United States
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Agency

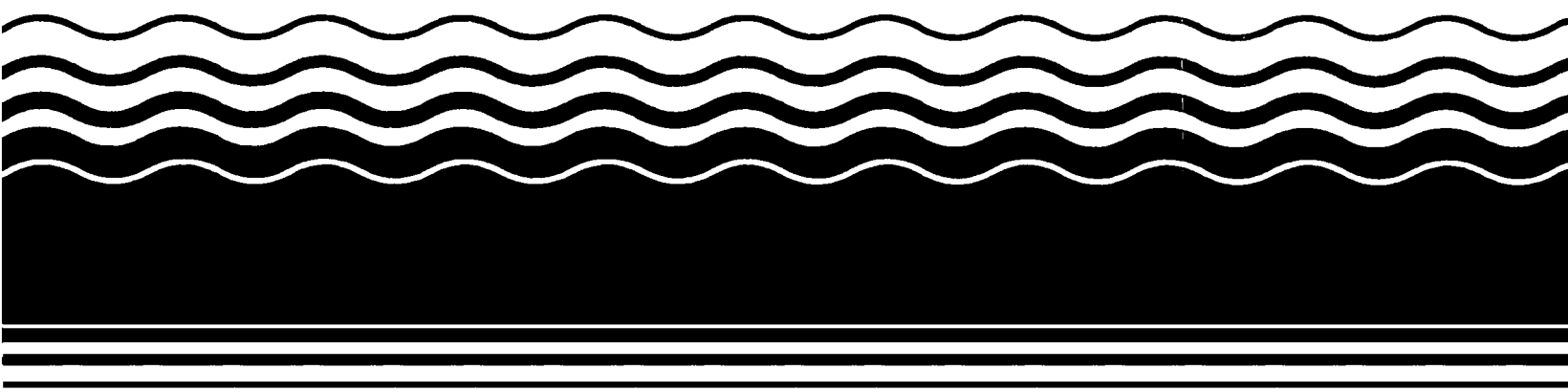
Office of
Emergency and
Remedial Response

EPA/ROD/R04-93/165
July 1993

EPA

Superfund Record of Decision:

USDOE Paducah Gas Diffusion Plant, KY



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SUPERFUND RECORD OF DECISION
USDOE Paducah Gas Diffusion Plant, KY
First Remedial Action

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16. Abstract (Limit: 200 words)

The USDOE Paducah Gas Diffusion Plant is an active Uranium Enrichment facility in McCracken County, Kentucky, three miles south of the Ohio River. Land use in the area is predominantly industrial. From 1952 to present, the USDOE Paducah Gaseous Diffusion Plant (PGDP) has operated a uranium enrichment facility, which supplies fuel for commercial reactors. The PGDP uses a gaseous diffusion process to provide a physical separation process, which allows for enrichment of the uranium. TCE has been used continuously at the site to degrease fabricated metal parts. Technetium (Tc99) was introduced to PGDP as a by-product of the reprocessing of uranium. An evaluation of the quantities, concentrations, and records related to Tc99 indicated that this radionuclide probably was introduced to ground water from past handling or disposal of TCE contaminated with Tc99 and scrap metal contaminated with Tc99. In 1988, VOCs and radionuclides were detected in private wells north of the PGDP. Later in 1988, EPA required DOE to conduct an investigation to determine the nature and extent of contamination. The site investigation demonstrated that improper past handling practices and disposal of waste material led to the contamination of ground water, including DNAPLs, migrating to the northwest from PGDP. The contamination is spreading toward the Ohio River in multiple plumes. Following the discovery of ground water

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - USDOE Paducah Gas Diffusion Plant, KY
First Remedial Action
Contaminated Medium: gw
Key Contaminants: DNAPLs, VOCs (TCE), radioactive material

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 52
	20. Security Class (This Page) None	22. Price

EPA/ROD/R04-93/165
USDOE Paducah Gas Diffusion Plant, KY
First Remedial Action

Abstract (Continued)

contamination, DOE began providing an alternative water supply to those residences with contaminated ground water. This ROD addresses interim remediation of the ground water in the northwest plume and will control the ongoing migration of contaminants in the northwest plume. Future RODs will provide a final remedy for the ground water contamination and for other onsite media. The primary contaminants of concern affecting the ground water are DNAPLs; VOCs, including TCE; and radioactive materials.

SELECTED REMEDIAL ACTION:

The selected remedial action for this site includes extracting and containing DNAPL-contaminated ground water; treating the ground water onsite using ion exchange, followed by air stripping with onsite discharge of the treated water to a State permitted outfall; filtering offgas emissions; and implementing a treatability study to evaluate the use of iron filings as an innovative technology and an alternative to pumping and treatment in the final remedial action. The estimated present worth cost for this remedial action is $15,188,190, which includes an estimated annual O&M cost of $1,719,236.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific ground water interim cleanup goals are based on SDWA MCLs, and include TCE 5 ug/l.

DOE/OR/06-1143&D4

Record of Decision for Interim Remedial Action of the Northwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

July 1993

DOE/OR/06-1143&D4

Record of Decision for Interim Remedial Action of the Northwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

July 1993

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Prepared for
U.S. Department of Energy
Enrichment Restoration Division

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NOTATIONS

The following list of acronyms, and abbreviations (including units of measure) are provided to assist in the review of this document. Acronyms used in tables only are defined in those respective tables.

ACRONYMS AND ABBREVIATIONS

ACO	Administrative Order by Consent
AEA	Atomic Energy Act
ALARA	as low as reasonably allowable
ARARs	applicable or relevant and appropriate requirements
BAT	best available technology
BETX	benzene, ethlybenzene, toulene and xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
CWA	Clean Water Act
DCGs	drivied concentration guides
DNAPL	dense non-aqueous phase liquids
DOE	U.S. Department of Energy
DOI	Department of Interior
DOT	Department of Transportation
DQO	Data Quality Objective
EDE	effective dose equivalent
Energy Systems	Martin Marietta Energy Systems Inc.
EPA	U.S. Environmental Protection Agency
Fe	iron
FS	feasibility study
HSWA	Hazardous and Solid Waste Amendments
HSP	Health and Safety Plan
ICM	Interim Corrective Measure
IM	interim measures
IROD	interim record of decision
KAR	Kentucky Administrative Record
KDEP	Kentucky Department for Environmental Protection
KDFW	Kentucky Division of Fish and Wildlife
KPDES	Kentucky Pollutant Discharge Elimination System
LDR	land disposal restrictions
LLRWPA	Low-Level Radioactive Waste Policy Act of 1985
MCL	Maximum Contaminant Level
MSL	Mean Sea Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act of 1969
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbon
PGDP	Paducah Gaseous Diffusion Plant

PHEA	Results of the Public Health and Ecological Assessment, Phase II
PP	proposed plan
RBC	Kentucky Radiation Control Branch
RCRA	Resource Conservation and Recovery Act, as amended
RGA	regional gravel aquifer
RME	reasonable maximum exposure
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
Si	silicon
SMP	Site Management Plan
TBC	to be considered
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
TcO_4	pertechtenate ion
^{99}Tc	technetium-99
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TVA	Tennessee Valley Authority
UCRS	upper continental recharge system
UF_6	uranium hexafluoride
USGS	United States Geological Survey
UV	ultraviolet
^{235}U	uranium-235
^{238}U	uranium-238
VOC	volatile organic compound
WAGs	waste area groups
WQC	water quality criteria
WKWMA	West Kentucky Wildlife Management Area

DECLARATION FOR THE RECORD OF DECISION

INTERIM REMEDIAL ACTION OF THE NORTHWEST PLUME

SITE NAME AND LOCATION

Northwest Plume
Paducah Gaseous Diffusion Plant
Paducah, Kentucky

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Northwest Plume at the Paducah Gaseous Diffusion Plant (PGDP) in Paducah, Kentucky, chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Oil and Hazardous Substance Contingency Plan. This decision is based on the administrative record file for this site.

This action was initiated pursuant to the Interim Measure provisions of the EPA and Commonwealth of Kentucky Resource Conservation and Recovery Act (RCRA) permits. The Commonwealth of Kentucky concurs with the Federal Agencies on the selected interim action, in accordance with the requirements of the Kentucky Hazardous Waste permit.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this record of decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF SELECTED REMEDY

The primary objective of this interim remedial action is to initiate a first phase remedial action, as an interim action to initiate control of the source and mitigate the spread of contamination in the Northwest plume. This operable unit addresses a portion of the contaminated ground water. Additional interim actions associated with this integrator operable unit are being considered, as well as for other areas of contaminated ground water. Other investigations are underway to address other environmental media (e.g., surface water) and contaminated source areas.

The major components of the interim action remedy include:

- The contaminated ground water will be extracted at two locations. The first location, immediately north of the plant on the U.S. Department of Energy (DOE) property, is intended to control the source. The second ground water extraction location is offsite of the DOE reservation at the northern tip of the most contaminated portion of the plume [greater than 1000 µg/l of trichloroethylene) TCE]. The contaminated ground water will be pumped at a rate to reduce further contribution to contamination northwest of the plant without changing hydraulic gradients enough to mobilize Dense Non-aqueous Phase Liquids (DNAPL) or significantly affect other plumes. This pumping rate may be modified during operation to optimize hydraulic containment by adjusting flow from the extraction wells and to support subsequent actions.

- The extracted ground water will be collected in a manifold and piped to the treatment system, which will consist of two ion exchange units in parallel followed by an air stripper with treatment for off gas emissions. This technology will provide treatment to the contaminants of concern (TCE and technetium-99). The target level for treatment of TCE is 5 ppb and 900 pCi/l for ^{99}Tc.

- The amount of treated water discharged will be limited by the flow capacity of the skid mounted treatment units. The treated water will be discharged through Kentucky Pollution Discharge Elimination System (KPDES) permitted outfall 001.

- This interim action also includes implementation of a treatability study to evaluate an innovative technology. The innovative technology to be studied involves the potential utilization of iron filings as a viable alternative to pump and treat technology for ground water treatment.

- The remedy does not address source remediation, however; the remedy will address continuing release from a DNAPL principal threat source area.

DECLARATION

This interim action is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements for this limited-scope action, and is cost-effective. Although this interim action is not intended to address fully the statutory mandate for permanence and treatment to the

maximum extent practicable, this interim action does utilize treatment and thus is in furtherance of that statutory mandate. Although partially addressed in this remedy, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element will be addressed by both this and the final response action. Subsequent actions are planned to address fully the principal threats posed by the conditions at this site. This pilot plant will be examined during the next two years to determine the effectiveness of the remedial action. Remedial activities associated with this remedy which continue beyond the pilot plant phase will require a review be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within five years after commencement of the remedial action. This review is necessary because this remedy will result in hazardous substances remaining on site above health-based levels. Because this remedy is an interim action ROD, review of this site and of this remedy will be ongoing as DOE continues to develop final remedial alternatives for the integrator operable unit.

William D. Adams — Date 7-15-93

William D. Adams
Assistant Manager for Environmental Restoration and Waste Management
U.S. Department of Energy

Date 7-22-93

Regional Administrator
U.S. Environmental Protection Agency, Region IV

PART 2

DECISION SUMMARY

DECISION SUMMARY

2.1 Site Name, Location, and Description

The Paducah Gaseous Diffusion Plant (PGDP) is an active Uranium Enrichment facility owned and operated by the United States Department of Energy (DOE) and co-operated by Martin Marietta Energy Systems, Inc. (Energy Systems). PGDP is located in the northwestern corner of Kentucky in western McCracken County, about 10 miles west of Paducah, Kentucky, and 3 miles south of the Ohio River (Figures 1 and 2).

