PAD-ENM-0055/R1

Environmental Monitoring Plan
Fiscal Year 2012
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

This document is approved for public release per review by:

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LATA Kentucky Classification Support

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Environmental Monitoring Plan
Fiscal Year 2012
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

Date Issued—November 2011

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

LATA ENVIRONMENTAL SERVICES OF KENTUCKY, LLC
managing the
Environmental Remediation Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-10CC40020

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ACRONYMS

AEC	Atomic Energy Commission
AIP	Agreement in Principle
ASER	Annual Site Environmental Report
CAP-88	Clean Air Act Assessment Package-88
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
DCG	Derived Concentration Guide
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQO	data quality objective
EDE	effective dose equivalent
EM	environmental monitoring
EMP	Environmental Monitoring Plan
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FY	fiscal year
GSA	General Services Administration
ISMS	Integrated Safety Management System
KAR	*Kentucky Administrative Regulation*
KDOW	Kentucky Division of Water
KDWM	Kentucky Division of Waste Management
KPDES	Kentucky Pollutant Discharge Elimination System
MDL	method detection level
MW	monitoring well
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
OU	operable unit
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
QA	quality assurance
RADCON	radiological control
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SPCC	spill prevention control and countermeasure
SARA	Superfund Amendments Reauthorization Act
Tc-99	technetium-99
TCE	trichloroethene
TLD	thermoluminescent dosimeter
UE	uranium enrichment
USEC	United States Enrichment Corporation
Water Policy	Action Memorandum for the Water Policy at PGDP
WKWMA	West Kentucky Wildlife Management Area
WMP	Watershed Monitoring Program

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EXECUTIVE SUMMARY

This Paducah Site Environmental Monitoring Plan (EMP) for fiscal year (FY) 2012 is intended to document the rationale, sampling frequency, parameters, and analytical methods for environmental monitoring (EM) activities at the Paducah Site and provide information on site characteristics, environmental pathways, dose assessment methodologies, and quality assurance management.

EM at the Paducah Site consists of effluent monitoring and environmental surveillance activities and supports the evaluation and assessment of unplanned releases. Monitoring is conducted for a variety of media including air, surface water, groundwater, soil, and sediment.

Sampling frequencies and sampling parameters that were modified for a sampling program that was permit-driven or collected as a result of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or Resource Conservation and Recovery Act (RCRA) decision document were changed only if the permit allowed the change. Data collected under existing permits and under CERCLA or RCRA decision documents will continue to be evaluated in FY 2012. If changes are deemed appropriate based on trending analyses, they will be proposed via a permit modification or decision document change and implemented immediately after approval by the regulatory agencies. These changes will be incorporated in the FY 2013 EMP.

Changes to the sampling programs reflected in the FY 2012 EMP include, but are not limited to, the following actions.

- Elimination of Total Suspended Solids from the C-746-S&T and C-746-U Landfills groundwater monitoring programs. This parameter is not required by the permits, the regulations, or the permit application.

- Elimination of the macroinvertebrate benthic collection in the Little Bayou and Bayou Creeks. The justification for this reduction, resulting from the review of extensive data sets from historical sampling campaigns, is documented in the Kentucky Pollutant Discharge Elimination System (KPDES) permit, as well as the Watershed Monitoring Plan.

- Elimination of the deer harvest program. Prior to the elimination of this program, the U.S. Department of Energy (DOE) performed an extensive review of historical data sets. As a result of this review, DOE eliminated the deer harvest because of a downward trend and a continued lack of detection in the deer harvest results, as well as an overall downward trend in the concentration of contaminants found at the Paducah Site due to remediation efforts.

- Elimination of sediment sampling at the Northwest Storm Water Control Facility, also known as the C-613 Sedimentation Basin. The elimination of the macroinvertebrate benthic collection, deer harvest, and the sediment from the sedimentation basin was approved by DOE during FY 2011 and is being incorporated into this FY 2012 EMP.

Based on an evaluation performed in FY 2011 of long-term groundwater data trends for nonregulatory-required monitoring activities, the sampling frequency for certain monitoring wells (MWs) was reduced; therefore, sampling in some programs will not be conducted in FY 2012. For ease of review, however, these MWs are still listed in their programs in Appendices B and C. Appendix C explains the next FY in which the MWs will be sampled.

DOE Orders referenced in this plan are current with the contracting requirements; however, some DOE Orders referenced have been revised or replaced. If contractual, requirements to revise the DOE Orders are deemed necessary, changes will be incorporated in the FY 2013 EMP.

1. INTRODUCTION

1.1 PURPOSE

This Paducah Site Environmental Monitoring Plan (EMP) for fiscal year (FY) 2012 is intended to document the rationale, sampling frequency, parameters, and analytical methods for environmental monitoring (EM) activities at the Paducah Site and provides information on site characteristics, environmental pathways, dose assessment methodologies, and quality assurance (QA) management. Guidance for EM is included in U.S. Department of Energy (DOE) Order (O) 450.1A, *Environmental Protection Program*; DOE O 5400.5, *Radiation Protection of the Public and the Environment* and DOE/E-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), hereinafter identified as the Radiological Guide; and Commonwealth of Kentucky and federal regulations that implement federal environmental laws.

The purpose of DOE O 450.1A is to implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by DOE operations, through which DOE cost effectively meets or exceeds compliance with applicable environmental, public health, and resource protection requirements. DOE O 5400.5 establishes standards and requirements for DOE operations with respect to protection of the public and the environment against undue risk from radiation.

The Radiological Guide establishes the "elements of a radiological effluent monitoring and environmental surveillance program considered acceptable to DOE, in support of DOE O 5400.5 (Radiation Protection of the Public and the Environment) and DOE 450.1A, described above. This EMP is written to comply with "*should*" statements in the Radiological Guide, unless noted otherwise as an allowable exception.

This EMP also supports permit requirements and supplements the ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigations (RIs) being conducted at the Paducah Site. In accordance with the Paducah Site Federal Facility Agreement (FFA), there are five defined CERCLA operable units (OUs)—surface water, groundwater, soils, burial grounds, and decontamination and decommissioning—that require investigation. This EMP is integrated with each OU investigation and/or remedial action to help provide collection of optimal data sets.

1.2 SCOPE

EM at the Paducah Site consists of effluent monitoring and environmental surveillance activities and supports the evaluation and assessment of unplanned releases. Monitoring is conducted routinely for a variety of media including air, surface water, groundwater, soil, and sediment. Effluent monitoring is the direct measurement or the collection and analysis of liquid and gaseous discharges to the environment. Environmental surveillance is the direct measurement or the collection and analysis of ambient air, surface water, groundwater, sediment, soil, biota, and other media.

The United States Enrichment Corporation (USEC) leases and operates the Paducah Gaseous Diffusion Plant (PGDP) uranium enrichment facility at the Paducah Site and conducts its own EM activities. This EMP does not address EM activities conducted by USEC.

In order for DOE and its primary remediation contractor to meet or exceed compliance with applicable environmental, public health, and resource protection requirements cost effectively, the EMP is evaluated and modified as appropriate. These modifications may include adjusting the number of monitoring wells, changing sampling frequency of certain activities, or eliminating parameters to avoid duplication of data.

As the prime contractor for DOE at the Paducah Site, LATA Environmental Services of Kentucky currently is evaluating the existing site permits to determine whether changes in sampling frequency or parameters are appropriate and acceptable to the regulatory agencies. Optimization of permit-required sampling will be implemented following approval by the regulatory agencies.

The Paducah Site EMP is prepared annually for implementation on an FY basis (i.e., October 1 through September 30). The DOE prime contractor is responsible for implementing the EMP. The results are published and made available to the public in the form of the Annual Site Environmental Report (ASER).

1.3 RATIONALE

The rationale for EM activities at the Paducah Site for FY 2012 is premised by the understanding that sampling frequency, sampling parameters, and analytical methods must be sufficient to meet regulatory and contractual requirements and support appropriate DOE Orders and Guidance cost effectively.

Sampling frequencies and sampling parameters that were modified for a sampling program that was permit-driven or collected as a result of a CERCLA or Resource Conservation and Recovery Act (RCRA) decision document were changed only if the permit allowed the change. Data collected under existing permits and under CERCLA or RCRA decision documents will continue to be evaluated in FY 2012. If changes are deemed appropriate based on trending analyses, they will be proposed via a permit modification or decision document change and implemented immediately after approval by the regulatory agencies. These changes will be incorporated in the FY 2013 EMP.

Changes to the sampling programs reflected in the FY 2012 EMP include, but are not limited to, the following actions.

- Elimination of Total Suspended Solids from the C-746-S&T and C-746-U Landfills groundwater monitoring plans. This parameter is not required by the permits, the regulations, or the permit application.

- Elimination of the macroinvertebrate benthic collection in the Little Bayou and Bayou Creeks. The justification for this reduction, resulting from the review of extensive data sets from historical sampling campaigns, is documented in the Kentucky Pollutant Discharge Elimination System (KPDES) permit, as well as the Watershed Monitoring Plan.

- Elimination of the deer harvest program. Prior to the elimination of this program, DOE performed an extensive review of historical data sets. As a result of this review, DOE eliminated the deer harvest because of a downward trend and a continued lack of detection in the deer harvest results, as well as an overall downward trend in the concentration of contaminants found at the Paducah Site due to remediation efforts.

- Elimination of sediment sampling at the Northwest Storm Water Control Facility, also known as the C-613 Sedimentation Basin. The elimination of the macroinvertebrate benthic collection, deer harvest and the sediment from the sedimentation basin was approved by DOE during FY 2011 and is being incorporated into this FY 2012 EMP.

Based on an evaluation performed in FY 2011 of long-term groundwater data trends for nonregulatory-required monitoring activities, the sampling frequency for certain monitoring wells (MWs) was reduced; therefore, sampling in some programs will not be conducted in FY2012. For ease of review, however,

these MWs still are listed in their respective programs in Appendices B and C. Appendix C explains the next FY in which the MWs will be sampled.

1.4 GENERAL CONSIDERATIONS

1.4.1 Site Description

The Paducah Site, comprised of PGDP and surrounding acreage, is located in a generally rural area of McCracken County, Kentucky (population approximately 66,000). The site is comprised of approximately 3,500 acres in western McCracken County, 10 miles west of Paducah, Kentucky (population approximately 26,000), and 3.5 miles south of the Ohio River (Figure 1). The plant is on approximately 1,350 acres with controlled access. Roughly, 650 acres of the site are enclosed within a fenced security area. An uninhabited buffer zone of at least 400 yd surrounds the entire fenced area. PGDP is an active uranium enrichment facility consisting of a diffusion cascade and extensive support facilities. The cascade, including product and tails withdrawal, is housed in six large process buildings within the fenced security area.

1.4.2 Site Background Information

Before World War II, the area now occupied by PGDP was used for agricultural purposes. Numerous small farms produced various grain crops, provided pasture for livestock, and included large fruit orchards.

During World War II, a 16,126-acre tract was assembled for construction of Kentucky Ordnance Works, which subsequently was operated by the Atlas Powder Company until the end of the war. At that time, it was turned over to the Federal Farm Mortgage Corporation and then to the General Services Administration (GSA).

In 1950, the U.S. Department of Defense (DOD) and DOE's predecessor, the Atomic Energy Commission (AEC), began efforts to expand fissionable material production capacity. As part of this effort, the National Security Resources Board was instructed to designate power areas within a strategically safe area of the United States. Eight government-owned sites initially were selected as candidate areas. In October 1950, as a result of joint recommendations from DOD, U.S. Department of State, and AEC, President Harry S. Truman directed AEC to expand further production of atomic weapons. One of the principal facets of this expansion program was the provision for a new gaseous diffusion plant. On October 18, 1950, AEC approved the Paducah Site for uranium enrichment (UE) operations and formally requested the Department of the Army to transfer the site from GSA to AEC. Of the 7,566 acres acquired by the AEC, 1,361 acres subsequently were transferred to the Tennessee Valley Authority (Shawnee Fossil Plant Site), and approximately, 2,700 acres were conveyed to the Commonwealth of Kentucky for wildlife conservation and for recreational purposes [West Kentucky Wildlife Management Area (WKWMA)].

Although construction of PGDP was not complete until 1954, production of enriched uranium began in 1952. Recycled uranium from nuclear reactors was introduced into the PGDP enrichment "cascade" in 1953 and continued through 1964. In 1964, cascade feed material was switched solely to virgin-mined uranium. Use of recycled uranium resumed in 1969 and continued through 1976.

In 1976, the practice of recycling uranium feed material from nuclear reactors was halted and never resumed. During the recycling time periods, Paducah received approximately 100,000 tons of recycled uranium containing an estimated 328 grams of plutonium-239 (Pu-239), 18,400 grams of neptunium-237

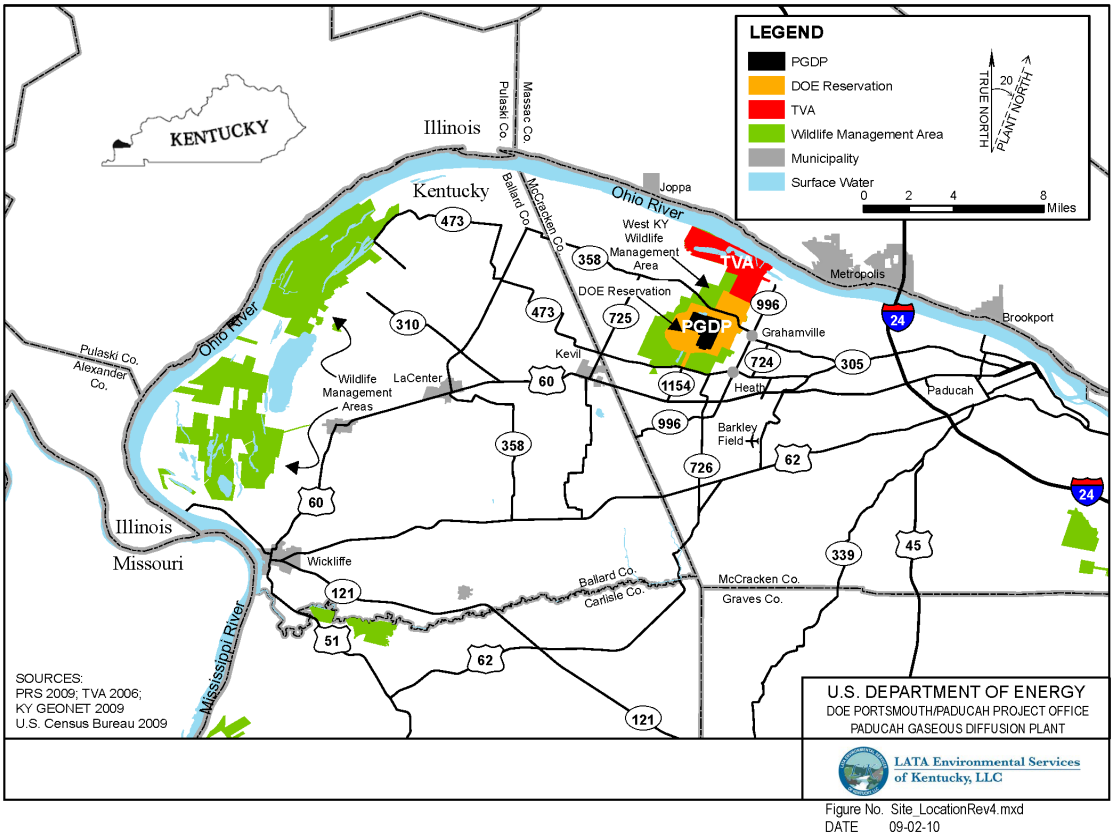

Figure 1. Location of the Paducah Site

(Np-237), and 661,000 grams of technetium-99 (Tc-99). The majority of the Pu-239 and Np-237 was separated out during the initial chemical conversion to uranium hexafluoride (UF_6). Concentrations of transuranics (e.g., Pu-239 and Np-237) and Tc-99 are believed to have been deposited on internal surfaces of process equipment and in waste products.

In October 1992, congressional passage of the 1992 National Energy Policy Act established USEC.

Effective July 1, 1993, DOE leased the plant UE operation facilities to USEC. Under the terms of the lease, USEC assumed responsibility for environmental compliance activities directly associated with UE operations. The plant's mission of UE has continued unchanged since 1950, and the original facilities still are in operation, albeit with substantial upgrading and refurbishment.

The PGDP was placed on the U.S. Environmental Protection Agency (EPA) National Priorities List on May 3, 1994, with an effective date of June 30, 1994. Environmental restoration is being addressed under an FFA with EPA and the Commonwealth of Kentucky. The FFA became effective February 13, 1998.

1.5 PLAN OBJECTIVES

The main objectives of this EMP are as follows:

- Ensure the early identification and appropriate response to potential adverse environmental impacts associated with DOE operations through effluent monitoring and environmental surveillance.

- Ensure that analytical work supporting EM is implemented using the following:
  - A consistent system for collecting, assessing, and documenting environmental data of known and documented quality;
  - A validated and consistent approach for sampling and analysis of radionuclide samples to ensure laboratory data meet program-specific needs and requirements; and
  - An integrated sampling approach to avoid duplicative data collection.
- Support the "fully implemented status" of the Paducah Site Environmental Management System (EMS).
- Support the implementation of the Paducah Site Integrated Safety Management System (ISMS).
- Ensure integration of EMS into the site's ISMS.

Outputs from implementation of the EMP may be used to do the following:

- Provide data for use in the ASER, which informs the public about releases and potential impacts from DOE operations to human health and the environment;
- Identify DOE operations pollutant contributions;
- Provide ancillary data that may be required to assess the consequences of a spill or release;
- Identify significant changes in sample analytical results;
- Support or supplement data needs for CERCLA actions; and
- Provide a mechanism for long-term data collection needs under the FFA, when applicable.

1.6 PLAN OVERVIEW

Section 1 is used to describe relevant background and current information. Section 2 of this document describes effluent monitoring for liquid and airborne radiological constituents. Section 3 addresses meteorological monitoring, which is collected from the National Weather Service. Section 4 addresses, by media, environmental surveillance activities undertaken to monitor the radiological impacts of DOE operations. Section 5 describes the dose calculation methods used for the site. Section 6 provides various reporting requirements. Section 7 lists references utilized in the preparation of this plan.

The appendices provide detailed information regarding site permits, groundwater well information, sampling program details, QA, and data management.

1.6.1 Measuring Facility Impact

The Radiological Guide requires comparisons of the measured concentrations against "background" concentrations. For the purposes of this EMP, a "background" location is called a reference location and is defined as an area unaffected by releases from PGDP. The area could, however, be impacted by the operation of other industrial or commercial facilities. When no standards or criteria exist for contaminants

that may have an impact on human health or the environment, comparisons to concentrations at reference locations can be made to determine if concentrations are significantly higher near the Paducah Site boundary.

2. EFFLUENT MONITORING

Effluent monitoring is the collection and analysis of samples or measurements of liquid and gaseous effluents to quantify and officially report chemical and radiological contaminants, assess radiation exposures of the public, provide a means to control effluents at or near the point of discharge, and demonstrate compliance with applicable standards and permit requirements. Effluent monitoring is initiated to demonstrate compliance with one or more federal or Commonwealth of Kentucky regulations, permit conditions, or environmental commitments made in environmental impact statements, environmental assessments, DOE Orders and guides, or other official documents. Table 1 lists the various routine effluent monitoring activities performed at the Paducah Site. A summary of permits and compliance agreements is included in Appendix A.

Table 1. Routine Effluent Monitoring

Program	Number of Locations	Sampling Frequency	Parameters
Surface Water			
C-746-S&T Landfills	3[1]	Quarterly	See Appendix C
C-746-U Landfill	3[1]	Quarterly	
KPDES			
Chemical	1	Weekly	See Appendix C
	4	Monthly	
Chemical/Toxicity	5	Quarterly	
Leachate			
C-746-S&T Landfills	1	As required and annually	See Appendix C
C-746-U Landfill	1	As required and annually	
C-404 Landfill	1	As required	
C-637 Cooling Tower*	1	Monthly	N/A

[1] One location, L154, is permitted for both the C-746-S&T Landfills, as well as for C-746-U Landfill. Totals represent this location for each landfill.
* Sample collected by Northeast Plume Operations personnel; parameter information provided in the Northeast Plume Operations and Maintenance Plan.
KPDES = Kentucky Pollutant Discharge Elimination System
N/A = not applicable

The primary statute governing the monitoring of effluents to surface water is the Clean Water Act, which requires the issuance of a National Pollutant Discharge Elimination System (NPDES) permit. EPA has delegated the administration of the NPDES Program to the Kentucky Division of Water (KDOW) KPDES Program. Sampling and analytical methods meet the requirements described in 40 *CFR* § 136 or the KPDES Permit (KY0004049). In addition, DOE O 5400.5, *Radiation Protection of the Public and the Environment,* and the Radiological Guide provide general and detailed guidance regarding the establishment of effluent monitoring programs for radiological parameters.

Rationale and Design Objectives. The objectives of the Effluent Monitoring Program include the following:

- Verifying compliance with applicable federal, Commonwealth of Kentucky, and local effluent regulations and DOE Orders;

- Determining compliance with commitments made in environmental impact statements, environmental assessments, or other official documents;

- Evaluating the effectiveness of treatment processes and pollution control;
- Identifying potential environmental problems and evaluating the need for remedial actions or mitigating measures;
- Supporting permit revision and/or reissuance;
- Detecting, characterizing, and reporting unplanned releases; and
- Measuring trends in effluents.

In addition, the Radiological Guide recommends that this plan document the following:

- Effluent monitoring (sampling or *in situ* measurement) extraction locations used for providing quantitative effluent release data for each outfall;
- Procedures and equipment used to perform the extraction and measurement;
- Frequency and analyses by analyte required for each extraction (continuous monitoring and/or sampling) location;
- Minimum detection level (MDL) and accuracy by analyte; and
- QA components.

The preceding requirements are addressed as follows:

- Appendix C of this document lists all effluent monitoring locations. This appendix specifies sampling and field measurements. Appendix C also lists the sampling frequency at each location, as well as the required analytical parameters by each method type (i.e., volatiles, radionuclides, etc.).
- Appendix D of this document is the Environmental Management QA Plan. All QA components are outlined within this plan. Appendix D lists all procedures associated with sample extraction, as well as field measurements.
- Each contracted laboratory receives a statement of work for all sampling activities. In cases where reporting limits are specified under a given permit, the statement of work specifies these reporting limits as a requirement for the bid for work. In cases where there are no regulatory drivers, laboratories are directed to use the lowest routinely achievable reporting limit. (Note: The reporting limits referenced in this bullet are limits that are multiples of the MDL. For example, the laboratory may have an MDL of 1.2 milligram per liter (mg/L) for arsenic; however, the laboratory may use 5.0 mg/L as the reporting limit.)
- Effluent monitoring results from the KPDES outfalls are summarized in the discharge monitoring reports, which are submitted on a monthly basis to the KDOW as required by the KPDES permit. Notifications of nonconformances are submitted per the specifications within the permits. Surface water monitoring results at the landfills are summarized in quarterly reports and submitted to Kentucky Division of Waste Management (KDWM) on a quarterly basis.

Evaluation of Effluents. Effluents, regardless of whether they contain radiological contaminants from new or modified facilities, are to be evaluated by the regulatory compliance organization to determine the appropriate response.

Physical/Chemical/KPDES. KPDES is the regulatory program administered by KDOW for discharge of wastewaters to the waters of the Commonwealth of Kentucky. The DOE Paducah Site KPDES permit establishes monitoring requirements for the discharge of wastewater. The KPDES permit became effective on December 1, 2009. This modification added Outfall 020 and removed some parameters. A modification to the permit became effective on September 1, 2010. This latest modification did not affect the sampling locations or parameter list.

The permit defines limits on the concentration and amounts of specific chemicals that can be discharged and on the physical impact of those discharges (e.g., temperature or biological harm) to surface waters.

Processes for DOE operations have been evaluated to determine the chemicals, radiological species, and physical parameters (e.g., temperature) likely to affect the KPDES-permitted effluents. Effluents from permitted landfills are evaluated during the reporting and permit renewal processes. An application for renewal was submitted in 2011. KDOW currently is reviewing the application.

Radiological. Based on the evaluation of emissions and the results of radiological monitoring reported in the ASER for 2004, neither continuous monitoring nor continuous sampling with frequent analyses are required by DOE O 5400.5. This is because the weighted sum of radiological constituents is less than "one" and does not exceed the Derived Concentration Guide (DCG) at all the KPDES discharge points, DOE-owned and USEC-leased. Radiological analyses are performed on grab samples from rain runoff locations (i.e., outfalls, landfills, etc.). Due to historical downward trending of radiological parameters in Little Bayou and Bayou Creeks, the radiological testing was discontinued in these creeks in the FY 2011 EMP.

Program Implementation Procedures. The environmental monitoring and reporting manager (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the environmental monitoring and reporting manager reports through a line organization to the Manager of Projects and provides centralized coordination responsibilities.

2.1 LIQUID

2.1.1 Surface Water

Surface water leaving DOE-owned outfalls (Outfalls 001, 015, 017, 019, and 020) includes rainfall runoff from cylinder yards and landfills and effluent from site processes (e.g., the C-612 Northwest Plume Groundwater Treatment System and the C-616 USEC Wastewater Treatment Facility). The intent of monitoring is to assess compliance with Commonwealth of Kentucky and federal regulations, permits, and DOE Orders and to assess the impact of DOE operations on the local environment. In addition, DOE has responsibility for "legacy" contaminants, such as polychlorinated biphenyls (PCBs) and trichloroethene (TCE), in outfalls.

C-746-S&T and C-746-U Surface Water. Rainfall runoff from three locations at C-746-U and three locations at C-746-S&T Landfills are sampled quarterly for parameters listed in Appendix C. Although three locations are cited for each, there are only five unique locations. As part of the November 20, 2008, permit modification, the locations were revised and one location is listed for both the C-746-U Landfill and the C-746-S&T Landfills.

KPDES Monitoring. Five DOE-owned effluent sampling points covered by the KPDES permit (Outfalls 001, 015, 017, 019, and 020) are illustrated in Appendix C. Sampling is conducted weekly at Outfall 001 and monthly at Outfalls 015, 017, 019, and 020, when water is flowing.

2.1.2 Leachate

C-746-S and C-746-U Leachate. Leachate from the solid waste landfills is sampled annually and is analyzed for the parameters listed in Appendix C in accordance with permit requirements.

C-404 Leachate. Leachate samples are collected from the C-404 Landfill Leachate Collection System when leachate is removed and analyzed for the parameters listed in Appendix C in accordance with permit requirements.

2.1.3 C-637 Cooling Tower

Northeast Plume Cooling Tower. C-637-2A basin (previously called L-234) is sampled monthly for TCE. Samples also are collected at the riser (RISR6) and sometimes at C-637-2B and RISR1, when those areas receive water from the Northeast Plume Containment System.

2.2 AIRBORNE

Industrial operations that emit airborne pollutants considered potentially harmful to the environment are regulated through operating permits. DOE operations at the Paducah Site currently are not considered to be a major source of pollutants and consequently have no air permits.

3. METEOROLOGICAL MONITORING

DOE operations may have airborne radionuclide and chemical emissions from various sources such as CERCLA remedial actions, as well as fugitive emissions. Data used for chemical emission modeling purposes are available from the National Weather Service including information from the station located at the Barkley Airport approximately 6.4 km (4 miles) southeast of the Paducah Site. Meteorological data utilized for the Clean Air Act Assessment Package-88 (CAP-88) radionuclide emission modeling is compiled from historical data from a former on-site meteorological tower.

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4. ENVIRONMENTAL SURVEILLANCE

In support of DOE O 450.1A, the Paducah Site performs environmental surveillance. Environmental surveillance is the collection and analysis of samples or direct measurements of air, water, soil, biota, and other media from DOE sites and their environment for the purpose of determining compliance with applicable standards and permit requirements, assessing radiation exposures of members of the public, and assessing the effects, if any, on the local environment.

DOE O 5400.5 has established a radiation protection standard of 100 mrem per year from all exposure pathways to members of the public. This order requires that exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an effective dose equivalent (EDE) greater than, 100 mrem. Any one air emission source is limited to 10 mrem EDE to the maximum exposed member of the public per 40 *CFR* § 61 Subpart H. The maximum dose the public may receive from drinking water, as specified by the Safe Drinking Water Act, is 4 mrem per year.

DOE O 5400.5 defines "public dose" as the dose received by member(s) of the public from exposure to radiation and to radioactive material released by a DOE facility or operation, whether the exposure is within a DOE site boundary or off-site. It does not include doses received from occupational exposures, doses received from naturally occurring "reference" radiation, doses received by a patient from medical procedures, or doses received from consumer products. The determination of the public dose, as established by EPA regulation 40 *CFR* § 61, differs in that the 10 mrem EDE per year limit applies to dose received where the members of the public reside.

The Radiological Guide recommends that DOE facilities perform routine surveillance if an annual dose of site origin at the site boundary exceeds either 5 mrem EDE to an individual or 100-person rem collective EDE within a radius of 80 km (49.7 miles) of a central point on the site. Historically, as reported in previous ASERs, the annual dose due to DOE operations at the Paducah Site has been less than 5 mrem EDE (individual) or 100-person rem; therefore, no routine radiological surveillance is required. As a result, it was removed from the surface and sediment monitoring programs in the FY 2011 EMP.

An overview of routine environmental surveillance is provided in Table 2, which lists for each program the number of sampling locations, sampling frequency, sample type, and parameters for the analysis performed.

4.1 GROUNDWATER

4.1.1 Introduction

The Paducah Site, located in the Jackson Purchase region of western Kentucky, lies within the northern tip of the Mississippi Embayment portion of the Gulf Coastal Plain Province. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediment unconformably overlying Paleozoic bedrock. The *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III* (Clausen et al. 1992) discusses geology and hydrogeology of the Paducah Site in detail. Additional information regarding the geology and hydrogeology at the Paducah Site is covered in the *Groundwater Conceptual Model for the Paducah Gaseous Diffusion Plant* (PRS 2010).

Table 2. Routine Environmental Surveillance

Program	Number of Locations	Sampling Frequency	Sample Type	Parameters
Groundwater				
Surveillance	28	Annually	Grab	See Appendix C
Surveillance	107[a]	Biennially (Scheduled FY 2012)	Grab	See Appendix C
Surveillance Geochemical	44[b]	Every 3 years (Scheduled FY 2013)	Grab	See Appendix C
C-746 S&T Landfills	25[c]	Quarterly	Grab	See Appendix C
C-746-U Landfill	21[c]	Quarterly	Grab	See Appendix C
C-404 Landfill	9	Semiannually	Grab	See Appendix C
C-746-K Landfill	4	Semiannually	Grab	See Appendix C
Northeast Plume	11	Semiannually	Grab	See Appendix C
Northeast Plume	5	Quarterly	Grab	See Appendix C
Northwest Plume	22	Quarterly/	Grab	See Appendix C
Northwest Plume	11	Semiannually	Grab	See Appendix C
C-400	6	Quarterly	Grab	See Appendix C
C-400	6	Semiannually	Grab	See Appendix C
Residential Annually	14	Annually	Grab	See Appendix C
Residential Monthly	2	Monthly	Grab	See Appendix C
Residential Carbon Filter System	1	Semiannually	Grab	See Appendix C
Water Levels Quarterly	98	Quarterly	Grab	N/A
Water Levels Quarterly	6	Quarterly	Grab	N/A
Water Levels Quarterly	265	Quarterly	Grab	N/A
Surface Water and Seeps				
Surface water and seeps	20	Quarterly	Grab	See Appendix C
C-613 Sediment Basin	1	Quarterly	Grab	See Appendix C
KPDES	1/4/5	Weekly/Monthly/ Quarterly	Grab	See Appendix C
Sediment	14	Semiannually	Grab	See Appendix C
Ambient Air[d]	N/A	N/A	N/A	N/A
Meterologic[e]	N/A	N/A	N/A	N/A
Environmental TLDs	46	Quarterly	Continuous	External Gamma

TLD = thermoluminescent dosimeter

[a] Biennial frequency collected in FY 2011 and will not be collected again until FY 2013.

