Department of Energy

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

AUG 3 1 2015

Ms. Julie Corkran
Federal Facility Agreement Manager
U.S. Environmental Protection Agency, Region 4
Federal Facilities Branch
61 Forsyth Street
Atlanta, Georgia 30303

PPPO-02-3100686-15

Ms. April Webb
Acting Interim Federal Facility Agreement Manager
Kentucky Department for Environmental Protection
Division of Waste Management
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601

Dear Ms. Corkran and Ms. Webb:

EXPLANATION OF SIGNIFICANT DIFFERENCES TO THE RECORD OF DECISION FOR THE INTERIM REMEDIAL ACTION OF THE NORTHEAST PLUME AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, DOE/LX/07-1291&D2/R1, AND REMEDIAL ACTION WORK PLAN FOR OPTIMIZATION OF THE NORTHEAST PLUME INTERIM REMEDIAL ACTION AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, DOE/LX/07-1280&D2/R1

Please find the subject documents enclosed for your review and approval. Each document has been modified to incorporate the requirements that resulted from the signing of the "Memorandum of Agreement for Resolution of the Formal Dispute of the Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-1291&D2), and Remedial Action Work Plan for the Optimization of the Northeast Plume Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-1280&D2)" (MOA for Resolution). Additionally, any comments received on the D2 versions of the documents that were not covered by the MOA for Resolution also have been incorporated (i.e., land disposal restrictions, EW235 location, and air dispersion calculations). Also, modifications to the document were made to reflect the Paducah Gaseous Diffusion Plant (PGDP) turnover to the U.S. Department of Energy and transition of contractors, which includes use of the Kentucky Pollutant Discharge Elimination System/Comprehensive Environmental Response Compensation and Liability Act outfalls, and procedure updates including applicable health and safety and data management plans. A redlined version of each document also is included to assist in identifying the modifications made.

The schedule for completion of the optimization process was discussed during a conference call by the Federal Facility Agreement (FFA) parties on Friday, August 7, 2015, and is documented in the referenced D2/R1 Remedial Action Work Plan (RAWP). This schedule is included in Section 4 of the updated RAWP. The project schedule includes activities through initiation of quarterly sampling. Additional optimization activities (installation of the extraction wells, second treatment unit, and installation of the remaining monitoring well system) will follow completion of the required four quarters of sampling data for baseline determination and completion of the assessment by the FFA parties. The following criteria provide the reasoning for the scheduling approach that is being used:

- Allows the use of the groundwater sampling data collected from the monitoring well transect to define baseline conditions that can be included in finalization of the extraction well locations and operating parameter decision process;
- Allows use of the updated PGDP sitewide groundwater model that is being updated at this time;
- Reduces the technical risk of locating the optimized extraction wells and remaining monitoring wells in locations that are not technically optimal; and
- Reduces the potential risk of compromising well integrity associated with having the optimized extraction wells and remaining monitoring wells being idle for an extended period of time.

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

Sincerely,

Jennifer Woodard

Jennifer Woodard
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:
1. ESD Certification Page
2. RAWP Certification Page
3. Northeast Plume ESD, DOE/LX/07-1291&D2/R1 Redline and Clean
4. Northeast Plume RAWP, DOE/LX/07-1280&D2/R1 Redline and Clean

e-copy w/enclosures:
april.webb@ky.gov, KDEP/Frankfort
brian.begley@ky.gov, KDEP/Frankfort
corkran.julie@epa.gov, EPA/Atlanta
dave.dollins@lex.doe.gov, PPPO/PAD
ffscorrespondence@ffspaducah.com, FFS/PAD
gaye.brewer@ky.gov, KDEP/PAD
jennifer.woodard@lex.doe.gov, PPPO/PAD
john.kelly@ffspaducah.com, FFS/Kevil
leo.williamson@ky.gov, KDEP/Frankfort
mark.duff@ffspaducah.com, FFS/Kevil
mike.guffey@ky.gov, KDEP/Frankfort
myrna.redfield@ffspaducah.com, FFS/Kevil
reinhard.knerr@lex.doe.gov, PPPO/PAD
richards.jon@epamail.epa.gov, EPA/Atlanta
stephaniec.brock@ky.gov, KYRHB/Frankfort

CERTIFICATION

Document Identification: ***Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,*** **DOE/LX/07-1291&D2/R1**

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

Fluor Federal Services, Inc.

John C. Kelly

John Kelly, Project Manager

8/28/15

Date Signed

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

U.S. Department of Energy (DOE)

WE Murphie

William E. Murphie, Manager
Portsmouth/Paducah Project Office

8/28/15

Date Signed

DOE/LX/07-1291&D2/R1
Primary Document

Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant Paducah, Kentucky

CLEARED FOR PUBLIC RELEASE

DOE/LX/07-1291&D2/R1
Primary Document

Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant Paducah, Kentucky

Date Issued—August 2015

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FLUOR FEDERAL SERVICES, INC.,
Paducah Deactivation Project
managing the
Deactivation Project at the
Paducah Gaseous Diffusion Plant
under Task Order DE-DT0007774

CLEARED FOR PUBLIC RELEASE

THIS PAGE INTENTIONALLY LEFT BLANK

PREFACE

The regulations to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) require that changes to remedial actions that are proposed after the adoption of a signed Record of Decision (ROD) be documented using one of the following three processes: (1) ROD Amendment if the change "fundamentally alters" basic features of the remedy; (2) Explanation of Significant Differences (ESD) if the change is significant, but not fundamentally different from the selected remedy in the ROD; or (3) Memorandum to File if the proposed changes to the remedy are minor. The proposed changes to the Northeast Plume interim remedial action (IRA) are not considered to "fundamentally alter" the basic features of the remedy, as presented in the ROD, but certain components of the proposed changes are considered "significant" changes that require development of an ESD. This *Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1291&D2/R1, was prepared in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 117(c); 40 *CFR* § 300.435(c)(2)(i) of the NCP; and a *Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Decision Documents,* EPA 540-R-98-031, July 1999. It provides the public the opportunity to understand the proposed modifications to the IRA for the Northeast Plume and the changes that significantly differ from the approach delineated in the *Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/06-1356&D2 (DOE 1995).

The major components of the interim action remedy in the 1995 ROD include these:

- The contaminated groundwater was to be extracted at a location in the northern portion of the high trichloroethene (TCE) concentration area of the plume (greater than 1,000 μg/L of TCE). The contaminated groundwater was to be pumped at a rate of approximately 100 gal per minute (gpm) to initiate hydraulic control without changing groundwater gradients enough to cause adverse effects. During operation, this pumping rate may have been modified to optimize the hydraulic containment by adjusting flow from the extraction wells (EWs) and to support subsequent actions.

- The extracted groundwater was to be collected and piped to a treatment system prior to release to a Kentucky Pollutant Discharge Elimination System-permitted outfall. The treatment facility was to consist of a sand filter for removal of suspended solid materials and utilization of the Paducah Gaseous Diffusion Plant's (PGDP's) cooling towers for volatilization of contaminated groundwater. The chemicals of concern are TCE and 1,1-dichloroethene (1,1-DCE).

- Two treatability studies were to be conducted to include (1) photocatalytic oxidation of TCE-contaminated off-gas and (2) *in situ* treatment of TCE-contaminated groundwater.

The U.S. Environmental Protection Agency (EPA) and Kentucky Department for Environmental Protection, in a letter received on April 23, 1996, agreed to remove the sand filter from the IRA since the EWs were designed with an artificial sand pack that serves as a sand filter for sediments. Thus, the quality of water being discharged from the EWs would be similar to that of a drinking water well, with the exception of the TCE contamination.

A minor modification to the ROD was written on May 2, 1996, to postpone the treatability studies [(1) photocatalytic oxidation of TCE-contaminated off-gas and (2) *in situ* treatment of TCE-contaminated groundwater].

The proposed changes described by this ESD will be implemented in a phased approach and will consist of the following anticipated modifications to the IRA:

- Replace the two existing EWs (EW331 and EW332) with two new groundwater EWs (EW234 and EW235) to be in the upgradient high concentration portion of the Northeast Plume and near the eastern edge of the PGDP industrial facility (approximately 300 gal per minute combined).

- Install new treatment units as an alternative to the cooling towers to remove volatile organic compounds (VOCs), namely TCE and DCE, from extracted groundwater. These units will include pretreatment filtration and removal of VOCs via air stripping technology. The two treatment units will strip VOCs and discharge treated groundwater at levels that are compliant with identified applicable or relevant and appropriate requirements.

- Create a maximum of two new CERCLA outfalls for discharge of treated groundwater from the treatment units into Little Bayou Creek.

The extraction of Northeast Plume mass from new EWs (EW234 and EW235) located upgradient of the current EWs (EW331 and EW332) and in the vicinity of the eastern boundary of the plant site will remove both VOC mass in the contaminated groundwater from the higher concentration portion of the Northeast Plume and control the amount of plume mass migrating off-site.

None of the above anticipated changes are considered to be fundamentally different from the original selected remedy in the 1995 ROD; however, the creation of up to two new CERCLA outfalls for discharge of the treated groundwater will require identification and inclusion of new applicable or relevant and appropriate requirements. Under EPA guidance (EPA 1999), these new discharges would be considered to be a significant change that should be documented in an ESD. EPA guidance (EPA 1999) states that while the ESD is being prepared and made available to the public, the lead agency may proceed with the pre-design, design, construction, or operation activities associated with the remedy.

CONTENTS

FIGURES

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

ACRONYMS

ARAR	applicable or relevant and appropriate requirement
ATU	alternate treatment unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulation*
CWA	Clean Water Act
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ESD	explanation of significant differences
EW	extraction well
Fed. Reg.	Federal Register
FFA	Federal Facility Agreement
IRA	interim remedial action
KAR	*Kentucky Administrative Regulation*
KDAQ	Kentucky Division for Air Quality
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollution Discharge Elimination System
MOA	Memorandum of Agreement
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PGDP	Paducah Gaseous Diffusion Plant
RAWP	remedial action work plan
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
ROD	record of decision
USEC	United States Enrichment Corporation
VOC	volatile organic compound
VOHAP	volatile organic hazardous air pollutant

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) has prepared this Explanation of Significant Differences (ESD) to document the changes to the Record of Decision (ROD) for Interim Remedial Action (IRA) of the Northeast Plume at the Paducah Gaseous Diffusion Plant (PGDP) that are necessary to optimize the existing Northeast Plume Groundwater System.

The ROD was signed by DOE, the U.S. Environmental Protection Agency (EPA), and the Kentucky Department for Environmental Protection in June 1995. The primary objective of this IRA is, "to implement a first-phase remedial action as an interim action to initiate hydraulic control of the high concentration area within the Northeast Plume that extends outside the plant security fence." The selected remedy was designed to reduce the concentrations of trichloroethene (TCE) in the most contaminated portions of the Northeast Plume. The extraction well (EW) location was defined in the ROD as the northern portion of the high TCE concentration of the plume (greater than 1,000 μg/L of TCE). The planned changes presented in the ESD are protective of human health and the environment and will not impact the protectiveness of the IRA. As recognized in the ROD, successful control of the plume, in combination with existing controls (alternate water supply, monitoring, etc.), ensures protection during the period of the interim response.

The modification to the IRA for the Northeast Plume documented in this ESD is as follows:

- Replace the two existing EWs (EW331 and EW332) with two new groundwater EWs (EW234 and EW235) to be in the upgradient high concentration portion of the Northeast Plume and near the eastern edge of the PGDP industrial facility (approximately 300 gal per minute combined extraction rate). The EW extraction rates may be adjusted if monitoring results identify potential changes in groundwater flow or contaminant source impacts (e.g., rising contaminant concentrations in the Northeast Plume, source migration, etc.) in order to minimize these potential impacts.