The DOE in the role of "Lead Agency," as defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) is conducting cleanup activities at PGDP under its Environmental Restoration and Waste Management Program. Pursuant to Executive Order No. 12,580, 3 C.F.R. 193 (1987), 53 Fed. Reg. 2923 (January 29, 1987), the Lead Agency is required to assume the responsibility of ensuring that sufficient action is taken to cleanup its sites so as to provide protection for human health and the environment. These remedial activities are being conducted in compliance with the requirements of the Commonwealth of Kentucky, the Environmental Protection Agency (EPA) and DOE, as further described in the following section.

The PGDP is an active uranium enrichment facility which supplies fuel for commercial reactors. Construction of the plant began in 1951 with operations initiated by 1952. The PGDP uses gaseous diffusion to provide a physical separation process which allows for enrichment of the uranium. Commercially produced uranium hexafluoride (UF_6) is composed of mostly uranium-238 (^{238}U), with a small percent of uranium-235 (^{235}U). The gaseous diffusion process is premised on the fact that UF_6 with fissionable ^{235}U is slightly lighter than UF_6 with ^{238}U. Therefore, as the UF_6 passes through the gaseous diffusion plant's cascade system, separation of the ^{235}U from the ^{238}U takes place. This separation results in enriched uranium (slightly higher percentage of ^{235}U). The enriched uranium can then be transported to other DOE facilities for further enrichment.

2.2 Site History and Enforcement Activities

In August 1988, volatile organic compounds (VOCs) and radionuclides were detected in private wells north of the PGDP. The site investigation demonstrated that the principle contaminants of concern in the offsite ground water are technetium-99 (^{99}Tc), a radionuclide, and trichloroethylene (TCE), an organic solvent. The

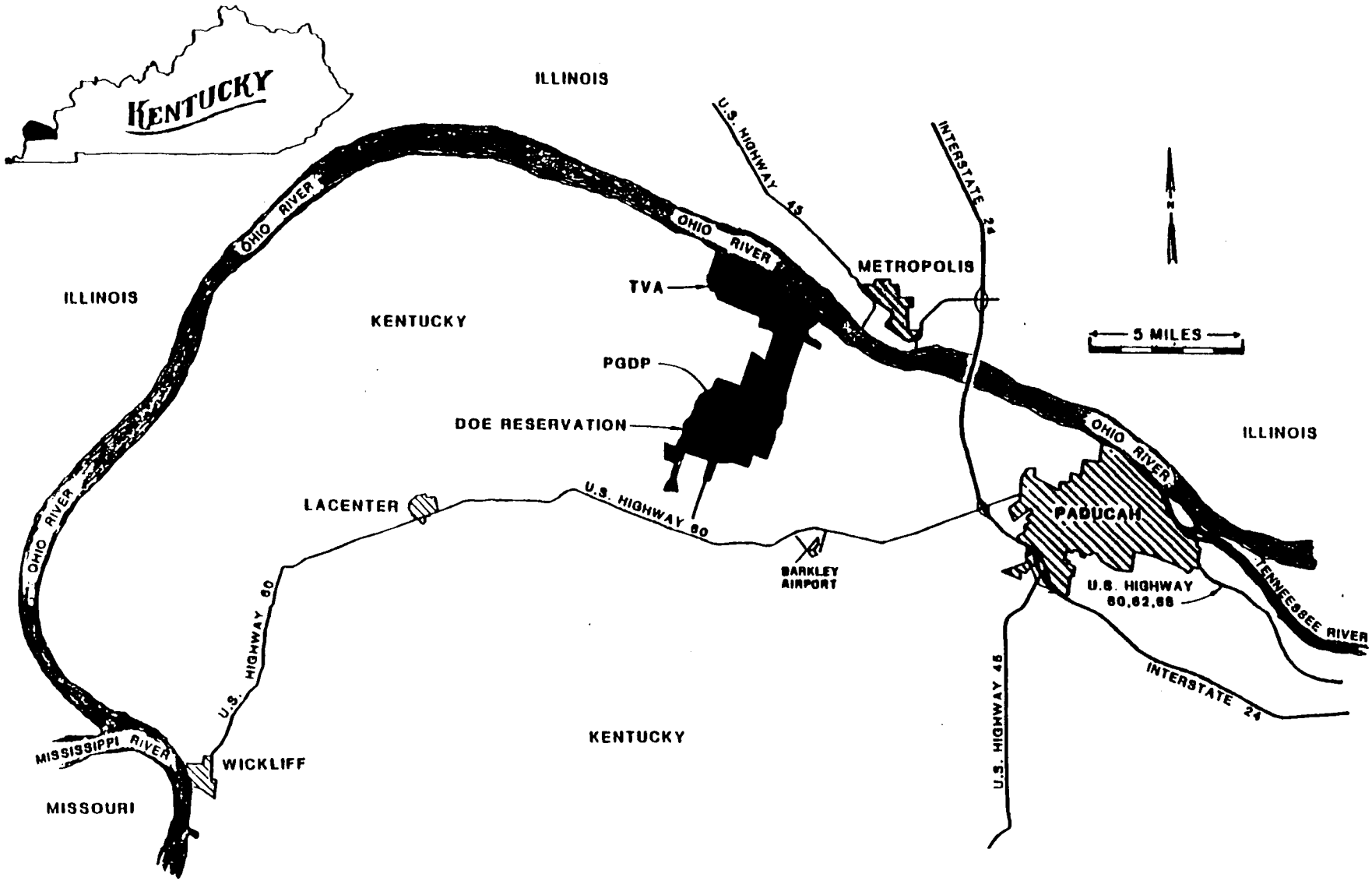

Figure 1. Location Map – Paducah Gaseous Diffusion Plant

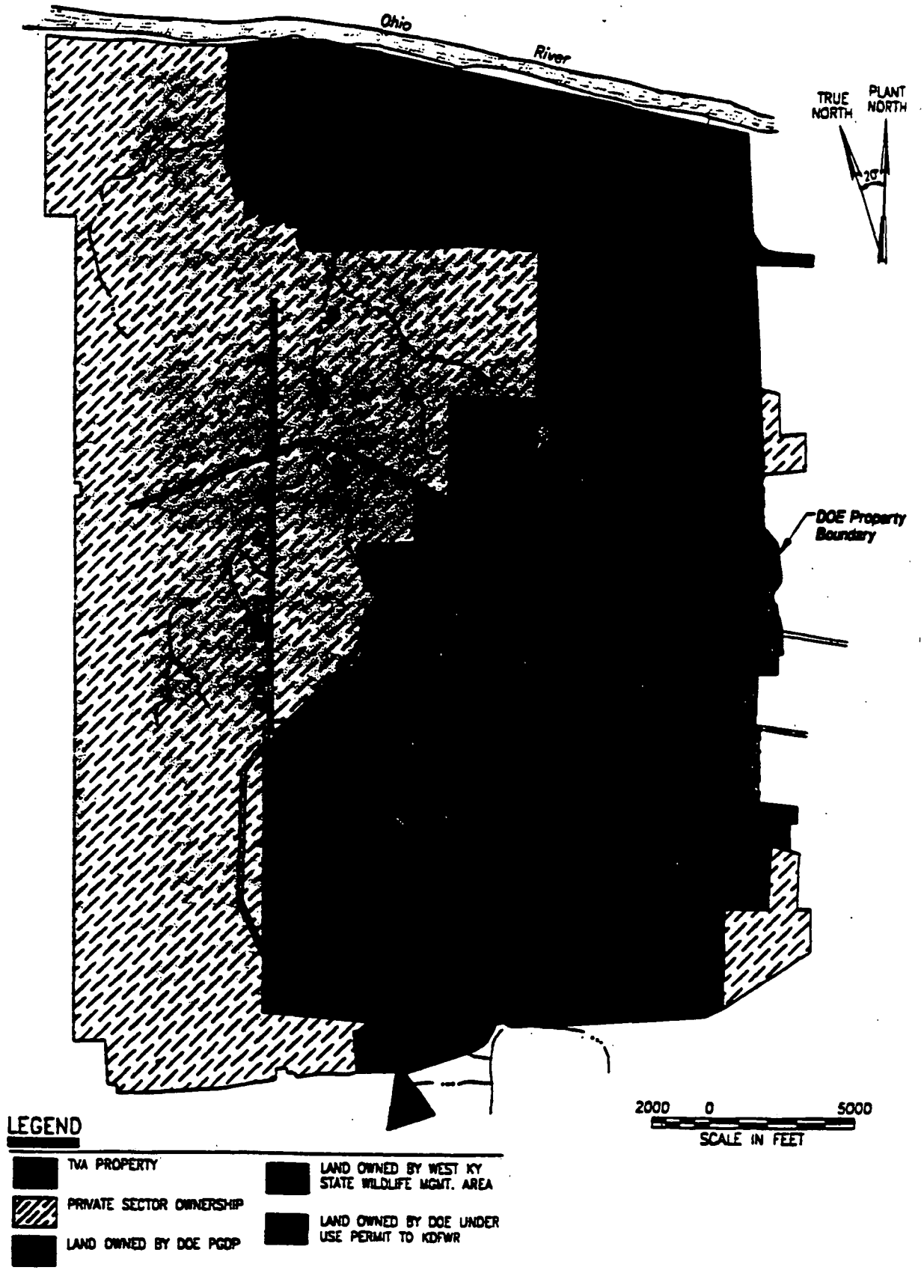

Figure 2. Current Land Ownership Map – Paducah Gaseous Diffusion Plant

contamination is spreading generally northward towards the Ohio River in multiple plumes. Past handling practices and disposal of waste material has lead to the contamination of the ground water migrating to the northwest from PGDP. The interpretation of the location of these plumes is presented in Figure 3. This figure is for illustrative purposes only and should not be interpreted as a precise description of the locations of the plumes. The outer boundary of the plume is approximately three miles from the northern border of the facility security fence.

The contaminated area spans approximately 1.6 square miles. The contamination of approximately three billion gallons of ground water may have occurred in the Northwest Plume. Concentrations of the contaminants within the Northwest Plume vary, with the higher concentrations within the centroid of the mass. The concentrations also increase with proximity to the source areas (northwest corner of PGDP).

Trichloroethylene is a nonflammable, highly volatile, colorless liquid used extensively for degreasing fabricated metal parts. Trichloroethylene (TCE) has been produced commercially in the United States since 1925, and used at PGDP continuously since 1952. The use of this product has been steadily reduced by DOE during the last several years by instituting waste minimization activities and using alternative compounds.

Technetium was introduced to PGDP as a by-product of the reprocessing of uranium. An evaluation of the quantities, concentrations, and all records related to ^{99}Tc indicates that this radionuclide was probably introduced to ground water from past handling or disposal of TCE contaminated with ^{99}Tc and scrap metal contaminated with ^{99}Tc.