[b] Baseline established in FY 2010. The next schedule sampling is in FY 2013.

[c] Four of the same wells are cited in both C-746-U and C-746-S&T Landfills permits. For these totals, the wells are counted for both programs. Also, for the C-746-S&T Landfills locations, the count of 25 wells includes two wells that are measured only for water level. The number of locations sampled for analytical laboratory parameters is 23 locations.

[d] Operated by Commonwealth of Kentucky personnel.

[e] Information is taken from the National Weather Service.

4.1.2 Rationale and Design Criteria

The groundwater monitoring program consists of routine compliance monitoring designed to accomplish the following:

- Obtain data to determine baseline conditions of groundwater quality and quantity;

- Demonstrate compliance with and implementation of all applicable regulations and DOE Orders;
- Provide data to permit early detection of groundwater pollution or contamination;
- Identify existing and potential groundwater contamination sources and maintain surveillance of these sources; and
- Provide data for making decisions about waste disposal on land-based units and the management and protection of groundwater resources.

The following addresses specific laws, regulations, and orders.

DOE Orders. DOE O 450.1A does not require specific groundwater sampling frequencies or parameters; however, "Sample collection programs shall reflect specific facility needs. Type and frequency of sampling shall be adequate to characterize effluent streams." The order requires that DOE identify existing and potential groundwater contamination sources and maintain surveillance of these sources via groundwater monitoring. Monitoring verifies that releases are sustainable without causing environmental harm. The EMP was written to include effluent monitoring and environmental surveillance at the Paducah Site. Background wells are monitored biennially for several parameters, including organics, inorganics, and radionuclides.

Commonwealth of Kentucky Regulation. Preparation of a Groundwater Protection Plan that addresses requirements to ensure protection for all current and future uses of groundwater and to prevent groundwater pollution is required by 401 *KAR* Section 5:037. This requirement was addressed by DOE, by writing and implementing a Groundwater Protection Plan, according to 401 *KAR* Section 5:037, prior to the deadline of August 24, 1995. This document was revised in August 2010. It will be revised on a three-year basis.

Agreement in Principle Sampling. The Agreement in Principle (AIP) supports groundwater program activities by providing oversight of the groundwater program. The oversight includes location of wells, sample analysis, statistical analysis of sample results, and data quality. KDWM AIP personnel conduct independent groundwater sampling and obtain DOE sample splits.

AIP personnel also respond to questions and concerns from the public, including sampling of residential wells. The AIP personnel participate in public meetings to provide an independent view of the effect of the Paducah Site on the local environment and health of the public.

CERCLA Actions. The FFA among DOE, EPA, and the Commonwealth of Kentucky states that sampling of residential wells is required for those wells potentially affected by migration of the Northeast and Northwest Plumes. Another requirement of the FFA is to determine the nature and extent of off-site contamination. This requirement is addressed through the RI process and ongoing remedial actions for operable units at the Paducah Site.

The *Action Memorandum for the Water Policy at Paducah Gaseous Diffusion Plant* (Water Policy) (DOE 1994) also requires groundwater sampling of residential wells affected by off-site contamination (DOE 1995; DOE 1993). Sixteen residential wells currently are sampled for the parameters listed in Appendix C. Ten of the sixteen wells are utilized only for sampling purposes, as the residents have been supplied an alternate water source in accordance with the Water Policy. The remaining six wells (R90, R114, R302, R384, R387, R392) are outside the Water Policy boundary and are sampled routinely and monitored for the presence of groundwater contamination. The Water Policy was established in accordance with the Administrative Consent Order, following an Engineering Evaluation/Cost Analysis,

and was written to document the preferred alternative addressing the need for protection of human health due to the presence of groundwater contamination originating from the Paducah Site. As soon as possible after contamination was found in local residential water supply wells, the affected households were supplied with bottled water. Construction of water mains allowed access to water lines for homes in the affected area. This was accomplished as a non-time-critical removal action under CERCLA.

The EMP also supplements the Paducah CERCLA RIs and ongoing remedial actions. Currently, there are five defined CERCLA OUs (i.e., surface water, groundwater, soils, burial grounds, and decontamination and decommissioning) that have been, or will be, investigated under the Paducah FFA. The EMP is integrated with each operable unit investigation to provide collection of optimal data sets.

FFA Requirement and Operation and Maintenance Plan for the Northwest and Northeast Plume Programs. In order to monitor the nature and extent of groundwater contamination and to evaluate any cyclic trends in water quality that may affect contaminant migration, 33 wells are required to be sampled for the Northwest Plume and 16 for the Northeast Plume, according to their respective Operation and Maintenance Plans.

The number of MWs sampled in support of the Northwest Plume monitoring program increased due to completion of the Northwest Plume Optimization project in August 2010. The increase in the program will aid in determining the effectiveness of the new extraction wells installed as part of this optimization program.

4.1.2.1 Landfill Groundwater Monitoring Program

C-746-S and C-746-T Landfills. C-746-S and C-746-T Solid Waste Landfills are closed landfills owned by DOE. These landfills currently are in postclosure status under the Landfill Permits SW07300014 and SW07300015. The groundwater is monitored utilizing a total of 25 MWs near the two landfills. Of these 25, 23 are used for collection of samples to analyze organic, inorganic, and radiological parameters identified in Appendix C. The remaining two are used for water level measurements. The total suspended solids analysis on the groundwater and leachate samples was eliminated in the FY 2012 EMP. This parameter is not required by the permit, permit application, or regulation.

C-746-U Landfill. The C-746-U Solid Waste Landfill is an operating landfill owned and managed by DOE. This landfill currently is being operated as a permitted (SW0730045), contained landfill, and 21 MWs are monitored quarterly for organic, inorganic, and radiological parameters, as listed in Appendix C. The total suspended solids analysis on the groundwater and leachate samples was eliminated in the FY 2012 EMP. This parameter is not required by the permit, permit application, or regulation.

C-404 Landfill. The C-404 Hazardous Waste Landfill is closed and monitored under EPA Hazardous Waste Permit KY8-890-008-982. The C-404 Hazardous Waste Landfill currently is being monitored under detection monitoring (semiannual sampling) according to permit requirements. The groundwater is monitored utilizing nine MWs. There are six downgradient and three upgradient compliance point wells. Parameters specified to be analyzed are provided in Appendix C.

C-746-K Landfill. Sampling of four MWs is conducted to evaluate the potential impact of historical waste disposal activities at the C-746-K Landfill on the groundwater quality parameters, which are analyzed semiannually, as identified in Appendix C. Requirements to sample these four MWs are outlined in the Record of Decision for Waste Area Groups 1 and 7. Sampling of these wells is not required by a permit, but is conducted in support of the FFA CERCLA investigation and RCRA facility investigations, as well as DOE O 450.1A, according to the Paducah FFA.

4.1.2.2 Surveillance Monitoring Program

Environmental Surveillance (Annual and Biennial Monitoring) Program. In order to monitor the nature and extent of groundwater contamination and to monitor groundwater quality, 103 non-background MWs are sampled biennially and 27 are monitored annually, as shown in Appendix C. Sampling of these MWs is not driven by a permitted process, but is conducted in support of the FFA CERCLA investigations, as well as DOE O 450.1A. The inclusion of these MWs in this program does not exclude them from other sampling programs. For ease of review, Appendix B of this document contains a well inventory list, which acts as a crosswalk for each MW and sampling program.

The sampling frequency for this program was modified in the FY 2011 EMP. The sampling frequency was modified from a quarter/semiannual basis to an annual/biennial basis. This modification was justified by an evaluation of the data collected over the last ten years, which showed that there have not been significant changes that merited the need for sampling as frequently. The 27 MWs that were selected to be monitored annually were selected based on their location within the plumes. Some MWs are key for early detection of plume migration; others are key for ongoing CERCLA work. The balance of the MWs will be sampled again in FY 2013.

Background Monitoring Program. Four background wells are sampled biennially and one annually to monitor the background water chemistry of wells located upgradient of the plant to compare with MWs potentially impacted from plant activities.

Environmental Surveillance (Geochemical Monitoring) Program. In order to monitor the effects of natural attenuation of groundwater contamination and to monitor groundwater quality, 44 MWs are to be sampled every three years. Sampling of these wells is not driven by a permitted process, but is conducted in support of the FFA CERCLA investigations, as well as DOE O 436.1.

The sampling frequency for this program was modified in the FY 2011 EMP. The sampling frequency was modified from an annual basis to a triennial basis. The next sampling event under this program is projected for FY 2013 and will include all 44 wells.

4.1.3 Extent and Frequency of Monitoring

Appendix B provides information for all wells used at the Paducah Site, as well as residential wells located off-site. The groundwater sampling frequency and parameters, which are identified in Appendix C, are reviewed annually. The information detailed in Appendix C is the planning document for all monitoring and lists sites to be monitored, the governing program(s), MWs, parameters, and the frequency.

4.1.4 Program Implementation Procedures

Organization. The environmental monitoring and reporting manager is responsible for implementing all relevant aspects of the EMP.

Plans. The *Groundwater Protection Plan*, last issued in August 2010, addresses the following specific requirements listed in Section 3(3) of 401 *KAR* 5:037:

(a) General information regarding the facility and its operation;

(b) Identification of activities associated with the facility, as identified in Section 2 of the regulation;

(c) Identification of all practices chosen for the plan to protect groundwater from pollution;

(d) Implementation schedules for the protection practices;

(e) Description of and implementation schedule for employee training necessary to ensure implementation of the plan;

(f) Schedule of required inspections, as applicable; and

(g) Certification of the plan by the appropriate PGDP representative.

These plans and the EMP provide the framework of the Groundwater Monitoring Program.

4.2 SURFACE WATER/SEDIMENT ENVIRONMENT

Surface Water. Measurement of water quality parameters in surface water samples provides a general guide to the environmental health of the system. Certain contaminants (e.g., volatile organic compounds) that are not particularly concentrated in other media are more efficiently analyzed in water samples.

Sediment. A single sediment sample can represent information that would require a large number of water samples, spaced over a period of time, to reconstruct. Sediment acts to collect, concentrate, and store specific kinds of contaminants at specific locations. Concentrations of contaminants in sediments represent integrated measures of aqueous contaminant concentrations over some preceding period of time.

The Environmental Surveillance Watershed Monitoring Program at the Paducah Site for surface water and sediment has evolved over a number of years in response to regulatory and community concerns. Initially, the prudent action was to sample surface water at the permitted outfalls and upstream and downstream within the receiving streams to assess potential impacts. Since that time, DOE has conducted remediation/removal efforts at the site, which has decreased the potential for surface water and sediment contamination. Additionally, the effluent from outfalls leaving the plant site is monitored to confirm no current impacts from ongoing operations. Effluent monitoring at the outfalls is permitted by KDOW through the KPDES permit. Data collected provide documentation of limited surface water impacts related to the site.

In 2010, an evaluation of historical data sets showed no upward trends in the results, as well as an overall downward trend in the concentration of contaminants found at the Paducah Site due to remediation efforts; therefore, the program was modified to include only those parameters required by the KPDES permit.

4.2.1 Rationale and Design Criteria

The surface water and sediment sampling sites included in this EMP are located on selected receiving streams downstream from primary contaminant sources and reference streams, either off-site or upstream of the Paducah Site. Contaminant sources include both point sources (e.g., effluent outfalls) and nonpoint sources, such as waste disposal areas or burial grounds.

As discussed in 4.2, evaluations of historical data sets showed a justification in the reduction in monitoring efforts for surface water and sediment. Sampling to meet the requirements set forth by the KPDES permit, which includes effluent sampling at the outfalls, surface water, and sediment for required parameters, meets the design criteria of the EM program.

4.2.2 Extent and Frequency of Monitoring

4.2.2.1 Surface Water Program

Surface water is sampled at 20 locations (including 1 seep) upstream and downstream from Paducah Site operations. Samples collected at upstream locations are considered background locations. Grab samples are collected quarterly. Samples also are taken from a location at the Paducah Site water intake on the Ohio River to evaluate the role of feed water in affecting water quality of discharges. Frequency, field measurements parameters, and analytical parameters are listed in Appendix C.

4.2.2.2 Sediment Program

Sediment samples are collected semiannually from 14 locations, two of which are considered background locations. Sediment is sampled near the surface water and biological stations at locations downstream from plant operations and in background (reference) streams. Station locations coincide with those for surface water in Bayou Creek and Little Bayou Creek. Sediment samples also are taken from a location in Little Bayou Creek upstream of plant inputs where the stream does not have permanent flow. Sampling frequency, field measurement parameters, and analytical parameters are listed in Appendix C.

4.2.3 Program Implementation Procedures

The Environmental Monitoring and Reporting manager (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the Environmental Monitoring and Reporting Manager reports through a line organization to the Manager of Projects and provides centralized coordination responsibilities.

4.3 TERRESTRIAL ENVIRONMENT

Woodlands, meadows, and cultivated fields dominate the rural landscape around the DOE Reservation. Immediately adjacent to the DOE Reservation is WKWMA, which is used by a considerable number of hunters, trappers, and anglers each year. Hunting and trapping activities may include such wildlife as rabbit, deer, quail, raccoon, squirrel, dove, turkey, waterfowl, and beaver. Additionally, the WKWMA sponsors annual field hunting trials for dogs.

This section discusses the terrestrial environment near the Paducah Site that could become contaminated as a result of releases of materials from current or past DOE operations. Farm-raised animal products, as well as local wildlife in the area, may be contaminated through water releases. Wildlife and animal products, including meat, eggs, and milk, may become contaminated through animal ingestion of contaminated water, sediment, other animals, or through direct contact with contaminated areas. The subsequent ingestion of these products can lead to a dose to man and is discussed in subsequent sections. Concentrations of both radionuclide and chemical contaminants are evaluated in the terrestrial environment. The Radiological Guide suggests that if wild game, such as deer or game birds, is available locally, these species should be considered for radiological sampling purposes.

4.3.1 Rationale and Design Criteria

4.3.1.1 Milk

Because a predicted effective dose from the airborne pathway is insignificant from a risk perspective, and Tc-99 and uranium do not bioaccumulate in milk, the surveillance of milk is not required or recommended by the Radiological Guide and is not performed by the Paducah Site.

4.3.1.2 Food crops

Food crops are not pathways because no significant [i.e., exceeding National Emission Standards for Hazardous Air Pollutants (NESHAP) regulatory levels] airborne sources of contaminants have been identified for DOE operations utilizing the EPA data quality objectives (DQOs).

4.3.1.3 Wildlife

A modification to the FY 2012 EMP includes the elimination of the deer harvest. During FY 2011, DOE performed an extensive review of data sets from 20 years of deer harvesting events. As a result of this review, DOE eliminated the deer harvest because of a downward trend and a continued lack of detection in the results, as well as an overall downward trend in the concentration of contaminants found at the Paducah Site due to remediation efforts.

4.4 EXTERNAL GAMMA RADIATION

Due to past releases of radionuclides and current operations involving radioactive sources [e.g., depleted uranium hexafluoride cylinder management], the Paducah Site conducts routine surveillance of external gamma radiation exposure. Historical monitoring has shown that the external gamma radiation dose from routine DOE operations at the Paducah Site boundary is well under 5 mrem (individual) and 100-person rem. Routine surveillance of external gamma radiation with thermoluminescent dosimeter (TLD) monitors is conducted as a conservative measure, although it is not required to comply with DOE O 5400.5 or other regulations or requirements.

4.4.1 Objectives

A primary objective of external exposure monitoring is to establish the potential radiation dose to a member of the public from direct exposure to DOE operations at the boundary of the DOE perimeter fence.

A second objective is to establish the potential dose that a member of the public may receive while visiting or passing through the accessible portion of the reservation. Public traffic is allowed on the main reservation roads outside of the active plant area as a courtesy to the public, and some members of the public “visit” the DOE Reservation for various reasons, including hunting.

A third objective is to calculate the dose equivalent of the maximally exposed individual member of the public.

4.4.2 Rationale and Design Criteria

Both theoretical calculations and historical monitoring indicate that any plausible DOE contribution to ambient gamma radiation levels is negligible. Higher radiation levels in the cylinder yards are due to

protactinium, a decay product of U-238. Past liquid releases to Little Bayou Creek have resulted in contamination of the sediment, which also contributes to the elevated gamma readings (DOE 2010).

The External Gamma Radiation Monitoring Program is designed to provide exposure data on direct radiation from DOE operations to members of the public. The primary factor in selecting the monitoring locations is the potential for a member of the public to be exposed to direct radiation. The highest potential radiation exposure to the public is at the plant perimeter.

The monitoring program conducts area gamma radiation dose monitoring using calcium sulfate-type TLDs. Devices of this type are capable of measuring exposure resulting from gamma radiation and are used throughout the industry to perform EM.

The primary source for radiation exposure to areas outside the PGDP security fence is the UF_6 cylinder storage yards, which are located within the secured area, but in close proximity to the perimeter of the fence. Studies conducted within the cylinder storage yards have shown that the cylinders are sources of both gamma and neutron radiation. The neutrons are produced at moderate energy levels by the alpha-fluorine reaction taking place within the residual UF_6 material. Further studies have indicated that the range of the neutrons is such that the neutron dose rate falls off rapidly with distance. Past monitoring has demonstrated that neutron producing radionuclides have not been detected in sufficient quantity to create a significant source for neutron radiation.

The radiological control (RADCON) organization performs area dose rate monitoring within the security fence at PGDP. This monitoring includes devices for measuring both gamma and neutron radiation. Neutrons are included in the area RADCON monitoring due to the reduced source to receptor distance for workers within the confines of the PGDP fenced security area. Results from area dose rate monitoring are included in the ASER.

4.4.3 Extent and Frequency of Monitoring

The extent and frequency of monitoring for external gamma radiation are determined based on the principle that the exposure levels decrease with distance from the sources and that the levels are relatively constant over time.

Public access assumptions are that (1) the security fence provides a physical boundary beyond which the public has no access, (2) public access to the reservation is controlled administratively and limited, (3) the locations of residences and communities outside the reservation are known, and (4) individual exposure scenarios may vary.

Environmental gamma detection TLDs are located at 46 locations including the PGDP perimeter, outfalls, ditches, and background locations. TLDs also have been placed in areas that historically have received the highest radiation exposure.

The RADCON organization also utilizes TLDs on or near the site. The areas monitored by this program include routinely occupied break areas, cylinder yards, storage facilities, and areas with elevated dose rates. The RADCON and EM programs operate independently of the other; however, opportunities to consolidate the monitoring at some of the locations may be considered at any time.

Data comparisons are made yearly between the current year and the prior year's radiation monitoring and the results are presented in the Annual Report for External Gamma Radiation Monitoring.

4.5 AMBIENT AIR

DOE complies with 40 *CFR* § 61, Subpart H, to control airborne emissions of radionuclides. This compliance includes evaluation of activities that have potential radionuclide emissions. For any activities that meet the definition of construction under 40 *CFR* § 61, Subpart A, or any activities such as fabrication, erection, or installation of a new building or structure within a facility that emits radionuclides, the potential emissions must be evaluated against the NESHAP requirements. If the EDE caused by all emissions from the new construction or modification within an existing facility is less than 1% of the standard prescribed in Section 61.92, then an application for approval under Section 61.07 or notification of startup under Section 61.09 does not need to be filed, per Section 61.96. The EDE shall be calculated in accordance with 40 *CFR* § 61, Subpart H.

DOE has identified several areas as potential fugitive and diffuse sources. Based on prior health physics data and historical ambient air monitoring, it is unlikely that any of these potential sources are significant; however, in accordance with methods utilized at other DOE facilities, DOE utilized ambient air monitoring data to verify insignificant levels of radionuclides in off-site ambient air. Ambient air data collected at sites surrounding the plant capture radionuclides from all sources, including fugitive and diffuse. The Radiation Health Branch of the Department for Public Health of the Kentucky Cabinet for Health and Family Services conducts ambient air monitoring for the Paducah Site. The air monitoring network is comprised of 10 ambient air monitoring stations, including one background station. Commonwealth of Kentucky ambient air monitoring data are reviewed and included in the NESHAP and ASER reports.

4.6 VEGETATION/SOIL

Vegetation and soil are not considered completed pathways because no significant airborne sources of contaminants (i.e., exceeding NESHAP regulatory levels) have been identified for DOE operations utilizing the DQO process.

4.7 WATERSHED BIOLOGICAL MONITORING

Biological monitoring of receiving streams at the Paducah Site was initiated in 1987 and has been revised over the years as a result of results and permit requirements. While the KPDES permit outlines requirements of the biological monitoring program, the KPDES permit also requires that biological monitoring design and rationale be presented in the site's Watershed Monitoring Plan (WMP).

The site's WMP was modified in FY 2011. This modification eliminated the requirement for biological monitoring in the creeks surrounding the site. The WMP requires that the watershed monitoring consist of the toxicity analysis conducted at the outfalls, as required by the KPDES permit. The toxicity analysis at the outfalls is discussed in Appendix C of this EMP. The justification for this elimination presented in the KPDES permit is that, over the years, the watersheds have been extensively sampled to the point that further collection of aquatic organisms could result in a deleterious effect on the aquatic community; therefore, biological sampling no longer is required. The elimination of the aquatic organism sampling event is documented in this FY 2012 EMP and is not referenced in Appendix C.

5. DOSE CALCULATIONS

Operations at the Paducah Site may emit waterborne radionuclides and chemicals. After release, these substances disperse through the environment by transport mechanisms where they eventually may reach and affect humans. This section describes the methodologies used to model the dispersion of radionuclides and chemicals and to estimate human exposure resulting from the intake of the dispersed substances. Human exposures to radionuclides are characterized in terms of total EDEs to maximally exposed off-site individuals and to the entire population residing within 49.7 miles of the site. Exposures to chemicals are characterized in terms of percent allowable daily intake or reference dose.

5.1 CONFORMANCE WITH STANDARDS FOR PUBLIC DOSE CALCULATIONS

Models selected to assess environmental transport of and human exposures to substances released from DOE operations are appropriate for the physical and environmental situation encountered and for the data available to characterize the situation. Input data, including default values, are documented and evaluated for applicability to the situation being modeled.

A complete set of potential human exposure pathways is considered in the assessments of radiological and chemical exposures. Those pathways that represent the potential exposures to the most exposed individual and to the entire population residing within 49.7 miles of the site are evaluated. The pathways that are evaluated are discussed in Sections 5.3 and 5.4.

Descriptions of the models and computer codes may consist of references to published descriptions or of actual mathematical formulations developed for special calculations. Surface water and groundwater modeling are conducted, as necessary, to conform to applicable requirements of the Commonwealth of Kentucky and of the regional EPA office.

5.2 MAJOR CONSIDERATIONS

Members of the public may receive radiation and chemical doses from the Paducah Site from materials released to ground and surface waters. In addition, some members of the public may receive minor radiation doses through direct external irradiation by radiation emanating from the cylinder yards located within plant. Doses are estimated for all potentially important exposure pathways relevant to the above exposure modes. Table 3 lists environmental release and transport mechanisms that apply to emissions from DOE operations. Estimation of the consequences of radionuclide or chemical releases from DOE operations must consider all potential pathways by which these materials may reach the surrounding population. To aid in selecting potentially important pathways, a land use survey was performed in 1990. This survey recorded and mapped the locations of all residences, dairy and meat animals, and vegetable gardens within a 3-mile radius of the site. All identified locations were plotted on a map divided into 16 equal sectors corresponding to the 16 cardinal compass points. This information was compared to modeling results to identify the maximally exposed individual. The survey also verified the accumulated data with flyover photographs and through consultation with the McCracken County Cooperative Extension Service. Information kept on file by DOE was used to verify residences. Demographic data were obtained from the Bureau of the Census to document characteristics of the people who live near the site.

Table 3. Environmental Transport Mechanisms Applicable to Releases from DOE Operations

Releases to surface water	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Deposit in sediment Infiltrate to groundwater
Releases to groundwater	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Flow into surface water
Radionuclides in objects	Remain in fixed sources

As part of a CERCLA site investigation, a survey was taken of users of surface and groundwater in the vicinity of the Paducah Site to determine the number of residents using water wells within a 4-mile radius and to determine the number of surface water intakes on the Ohio River up to 15 mile downstream from the Site.

No resident or business responding to the survey reported using a private intake on the Ohio River or on Bayou Creek or Little Bayou Creek for any part of their water supply. On the Ohio River, the nearest downstream water-intake point used for drinking water is at Cairo, Illinois. Cairo is within 50 miles of the Paducah Site, and drinking water concentrations to the population at that location are considered in the dose assessment. Figures 2 and 3 list potential environmental pathways to humans and associated human exposure modes for the release mechanisms given in Table 3. Sections 5.3 and 5.4 discuss the environmental transport, food chain, and dosimetric models used to evaluate human exposures due to current or past DOE operations. Input data to the models are evaluated using site-specific (collected under the EM and surveillance activities described earlier in this plan), historical data, and generic (default) values.

Models and computer codes for evaluating public exposures to released radionuclides and chemicals are selected based on (1) the applicability of the model to the situation being evaluated, (2) the degree to which the model has been documented and verified, and (3) the availability of the data needed to implement the model.

5.3 TRANSPORT MODELS

This section describes the methodologies used to characterize environmental concentrations of radiological materials released from current or past DOE operations. In some cases, transport models are used to predict concentrations; in other cases, measured concentrations are available. When both predicted and measured concentrations are available, the measured concentrations are used to verify modeling predictions.

5.3.1 Atmospheric Transport

Contaminants released to air may be inhaled by individuals or deposit on vegetation that may be consumed by farm animals or humans.

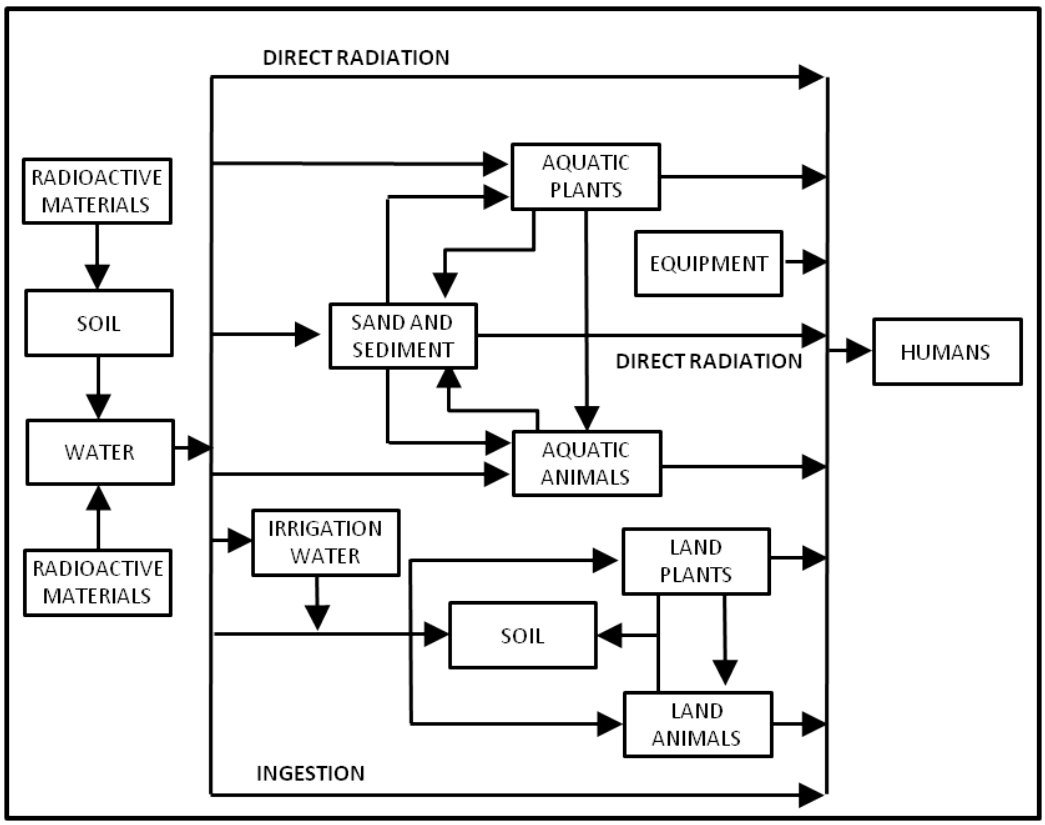

Figure 2. Possible Pathways between Radioactive Material Released to the Atmosphere and Humans

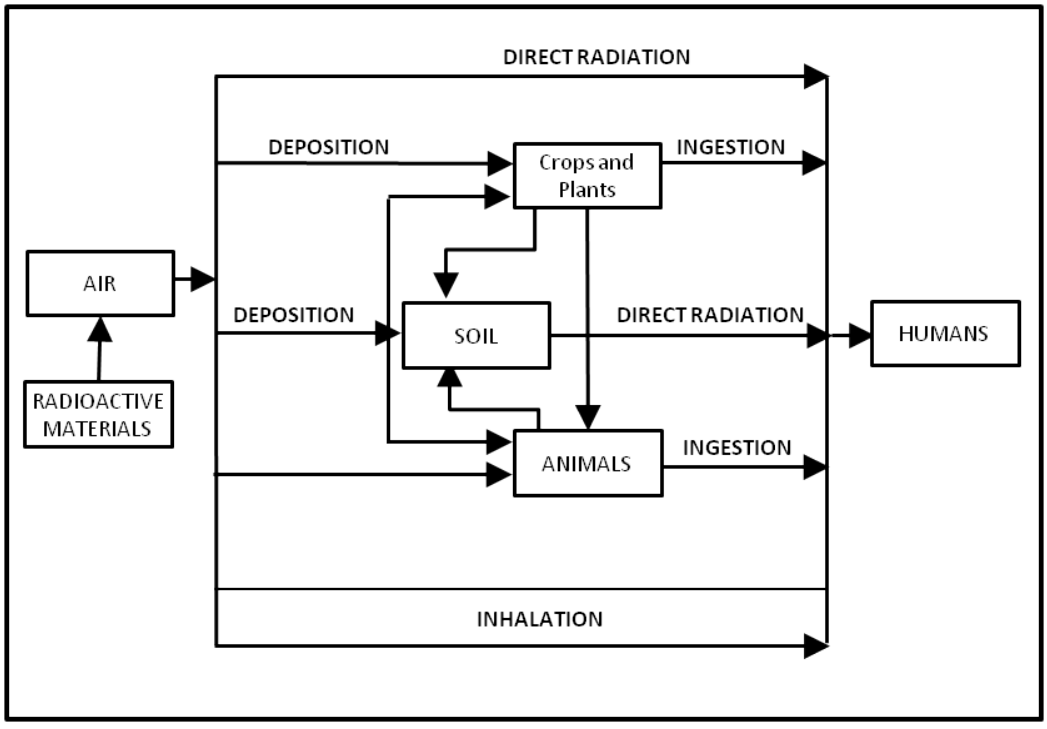

Figure 3. Possible Pathways between Radioactive Materials Released to the Ground or to Surface Waters and Humans

Dose calculations on atmospheric releases are described in Section 5.4.1.