- Install new treatment units as an alternative to the cooling towers to remove volatile organic compounds (VOCs), namely TCE and dichloroethene, from extracted groundwater. These treatment units will include pretreatment filtration and removal of VOCs via air stripping technology. The two treatment units will strip VOCs and discharge treated groundwater at levels that are compliant with identified applicable or relevant and appropriate requirements.

- Create a maximum of two Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) outfalls for discharge of treated groundwater from the treatment units into Little Bayou Creek.

- Install 18 monitoring wells to evaluate performance and effectiveness of the optimized EWs. Consistent with the MOA for Resolution, five of these monitoring wells, at a minimum, will be located in a north-south transect located approximately 600 ft east of the C-400 Building. These transect monitoring wells will be used to assess the impact of groundwater EWs on contaminant migration from source areas, including impacts to the groundwater divide east of C-400 Building.

Design, construction, and operation will be performed in addition to start-up testing and will include installation of piping, process control equipment, electrical equipment, and placement of additional monitoring wells to evaluate performance and effectiveness of the new optimization system. This Northeast Plume IRA optimization project is intended to increase volatile organic compound mass removal and enhance capture of contaminants migrating in the Northeast Groundwater Plume at the eastern edge of the PGDP industrial facility (see Figure 1). This optimization action was initiated in

response to recommendations that are documented in the Sitewide Remedy Review (DOE 2006); *Review Report: Groundwater Remedial System Performance Optimization at PGDP, Paducah, Kentucky* (DOE 2007); 2008 CERCLA Five-Year Review and approval letters (DOE 2009; EPA 2009; KEEC 2009); Site Management Plan (DOE 2012); negotiations among the Federal Facility Agreement parties, including the Memorandum of Agreement for Resolution (DOE 2015a); and in response to the deactivation of PGDP.

In conclusion, the planned changes presented in the ESD are protective of human health and the environment and will not impact the protectiveness of the IRA. The optimized interim action will continue to rely on other actions to achieve protectiveness while the IRA continues.

1. INTRODUCTION AND PURPOSE

The U.S. Department of Energy (DOE) is conducting cleanup activities at the Paducah Gaseous Diffusion Plant (PGDP) under its Environmental Management Program. Cleanup efforts are necessary to address contamination resulting from past waste-handling and disposal practices at the plant. The cleanup activities comply with the requirements of the U.S. Environmental Protection Agency (EPA), the Kentucky Energy and Environment Cabinet, and DOE.

Pursuant to the Record of Decision (ROD) for Interim Remedial Action (IRA) of the Northeast Plume at PGDP signed by DOE, EPA, and Kentucky Department for Environmental Protection (KDEP) in June 1995, DOE currently is operating groundwater extraction wells (EWs) (EW331 and EW332) and a treatment system at PGDP to initiate hydraulic control of the high concentration area within the Northeast Plume that extends outside the plant security fence. The treatment system is designed to remove trichloroethene (TCE) and 1,1-dichloroethene (1,1-DCE) from extracted groundwater.

Reviews and assessments, including the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-mandated periodic five-year review documents for years 2003 and 2008 and approval letters (DOE 2003; DOE 2009; EPA 2009; KEEC 2009) have resulted in recommended changes to the IRA to enhance capture of the Northeast Plume contamination in the vicinity of the eastern edge of PGDP industrial facility and to reduce further migration off-site. The *Memorandum of Agreement for Resolution of Formal Dispute of the Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1291&D2, and *Remedial Action Work Plan for Optimization of the Northeast Plume Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-1280&D2, (DOE 2015a) (MOA for Resolution) also documents the Federal Facility Agreement (FFA) parties' agreement that an optimization of the existing Northeast Plume IRA is warranted. Accordingly, DOE has prepared this Explanation of Significant Differences (ESD) to document the changes made to the Northeast Plume IRA that were necessary in optimizing the IRA.

This ESD has been prepared in accordance with CERCLA Section 117(c) and 40 *CFR* § 300.435(c)(2)(i) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). An ESD is required when a significant change is made to the remedy defined in the decision document (e.g., ROD). A significant change generally involves a change to a component of a remedy that does not fundamentally alter the overall cleanup approach. This ESD describes the nature of the significant change, summarizes the information that led to making the change(s), and affirms that the revised remedy complies with the NCP and the statutory requirements of CERCLA. As required by 40 *CFR* § 300.435(c)(2)(i)(B), DOE will publish a notice of availability and a brief description of the ESD in a major local newspaper of general circulation. The ESD also is made available to the public by placing it in the Administrative Record file and information repository [40 *CFR* § 300.435(c)(2)(i)(A) and § 300.825(a)(2)].

1.1 SITE NAME AND LOCATION

PGDP is located in the northwestern corner of Kentucky in western McCracken County, about 10 miles west of Paducah, Kentucky, and 3.5 miles south of the Ohio River (Figure 1). Past operations and disposal of waste material resulted in the contamination of the groundwater migrating to the northeast from PGDP (Figure 2). Areas of contaminated groundwater within the Regional Gravel Aquifer (RGA) extend beyond the DOE property boundary on the north and northeast. These areas are referred to as the Northwest and Northeast Plumes, respectively. A portion of the Northwest Plume discharges to Little Bayou Creek, a perennial surface water body located northeast of the DOE property.

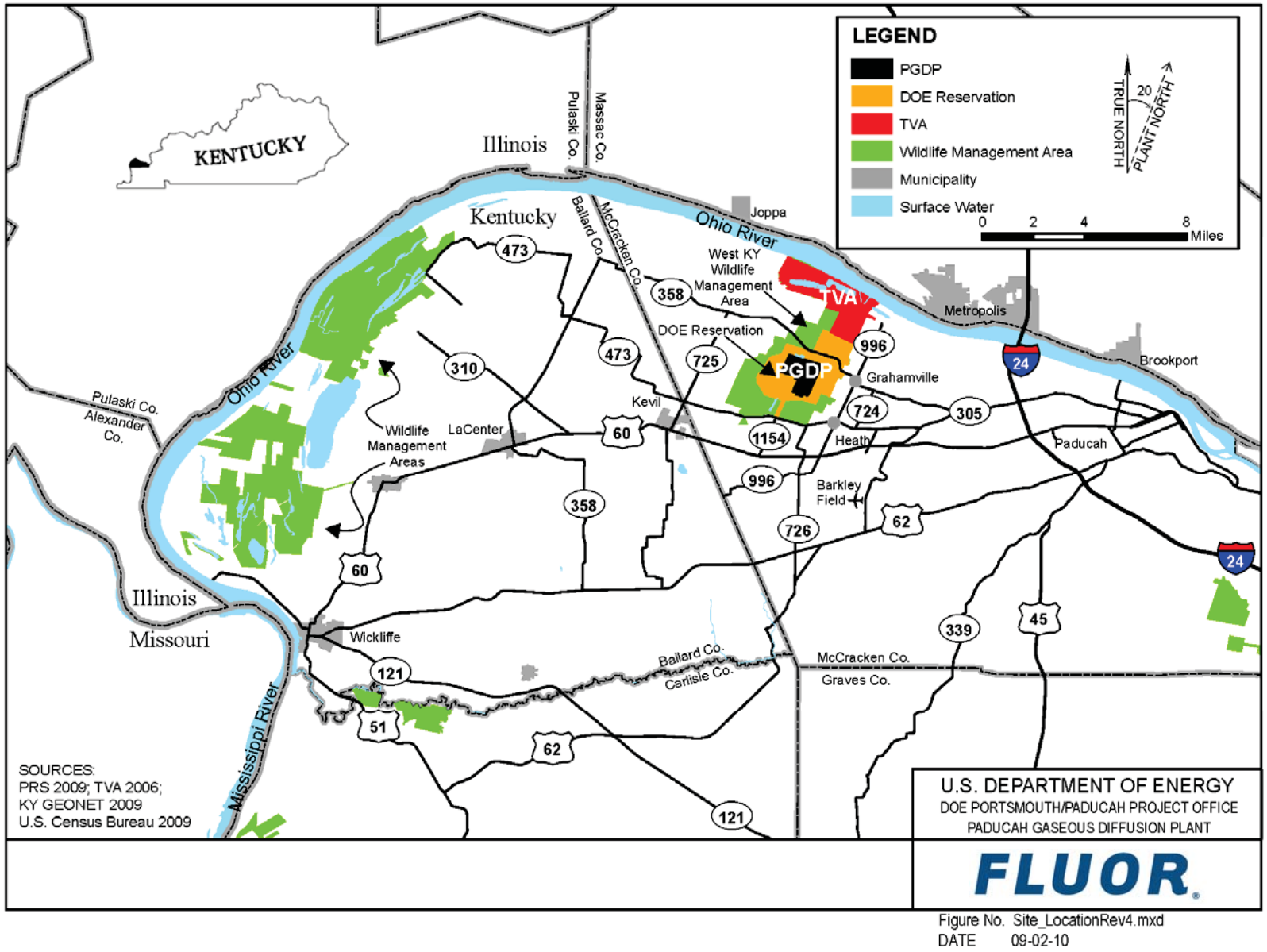

Figure 1. PGDP Location

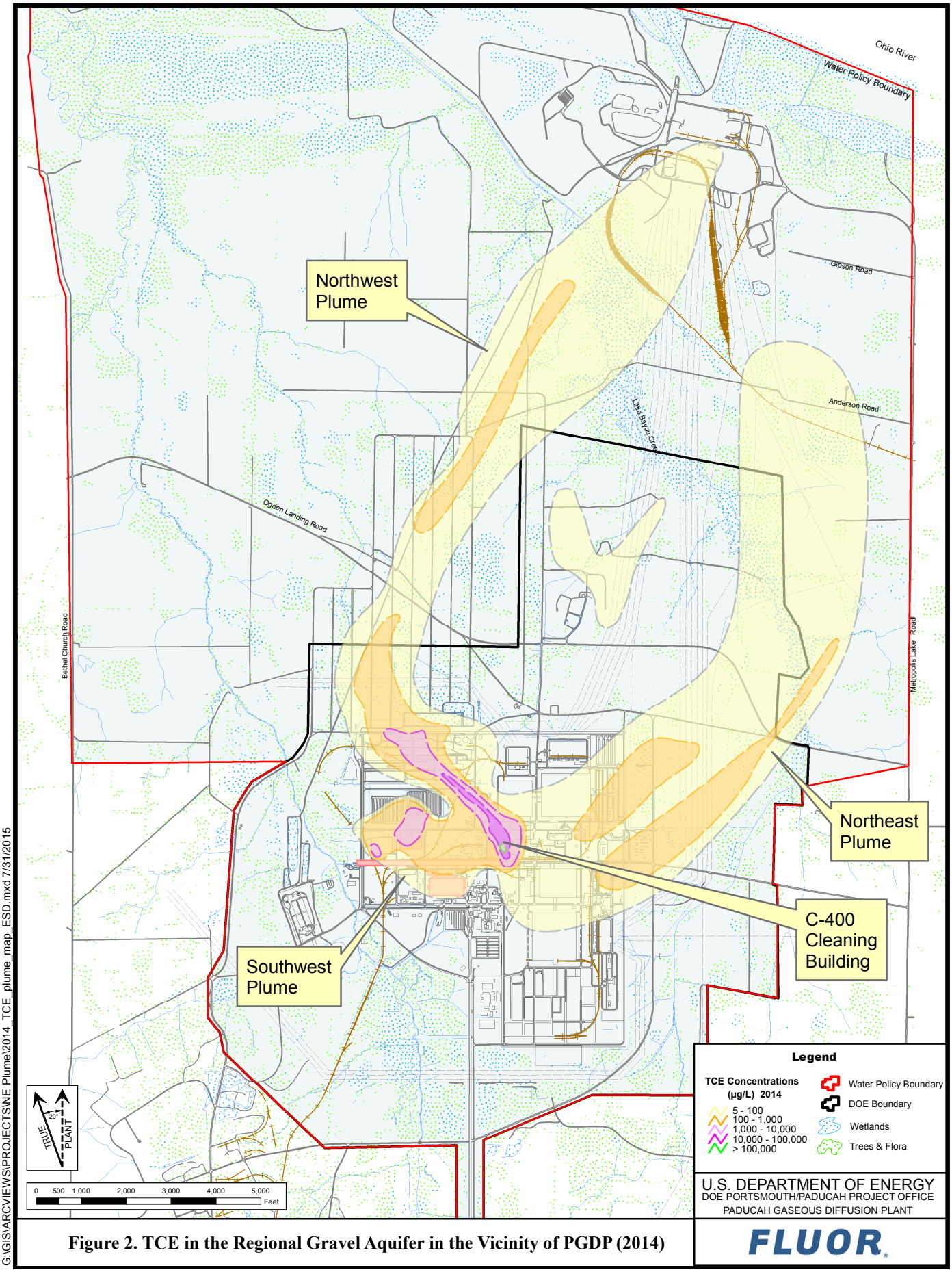

Figure 2. TCE in the Regional Gravel Aquifer in the Vicinity of PGDP (2014)

1.2 REGULATORY BACKGROUND

PGDP was placed on the National Priorities List in 1994. Pursuant to Section 120 of CERCLA, the PGDP FFA (EPA 1998) was negotiated and implemented to coordinate the CERCLA remedial action and Resource Conservation and Recovery Act (RCRA) corrective action processes into a set of comprehensive requirements for site remediation. Since 1998, DOE, EPA, and KDEP have been operating under the FFA, with DOE as the lead agency and EPA and KDEP as support agencies providing oversight.