In the fall of 1988, the EPA and DOE entered into an "Administrative Order by Consent" (ACO) under Sections 104 and 106 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA) to address the offsite contamination. Pursuant to the ACO, PGDP conducted an investigation to determine the nature and extent of contamination. Results of this effort were published in a document entitled *Results of the Site Investigation, Phase I* (Document #KY/ER-4, March 1991). A subsequent investigation sought to further characterize the extent of contamination. Results of this investigation were published in *Draft Results of the Site Investigation, Phase II* (Document #KY/SUB/13B-97777CP-03/1991/1, October 1991). A revised version of this document was submitted to EPA and the Commonwealth of Kentucky in April 1992. Alternatives for remediation were identified and evaluated and published in the

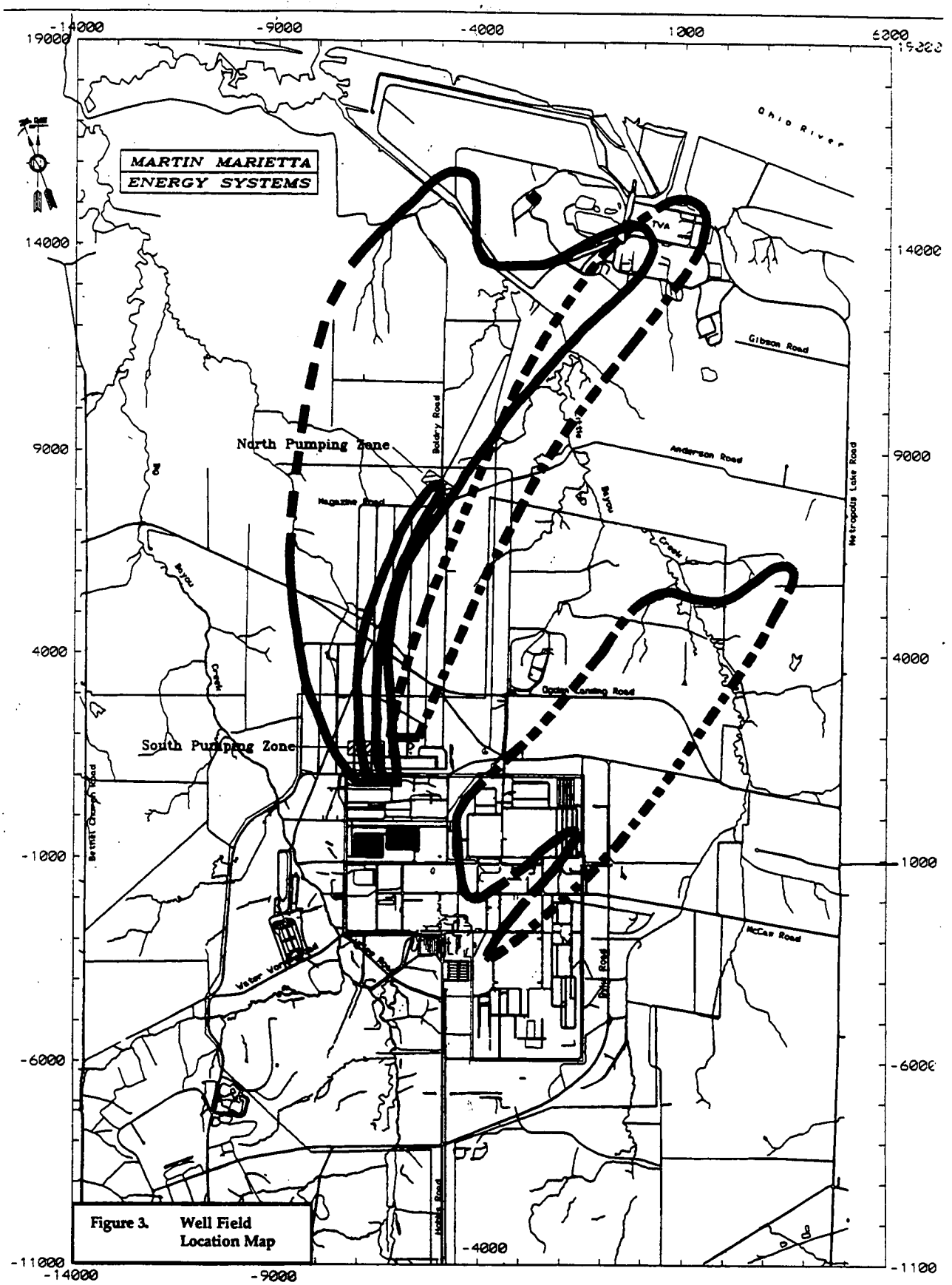

Figure 3. Well Field Location Map

Legend
- TCE Plume
- DPP-Site Tc-99 Plume
- TCE and Tc-99 Plume
- High Zone of TCE and Tc-99
- PGDP Boundaries
- Plant Fence
- Creeks, Ditches, and Streams

Map created by Bruce E. Hawkins (CED)
Created from data provided by CHEMRIS

Map Source
Modified from J. L. Clausen et. al. 1992.
Report of the PGDP Groundwater Investigation
Phase 3, KY/E-130,
Martin Marietta Energy Systems, Inc.,
Paducah Gaseous Diffusion Plant

1/4 1/2 1 Mile

1 INCH = 2230 FEET
or 679.7 METERS

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document *Draft Summary of Alternatives for Remediation of Offsite Contamination at the Paducah Gaseous Diffusion Plant* (Document #DOE/OR-1013, December 1991).

On July 16, 1991, EPA and the Commonwealth of Kentucky jointly issued permits under the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendment of 1984 (HSWA). The EPA permit contains only provisions of HSWA, while the Commonwealth of Kentucky permit contains provisions to address hazardous waste management as well as provisions of HSWA. The HSWA provisions require evaluation of hazardous constituents releases and implementation of interim and final corrective measures to address such releases. In May, 1992 the *Draft Interim Corrective Measure Work Plan For Hydraulic Containment and Ground Water Treatability Test* (ICM) (Document #DOE-OR-1031) was submitted to EPA and the Commonwealth, in accordance with the HSWA provisions of the Commonwealth of Kentucky and EPA permits, describing an option for initiating containment of the Northwest ground water plume. However, information derived from ongoing ground water investigations indicated the need to modify this work plan. The rationale for this modification included: collection of additional information concerning the characteristics of the Northwest Plume, better definition of the plume's boundaries, and to ensure consistency with the final action which may include a passive treatment system.

A series of meetings between DOE, EPA and the Commonwealth of Kentucky, lead to the agreement whereby DOE utilized the Interim Corrective Measure (ICM) Work Plan to develop a *Technical Memorandum for Hydraulic Containment of the Northwest Plume,* (SAIC 1993). The Technical Memorandum, in combination with the Draft Summary of Alternatives for Remediation of Offsite Contamination constitute DOE's equivalent of a Focused Feasibility Study for the Northwest Plume interim remedial action. The interim alternatives were summarized and transmitted for Public and Regulatory comment in the *Proposed Plan for Interim Remedial Action of the Northwest Plume,* (SAIC 1993). The Technical Memorandum will also serve as the ICM Work Plan, subject to review and approval in accordance with the provisions of HSWA.

2.3 Highlights of Community Participation

On March 14, 1993, a notice of availability was published in *The Paducah Sun*, a regional newspaper, regarding the Proposed Plan. This notice appeared in *The Paducah Sun* from March 14th until the 21st of 1993. The *Proposed Plan for Interim Remedial Action of the Northwest Plume* was released to the public on March 18, 1993. This document was made available at both the on-site and off-site

administrative records and at the Paducah Public Library. A public comment period was held from March 18, 1993 through April 16, 1993.

Specific groups which received individual copies of the Proposed Plan included the local PGDP Neighborhood Council, Natural Resource Trustees, and the PGDP Environmental Advisory Committee. Informal meetings were held with each group on March 18th and 22nd, respectively. At these meetings, DOE personnel briefed the groups on the proposed action and solicited both written and verbal comments.

On March 29, 1993, an announcement of a public meeting scheduled for April 6th appeared in *The Paducah Sun*. A display ad was placed in the newspaper on April 4, 1993 which also announced the public meeting and the availability of the document. Information bulletins were mailed to 1,933 residents, 1,850 PGDP employees, and 133 local officials on March 31, 1993. Phone calls and/or visits were made to various stakeholders, including neighbors and representatives of environmental groups, to alert them of the public comment period and briefly explain the Proposed Plan. Proposed Plans and/or Technical Memorandums were mailed to those contacted. At the April 6th public meeting, representatives of DOE, EPA and the Commonwealth of Kentucky answered questions and addressed community concerns. Pursuant to a request from the Tennessee Valley Authority (TVA) the comment period was extended until April 23, 1993. This extension of time for public comment appeared in *The Paducah Sun* on April 18, 1993. A response to the comments received during the public participation period is included in the Responsiveness Summary, which is part of this Record of Decision.

This decision document presents the selected interim remedial action for the Northwest Plume at PGDP, chosen in accordance with CERCLA, as amended by SARA, the EPA and Commonwealth of Kentucky permits issued under the RCRA, as amended by HSWA, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision for this interim action at this site is based on the administrative record.

2.4 Scope and Role of Operable Unit or Response Action

Previous Response Action Associated with this Response Action

Following the initial discovery in 1988 of ground water contamination, DOE began providing an alternative water supply to those residences with contaminated ground water. Provision of an alternate water supply was initiated to ensure immediate protection of human health from potential adverse effects due to the consumption and use of the contaminated ground water.

This Response Action and the Site Management Strategy

Pursuant to EPA Office of Solid Waste and Emergency Waste Response (OSWER) Directive 9355.3-02, possible reasons for implementing an interim action include: protection of human health and the environment from an imminent threat, or institution of temporary measures to stabilize the site to prevent further migration of the contaminant plume. The primary objective of this response action is to stabilize the site by controlling the ongoing migration of contaminants in the Northwest Plume.

A Site Management Plan (SMP) has been drafted which specifies the strategy for investigating and remediating hazardous substance releases. The draft SMP was submitted to the EPA and the Commonwealth of Kentucky for review. The proposed strategy in the draft SMP is to divide the site into source areas and environmental media which may be impacted by commingled hazardous substance releases from source areas. Discrete response actions (i.e., operable units) will be selected and implemented to address the source areas (i.e., source operable units) and the environmental media (i.e., integrator operable units) impacted by commingled releases from source operable units. Prioritization in the draft SMP for investigation and possible interim remedial actions have been assigned to each of the integrator operable units and source operable units depending on their potential for contributing to off-site contamination. Because integrator units serve as migration pathways that transport contamination from source operable units to off-site receptors, they receive the highest priority for undergoing initial evaluation and interim actions.

Consistent with the site management strategy in the draft SMP, this action has been prioritized to address the Northwest Plume of the ground water integrator operable unit which includes offsite contamination that may continue to migrate and contaminate clean aquifers and potentially expose additional offsite receptors. This interim action (operable unit) comprises an incremental step towards comprehensively addressing site problems. The primary objective of the interim action is to stabilize the site by initiating control of the northwest contamination plume. This interim remedial action addresses a portion of the ground water integrator operable unit by mitigating the spread of the high concentration portion of the Northwest Plume, decreasing the migration of contaminants from the Northwest Plume source area, and providing mass removal of the contaminants in the Northwest Plume. By implementation of interim actions, the ground water integrator unit can be addressed in the most expedient manner consistent with the program management principles of the NCP.

The limited scale extraction and treatment systems in this ROD constitute the first phase in remediation of the ground water contamination. This action can be implemented rapidly while feasibility studies can be conducted for the remainder of the integrator operable unit. This phased approach is consistent with EPA OSWER Directive 9283.1-06 which sets EPA's policy for remediation of DNAPL contaminated ground water. The directive advises that the plume should be contained early, that initiation of early actions should take place as soon as possible after a problem is identified for which an early action is appropriate, and early actions should be coordinated with final remedies such that they are the first phase of the overall remedial action. The directive further advises that remedial actions for DNAPL contaminated ground water should be implemented in a phased approach so that information gathered from implementation of the early phase(s) can support selection of an appropriate final action.