5.3.2 Surface Water Transport

Contaminants released to surface water may remain dissolved or suspended in water, deposited in sediment, deposited on ground or vegetation by irrigation, or may infiltrate to the groundwater. Quantities of radionuclides and chemicals released to surface waters are determined by sampling permitted outfalls in each of the local receiving streams.

5.3.3 Groundwater Transport

Contaminants released into groundwater may remain dissolved or suspended in the water and may be deposited by irrigation onto the ground surface and vegetation. Residences north of the plant between the site boundary and the Ohio River historically have used groundwater. Contamination of private wells with both Tc-99 and TCE due to releases from historical DOE operations led to a response action in 1988. DOE supplied potable water to affected residents and installed an interim water supply for each resident whose water had TCE above the laboratory reporting limit of 1 ppb. For a long-term water supply, a community water line was extended to the residents with contaminated wells. Irrigation of gardens and watering of livestock using contaminated well water has ceased. Presently, groundwater transport is not modeled, but such modeling is initiated if off-site samples indicate a need for risk assessment purposes.

5.4 ENVIRONMENTAL PATHWAY MODELS

This section describes the methodologies that are used to characterize mechanisms for human uptake and exposure to the radiological contaminant concentrations described in Section 5.3. As in Section 5.3, both modeling and sampling are used to obtain contaminant concentrations in media and foods to which humans may be exposed. In addition, environmental gamma radiation exposure is measured through a TLD program. Regulatory Guide 1.109 models (NRC 1977) are used.

5.4.1 Contaminants in Air

The ambient air surrounding the Paducah Site is monitored by the Kentucky Cabinet for Health and Family Services to evaluate public exposure to airborne radionuclides. The results of this ambient air monitoring also are used by DOE to demonstrate compliance with Commonwealth of Kentucky and federal regulations as well as with DOE directives. Figure 4 illustrates current air monitoring locations. The DOE contribution to airborne radioactivity from operations at the Paducah Site normally is too low to be detected in the presence of natural background radiation in the environment; therefore, as required under 40 *CFR* § 61, Subpart H, potential doses to the public from point sources also are calculated with a dispersion model. This model calculates how measured quantities of released radionuclides mix with the atmosphere, where they travel, how they are mixed in the atmosphere, and where they could deposit. Once the dispersion is calculated, population data and concentration/dose conversion factors are used to calculate individual and population doses. These doses include exposure from all the pathways represented in Figure 3, although the primary pathway of exposure is inhalation. The ambient air monitoring data collected from the ambient air monitoring network are used to assess the impact of emissions of all point and fugitive sources.

The radiation dose calculations are performed using the CAP-88 computer codes. This package contains EPA's most recent version of the AIRDOS-EPA computer code. The code uses a steady-state, Gaussian

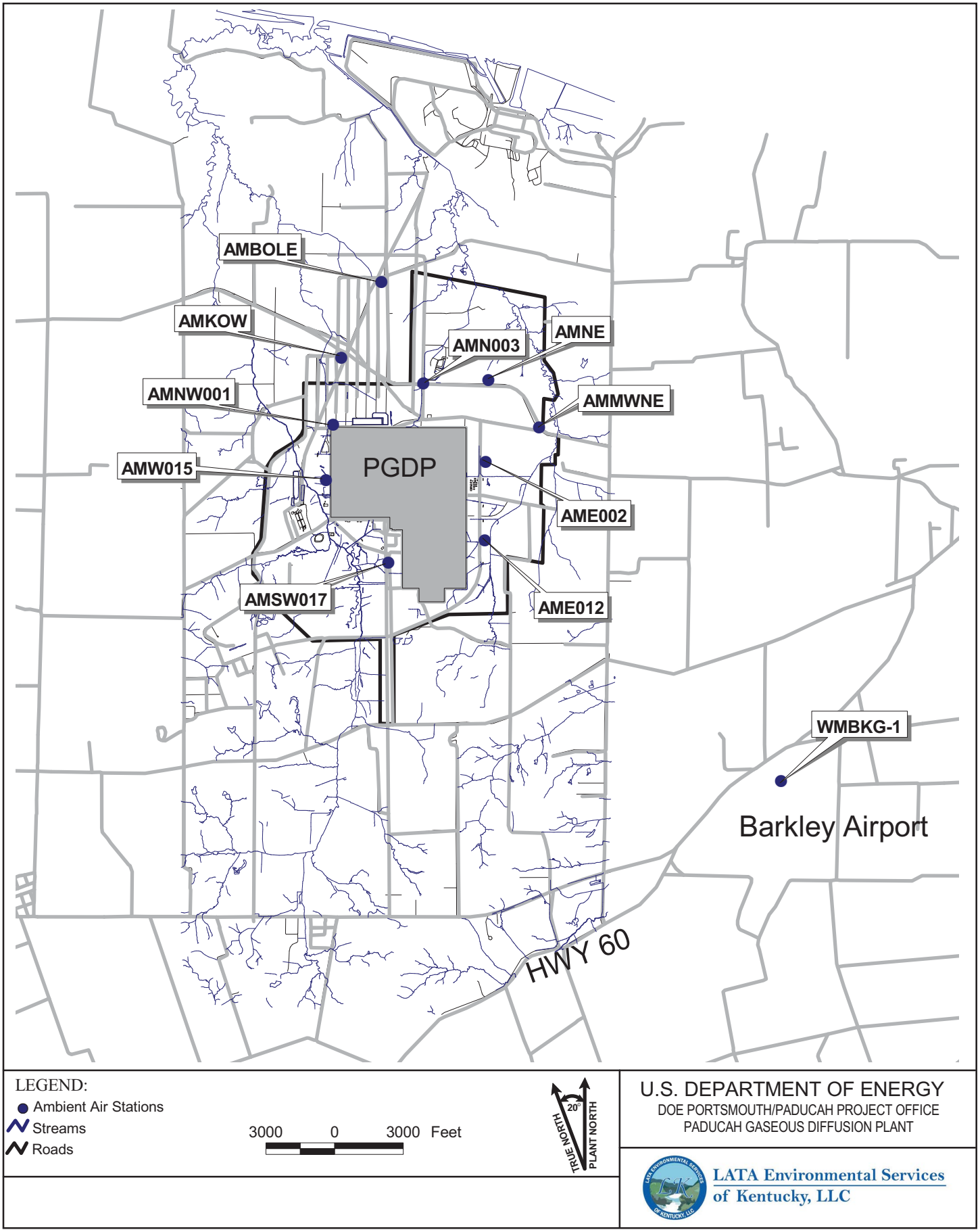

Figure 4. Paducah Site Ambient Air Monitoring Stations

plume, atmospheric dispersion model to calculate environmental concentrations of released radionuclides. The code also uses *Regulatory Guide* 1.109 for food chain models to calculate human exposures, both internal and external, to radionuclides deposited in the environment. EPA's latest version of the DARTAB computer code then uses the human exposure values to calculate radiation doses to the public from radionuclides released during the year. The dose calculations use dose conversion factors from the latest version of the RADRISK data file, which EPA provides with CAP-88.

5.4.2 Contaminants in Surface Water

Potential direct pathways of human exposure to contaminants in surface waters include ingestion (drinking water), immersion (swimming, wading, showering), direct irradiation (boating, skiing, shoreline use), and inhalation (breathing water vapor while showering). Indirect pathways involve deposition on soil and crops by irrigation (Section 5.3.2); deposition in sediment (Section 5.3.2); uptake by fish (Section 5.4.7), and ingestion by terrestrial animals (Section 5.4.7). While surface water is not used for drinking or irrigation near the plant, Cairo, Illinois, less than 80.5 km (50 miles) downstream on the Ohio River, has the nearest drinking water intake to the plant. The dose to a Cairo, Illinois, resident from drinking water ingestion (730 liter/year from the Ohio River) is estimated based on historical data collected from that location. Radiological samples at the Cairo, Illinois, location were eliminated in the FY 2011 EMP based upon the evaluation of historical data sets showing no upward trends or results above background.

5.4.3 Contaminants in Sediment

Discharges from DOE operations to surface waters may result in accumulations in sediment of radionuclides. Potential pathways of human exposure from sediment are direct irradiation and ingestion. An example of an indirect pathway involves fish ingesting contaminated sediment and subsequent human ingestion of the fish.

External irradiation from contaminated sediment in Little Bayou Creek is a pathway of potential importance. Sediment is known to contain uranium isotopes, Np-237, and Pu-239. Radionuclides deposited on the shores of rivers or creeks may accumulate over a period of time, leading to external irradiation of persons standing on contaminated surfaces. The amount of the nuclides built up on the shoreline depends on the concentration in the water, the depth of deposit, and the length of the period of buildup. The dose to persons depends on the time the contaminants remain on the skin surfaces.

Incidental ingestion of contaminated sediment may result from exposure during fishing, hunting, or other recreational activities. To determine a scenario for exposure time for the Little Bayou Creek area, several assumptions are made. During 1990, WKWMA allowed hunting and dog trials in this area for a period ranging from September 1 to March 30 (213 days). For both the direct irradiation and incidental ingestion pathways, an individual was assumed to hunt every other day (106 days) during this period and spend a total of one-half hour in the Little Bayou Creek bed. This exposure time probably is unrealistically long because signs are posted in this area stating that prolonged exposure could result in a dose above background. The ingestion rate of 50 mg/day incidental soil/sediment intake for adults is based on EPA *Exposure Factors Handbook*, EPA/600/P-95/002Fa (EPA 1997).

5.4.4 Contaminants in Groundwater

Potential direct pathways of human exposure to contaminants in groundwater include ingestion (drinking water), immersion (showering), and inhalation (breathing water vapor while showering). Indirect pathways involve deposition on soil and crops by irrigation (Section 5.4.5) and ingestion by terrestrial animals (Section 5.4.7).

Dose calculations are made for the drinking water pathway if measurable concentrations of radionuclides are found in water samples collected from private drinking water systems. A maximally exposed individual is assumed to ingest 730 liters of water per year containing the measured concentrations of radionuclides per year. These calculations continue to be performed as dictated by the findings of the sampling program. Verification is based on comparison of measured concentrations with federal and Commonwealth of Kentucky standards and with historical concentrations for each contaminant found.

5.4.5 Contaminants in Soil

DOE operations do not have any potential sources because no significant (i.e., exceeding NESHAP regulatory levels) airborne sources of contaminants have been identified for DOE operations.

5.4.6 Contaminants in or on Vegetation

DOE operations do not have any potential sources because no significant (i.e., exceeding NESHAP regulatory levels) airborne sources of contaminants have been identified for DOE operations.

5.4.7 Contaminants in Terrestrial Animals and Fish

Contaminants may accumulate in terrestrial animals from eating contaminated feed, drinking contaminated water (not modeled), and breathing contaminated air (not modeled). Contaminants may accumulate in fish when they eat contaminated foods and equilibrate with surrounding waters. Potential direct pathways for human exposure to contaminants in terrestrial animals and fish are eating meat, eggs and fish, and in drinking milk. Because bioconcentration factors associated with radionuclides of concern at the Paducah Site in fish, milk, and eggs are low, assessments of these pathways are not performed based on measured concentrations.

During the 20-year period of deer harvesting at the site, dose assessments from the ingestion of deer meat were performed using measured concentrations of contaminants. In 2011, DOE conducted an evaluation of the data sets from the years of deer harvesting events. As a result of this review, DOE eliminated the deer harvest because of a downward trend and a continued lack of detection in the results, as well as an overall downward trend in the concentration of contaminants found at the Paducah Site due to remediation efforts. The elimination of the deer harvest program is documented in this FY 2012 EMP and is not referenced in Appendix C.

5.4.8 Radionuclides in Objects

The only identified source of potential exposure to the public from radiation emanating from radionuclides contained in structures and other objects is gamma radiation from the uranium cylinder storage yards.

5.4.9 Waterborne Radionuclides

In 1990, a survey of surface water and groundwater users in the vicinity of the Paducah Site was conducted to determine the number of residents using water wells within a 6.4-km (4-mile) radius and to determine the number of surface water intakes on the Ohio River within 24.1 km (15 miles) downstream of the plant. No residents or businesses that responded to the survey questionnaire reported using a private surface water intake on the Ohio River, Bayou Creek, or Little Bayou Creek for any part of their water supply. Private groundwater wells were the major water supply for residents surrounding the Paducah Site. Most residents reported using water from their residential wells for drinking, irrigation, and domestic uses.

In September 1988, following the discovery of contamination in residential drinking water wells, water was supplied to all wells with contamination. In 1992, a Water Policy was developed, which specified that residents in the Water Policy box were to receive supplied water either through bottled water or municipal water. That effort was completed May 31, 1994.

Under conditions of continuous exposure, members of the public are assumed to ingest 730 liters of drinking water per year. Based on this criterion, the dose of the maximally exposed individual was calculated from drinking well water contaminated with Tc-99 at the Safe Drinking Water Act level is 900 pCi/L. This dose would be 0.85 millirem per year (mrem/year). A risk estimate was prepared for the Phase I Site Investigation to assess the potential risk to individuals who previously might have been exposed to contaminated groundwater based on this dose calculation.

5.5 INTERNAL DOSIMETRY MODELS

The results of all dose calculations are reported in terms of total EDE, the sum of EDEs received during the year from external exposures, plus the 50-year committed EDEs from intake of radionuclides during the year. Dose conversion factors used in the calculations are obtained from the following sources and any revisions to them. Factors that are used in the calculations are given in DOE/EH-0070, *External Dose-Rate Conversion Factors for Calculation of Dose to the Public* (DOE 1988a); DOE/EH-0071, *Internal Dose Conversion Factors for Calculation of Dose to the Public* (DOE 1988b); and EPA-520/l-88-020, Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion* (EPA 1988). Although not used in specific dose calculations, the DCGs given in DOE O 5400.5 4 may be used to infer the acceptability or magnitude of doses associated with measured concentrations of radionuclides in environmental media.

5.6 RADIATION DOSE TO NATIVE AQUATIC ORGANISMS

Compliance with DOE O 5400.5 regarding the 1-rad/day absorbed dose rate limit to native aquatic organisms (e.g., invertebrates, fish, and muskrats) is demonstrated using generally accepted methods of dose calculation. Current practice estimates absorbed doses by multiplying measured radionuclide concentrations in surface waters by internationally recognized, organism-specific dose rate factors for external and internal exposures (NRCC 1983) and summing the external and internal contributions. Results from this study are included in the ASER.

5.7 REPORTS AND RECORDS

Doses to the maximally exposed individual and to the population are published in the ASER. In addition, if the dose to the maximally exposed individual exceeds 10 mrem EDE in a year, the Paducah Site notifies DOE Headquarters. All input data used in dose calculations are considered as records requiring "permanent retention."

6. REPORTS

6.1 INTRODUCTION

This section provides an overview of the reporting requirements that are followed by the Paducah Site for the EMP. These requirements have been established in regulations, statutes, and orders issued by regulatory agencies and by DOE and are addressed specifically in the individual sections of this plan.

It is the policy of DOE to comply with all applicable environmental requirements, and those listed here are subject to supersession and/or amendment as well as being variable in applicability to individual DOE sites or facilities.

6.2 REPORTING REQUIREMENTS

The preparation and disposition of reports relevant to EM are shown in Table 4, Applicable Reporting Requirements. The ASER contains a summary for the effluent monitoring and environmental surveillance data for a calendar year. Data that are collected less frequently than annually are contained in each year's reports until new data are available. The ASER includes comparisons of values of contaminants at sampling locations to average reference values or to environmental standards, criteria, or permit limits. All permit activities, such as mitigation action plans, new requirements, or emission sources are described.

The ASER also includes the information from the Superfund Amendments Reauthorization Act (SARA) Title III, Section 313, *Toxic Chemical Release Inventory Report,* on quantities of nonradiological chemical emissions to the environment from unplanned releases. The ASER also includes the chemicals reported in the Emergency Planning and Right-to-Know Act, Section 312, Hazardous Chemical Inventory.

Table 4. Applicable Reporting Requirements

Reporting	Due Date	Source of Requirement	Requirement
Annual Site Environmental Report	October 1	DOE O 231.1A	All DOE facilities that conduct significant environmental protection programs shall prepare an ASER for DOE. The report must provide a comprehensive review of the Environmental Surveillance Programs, status of environmental compliance, and effluent data for nonradioactive pollutants.
Annual NESHAP Compliance Report	June 30	NESHAP 40 *CFR* § 61 Subpart H	Reporting shall include results from monitoring of radionuclide emissions to the ambient air, as well as, required dose calculations. Ambient air monitoring data are included in the NESHAP reports for assessment of fugitive and diffuse emission sources.
Discharge Monitoring Reports	Monthly and Quarterly	Clean Water Act	Discharge Monitoring Reports are required for compliance with KPDES Permit KY0004049.
Toxicity Report	Quarterly	Clean Water Act	Toxicity reports are required for compliance with KPDES Permit KY0004049.
Annual PCB Document	July 1	40 *CFR* § 761.180	The Annual PCB Document is required for PCBs in use and PCB wastes.

Table 4. Applicable Reporting Requirements (Continued)

Reporting	Due Date	Source of Requirement	Requirement
SARA Section 313	June 1	SARA Title III	Covered facilities (see above) shall report to EPA and the Commonwealth of Kentucky, all environmental releases of specified toxic chemicals that are manufactured, processed, or otherwise used in excess of specified thresholds.
SARA Section 312	March 1	SARA Title III	Annual Hazardous Chemical Inventory Report.
C-746-U Landfill Compliance Monitoring Report	Quarterly	401 *KAR* Section 47:130	This report is required in accordance with Landfill Solid Waste Permit SW07300045.
C-746-U Landfill Quarterly Operating Report	Quarterly	401 *KAR* Section 47:130	This report is required in accordance with Landfill Solid Waste Permit SW07300045.
C-746-S&T Landfills Compliance Monitoring Report	Quarterly	401 *KAR* Section 47:130	This report is required in accordance with Landfill Solid Waste Permits SW07300014 and SW07300015.
C-746-S&T Landfills Quarterly Operating Report	Quarterly	401 *KAR* Section 47:130	This report is required in accordance with the Landfill Solid Waste Permits, SW07300014 and SW07300015.
Semiannual C-404 Landfill Groundwater Monitoring Report	May, November	401 *KAR* Section 34:060	This report is required in accordance with Paducah Hazardous Waste Permit KY8-890-008-982.
Watershed Monitoring Report	April 28 Annually	Clean Water Act	Watershed Monitoring is required by KPDES Permit KY0004049.
Environmental Monitoring Plan	October 1 Annually	DOE O 450.1A	Conduct monitoring as appropriate to support the site's ISMS; detect, characterize, and respond to releases from DOE activities; assess impacts; estimate dispersal patterns in the environment; characterize the pathways of exposure to members of the public; characterize the exposures and doses to individuals and to the population; and evaluate the potential impacts to the biota in the vicinity of DOE activity.
Groundwater Protection Plan	Three Years August 2013	401 *KAR* Section 5:037	This regulation establishes the requirement to prepare and to implement groundwater protection plans to ensure protection for all current and future uses of groundwater and to prevent groundwater pollution.
Best Management Practices Plan	Review Annually; Last Updated September 2011		This plan is required by KPDES Permit KY0004049.
Spill Prevention Control and Countermeasure (SPCC) Plan	Five Years ; Last Updated September 2011	40 *CFR* § 112	Requires regulated facilities to prepare and implement a SPCC. The purpose of a SPCC Plan is to form a comprehensive spill prevention program that minimizes the potential for discharges.
Annual External Gamma Monitoring Report	March 1	DOE O 5400.5	This report estimates the external gamma dose on an annual basis; it also is included in the ASER.

Table 4. Applicable Reporting Requirements (Continued)

Reporting	Due Date	Source of Requirement	Requirement
FFA Semiannual Report	April 30 October 30	Paducah FFA	This report is required by the FFA document. Data generated in sampling programs referenced in Appendix C are reported in this report.

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7. REFERENCES

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NRC (U.S. Nuclear Regulatory Commission) 1977. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50,* Appendix I, Regulatory Guide 1.109, Revision 1, USNRC, Office of Standards Development, Washington, DC.

NRCC (National Research Council of Canada) 1983. *Radioactivity in the Canadian Aquatic Environment*, Publication No. NRCC 19250, ISSN, 0316-0114.

PRS (Paducah Remediation Services, LLC) 2010. *Update of the Paducah Gaseous Diffusion Plant Sitewide Groundwater Flow Model,* PRS-ENR-0028, Paducah Gaseous Diffusion Plant Site, Groundwater Modeling Working Group, February.

APPENDIX A

PADUCAH PERMIT SUMMARY

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U.S. DEPARTMENT OF ENERGY PERMIT SUMMARY FOR THE PADUCAH GASEOUS DIFFUSION PLANT

Permit Type	Issuer	Expiration Date	Permit Number	Permittee
WATER				
Kentucky Pollutant Discharge Elimination System	Kentucky Division of Water (KDOW)	10/31/2011[a]	KY0004049	U.S. Department of Energy (DOE), LATA Environmental Services of Kentucky, LLC, and Babcock & Wilcox Conversion Services, LLC
SOLID WASTE				
C-746-S Residential Landfill (Closed)	Kentucky Division of Waste Management (KDWM)	11/04/2016	SW07300014	DOE/LATA Environmental Services of Kentucky, LLC
C-746-T Inert Landfill (Closed)	KDWM	11/04/2016	SW07300015	DOE/LATA Environmental Services of Kentucky, LLC
C-746-U Solid Waste Landfill	KDWM	11/04/2016	SW07300045	DOE/LATA Environmental Services of Kentucky, LLC
RCRA				
Hazardous Waste Facility Operating Permit	KDWM	10/31/2014	KY8-890-008-982	DOE/LATA Environmental Services of Kentucky, LLC

[a] The renewal application for the KPDES Permit was filed with KDOW in May 2011. The requirements in the current permit will be followed until issuance of the renewed permit.

U.S. DEPARTMENT OF ENERGY COMPLIANCE AGREEMENTS SUMMARY FOR THE PADUCAH GASEOUS DIFFUSION PLANT

Agreement	Effective Date	Expiration Date	Entities
TSCA FFCA (Toxic Substances Control Act Federal Facility Compliance Agreement)	03/1992	To be determined	EPA and DOE
Federal Facilities Compliance Act Agreed Order/Site Treatment Plan	10/1995	2015	KDWM and DOE
Federal Facility Agreement	02/1998	Ongoing	KDWM, EPA, and DOE
Agreed Order for Waste, Air, and Water Violations	10/2003	Ongoing	Commonwealth of Kentucky and DOE
Agreed Order for DUF_6 Management	10/2003	Ongoing	KDWM and DOE

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APPENDIX B

WELL PROGRAM INVENTORY

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ACRONYMS

400GQ	C-400 groundwater well quarterly
400GSA	C-400 groundwater well semiannually
404G	C-404 Landfill groundwater well
A	annual inspection
AB	abandoned
AB-IP	abandoned in place
A-TS	inspect only, transducer in well
CARB	residential well sampled under the Carbon Filter Treatment System
CM	construction monitoring well
EW	extraction well
FYR	inspection coordinated with the submittal of the CERCLA Five-Year Review
GC	geochemical surveillance well
GWESA	environmental surveillance annual sampling
GWESBA	environmental surveillance biennial sampling
GWNEQ	groundwater Northeast quarterly
GWNESA	groundwater Northeast Plume semiannual well
GWNWQ	groundwater Northwest Plume O&M Quarterly
GWNWSA	groundwater Northwest Plume O&M semiannually
GWRESM	groundwater residential monthly well
GWRESA	groundwater residential annual well
KG	C-746-K Landfill groundwater well
LRGA	Lower Regional Gravel Aquifer
MW	monitoring well
NA	not applicable; monitoring well or piezometer abandoned; EW, not sampled under EMP Program
NI	not inspected
NR	not required
NS	not sampled
PTZ	PTZ Project multiport well
PZ	piezometer
Q	In the Water Level column, “Q” indicates water levels are collected quarterly
RGA	Regional Gravel Aquifer
SG	C-746-S&T Landfills groundwater well
UCRS	Upper Continental Recharge System
UG	C-746-U Landfill groundwater well
Unknown	information is unknown, cannot be confirmed, or is unavailable
URGA	Upper Regional Gravel Aquifer
W	A well with physical characteristics not considered typical of a monitoring well

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Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW1	RGA	AB 94	NA	NA	NA
MW2	Unknown	AB 88	NA	NA	NA
MW3	Unknown	AB 88	NA	NA	NA
MW4	Unknown	AB 88	NA	NA	NA
MW5	Unknown	AB 88	NA	NA	NA
MW6	Unknown	AB 88	NA	NA	NA
MW7	UCRS	AB 94	NA	NA	NA
MW8	RGA	AB 94	NA	NA	NA
MW9	RGA	AB 94	NA	NA	NA
MW10	RGA	AB	NA	NA	NA
MW11	UCRS	AB 94	NA	NA	NA
MW12	RGA	AB 94	NA	NA	NA
MW13	UCRS	AB 94	NA	NA	NA
MW14	UCRS	AB 94	NA	NA	NA
MW15	RGA	AB 94	NA	NA	NA
MW16	UCRS	AB 94	NA	NA	NA
MW17	RGA	AB 94	NA	NA	NA
MW18	UCRS	AB 94	NA	NA	NA
MW19	RGA	AB 94	NA	NA	NA
MW20	RGA	Current	GC	Q	A
MW21	RGA	AB 94	NA	NA	NA
MW22	RGA	AB 94	NA	NA	NA
MW23	Porters Creek Clay	AB 94	NA	NA	NA
MW24	Porters Creek Clay	AB 94	NA	NA	NA
MW25	Porters Creek Clay	AB 94	NA	NA	NA
MW26	Porters Creek Clay	AB 94	NA	NA	NA
MW27	Porters Creek Clay	AB 94	NA	NA	NA
MW28	UCRS	AB 94	NA	NA	NA
MW29	UCRS	AB 94	NA	NA	NA
MW30	UCRS	AB 94	NA	NA	NA
MW31	UCRS	AB 94	NA	NA	NA
MW32	UCRS	AB 94	NA	NA	NA
MW33	UCRS	AB	NA	NA	NA
MW34	UCRS	AB 94	NA	NA	NA
MW35	UCRS	AB 94	NA	NA	NA
MW36	UCRS	AB 94	NA	NA	NA
MW37	UCRS	AB 94	NA	NA	NA
MW38	RGA	AB 94	NA	NA	NA
MW39	RGA	AB 94	NA	NA	NA
MW40	RGA	AB 94	NA	NA	NA

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW41	RGA	AB 94	NA	NA	NA
MW42	RGA	AB 94	NA	NA	NA
MW43	RGA	AB 94	NA	NA	NA
MW44	RGA	AB 94	NA	NA	NA
MW45	RGA	AB 87	NA	NA	NA
MW46	RGA	AB 94	NA	NA	NA
MW47	UCRS	AB 94	NA	NA	NA
MW48	RGA	AB 94	NA	NA	NA
MW49	UCRS	AB 94	NA	NA	NA
MW50	RGA	AB 94	NA	NA	NA
MW51	RGA	AB 94	NA	NA	NA
MW52	RGA	AB 94	NA	NA	NA
MW53	RGA	AB 94	NA	NA	NA
MW54	RGA	AB 94	NA	NA	NA
MW55	RGA	AB 87	NA	NA	NA
MW56	UCRS	AB 87	NA	NA	NA
MW57	UCRS	AB 94	NA	NA	NA
MW58	UCRS	AB 90	NA	NA	NA
MW59	RGA	AB	NA	NA	NA
MW60	UCRS	AB	NA	NA	NA
MW61	RGA	AB	NA	NA	NA
MW62	RGA	AB	NA	NA	NA
MW63	RGA	Current	GWNWSA	Q	A
MW64	UCRS	Current	NS	Q	A
MW65	RGA	Current	GWNWSA	Q	A
MW66	RGA	Current	GWNWSA	Q	A
MW67	RGA	Current	GWESBA, 404G	Q	A
MW68	RGA	Current	NS	Q	A
MW69	UCRS	Current	NS	Q	A
MW70	RGA	AB 94	NA	NA	NA
MW71	RGA	Current	NS	Q	A
MW72	RGA	Current	NS	Q	A
MW73	RGA	Current	NS	Q	A
PZ74	UCRS	Current	NS	Q	A
MW75	UCRS	Current	NS	Q	A
MW76	RGA	Current	GWESBA, 404G	Q	A
MW77	RGA	Current	NS	Q	A
MW78	RGA	Current	NS	Q	A
MW79	RGA	Current	NS	Q	A
MW80	RGA	Current	NS	Q	A
MW81	RGA	Current	NS	Q	A
MW82	UCRS	Current	NS	Q	A
MW83	UCRS	Current	NS	Q	A
MW84	RGA	Current	404G	Q	A
MW85	UCRS	Current	404G	Q	A
MW86	RGA	Current	GWESBA, 404G	Q	A

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW87	RGA	Current	404G	Q	A
MW88	UCRS	Current	404G	Q	A
MW89	RGA	Current	GWESBA, 404G	Q	A
MW90	RGA	AB 2001	NA	NA	NA
MW90A	RGA	Current	404G	Q	A
MW91	UCRS	Current	404G	Q	A
MW92	RGA	Current	GWESBA, 404G	Q	A
MW93	RGA	Current	404G	Q	A
MW94	UCRS	Current	404G	Q	A
MW95	RGA	AB 2001	NA	NA	NA
MW95A	RGA	Current	GWESBA, 404G	Q	A
MW96	UCRS	Current	NS	Q	A
MW97	RGA	AB 97	NA	NA	NA
MW98	RGA	Current	GWESA	Q	A
MW99	RGA	Current	GWESA,GC	Q	A
MW100	RGA	Current	GWESA,GC	Q	A
PZ101	Terrace	Current	NS	Q	A
MW102	McNairy	Current	NS	Q	A
MW103	RGA	Current	GWESBA	Q	A
MW104	UCRS	AB 96	NA	NA	NA
MW105	RGA	AB	NA	NA	NA
MW106	RGA	Current	GWESBA	Q	A
PZ107	RGA	Current	NS	Q	A
W108	RGA	Current	NS	Q	A
PZ109	RGA	Current	NS	Q	A
PZ110	RGA	Current	NS	Q	A
PZ111	UCRS	Current	NS	Q	A
PZ112	UCRS	Current	NS	Q	A
PZ113	RGA	Current	NS	Q	A-TS
PZ114	McNairy	Current	NS	Q	A
PZ115	McNairy	Current	NS	Q	A
PZ116	RGA	Current	NS	Q	A
PZ117	RGA	Current	NS	Q	A
PZ118	RGA	Current	NS	Q	A
MW119	RGA	AB	NA	NA	NA
MW120	McNairy	Current	NS	Q	A
MW121	McNairy	Current	NS	Q	A
MW122	McNairy	Current	NS	Q	A
MW123	RGA	Current	NS	Q	A
MW124	RGA	Current	GWNESA	Q	A
MW125	RGA	Current	GWESBA, GC	Q	A
MW126	RGA	Current	GWNESA	Q	A
MW127	UCRS	AB-IP	NA	NA	NA
MW128	UCRS	AB-IP	NA	NA	NA
MW129	Terrace	AB-IP	NA	NA	NA
MW130	Terrace	AB-IP	NA	NA	NA