In 1995, a decision was made among DOE, EPA, and KDEP to proceed with an IRA for the high TCE concentration Northeast Groundwater Plume. The ROD for this IRA of the Northeast Plume was signed by DOE, EPA, and KDEP in June 1995. The remedy has been effective in achieving hydraulic control and reducing off-site TCE levels in the Northeast Plume and, in combination with existing controls (alternate water supply, monitoring, etc.), remains protective of human health and the environment and continues to comply with federal and state applicable or relevant and appropriate requirements (ARARs) that were identified in the ROD.

1.3 CIRCUMSTANCES CREATING THE NEED FOR AN ESD

The Northeast Plume IRA optimization project is to continue to serve as an interim measure to remove TCE and 1,1-DCE mass and enhance capture of the Northeast Plume contamination in the vicinity of the eastern edge of PGDP industrial facility to reduce further migration off-site. This optimization action was initiated in response to recommendations documented in the following documents:

- Sitewide Remedy Review (DOE 2006)
- *Review Report: Groundwater Remedial System Performance Optimization at PGDP, Paducah, Kentucky* (DOE 2007)h
- 2008 CERCLA Five-Year Review and approval letters (DOE 2009; EPA 2009; KEEC 2009)
- Site Management Plan (DOE 2012)
- 2013 CERCLA Five-Year Review (DOE 2014)
- *Memorandum of Agreement for Resolution of Formal Dispute of the Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-1291&D2, and *Remedial Action Work Plan for Optimization of the Northeast Plume Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-1280&D2 (MOA for Resolution) (DOE 2015a)

The cessation of enrichment operations at PGDP by the United States Enrichment Corporation (USEC) in June 2013, resulted in loss of the cooling tower that acted as the air stripper and provided further need to optimize the system with the use of a treatment unit that could air strip the contamination.

The scope of the Northeast Plume optimized project, as documented in this ESD and the *Remedial Action Work Plan for Optimization of the Northeast Plume Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2015b), is consistent with the general findings and recommendations in the documents referenced above and with the identified modifications by the FFA

parties as contained in the 2015 MOA for Resolution of formal dispute. Additional specific supporting information from these evaluations is contained in Section 3, Basis for the ESD.

THIS PAGE INTENTIONALLY LEFT BLANK

2. SITE HISTORY, CONTAMINATION, AND SELECTED REMEDY

This section provides a brief summary of the site contamination and history along with presenting the selected remedy as originally described in the ROD.

2.1 SITE HISTORY AND CONTAMINATION ASSOCIATED WITH THE NORTHEAST PLUME

In August 1988, volatile organic compounds (VOCs) and radionuclides were detected in private wells north of PGDP. The site investigation demonstrated that the principal contaminants of concern in the off-site groundwater are Tc-99, a radionuclide, and TCE, an organic solvent. TCE is a nonflammable, highly volatile, colorless liquid used extensively for removing grease. The PGDP's use of TCE as a degreaser ceased July 1, 1993. Tc-99 is a radionuclide that was introduced at the PGDP through the reprocessing of uranium.

Past handling practices and disposal of waste material resulted in the contamination of the groundwater migrating to the northwest and northeast from PGDP. Over time, dissolved-phase TCE in groundwater in the RGA has spread generally northeastward toward the Ohio River in multiple plumes. In the 1993 time frame, the outer boundary of the Northeast Plume was approximately 1 mile from the northeastern border of the PGDP facility. Concentrations of TCE within the Northeast Plume exceeded 1,000 μg/L in some locations.

Figure 2 illustrates the extent of the Northeast Plume. Figures 3 and 4 compare the TCE plumes between 1994 and 2014 (the latest available plume map). The downgradient limit of the Northeast Plume is in the vicinity of the Ohio River, Tennessee Valley Authority Shawnee Fossil Plant, and Little Bayou Creek.

2.2 INTERIM REMEDIAL ACTION REMEDY APPROVED IN THE ROD

The major components of the selected remedy defined in the ROD (DOE 1995) included the following:

- The contaminated groundwater was to be extracted at a location in the northern portion of the high TCE concentration area of the plume (greater than 1,000 μg/L of TCE). The contaminated groundwater was to be pumped at a rate of approximately 100 gal per minute (gpm) to initiate hydraulic control without changing groundwater gradients enough to cause adverse effects. During operation, this pumping rate may have been modified to optimize the hydraulic containment, by adjusting flow from the EWs (EW331 and EW332), and to support subsequent actions.

- The extracted groundwater was to be collected and piped to a treatment system prior to release to a KPDES-permitted outfall. The treatment facility was to consist of a sand filter for removal of suspended solid materials, and utilization of the PGDP's existing cooling towers for volatilization of contaminated groundwater. The chemicals of concern were TCE and 1,1-DCE.

- Two treatability studies were to be conducted to include (1) photocatalytic oxidation of TCE-contaminated off-gas and (2) *in situ* treatment of TCE-contaminated groundwater.

EPA and KDEP, in a letter received on April 23, 1996, agreed to remove the sand filter from the IRA because the EWs (EW331 and EW332) were designed with an artificial sand pack that serves as a sand

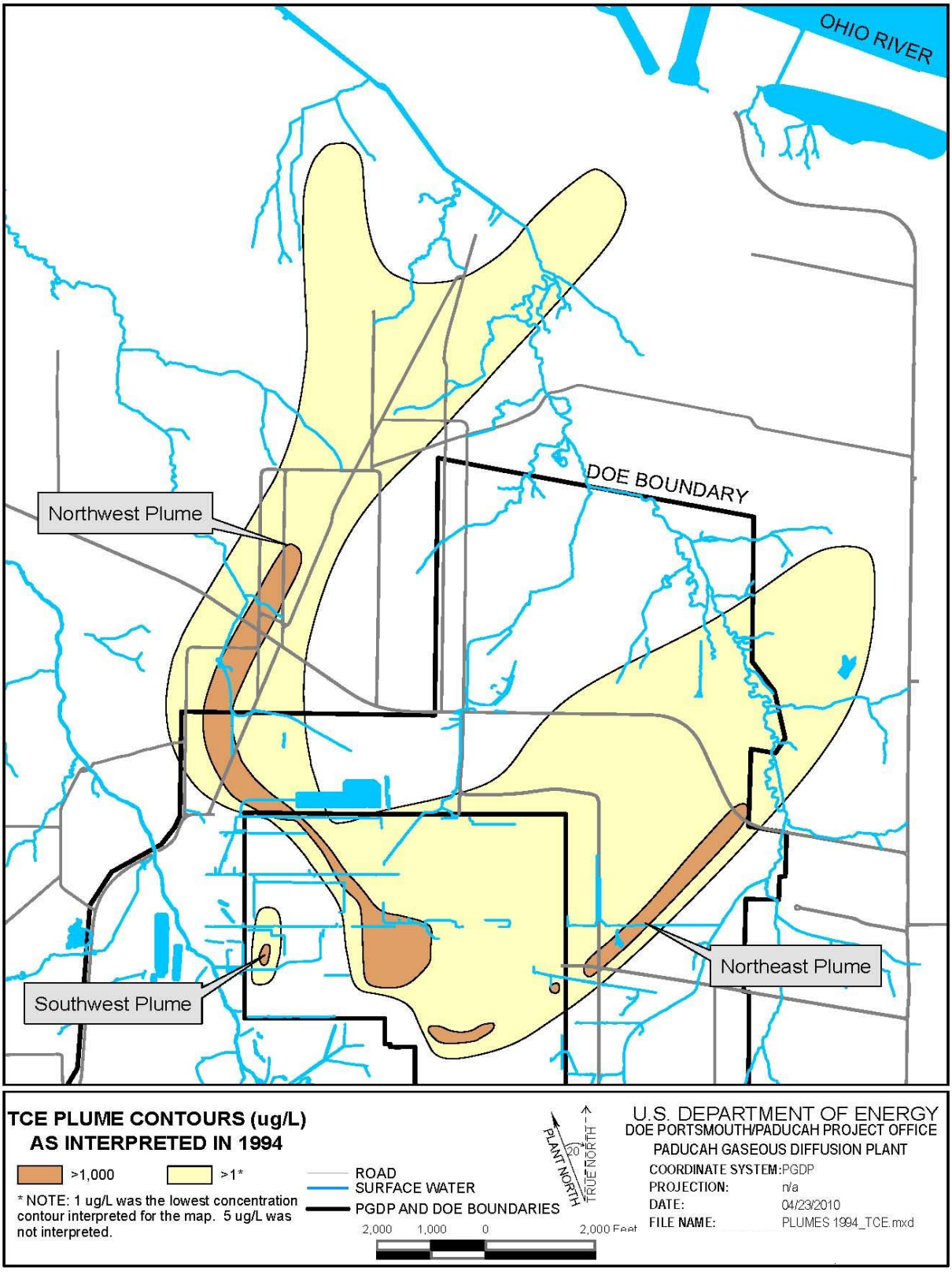

Figure 3. Extent of PGDP TCE Plumes (1994)