This interim action also includes implementation of a treatability study to evaluate an innovative technology that may serve to further reduce the long-term operating costs associated with this remedial action. The innovative technology to be studied is the utilization of iron filings as a viable alternative to pump and treat technology for ground water treatment. Section 2.7 of this ROD provides greater detail regarding the innovative technology and its treatability evaluation.

Future Response Actions Associated with this Response Action

The remedial action described by this ROD is not the final action for ground water or for the Northwest Plume. Following issuance of the ROD for this extraction and treatment system interim action, a feasibility study will be initiated to evaluate additional remedial alternatives to improve the effectiveness of this limited scope interim remedial action. The use of low permeability walls around the source and pump areas of the dissolved phase plume will be included in the feasibility study. This study may lead to a Proposed Plan for a second interim action for the Northwest Plume.

Although a site investigation, public health and ecological assessment, and an alternative evaluation was performed for the PGDP site, a final action cannot be recommended until further characterization activities have been completed. Before a final action can be recommended for the ground water integrator operable unit, a baseline risk assessment must be completed for the ground water integrator operable unit, including ecological risk, and the following data gaps need to be addressed, at a minimum: more complete characterization of the Northeast Plume; the interaction between the Regional Gravel Aquifer (RGA) and the deep aquifer; the interaction

between the RGA and Ohio River; and the interaction of all source operable units with the ground water integrator operable unit. Although additional data will be needed before the selection of a final action, sufficient information is available to support the interim remedial action presented in this document. This interim action should not be inconsistent with nor preclude implementation of any currently anticipated final remedy. Furthermore, data which is collected during this interim action will be utilized to assist in evaluation of design and implementation of the final action.

2.5 Integrator Operable Unit Characteristics

Hydrogeologic Characteristics

The subsurface underlying the PGDP consists of four primary, correlational hydrogeologic units, the Upper Continental Recharge System (UCRS), the RGA, the Porters Creek Clay, and the McNairy Formation. These correlations are based primarily on the physical properties of the specific units. (See Figure 4).

The UCRS consists of clayey silt, with thin zones of sand and gravel appearing at various elevations throughout the plant site. The sand and gravel are relatively discontinuous laterally throughout the predominantly clayey silt of the upper continental deposits. The flow direction is primarily vertical in this unit owing to the large conductivity contrasts between it and the underlying RGA.

The RGA consists of sand and gravel facies of the lower continental deposits. This is the dominant flow system for this region due to its relatively high hydraulic conductivity and is the primary aquifer of interest in this interim remedial action. The unit ranges in thickness from 10 to 40 feet with its main source of recharge as infiltration from the upper continental deposits. The RGA is truncated by the Porters Creek Clay. This "terrace" results in the restriction of flow and high hydraulic gradient in this region of the plant. Toward the north end of the plant, near the Ohio River, the gradient increases indicating discharge conditions. Existing regional maps show that the RGA is thin or absent beneath the river implying that flow beneath the river is unlikely. The normal pool elevation of the Ohio River as reported by the United States Geological Survey (USGS) is 290 feet Mean Sea Level (MSL). This level depicts discharge conditions at the boundary of the RGA with the Ohio River. Consequently, the Ohio River is assumed to act as a sink, or hydraulic boundary to the flow system and is designated a constant head boundary with an elevation of 290 feet (MSL) for both the UCRS and the RGA.

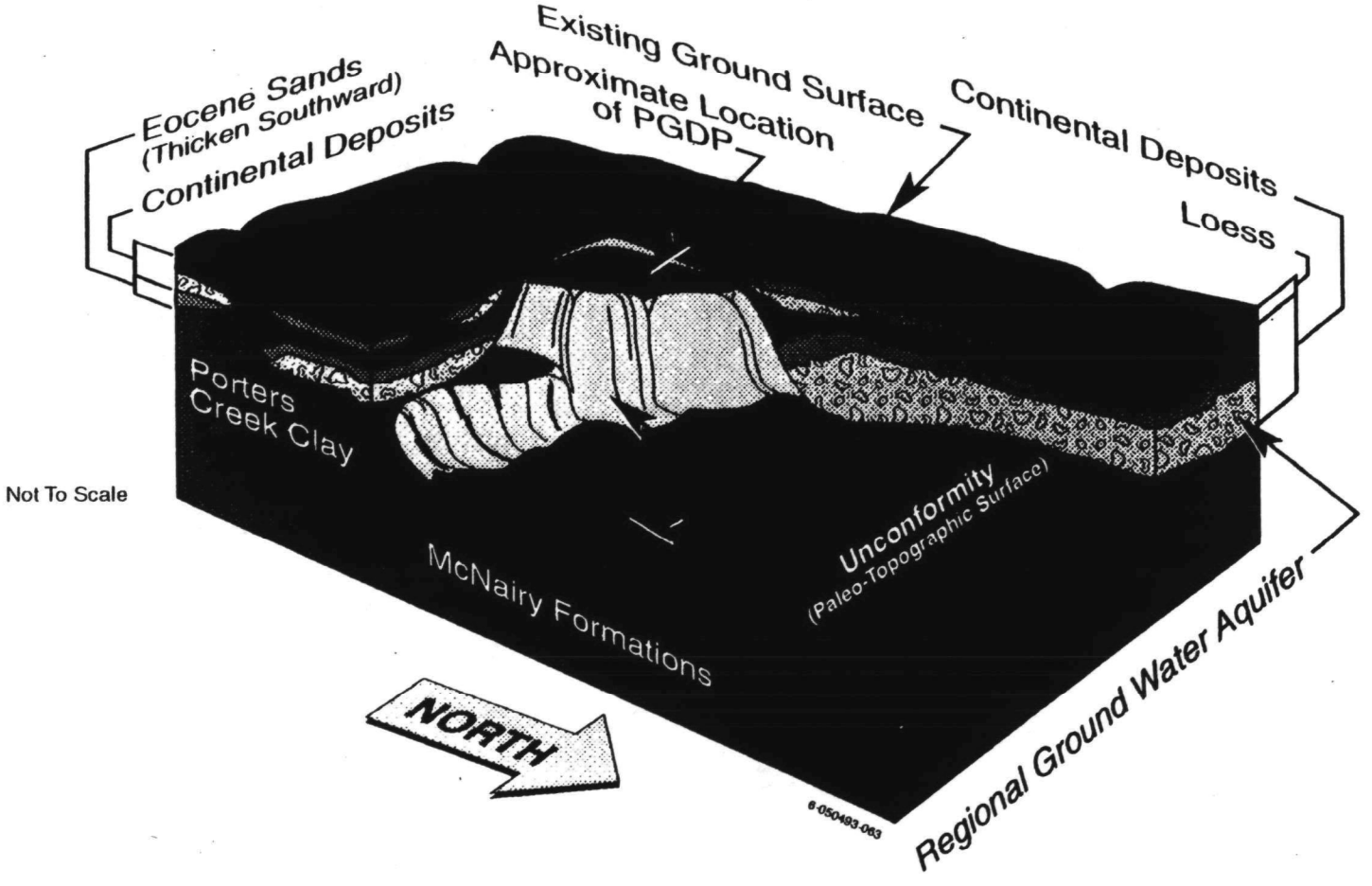

Figure 4. Conceptual Site-Specific Geology in the Vicinity of the Paducah Gaseous Diffusion Plant

The Porters Creek Clay is a predominantly clay layer that appears as a confining layer to the McNairy Formation only at the southern portions of the PGDP site, and is absent beneath most of the site. The exact northerly extent of this layer is not certain, but it appears to extend only slightly north of the terrace.

The McNairy Formation consists of interbedded and interlensing sand, silt, and clay. This unit is approximately 225 feet thick and lies at depths ranging from 70 to 100 feet below the ground surface. Regionally, the McNairy grades from predominantly sand near the Mississippi River Valley to both sand and clay near the PGDP. Water within this unit moves probably in a northerly direction with discharge areas along the Ohio River.

Various testing methods were used to characterize these units with respect to conductivity, transmissivity, storativity, and hydraulic gradient. Investigative methods include collection of monthly water level data from monitoring wells onsite and offsite of the plant, aquifer pump tests, slug tests and numerical modeling and optimization of the site. The most complete set of conductivity data for the area comes from slug tests performed on the various hydrogeologic units.

In 1990, DOE commissioned the Phase I Ground Water Study which prepared a three dimensional ground water flow model of the PGDP. This model has been updated into a regional three dimensional ground water flow model for the PGDP and an optimization plan for well placement by means of a three phase study incorporating the results of new data obtained at the plant since 1990. The Phase I Ground Water Study which was completed in March, 1992 served to outline the strategy proposed to meet the objectives for the updated three phase study. Specifically, Phase 1 outlined the current conceptual model and new hydrogeologic data to be incorporated into the new model.

The Phase II Ground Water Study incorporated the new data and conceptual model revisions into an updated three dimensional flow model. Calibration and sensitivity analyses also were conducted. This phase was completed in August of 1992. The Phase III Ground Water Study is the latest optimization plan for well placement utilizing the results from the updated Phase II Ground Water Study flow model. This phase was completed in December of 1992 .

The model is based on a USGS finite difference block centered numerical code called MODFLOW. This code allows variable grid dimensions, layer thickness and a mixed distribution of aquifer parameters. In addition, MODFLOW is modular, which means that additional programs may be used in conjunction with the main code. Additional enhancement codes have been utilized for purposes of modeling the

PGDP to mathematically determine the best well locations and optimal pumping rates necessary to contain the plume.

The model was calibrated by matching computer generated water levels to observed water levels. Calibration helped to determine layer elevations and hydraulic aquifer parameters. Following calibration, the pathway and rates of ground water movement were modeled using particle tracking.

Contaminant Characteristics

The contaminants of concern within the Northwest plume are TCE and ^{99}Tc. TCE was commonly used onsite as an industrial solvent for several years. This halogenated compound is designated as a dense non-aqueous phase liquid (DNAPL) due to the characteristic insolubility at high concentrations and a higher specific gravity than water. Once released into the environment TCE tends to travel by gravity in a downward path. Lateral movement results predominantly by contact with low permeable areas and capillary action. Due to the insolubility, TCE will tend to travel along bedding planes regardless of the direction of ground water flow. DNAPLs tend to persist for long periods, while slowly releasing a dissolve phase into the ground water.

^{99}Tc is the most widespread radionuclide present at PGDP. This radionuclide resulted as a by-product of the reprocessing of uranium. The introduction of TCE and ^{99}Tc into the ground water was probably due to the past handling or disposal practices. ^{99}Tc is very soluble in water and will tend to readily migrate in the direction of normal ground water flow.

2.6 Summary of Site Risks

The findings of an assessment of potential risks to public health and the environment as a result of the contamination migrating offsite was reported in the *Draft Results of the Public Health and Ecological Assessment, Phase II* (Document #KY/SUB/13B-97777CP-03/1991/1, 1991). Contaminated residential wells are currently not being utilized for domestic use of ground water. However, the domestic use of off-site ground water is a potential future exposure pathway.

The results of the *Draft Results of the Public Health and Ecological Assessment, Phase II* (PHEA) suggested potential adverse effects from domestic use of ground water based on the estimated excess lifetime cancer risk and hazard indices. Trichloroethylene from off-site monitoring wells created a potential increased lifetime cancer risk for the sum of ingestion and inhalation pathways. The

concentration of TCE within the area of the planned interim action is above 1,000 µg/l, while the Maximum Contaminant Level (MCL) cited in the Safe Drinking Water Act (SDWA) is 5 µg/l.