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW131	Terrace	AB-IP	NA	NA	NA
MW132	RGA	Current	NS	Q	A
MW133	McNairy	Current	NS	Q	A
MW134	RGA	Current	GWESBA, GC	Q	A
MW135	RGA	Current	GWESBA	Q	A
MW136	UCRS	AB	NA	NA	NA
MW137	RGA	Current	NS	Q	A
MW138	UCRS	Current	NS	Q	A
MW139	RGA	Current	GWESBA	Q	A
MW140	McNairy	AB	NA	NA	NA
MW141	RGA	AB 98	NA	NA	NA
MW142	RGA	AB 98	NA	NA	NA
MW143	UCRS	AB 98	NA	NA	NA
MW144	RGA	Current	NS	Q	A
MW145	RGA	Current	GWNESA, GC	Q	A
MW146	RGA	Current	GWESBA	Q	A
MW147	RGA	Current	NS	Q	A
MW148	RGA	Current	GWESBA	Q	A
MW149	UCRS	Current	GWESBA	Q	A
MW150	RGA	Current	GWESA	Q	A
MW151	Terrace	Current	NS	Q	A
MW152	RGA	Current	GWESA, GC	Q	A
MW153	UCRS	Current	NS	Q	A
MW154	UCRS	Current	NS	Q	A
MW155	RGA	Current	400GQ	Q	A
MW156	RGA	Current	400GQ	Q	A
MW157	UCRS	Current	NS	Q	A
MW158	RGA	AB 99	NA	NA	NA
MW159	RGA	AB 99	NA	NA	NA
MW160	UCRS	AB 99	NA	NA	NA
MW161	RGA	Current	GWESA, GC	Q	A
MW162	UCRS	Current	NS	Q	A
MW163	RGA	Current	GWESBA, GC	Q	A
MW164	UCRS	Current	NS	Q	A
MW165	RGA	Current	GWNWSA	Q	A
MW166	UCRS	Current	NS	Q	A
MW167	UCRS	Current	NS	Q	A
MW168	RGA	Current	GWESBA	Q	A
MW169	RGA	Current	GWESBA	Q	A
MW170	UCRS	Current	NS	Q	A
MW171	UCRS	Current	NS	Q	A
MW172	UCRS	Current	NS	Q	A
MW173	RGA	Current	GWNWSA	Q	A
MW174	UCRS	Current	GWESBA	Q	A
MW175	RGA	Current	400GSA	Q	A
MW176	UCRS	Current	NS	Q	A

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW177	UCRS	Current	NS	Q	A
MW178	RGA	Current	NS	Q	A
MW179	RGA	AB 2003	NA	NA	NA
MW180	UCRS	Current	NS	Q	A
MW181	RGA	AB 2000	NA	NA	NA
MW182	UCRS	Current	GWESA	Q	A
183, Not Installed	NA	NA	NA	NA	NA
MW184	UCRS	AB 98	NA	NA	NA
MW185	RGA	Current	NS	Q	A
MW186	UCRS	Current	GWESBA	Q	A
MW187	UCRS	Current	GWESBA	Q	A
MW188	RGA	Current	GC	Q	A
MW189	UCRS	Current	NS	Q	A
MW190	UCRS	Current	NS	Q	A
MW191	RGA	Current	GWESA	Q	A
MW192	UCRS	Current	NS	Q	A
MW193	RGA	Current	GWESBA, GC	Q	A
MW194	RGA	Current	GWESBA	Q	A
MW195	UCRS	AB 94	NA	NA	NA
MW196	Terrace	Current	NS	Q	A
MW197	RGA	Current	GWESBA	Q	A
MW198	UCRS	Current	NS	Q	A
MW199	RGA	Current	GWESBA	Q	A
MW200	RGA	Current	GWESBA	Q	A
MW201	RGA	Current	GWESBA, GC	Q	A
MW202	RGA	Current	GWESBA	Q	A
MW203	RGA	Current	GWESA	Q	A
MW204	UCRS	Current	NS	Q	A
MW205	RGA	Current	GWESBA	Q	A
MW206	RGA	Current	GWESA, GC	Q	A
MW207	UCRS	Current	NS	Q	A
MW208	UCRS	Current	NS	Q	A
MW209	UCRS	Current	NS	Q	A
MW210	UCRS	Current	NS	Q	A
MW211	UCRS	Current	NS	Q	A
MW212	UCRS	Current	NS	Q	A
MW213	UCRS	Current	NS	Q	A
MW214	UCRS	Current	NS	Q	A
MW215	UCRS	Current	NS	Q	A
MW216	UCRS	Current	NS	Q	A
MW217	UCRS	Current	NS	Q	A
MW218	UCRS	Current	NS	Q	A
MW219	UCRS	Current	NS	Q	A
MW220	RGA	Current	SG	Q	A
MW221	RGA	Current	SG	Q	A
MW222	RGA	Current	SG	Q	A

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW223	RGA	Current	SG	Q	A
MW224	RGA	Current	SG	Q	A
MW225	RGA	Current	NS	Q	A
MW226	RGA	Current	GWESBA, 404G	Q	A
MW227	RGA	Current	GWESBA, 404G	Q	A
EW228	RGA	Current	NA	NA	NR
EW229	RGA	Current	NA	NA	NR
EW230	RGA	Current	NA	NA	NR
EW231	RGA	Current	NA	NA	NR
EW232	RGA	Current	NA	NA	NR
EW233	RGA	Current	NA	NA	NR
232, Not Installed	NA	NA	NA	NA	NA
MW233	RGA	Current	GWESA	Q	A
MW234	RGA	AB 2002	NA	NA	NA
MW235	RGA	AB 2002	NA	NA	NA
MW236	RGA	Current	GWESA	Q	A
MW237	UCRS	Current	NS	Q	A
MW238	RGA	Current	NS	Q	A
MW239	McNairy	Current	NS	Q	A
MW240	RGA	Current	GWESA	Q	A
MW241	RGA	AB 2003	NA	NA	NA
MW241A	RGA	Current	NS	Q	A
MW242	RGA	Current	GWNWQ, GC	Q	A
MW243	RGA	Current	GWNWQ, GC	Q	A
MW244	RGA	Current	GWNWQ	Q	A
MW245	RGA	Current	GWNWQ	Q	A
MW246	UCRS	Current	NS	Q	A
MW247	McNairy	Current	NS	Q	A
MW248	RGA	Current	GWNWQ	Q	A
MW249	RGA	Current	NS	Q	A
MW250	RGA	Current	GWNWQ	Q	A
PZ251	UCRS	Current	NS	Q	A
MW252	RGA	Current	GWESA	Q	A
MW253	RGA	Current	GWESA	Q	A
254, Not Installed	NA	NA	NA	NA	NA
MW255	RGA	Current	GWNEQ, GC	Q	A
MW256	RGA	Current	GWNEQ, GC	Q	A
MW257	RGA	Current	GC	Q	A
MW258	RGA	Current	GWNEQ, GC	Q	A
259, Not Installed	NA	NA	NA	NA	NA
MW260	RGA	Current	GWESBA, GC	Q	A
MW261	RGA	Current	GWESA, GC	Q	A
MW262	RGA	Current	GWESBA	Q	A
MW263	RGA	AB 2003	NA	NA	NA
MW264	RGA	AB 2003	NA	NA	NA
MW265	RGA	AB 2000	NA	NA	NA

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW266	RGA	AB 2003	NA	NA	NA
MW267	RGA	AB 2003	NA	NA	NA
MW268	RGA	AB 2002	NA	NA	NA
MW269	RGA	AB 2002	NA	NA	NA
MW270	RGA	AB 2000	NA	NA	NA
MW271	RGA	AB 2002	NA	NA	NA
MW272	RGA	AB 2002	NA	NA	NA
MW273	RGA	AB 2002	NA	NA	NA
MW274	RGA	AB 2002	NA	NA	NA
MW275	RGA	AB 2002	NA	NA	NA
MW276	RGA	AB 2002	NA	NA	NA
MW277	RGA	AB 2000	NA	NA	NA
PZ278	UCRS	AB 97	NA	NA	NA
PZ279	UCRS	AB 97	NA	NA	NA
PZ280	UCRS	AB 97	NA	NA	NA
PZ281	UCRS	AB 97	NA	NA	NA
PZ282	UCRS	AB 97	NA	NA	NA
MW283	RGA	Current	GWNESA	Q	A
MW284	RGA	Current	NS	Q	A
285, Not Installed	NA	NA	NA	NA	NA
286, Not Installed	NA	NA	NA	NA	NA
PZ287	RGA	Current	NS	Q	A
MW288	RGA	Current	GWNEQ, GC	Q	A
PZ289	RGA	Current	NS	Q	A
PZ290	RGA	Current	NS	Q	A
MW291	RGA	Current	GWNESA, GC	Q	A
MW292	RGA	Current	GWNEQ, GC	Q	A
MW293	RGA	AB 2003	NA	NA	NA
MW293A	RGA	Current	GWNESA	Q	A
MW294	RGA	AB 2003	NA	NA	NA
MW294A	RGA	Current	NS	Q	A
295, Not Installed	NA	NA	NA	NA	NA
296, Not Installed	NA	NA	NA	NA	NA
297, Not Installed	NA	NA	NA	NA	NA
298, Not Installed	NA	NA	NA	NA	NA
299, Not Installed	NA	NA	NA	NA	NA
MW300	Terrace	Current	KG	Q	A
MW301	Terrace	Current	KG	Q	A
MW302	Terrace	Current	KG	Q	A
MW303	Terrace	AB 94	NA	NA	NA
MW304	Terrace	Current	NS	Q	A
MW305	Eocene	Current	GWESBA	Q	A
MW306	Eocene	Current	NS	Q	A
MW307	Eocene	Current	NS	Q	A
MW308	Eocene	Current	NS	Q	A
MW309	Terrace	Current	NS	Q	A

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW310	Terrace	Current	NS	Q	A
MW311	Terrace	Current	NS	Q	A
MW312	UCRS	Current	NS	Q	A
MW313	UCRS	Current	NS	Q	A
MW314	UCRS	Current	NS	Q	A
MW315	UCRS	Current	NS	Q	A
MW316	UCRS	Current	NS	Q	A
MW317	Terrace	Current	NS	Q	A
MW318	Terrace Gravels	Current	NS	Q	A
319, Not Installed	NA	NA	NA	NA	NA
320, Not Installed	NA	NA	NA	NA	NA
321, Not Installed	NA	NA	NA	NA	NA
322, Not Installed	NA	NA	NA	NA	NA
323, Not Installed	NA	NA	NA	NA	NA
324, Not Installed	NA	NA	NA	NA	NA
MW325	RGA	Current	NS	Q	A
MW326	RGA	Current	NS	Q	A
MW327	RGA	Current	NS	Q	A
MW328	RGA	Current	GWESBA, GC	Q	A
MW329	RGA	Current	GWESBA, GC	Q	A
MW330	RGA	Current	NS	Q	A
EW331	RGA	Current	NA	NA	NR
EW332	RGA	Current	NA	NA	NR
MW333	RGA	Current	GWESBA, 404G	Q	A
PZ334	UCRS	Current	NS	Q	A
PZ335	UCRS	Current	NS	Q	A
PZ336	UCRS	Current	NS	Q	A
MW337	RGA	Current	GWESBA, 404G	Q	A
MW338	RGA	Current	GWESBA, 404G	Q	A
MW339	RGA	Current	GWNWSA, GC	Q	A
MW340	RGA	Current	GWNWSA	Q	A
MW341	RGA	Current	GWESBA	Q	A
MW342	RGA	Current	400GSA	Q	A
MW343	RGA	Current	GWESBA, 400GSA, GC	Q	A
MW344	Terrace	Current	KG	Q	A
MW345	Rubble Zone	Current	GWESA	Q	A
MW346	Rubble Zone	Current	NS	Q	A
MW347	Rubble Zone	Current	NS	Q	A
PZ348	UCRS	Current	NS	Q	A
PZ349	RGA	Current	NS	Q	A
PZ350	UCRS	Current	NS	Q	A
PZ351	RGA	Current	NS	Q	A
MW352	RGA	AB 2002	NA	NA	NA
MW353	RGA	Current	NS	Q	A
MW354	RGA	Current	GWESBA	Q	A
MW355	RGA	Current	GWNWSA	Q	A

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW356	RGA	Current	GWESBA	Q	A
MW357	URGA	Current	UG	Q	A
MW358	LRGA	Current	UG	Q	A
MW359	UCRS	Current	UG	Q	A
MW360	URGA	Current	UG	Q	A
MW361	LRGA	Current	UG	Q	A
MW362	UCRS	Current	UG	Q	A
MW363	URGA	Current	UG	Q	A
MW364	LRGA	Current	UG	Q	A
MW365	UCRS	Current	UG	Q	A
MW366	URGA	Current	UG	Q	A
MW367	LRGA	Current	UG	Q	A
MW368	UCRS	Current	UG	Q	A
MW369	URGA	Current	UG/SG	Q	A
MW370	LRGA	Current	UG/SG	Q	A
MW371	UCRS	Current	UG	Q	A
MW372	URGA	Current	UG/SG	Q	A
MW373	LRGA	Current	UG/SG	Q	A
MW374	UCRS	Current	UG	Q	A
MW375	UCRS	Current	UG	Q	A
MW376	LRGA	Current	UG	Q	A
MW377	UCRS	Current	UG	Q	A
378, Not Installed	NA	NA	NA	NA	NA
379, Not Installed	NA	NA	NA	NA	NA
MW380	RGA	Current	NS	Q	A
MW381	RGA	Current	GC	Q	A
382, Not Installed	NA	NA	NA	NA	NA
383, Not Installed	NA	NA	NA	NA	NA
MW384	URGA	Current	SG	Q	A
MW385	LRGA	Current	SG	Q	A
MW386	UCRS	Current	SG	Q	A
MW387	URGA	Current	SG	Q	A
MW388	LRGA	Current	SG	Q	A
MW389	UCRS	Current	SG	Q	A
MW390	UCRS	Current	SG	Q	A
MW391	URGA	Current	SG	Q	A
MW392	LRGA	Current	SG	Q	A
MW393	UCRS	Current	SG	Q	A
MW394	URGA	Current	SG	Q	A
MW395	LRGA	Current	SG	Q	A
MW396	UCRS	Current	SG	Q	A
MW397	LRGA	Current	SG	Q	A
398, Not Installed	NA	NA	NA	NA	NA
399, Not Installed	NA	NA	NA	NA	NA
400, Not Installed	NA	NA	NA	NA	NA
MW401	RGA	Current	NS	Q	A

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW402	RGA	Current	NS	Q	A
MW403	RGA	Current	GWESBA, GC	Q	A
MW404	RGA	Current	GWESBA, GC	Q	A
MW405	RGA	Current	GWESBA, 400GQ	Q	A
MW406	RGA	Current	GWESBA, 400GQ	Q	A
MW407	RGA	Current	GWESBA, 400GQ	Q	A
MW408	RGA	Current	GWESBA, 400GQ	Q	A
MW409	RGA	Current	GWESA, GC	Q	A
MW410	RGA	Current	GWESA	Q	A
MW411	RGA	Current	GWESA	Q	A
412, Not Installed	NA	NA	NA	NA	NA
413, Not Installed	NA	NA	NA	NA	NA
MW414	RGA	Current	GWESBA, GC	Q	A
MW415	RGA	Current	GWESBA	Q	A
MW416	RGA	Current	GWESBA	Q	A
MW417	RGA	Current	GWESBA	Q	A
MW418	RGA	Current	GWESA	Q	A
MW419	RGA	Current	GWESA	Q	A
MW420	URGA	Current	404G	Q	A
MW421	RGA	Current	400GSA	Q	A
MW422	RGA	Current	400GSA	Q	A
MW423	RGA	Current	400GSA	Q	A
MW424	RGA	Current	400GSA	Q	A
MW425	RGA	Current	400GSA	Q	A
MW426	RGA	Current	GWESBA, GC	Q	A
MW427	RGA	Current	GWESBA, GC	Q	A
MW428	RGA	Current	GWNWSA	Q	A
MW429	RGA	AB 2009	NA	NA	NA
MW429 A	RGA	Current	GWNWSA	Q	A
MW430	RGA	Current	GWNWSA	Q	A
MW431	RGA	Current	GWESBA	Q	A
MW432	RGA	Current	GWESBA	Q	A
MW433	RGA	Current	GWESBA	Q	A
434, Not Installed[b]	RGA	NA	GWESBA	Q	A
MW435	RGA	Current	GWESBA	Q	A
436, Not Installed[b]	RGA	NA	GWESBA	Q	A
437, Not Installed[b]	RGA	NA	GWESBA	Q	A
438, Not Installed[b]	RGA	NA	GWESBA	Q	A
MW439	RGA	Current	GWESBA, GC	Q	A
MW440	RGA	Current	GWESBA	Q	A
MW441	RGA	Current	GWESBA, GC	Q	A
MW442	RGA	Current	GWESBA	Q	A
MW443	RGA	Current	GWESBA	Q	A
MW444	RGA	Current	GWESBA	Q	A
MW445	RGA	Current	GWESBA	Q	A
446, Not Installed[b]	RGA	NA	GWESBA	Q	A

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW447	RGA	Current	GWESBA, GC	Q	A
MW448	RGA	Current	GWESBA	Q	A
449, Not Installed[b]	RGA	NA	GWESBA	Q	A
MW450	RGA	Current	GWESBA	Q	A
MW451	RGA	Current	GWESBA	Q	A
MW452	RGA	Current	GWESBA	Q	A
MW453	RGA	Current	GWESBA	Q	A
MW454	RGA	Current	GWESBA	Q	A
MW455	RGA	Current	GWNWQ	Q	A
MW456	RGA	Current	GWNWQ	Q	A
MW457	RGA	Current	GWNWQ	Q	A
MW458	RGA	Current	GWNWQ	Q	A
MW459	RGA	Current	GWNWQ	Q	A
MW460	RGA	Current	GWNWQ	Q	A
MW461	RGA	Current	GWNWQ	Q	A
MW462	RGA	Current	GWNWQ	Q	A
MW463	RGA	Current	GWESBA	Q	A
MW464	RGA	Current	GWESBA	Q	A
MW465	RGA	Current	GWESA	Q	A
MW466	RGA	Current	GWESA	Q	A
MW467	RGA	Current	GWESBA	Q	A
MW468	RGA	Current	GWESBA, GC	Q	A
MW469	RGA	Current	GWESA	Q	A
MW470	RGA	Current	GWESA	Q	A
MW471	RGA	Current	GWESA	Q	A
MW472	RGA	Current	GWESA	Q	A
MW473	RGA	Current	GWESBA, GC	Q	A
MW474	RGA	Current	GWESBA, GC	Q	A
MW475	RGA	Current	GWESBA	Q	A
MW476	RGA	Current	GWESBA	Q	A
MW477	RGA	Current	GWESBA	Q	A
MW478	RGA	Current	GWESBA	Q	A
MW479	RGA	Current	GWESBA	Q	A
MW480	RGA	Current	GWESBA	Q	A
MW481	RGA	Current	GWESBA	Q	A
MW482	RGA	Current	GWESBA	Q	A
MW483	RGA	Current	GWESBA	Q	A
MW484	RGA	Current	GWESBA	Q	A
MW485	RGA	Current	GWESBA	Q	A
MW486	RGA	Current	GWESBA	Q	A
MW487	RGA	Current	GWESBA	Q	A
MW488	RGA	Current	GWESBA	Q	A
MW489	RGA	Current	GWESBA	Q	A
MW490	RGA	Current	GWESBA, GC	Q	A
MW491	RGA	Current	GWESBA	Q	A
MW492	RGA	Current	GWESBA	Q	A

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW493	RGA	Current	GWESBA	Q	A
MW494	RGA	Current	GWESBA	Q	A
MW495	RGA	Current	GWESBA	Q	A
MW496	RGA	Current	GWESBA	Q	A
MW497	URGA	Current	GWNWQ	Q	A
MW498	LRGA	Current	GWNWQ	Q	A
MW499	URGA	Current	GWNWQ	Q	A
MW500	LRGA	Current	GWNWQ	Q	A
MW501	URGA	Current	GWNWQ	Q	A
MW502	LRGA	Current	GWNWQ	Q	A
MW503	URGA	Current	GWNWQ	Q	A
MW504	LRGA	Current	GWNWQ	Q	A
MW505	RGA	Current	400GQ	Q	A
MW506	RGA	Current	400GQ	Q	A
MW507	RGA	Current	400GQ	Q	A
PZ5G	Unknown	Current	NS	Q	A
PZ5S	Unknown	Current	NS	Q	A
Z12	Unknown	Current	NS	NA	A
Z16	Unknown	Current	NS	NA	A
CM01	PTZ Project	Current	NS	Q	A
CM02	PTZ Project	Current	NS	Q	A
CM03	PTZ Project	Current	NS	Q	A
CM04	PTZ Project	Current	NS	Q	A
CM05	PTZ Project	Current	NS	Q	A
CM06	PTZ Project	Current	NS	Q	A
CM07	PTZ Project	Current	NS	Q	A
CM08	PTZ Project	Current	NS	Q	A
CM09	PTZ Project	Current	NS	Q	A
CM10	PTZ Project	Current	NS	Q	A
CM11	PTZ Project	Current	NS	Q	A
CM12	PTZ Project	Current	NS	Q	A
R2	Unknown	Current	GWRESA	NS	FYR
R5	Unknown	Current	NS	NS	FYR
R9	Unknown	Current	GWRESA	NS	FYR
R10	Unknown	Current	NS	NS	FYR
R12	Unknown	Current	GWRESA	NS	FYR
R13	Unknown	Current	GWRESA	NS	FYR
R14	Unknown	Current	GWRESA	NS	FYR
R16	Unknown	Current	NS	NS	FYR
R17	Unknown	Current	NS	NS	FYR
R18	Unknown	Current	NS	NS	FYR
R19	Unknown	Current	GWRESA	NS	FYR
R20	RGA	Current	GWRESA	NS	FYR
R21	Unknown	Current	GWRESA	NS	FYR
R22	Unknown	Current	NS	NS	FYR
R23	Unknown	Current	NS	NS	FYR

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
R24	Unknown	Current	NS	NS	FYR
R25[a]	Unknown	Current	NS	NS	FYR
R27	Unknown	Current	NS	NS	FYR
R28	Unknown	Current	NS	NS	FYR
R31	Unknown	Current	NS	NS	FYR
R39	Unknown	Current	NS	NS	FYR
R40	Unknown	Current	NS	NS	FYR
R53[a]	Unknown	Current	NS	NS	FYR
R65	Unknown	Current	NS	NS	FYR
R68	Unknown	Current	NS	NS	FYR
R69[a]	Unknown	Current	NS	NS	FYR
R72	Unknown	Current	NS	NS	FYR
R82	Unknown	Current	NS	NS	FYR
R83	Unknown	Current	GWRESA	NS	FYR
R90	Unknown	Current	GWRESA	NS	FYR
R113	Unknown	Current	NS	NS	FYR
R114	Unknown	Current	GWRESA	NS	FYR
R245	Unknown	Current	NS	NS	FYR
R246	Unknown	Current	NS	NS	FYR
R278	Unknown	Current	NS	NS	FYR
R293	Unknown	Current	NS	NS	FYR
R294	RGA	Current	GWRESM	NS	FYR
R295	Unknown	Current	NS	NS	FYR
R297	Unknown	Current	NS	NS	FYR
R278	Unknown	Current	NS	NS	FYR
R299	Unknown	Current	NS	NS	FYR
R302	RGA	Current	GWRESM	NS	FYR
R381	Unknown	Current	NS	NS	FYR
R382	Unknown	Current	NS	NS	FYR
R384	RGA	Current	GWRESA	NS	FYR
R386	Unknown	Current	NS	NS	FYR
R387	RGA	Current	GWRESA	NS	FYR
R392	RGA	Current	GWRESA	NS	FYR
R424	RGA	Current	CARB	NS	FYR
R434	Unknown	Current	NS	NS	FYR
R512	Unknown	Current	NS	NS	FYR
R517[a]	Unknown	Current	NS	NS	FYR
R518[a]	Unknown	Current	NS	NS	FYR
R519	Unknown	Current	NS	NS	FYR
R520	Unknown	Current	NS	NS	FYR
R521	Unknown	Current	NS	NS	FYR
R522	Unknown	Current	NS	NS	FYR
R523	Unknown	Current	NS	NS	FYR
R524	Unknown	Current	NS	NS	FYR
R525[a]	Unknown	Current	NS	NS	FYR

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
R527	Unknown	Current	NS	NS	FYR
R528[a]	Unknown	Current	NS	NS	FYR
R529	Unknown	Current	NS	NS	FYR
R530[a]	Unknown	Current	NS	NS	FYR
R531[a]	Unknown	Current	NS	NS	FYR
R532	Unknown	Current	NS	NS	FYR
R533	Unknown	Current	NS	NS	FYR
R534	Unknown	Current	NS	NS	FYR
R537	Unknown	Current	NS	NS	FYR
R540	Unknown	Current	NS	NS	FYR
R541	Unknown	Current	NS	NS	FYR

Note: Residential wells will be inspected prior to the submittal of the CERCLA Five-Year Review (December 2013).
[a] Wells that are no longer accessible for inspection (e.g., owner has paved over, etc.).
[b] These monitoring wells are not scheduled to be installed in FY 2012; however, they are included in Appendix C within their future sampling program.

QUARTERLY WATER LEVEL SUITES AT LANDFILLS

Quarterly water levels are collected in support of the quarterly landfill groundwater monitoring program for reporting groundwater flow rate and direction. Wells at the following landfills are sampled in a suite within as short a time period as possible. Noncommitment wells are those wells that also are measured within that time period, but the data is for information purposes only.

C-404 Landfill Quarterly Water Levels (9) Permitted Wells
MW84
MW87
MW90A
MW85
MW88
MW91
MW93
MW420
MW94
Commitment Wells (7)[a]
MW 67
MW76
MW227
MW333
MW337
MW414
MW416
Noncommitment Wells (6)
MW86
MW89
MW92
MW95A
MW226
MW338

C-746-U Landfill Quarterly Water Levels (21) Permitted Wells	
MW357	MW368
MW358	MW369[b]
MW359	MW370[b]
MW360	MW371
MW361	MW372[b]
MW362	MW373[b]
MW363	MW374
MW364	MW375
MW365	MW376
MW366	MW377
MW367	
Noncommitment Wells (9)	
MW 98	MW173[d]
MW100	MW193
MW125	MW197
MW139	MW200
MW165[d]	

C-746-S&T Landfills Quarterly Water Levels (25) Permitted Wells
MW220
MW221
MW222
MW223
MW224
MW225[c]
MW353[c]
MW384
MW385
MW386
MW387
MW388
MW389
MW390
MW391
MW392
MW393
MW394
MW395
MW396
MW397
MW369[b]
MW370[b]
MW372[b]
MW373[b]
Noncommitment Wells (2)
MW418
MW419

[a] Per a DOE commitment (pertaining to C-404 Landfill permitting process), quarterly water level measurements will be taken for seven additional wells that were not cited within the permit within a 24 hour window of when water level measurements are collected on the C-404 permitted wells. Although these wells are not identified in the permit, the obtained data will be reported in the landfill report.
[b] Wells are cited in both the C-746-U Landfill permit, as well as in the C-746-S&T Landfill permit.
[c] Based on the approved permit on for the C-746-S&T Landfills, these two wells are permitted wells; however, they are permitted only for water level measurements.
[d] These wells are also sampled under the Northwest Plume Program.

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APPENDIX C

ENVIRONMENTAL SAMPLING FREQUENCY AND PARAMETERS

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CONTENTS

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FIGURES

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TABLES

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ACRONYMS

ANOVA	Analysis of Variance
ASER	Annual Site Environmental Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EM	environmental monitoring
EMP	Environmental Monitoring Plan
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FY	fiscal year
GWPP	Groundwater Protection Program
IRA	interim remedial action
KDWM	Kentucky Division of Waste Management
KPDES	Kentucky Pollutant Discharge Elimination System
MCL	maximum contaminant level
MW	monitoring well
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
RFI	Resource Conservation and Recovery Act Facility Investigation
RGA	Regional Gravel Aquifer
ROD	Record of Decision
Tc-99	technetium-99
TCE	trichloroethene
TLD	thermoluminescent dosimeter
WAG	waste area grouping
WMP	Watershed Monitoring Plan

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C.1. INTRODUCTION

Three-hundred sixty monitoring wells (MWs) and piezometers are active and monitored as part of the Environmental Monitoring (EM) program. Active wells are included in either an analytical sampling program or may be evaluated for water level measurements only. This appendix shows a summary of each analytical sampling program. Figure C.1 shows the locations of each MW that is included in an analytical sampling program.

In addition to MW locations, the sampling programs within this appendix include sampling parameters for other locations covered in the EM program (i.e., surface water and sediment programs).

Each summary includes the environmental sampling frequencies and parameters, the sampling drivers, rationale for conducting the sampling, which document (s) the sampling results are reported in, and a list of locations that are sampled.

An effort has been made to reduce the amount of sampling performed. The criteria used to determine less frequent sampling include the following:

- New understanding of contaminant migration pathways and contaminants present,
- Review of historical results and long-term trends,
- Analyses to determine if the MW meets the current and future objective of the Groundwater Protection Plan (GWPP), and
- Addition of new MWs that may eliminate the need for sampling older MWs.

A brief summary of changes that have been made from the fiscal year (FY) 2011 to the FY 2012 Environmental Monitoring Plan (EMP) is included in each sampling program section. The changes described in this appendix were made using the criteria listed above. Data collected under the sampling programs defined in this appendix will be evaluated in FY 2012 and, based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification or via modification of the appropriate driver and reflected in the FY 2013 EMP.