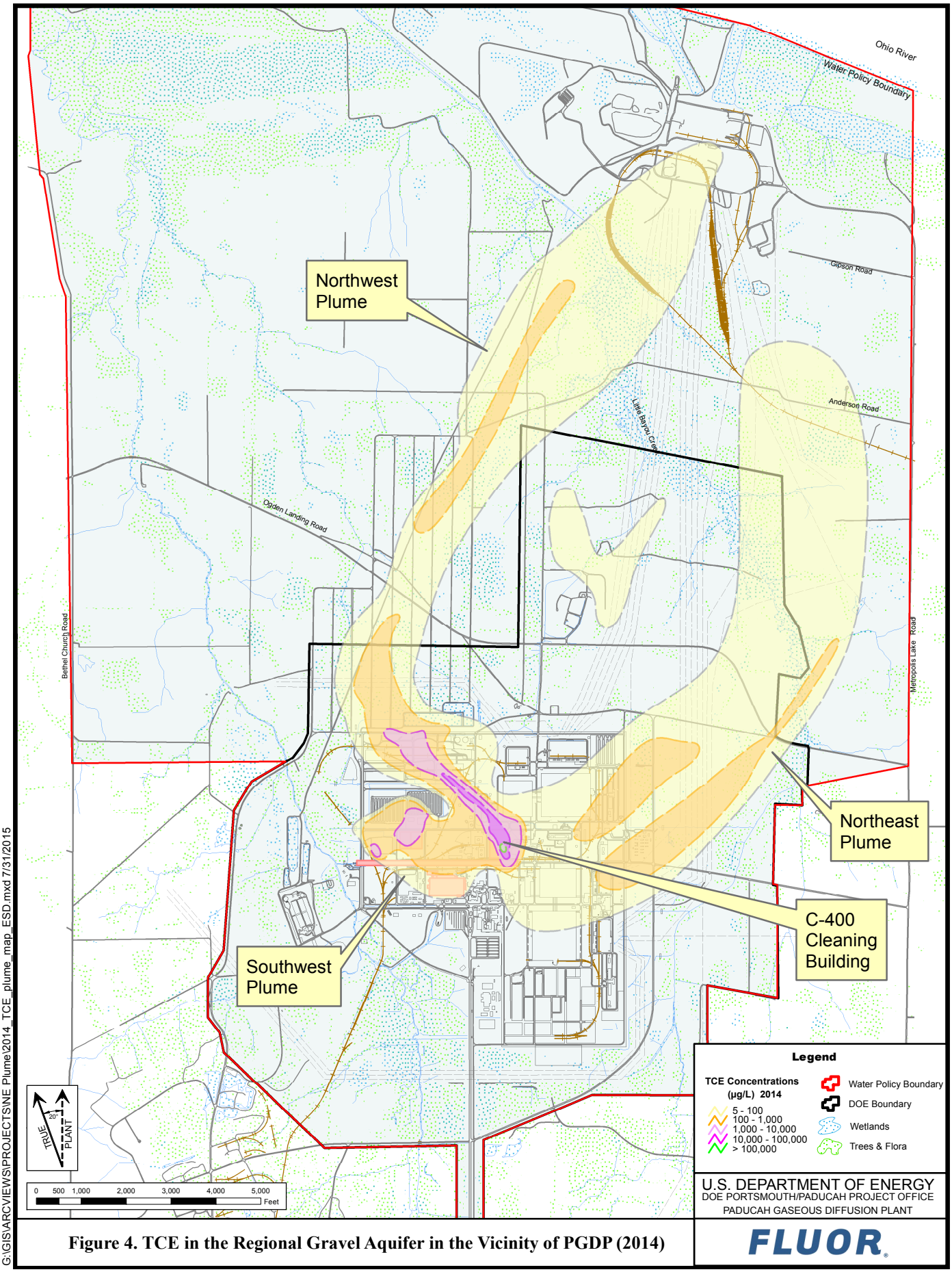

Figure 4. TCE in the Regional Gravel Aquifer in the Vicinity of PGDP (2014)

filter for sediments; thus, the quality of water being discharged from the EWs (EW331 and EW332) would be similar to that of a drinking water well, with the exception of the TCE contamination.

A minor modification to the ROD was written on May 2, 1996, to postpone the treatability studies [(1) photocatalytic oxidation of TCE-contaminated off-gas and (2) *in situ* treatment of TCE-contaminated groundwater].

3. BASIS FOR THE ESD

This section presents information that formed the basis for changes to the remedy. In general, installation of the new optimization wells will reduce off-site groundwater migration of VOCs, in particular TCE, and continue treatment of high concentrations of VOCs in groundwater. Installation of the ATU and creation of the new CERCLA outfall(s) are necessary to provide an alternate treatment/discharge option to the cooling towers that have been shut down.

3.1 INFORMATION SUPPORTING OPTIMIZED REMEDY

Five evaluations have been conducted that support the proposed changes to the Northeast Plume Groundwater System. Summary of the evaluation and relevant findings for these five evaluations are detailed in this section.

3.1.1 Five-Year Reviews for Remedial Actions at the Paducah Gaseous Diffusion Plant

The Northeast Plume IRA optimization project is to serve as an interim measure to remove TCE and 1,1-DCE mass and enhance capture of the Northeast Plume contamination in the vicinity of the eastern edge of PGDP industrial facility and to reduce further migration off-site. This action was initiated in response to recommendations documented in past system evaluations and assessments as follows:

- 2008 CERCLA Five-Year Review and approval letters (DOE 2009; EPA 2009; KEEC 2009)
- 2013 CERCLA Five-Year Review (DOE 2014)

Sitewide Remedy Review (March 2006)

In February and March 2006, DOE Headquarters conducted a Sitewide Remedy Review at PGDP. A report following the assessment was generated and finalized in April, 2006 and was titled, Paducah 2006 Sitewide Remedy Review. The Sitewide Remedy Review report recommended an optimization of the Northeast Plume IRA.

Site Management Plan (February 2012)

Implementation of an optimized IRA was evaluated along with other Groundwater Operable Unit projects relative to site priorities in the approved Site Management Plan (DOE 2012). The prioritization was performed by the FFA managers, with consideration given to the sitewide strategy that includes a series of sequenced activities consisting of source actions and control of off-site groundwater migration followed by a final action for the overall dissolved-phased plume. This evaluation resulted in the optimization of the Northeast Plume IRA being prioritized to further enhance controls to prevent off-site migration prior to implementing final actions for the off-site dissolved-phase plume.

Additionally, cessation of enrichment operations at PGDP resulted in the loss of the use of the cooling tower used in the original operational approach, thus requiring an alternate treatment approach, as of June 2013.

Memorandum of Agreement for Resolution of Formal Dispute (July 2015)

The MOA documents the FFA parties' agreement that an optimization of the existing Northeast Plume Interim Remedial Action (namely relocation of the two EWs upgradient and operation of two treatment

units) is warranted to increase TCE mass removal and to enhance control of Northeast Plume migration at the eastern edge of the PGDP industrial facility. The FFA parties reached consensus that the optimized EWs installed under this ESD should not cause or contribute to the undesired migration of Tc-99 contamination from the source area(s) (e.g., C-400 Building and Northwest Plume) and that actions (as further described herein) may be undertaken to prevent any undesirable expansion of Tc-99 and TCE within the Northeast Plume.

3.2 REMEDIAL ACTION WORK PLAN FOR THE NORTHEAST PLUME INTERIM REMEDIAL ACTION OPTIMIZATION

The Remedial Action Work Plan (RAWP) for Optimization of the Northeast Plume IRA documents the design and construction process associated with the optimization process (DOE 2015b). Detailed information is included concerning the use of the PGDP groundwater model to optimize the locations of the EWs for increased contaminant capture, treatment equipment capabilities, and EW construction, including screen size and locations.

3.3 ADMINISTRATIVE RECORD INFORMATION SUPPORTING THE NEEDED CHANGE

Information contained in the administrative record that supports the modified remedy is discussed in Section 3.1. As required by 40 *CFR* § 300.825(a)(2), this ESD will be made available to the public by placing it in the Administrative Record file. Contact information for the Administrative Record is as follows:

DOE Environmental Information Center
115 Memorial Drive, Barkley Centre
Paducah, KY 42001
(270) 554-3004
http://www.paducaheic.com

Hours of Operation: Monday through Friday
8 A.M.–12:00 P.M.

4. DESCRIPTION OF SIGNIFICANT DIFFERENCES

This section describes the key differences between the remedy in the ROD and the ESD modifications, highlighting scope, cost, and performance along with any changes in expected outcomes when the modifications are implemented.

4.1 SIGNIFICANT DIFFERENCES BETWEEN THE REMEDY AND ESD MODIFICATIONS

Table 1 summarizes the main components of the selected remedy and identifies how the remedy modification impacts these components.

Table 1. Summary of Modifications to the Selected Remedy

Selected Remedy (IRA) in the ROD	Remedy Modification
The contaminated groundwater will be extracted at a location in the northern portion of the high TCE concentration area of the plume (greater than 1,000 μg/L of TCE).	The optimized remedy modifies the location of the EWs to be in the upgradient portion of the high concentration portions of the Northeast Plume as documented in the 2014 Plume Map (see Figure 5) and near the eastern edge of the PGDP industrial facility.
The contaminated groundwater will be pumped at a rate of approximately 100 gpm to initiate hydraulic control without changing groundwater gradients enough to cause adverse effects. During operation, this pumping rate may be modified to optimize the hydraulic containment, by adjusting flow from the EWs, and to support subsequent actions.	The existing IRA allows the pumping rate to be modified. The estimated combined pumping rate is expected to be approximately 300 gpm. Install 18 monitoring wells to evaluate performance and effectiveness of the optimized EWs. Consistent with the MOA for Resolution, five of these monitoring wells, at a minimum, will be located in a north-south transect located approximately 600 ft east of the C-400 Building. These transect monitoring wells will be used to assess the impact of groundwater EWs on contaminant migration from source areas, including impacts to the groundwater divide east of C-400 Building. If TCE and/or Tc-99 concentrations in any of the newly constructed transect monitoring wells increase, as described in Section 3 of the MOA for Resolution, then potential changes in groundwater flow or source impacts will be examined further, and the FFA parties will consider adjustments for the optimized Northeast Plume interim action to minimize these potential impacts.
The extracted groundwater will be collected and piped to a treatment system prior to release to a KPDES-permitted outfall.	Treated groundwater will be discharged through a maximum of two created CERCLA outfall(s) or a KPDES outfall.
The treatment facility will consist of a sand filter* for removal of suspended solid materials, and utilization of the PGDP's existing cooling towers for volatilization of contaminated groundwater. The chemicals of concern are TCE and 1,1-DCE.	The modified remedy will provide an engineered treatment unit, using air stripping, capable of treating TCE and 1,1-DCE in water in the range of expected contaminant concentrations.

*The EPA and KDEP, in a letter received on April 23, 1996, agreed to remove the sand filter from the IRA because the EWs were designed with an artificial sand pack that serves as a sand filter for sediments. Thus, the quality of water being discharged from the EWs would be similar to that of a drinking water well, with the exception of the TCE contamination.