The PHEA found that the critical exposure pathway is related to the offsite migration of on-site contaminant sources. The PHEA also recommended action to eliminate the off-site migration of these contaminants. Based on the preliminary results of the PHEA and the ground water studies, DOE, EPA, and the Kentucky Division of Waste Management have decided that there is sufficient potential risk to the public and environment to warrant an interim action. The principle goals of this interim action are to decrease the risk by mitigating the spread of the high concentration portion of the Northwest Plume, retarding the migration of the contaminants emanating from the source area, and to provide mass removal of the contaminants in the Northwest Plume. Prior to the implementation of the final remedial action a baseline risk assessment will be conducted on the ground water integrator operable unit.

2.7 Description of Alternatives

Two alternatives were considered for addressing the ground water contamination in the Northwest Plume. The first alternative would be to take no action at this time and simply allow the ground water to continue to migrate toward the Ohio River. The second alternative would provide for an interim action which will alter the hydraulic gradients through ground water extraction. This second alternative will initiate containment of both the source and high concentration areas of the ground water plume. These two alternatives are described in greater detail in the subsequent paragraphs.

Alternative 1 - No Action

Pursuant to Section 300.430(e)(6) of the NCP, DOE is required to consider a no action alternative. This alternative is useful as a baseline for comparison between potential alternatives. Under this alternative no further action would be taken with regard to the contaminated ground water.

Alternative 2 - Extraction and Treatment, and Innovative Technology Treatability Study

This alternative involves the operation of a pilot extraction and treatment system to initiate hydraulic containment of the source area and the centroid of the plume. The selected remedy will include the following activities:

i) The contaminated ground water will be extracted at two locations. The first location, immediately north of the plant on DOE property, is to initiate control of the source. While the second ground water extraction location is offsite of the DOE reservation at the northern tip of the most contaminated portion (greater than 1000 µg/l of TCE) of the plume. The contaminated ground water will be pumped at a rate to reduce further contribution to contamination northwest of the plant without changing hydraulic gradients enough to mobilize Dense Non-aqueous Phase Liquids (DNAPL) or significantly affect other plumes. This pumping rate may be modified during operation to optimize hydraulic containment by adjusting flow from the extraction wells and to support subsequent actions.

ii) The extracted ground water will be collected in a manifold and piped to the treatment system, which will consist of two ion exchange units in parallel followed by an air stripper with filtration for off gas emissions.

iii) The amount of treated water discharged will be limited by the flow capacity of the skid mounted treatment units. The treated water will be discharged through Kentucky Pollution Discharge Elimination System (KPDES) permitted outfall 001.

iv) This interim action also includes implementation of a treatability study to evaluate an innovative technology. The innovative technology to be studied involves the potential utilization of iron filings as a viable alternative to pump and treat technology for ground water treatment.

v) The remedy does not address source remediation, however; the remedy will address continuing release from a DNAPL principal threat source area.

Approximately fourteen (14) months will be required to design and construct the selected remedy prior to initiation of operation and maintenance activities. This pilot system will be evaluated for a period of 2 years to determine the treatment

efficiency of the extracted ground water, the effect of extraction on the RGA, and to evaluate the potential benefit of an innovative technology (treatment with iron filings) Alternative 2 as developed in the Focused Feasibility Study and presented in the Proposed Plan, satisfies all identified ARARs for the interim action cited within this document.

2.8 Summary of the Comparative Analysis of the Interim Alternative

This section provides the basis for determining which alternative (i) meets the threshold criteria of overall protection of human health and the environment, State approval, and compliance with ARARs, and (ii) provides the best balance between effectiveness and reduction of toxicity, mobility, or volume through treatment, implementability, and cost, and (iii) satisfies community acceptance. Because of the limited scope of this interim action, the comparative analysis focuses on the selected remedy, while considering the no action alternative under the appropriate criteria.

Federal law requires nine criteria be used for evaluating the expected performance of remedial actions. The nine criteria are introduced below and the present proposal is evaluated on the basis of these criteria. Because this action is intended to integrate both RCRA and CERCLA requirements, State acceptance has been substituted for State approval and listed as one of the threshold criteria. This change is necessary to reflect the fact that this interim action was initiated under the provisions of the Kentucky Hazardous Waste Permit and must fulfill those RCRA requirements.

1. *Overall protection of human health and the environment.* Requires that the alternative adequately protect human health and the environment, in both the short and long-term. Protection must be demonstrated by the elimination, reduction, or control of unacceptable risks.

2. *Compliance with applicable or relevant and appropriate requirements (ARARs).* The alternatives must be assessed to determine if they attain compliance with applicable or relevant and appropriate requirements of both state and federal law.

3. *Long-term effectiveness and permanence.* Focuses on the magnitude and nature of the risks associated with untreated waste and/or treatment residuals. This criterion includes consideration of the adequacy and reliability of any associated engineering controls, such as monitoring and maintenance requirements.

4. *Reduction of contaminant toxicity, mobility, or volume through treatment*. The degree to which the alternative employs treatment to reduce the toxicity, mobility, or volume of the contamination.

5. *Short-term effectiveness*. The effect of implementing the alternative relative to the potential risks to the general public, potential threat to workers and the time required until protection is achieved.

6. *Implementability*. Potential difficulties associated with implementing the alternative. This may include: the technical feasibility, administrative feasibility, and the availability of services and materials.

7. *Cost*. The costs associated with the alternatives. These include the capital cost, annual operation and maintenance and the combined net present value.

8. *State approval*. The incorporation of any formal comments by the Kentucky Division of Waste Management to the Interim Measure for the Northwest Plume.

9. *Community acceptance*. The consideration of any formal comments by the community to the Proposed Plan for interim remedial action.

The criteria listed above are categorized into three groups. The first, second, and eighth categories are threshold criteria. The chosen final alternative must meet the threshold criteria to be eligible for selection. The five primary balancing criteria include criterion three through seven. The last criterion is termed the modifying criterion. The modifying criterion was evaluated following issuance of the Proposed Plan for public review and comment.

Overall Protection of Human Health and the Environment

Alternative 1 doesn't provide protection of human health or the environment. However, the risk cannot be quantified until a baseline risk assessment has been conducted at this site. Alternative 2 is intended to serve as an interim action which will provide protection to both the public and the environment by limiting the migration of the contaminated plume. Additionally, Alternative 2 will provide treatment of the ground water to decrease the concentration of the specific contaminants which are causing the threat.

Currently, the threat of direct exposure to the contaminated ground water has been mitigated by the supply of a clean alternative water source to the affected residences. However, due to the persistence of this form of contamination in ground water the potential exists for risk to future water well users.

Compliance with ARARs

Table 1 lists the ARARs for this interim remedial action. This table only lists those ARARs pertinent to the limited scope of this interim remedial action. Therefore the ARARs listed in Table 1 pertain to the extraction and treatment system operations and not to any ARARs associated with aquifer remediation goals. Such ARARs will be addressed in subsequent remedial actions. In some instances, rules cited contain both substantive and procedural or administrative requirements. In accordance with the NCP, only the substantive requirements are ARARs.

Alternative 2 as developed in the Focused Feasibility Study and presented in the Proposed Plan, satisfies all identified ARARs for the interim action cited within this document. No ARAR waivers were necessary.

Long-term Effectiveness and Permanence

The no action alternative could cause potential health and environmental impacts to occur through a future exposure scenario. The extraction and treatment system is intended as an interim action until sufficient information can be accumulated to formulate the final solution for this integrator operable unit. This action is intended to be consistent and appropriate with the final remedial action. The effectiveness and efficiency of this system will be evaluated for potential final actions. Additionally, the treatability test for the in situ reactor concept will be evaluated to determine its feasibility as a future remedial solution. This potential future action uses an innovative passive system which utilizes iron filings to efficiently remove contaminants while also providing cost effectiveness.

Reduction of Toxicity, Mobility, or Volume Through Treatment

The extraction and treatment system would serve to reduce the mobility of the contamination by initiating control of the source area and preventing further spread of the high concentration areas of the ground water plume. Further, the extracted ground water will be treated by ion exchange and air stripping to lower the concentration of the contaminants to reduce the toxicity and volume of the contaminants. The potential exists for the ^{99}Tc to become concentrated within the

Table 1. Applicable or Relevant and Appropriate Requirements (ARARs) and Guidance for the Hydraulic Containment of Off-Site Ground Water

Actions	Requirements	Prerequisites	Federal citation	Title 401, KAR[a] Chapter
CHEMICAL-SPECIFIC				
Treatment of contaminated ground water	Prevent creation of any new pollution	Direct discharge of groundwater to a surface water body - **applicable**		5:029(2)
	Discharge must not exceed DCGs[e] for radionuclides; discharge of radionuclides must not exceed 1 rad/day for protection of aquatic organisms	Direct discharge of groundwater to a surface water body - **TBC[f] guidance**	DOE Order 5400.5	
Protection of the general public from all sources of radiation	The general public must not receive an effective dose equivalent greater than 100 mrem/year	Dose received by the general public from all sources of radiation exposure at a DOE facility - **TBC guidance**	DOE Order 5400.5	
	All releases of radioactive material must be "as low as reasonably achievable" (ALARA)	Releases of radioactive material from DOE activities - **TBC guidance**	DOE Order 5400.5	
Protection of the general public from all sources of air emissions	No member of the general public shall receive an effective dose equivalent greater than 10 mrem/year	Emissions of radionuclides to the ambient air from DOE facilities - **Applicable**	40 CFR 61.92; DOE Order 5400.5	
Worker protection	Maintain worker exposures to ALARA	Internal and external sources of continuous exposure to occupational workers at a DOE facility - **TBC guidance**	DOE Order 5480.11	
	Maximum exposure to occupational workers: 5 rem/year (stochastic); 50 rem/year (nonstochastic) effective dose equivalent	Internal and external sources of continuous exposure to occupational workers at a DOE facility - **TBC guidance**	DOE Order 5480.11	
LOCATION-SPECIFIC				
Protection of the environment	Prepare an Environmental Impact Statement (EIS) or Environmental Assessment (EA) or apply for a Categorical Exclusion (CX) from such requirements	Any federal action that will have a significant impact on the quality of the environment - **Applicable**	10 CFR 1021; 40 CFR 1500-1508; 57 *FR* 15122; DOE Order 5440.1D	

Table 1. Applicable or Relevant and Appropriate Requirements (ARARs) and Guidance for the Hydraulic Containment of Off-Site Ground Water

(Continued)

Actions	Requirements	Prerequisites	Federal citation	Title 401, KAR[a] Chapter
ACTION-SPECIFIC				
Site preparation	Reasonable precaution must be taken to prevent particulate matter from becoming airborne	Handling, processing, construction, road grading, and land clearing activities - **Applicable**		63:010
Surface water control	Implement good site planning and best management practices to control storm water discharges; comply with storm water runoff requirements of KPDES Permit KY0004049	Construction activities at industrial sites involving disturbance of 5 acres total land - **Applicable if over 5 acres disturbed; relevant and appropriate if less than 5 acres disturbed**	40 CFR 122	5:080.1
Well construction	Construction by a certified driller required; construction report must be submitted to the Cabinet within 30 days after construction	Commercial water well drilling - **Applicable**		6:310.3(1); 6:310.3(2)
Pumping	Compliance with the substantive requirements of the water well withdrawal permitting process must be assured for a CERCLA§ response	Water withdrawal exceeding 10,000 gallons/day - **Applicable**		KRS 151; 4:010
	Must apply for a water withdrawal permit	Water withdrawal exceeding 10,000 gallons/day - **While substantive requirements are applicable; procedural requirements are not applicable**		KRS 151.140; 4:010
Air stripping	Must ensure that emissions do not exceed standards for control of emissions of volatile organics.	Emission from air contaminant source - **Applicable**		63:022
	Air construction permit application required for an air contaminant source.	Construction of an air contaminant source - **While substantive requirements are applicable; procedural requirements are not applicable**		50:035

