-term effectiveness:** How soon will risks be adequately reduced? Are there short-term hazards to workers, the community, or the environment that could occur during the cleanup process?
6. **Implementability:** Is the alternative technically and administratively feasible? Are the goods and services needed to implement the alternative (e.g., treatment machinery, space at an approved disposal facility) readily available?
7. **Cost:** What is the total cost of constructing and operating the alternative? Costs presented in this document represent the present worth costs of construction, operations, and monitoring for the anticipated lifetime of the alternative.

Modifying Criteria

8. **State acceptance:** Do state environmental agencies agree with the recommendations? What are their preferences and concerns?
9. **Community acceptance:** What suggestions or modifications do residents of the community offer during the comment period? What are their preferences and concerns?

Of these nine criteria, the two threshold criteria (protection of human health and the environment and compliance with ARARs) must be met for a candidate cleanup alternative to be selected. The five balancing criteria are used to evaluate and compare the elements of the alternatives that meet the threshold criteria. This comparison evaluates which alternative provides the best balance of trade-offs with respect to the balancing criteria outlined above (3-7). State and community acceptance are considered modifying criteria and are factored into a final evaluation of all criteria to select a remedy. Consideration of state and community comments may prompt aspects of the preferred alternative to change or that another alternative provides a more appropriate balance.

This document serves as both a Proposed Remedial Action Plan and as a Statement of Basis.

To send written comments or obtain further information about this Proposed Remedial Action Plan, contact:
Dave Dollins
U.S. Department of Energy
Paducah Site Office
P.O. Box 1410
Paducah, KY 42001
(270) 441-6800

To send written comments about this Statement of Basis, contact:
Tony Hatton
Kentucky Department for Environmental Protection
Division of Waste Management
14 Reilly Road
Frankfort, KY 40601
(502) 564-6716

Administrative Record Availability

Information about this site considered during the response action determinations for this project, including the Proposed Remedial Action Plan, is available for review at the
DOE Environmental Information Center
115 Memorial Drive, Barkley Centre
Paducah, KY 42001
(270) 554-6979

Hours: 8:00 A.M. to 4:00 P.M. Monday through Friday

The Proposed Remedial Action Plan also is available at the
McCracken County Public Library
555 Washington Street, Paducah, KY 42001
(270) 442-2510

Hours: 9:00 A.M. to 9:00 P.M. Monday through Thursday
9:00 A.M. to 6:00 P.M. Friday and Saturday
1:00 to 6:00 P.M. Sunday

or contact:
Kentucky Department for Environmental Protection
Division of Waste Management
200 Fair Oaks, 2nd Floor
Frankfort, KY 40601-1190
Attention: Edward Winner
(502) 564-6716

(Record reviews at the Kentucky Department for Environmental Protection are by appointment only.)

U. S. Environmental Protection Agency
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960
Attention: Turpin Ballard (4 WD-FFB)
ballard.turpin@epa.gov
(404) 562-8550

The ROD and the proposed modification to the Kentucky Hazardous Waste Management Permit will be made available at the Environmental Information Center and at the Paducah Public Library after they have been signed by the United States Department of Energy and the United States Environmental Protection Agency and concurred with by the Kentucky Department for Environmental Protection.

The United States Department of Energy, the United States Environmental Protection Agency, and the Kentucky Environmental and Public Protection Cabinet do not discriminate upon the basis of race, color, national origin, sex, age, religion, or disability in the provision of services. Upon request, reasonable accommodations will be provided. These accommodations include auxiliary aids and services necessary to afford an individual with a disability an equal opportunity to participate in all services, programs, and activities. To request appropriate accommodations for a public hearing or meeting (such as an interpreter) or alternate formats for printed information, contact Matthew Hackathorn at (502) 564-6716 or the Paducah Remediation Services, LLC, Public Information Officer at (270) 441-5000.