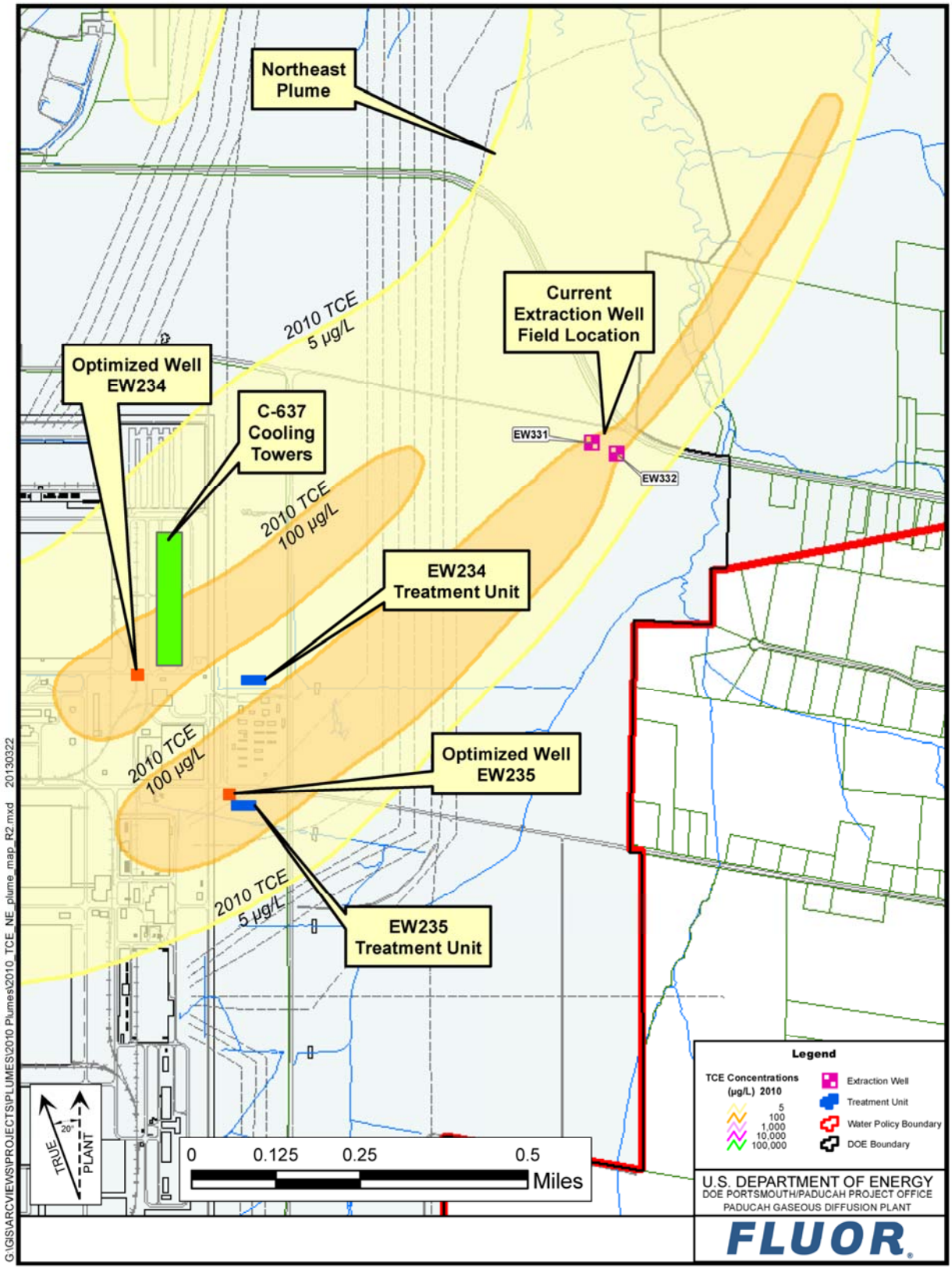

Figure 5. Locations of New and Preexisting EWs Associated with the Northeast Plume IRA at PGDP

None of the above anticipated changes in Table 1 are considered to be "fundamentally" different from the original selected remedy in the 1995 ROD; however, the creation of up to two CERCLA outfall(s) for discharge of treated groundwater will require identification and inclusion of new ARARs. Under EPA guidance (EPA 1999), these new discharges would be considered to be a "significant" change that should be documented in an ESD. EPA guidance (EPA 1999) states that while the ESD is being prepared and made available to the public, the lead agency may proceed with the predesign, design, construction, or operation activities associated with the remedy.

4.2 EXPECTED OUTCOMES OF THE ESD

The optimization of the Northeast Plume IRA is intended to increase TCE and 1,1-DCE mass removal and enhance control of the Northeast Plume migration at the eastern edge of the PGDP facility. The key components of the optimization are discontinuing the use of the two existing EWs (EW331 and EW332) and replacing those wells with two new EWs (EW234 and EW235) currently located, as shown in Figure 5, near the eastern edge of the PGDP facility. Groundwater modeling was performed to guide the placement of EWs (EW234 and EW235) and will continue to be utilized to determine the need for further optimization. The FFA parties will continue to work together to establish completion criteria for operation of the EWs in a manner consistent with requirements set forth in the MOA for Resolution. Additional key components of the optimization include increasing the treatment capacity through installation of two new engineered water treatment units and discharging the treated groundwater through up to two CERCLA outfall(s) or a KPDES outfall. The changes being made to the remedial action do not alter the type of treatment technology being deployed (i.e., air stripping), or the reliability or protectiveness of the overall remedy.

4.2.1 Key Design Changes

The Northeast Plume IRA optimization was designed based on the following key changes and assumptions that are different from that documented in the ROD (DOE 1995):

- Northeast Plume EWs (EW234 and EW235) will be located near the eastern edge of PGDP and the existing EWs (EW331 and EW332) will be kept in good working condition until the FFA parties agree the maintenance no longer is necessary.

- Install 18 monitoring wells to evaluate performance and effectiveness of the optimized EWs. Consistent with the MOA for Resolution, five of these monitoring wells, at a minimum, will be located in a north-south transect located approximately 600 ft east of the C-400 Building. These transect monitoring wells will be used to assess the impact of groundwater EWs on contaminant migration from source areas, including impacts to the groundwater divide east of C-400 Building. The MOA requires quarterly sampling of the transect monitoring wells and describes actions that may be taken by the FFA parties based upon transect monitoring well sampling results.

- Use of the PGDP cooling towers for stripping TCE and 1,1-DCE has been discontinued and was replaced with engineered water treatment unit(s) that utilize air stripping (shallow tray air stripper) for TCE and 1,1-DCE contamination.

- Treated VOC-contaminated groundwater discharge will be through a maximum of two CERCLA designated outfalls or a KPDES outfall. The receiving water body is the Little Bayou Creek, which carries a Kentucky use classification of Recreational.

- A new electrical power connection will be installed for the treatment units and EWs (EW234 and EW235).

4.2.2 Key Design Assumptions

The Northeast Plume IRA optimization was designed based on keeping the existing EWs (EW331 and EW332), to the extent required by Section 4 of the MOA for Resolution, in good working condition until the FFA parties agree the maintenance no longer is necessary. The optimized Northeast Plume EW field volumetric flow rate is limited not by the engineered treatment plant capacity (approximately 200 gpm per unit) but by EW yield.

4.2.3 Well Field Design

Well field optimization modeling indicates that a two-well configuration is optimal. The two new wells, EW234 and EW235 based in part on groundwater modeling, are to be located near the eastern edge of the PGDP facility. Refer to Figure 5 for well locations. The EWs (EW234 and EW235) are expected to have an operational flow rate of approximately 150 gpm each. Detailed lithologic logs and grain size analysis to the extent available will be used in well screen and filter pack design of the new EWs (EW234 and EW235). Once the two optimized EWs are online, contaminant concentrations in samples from the transect wells will be collected on a quarterly basis and reported to EPA and KDEP. If contaminant concentrations in any transect well's quarterly samples are determined to be increasing and may double above the established baseline within a year of the quarterly samples' showing an increase, then potential changes in groundwater flow or source impacts (e.g., rising contaminant concentrations in the Northeast Plume, source migration, etc.) will be examined further. The FFA parties will consider adjustments (e.g., adjusting EW pumping rates) for the optimized Northeast Plume interim action to minimize these potential impacts. These adjustments are considered within the scope of the optimization under the ESD.

4.2.4 Baseline Monitoring

The transect monitoring wells will be monitored for four consecutive quarters to establish baseline contaminant concentrations before the two newly relocated EWs begin operation.

4.2.5 Construction

Construction of the optimization project will be performed consistent with the RAWP and certified for construction remedial design drawings and specifications.

4.2.6 Start-up and Testing

The Northeast Plume optimized IRA system will undergo start-up and integrated testing consistent with quality requirements contained in the approved RAWP and certified for construction remedial design drawings and specifications. Additionally, start-up and testing of the optimized IRA system will be contingent upon baseline monitoring results and requirements as documented in Section 2 of the MOA for Resolution.

4.2.7 Operation and Maintenance

Following successful completion of construction and start-up and integrated testing of facilities of the Northeast Plume, and contingent upon the results of baseline and ongoing monitoring activities described in Sections 2 through 4 of the MOA for Resolution, optimized IRA operations will be initiated consistent with the approved operation and maintenance plan.

The optimized Northeast Plume system will continue operating until one the following occurs:

- The FFA parties mutually agree to cease operations,
- The FFA parties decide to implement a modification to the IRA to address the Northeast Plume contamination (including contaminated groundwater plume expansion) and to prevent Tc-99 at levels above the MCL from being pulled further within the Northeast Plume,
- A CERCLA Five-Year Review determination supports ceasing operations, or
- The ROD associated with the Dissolved-Phase Plume supports ceasing operations.

4.2.8 Remedial Action Work Plan

An RAWP was developed for the implementation of the remedy modifications based on the above assumptions and expected outcomes. The RAWP includes an overview of the optimization modeling, system design and construction, start-up and testing, operations and maintenance requirements, and plans for environmental compliance, waste management, worker health and safety, quality assurance, and data management.

THIS PAGE INTENTIONALLY LEFT BLANK

5. SUPPORT AGENCY CONCURRENCE

KDEP and EPA have evaluated the information contained in the Administrative Record for this IRA and concur that the information supports the need for the modification to the remedy, and both agencies concur with the revised remedy selected in this ESD.

THIS PAGE INTENTIONALLY LEFT BLANK

6. STATUTORY DETERMINATIONS

The modified interim remedy will increase TCE and 1,1-DCE mass removal and enhance control of Northeast Plume migration at the eastern edge of the PGDP industrial facility. As such, the modified interim remedy, meets the threshold criteria of CERCLA Section 121 and the NCP. The planned changes presented in the ESD will not impact the protectiveness of the IRA. As recognized in the ROD, successful control of the plume, in combination with existing controls (alternate water supply, monitoring, etc.), ensures protection during the period of the interim response. The modified interim remedy continues to be protective of human health and the environment and complies with ARARs presented in the ROD, as supplemented and modified by the ARARs provided in Table 2. As part of this modification, however, ARARs included in the ROD pertaining to discharge through a KPDES-permitted outfall are being supplemented with ARARs to allow the utilization of up to two CERCLA outfall(s) for treated water discharge, as defined by Table 2 of this ESD. The ARARs address requirements necessary to ensure the protection of the waters of the Commonwealth for the discharge of effluent through up to two CERCLA outfall(s) or KPDES outfall. Based on the ARARs contained in Table 2, the outfall discharge criteria contained in Table 3 will serve as the criteria and effluent limits for discharge to the new CERCLA outfalls.

The Northeast Plume groundwater is contaminated with certain VOCs that originated from disposal of spent solvents. As a result, the TCE contamination in the Northeast Plume has been declared a RCRA listed hazardous waste (code F001, F002, U228). Additionally, 1,1,1-trichloroethane (1,1,1-TCA), also a RCRA hazardous waste constituent associated with F001 and F002, has been detected at low levels in the Northeast Plume. Under the EPA "contained-in" policy, environmental media, such as groundwater, must be managed as hazardous waste if they "contain" listed hazardous waste. EPA guidance, *Management of Remediation Waste under RCRA*, recommends that "contained-in" determinations use conservative, health-based standards to develop site-specific health-based levels of hazardous constituents below which contaminated environmental media would be considered to no longer contain hazardous waste (EPA 1998). Consequently, per the EPA's contained-in policy, the Northeast Plume groundwater is considered to contain the RCRA listed hazardous waste. Management of such groundwater must comply with the RCRA ARARs for hazardous waste identified in the original ROD and this ESD, unless the groundwater is determined to contain TCE below the health-based level. The site-specific health-based level for TCE in groundwater at PGDP has been established at 30 ppb, which is based on Kentucky ambient water quality criteria for protection of human health for consumption of fish [401 *KAR* 10:031 § 6(1)]. Groundwater contaminated with TCE generated from the Northeast Plume project at or below 30 ppb will be considered to no longer contain the RCRA listed hazardous waste (F001, F002, U228). Groundwater that meets the health-based level for TCE also shall be deemed to no longer contain 1,1,1-TCA. Degradation products (*cis*-1,2-DCE; *trans*-1,2-DCE; or vinyl chloride) associated with TCE may be present in groundwater, and any treatment process used for the TCE-contaminated groundwater also would be effective in treating/reducing the concentrations of the degradation products.