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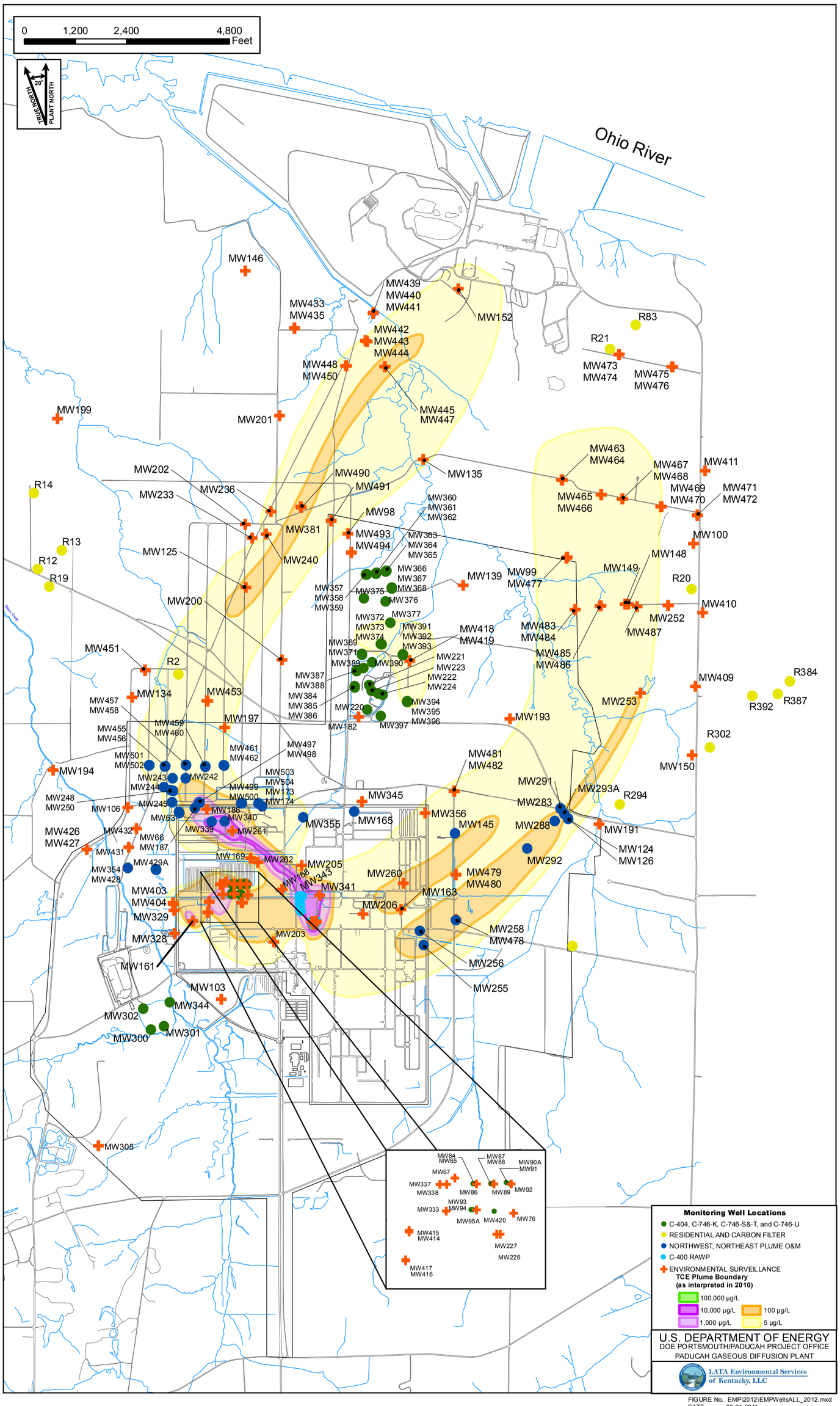

Figure C.1. Monitoring Wells Sampled under the EMP

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C.2. GROUNDWATER MONITORING

The Paducah Site samples individual monitoring and residential wells on a routine basis. Additionally, MWs are monitored for water levels on a routine basis. The environmental monitoring and reporting manager is responsible for accepting any new MWs installed and assuring that the wells meet the following standards:

(1) Construction requirements, as outlined in either the Statement of Work, Field Sampling Plan, or Work Plan for the project;

(2) Acceptance criteria for well development, as outlined in the U.S. Department of Energy's (DOE) prime contractor procedures;

(3) Requirements for pump and packer placement; and

(4) The well is functioning properly and has no deficiencies.

MWs that do not meet these requirements will not be accepted by the environmental monitoring and reporting manager until all deficiencies have been corrected.

All MWs are inspected, at a minimum, on an annual basis. The *Monitoring Well Maintenance Implementation Plan for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* PAD-PROJ-0025, outlines the MW evaluation and rehabilitation methods. Maintenance activities are documented and maintained by the environmental monitoring and reporting manager.

C.2.1 GROUNDWATER MONITORING PROGRAM FOR LANDFILL OPERATIONS

C-746-S, C-746-T, and C-746-U Landfills (Solid Waste Landfill Monitoring)

Frequency: Quarterly

Driver: Sampling requirements are outlined in the Solid Waste Landfill permits issued by the Kentucky Division of Waste Management (KDWM).

Reported: Quarterly Compliance Monitoring Reports, as required by the applicable Solid Waste Landfill permits.

Rationale: To evaluate the potential impact of historical waste disposal activities at the C-746-S&T Landfills, as well as historical and current waste disposal activities at the C-746-U Landfill on groundwater quality and to comply with compliance monitoring requirements, as set forth in the Solid Waste Landfill permits.

Rule: For the C-746-U Landfill: Solid Waste Permit SW07300045, GSTR0001, Standard Requirement 8, "If the analysis of the groundwater sample results indicates contamination [i.e., a statistical or maximum contaminant level (MCL) exceedance] as specified in 401 *KAR* 48:300 Section 8(1), the owner or operator shall notify the cabinet within (forty-eight) 48 hours of receiving the results and shall arrange to split sample no later than ten (10) days from the receipt of the results [401 *KAR* 48:300 Section 7]."

For C-746-S&T Landfills: Solid Waste Permits SW07300014 and SW07300015, GSTR0003, Standard Requirement 8, "If the analysis of the groundwater sample results indicates contamination (i.e., a statistical or MCL exceedance) as specified in 401 *KAR* 48:300 Section 8(1), the owner or operator shall notify the cabinet within (forty-eight) 48 hours of receiving the results and shall arrange to split samples no later than ten (10) days from the receipt of the results [401 *KAR* 48:300 Section 7]."

Comments: The current Solid Waste Landfill permits were received on August 2, 2010, for the C-746-S&T and C-746-U Landfills.

Sampling frequencies and locations were not modified for this sampling program in FY 2012. Total Suspended Solids was removed as a parameter for the C-746-S&T and C-746-U Landfills sampling programs in the FY 2012 EMP. Total suspended solids is not required by the permit, the permit application, or the regulations.

Data collected under this program will be evaluated and, based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification and reflected in the FY 2013 EMP.

Tables C.1 and C.2 list MWs for the C-746-S, C-746-T, and C-746-U Landfills, and Table C.3 lists the quarterly analytical parameters for these landfills. Locations are shown on Figure C.2.

Table C.1. C-746-S and C-746-T Landfill Wells (23)[a]

MW220	MW386
MW221	MW387
MW222	MW388
MW223	MW389
MW224	MW390
MW369[b]	MW391
MW370[b]	MW392
MW372[b]	MW393
MW373[b]	MW394
MW384	MW395
MW385	MW396
	MW397

Table C.2. C-746-U Landfill Wells (21)

MW357	MW367
MW358	MW368
MW359	MW369[b]
MW360	MW370[b]
MW361	MW371
MW362	MW372[b]
MW363	MW373[b]
MW364	MW374
MW365	MW375
MW366	MW376
	MW377

[a] The total number of permitted wells associated with the C-746-S&T Landfills is 25; however, two of these wells (MW225, MW353) are permitted only for water level measurement. The total number of analytically measured wells, therefore, is 23.

[b] Wells are sampled with the C-746-U Landfill; these four wells are not counted in the totals for the C-746-S&T Landfills, but are reported in both the compliance Monitoring Reports for the C-746-U and C-746-S&T Landfills. These wells are upgradient wells for the C-746-U Landfill and are downgradient wells for the C-746-S&T Landfills.

Table C.3. C-746-S, C-746-T, C-746-U
Quarterly Analytical Parameters

Volatiles	*trans*-1,3-Dichloropropene	Zinc
1,1,1,2-Tetrachloroethane	*trans*-1,4-Dichloro-2-Butene	Barium, Dissolved
1,1,1-Trichloroethane	Trichloroethene	Chromium, Dissolved
1,1,2,2-Tetrachloroethane	Trichlorofluoromethane	Uranium, Dissolved
1,1,2-Trichloroethane	Vinyl Acetate	
1,1-Dichloroethane	Vinyl Chloride	**Miscellaneous**
1,1-Dichloroethene		Chemical Oxygen Demand
1,2,3-Trichloropropane	**Anions**	Cyanide
1,2-Dibromo-3-chloropropane	Bromide	Total Organic Carbon
1,2-Dibromoethane	Chloride	Total Organic Halides
1,2-Dichlorobenzene	Fluoride	Total Dissolved Solids
1,2-Dichloroethane	Nitrate as Nitrogen	
1,2-Dichloropropane	Sulfate	
1,4-Dichlorobenzene		**Field Parameters**
2-Butanone	**Metals**	Conductivity
2-Hexanone	Aluminum	Depth to Water
4-Methyl-2-pentanone	Antimony	Dissolved Oxygen
Acetone	Arsenic	Eh
Acrolein	Barium	pH
Acrylonitrile	Beryllium	Temperature
Benzene	Boron	Turbidity
Bromochloromethane	Cadmium	
Bromodichloromethane	Calcium	**PCBs**[b]
Bromoform	Chromium	PCB, Total
Bromomethane	Cobalt	PCB-1016
Carbon Disulfide	Copper	PCB-1221
Carbon Tetrachloride	Iodide	PCB-1232
Chlorobenzene	Iron	PCB-1242
Chloroethane	Lead	PCB-1248
Chloroform	Magnesium	PCB-1254
Chloromethane	Manganese	PCB-1260
cis-1,2-Dichloroethene	Mercury	PCB-1268
cis-1,3-Dichloropropene	Molybdenum	
Dibromochloromethane	Nickel	**Radionuclides**
Dibromomethane	Potassium	Alpha Activity
Dimethylbenzene, Total[a]	Rhodium	Beta activity
Ethylbenzene	Selenium	Iodine-131[c]
Iodomethane	Silver	Radium-226
Methylene Chloride	Sodium	Radium-228[d]
Styrene	Tantalum	Strontium-90
Tetrachloroethene	Thallium	Technetium-99
Toluene	Uranium	Thorium-230
trans-1,2-Dichloroethene	Vanadium	Thorium-232[d]
		Tritium

[a] Xylenes
[b] Polychlorinated biphenyls (PCBs) are required under the Solid Waste Permits to be monitored quarterly for the C-746-U Landfill and annually for the C-746-S&T Landfills; however, based on the data quality objectives determined for the landfills, PCBs were added to the C-746-S&T Landfills quarterly.
[c] There is a pending permit modification request to remove iodine-131. Analysis for this parameter will continue until modification is accepted by KDWM.
[d] Permit does not require analysis of radium-228 and thorium-232. These parameters are analyzed for information purposes only in support of the C-746-U Landfill assessment.

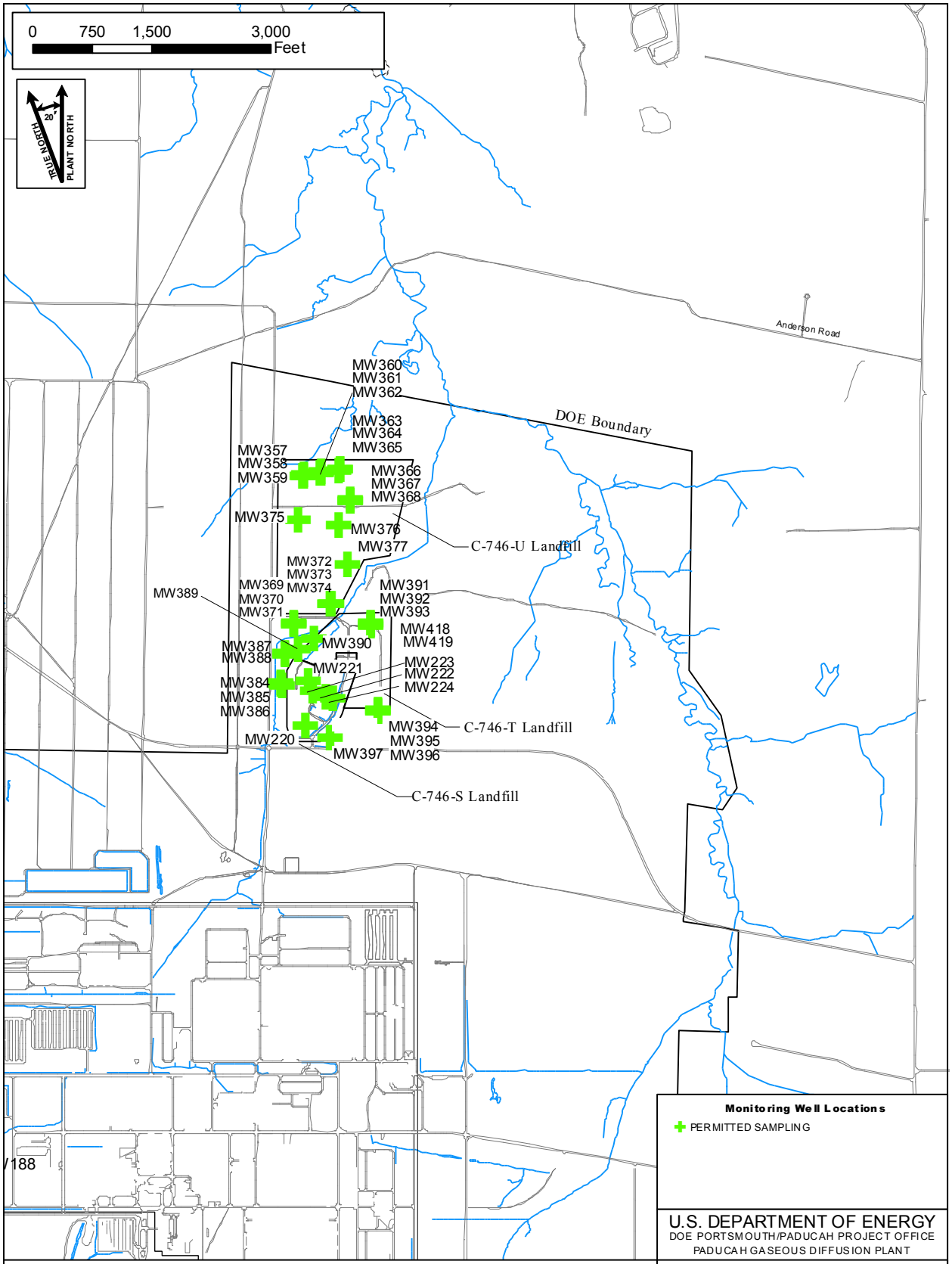

Figure C.2. Groundwater Monitoring Wells Near the C-746-S, T, and U Landfills

FIGURE No. EMP\2012\EMPWellsSTU_2012.mxd
DATE 08-24-2011

C-404 Low-Level Radioactive Waste Burial Ground (RCRA Detection Status Monitoring)

Frequency: Semiannually

Driver: The semiannual parameters are required to be sampled per Hazardous Waste Facility Permit, KY8-890-008-982.

Reported: Semiannual C-404 Groundwater Monitoring Report required by the permit.

Rationale: To monitor the C-404 Low-Level Radioactive Waste Burial Ground under detection monitoring program regulations.

Rule: Determine, within 30 days of the completion of data validation, if there is a statistical increase over background for permit parameters using the Analysis of Variance (ANOVA) method. If there is an increase, then evaluate if the contamination is from the C-404 Landfill or another source. If another source is the cause of the contamination, then a notification must be submitted to KDWM within 7 days.

Comments: MW90 and MW95 were replaced in 2002 with MW90A and MW95A, respectively. Prior to the replacement activities, evaluations of these MWs were conducted and results were presented to KDWM. Although initial evaluation indicated that the MWs maintained the integrity required for use in groundwater monitoring, the KDWM's view was that because leaky casing joints were identified, the MWs must be abandoned.

In the event that only a partial sample can be obtained, the following priority will be followed: field parameters, trichloroethene (TCE), metals. The dissolved metal samples (arsenic, cadmium, chromium, lead, mercury, selenium, and uranium) are filtered in the laboratory.

Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2012, as it is permit driven. Data collected under this program were evaluated, and, based on trending results, LATA Environmental Services of Kentucky, LLC, proposed changes to the permit regarding statistical trending. The changes still are under consideration by KDWM. The sampling program remains unchanged in FY 2012, but will be revised and implemented upon acceptance of the modified permit.

A listing of MWs for the C-404 Landfill is presented in Table C.4 and the analytical parameters are presented in Table C.5. Locations are shown on Figure C.3.

Table C.4. C-404 Landfill Wells

C-404 Landfill Wells (9)	Opted to Sample—Not Committed to KDWM (11)[a] TCE, Tc-99, and Field Parameters
MW84	MW67
MW85	MW76
MW87	MW86
	MW89
MW88	MW92
MW90A	MW95A
MW91	MW226
MW93	MW227
MW94	MW333
MW420	MW337
	MW338

[a] MWs 414 and 416 are also part of this special sampling event; however, only depth to water measurements are collected for these two wells.

Table C.5. C-404 Landfill Semiannual Analytical Parameters

Volatiles	Field Parameters
Trichloroethene	Barometric Pressure
	Conductivity
Metals	Depth to water
Arsenic	Dissolved Oxygen
Cadmium	Eh
Chromium	pH
Iron	Temperature
Lead	Turbidity
Manganese	
Mercury	**Radionuclides**
Selenium	Technetium-99
Uranium	Uranium-234
Arsenic, Dissolved	Uranium-235
Cadmium, Dissolved	Uranium-238
Chromium, Dissolved	
Lead, Dissolved	**Other**
Mercury, Dissolved	Sulfide
Selenium, Dissolved	Sulfite
Uranium, Dissolved	Sulfate
	Total Organic Carbon

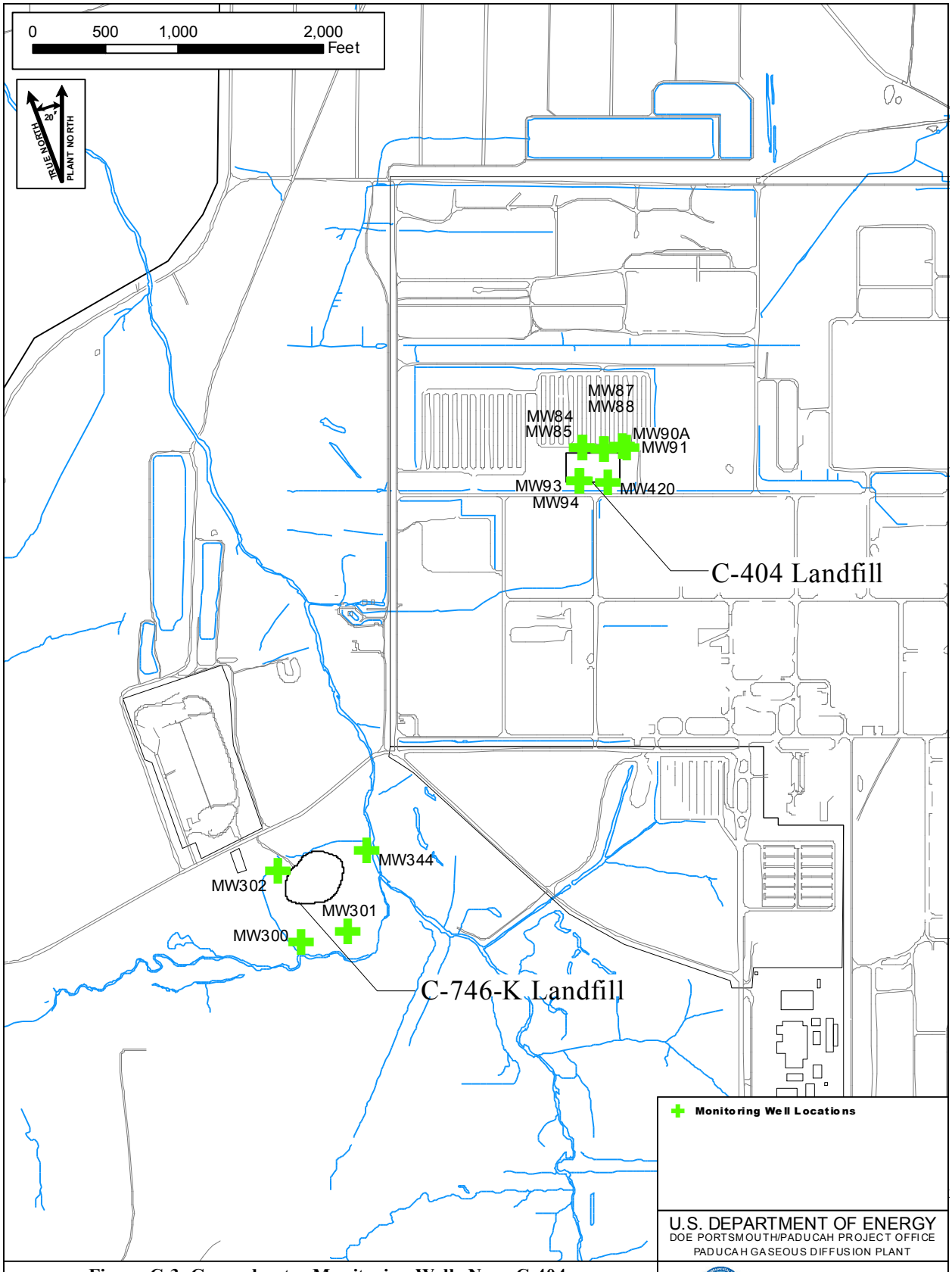

Figure C.3. Groundwater Monitoring Wells Near C-404 and C-746-K Landfills

FIGURE No. EMP\EMPWells404K_2012.mxd
DATE 08-24-2011

C-746-K Landfill Monitoring

Frequency: Semiannually

Driver: Requirements to sample four MWs are outlined in the Record of Decision (ROD) for Waste Area Groups (WAGs) 1 and 7. In addition, the parameters to be analyzed originally were documented in the Sampling and Analysis Plan Addendum, KY/ER-2. The ROD allows for annual evaluation of parameters. The Sampling and Analysis Plan Addendum, KY/ER-2, was superseded previously by the EMP.

Reported: Semiannual Federal Facility Agreement (FFA) Progress Report and Annual Site Environmental Report (ASER).

Rationale: To evaluate the potential impact of historical waste disposal activities at the C-746-K Landfill on groundwater quality.

Comments: In the event a well becomes dry while purging, no sample will be taken; however, it should be recorded that no sample was collected because the well was dry. The Interim Corrective Measures Work Plan specified the addition of metals analysis to the sampling plan. Dissolved metals only are analyzed if there are detections in the total metals analysis. Starting in 2005, the frequency was reduced from quarterly to semiannually.

[Note: In addition to MW samples, the ROD for WAGs 1 and 7 referenced the need for a continued surface water sampling program. See Section C.3.2 in this EMP for details of the surface water sampling program. The surface water program has been modified over the years as a result of trending data sets. Because of downward trends/lack of detection in historical data that was a result of remediation efforts, the surface water sampling program has been modified to include a more limited number of parameters. Additionally, the Kentucky Division of Water through the Kentucky Pollutant Discharge Elimination System (KPDES) permitting process is involved in the surface water program. A condition of the current KPDES permit requires the collection of surface water samples for PCB and Trichloroethene analysis. The KPDES permit also requires a Watershed Monitoring Plan (WMP). Like the surface water program, the WMP has been modified over the years as a result of trending results. The objectives of the WMP are met by performing the analyses specified by the KPDES permit at the effluent compliance points.]

Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2012.

Tables C.6 and C.7 provide a listing of landfill wells and analytical parameters, respectively. Locations are shown on Figure C.3.

Table C.6. C-746-K Landfill Wells (4)

MW300
MW301
MW302
MW344

Table C.7. C-746-K Landfill
Semiannual Analytical Parameters

Volatiles	**Metals**
1,1,1-Trichloroethane	Barium, Dissolved
1,1,2-Trichloroethane	Beryllium, Dissolved
1,1-Dichloroethane	Cadmium, Dissolved
1,1-Dichloroethene	Lead, Dissolved
1,2-Dichloroethane	Arsenic, Dissolved
Benzene	Uranium, Dissolved
Bromodichloromethane	Aluminum
Carbon Tetrachloride	Arsenic
Chloroform	Barium
cis-1,2-Dichloroethene	Beryllium
Dimethylbenzene, Total[a]	Cadmium
Ethylbenzene	Calcium
Tetrachloroethene	Iron
Toluene	Lead
trans-1,2-Dichloroethene	Magnesium
Trichloroethene	Manganese
Vinyl Chloride	Nickel
	Potassium
Field Parameters	Sodium
Conductivity	Uranium
Barometric Pressure	
Depth to water	**Radionuclides**
Dissolved Oxygen	Alpha Activity
pH	Beta Activity
Temperature	Technetium-99
Turbidity	
Eh	**Anions**
	Chloride
Other	Sulfate
Alkalinity	Nitrate
Ferrous Iron (Fe^{+2})	

[a] Xylenes

C.2.2 NORTHEAST PLUME OPERATIONS AND MAINTENANCE PROGRAM

Northeast Plume Monitoring

Frequency: Quarterly and Semiannually

Driver: The MWs are required to be sampled according to the Operations and Maintenance Plan for the Northeast Plume.

Reported: Semiannual FFA Progress Report and ASER.

Rationale: To monitor the nature and extent of groundwater contamination and to evaluate any cyclic trends in water quality that may affect contaminant migration.

Comments: The extraction wells are not sampled under the groundwater program, but rather are sampled under the Operations and Maintenance Plan for the Northeast Plume.

Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2012.

Table C.8 provides a listing of Northeast Plume MWs sampled semiannually and the associated parameters. MW409 and MW410, which are part of the Environmental Surveillance sampling program, are to be collected at the same time as the Northeast Plume Semiannual Table C.9 provides a listing of Northeast Plume MWs sampled quarterly and the associated parameters. Locations are shown on Figure C.4.

Table C.8. Northeast Plume Semiannual Wells and Parameters

Semiannual Wells (11)	Semiannual Analytical Parameters	
MW124	**Volatiles**	**Radionuclides**
MW126	1,1,1-Trichloroethane	Alpha Activity
MW145	1,1,2-Trichloroethane	Beta Activity
MW255	1,1-Dichloroethane	Technetium-99
MW256	1,1-Dichloroethene	
MW258	1,2-Dichloroethane	**Field Parameters**
MW283	Benzene	Barometric Pressure
MW288	Bromodichloromethane	Conductivity
MW291	Carbon Tetrachloride	Depth to Water
MW292	Chloroform	Dissolved Oxygen
MW293A	*cis*-1,2-Dichloroethene	Eh
	Dimethylbenzene,	pH
	Total/Xylenes	Temperature
	Ethylbenzene	Turbidity
	Tetrachloroethene	
	Toluene	
	trans-1,2-Dichloroethene	
	Trichloroethene	
	Vinyl Chloride	

[a] Samples from MW409 and MW410 are not part of this specific project; however, these MWs will be scheduled to be collected at the same time as the MWs listed in this table.

Table C.9. Northeast Plume Quarterly Wells and Parameters

Quarterly Wells (5)	Quarterly Analytical Parameters
MW255	**Radionuclides**
MW256	Technetium-99
MW258	
MW288	**Field Parameters**
MW292	Barometric Pressure
	Conductivity
	Depth to Water
	Dissolved Oxygen
	Eh
	pH
	Temperature
	Turbidity

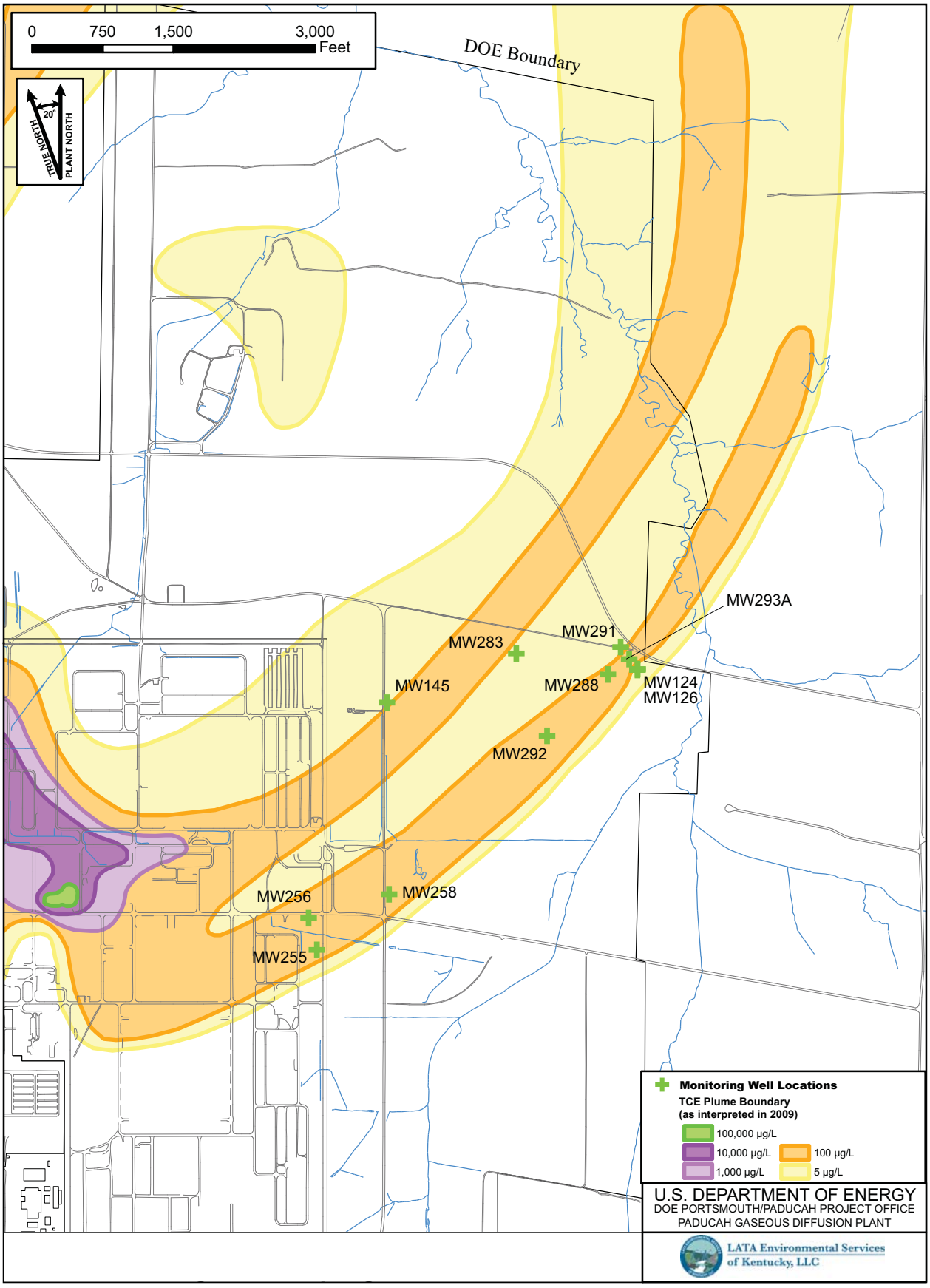

Figure C.4. Northeast Plume Monitoring Wells

C.2.3 NORTHWEST PLUME OPERATIONS AND MAINTENANCE PROGRAM

Northwest Plume Monitoring

Frequency: Quarterly and Semiannually

Driver: The MWs are required to be sampled according to the Operations and Maintenance Plan for the Northwest Plume.