Table 1. Applicable or Relevant and Appropriate Requirements (ARARs) and Guidance for the Hydraulic Containment of Off-Site Ground Water

(Continued)

Actions	Requirements	Prerequisites	Federal citation	Title 401, KAR[a] Chapter
Air stripping (cont.)	Must apply for a Wastewate Facility Construction Permit	Construction of a water treatment facility - **While substantive requirements are applicable; procedural requirements are not applicable**		KRS 151.140; 4:010
Container Storage (on-site)	Containers of hazardous waste must be: _ Maintained in good condition; _ Compatible with hazardous waste to be stored; and _ Closed during storage (except to add or remove waste). Inspect container storage areas weekly for deterioration.	Storage of RCRA hazardous waste (listed or characteristic) not meeting small quantity generator criteria held for a temporary period before treatment, disposal, or storage elsewhere, in a container (i.e., any portable device in which a material is stored, transported, disposed of, or handled). A generator who accumulates or stores hazardous waste on-site for 90 days or less in compliance with 40 CFR 262.34(a)(1-4) is not subject to full RCRA storage requirements - **Applicable**	40 CFR 264 (Subpart I) 40 CFR 264.171 40 CFR 264.172 40 CFR 264.173 40 CFR 264.174	34:180 34:180.2 34:180.3 34:180.4 34.180.5
	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide containment system with a capacity of 10% of the volume containers. Remove spilled or leaked waste in a timely manner to prevent overflow to the containment system.		40 CFR 264.175	34:180.6
	At closure, remove all hazardous waste and residues from the containment system and decontaminate or remove all containers, liners.		40 CFR 264.178	34:180.9

Table 1. Applicable or Relevant and Appropriate Requirements (ARARs) and Guidance for the Hydraulic Containment of Off-Site Ground Water

(Continued)

Actions	Requirements	Prerequisites	Federal citation	Title 401, KAR[a] Chapter
Container Storage (on-site) (Cont.)	Storage of banned wastes must be in accordance with 40 CFR 268. When such storage occurs beyond one year, the owner/operator bears the burden of providing that such storage is solely for the purpose of accumulating sufficient quantities to allow for proper recovery, treatment, and disposal.		40 CFR 268.50	37:050.2
Transportation of treatment residuals	Waste must be manifested	Treatment residuals exhibit a RCRA hazardous waste characteristic as defined by Subpart C of 40 CFR § 261 and off-site transportation occurs	40 CFR 262	
	Waste must be packaged and transported accordance with DOT[l] requirements	The treatment residuals are considered a RCRA hazardous waste by characteristic, or a hazardous substance that equals or exceeds a reportable quantity; and, transportation in commerce occurs. **Applicable if DOE does not close off the road to public use during transport; if the transport does not occur in a DOE operated government vehicle; or if access to the roads is not controlled by the use of gates and guards**	49 CFR 172, 173, 178, and 179	
	Waste must be packaged and transported according to DOE requirements	Transportation of hazardous materials - **TBC guidance**	DOE Order 5480.3	
Direct discharge of treatment system effluent	The discharge must comply with the KPDES effluent limitations of KY0004049 for Outfall 001.	Point-source discharge to waters of the United States[m] - **Applicable**	40 CFR 122.44(a)	5:080.1
	Must apply for a KPDES permit modification for increased discharge to Outfall 001.	Point-source discharge to waters of the United States[m] - **Applicable**		5:055

Table 1. Applicable or Relevant and Appropriate Requirements (ARARs) and Guidance for the Hydraulic Containment of Off-Site Ground Water

(Continued)

[a]KAR = Kentucky Administrative Record.
[b]KPDES = Kentucky Pollutant Discharge Elimination System.
[c]CFR = Code of Federal Regulations.
[d]KRS = Kentucky Revised Statute.
[e]DCG = Derived concentration guide.
[f]TBC = "to be considered."
[g]CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980.
[h]RCB = Kentucky Radiation Control Board.
[i]RCRA = Resource Conservation and Recovery Act.
[j]CWA = Clean Water Act.
[k]CAMU = corrective action management unit, regulated under RCRA Subpart S (58 *FR* 8658, February 16, 1993).
[l]DOT = Department of Transportation.
[m]The term ``Waters of the U.S.'' is defined broadly in 40 CFR 122.2 and includes essentially any water body and wetland.

ion exchange media. The DOE is prepared to provide for the handling and storage of contaminated ion exchange material at PGDP.

Short-term Effectiveness

The remediation of ground water contaminated with organic solvents and radionuclides is a long-term process. The treatment systems may require extensive periods of time before the remedial objective can be defined and attained. This interim action will provide effective short-term stabilization of the contaminated plume.

The extraction and treatment will be conducted in compliance with all of the ARARs cited in Table 1. This alternative will not pose a threat to nearby communities or the workers associated with the operation and maintenance of the treatment system. Workers associated with the construction and operation of the extraction and treatment system will abide by the requirements of a site-specific Health and Safety Plan (HSP). This HSP will be prepared as part of the bid package and submitted to the selected contractor prior to the award of the project. Prior to implementation of this interim action the EPA and KDEP will be provided the opportunity to review the HSP. The draft HSP will be modified by the contractor to reflect pertinent comments by the Regulatory Agencies.

Implementability

The ground water extraction, and air stripping, cited in Alternative 2 are readily available technologies and no difficulty should be encountered in finding vendors to supply the treatment equipment. Experience with large scale treatment for ^{99}Tc, however, is limited and data on the capacity of the ion exchange resins selected for this action is incomplete.

Cost

The estimated capital cost of the extraction and treatment system is between $11-12 million with an annual operating cost of between $1.5-2 million. A complete breakdown estimate for the costs associated with Alternative 2 is included in Table 2 of this document. DOE considers the expenditures associated with extraction and treatment to be reasonable and appropriate for this interim remedial action.

Table 2. Surface water discharge Air Stripper with carbon filtration, double-walled piping

PILOT PLANT	Materials				Subcontractor Charges	Non-capitalized Operating expense		
	QTY	UNIT	UNIT PR	TOTAL	TOTAL	UNITS	RATE	TOTAL
submersible pumps	6	ea	$1,066	$6,396				
well installation	6	ea	$95,700	$574,200				
observation wells	20	ea	$47,850	$957,000				
aquifer test	1	ls	$100,000	$100,000				
valves	50	ea	$196	$9,805				
ion exchange	4	units	$20,000	$80,000				
cost of cont. and storage of spent resin								$86,800
Air Stripper with carbon filtration	2	ea	$104,710	$209,420				
process pumps	3	ea	$1,066	$3,198				
well development water	12000	gal	$1	$12,000				
soil dispose	12	cu yd	$729	$8,748				
housing(inc.fire prot., site prep.,etc.)	1500	sq ft	$45	$67,500				
utilities relocation	1	ls	$75,000	$75,000				
piping (double-walled)	7200	feet	$35	$252,000		Utility Expense:		$32,850
construction				$0	$21,800			
Gas chromatography	1	ea	$25,000	$25,000		O&M Expense:		$56,600
Scintillation counter	1	ea	$100,000	$100,000				
refrigerator	3	ea	$2,058	$6,174				
fence	100	ft	$8	$800				
HVAC				$5,100	$800			
lighting				$20,000				
in line pH	4	ea	$1,250	$5,000				
pH meter	1	ea	$1,250	$1,250				
Resistance Temperature Detectors (RTDs)	10	ea	$95	$950				
RTD output	2	ea	$2,215	$4,430				
Analyses (annual rate)						$2,600	$500	$1,300,000
Technicians(hours)						$4,160	$58	$242,986
Process Control Equipment				$600,000				
Data Management				$60,000				
Communications and alarm	1	sys		$10,000				
health and safety requirements	1	ls	$515,520	$515,520				
differential pressure meter	8	ea	$695	$5,560				
Total direct				$3,715,051		Total Operating		
					$22,600	Expense per year:		$1,719,236
lax (6%)				$222,903				
subtotal				$3,960,555				
total indirect (26%)				$1,029,744				
subtotal				$4,990,299				
construction mgt. fee (47%)				$2,345,440				
subtotal				$7,335,739				
engineering design (25%)				$1,833,935				
subtotal				$9,169,674				
escalation factor (3%)				$275,090				
subtotal				$9,444,764				
contingency (25%)				$2,361,191				
total capital investment				$11,805,955				

Assuming:
Two years of operation
Discount rate= 7.00%
Inflation rate= 3.50%

Present worth cost= $15,188,190

State Approval

The Technical Memorandum, Proposed Plan and Draft ROD were issued for review and comments by both the Commonwealth of Kentucky and the EPA. This documentation was developed consistent with the RCRA Interim Corrective Measures Work Plan. The Kentucky Division of Waste Management concurs with this action, consistent with the requirements of the Commonwealth of Kentucky's RCRA permit.

Community Acceptance

Judging from the comments received during the public comment period, the selected interim remedy specified in the Record of Decision is supported by the residents of McCracken County, Kentucky; including the local PGDP Neighborhood Council, and the PGDP Environmental Advisory Committee. The United States Environmental Protection Agency, Kentucky Division of Waste Management, the Tennessee Valley Authority, and the United States Department of the Interior also concur with the selected remedy.

Groups and organizations which oppose this interim action include the Association of Concerned Environmentalists, the Coalition for Health Concern, and the Kentucky Radiation Control Branch (RCB). Those opposing the interim remedial action generally expressed a concern that insufficient information is available to select a remedial action and that this remedy is not cost effective.

Community response to the alternatives is presented in the responsiveness summary which addresses comments received during the public meeting and the public comment period.

2.9 Selected Remedy

The selected remedy for the interim action at the Northwest Plume is Alternative 2. The principle objectives of this action are to initiate a first phase remedial action, which in combination with possible future remedial actions for ground water, will ultimately result in achieving the final remedial goals for the site. The ground water will be extracted at two locations and pumped to mobile treatment units. The first well location is just north of the plant on DOE property. The second well location is at the northern tip of the most contaminated portion (TCE greater than 1000 µg/l) of the plume (Figure 3). The contaminated ground water will be pumped at a rate based on the predictions provided by ground water modeling. The rate at which the ground water will be extracted will be adjusted to reduce further contribution to

contamination northwest of the plant without changing hydraulic gradients enough to mobilize DNAPL or significantly affect other plumes. Data gathered during the operation will be used to modify the model in order to optimize hydraulic containment by adjusting flow from the extraction wells.

The extracted ground water will be collected and piped to the treatment system consisting of two ion exchange units followed by an air stripper unit. The amount of water discharged will be limited by the flow capacity of the skid mounted treatment units. The treated water will be discharged through Kentucky Pollution Discharge Elimination System (KPDES) permitted outfall 001. This outfall is located on DOE property and discharges into Big Bayou Creek.

Ion exchange is a process by which an ion is captured from a solution and replaced with a different ion. The capture takes place by chemisorption onto an electrochemically charged resin surface. Anion exchange resin beads are composed of chemicals which carry positive charges. The resin contains anions adsorbed onto the surface of the resin beads. Pertechnetate (TcO_4^-) ions have a greater affinity for the resins under consideration than other ions in the ground water so that pertechnetate ions tend to preferentially adsorb onto the surface of the resin. Lab and bench scale studies using ion exchange to remove ^{99}Tc have shown this method to be effective.