Most of the contaminated groundwater extracted for treatment exceeds this site-specific health-based level; thus, it must be managed as RCRA listed hazardous waste. Consequently, certain solid wastes generated from treatment units that treat groundwater containing TCE above 30 ppb are considered RCRA hazardous waste due to the derived-from rule at 40 *CFR* § 261.3(c) and (d) (401 *KAR* 31:010 § 3). The treated groundwater that is discharged into the receiving surface water body (e.g., Little Bayou Creek) through the CERCLA outfalls or KPDES outfall will comply with identified Clean Water Act and Kentucky water quality standards identified as ARARs and will be below the 30 ppb TCE. Pursuant to 40 *CFR* § 261.4(a)(2) (401 *KAR* 31:010 § 4), point source discharges are excluded from regulation as a hazardous wastes. The exclusion applies only to the actual point source discharge and does not exclude

Table 2. Additional Applicable or Relevant and Appropriate Requirements

Action	Requirements	Prerequisite	Citation
General duty to mitigate for discharge of wastewater from groundwater treatment system	Take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of effluent standards which has a reasonable likelihood of adversely affecting human health or the environment.	Discharge of pollutants to surface waters—**applicable**.	401 *KAR* 5:065 § 2(1) and 40 *CFR* § 122.41(d)
Operation and maintenance of treatment system	Properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the effluent standards. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures.	Discharge of pollutants to surface waters—**applicable**.	401 *KAR* 5:065 § 2(1) and 40 *CFR* § 122.41(e)
Technology-based treatment requirements for wastewater discharge	To the extent that EPA promulgated effluent limitations are inapplicable, shall develop on a case-by-case Best Professional Judgment basis under § 402(a)(1)(B) of the Clean Water Act (CWA), technology based effluent limitations by applying the factors listed in 40 *CFR* § 125.3(d) and shall consider: • The appropriate technology for this category or class of point sources, based upon all available information; and • Any unique factors relating to the discharger.	Discharge of pollutants to surface waters from other than a publicly owned treatment works—**applicable**.	40 *CFR* § 125.3(c)(2)
Water quality-based effluent limits for wastewater discharge	Must develop water quality based effluent limits that ensure that: • The level of water quality to be achieved by limits on point source(s) established under this paragraph is derived from, and complies with all applicable water quality standards; and • Effluent limits developed to protect narrative or numeric water quality criteria are consistent with the assumptions and any available waste load allocation for the discharge prepared by the State and approved by EPA pursuant to 40 *CFR* § 130.7.	Discharge of pollutants to surface waters that causes, or has reasonable potential to cause, or contributes to an instream excursion above a narrative or numeric criteria within a State water quality standard established under § 303 of the CWA—a**pplicable**.	40 *CFR* § 122.44(d)(1)(vii)

Table 2. Additional Applicable or Relevant and Appropriate Requirements (Continued)

Action	Requirements	Prerequisite	Citation
Water quality-based effluent limits for wastewater discharge (continued)	Must attain or maintain a specified water quality through water quality related effluent limits established under § 302 of the CWA.	Discharge of pollutants to surface waters that causes, or has reasonable potential to cause, or contributes to an instream excursion above a narrative or numeric criteria within a state water quality standard—**applicable**.	40 *CFR* § 122.44(d)(2)
	The numeric water quality criteria for fish consumption specified in Table 1 of 401 *KAR* 10:031 Section 6(1) provides allowable instream concentrations of pollutants that may be found in surface waters or discharged into surface waters.		401 *KAR* 10:031 § 6(1)
Monitoring requirements for groundwater treatment system discharges	In addition to 40 *CFR* §122.48(a) and (b) and to assure compliance with effluent limitations, one must monitor, as provided in subsections (i) thru (iv) of 122.44(i)(1). *NOTE: Monitoring parameters, including frequency of sampling, will be developed as part of the CERCLA process and included in a Remedial Design, RAWP, or other appropriate FFA CERCLA document.*	Discharge of pollutants to surface waters—**applicable**.	40 *CFR* § 122.44(i)(1) 401 *KAR* § 5:065 2(4)
	All effluent limitations, standards and prohibitions shall be established for each outfall or discharge point, except as provided under § 122.44(k).		40 *CFR* § 122.45(a) 401 *KAR* § 5:065 2(5)
	All effluent limitations, standards and prohibitions, including those necessary to achieve water quality standards, shall unless impracticable be stated as: Maximum daily and average monthly discharge limitations for all discharges.	Continuous discharge of pollutants to surface waters—**applicable**.	40 *CFR* § 122.45(d)(1) 401 *KAR* § 5:065 2(5)
Mixing zone for discharge of pollutants	The relevant requirements provided in 401 *KAR* 10:029 § 4 shall apply to a mixing zone for a discharge of pollutants. *NOTE: Determination of the appropriate mixing zone will, if necessary, be documented in the CERCLA remedial design or other appropriate CERCLA document.*	Discharge of pollutants to surface waters—**applicable**.	401 *KAR* 10:029 § 4

Table 2. Additional Applicable or Relevant and Appropriate Requirements (Continued)

Action	Requirements	Prerequisite	Citation
Minimum criteria applicable to all surface waters	Surface waters shall not be aesthetically or otherwise degraded by substances that: • Settle to form objectionable deposits; • Float as debris, scum, oil, or other matter to form a nuisance; • Produce objectionable color, odor, taste, or turbidity; • Injure, are chronically or acutely toxic to or produce adverse physiological or behavioral responses in humans, animals, fish, and other aquatic life; • Produce undesirable aquatic life or result in the dominance of nuisance species; 1. Cause fish flesh tainting. 2. The concentration of phenol shall not exceed 300 mg/L as an instream value.	Discharge of pollutants to surface waters—**applicable**.	401 *KAR* 10:031 § 2(1)(a-f)
	The water quality criteria for the protection of human health related to fish consumption in Table 1 of 401 *KAR* 10:031 § 6 are applicable to all surface water at the edge of assigned mixing zone except for those points where water is withdrawn for domestic water supply use. (a) The criteria are established to protect human health from the consumption of fish tissue and shall not be exceeded. (b) For those substances associated with a cancer risk, an acceptable risk level of not more than one (1) additional cancer case in a population of 1,000,000 people, (or 1×10^{-6}) shall be utilized to establish the allowable concentration.		401 *KAR* 10:031 § 2(2)(a) and (b)

Table 2. Additional Applicable or Relevant and Appropriate Requirements (Continued)

Action	Requirements	Prerequisite	Citation
Criteria for surface water designated as warm water aquatic life habitat	The following parameters and associated criteria shall apply for the protection of productive warm water aquatic communities, fowl, animal wildlife, arborous growth, agricultural, and industrial uses: • Natural alkalinity as $CaCO_3$ shall not be reduced by more than 25 percent; • pH shall not be less than 6.0 nor more than 9.0 and shall not fluctuate more than 1.0 pH units over a period of 24 hours; • Flow shall not be altered to a degree that will adversely affect the aquatic community; • Temperature shall not exceed 31.7°C (89°F); • Dissolved oxygen shall be maintained at a minimum concentration of 5.0 mg/L as a 24 hour average; instantaneous minimum shall not be less than 4.0 mg/L; • Total dissolved solids or specific conductance shall not be changed to the extent that the indigenous aquatic community is adversely affected; • Total suspended solids shall not be changed to the extent that the indigenous aquatic community is adversely affected; • Addition of settleable solids that may alter the stream bottom so as to adversely affect productive aquatic communities shall be prohibited; • Concentration of the un-ionized ammonia shall not be greater than 0.05 mg/L at any time instream after mixing; Instream concentrations for total residual chlorine shall not exceed an acute criteria value of 19 µg/L or a chronic criteria value of 11 µg/L.	Discharge of pollutants to surface waters designated as warm water aquatic life habitat—**applicable**.	401 *KAR* 10:031 § 4(1)(a)-(i) and (k)
	The allowable instream concentration of toxic substances, or whole effluents containing toxic substances, which are noncumulative or nonpersistent with a half-life of less than 96 hours, shall not exceed: a. 0.1 of the 96 hour median LC_{50} of representative indigenous or indicator aquatic organisms; or b. A chronic toxicity unit of 1.00 utilizing the 25 percent inhibition concentration, or LC_{25}.	Discharge of toxic pollutants to surface waters designated as warm water aquatic life habitat—**applicable**.	401 *KAR* 10:031 § 4(1)(j)(1)

Table 2. Additional Applicable or Relevant and Appropriate Requirements (Continued)

Action	Requirements	Prerequisite	Citation
Criteria for surface water designated as warm water aquatic life habitat (continued)	The allowable instream concentration of toxic substances, or whole effluents containing toxic substances, which are bioaccumulative or persistent, including pesticides, if not otherwise regulated, shall not exceed: a. 0.01 of the 96 hour median LC_{50} of representative indigenous or indicator aquatic organisms; or b. A chronic toxicity unit of 1.00 utilizing the LC_{25}.		401 *KAR* 10:031 § 4(1)(j)(2)
	In the absence of acute criteria for pollutants listed in Table 1 of 401 *KAR* 10:031 § 6, for other substances known to be toxic but not listed in this regulation, or for whole effluents that are acutely toxic, the allowable instream concentration shall not exceed the LC_1 or 1/3 LC_{50} concentration derived from toxicity tests on representative indigenous or indicator aquatic organisms or exceed 0.3 acute toxicity units.		401 *KAR* 10:031 § 4(1)(j)(3)
	If specific factors have been determined for a toxic substance or whole effluent such as an acute to chronic ratio or water effect ratio, they may be used instead of the 0.1 and 0.01 factors upon demonstration that such factors are scientifically defensible. *NOTE: Demonstration that such factors are scientifically defensible will be reflected in the appropriate CERCLA document.*		401 *KAR* 10:031 § 4(1)(j)(4)
	If a discharge causes, has the reasonable potential to cause, or contribute to an in-stream excursion above the numeric criterion for whole effluent toxicity using the procedures in paragraph (d)(1)(ii), develop effluent limits for whole effluent toxicity.	Discharge of wastewater causes, has the reasonable potential to cause, or contributes to an in-stream excursion above the numeric criterion for whole effluent toxicity—**applicable**.	40 *CFR* § 122.44(d)(1)(iv)

Table 2. Additional Applicable or Relevant and Appropriate Requirements (Continued)

Action	Requirements	Prerequisite	Citation
Characterization of industrial wastewater	Industrial wastewater discharges that are point source discharges subject to regulation under section 402 of the Clean Water Act, as amended, are not solid wastes for the purpose of hazardous waste management. [Comment: This exclusion applies only to the actual point source discharge. It does not exclude industrial wastewaters while they are being collected, stored or treated before discharge, nor does it exclude sludges that are generated by industrial wastewater treatment.] *NOTE: For purpose of this exclusion, the CERCLA on-site treatment system will be considered equivalent to a wastewater treatment unit and the point source discharges subject to regulation under CWA Section 402, provided the effluent meets all identified CWA ARARs.*	Generation of industrial wastewater for treatment and discharge into surface water—**applicable**.	40 *CFR* § 261.4(a)(2) 401 *KAR* 31:010 § 4
Transport or conveyance of collected RCRA wastewater to a wastewater treatment unit located on the facility	All tank systems, conveyance systems, and ancillary equipment used to treat, store, or convey wastewater to an on-site wastewater treatment facility are exempt from the requirements of RCRA Subtitle C standards. *NOTE: For purposes of this exclusion, any dedicated tank systems, conveyance systems, and ancillary equipment used to treat, store or convey CERCLA remediation wastewater to a CERCLA on-site wastewater treatment unit that meets all of the identified CWA ARARs for point source discharges from such a facility, are exempt from the requirements of RCRA Subtitle C standards.*	On-site wastewater treatment units (as defined in 40 *CFR* § 260.10) subject to regulation under § 402 or § 307(b) of the CWA (i.e., KPDES-permitted) that manages hazardous wastewaters—**applicable**.	40 *CFR* § 264.1(g)(6) 401 *KAR* 34:010 § 1
Activities causing toxic substances or potentially hazardous matter emissions	Persons responsible for a source from which hazardous matter or toxic substances may be emitted shall provide the utmost care and consideration in the handling of these materials to the potentially harmful effects of the emissions resulting from such activities. No owner or operator shall allow any affected facility to emit potentially hazardous matter or toxic substances in such quantities or duration as to be harmful to the health and welfare of humans, animals and plants.	Emissions of potentially hazardous matter or toxic substances as defined in 401 *KAR* 63:020 § 2 (2) —**applicable**.	401 *KAR* 63:020 § 2