Reported: Semiannual FFA Progress Report and ASER

Rationale: To determine the effectiveness of the optimization of Northwest Plume operations, monitor the nature and extent of groundwater contamination, and to evaluate any cyclic trends in water quality that may affect contaminant migration.

Comments: The extraction wells are not sampled under the groundwater program, but rather are sampled under the Operations and Maintenance Plan for the Northwest Plume.

The number of MWs sampled for the Northwest Plume increased from 12 in FY 2010 to 33 in FY 2011. This is due to the completion of the Northwest Plume Optimization project in August 2010. In accordance with the plan, 22 MWs will be monitored quarterly and 11 MWs monitored semiannually during FY 2012. The frequency will be dropped to a semiannual and annual basis, respectively, in FY 2013.

Table C.10 provides a listing of Northwest Plume MWs sampled quarterly and semiannually and the associated parameters. Table C.11 provides the Northwest Plume analytical parameters. Locations are shown on Figure C.5.

Table C.10. Northwest Plume Wells (33)

Quarterly Wells (22)		Semiannual Wells (11)
MW242	MW460	MW63
MW243	MW461	MW65
MW244	MW462	MW66
MW245	MW497	MW165
MW248	MW498	MW173
MW250	MW499	MW339
MW455	MW500	MW340
MW456	MW501	MW355
MW457	MW502	MW428
MW458	MW503	MW429A
MW459	MW504	MW430

Table C.11. Northwest Plume Analytical Parameters

Volatiles	Field Parameters
1,1,1-Trichloroethane	Barometric Pressure
1,1,2-Trichloroethane	Conductivity
1,1-Dichloroethane	Depth to Water
1,1-Dichloroethene	Dissolved Oxygen
1,2-Dichloroethane	Eh
Benzene	pH
Bromodichloromethane	Temperature
Carbon Tetrachloride	Turbidity
Chloroform	
cis-1,2-Dichloroethene	**Radionuclides**
Dimethylbenzene, Total[a]	Alpha Activity
Ethylbenzene	Beta Activity
Tetrachloroethene	Technetium-99
Toluene	
trans-1,2-Dichloroethene	
Trichloroethene	
Vinyl Chloride	

[a] Xylenes

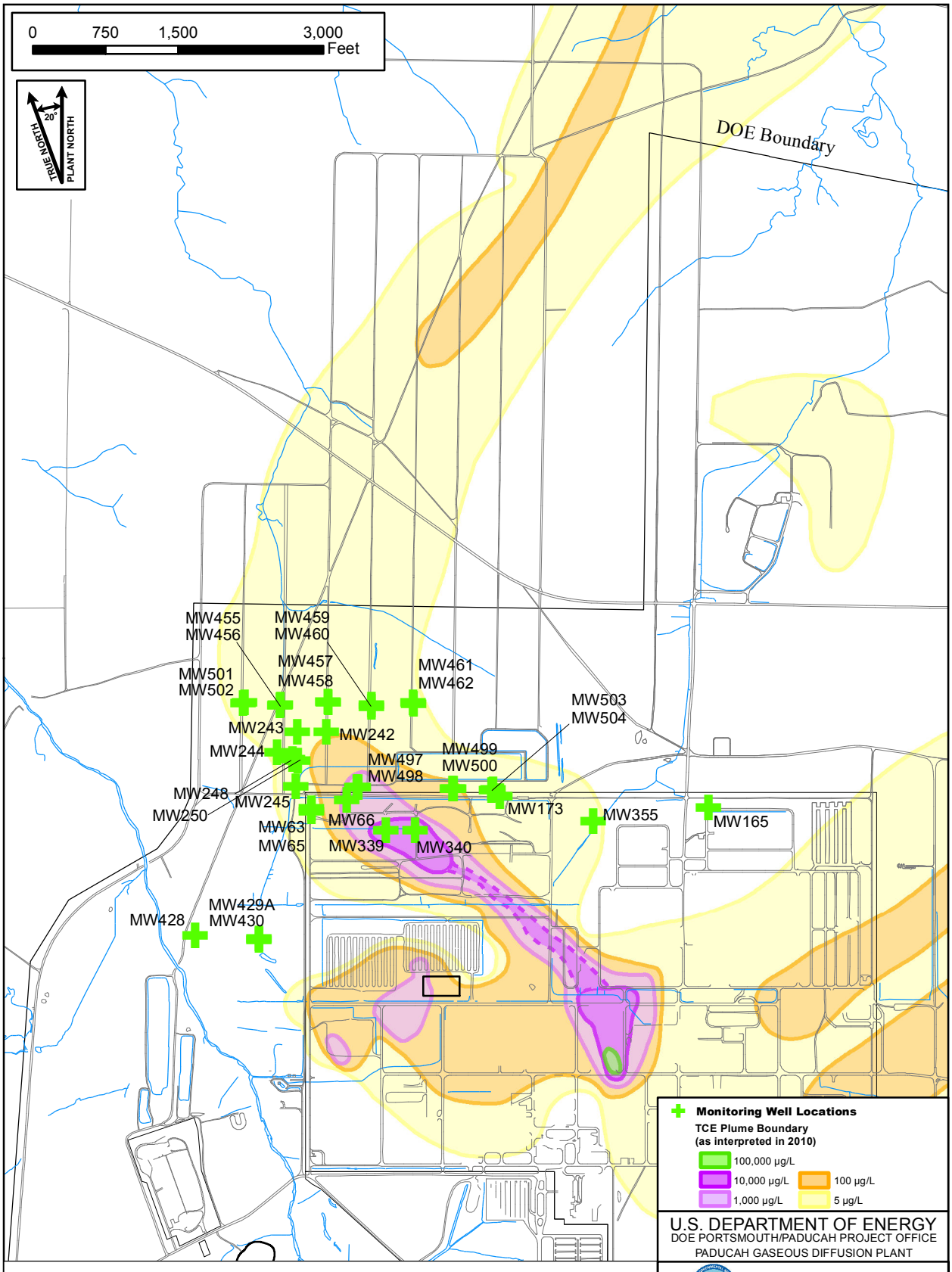

Figure C.5. Northwest Plume Monitoring Wells

FIGURE No. EMP\2012\EMPWellsNWP_2012R1.mxd
DATE 11-02-2011

C.2.4 C-400 MONITORING WELLS

C-400 Wells

Frequency: Quarterly and Semiannually

Driver: The MWs are required to be sampled by the *Remedial Action Work Plan for the Interim Remedial Action for the Volatile Organic Compound Contamination at the C-400 Cleaning Building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0004&D2/R2/A1/R2.

Reported: Semiannual FFA Progress Report and ASER.

Rationale: These MWs will provide a meaningful tool for evaluating the downgradient dissolved-phase contamination in the Northwest Plume and the efficacy of the C-400 Interim Remedial Action (IRA). Long-term assessment of the C-400 IRA impact on the groundwater plumes will be provided by sampling of existing MWs MW155, MW156, MW405, MW406, MW407, and MW408 in the vicinity of the source area. Additionally, Regional Gravel Aquifer (RGA) wells MW175 (screened 75–80 ft bgs), MW342 (screened 75–85 ft bgs), and MW343 (screened 75–85 ft bgs) monitor the lower RGA along the west side of C-400 and north of C-400. RGA MWs MW421, MW422, MW423, MW424, and MW425 (all with ports centered at 72 ft, 80 ft, and 84 ft bgs) monitor the middle and lower RGA in the northwest corner of C-400. MWs MW505, MW506, and MW507 monitor the upper, middle, and lower RGA upgradient of the southeast corner of C-400.

Comments: Sampling frequencies and sampling parameters were modified for this sampling program for FY 2012 to focus data on the locations near the Phase I IRA to determine longer term effects of Phase I and a baseline for Phase II.

Table C.12 provides a listing of the C-400 MWs and Table C.13 provides the analytical parameters for these MWs. Locations are shown on Figure C.6.

Table C.12. C-400 Monitoring Wells (17)

Quarterly Wells (9)	Semiannual Wells (8)
MW155	MW175
MW156	MW342
MW405 Port 5	MW343
MW406 Port 5	MW421 Port 3
MW407 Port 4	MW422 Port 3
MW408 Port 5	MW423 Port 3
MW505	MW424 Port 3
MW506	MW425 Port 3
MW507	

Table C.13. C-400 Monitoring Well Analytical Parameters

Volatiles	Radionuclides
1,1-Dichloroethene	Technetium-99
cis-1,2-Dichloroethene	Alpha Activity
trans-1,2-Dichloroethene	Beta Activity
Trichloroethene	
Vinyl Chloride	**Field Parameters**
	Barometric Pressure
Metals	Conductivity
Uranium	Depth to Water
	Dissolved Oxygen
	Eh
Anions	pH
Chloride	Temperature
	Turbidity

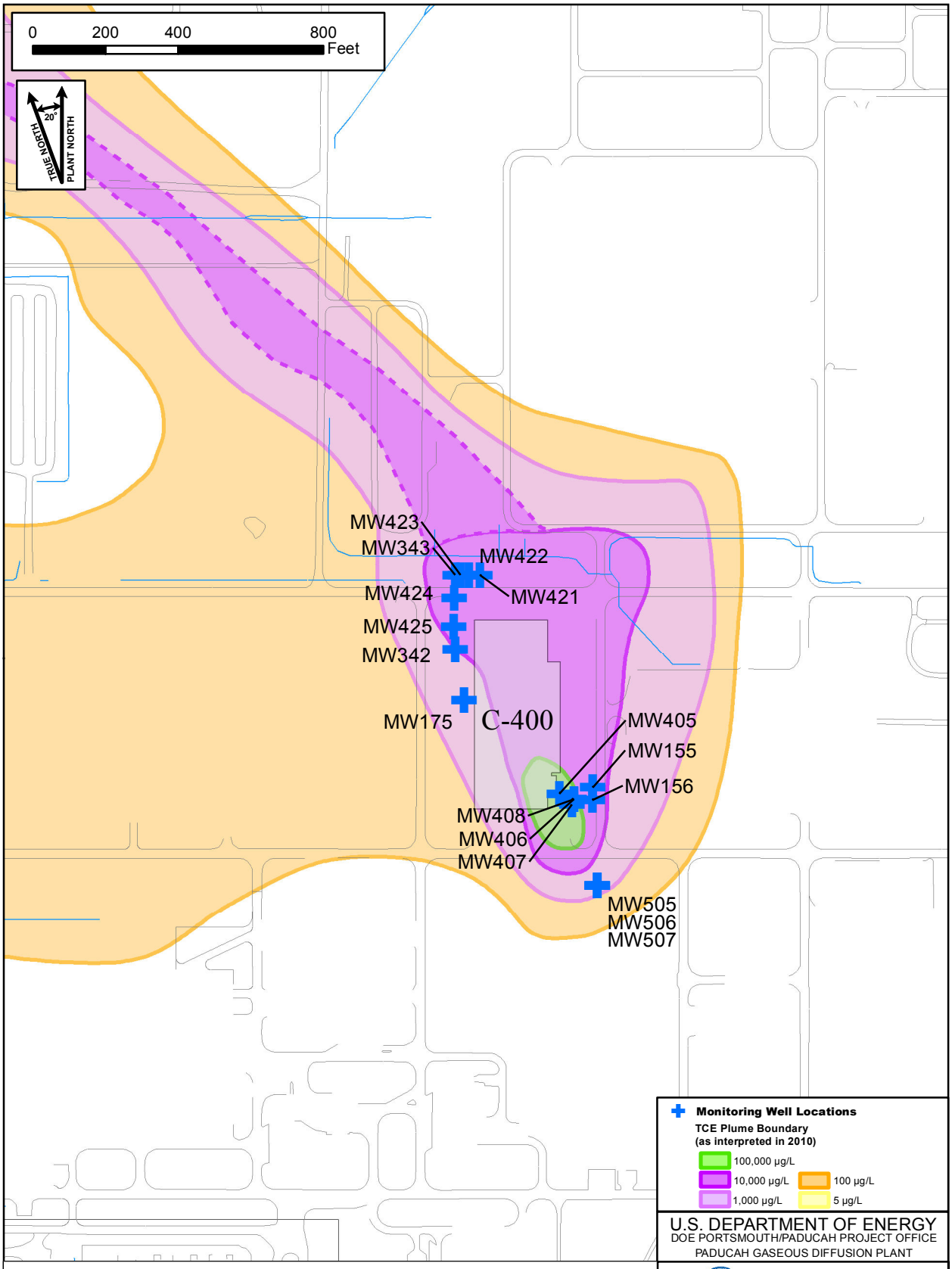

Figure C.6. C-400 Monitoring Wells

C.2.5 C-613 NORTHWEST STORM WATER CONTROL FACILITY

C-613 Sediment Basin—Storm Water

Frequency: Quarterly

Driver: DOE/OR/07-2044&D1/R3 and the Paducah FFA.

Rationale: To monitor water collected in the C-613 Sediment Basin to ensure that discharges to KPDES Outfall 001 will not cause the effluent at KPDES Outfall 001 to exceed regulatory limits.

Reported: Reported to KDWM via electronic mail.

Comments: Table C.14 provides a listing of the C-613 Sediment Basin quarterly water parameters. Location of the C-613 Sediment Basin is shown on Figure C.7.

C-613 Sediment Basin Third Quarter Split Sample—Water

Frequency: Annually, during the third quarter

Driver: Availability of data to compare to KDWM sample results.

Rationale: Sampling will be conducted during non-discharge operations of the C-613 Sediment Basin, as decided by KDWM.

Reported: Not applicable.

Comments: Table C.15 provides a listing of the C-613 Sediment Basin third quarter analytical parameters.

Table C.14. C-613 Sediment Basin Quarterly Water Parameters

Miscellaneous
pH
Total Suspended Solids
Turbidity
Field Parameters
pH
Turbidity

Table C.15. C-613 Sediment Basin Third Quarter Water Analytical Parameters

Metals	**Miscellaneous**
Antimony	Total Suspended Solids
Arsenic	
Beryllium	**Radionuclides**
Cadmium	Gross alpha
Chromium	Gross beta
Copper	Uranium
Iron	
Lead	**Field Parameters**
Nickel	pH
Selenium	Turbidity
Silver	
Thallium	
Uranium	
Zinc	
Mercury	

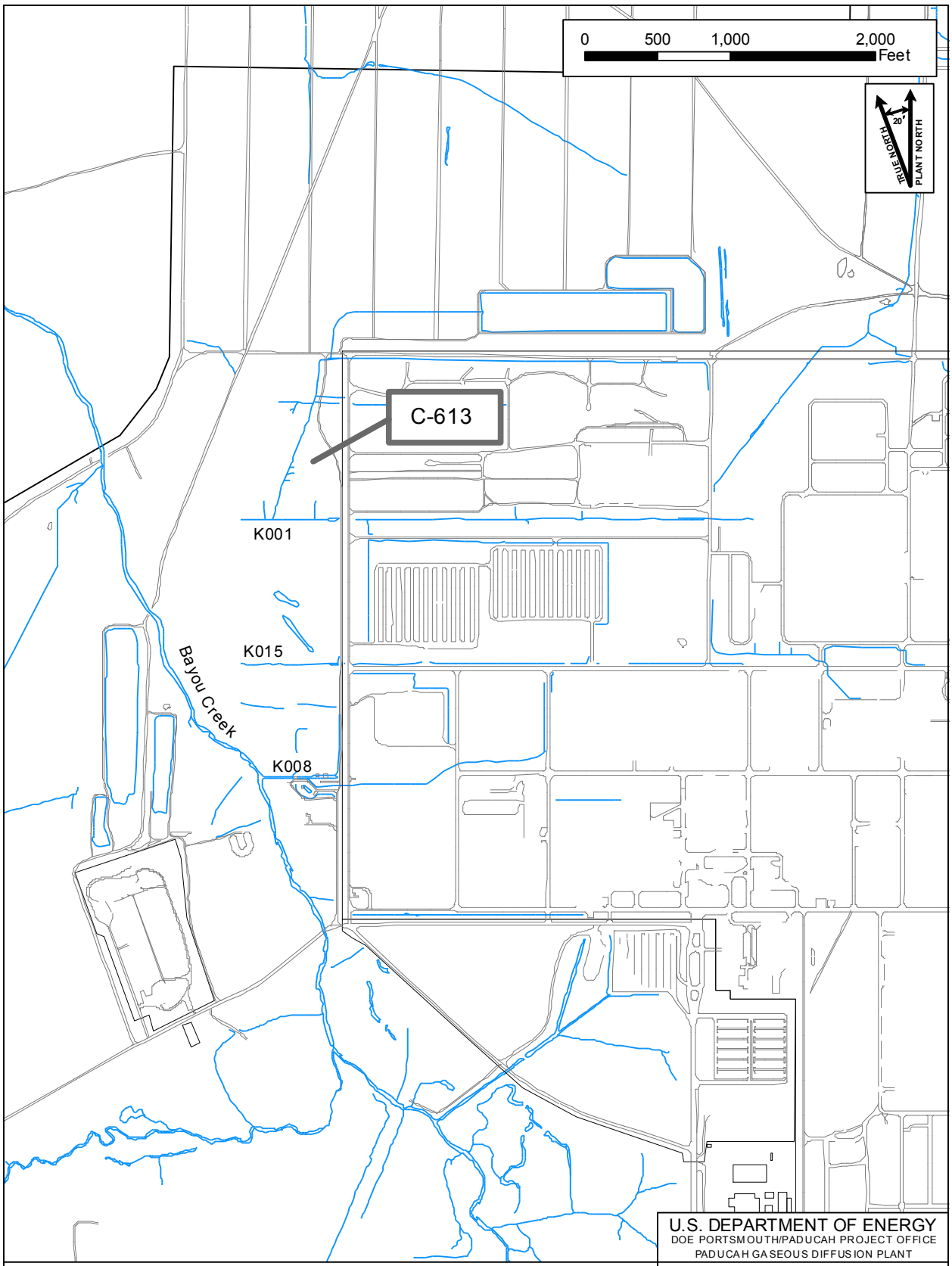

Figure C.7. C-613 Sedimentation Basin

C.2.6 RESIDENTIAL GROUNDWATER MONITORING PROGRAM

Monthly Residential Monitoring

Driver: As required by the DOE Water Policy, per the Action Memorandum outlined in DOE/OR/06-1142&D3, among DOE, Commonwealth of Kentucky, and the U.S. Environmental Protection Agency (EPA).

Reported: Quarterly letter to the resident summarizing the monthly data and the Annual Site Environmental Report.

Driver: If a residential well outside the current water box contains TCE or technetium-99 (Tc-99) and is confirmed, based on resampling and analysis to have originated from the plant, as determined by a review of MW data, historical data, or existing information at plant action levels (TCE greater than 1 ppb and Tc-99 greater than 25 pCi/L), then provide drinking water to the resident, revise the contaminant boundary, provide water to those residents within the new contaminant boundary, and reevaluate the existing Water Policy. If a well is inaccessible, it will not be sampled.

Comments: In FY 2006, the sampling frequency for well R2 was changed from monthly to annually. Tables C.16 and C.17 identify residential wells and residential analytical parameters, respectively. Locations are shown on Figure C.8.

Annual Residential Monitoring

Driver: As required per the Action Memorandum outlined in DOE/OR/106-1142&D3, among DOE, the Commonwealth of Kentucky, and EPA.

Reported: Letters to residents and Annual Site Environmental Report.

Driver: If a residential well outside the current water box contains TCE or Tc-99 and is confirmed, based on resampling and analysis to have originated from the plant, as determined by a review of MW data, historical data, or existing information at plant action levels (TCE greater than 1 ppb and Tc-99 greater than 25 pCi/L), then provide drinking water to the resident, revise the contaminant boundary, provide water to those residents within the new contaminant boundary, and reevaluate the existing Water Policy. If a well is inaccessible, it will not be sampled.

Comments: In FY 2006, the frequency for all wells that had been sampled on a semiannual basis was changed to an annual basis. Tables C.16 and C.17 identify residential wells and residential analytical parameters, respectively. Locations are shown on Figure C.7. At the onset of FY 2010, no Water Policy license agreement with DOE was in place with the residents who own the property where wells R72 and R82 are located; therefore, these wells were removed from the sampling schedule. In 2010, sampling at well R23 was discontinued due to safety and access issues with this well.

Table C.16. Residential Wells (16)

Monthly (2)	
R294	P
R302	P
Annually (14)	
R2	P
R114	H
R12	P
R13	P
R14	P
R19	P
R20	P
R21	P
R384	H
R387	H
R392	H
R83	P
R9	H
R90	H

H – Hose–depth to water not collected
P – Pump

Table C.17. Residential Analytical Parameters

Monthly
Barometric Pressure
Conductivity
Depth to Water[a]
Dissolved Oxygen
Eh
pH
Temperature
Alpha Activity
Beta Activity
Technetium-99
Trichloroethene
Annual
Barometric Pressure
Conductivity
Depth to Water[a]
Dissolved Oxygen
Eh
pH
Temperature
Technetium-99
Trichloroethene

[a] Not available at all locations

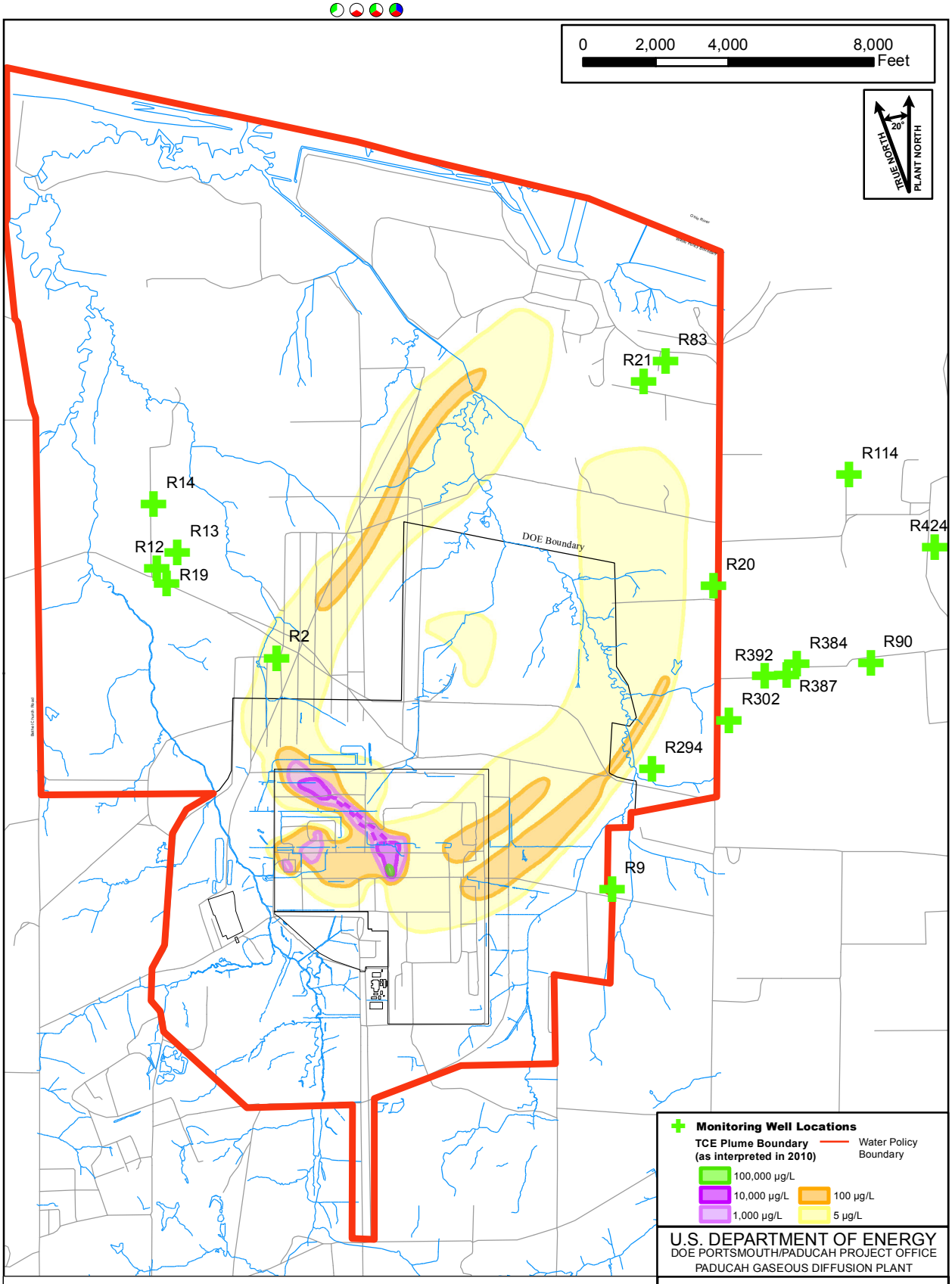

Figure C.8. Residential Wells

FIGURE No. EMP\2012\EMPWellsRes_2012R1.mxd
DATE 11-02-2011

Carbon Filter Treatment System

Frequency: Semiannually

Driver: DOE decision.

Reported: Letters to residents and Annual Site Environmental Report.

Comments: DOE is maintaining a treatment system for one resident who is outside the Water Policy box. Tables C.18 and C.19 identify carbon filter treatment system wells and carbon filter treatment system analytical parameters, respectively. Location is shown on Figure C.8.

Table C.18. Carbon Filtration System (1)

R424 Port 1 direct groundwater
R424 Port 2 after carbon filter
R424 Port 3 after ultraviolet light

Table C.19. Carbon Filtration System Analytical Parameters

Conductivity
Dissolved Oxygen
Eh
pH
Temperature
Technetium-99
Total Coliform
Trichloroethene

C.2.7 ENVIRONMENTAL SURVEILLANCE GROUNDWATER MONITORING PROGRAM

Annual and Biennial Environmental Surveillance Monitoring

Driver: DOE Order 450.1A and the Paducah FFA.

Reported: Annual Site Environmental Report and Plume Maps.

Rationale: To monitor the nature and extent of groundwater contamination and to monitor groundwater quality. Sampling of these wells is conducted in support of the Paducah FFA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Investigation; Resource Conservation and Recovery Act Facility Investigations (RFIs); and DOE Order 450.1A.

Rule: If a MW outside the current water policy box contains confirmed TCE and Tc-99 originating from the plant, as determined by a review of MW data, historical data, or existing information at the plant action levels (TCE greater than 1 ppb and Tc-99 greater than 25 pCi/L), then evaluate the need to sample other wells in the vicinity.

Comments: Evaluation of the data collected to date shows that no significant changes have occurred that merits the need for sampling wells quarterly and/or semiannually. The program was modified in FY 2011 to focus on sampling key wells annually and reduce sampling of other wells to a biennial or triennial basis.

Tables C.20 and C.21 identify surveillance wells and environmental surveillance analytical parameters, respectively. Tables C.22 and C.23 show surveillance geochemical wells and surveillance geochemical annual analytical parameters, respectively. Locations are shown on Figure C.9.

The wells to be monitored annually were selected based on their location within the plumes. Some are key for early detection of plume migration; others are key for ongoing CERCLA work.

Two MWs (MW409 and MW410) were reduced from quarterly sampling of TCE to a semiannual frequency for FY 2012.

The biennial grouping for Surveillance Wells are within Table C.20. They will not be sampled in FY 2012, but will be sampled in FY 2013. The triennial grouping for the Geochemical Wells are listed in Table C.22. They will not be sampled in FY2012, but will be sampled in FY 2013.

For completeness, these groupings are highlighted in gray to ensure clarity that the wells are part of the program.

Table C.20. Surveillance Wells (135)

Biennial (107)[a]			
MW67	MW260	MW436[b]	MW478
MW76	MW262	MW437[b]	MW479
MW86	MW328	MW438[b]	MW480
MW89	MW329	MW439	MW481
MW92	MW333	MW440	MW482
MW95A	MW337	MW441	MW483
MW106	MW338	MW442	MW484
MW125	MW341	MW443	MW485
MW134	MW343	MW444	MW486
MW135	MW354	MW445	MW487
MW139	MW356	MW446[b]	MW488
MW146	MW403 Port 3	MW447	MW489
MW148	MW404 Port 4	MW448	MW490
MW149	MW405 Port 5	MW449[b]	MW491
MW163	MW406 Port 5	MW450	MW492
MW168	MW407 Port 4	MW451	MW493
MW169	MW408 Port 5	MW452	MW494
MW174	MW414	MW453	MW495
MW186	MW415	MW454	MW496
MW187	MW416	MW463	
MW193	MW417	MW464	**Background (4)**
MW197	MW426	MW467	MW103
MW200	MW427	MW468	MW194
MW201	MW431	MW473	MW199
MW202	MW432	MW474	MW305
MW205	MW433	MW475	
MW226	MW434[b]	MW476	
MW227	MW435	MW477	
Annually (28)			
MW98	MW206	MW409[d]	MW470
MW 99	MW233	MW410[d]	MW471
MW 100	MW236	MW411	MW472
MW152	MW240	MW418[c]	
MW161	MW252	MW419[c]	**Background (1)**
MW182[c]	MW253	MW465	MW150
MW191	MW261	MW466	
MW203	MW345	MW469	

[a] These wells scheduled for biannual sampling will not be sampled in FY 2012, these wells will be sampled in FY 2013. Shading indicates that the wells are part of the program.
[b] These monitoring wells have not been installed.
[c] These three wells are sampled for PCBs.
[d] These wells will be sampled semiannually in FY 2012 for TCE to evaluate Northeast Plume migration.