Air stripping is a process by which water containing VOCs is brought into contact with air. The stripper will be designed to reduce the concentrations of TCE in the water. Other VOC contaminants such as TCE degradation products are present in much smaller concentrations so that an air stripper that removes the TCE will also remove other volatiles that might be present. The effectiveness of this technology is enhanced by exposing an increased surface area of contaminated water with the airstream. This is accomplished by performing the operation in packed towers. Conventional air strippers spray water into the top of the column and allow the water to trickle over the packing. Air is blown into the bottom of the tower and contacts the water in a counter-current flow. In the event that air stripping is selected, it will be necessary to install a filter system to eliminate mobilization of contamination into the air. The decision to install these filters is based upon EPA OSWER Policy Directive 9355.0-28, and Sections 300.430(e)(7)(i) and 300.430(e)(9)(iii)(D) of the NCP, which sets forth the statutory preference for implementing actions which employs effective treatment.

It may be necessary to obtain a permit for discharging TCE into the airstream. A Kentucky water withdrawal permit may also be required by the State for withdrawal, diversion, or public transfer of more than 10,000 gallons per day public water from its

source. The State also may require construction and operating permits for the construction of the wastewater treatment facility. Estimated cost of the hydraulic containment remedy is presented in Table 3.

The DOE will begin to prepare a detailed design of the treatment system when EPA and the Kentucky Division of Waste Management concur with the ROD for this interim action, in accordance with the approved ICM Work Plan. The conceptual proposal presented in the *Technical Memorandum for Interim Action of the Northwest Plume* suggests the following system. Ground water would be pumped into a manifold where it will be routed to the water into the treatment system. A sample valve would be installed just before the treatment system for inlet water sampling. The water then passes through an inlet filter which removes suspended solids from the water. A side stream is pulled off after the inlet filter to supply the treatability study for the iron filings reactor on the south treatment system. The other treatment system will not have an iron filing reactor. The next split in the line allows the air stripping process to occur prior to ^{99}Tc removal if desired. The influent is split into two streams to supply each of the ion exchange columns. Both streams pass through flow rate meters and cumulative flow meters in route to the ion exchangers. From the ion exchange columns, the water passes another sample point and through a second anion exchange column to monitor the discharge for radiation. The treated water from the bottom of the air stripper is pumped to either discharge or to the ^{99}Tc treatment loop. A sample valve is provided after the pump discharge line.

The primary parameters to be monitored are the influent and effluent concentrations of contaminants. The data quality objectives (DQO) for these parameters will include level I (field data), II (field scintillation), and III (laboratory data). Influent and effluent concentrations will be monitored on a daily basis throughout the testing program. Each treatment system will be sampled on alternate days. Analytes initially will included ^{99}Tc, TCE, and pH, although this list may be expanded or reduced as the program evolves upon concurrence by EPA and KDEP.

Piezometric measurements of the water table will be made throughout the program to gather data necessary for ground water modeling and to demonstrate gradients toward the collection wells. These measurements will meet the criteria for DQO level I.

Cumulative flows will be monitored in order to establish resin capacity in the ion exchange treatment system. The DQO level for these measurements will be level I. DQO level I & II analyses will be performed by personnel on-site. Each treatment

Table 3. Estimated Cost of Hydraulic Containment Remedy

Surface water discharge, Air Stripper with carbon filtration, double-walled piping

Capital Investment of Hydraulic Containment Option with Air Stripping and Ion Exchange Systems:	
1. Ion Exchange System:	$202,223
2. Air Stripping System:	$529,370
3. Well Installation, laboratory construction, piping and miscellaneous:	$8,713,171
Subtotal	$9,444,764
Contingencies @25%:	$2,361,191
Total Capital Investment:	$11,805,955
Estimated Operation and Maintenance Expense (annually):	$1,719,236
TOTAL COSTS:	
Net Present Value assuming an inflation rate of 3.5%, a discount rate of 7% and two years of operation:	$15,188,190

facility will be sampled every other day. Monthly samples will be taken from both treatment facilities on the first working day of each month. The frequencies may be changed when sufficient data has been accumulated to make more informed judgments about data adequacy. Changes in frequencies or in operating parameters will occur only after concurrences by EPA and the Commonwealth of Kentucky. Monthly replicate samples taken by on-site personnel will be analyzed by laboratory personnel. The cost of the analysis of the replicates is estimated to be $100/sample for TCE, $40/sample for ^{99}Tc, and $200/sample for metals. Other compounds that will be analyzed on a monthly basis include TCE degradation products and other organic compounds.

Observation wells will be installed in the area proximal to the extraction wells. Approximately 20 observation wells will be installed near the pumping wells. Data loggers will be installed in the well field to constantly monitor ground water level. All observation wells will be use in the effectiveness monitoring program. The purpose of the well effectiveness monitoring is to create and maintain an adequate database on the hydrogeologic situation in the Northwest Plume and to enable changes to be made in extraction/injection that will optimize remediation and containment. This data base will be created using newly constructed and existing wells.

Concurrent with the interim remedial action proposed in Alternative 2, was a provision for a treatability study to examine a promising innovative technology. In this treatability test, ground water will be extracted from wells just north of the plant and diverted from the treatment facility to a cylinder packed with iron filings in order to ascertain the effectiveness of iron filings in destroying TCE and precipitating ^{99}Tc. Studies examining sorption of organic contaminants on well casing materials demonstrated that several chlorinated organic compounds disappeared from solution over time when in contact with galvanized metal and aluminum. Further investigation verified the disappearance of chlorinated organic compounds from solutions when in contact with various metals. The same effect was later demonstrated using iron filings. The reaction mechanism associated with this innovative treatment technology has not yet been fully explained. Pilot demonstrations have been conducted using an in situ reactor which consisted of a wall composed of 22% by weight iron and 78% by weight sand constructed below the ground perpendicular to the direction of flow of the ground water. A source of mixed chlorinated organic compounds, including TCE, was emplaced upstream of the wall and it was demonstrated that the TCE concentration was reduced by 95% as a result of passing through the reactive wall. Since iron will also reduce pertechnetate ion to insoluble technetium dioxide, the reactive wall concept can also be used for removal of ^{99}Tc from the ground water.

If the innovative technology is shown to be an effective treatment technology, a feasibility study will evaluate use of this technology as a reactive material placed as a vertical wall in the contaminated aquifer. The wall would be designed to allow ground water to naturally flow through the reactive medium and be passively treated without extraction and treatment at the surface. The reactive wall concept shows great promise as a viable alternative to pump and treat technology for ground water treatment. However, at this time, it is an emerging innovative technology which needs further development before it can be utilized as a final remedy.

An additional aspect of the treatability study of this action is to evaluate, on a pilot plant scale, the effectiveness of ion exchange technology in remediation of ground water contaminated with technetium.

2.10 Statutory Determinations

The DOE, EPA and Kentucky Division of Waste Management concur that the extraction and treatment system will satisfy the CERCLA § 121(b) statutory requirements of: providing protection of human health and the environment, attaining applicable or relevant and appropriate requirements directly associated with this action, being cost-effective, utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable, and a preference for treatment as a principle element.

Protection of Human Health and the Environment

Although the ground water within the contaminated plume is not currently used as a source of drinking water for the local residents, under future use scenarios it presents a potential threat to human health and the environment. The interim action remedy initiates protection of human health for the future users through mitigation of the spread of the plume until a final action is determined. The remedy also provides protection to the environment by providing treatment of the extracted ground water prior to discharge, and effective management of all residual wastes generated during implementation of the action.

Compliance with ARARs

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 was passed by Congress and signed into law on December 11, 1980 (Public Law 96-510). This act was intended to provide for "liability, compensation, cleanup, and emergency response for hazardous substances released into the

environment and the cleanup of inactive waste disposal sites." The Superfund Amendments and Reauthorization Act (SARA), adopted on October 17, 1986 (Public Law 99-499), did not substantially alter the original structure of CERCLA but provided extensive amendments to it. In particular, § 121 of CERCLA specifies that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws which are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site. Inherent in the interpretation of applicable or relevant and appropriate requirements (ARARs) is the assumption that protection of human health and the environment is ensured.

CERCLA on-site remedial response actions must only comply with the substantive requirements of a regulation and not the administrative requirements to obtain federal, state, or local permits [CERCLA § 121(e). For the purposes of this ARAR summary, remediation of off-site ground water at PGDP is considered an "on-site" CERCLA response pursuant to the *National Contingency Plan*, 40 C.F.R. § 300.5.]

The final cleanup levels for the ground water are not addressed in this ROD because such goals are beyond the limited scope of this action. The final cleanup levels will be addressed by the final remedial action ROD for the ground water integrator operable unit.

The treatment system for the extracted ground water will meet all Federal and State surface water quality standards. Additionally, the air stripper will be designed to meet the Federal and State air quality standards. The treated ground water will meet the substantive requirements of the Kentucky Pollutant Discharge Elimination System (KPDES) program for discharge to surface water.

A listing of ARARs (chemical-specific, location-specific, and action-specific) are provided in Table 1 of this document. Pursuant to 300.430(f)(1)(ii)(C) of the NCP an alternative which doesn't meet federal or state ARARs can be selected if the action is an interim measure that would become part of a final action which will attain ARARs.

Chemical-Specific ARARs

The principal contaminants of concern in the off-site ground water are ^{99}Tc and TCE. Therefore, available chemical-specific criteria that have been promulgated under federal and Kentucky state law that are applicable to this response action are listed in Table 1. TCE degradation products, metals, and gross alpha and beta activity will be included in the list of analytes and analyzed on a routine basis.

The Kentucky Water Quality Standards nondegradation policy [Title 401 Kentucky Administrative Record (KAR), Chapter 5:029(2)] is to safeguard the surface waters of the state for their designated uses, to prevent the creation of any new pollution, and to abate existing pollution. The Kentucky regulations list six use-designation categories for Kentucky's surface waters (KAR 5:026). Specific water quality standards are promulgated for each use category. Big Bayou Creek is not specifically listed and given a use classification in the Kentucky water regulations (401 KAR 5:026); however, it is classified by reference for warm water aquatic habitat, and primary and secondary contact recreation [401 KAR 5:026; KAR 5:200(2)]. The Kentucky WQC for warm water habitat are found in Title 401 KAR 5:031.

Also listed on Table 1 are the effluent limitations established for Outfall 001 on Big Bayou Creek (KPDES Permit No. KY0004049). This permit was revised and reissued, effective November 1, 1992.

The chemical-specific federal and state regulations for protection of the surface water are presented below in Table 4.

Table 4. Chemical-Specific Federal and State Regulations for Protection of Ground Water and Surface Water (µg/L)

Chemical	KAR Warm Water Aquatic Habitat WOC[c]		KPDESd Permit No. KY0004049
	Acute Criteria	Chronic Criteria	Effluent Characteristics (Monthly avg.)
Trichloroethylene	–	–	81
Radionuclides			
Gross alpha	–	–	report
Gross beta	–	–	report
Uranium	–	–	report
All other man-made radionuclides	–	–	report

[a] WQC = water quality criteria; Title 401 Kentucky Administrative Regulations (KAR), Chapter 5:031, unless otherwise footnoted.

[b] KPDES = Kentucky Pollutant Discharge Elimination System.

[c] Daily maximum.

Radiation Protection Standards

Very few applicable standards are available for the cleanup of radioactively contaminated CERCLA sites. The Atomic Energy Act (AEA) of 1954 and its amendments delegated authority for control of nuclear energy to DOE, the U.S. Nuclear Regulatory Commission (NRC), and EPA. In addition, certain states have regulatory authority and programs for radioactive waste. EPA's regulations are derived from several other statutes as well and cover many types of activities and all types of radioactive materials. The NRC licenses the possession and use of various types of radioactive materials at certain types of facilities. Kentucky is an NRC-agreement state and, as such, has its own authority and licensing regulations. DOE is authorized to control all types of nuclear materials at sites under its jurisdiction and is exempt from the NRC licensing and regulatory requirements.