Table 2. Additional Applicable or Relevant and Appropriate Requirements (Continued)

Action	Requirements	Prerequisite	Citation
Activities causing radionuclide emissions	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.	Radionuclide emissions from point sources at a DOE facility—**applicable**.	40 *CFR* § 61.92 401 *KAR* 57:002
General standards for process vents used in treatment of VOC contaminated groundwater	For each affected process vent, except as exempted under 40 *CFR* § 63.7885(c), must meet one of the options in paragraphs (b)(1) through (b)(3) of this section. • Control HAP emissions from the affected process vents according to the applicable standards specified in § 63.7890 through 63.7893. • You determine for the remediation material treated or managed by the process vent through the affected process vents that the average total VOHAP [volatile organic hazardous air pollutant] concentration, as defined in Section 63.7957, of this material is less than 10 ppmw. Determination of the VOHAP concentration is made using the process specified in Section 63.7943. • If the process vent is also subject to another subpart under 40 *CFR* part 61 or part 63, you control emissions of the HAP listed in Table 1 of this subpart from the affected process vent in compliance with the standards specified in the applicable subpart. This means you are complying with all applicable emissions limitations and work practice standards under the other subpart (e.g., you install and operate the required air pollution controls or have implemented the required work practice to reduce HAP emissions to levels specified by the applicable subpart). This provision does not apply to any exemption of the affected source from the emission practice standards allowed by the other applicable SUBPART. *NOTE: Any determination of the VOHAP concentration of the remediation material can be based on knowledge of the material. Based on existing data it is expected that the VOHAP concentration of the NE Plume groundwater is less than 10 ppmw. Historical data from the locations near the proposed new well locations shows the highest anticipated concentration of TCE in the groundwater is less than 1 ppmw*	Process vents as defined in 40 *CFR* § 63.7957 used in site remediation of media (e.g., soil and groundwater) that could emit hazardous air pollutants (HAP) listed in Table 1 of Subpart GGGGG of Part 63—**relevant and appropriate**.	40 *CFR* § 63:7885(b)(1)–(3) 401 *KAR* 63:002 § 1 and 2, except for 40 *CFR* § 63.72 as incorporated in § 2(3)

Table 3. Outfall Discharge Criteria

Effluent Parameter/Characteristic	Discharge Limitations			Initial Monitoring Frequency*
	Yearly Average	Monthly Average	Daily Maximum	
Flow (mgd)	N/A	Monitor Only	Monitor Only	Weekly
Total suspended solids (mg/L)	N/A	30	60	Weekly
Oil and grease (mg/L)	N/A	10	15	Weekly
Total residual chlorine (mg/L)	N/A	0.011	0.019	Weekly
Temperature (°F)	N/A	N/A	89	Weekly
Trichloroethene (µg/L)	N/A	30	N/A	Weekly
Chronic toxicity (TU_c)	N/A	N/A	1.00	Quarterly
Technetium-99 (µCi/ml)	N/A	N/A	N/A	Quarterly
pH	N/A	6 (min)	9	Weekly
1,1-Dichloroethene (µg/l)	N/A	7,100	N/A	Weekly

*Initial Monitoring Frequency based upon KPDES Permit KY0004049 at the time of the ESD; these monitoring frequencies may be adjusted in the operation and maintenance plan.

industrial wastewaters while they are collected, stored, treated before the discharge, nor does it exclude sludge that is generated by industrial wastewater treatment.

The modified interim remedy also changes the air emission point location and characteristics that affect the air distribution of TCE. As a result, the project consulted with the Kentucky Division for Air Quality (KDAQ). KDAQ requested the project comply with the substantive requirements of 401 *KAR* 63:020; consequently, 401 *KAR* 63:022 is being replaced with 401 *KAR* 63:020 § 3. Air dispersion analysis demonstrates that the anticipated TCE airborne emissions would not be harmful to the health and welfare of humans, animals, and plants. The analysis is included as an appendix to this ESD.

The revised remedy is cost-effective and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this site.

THIS PAGE INTENTIONALLY LEFT BLANK

7. PUBLIC PARTICIPATION REQUIREMENTS

Community involvement is a critical aspect of the cleanup process at PGDP. The DOE encourages the public to review this ESD. As required by 40 *CFR* § 300.435(c)(2)(i), a Notice Availability and brief description of this ESD will be published in the local newspaper announcing the availability of the ESD for review in the Administrative Record file as required by the NCP (40 *CFR* § 300.435(c)(2)(i)(A) and 300.825(a)(2)). The Administrative Record file that contains the ROD and the CERCLA Five-Year Reviews and other associated documentation is available for review at the following:

DOE Environmental Information Center
115 Memorial Drive, Barkley Centre
Paducah, KY 42001
(270) 554-3004
http://www.paducaheic.com

Hours of Operation: Monday through Friday
8 A.M.–12:00 P.M.

THIS PAGE INTENTIONALLY LEFT BLANK

8. APPROVALS

Explanation of Significant Differences
to the Record of Decision for the Interim Remedial Action
of the Northeast Plume at the
Paducah Gaseous Diffusion Plant
Paducah, Kentucky

DOE/LX/07-1291&D2/R1

August 2015

_____ _____

William E. Murphie, Manager
Portsmouth/Paducah Project Office
U.S. Department of Energy

Date

_____ _____

Franklin E. Hill, Director
Superfund Division
U.S. Environmental Protection Agency—Region 4

Date

_____ _____

Tony Hatton, Director
Division of Waste Management
Kentucky Department for Environmental Protection

Date

THIS PAGE INTENTIONALLY LEFT BLANK

9. REFERENCES

DOE (U.S. Department of Energy) 1995. *Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/06-1356&D2, U.S. Department of Energy, Paducah, KY, June.

DOE 2003. *Five-Year Review for Remedial Actions at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-2067&D2, U.S. Department of Energy, Paducah, KY, October.

DOE 2006. *Paducah 2006 Sitewide Remedy Review*, Office of Environmental Management, Office of Engineering Technical Expertise Project 610, U.S. Department of Energy, April 13.

DOE 2007. *Review Report: Groundwater Remedial System Performance Optimization at PGDP, Paducah, Kentucky*, prepared for Office of Groundwater and Soil Remediation and Office of Engineering and Technology, U.S. Department of Energy, May 24.

DOE 2009. *Five-Year Review for Remedial Actions at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0117&D2, U.S. Department of Energy, Paducah, KY, May.

DOE 2012. S*ite Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, Annual Revision—FY 2012, DOE/LX/07-1264&D2, U.S. Department of Energy, Paducah, KY, February.

DOE 2013b. *Operation and Maintenance Plan for the Northeast Plume Containment System Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1535&D3/R3, U.S. Department of Energy, Paducah, KY, May.

DOE 2014. *Five-Year Review for Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1289&D2/R1, Secondary Document, U.S. Department of Energy, Paducah, KY, May.

DOE 2015a. *Memorandum of Agreement for Resolution of Formal Dispute of the Explanation of Significant Differences to the Record of Decision for the Interim Remedial Action of the Northeast Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1291&D2, *and Remedial Action Work Plan for Optimization of the Northeast Plume Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1280&D2, U.S. Department of Energy, Paducah, KY, July.

DOE 2015b. *Remedial Action Work Plan for Optimization of the Northeast Plume Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1280&D2, U.S. Department of Energy, Paducah, KY, August.

EPA (U.S. Environmental Protection Agency) 1998. *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant,* DOE/OR/07-1707, U.S. Environmental Protection Agency, Atlanta, GA, February.

EPA 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision and Other Remedy Selection Decision Documents,* EPA 540-R-98-031, Office of Solid Waste and Emergency Response, Washington, DC, July.

EPA 2009. Franklin E. Hill, Director, Superfund Division, Sam Nunn Federal Center, Atlanta, GA, letter to William Murphie, Director Portsmouth/Paducah Project Office, U.S. Department of Energy, Paducah Site Office, Paducah, KY, "Approval of the 2008 CERCLA Five-Year Review for the Paducah Gaseous Diffusion Plant (DOE/LX/07-0117&D2)," June 4.

KEEC (Kentucky Energy and Environment Cabinet) 2009. April J. Webb, P.E., Manager, Hazardous Waste Branch, Kentucky Energy and Environment Cabinet, Frankfort, KY, letter to Reinhard Knerr, Paducah Site Lead, Portsmouth/Paducah Project Office, U.S. Department of Energy, Paducah, KY, approval of the "Five-Year Review for Remedial Actions at the Paducah Gaseous Diffusion Plant (DOE/LX/07-0117&D2)," March 30.

APPENDIX

AIR DISPERSION ANALYSIS

THIS PAGE INTENTIONALLY LEFT BLANK

A.1. INTRODUCTION

As a result of cessation of uranium enrichment operations at Paducah Gaseous Diffusion Plant (PGDP), the use of the C-637 Cooling Towers as an air stripper facility for trichloroethene (TCE)-contaminated groundwater was discontinued for this interim remedial action (IRA). Since PGDP ceased operations and until completion of the Northeast Plume IRA optimization project, one Northeast Plume treatment unit (TU), located near the planned location for EW234, will be used temporarily to continue treatment of groundwater from the two existing Northeast Plume extraction wells (EW331 and EW332) until EW234 and EW235 begin operation. The TU systems include a skid-mounted treatment system consisting of a high efficiency air stripper, air blower, effluent pump, influent bag filters, and process control system all enclosed in a heated weatherproof enclosure. In addition, the EW234 TU includes a tie-in point to the existing Northeast Plume IRA EWs. Two separate TUs will be used to treat extracted water from each new EW; one TU for EW234 and one TU for EW235, and will be located in the same general area as the new extraction wells.

This appendix describes the air dispersion analysis of potential hazardous air pollutant (HAP) and/or toxic air pollutant (TAP) emissions after implementation of the Northeast Plume IRA Optimization project is complete, and EW234 and EW235 have begun operation. The property boundary concentrations for potential HAP/TAP emissions were estimated using BREEZE AERMOD version 7.7.1. The results of the dispersion analysis are summarized herein.

A.1.1 AIR DISPERSION MODEL SELECTION

The BREEZE AERMOD version 7.7.1 program was used to conduct air dispersion modeling using the latest version (12345) of the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) to estimate maximum ground-level concentrations. AERMOD is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.

A.1.2 MODELING RECEPTOR GRIDS

Ground-level concentrations were calculated within one Cartesian receptor grid and at receptors placed along the property line (property line). The property line grid receptors were spaced at a maximum of approximately 50 m apart. The Cartesian receptor grid extending out a minimum of 600 meters beyond the property line was spaced at 200-m intervals in all directions. The Cartesian receptor grid was generated to ensure concentrations were decreasing away from the property line. All resultant maximum concentrations occur well within this distance.

A.1.3 TERRAIN

AERMOD uses advanced terrain characterization to account for the effects of terrain features on plume dispersion and travel. AERMOD's terrain pre-processor, AERMAP (latest version 11103), imports digital terrain data and computes a height scale for each receptor from National Elevation Dataset (NED) data files. A height scale is assigned to each individual receptor and is used by AERMOD to determine whether the plume will go over or around a hill.

The modeled receptor terrain elevations input into AERMAP are the highest elevations extracted from United States Geological Survey (USGS) 1:24,000 scale (7.5-minute series) NED data for the area surrounding PGDP. For each modeled receptor, the maximum possible elevation within a box centered on the receptor of concern and extending halfway to each adjacent modeled receptor was chosen. This is a conservative technique for estimating terrain elevations by ensuring that the highest terrain elevations are accounted for in the analysis. HAP/TAP emission concentrations were calculated at all receptors.