Table C.21. Environmental Surveillance Analytical Parameters

Annual and Biennial	
Field Parameters	**Volatiles**
Barometric Pressure	1,1,1-Trichloroethane
Conductivity	1,1,2-Trichloroethane
Depth to water	1,1-Dichloroethane
Dissolved Oxygen	1,1-Dichloroethene
pH	1,2-Dichloroethane
Temperature	Benzene
Turbidity	Bromodichloromethane
	Carbon Tetrachloride
PCBs, Total and Dissolved (MW182, MW418 and MW419)	Chloroform
	cis-1,2-Dichloroethene
	Dimethylbenzene, Total*
PCB, Total	Ethylbenzene
PCB-1016	Tetrachloroethene
PCB-1221	Toluene
PCB-1232	*trans*-1,2-Dichloroethene
PCB-1242	Trichloroethene
PCB-1248	Vinyl Chloride
PCB-1254	*Xylenes
PCB-1260	
PCB-1268	
Radionuclides	
Alpha Activity	
Beta Activity	
Technetium-99	
Uranium	

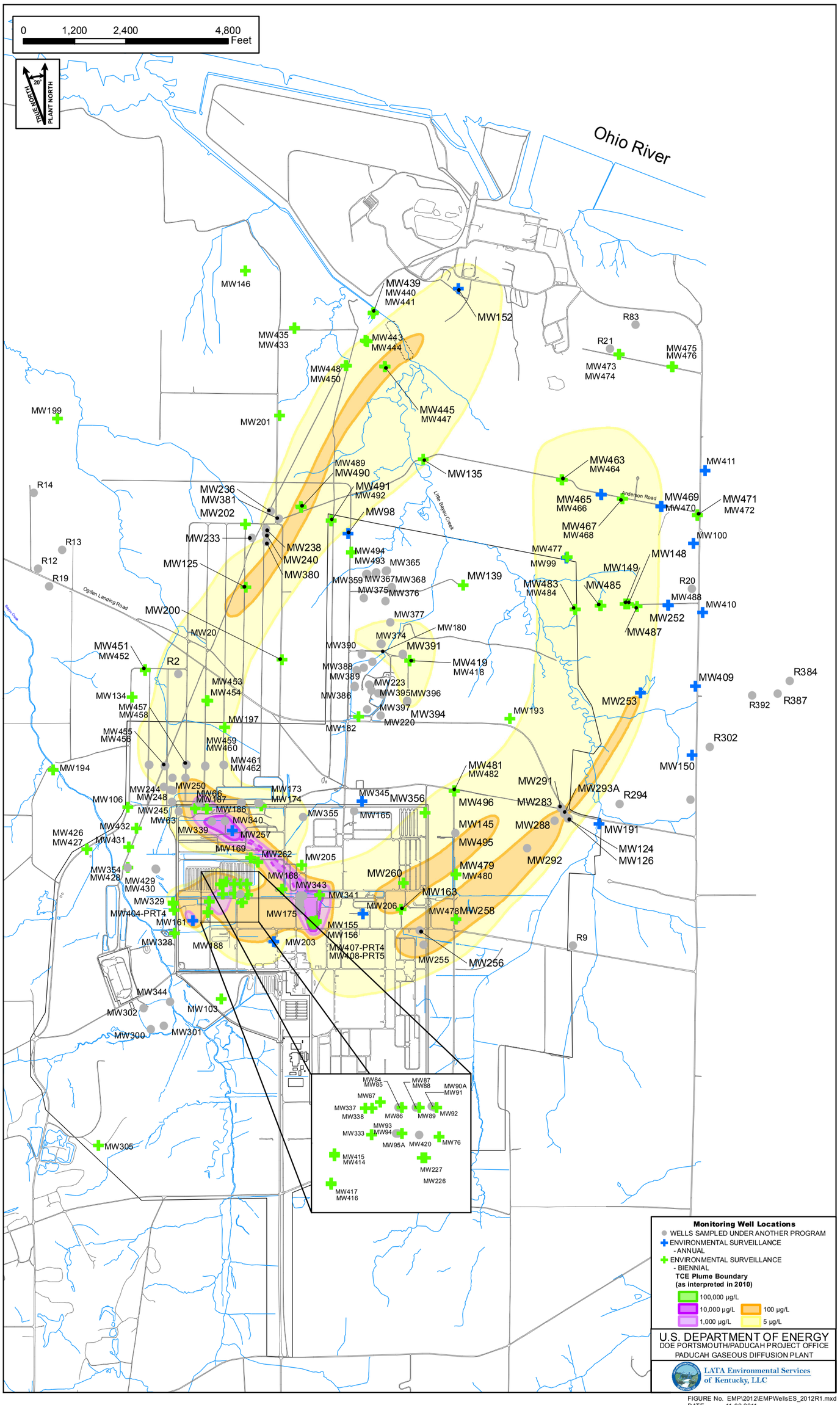

Figure C.9. Environmental Surveillance Groundwater Monitoring Wells

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Geochemical Environmental Surveillance Monitoring

Frequency: Every three years

Driver: DOE Order 450.1A and the Paducah FFA.

Rationale: Monitor the extent of groundwater contamination and groundwater quality. Sampling of these wells is conducted in support of the Paducah FFA CERCLA Investigation, RFIs, and DOE Order 450.1A.

Reported: ASER.

Comments: In the FY 2011 EMP, the sampling frequency was modified from an annual frequency to a triennial frequency. Based on this triennial schedule, these MWs will not be sampled until FY 2013.

In FY 2012, dissolved metals analysis was deleted from the program.

Tables C.22 and C.23 show surveillance geochemical wells and surveillance geochemical annual analytical parameters, respectively. Locations are shown on Figure C.9.

Table C.22. Surveillance Geochemical Wells (44)

MW20	MW291
MW99	MW292
MW100	MW328
MW125	MW329
MW134	MW339
MW145	MW343
MW152	MW381
MW161	MW403 Port 3
MW163	MW404 Port 3
MW188	MW404 Port 4
MW193	MW404 Port 5
MW206	MW409
MW201	MW414
MW242	MW426
MW243	MW427
MW255	MW439
MW256	MW441
MW257	MW447
MW258	MW468
MW260	MW473
MW261	MW474
MW288	MW490

Note: The baseline for these MWs was established in FY 2010 and FY 2011. The next sampling event is scheduled for FY 2013.

Table C.23. Surveillance Geochemical Annual Analytical Parameters

Miscellaneous	**Metals**
Sulfate	Aluminum
Nitrate	Antimony
Total Organic Carbon	Barium
Chloride	Beryllium
Total Dissolved Solids	Cadmium
Silica	Calcium
Fluoride	Chromium
Phosphate	Cobalt
Alkalinity	Copper
Ferrous Iron (Fe^{+2})	Iron
	Lead
Field Parameters	Magnesium
Barometric Pressure	Manganese
Conductivity	Molybdenum
Depth to water	Nickel
Dissolved Oxygen	Potassium
Eh	Silver
pH	Sodium
Temperature	Zinc
Turbidity	Arsenic
	Mercury
Volatiles	Selenium
Ethene	Uranium
Ethane	
Methane	

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C.3. SURFACE WATER, SEDIMENT, AND WATERSHED BIOLOGICAL MONITORING

C.3.1 EFFLUENT WATERSHED MONITORING PROGRAM

C-746-S &T Landfills and C-746-U Landfill Surface Water

Frequency: Quarterly

Driver: Landfill permits issued by KDWM.

Rationale: Monitor rain runoff from the C-746-S&-T and C-746-U Landfills.

Reported: Quarterly C-746-S&T and C-746-U Landfills Groundwater Compliance Monitoring Reports

Comments: Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2012, as it is permit driven.

Tables C.24 and C.25 show landfill surface water locations and landfill surface water parameters, respectively. Locations are shown on Figure C.10.

Table C.24. Landfill Surface Water Locations (6)

C-746-S&T	C-746-U
L135	L150
L136	L154[a]
L154 [a]	L351

[a]L154 is listed on both the C-746-S&T, as well as the C-746-U Landfill permits.

Table C.25. Landfill Surface Water Parameters

Anions	Other
Chloride	Total Dissolved Solids
Sulfate	Total Suspended Solids
	Total Solids
Field Measurements	Chemical Oxygen Demand
Conductivity	Total Organic Carbon
Dissolved Oxygen	
Flow Rate	**Radionuclides**
pH	Alpha Activity
Temperature	Beta Activity
Metals	
Iron	
Sodium	
Uranium	

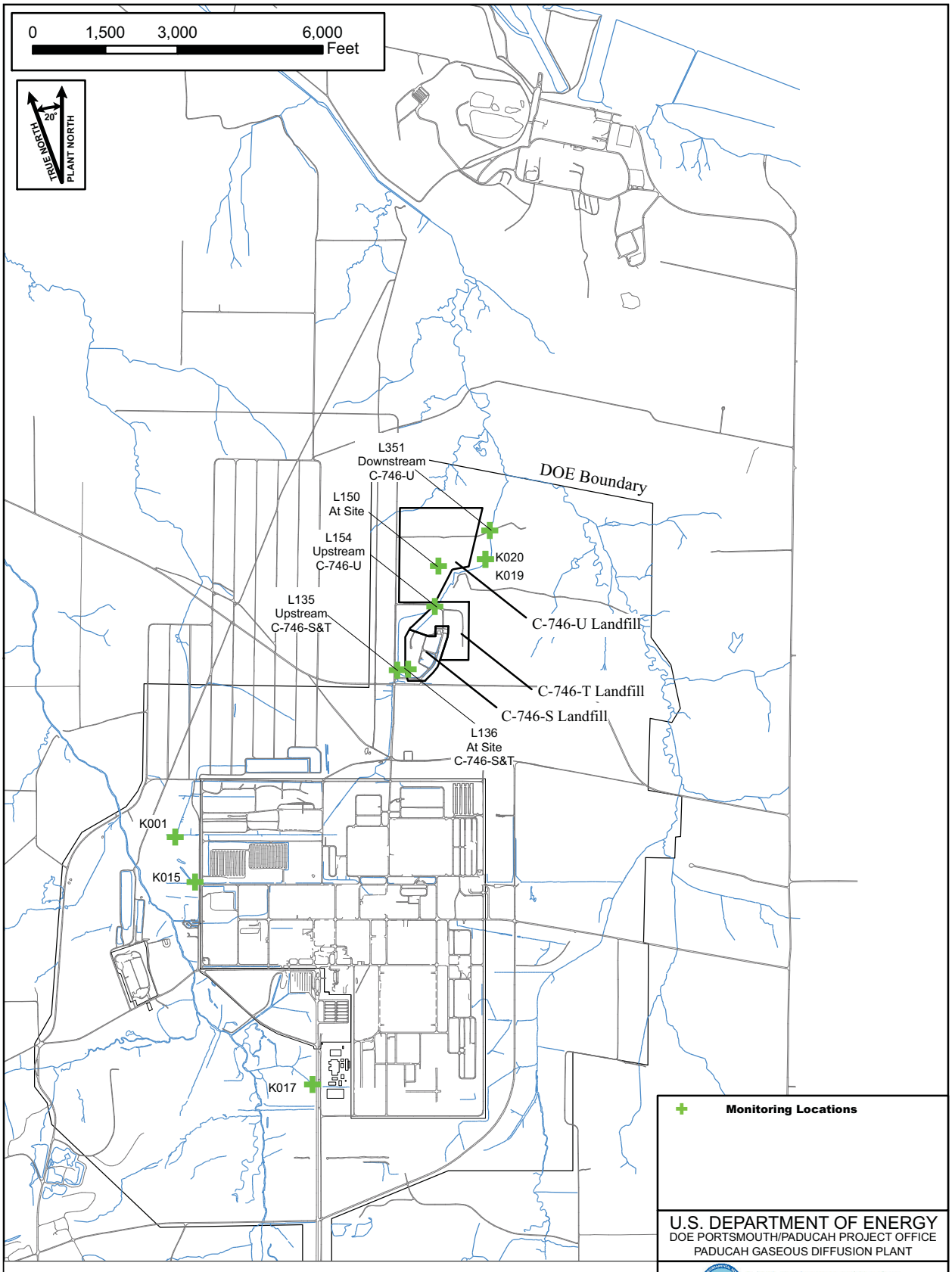

Figure C.10. KPDES and Landfill Surface Water Locations

FIGURE No. EMP|EMPKPDES-LF2011R0.mxd
DATE 09-21-2010

KPDES Outfall Sampling

Driver: DOE KPDES permit for the Paducah Gaseous Diffusion Plant (PGDP), permit number KY0004049, McCracken County, Kentucky.

Reported: Monthly and Quarterly Discharge Monitoring Reports.

Comments: The KPDES permit became effective on December 1, 2009. This modification added Outfall 020 and removed some parameters. A modification to the permit became effective on September 1, 2010. This modification did not affect the sampling locations or parameter list.

Temperature readings at Outfall 017 began at the end of FY 2011 due to start-up and testing of operations at the depleted uranium conversion facility. Because of intermittent operations at the depleted uranium conversion facility, chronic toxicity at Outfall 017 has not been initiated.

Table C.26 shows the current KPDES outfall sampling locations, frequency of sampling, and parameters. Locations are shown on Figure C.10.

Table C.26. KPDES Outfall Sampling Locations, Frequency, and Parameters

Analysis	Frequency of Sampling at KPDES Locations D—Daily; W—Weekly; M—Monthly; Q—Quarterly				
	K001	**K015**	**K017**	**K019**	**K020**
Flow (Mgd)	D	M	M	M	M
Total Suspended Solids (mg/L)	W	M	M	M	M
Oil & Grease (mg/L)	W	M	M	M	M
Total Residual Chlorine (mg/L)	W				
Temperature (°F)	W		M		
PCBs (mg/L)	W	M	M	M	Q
Trichloroethene (mg/L)	W				Q
Total Phosphorus (mg/L)	W				
Total Alpha (pCi/L)	W	M	M	M	M
Total Beta (pCi/L)	W	M	M	M	M
Uranium (µg/L)	W	M	M	M	M
Total Recoverable Zinc (µg/L)			M	M	Q
Total Recoverable Arsenic (µg/L)					Q
Total Recoverable Nickel (µg/L)					Q
Nitrates (mg/L N)					Q
1,1,1-Trichloroethane (mg/L)					Q
Chlorides (mg/L)					Q
Acute Toxicity (TU_A)[a]		Q	Q	Q	Q
Chronic Toxicity (TU_c)[b]	Q		M[d]		
Technetium-99 (pCi/L)	Q	Q	Q	Q	Q
Hardness (as mg/L $CaCO_3$)	Q	Q	Q	Q	Q
Phosphorous (mg/L)					Q
CBOD (mg/L)					Q
Dissolved Oxygen (mg/L)					Q
Total Recoverable Iron (µg/L)		Q		Q	Q
Benzo(a)anthracene (µg/L)		Q	Q		

Table C.26. KPDES Outfall Sampling Locations, Frequency, and Parameters (Continued)

Analysis	Frequency of Sampling at KPDES Locations D—Daily; W—Weekly; M—Monthly; Q—Quarterly				
	K001	**K015**	**K017**	**K019**	**K020**
Benzo(k)fluoranthene (µg/L)		Q			
Free Cyanide (µg/L)	Q				
Heptachlor (µg/L)	Q	Q	Q		
Indeno(1,2,3-cd) pyrene (µg/L)	Q				
pH (between 6–9)	W	M	M	W[c]	W[c]

[a]Acute toxicity sampling requires two grab samples.
[b]Chronic toxicity sampling requires three 24-hour composite samples.
[c] These effluents are sampled weekly when discharging to the outfalls.
[d] Chronic toxicity for Outfall 017 will become effective upon completion and commencement of operation of the depleted uranium conversion facility.

C.3.2 ENVIRONMENTAL SURVEILLANCE WATERSHED MONITORING PROGRAM

Surface Water Monitoring

Frequency: Quarterly

Driver: DOE KPDES Permit for PGDP, permit number KY0004049, McCracken County, Kentucky.

Rationale: To monitor potential contamination released into Bayou Creek and Little Bayou Creek surface water from historical plant operations.

Reported: ASER

Comments: The KPDES Permit requires that 19 in-stream surface water locations be sampled quarterly for PCBs and TCE. Based on these requirements, the radiological parameters were removed in the FY 2011 EMP.

Tables C.27, C.28, and C.29 include surface water and the seep sampling locations, quarterly analytical parameters, and the quarterly seep location analytical parameters, respectively. Locations are shown on Figure C.11.

Table C.27. Surface Water and Seep Sampling Locations (20)

Surface Water (19)
C612 (SP)[a]
C616
C746K-5
C746KTB1A
L1 (BG)
L10
L11
L194
L29A (BG/R)[a]
L291
L30 (R)[a]
L306 (R)[a]
L5
L12
L241
L6
L64(BG)
S31
K001UP
Seep (1)
LBCSP5[a]

BG – Background locations
R – Ohio River locations
SP – Sampling port
[a] Unable to obtain flow rates.

Table C.28. Surface Water Quarterly Analytical Parameters

PCBs	Field Measurements
PCB, Total	Alkalinity
PCB-1016	Conductivity
PCB-1221	Dissolved Oxygen
PCB-1232	Flow[a]
PCB-1242	pH
PCB-1248	Temperature
PCB-1254	
PCB-1260	**Volatiles**
PCB-1268	Trichloroethene

[a] See previous page for locations where flow rates are not collected.

Table C.29. Quarterly Seep Location Analytical Parameters

Volatiles
Trichloroethene
Field Measurements
pH
Dissolved Oxygen
Temperature
Conductivity

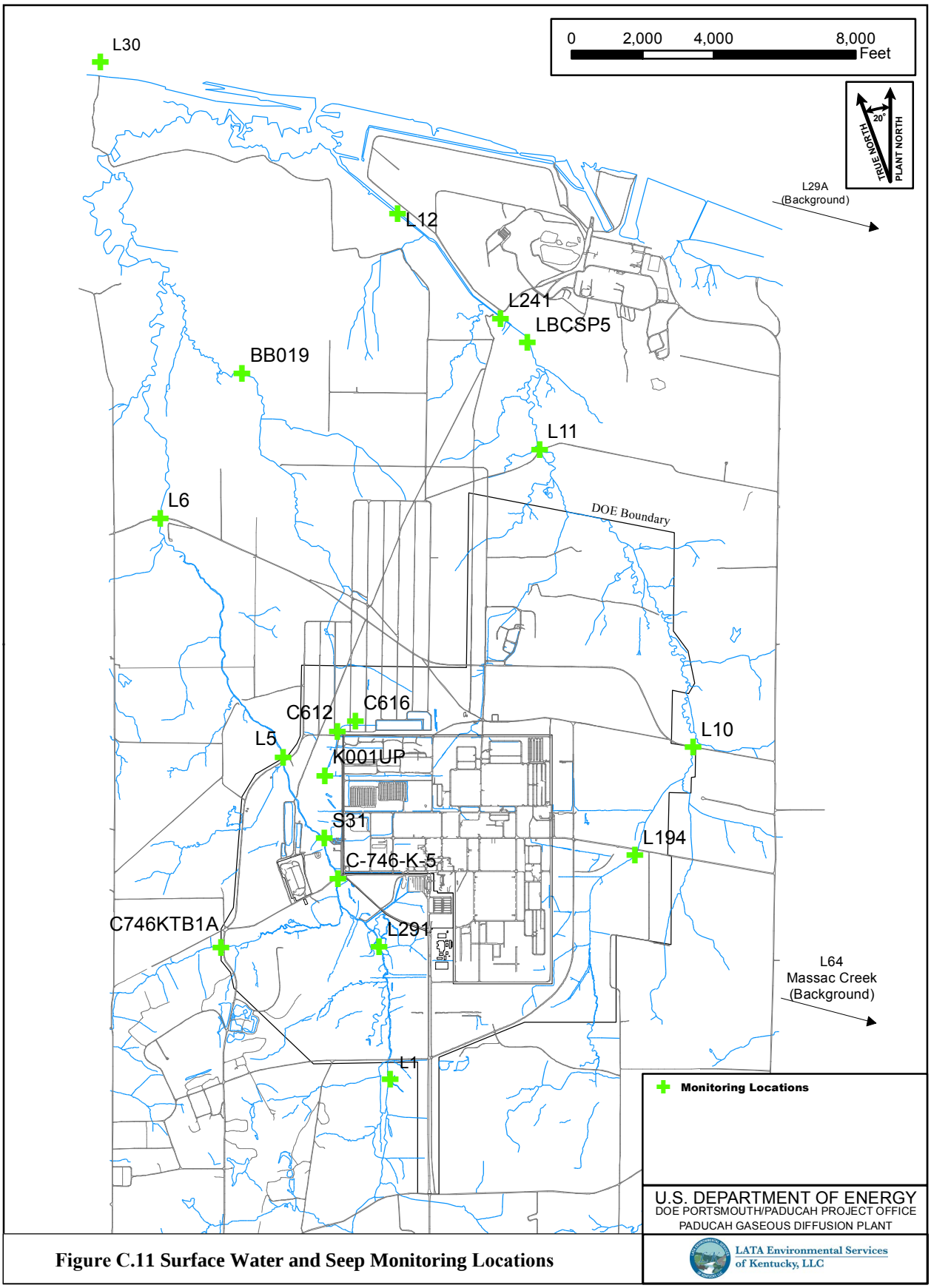

Figure C.11 Surface Water and Seep Monitoring Locations

Sediment Monitoring

Frequency: Semiannually

Driver: DOE KPDES Permit for PGDP, permit number KY0004049, McCracken County, Kentucky.

Rationale: Monitor potential contamination released into Bayou Creek and Little Bayou Creek sediments from historical plant operations.

Reported: ASER

Comments: The KPDES Permit requires that 14 locations be sampled semiannually for PCBs. Based on these requirements, the radiological and metals parameters were removed in the FY 2011 EMP.

Tables C.30 and C.31 show sediment sampling locations and analytical parameters. Locations are shown on Figure C.12.

Table C.30. Sediment Sampling Locations (14)

C612
C616
C746KTB2
K001
L194
S1
S2
S20 (BG)
S27
S28 (BG)
S31
S32
S33
S34

BG = Background locations

Table C.31. Sediment Analytical Parameters

PCBs
PCB, Total
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
PCB-1268

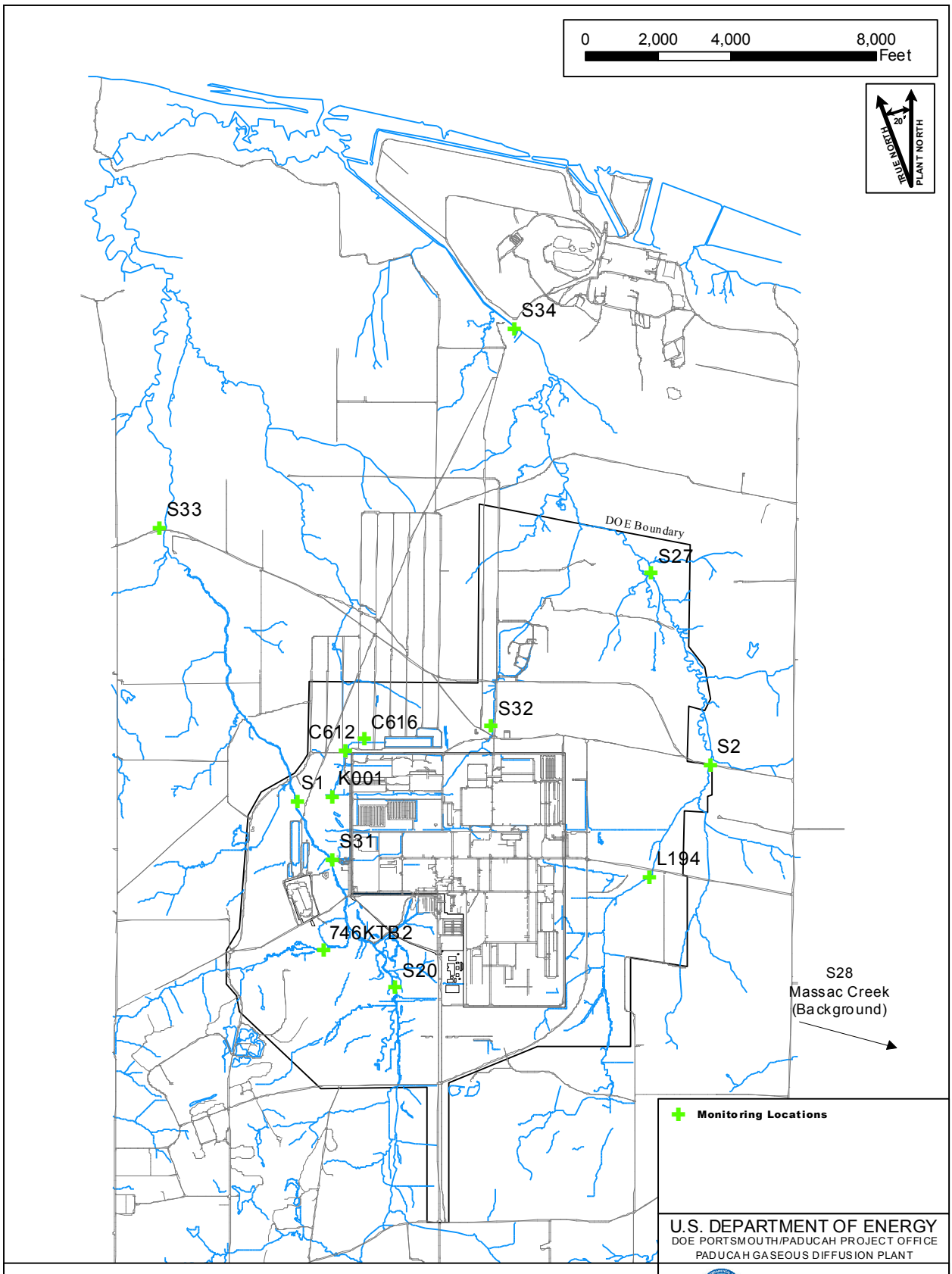

Figure C.12 Semiannual Sediment Locations

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C.4. LANDFILL LEACHATE SAMPLING

C-746-S and C-746-U Landfills Leachate Monitoring

Frequency: Annually

Driver: C-746-S, and C-746-U Landfill permits issued by KDWM, Permit Numbers SW07300014, SW07300015, and SW07300045, respectively.

Reported: Quarterly Compliance Operating Reports, as required by the applicable solid waste landfill permits.

Comments: Annual leachate parameters for C-746-S and C-746-U Landfills are presented in Table C.32.

Table C.32. C-746-S and C-746-U Annual Leachate Parameters

Volatiles	PCBs	Metals	Anions
1,1,1,2-Tetrachloroethane	PCB, Total	Aluminum	Bromide
1,1,1-Trichloroethane	PCB-1016	Antimony	Chloride
1,1,2,2-Tetrachloroethane	PCB-1221	Arsenic	Fluoride
1,1,2-Trichloroethane	PCB-1232	Barium	Nitrate as Nitrogen
1,1-Dichloroethane	PCB-1242	Beryllium	Sulfate
1,1-Dichloroethene	PCB-1248	Boron	
1,2,3-Trichloropropane	PCB-1254	Cadmium	**Field Parameters**
1,2-Dibromo-3-chloropropane	PCB-1260	Calcium	Conductivity
1,2-Dibromoethane	PCB-1268	Chromium	Dissolved Oxygen
1,2-Dichlorobenzene		Cobalt	Eh
1,2-Dichloroethane	**Radionuclides**	Copper	Temperature
1,2-Dichloropropane	Alpha Activity	Iodide	pH
1,4-Dichlorobenzene	Beta activity	Iron	
2-Butanone	Iodine-131[1]	Lead	**Miscellaneous**
2-Hexanone	Radium-226	Magnesium	Total Dissolved Solids
4-Methyl-2-pentanone	Strontium-90	Manganese	Chemical Oxygen Demand
Acetone	Technetium-99	Mercury	Cyanide
Acrolein	Thorium-230	Molybdenum	Total Organic Halides
Acrylonitrile	Tritium	Nickel	Total Organic Carbon
Benzene	Cesium-137	Potassium	Oil and Grease
Bromochloromethane	Cobalt-60	Rhodium	Phosphorus
Bromodichloromethane	Thorium-234	Selenium	Hardness—Total as CaCO3
Bromoform	Americium-241	Silver	Carbonaceous Biochemical Oxygen Demand
Bromomethane	Neptunium-237	Sodium	
Carbon Disulfide	Plutonium-239/240	Tantalum	
Carbon Tetrachloride	Activity of Uranium-235	Thallium	
Chlorobenzene	Uranium-234	Uranium	
Chloroethane	Uranium-238	Vanadium	
Chloroform	Dissolved Alpha	Zinc	
Chloromethane	Dissolved Beta	Barium, Dissolved	
cis-1,2-Dichloroethene	Technetium-99, Dissolved	Chromium, Dissolved	
cis-1,3-Dichloropropene	Cesium-137, Dissolved	Uranium, Dissolved	
Dibromochloromethane	Cobalt-60, Dissolved	Antimony, Dissolved	
Dibromomethane	Thorium-234, Dissolved	Arsenic, Dissolved	
Dimethylbenzene, Total[a]	Americium-241, Dissolved	Cadmium, Dissolved	
Ethylbenzene	Neptunium-237, Dissolved	Cobalt, Dissolved	
Iodomethane	Plutonium-239/240, Dissolved	Copper, Dissolved	
Methylene Chloride	Thorium-230, Dissolved	Lead, Dissolved	
Styrene	Activity of Uranium-235, Dissolved	Manganese, Dissolved	
Tetrachloroethene	Uranium-234, Dissolved	Nickel, Dissolved	
Toluene	Uranium-238, Dissolved	Selenium, Dissolved	
trans-1,2-Dichloroethene	Uranium	Silver, Dissolved	
trans-1,3-Dichloropropene	Uranium, Dissolved	Tin	
trans-1,4-Dichloro-2-Butene		Tin, Dissolved	
Trichloroethene		Titanium	
Trichlorofluoromethane		Titanium, Dissolved	
Vinyl Acetate		Uranium, Dissolved	
Vinyl Chloride		Vanadium, Dissolved	
		Zinc, Dissolved	

[a] Xylenes

[1] There is a pending permit modification request to remove Iodine-131. Analysis for this parameter will continue until modification is accepted by KDWM.

C-404 Low-level Radioactive Waste Burial Ground Leachate Monitoring

Frequency: As needed

Driver: The leachate parameters are required to be sampled per the Hazardous Waste Facility Permit, number KY8-890-008-982.

Reported: C-404 Semiannual Groundwater Report.

Comments: Leachate analytical parameters for C-404 Landfill are presented in Table C.33.

Table C.33. C-404 Landfill Leachate Analytical Parameters

Volatiles	**Metals**
Trichloroethene	Barium
	Cadmium
Radionuclides	Chromium
Technetium-99	Copper
Uranium-234	Iron
Uranium-235	Lead
Uranium-238	Nickel
Plutonium-239/240	Silver
Thorium-230	Zinc
Cesium-137	Arsenic
Neptunium-237	Mercury
	Selenium
PCBs	Uranium
PCB, Total	
PCB-1016	**Other**
PCB-1221	Fluoride
PCB-1232	Ammonia as Nitrogen
PCB-1242	
PCB-1248	**Field Parameters**
PCB-1254	pH
PCB-1260	Conductivity
PCB-1268	Dissolved Oxygen
	Eh
	Temperature

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C.5. EXTERNAL GAMMA RADIOLOGICAL MONITORING

Frequency: Collected continuously and analyzed quarterly; thermoluminescent dosimeters (TLDs) at 46 monitoring locations are changed quarterly for gamma radiation monitoring.

Driver: DOE Order 450.1A.

Reported: ASER and Annual Report for External Gamma Radiation Monitoring.

Figure C.13 shows TLD monitoring locations.