DOE regulations for handling and cleanup of radioactive materials are outlined in a series of internal DOE Orders that are contractually binding to DOE contractors but are not considered by EPA to be ARARs. However, DOE Orders are "generally" consistent with, and "typically" incorporate NRC technical requirements that are appropriate for DOE operations and waste management. Therefore, for the purposes of development of ARARs, DOE Orders will be treated as TBC guidance.

If any wastes generated during drilling of wells or as treatment residuals contain radionuclides and are identified as RCRA-characteristic waste, the waste would then be termed "mixed waste." In effect, mixed wastes are those containing a RCRA hazardous waste as defined in 40 C.F.R. § 261 and a radioactive waste subject to the AEA. RCRA regulations apply to the hazardous component of the waste, and AEA regulations apply to the radioactive component. When the application of both standards is conflicting or inconsistent, RCRA yields to the AEA. Kentucky received final authorization to regulate radioactive mixed waste on December 19, 1988 (53 Fed. Reg. 41164, October 20, 1988); however, the state has not implemented any regulations governing the radioactive component of mixed waste.

EPA has promulgated MCLs for radionuclides in community water systems. These MCLs appear in two forms—concentration limits for certain alpha-emitting radionuclides (40 C.F.R. § 141.15) and an annual dose limit for the ingestion of certain beta- and gamma-emitting radionuclides (40 C.F.R. § 141.16). Kentucky lists MCLs in the Kentucky Public and Semipublic Drinking Water Regulations, Title 401 KAR Chapter 8:550, Section 4 which are identical to the federal MCLs. The use of MCLs as ARARs are not appropriate for this action due to the fact that the extracted water will not be reinjected back into the aquifer and the scope of this interim action

is not intended to provide ground water restoration. However, the treatment system described in Alternative 2 will be designed to provide treatment to levels comparable with MCLs. Therefore, the MCL levels will be utilized as remedial goals. The treatment system will remain within compliance parameters as long as the applicable substantive KPDES requirements for discharge are maintained.

Subpart H of 40 C.F.R. § 61 addresses atmospheric radionuclide emissions from DOE facilities and may be applicable to airborne emissions during cleanup of contaminated ground water. EPA has issued a final NESHAP rule (54 Fed. Reg. 51654, December 15, 1989) that limits emissions of radionuclides to the ambient air from DOE facilities to amounts that would not cause any member of the public to receive an effective dose equivalent of 10 mrem/year (40 C.F.R. § 61.92).

DOE Orders. The radiation exposure limits for the general public defined in DOE Order 5400.5 (*Radiation Protection of the Public and the Environment*, February 8, 1990) are: an effective dose equivalent (EDE) of 100 mrem/year from all exposure pathways and all DOE sources of radiation and a dose of less than 500 rem/year as a temporary maximum exemption under specially-permitted and DOE-approved circumstances. The overriding principle of the DOE Order is that all releases of radioactive material shall be ALARA.

DOE Order 5400.5 lists Derived Concentration Guides (DCGs) for radionuclide isotopes which are based on a committed effective dose equivalent of 100 mrem/year for ingestion of air or water. For liquid wastes containing radionuclides which are discharged to surface waters, the best available technology (BAT) must be used if the receiving water, at the point of discharge, would receive radioactive material at a concentration greater than the DCG. Guidelines for selecting the BAT are given. Implementation of the BAT process is not required if annual releases to surface water are below the DCG. In the case of releases of multiple radionuclides, the sum of the fractional DCGs must not exceed unity. The ingested water DCG for ^{99}Tc is 1.0E-4 μCi/ml. In addition, effluent releases to surface water must not result in exposures to aquatic organisms which exceed an absorbed dose of 1 rad/d.

Location-Specific ARARs

Location-specific requirements "set restrictions upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations" (53 Fed. Reg. 51394). Table 1 lists location-specific ARARs that might be pertinent to this remedial action.

Aquatic resources. There are no federal wilderness areas, wildlife refuges, or scenic rivers near PGDP. However, the land between the plant boundary and the Ohio River was deeded or leased to the Kentucky Department of Natural Resources and Environmental Protection as part of the West Kentucky Wildlife Management Area (WKWMA). There are no federal or state regulations specifically applicable to wildlife management areas. However, the Kentucky Department of Fish and Wildlife (KDFW) manages the area. In the event that any remedial activities would impact the WKWMA, DOE will consult with KDFW.

Action-Specific ARARs

Performance, design, or other action-specific requirements set controls or restrictions on particular kinds of activities related to the management of hazardous waste (52 Fed. Reg. 32496). Selection of a particular remedial action at a site will invoke the appropriate action-specific ARARs that may specify particular performance standards or technologies, as well as specific environmental levels for discharged or residual chemicals. Federal and state regulations appear in Table 1 and are summarized below.

Construction Activities

Site preparation. Certain on-site construction activities may be necessary to prepare the site for remediation; these action might include the development of additional roads for vehicular traffic or site cleaning activities. Airborne pollutants may result from these construction activities. The primary concern is elevation of particulate concentrations resulting from earth-moving and site-grading activities. The Kentucky Air Quality regulations contain General Standards of Performance governing fugitive dust emissions (401 KAR 63:010).

Storm water discharges from activities at industrial sites involving construction operations that result in the disturbance of five acres total land have been included in the final rule for NPDES permits for storm water discharges (40 C.F.R. § 122). Kentucky is developing storm water discharge regulations; however, until they are promulgated, they are operating under 40 C.F.R. § 122. This Rule specifies that Best Management Practices and sediment and erosion controls be implemented at a site to control storm water runoff (57 Fed. Reg. 41176, September 9, 1992). Kentucky does have a general permit in place for storm water runoff from construction sites (KYP100000).

Well construction. Although the construction of water withdrawal wells is regulated under 401 KAR 6:310, this action will be exempted from this requirement. The

regulation is not applicable for monitoring wells. However, wells must be constructed by a certified driller [401 KAR 6:310(3)] according to specified design factors [401 KAR 6:310(4)] and construction materials [401 KAR 6:310(9)], as well as other requirements. Requirements are also given for monitoring well construction [401 KAR 6:310(13)].

Pumping. Water withdrawal permits are required under authority of KRS 151 and 401 KAR 4:010 for wells or systems that pump greater than 10,000 gallon per day. Although a permit is not required for a CERCLA action, the substantive requirements of these regulations are applicable.

Treatment. As mentioned previously, no federal or state permits are required for on-site CERCLA response. However, compliance with the substantive requirements of any applicable permitting processes are required. An air stripper with an air filter will be used to remove TCE and other degradation products from the water column, and an ion exchange column will remove radionuclides; mobile wastewater treatment units will be utilized.

Air emission control. Kentucky regulates air emissions via their Air Toxics Regulation (401 KAR 63:022); the state has issued a "Guidance for Compliance with the Air Toxics Rule." Since this is a CERCLA action, no air permit would be required if emissions exceed the standards, but the threshold of TCE will not be exceeded in the air stripper. However, compliance with the substantive requirements will be fulfilled.

Disposal of treatment residuals. During operation, spent ion exchange elements or other treatment residuals may be generated by the treatment unit. Accumulation or on-site storage of this waste may be required prior to disposal. If the residuals are RCRA-characteristic waste and are accumulated for greater than 90 days, the 40 C.F.R. § 264 regulations apply ("Container storage," Table 1). This wastewater treatment unit selected for this action will be exempt from RCRA Subtitle C standards for tank systems, conveyance systems, and other ancillary equipment. Under 40 C.F.R. § 270.1(c)(2)(v), the action would be considered an action under § 402 or 307(b) of the Clean Water Act, therefore fulfilling RCRA requirements for exemption.

Placement of treatment residuals containing RCRA-characteristic waste to another unit that has not been designated as a Corrective Action Management Unit, will trigger the 40 C.F.R. § 268 LDR. However, DOE applied for a one-year case-by-case extension under 40 C.F.R. § 268.5 of the May 8, 1992, effective date of the LDRs applicable to Third/Third mixed wastes generated and stored at PGDP, as well as 30 other sites (57 Fed. Reg. 22024, May 26, 1992). Whether the waste is characterized as

RCRA characteristic, LLW, or mixed waste, it will be stored at an appropriate facility at PGDP which meets the substantive requirements of RCRA.

Transportation of treatment residuals. RCRA hazardous waste must be packaged in accordance with Department of Transportation (DOT) regulations codified in 49 C.F.R. §§ 175, 178, and 179 if transporting occurs along public roads. In addition to the manifest and pre-transport requirements of 40 C.F.R. § 262, standards for labeling, marking, and placarding are stated in 49 C.F.R. § 172. These requirements are considered ARARs for hazardous or radioactive waste if the action meets the prerequisites as a generator of a hazardous waste and the transportation of wastes from the site to PGDP is considered an off-site action.

Disposal of Treated Media

Direct discharge to surface water body. Direct discharge to a surface water body (see "direct discharge of treatment system effluent," Table 1) will be implemented if the treated water meets CWA State Water Quality Criteria for the designated use of the water body and the substantive requirements of the Kentucky Pollutant Discharge Elimination System (KPDES) effluent standards for point source discharge to Outfall 001 (KPDES Permit KY0004049). Table 1 lists these standards.

The extraction and treatment system would meet all of the regulatory requirements cited as ARARs for this action. The final ground water effluent will meet all Federal and State water quality standards for discharge to surface water. In the event that air stripping is selected, it will be designed to meet the Federal and State air quality standards. This may include receipt or modification of the necessary permits, compliance with all maintenance and reporting requirements, and adherence to treatment performance criteria.

It is premature to establish chemical-specific ARARs for ground water at this time. Once the ground water is pumped to the surface, chemical-specific ARARs will apply in the form of discharge limits. Location-specific ARARs such as wetlands protection and action-specific ARARs such as monitoring wells will also apply.

Cost Effectiveness

The interim action remedy employs a proven technology which affords overall effectiveness proportional to its costs such that the remedy represents reasonable value. This action will utilize a relatively inexpensive technology to initiate control of the source and mitigate the spread of the contaminated ground water. This limited scale containment operation should reduce the cost of the overall

remediation of the integrator operable unit by retarding the migration of the high concentration portion of the plume. By extracting the ground water at the locations proposed in this document, DOE will be able to mitigate the area of highest contamination through the use of four wells and portable skid mounted treatment units.

Utilization of Permanent Solutions and Alternative Treatment Technologies

The objectives for this interim action are to stabilize the site by mitigating the spread of the most contaminated portion of the plume. This action should provide protection for human health and the environment. However, it does not fully address the principle threats to human health and the environment posed by the Northwest Plume operable unit. Extraction and treatment of contaminants in the aquifer will achieve some reduction in the contamination at the site. This is not the final action planned for the ground water contamination. Subsequent actions will address fully the principle threats posed by the conditions at the PGDP. Utilization of a permanent solution will be addressed in the final decision document for the site.

Preference for Treatment as a Principle Element

This interim action satisfies the statutory preference for treatment of the discharged effluent as a principle element of the containment system.

2.11 Documentation of Significant Changes

The Proposed Plan for Interim Remedial Action of the Northwest Plume, was released for public comment on March 18, 1993. The Proposed Plan identified Alternative 2, extraction and treatment, as the preferred alternative. DOE has reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, it was determined that no significant changes to the remedy, as it was originally identified in the Proposed Plan, were necessary.