A.1.4 BUILDING DOWNWASH ANALYSIS

The emission units were evaluated in terms of their proximity to nearby structures.[1] The purpose of this evaluation was to determine if stack discharge might become caught in the turbulent wakes of these structures leading to downwash of the plume. Wind blowing around a building creates zones of turbulence that are greater than if the building were absent. The current version of the AERMOD dispersion model treats building wake effects following the algorithms developed by Schulman and Scire.[2] This approach requires the use of wind direction-specific building dimensions for structures located within 5L of a stack, where L is the lesser of the height or projected width of a nearby structure. Stacks taller than the structure height plus 1.5L are not subject to the effects of downwash in the AERMOD model.

The current version of the AERMOD dispersion model considers the trajectory of the plume near a building and uses the position of the plume relative to the building to calculate interaction with the building wake. The direction-specific building dimensions used as inputs to the AERMOD model were calculated using the Building Profile Input Program Plume Rise Model Enhancement (BPIP PRIME), version 04274.[3] BPIP PRIME calculates fields of turbulence intensity, wind speed, and the slopes of the mean streamlines as a function of the projected building dimensions. BPIP PRIME is authorized by the U.S. Environmental Protection Agency (EPA) and is designed to incorporate the concepts and procedures expressed in the good engineering practice (GEP) technical support document,[4] the building downwash guidance document, and other related documents.

BPIP PRIME results indicate the stack height of each emission unit is greater than the GEP stack height; therefore, building downwash is not a concern. Each building processed using BPIP PRIME was assigned a unique numerical identification, which correspond to BPIP PRIME files, and are illustrated in Figure A.1.

---

[1] Buildings located farther than 800 m or 2,625 ft of a stack were not considered in the building downwash analysis. http://www.epa.state.oh.us/portals/27/aqmp/eiu/attach2.pdf

[2] Earth Tech, Inc., *Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model*, Concord, MA, November 1997.

[3] EPA, User's Guide to the Building Profile Input Program (Research Triangle Park, NC), EPA-454/R-93-038, April 2004.

[4] EPA, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised)* (Research Triangle Park, NC), EPA 450/4-80-023R, June 1985.

Figure A.1. Buildings Processed Using BPIP PRIME

A.2. IDENTIFICATION OF AIR POLLUTANTS

The potential HAPs/TAPs that could be emitted by the Northeast Plume IRA optimization project have been identified based on groundwater characterization. The potential HAPs/TAPs that could be emitted are trichloroethene (TCE) and 1,1-dichloroethene (1,1-DCE).

A.3. ALLOWABLE OFF-SITE CONCENTRATIONS CALCULATIONS

The treated vapor/gases must comply with the contaminant concentration requirements of 401 *KAR* 63:020. This states that no owner or operator shall allow any affected facility to emit potentially hazardous matter or toxic substances in such quantities or duration as to be harmful to the health and welfare of humans, animals, and plants.

A.3.1 TCE ALLOWABLE OFF-SITE CONCENTRATIONS

The maximum allowable air concentration for TCE was estimated using the EPA Region 9 Regional Screening Levels (RSLs), formerly referred to as Preliminary Remediation Goals, which are available from the EPA's Web site at: http://www.epa.gov/region9/superfund//prg/index.html. The TCE value is based on the carcinogenic risk posed by lifetime[5] exposure to TCE. The health effects of exposure to TCE are measured by a target risk of one in one million (1×10^{-6}). The residential RSL was used to develop an allowable off-site concentration limit.

The ambient air allowable off-site concentration for TCE is 0.43 µg/m^3. The allowable off-site concentration for TCE was selected from the EPA publication of RSLs. (Note: The air dispersion analysis was performed in 2013.)

A.3.2 1,1-DCE ALLOWABLE OFF-SITE CONCENTRATIONS

The maximum allowable air concentration for 1,1-DCE also was estimated using the EPA RSL. The 1,1-DCE value is based on the noncancer risks posed by long-term exposure to 1,1-DCE. The health effects of exposure to 1,1-DCE are measured by a hazardous index, with a hazard index of 1 being an indication of the nearest off-site receptor having detrimental health effects from exposure to 1,1-DCE. The residential RSL was used to develop an allowable off-site concentration limit.

The ambient air allowable off-site concentration for 1,1-DCE is 210 µg/m^3. The allowable off-site concentration for 1,1-DCE was selected from the EPA publication of RSLs. (Note: The air dispersion analysis was performed in 2013.)

---

[5] Lifetime exposure is assumed to be 70 years by convention for this air toxics risk assessment. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm. In such assessments, if exposure duration is less than 70 years, inhalation exposure estimates and/or allowable off-site concentrations limits may be adjusted accordingly. http://epa.gov/ttn/fera/risk_atra_vol2.html. For simplicity in this report, allowable off-site concentration limits were not adjusted although exposure duration is expected to be less than 70 years for this project.

The allowable off-site concentrations for TCE and 1,1-DCE are shown in Table A.1.

Table A.1. Allowable Off-site Concentration Limits

Pollutant	Allowable Off-site Concentration ($\mu g/m^3$)	Reference Source
TCE	0.43	Regional Screening Levels, May 2013
1,1-DCE	210	

A.4. ESTIMATED EMISSION RATES

A.4.1 EMISSIONS

During operation of the project, hazardous constituents in extracted groundwater will be volatilized using two identical TUs including, but limited to, a skid-mounted treatment system consisting of a high efficiency four-tray air stripper (QED EZ-Tray P/N EZ-24.4SS),[6] air blower, effluent pump, influent bag filters, and process control system all enclosed in a heated weatherproof enclosure. The current design criteria for the TUs are for each air stripper to have a removal efficiency of up to 99% for volatile organic compounds.[7] No vapor phase controls to capture or destroy contaminants prior to release to the atmosphere following stripping are included in the TUs at this time.

The following preliminary design parameters[8] for the stack were used in the model to estimate the dispersion of the hazardous constituents:

- 8-inch diameter;
- 19.5-ft high (approximate);
- 1,300 scfm flow rate (approximate);
- 55°F exhaust gas temperature; and
- The stack will not be equipped with a rain cap.

In order to assess the potential impacts on ambient TCE and 1,1-DCE concentrations from the project, modeling was performed using estimated maximum potential emissions based on the system's maximum TCE input of 1,000 ppb; information was provided from the manufacturer.

The average expected TCE concentrations in groundwater prior to treatment are 517 ppb and 450 ppb for ATU 234 and ATU 235, respectively. Based on average expected TCE concentration in untreated groundwater, the TCE emissions to air are estimated as 5.167×10^{-2} pound per hour (lb/hr) and 4.498×10^{-2} lb/hr for ATU 234 and ATU 235, respectively. The maximum observed TCE mass concentration based on sampling data from existing extraction wells was 870 ppb.[9] As such, 9.994×10^{-2} lb/hr based on 1,000 ppb provides a conservative basis for modeling potential emissions.

[6] Air stripper model information based on as-built equipment.
[7] http://www.qedenv.com/products/air_s.html
[8] Design parameters received in e-mail to Geosyntec on January 24, 2013, and January 28, 2013.
[9] Sampling data received in e-mail to Geosyntec on January 24, 2013. See May 8, 2013, e-mail to Todd Mullins, Kentucky Department for Environmental Protection, from Stan Knaus, LATA Environmental Services of Kentucky, LLC.

The maximum emission rates during operation for each model scenario are listed in Table A.2 in both lb/hr and g/s.

Table A.2. Estimated Emission Rates

Model ID	Scenario Description	TU 234 Mass Emissions (lb/hr)	TU 234 Mass Emissions (g/s)	Untreated Water Concentration (ppb)	TU 235 Mass Emissions (lb/hr)	TU 235 Mass Emissions (g/s)	Untreated Water Concentration (ppb)
Max_TCE	Maximum TCE	9.994×10^{-2}	1.259×10^{-2}	1,000	9.994×10^{-2}	1.259×10^{-2}	1,000
Max_11DCE	Maximum 1,1-DCE[10]	9.994×10^{-2}	1.259×10^{-2}	1,000	9.994×10^{-2}	1.259×10^{-2}	1,000

A.4.2 MAXIMUM OFF-SITE CONCENTRATIONS

The property boundary ambient concentration for each HAP/TAP was estimated using the air dispersion model BREEZE AERMOD version 7.7.1.

Surface meteorology data from station number 3816 (Paducah, KY) and the nearest available upper air meteorology data from station 00013897 (Nashville, TN) were used. Dispersion analysis was performed using meteorological data from these stations for calendar years 2008, 2009, 2010, 2011, and 2012 (January 1, 2008, through December 31, 2012). The AERMOD-ready meteorological files were purchased from Trinity Consultants, Inc.

The air dispersion modeling analysis was performed using the pollutant-specific controlled emission rates discussed in Section A.4.1 to estimate the off-site concentration for each pollutant.

The results of the air dispersion modeling analysis suggest that the maximum annual concentration occurs at a receptor (341114.10, 4109112.90) along the property boundary northeast of the proposed stack locations, illustrated in Figure A.2.

[10] 1,1-DCE is a volatile similar to TCE; therefore, mass emission rates of 1,1-DCE were conservatively assumed to equal TCE.

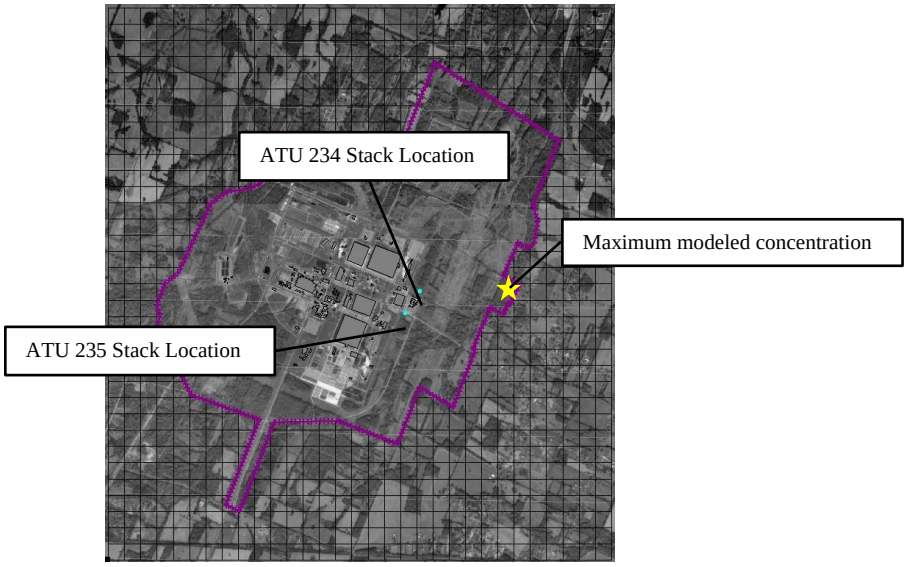

Figure A.2. Modeling Results

The estimated off-site pollutant concentrations for each modeling scenario are shown in Table A.3.

Table A.3. Estimated Off-site Concentrations

Model ID	Off-Site Concentration Limit ($\mu g/m^3$)	Annual Off-site Concentration ($\mu g/m^3$)	Below Limit? (Yes/No)
Max_TCE	0.43	0.084	Yes
Max_11DCE	210	0.084	Yes

The results of these air dispersion modeling analyses show the estimated maximum annual average concentration for both modeling scenarios will be below the corresponding maximum allowable off-site concentrations of respective pollutants. Additionally, the allowable off-site concentration limit for TCE was developed using a lifetime (i.e., 70-year exposure period) per EPA's RSL User's Guide.[11] The duration of potential exposure associated with the operation of the TUs will be less than 70 years. Therefore, emissions associated with this project are not expected to be harmful to the health and welfare of humans, animals, or plants.

[11] http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm

THIS PAGE INTENTIONALLY LEFT BLANK