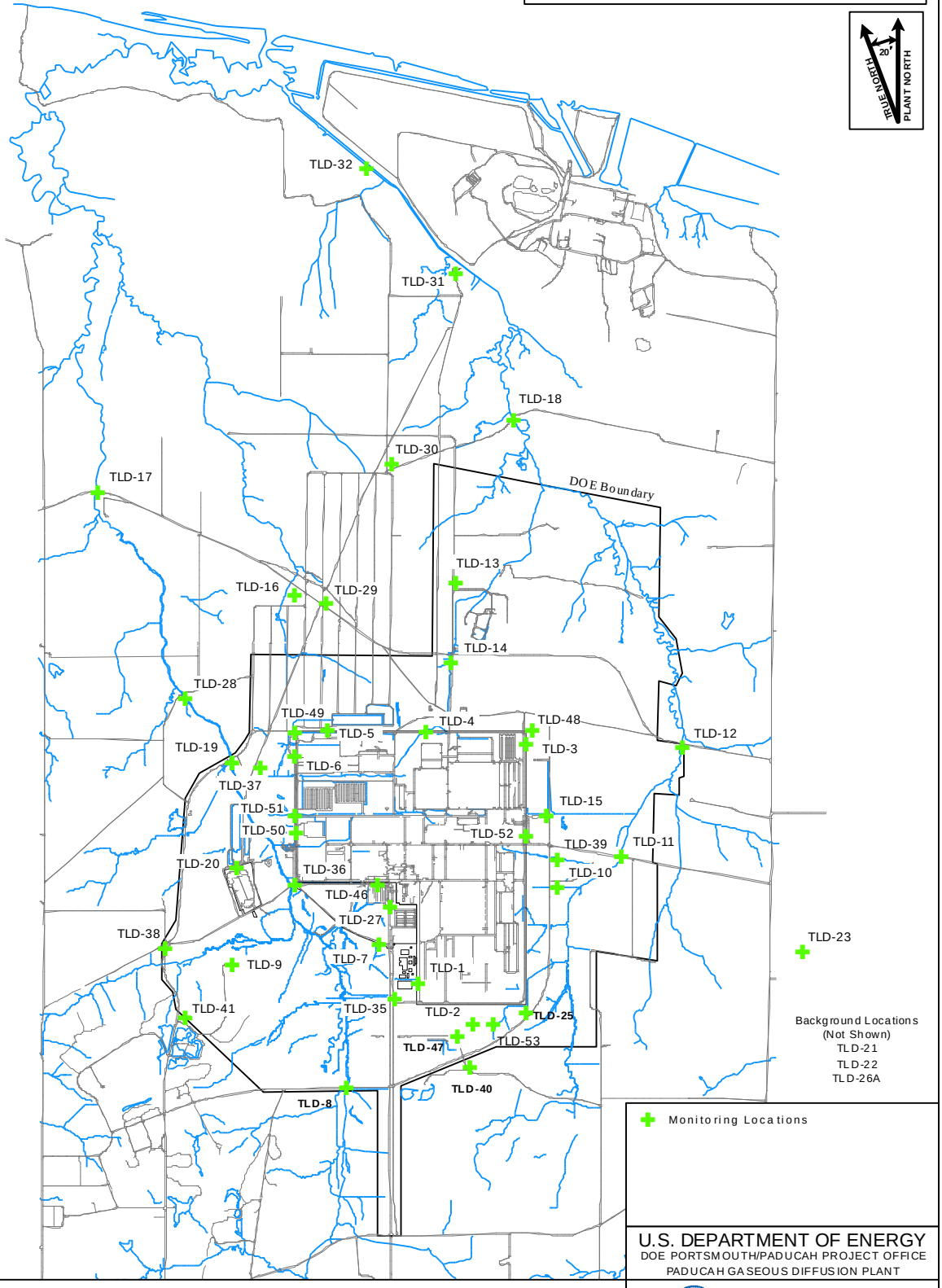

Figure C.13. TLD Monitoring Locations

APPENDIX D

ENVIRONMENTAL MONITORING
QUALITY ASSURANCE PROJECT PLAN

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Environmental Monitoring
Quality Assurance Project Plan
at the
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

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Environmental Monitoring
Quality Assurance Project Plan
at the
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

Date Issued—November 2011

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

LATA ENVIRONMENTAL SERVICES OF KENTUCKY, LLC
managing the
Environmental Remediation Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-10CC40020

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CONTENTS

TABLES

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ACRONYMS

ACO	Administrative Consent Order
AOC	Areas of Concern
CFR	*Code of Federal Regulations*
COC	chain-of-custody
DMC	Document Management Center
DMR-QA	Discharge Monitoring Report – Quality Assurance
DOE	U.S. Department of Energy
DQO	data quality objective
EDD	electronic data deliverable
EM	Environmental Monitoring
EM QAPP	Environmental Monitoring Quality Assurance Project Plan
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
ES	environmental services
FFA	Federal Facility Agreement
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
LATA Kentucky	LATA Environmental Services of Kentucky, LLC
MCL	maximum contaminant limit
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
Paducah OREIS	Paducah Oak Ridge Environmental Information System
OSHA	Occupational Safety and Health Administration
PARCCS	Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
QA	Quality Assurance
QAPIP	Quality Assurance Program and Implementation Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
RGA	Regional Gravel Aquifer
RPD	relative percent difference
RSD	relative standard deviation
SMO	Sample and Data Management Organization
SOW	statement of work
SWMU	solid waste management unit
Tc-99	technetium-99
TCE	trichloroethene
USEC	United States Enrichment Corporation
VOC	volatile organic compound

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D.1. INTRODUCTION TO THE QUALITY PROGRAM

The Environmental Monitoring (EM) Program, managed by LATA Environmental Services of Kentucky, LLC, (LATA Kentucky) and its subcontractors, performs environmental monitoring, effluent monitoring, environmental surveillance, and compliance reporting. The EM Quality Assurance Project Plan (QAPP) describes the responsibilities and activities that affect the quality of the operations, maintenance, and scientific and technical information collected. This EM QAPP is a stand-alone project plan that supports and is included as an appendix to the *Environmental Monitoring Plan* (EMP), PAD-ENM-0055.The EMP provides overall direction for EM activities.

The U.S. Department of Energy (DOE) Prime Contractor Quality Assurance Program and Implementation Plan (QAPIP) (PAD-PLA-QM-001) implements the quality assurance (QA) requirements established in 10 *CFR* § 830.120, DOE Order 414.1C, and American Society of Mechanical Engineers Nuclear Quality Assurance-1 and flows those requirements down into all DOE Prime Contractor activities and functions. The EM program is focused on obtaining environmental data and measurements; therefore, the EM QAPP follows the format established in the U.S. Environmental Protection Agency (EPA), *Requirements for Quality Assurance Project Plans* (QA/R-5) (May 2006). This EPA document applies specifically to environmental data collected and used in decision making and provides the structure, content, and guidance for Quality Assurance Plans (QAPs) associated with environmental data collection.

This plan will be updated through an annual review and revised as necessary. All revisions to the EM QAP will be subject to the DOE Prime Contractor internal review process.

Reference Documents

- PAD-ENM-0055, *Environmental Monitoring Plan*
- Kentucky Pollutant Discharge Elimination System (KPDES) Permit, KY0004049
- Solid Waste Residential Landfill (Closed) Permit, KYSW07300014
- Solid Waste Inert Landfill (Closed) Permit, KY SW07300015
- Solid Waste Contained Landfill (Open) Permit, KY SW07300045
- Hazardous Waste Facility Permit, KY8-890-008-982
- 10 *CFR* § 830.120, *Quality Assurance Requirements*
- DOE Order 414.1C, *Quality Assurance*
- EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans*
- SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*
- EPA Test Methods Series
- PAD-PLA-QM-001, *LATA Kentucky Quality Assurance Program and Implementation Plan for the Paducah Environmental Remediation Project*

D.2. PROJECT/TASK ORGANIZATION AND RESPONSIBILITY

D.2.1 PROJECT PERSONNEL

The Organizational Chart for Environmental Monitoring is shown in Attachment 1. The Environmental Monitoring and Reporting Manager, who is responsible for implementing all relevant aspects of the EMP, reports to the Manager of Projects. The organization is designed to

provide a clear line of functional and program responsibility and authority supported by a management control structure. Overall responsibilities for this project include the following:

- Establishing clearly defined lines of communication and coordination;
- Monitoring project budget and schedule;
- Providing progress reports;
- Establishing quality assurance and control;
- Ensuring health and safety;
- Ensuring project coordination; and
- Maintaining project database.

D.2.2 RESPONSIBILITIES

D.2.2.1 Environmental Monitoring and Reporting Manager

The Environmental Monitoring and Reporting Manager reports to the Manager of Projects and is responsible for implementation of all activities associated with EM such as maintaining budgets, schedules, and milestones. The Environmental Monitoring and Reporting Manager has direct responsibility for project oversight, issuing technical reports, and ensuring the project is on schedule and within budget. The Environmental Monitoring and Reporting Manager ensures that implementation of the QA and Health and Safety Programs are consistent with DOE guidelines. The Environmental Monitoring and Reporting Manager responds to QA/quality control (QC) deficiencies, initiates and completes corrective actions, and ensures data management requirements are followed.

D.2.2.2 Environmental Sampling/Well Activities Manager

The Environmental Sampling/Well Activities Manager is responsible for providing technical support to the EM project by generating required reports and making decisions regarding technical issues (i.e., sample locations, analytical methods, etc.). The Environmental Sampling/Well Activities Manager is responsible for ensuring that the monitoring activities are consistent with the sitewide groundwater program and other EM policies and procedures. The Environmental Sampling/Well Activities Manager also is responsible for managing and administering projects; planning activities; procuring services, as necessary; overseeing routine monitoring/sampling activities; maintaining and inspecting monitoring equipment; coordinating split sampling activities with the Commonwealth of Kentucky; overseeing procedures; and ensuring visitor and worker safety and health on the project site. For work performed by a subcontractor, such as well rehabilitation, well abandonment, or EM sampling, the Environmental Sampling/Well Activities Manager is responsible for the oversight of that work scope.

D.2.2.3 Samplers

The samplers report to the Environmental Sampling/Well Activities Manager and are responsible for all groundwater monitoring, KPDES, surface water, and sediment sampling activities, which include the following: maintaining logbook entries; calibrating monitoring equipment; performing field analyses; maintaining sampling equipment; performing well inspections; conducting all routine monthly, quarterly, semiannual, and annual sampling, as well as special, residential, and Commonwealth of Kentucky split sampling; preserving samples; and maintaining quality records of sampling events in written format. The samplers are responsible for overseeing the performance of necessary calibrations; decontaminating sampling equipment; performing laboratory inspections; maintaining an inventory list of reagents and

chemicals; managing and reviewing records and logbooks; and working in accordance with applicable Chemical Hygiene Plans.

D.2.2.4 Sample/Data Management Manager

The Sample/Data Management Manager reports to the Environmental Monitoring and Reporting Manager and is responsible for long-term storage of project data and for transmitting data to external agencies according to the *Paducah Site Data Management Plan*, DOE/OR/07-1595&D1, and the Paducah Data Management Policy ("Paducah Environmental Management & Enrichment Facilities Data Management Policy," internal correspondence number, LTR.KY/ER96-0281, from J. C. Massey to D. L. Chumbler et al., Lockheed Martin Energy Systems, Inc., Paducah, KY, November 11, 1996). The Sample/Data Management Manager ensures compliance with policies and procedures relating to data management with respect to the project and ensures that the requirements of PAD-ENM-5003, *Quality Assured Data*, as well as applicable validation procedures are followed. For work performed by a subcontractor, such as laboratory validation, the Sample/Data Management Manager is responsible for the oversight of that work scope.

D.2.2.5 Data Entry Specialist

The data entry specialist reports to the Sample/Data Management Manager and is responsible for data entry to Project Environmental Measurements System (PEMS), including chain-of-custody (COC) information, field data, validation qualifiers, and any pertinent sampling information. After receiving a notification that a fixed-base lab electronic data deliverable (EDD) is available to download, the Sample/Data Coordinator loads the EDD to environmental services (ES) PEMS, performs electronic verification of the data, and then compiles the data assessment package. The data entry specialist also prepares data for transfer from ES PEMS to the Paducah Oak Ridge Environmental Information System (OREIS) and coordinates transmittal of the data packages to the Document Management Center (DMC).

D.2.2.6 Sample/Data Coordinator

The Sample/Data Coordinator reports to the Sample/Data Management Manager and is responsible for contracting any fixed-base laboratory utilized during the sampling activities. The Sample/Data Coordinator also provides coordination for sample shipment to the laboratory, contractual screening of data packages, and transmittal of data packages to the DMC.

D.2.2.7 QA Specialist

The project QA specialist is responsible for QA oversight associated with EM activities. The QA specialist is part of the project team and is responsible for monitoring and sampling activities and other information to determine if the project team followed all applicable procedures. The QA Specialist is responsible for assessing the EM program and providing oversight to ensure that nonconformances and conditions adverse to quality are properly documented, reported to the DOE Prime Contractor Issues Management Program, and corrected.

D.2.2.8 Environmental Compliance Support Personnel

The Environmental Compliance support personnel are responsible for establishing regulatory compliance requirements; assisting in implementation, planning, and oversight of regulatory compliance; and providing assistance when needed.

D.3. PROGRAM DEFINITION/BACKGROUND

D.3.1 PROGRAM STATEMENT

The Environmental Monitoring program performs effluent monitoring and surveillance activities to do the following:

- Achieve compliance with federal or Commonwealth of Kentucky regulations, permit conditions, or environmental commitments both on and off-site;
- Better understand the effects of DOE operations on the quality of the regional environment;
- Address public concern about off-site contamination; and
- Meet DOE requirements.

D.3.2 BACKGROUND

The Paducah Gaseous Diffusion Plant (PGDP) located in Paducah, Kentucky, is an operating uranium enrichment facility owned by DOE. Effective July 1, 1993, DOE leased the plant production facilities at Paducah to the United States Enrichment Corporation (USEC) to provide operations and maintenance services. DOE contracted with LATA Kentucky effective July 26, 2010, to manage and integrate the EM activities for DOE.

During past operations of PGDP, hazardous substances generated as byproducts from the enrichment process were released into the environment. The source areas where releases originally occurred are often referred to as solid waste management units (SWMUs) and areas of concern (AOC). In general, SWMUs and AOC are typically areas such as burial grounds, spill sites, landfarms, surface impoundments, and underground storage tanks. The releases from these source areas can migrate into the surrounding soils, aquatic and terrestrial biota, and in some cases, the underlying groundwater and adjacent surface waters. In July 1988, groundwater samples collected from residential wells north of PGDP led to the discovery of trichloroethene (TCE) and technetium-99 (Tc-99) contamination in the Regional Gravel Aquifer (RGA). With the participation of the Commonwealth of Kentucky, EPA, and DOE, the Administrative Consent Order (ACO) was entered effective November 23, 1988. The ACO was a legally binding agreement for the participating parties that initiated the investigation into the nature and extent of the contamination in these wells. On May 31, 1994, the PGDP was put on the National Priorities List (NPL) and a Federal Facility Agreement (FFA) was negotiated among DOE, the Commonwealth of Kentucky, and EPA that became effective in February 1998.

D.4. PROJECT/TASK DESCRIPTION

D.4.1 PURPOSE

The purpose of this plan is to describe the practices used by EM and to ensure quality of the data collection, analytical data generation, handling, and reporting of the environmental monitoring data. It is further intended to prevent significant quality failures prior to data generation and to minimize the impact

of such failures. This plan also describes actions that are intended to ensure a high degree of confidence in the results of the EM projects for the Kentucky Department for Environmental Protection (KDEP), EPA Region 4, and the public.

D.4.2 SCOPE

EM performs effluent monitoring and environmental surveillance activities. Table D.4.1 provides a listing of the different tasks under EM.

Effluent monitoring is initiated to achieve compliance with one or more federal or state regulations, permit conditions, or environmental commitments. This consists of KPDES monitoring of DOE Outfalls; groundwater monitoring at permitted Resource Conservation and Recovery Act or solid waste landfill units, such as C-404, C-746-K, C-746-S, C-746-T, and C-746-U; and groundwater monitoring in response to administrative orders.

Table D.4.1. Summary of EM Activities

Effluent Monitoring	Groundwater Surface Water—C-746-S&T Landfill Runoff, KPDES Outfalls
Environmental Surveillance	Groundwater Surface Water Sediment External Gamma Radiation

Environmental surveillance, which excludes the effluent monitoring previously described, is defined as in-plume perimeter and off-site monitoring. Environmental surveillance activities are performed to better understand the effects of DOE operations on the quality of the regional environment, to better address public concern about off-site contamination, and to meet DOE requirements. Environmental surveillance activities consist of groundwater surveillance monitoring wells, surface water and sediment sampling, and external gamma radiation monitoring.

Other specific activities performed for both effluent monitoring, compliance monitoring, and environmental surveillance include, but are not limited to, collection of groundwater, surface water, and sediment; storing, analyzing, and shipping samples; and data evaluation, verification, validation, assessment, and reporting.

Requirements and responsibilities described in this plan apply to all routine activities conducted by EM personnel for effluent monitoring and environmental surveillance. Polychlorinated biphenyl (PCB) spills, asbestos events, and environmental spills are not within the scope of this QAPP.

D.4.3 REQUIREMENTS

The EM QAPP is written to meet requirements identified in EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans*; SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*; EPA Test Methods Series, and DOE Order 414.1C, *Quality Assurance*. This document is

supplemented by several DOE Prime Contractor procedures and other contractors' applicable plans and procedures (including a fixed-base laboratory QA plan).

D.5. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The QA objectives of EM are to generate quality assured data that ensures the data reported to EPA, KDEP, and the public is legally and scientifically defensible. The intended use of the acquired data is to provide regulatory reports and an annual site environmental report that discuss the solid and hazardous waste monitoring and the impact of PGDP operations on the environment.

Analytical data consists primarily of definitive data (formerly QC Level III and formerly QC Level IV) based on the data needs determined in the above-mentioned project objectives. Procedures used to assess precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters for data generated by EM activities are discussed below.

D.5.1 DATA QUALITY REQUIREMENTS AND PARCCS EVALUATION

This section defines the goals of PARCCS parameters for the data. Appropriate procedures and QC checks, as specified in the analytical method, are employed to assess the level of acceptance of these parameters. All sample results are reported for the data when the analytical sample set is completed. QC data generated are reported upon request. Acceptance criteria and evaluation of laboratory analytical results for the PARCCS parameters are determined according to the following outline, and the appropriate analytical method.

Once data have been reviewed, verified, and/or validated, data assessment personnel will evaluate the finalized data assessment packages against the EM program objectives. The evaluation will be used to determine whether the data meets the program objectives. The following text presents the methods used to evaluate the PARCCS parameters.

D.5.1.1 Accuracy, Precision, and Sensitivity of Analysis

The objective of the analytical QC requirements is to ensure adequate accuracy, precision and sensitivity of analysis. Samples collected for groundwater analysis during the project will be analyzed using EPA SW-846 analytical methods, for which QA/QC procedures have been established. Samples collected for KPDES will be analyzed using the analytical methods specified by the KPDES permit, or, if a method is not specified, the chosen analytical method will be an EPA approved method (e.g., SW-846 Method 8082 or EPA 200.8). Toxicity samples are analyzed in accordance with protocol published in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms,* EPA/600/4-89/001 (Second Edition). The precision and accuracy for each parameter/method are provided in the applicable methods.

- **Accuracy**

  Accuracy is defined as the nearness of a measurement to its true value. Accuracy measures the average or systematic error of a method. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the percent recovery. For organic analyses, two

types of recoveries are measured: matrix spike and surrogate spike. For a matrix spike, known amounts of standard compounds identical to the compounds present in the sample of interest are added to the sample. For a surrogate spike, the standards are chemically similar, but not identical to the compounds being analyzed in the fraction. The purpose of the surrogate spike is to provide QC on every sample by constantly monitoring for unusual matrix effects and gross sample processing errors. For inorganic analyses, only matrix spikes are measured in general. Because accuracy is often determined from spiked samples, laboratories commonly report accuracy in this form. Percent recovery is defined as

$$\% \text{ Recovery} = \frac{R-U}{S} \times 100$$

where S = concentration of spike added
U = measured concentration in unspiked aliquot
R = measured concentration in spiked aliquot

- **Precision**

Precision is the agreement between a set of replicate or duplicate measurements without assumption of knowledge of the true value. Precision is assessed by means of duplicate/replicate sample analysis. Precision can usually be expressed as relative percent difference (RPD) or relative standard deviation (RSD). The quantities are defined as follows:

$$RPD = 100 \times 2 |X_1 - X_2| / (X_1 + X_2)$$

where X_1 and X_2 are the reported concentrations for each duplicate or replicate

$$RSD = \frac{S}{X} \times 100$$

where S is the standard deviation of the series of individual measurements and X is the mean of the series of individual measurements

- **Sensitivity**

The sensitivity of analysis (or the detection limit) is determined by the analytical method and the laboratory analyst and instrumentation. During the development of data quality objective (DQOs), the required detection limit is determined based on regulatory restrictions such as maximum contaminant levels (MCLs) for drinking water standards. The analytical laboratory is requested to meet these requirements. The laboratory reporting limits (i.e., laboratory quantitation limits) are established upon the detection limits and are generally a 5 to 10 times the detection limits, as noted inSW-846, Chapter 1.

D.5.1.2 Field Representativeness, Completeness, and Comparability

The following discussion covers the DQOs of representativeness, completeness, and comparability and how these DQOs may be achievable through the field sampling operations and the analytical process.

- **Representativeness**

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. See Table D.7.1 for a list of field procedures that contribute to representativeness of the

sampled media. The documentation required in this QAP will enable checking that sampling protocols have been followed and sample identification and integrity have been assured. Field planning meetings, field assessments, and oversight by the Environmental Sampling/Well Activities Manager will provide opportunities to check that field procedures are being correctly implemented.

To ensure the representativeness of sampled media, demonstrated analyte-free water will be used in various field operations and during the preparation of trip blanks and field blanks. Samples will be preserved and maintained at specified temperatures in accordance with analytical requirements. Disposable gloves will be worn by field personnel and changed between sampling locations. The use of dedicated, decontaminated sampling equipment constructed with required material, such as Teflon® and stainless steel, also contributes to the sample's representativeness.

For the low-flow groundwater purging and sampling method, representativeness will be achieved by performing the sampling operation within the required criteria for water quality measurements, minimal drawdown, and low flow rate. The pump intake will be placed within the targeted horizon of the screened interval of the well. The water will be evacuated until water quality parameters have stabilized. Care will be taken to maintain sufficient pressure so as not to introduce air into the pump tubing. Samples will be collected with minimal turbulence directly from dedicated tubing constructed of appropriate material. The use of this sampling method should produce samples with less suspended solids than other groundwater sampling methods. Sampling methods and locations provide good representation of site characteristics.

- **Completeness**

Completeness is defined as the percentage of all measurements made whose results are judged to be valid. Invalid data will be the data that have been rejected during data validation. It is expected that the laboratory will provide valid data meeting acceptance criteria for 90% of the samples analyzed. If the data provided are less than 90% complete, an evaluation will be made to determine whether additional samples should be collected.

The completeness objective for this project is 90%.

Percent of completeness is defined as

$$\% \text{ Completeness} = \frac{V}{n} \times 100$$

where V = number of measurements judged valid
n = total number of measurements made

- **Comparability**

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data will be comparable with other measurement data for similar samples and sample conditions. Use of consistent and standardized methods and units of measurement will maintain comparability of the data. Actual detection and quantitation limits will depend on the sample matrix (necessary dilutions, etc.) and will be reported as defined for the specific samples.

D.6. SPECIAL TRAINING REQUIREMENTS/CERTIFICATIONS

Personnel are trained in the safe and appropriate performance of their assigned duties in accordance with the requirements as outlined in the project training matrix. The training matrix is divided into training related to health and safety requirements, and project-specific or job-specific training, identified as required or beneficial to perform an assigned duty or function. Based upon assigned duties, the training matrix may include, but not be limited to, the following:

Health and Safety-Related Training

- HAZWOPER training, such as 40-hour Occupational Safety and Health Administration (OSHA), 8-hour OSHA refresher, medical monitoring, and respirator training.

- Plant-specific training, such as lockout-tagout, fire watch, etc.

Project-Specific or Job-Specific Training

- Project-specific documents, such as required reading on QA/Data Management plans, Waste Management plans, Health & Safety plans, operating procedures, Chemical Hygiene Plans, and work instructions, etc.

Training files are maintained by the DOE Prime Contractor Training Organization. A training database is utilized to manage and track training. Subcontractors maintain copies of training records at the appropriate satellite temporary record storage area.

D.7. DOCUMENTATION AND RECORDS

D.7.1 DOCUMENTS, PLANS, PROCEDURES, WORK INSTRUCTIONS, AND OPERATOR AIDS

Applicable and appropriate documents, plans, and procedures utilized for EM activities are listed in D.7.1. [Note: Table D.7.1 is not a comprehensive list of all utilized documents, plans, and procedures.] Documents, plans, and procedures utilized are identified in this section and may be referenced in the appropriate section discussing each project. Procedures are managed by the DMC. The DMC ensures that the most current approved procedures and plans are available for personnel.

D.7.2 RECORDS MANAGEMENT

Records management is defined as the procedures and the process by which records will be maintained. The Environmental Monitoring team will implement the records management requirements.

Table D.7.1. DOE/DOE Prime Contractor Documents, Plans, and Procedures

Number	Title
DOE/OR/07-1707	Federal Facility Agreement for the Paducah Gaseous Diffusion Plant
DOE/OR/07-1595&D2	Data and Documents Management and Quality Assurance Plan
PAD-ENM-0811	Pesticide and PCB Data Verification and Validation
PAD-ENM-5007	Data Management Coordination
PAD-ENM-0021	Temperature Control for Sample Storage
KY0004049	KPDES Permit
KY073-00014	C-746-S Residential Landfill Permit
KY073-00015	C-746-T Inert Landfill Permit
KY073-00045	C-746-U Residential Landfill Permit
KY8-890-008-982	Hazardous Waste Facility Permit
PAD-ENM-0016	Maintenance and Use of ASTM Type II Water System
PAD-ENM-0023	Composite Sampling
PAD-ENM-0018	Sampling Containerized Waste
PAD-ENM-0025	Paducah Environmental Monitoring Waste Management Plan
PAD-ENM-0026	Wet Chemistry and Miscellaneous Analyses Data Verification and Validation
PAD-ENM-0055	Environmental Monitoring Plan
PAD-ENM-1001	Transmitting Data to the Paducah Oak Ridge Environmental Information System
PAD-ENM-1002	Submitting, Reviewing, and Dispositioning Changes to the Environmental Databases (OREIS and PEMS)
PAD-ENM-1003	Developing, Implementing, and Maintaining Data Management Implementat Plans
PAD-ENM-2100	Groundwater Level Measurement
PAD-ENM-2101	Groundwater Sampling
PAD-ENM-2203	Surface Water Sampling
PAD-ENM-2300	Collection of Soil Samples
PAD-ENM-2302	Collection of Sediment Samples Associated with Surface Water
PAD-ENM-2303	Borehole Logging
PAD-ENM-2700	Logbooks and Data Forms
PAD-ENM-2702	Decontamination of Sampling Equipment and Devices
PAD-ENM-2704	Trip, Equipment, and Field Blank Preparation
PAD-ENM-2708	Chain of Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals
PAD-ENM-5003	Quality Assured Data
PAD-ENM-5004	Sample Tracking, Laboratory Coordination, and Sample Handling Guidance
PAD-ENM-5007	Data Management Coordination
PAD-ENM-5102	Radiochemical Data Verification and Validation
PAD-ENM-5103	Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans Data Verification and Validation
PAD-ENM-5105	Volatile and Semivolatile Data Verification and Validation
PAD-ENM-5107	Inorganic Data Verification and Validation
PAD-PROJ-0025	Monitoring Well Maintenance Implementation Plan
PAD-PROJ-0061	Site Specific HASP for the Environmental Monitoring Project
PAD-QA-1210	Issues Management
PAD-QA-1220	Occurrence Notification and Reporting
PAD-QA-1420	Conduct of Assessment
PAD-RM-1009	Records Management, Administrative Record, and Document Control

D.7.2.1 Description of the Records Management System

The records management system is defined by PAD-RM-1009, *Records Management, Administrative Record, and Document Control.* This procedure establishes the requirements to ensure consistent management of records maintained by DOE Prime Contractor. The EM records are maintained at the appropriate satellite records storage area; the record copy is located within the DMC at the DOE Prime Contractor Kevil building and records that are in-use are located at the field office (C-743-T-03).

D.7.2.2 Personnel Responsible for Records

The Environmental Monitoring and Reporting Manager has direct responsibility for ensuring the requirements are adhered to as stated in this plan. The Sample/Data Management Manager is responsible for the daily activities associated with records management and implementing the requirements stated in this plan.

D.7.2.3 Identification of EM Records

Information maintained by EM includes, but is not limited to, documents, plans, procedures, logbooks, COC forms, personnel training records, and field forms. Records maintained by the DOE Prime Contractor include, but are not limited to, the following: training records, maintenance records, calibration records, assessment records, corrective action plans and evidence, procedures and work control documents, regulatory inspection records, field laboratory records, logbooks, waste inventory records, and COC.

D.7.2.4 Storage of EM Records

EM files are maintained as field operating records and are considered the project record copy.

D.7.2.5 Transfer of Records to the DMC

Documents, plans, procedures, and records to be submitted to the DMC are provided as specified in Table D.7.2.

Electronic copies of deliverables are maintained in the project files and provided to the appropriate personnel, as required.

D.7.2.6 Retention of Records

Quality records will be maintained in the DMC for duration of the project. Upon submittal of records to the DMC, the record will be identified as a quality record or otherwise. At that time, the DMC will determine the time frame for the retention of the record.

Table D.7.2. Transfer of Records to the DMC

Record Type	Storage Location	Frequency of Transfer	Comments
Training records	Kevil	As required	Submittal letter with a copy of training records will be submitted to the DMC and QA Manager.
Maintenance records	C-743-T-03	Annually	Copy of maintenance records will be submitted to the DMC.
Calibration records	C-743-T-03	Annually	Copy of calibration records will be submitted to the DMC.
Assessment records (i.e., audits, surveillances, and self assessment reports)	Kevil	Annually	Submittal letter with a copy of assessment records will be submitted to the DMC.
Corrective action plans and evidence	Kevil	As needed	Submittal letter with a copy of corrective action records will be submitted to the DMC and QA Manager.
Procedures and work control documents	Kevil	Periodically	Procedures, work instructions, and operator aids were initially submitted as required; changes will be submitted, as necessary, to the DMC.
Regulatory inspection records	Kevil	Annually	Submittal letter with a copy of regulatory inspection records will be submitted to the DMC.
Logbooks	C-743-T-03	Annually	Original logbooks will be submitted to the DMC.
Waste inventory records	C-743-T-03	Project completion	Copy of the waste inventory records will be submitted to the DMC.
Chain-of-custody	C-743-T-03	Monthly	Copy of each chain-of-custody is sent to Sample/Data Management.
Data Assessment Packages	Kevil	Annually	Data assessment packages will be submitted to the DMC.
Laboratory Data Packages	Kevil	Annually	Copies of laboratory data packages will be submitted to the DMC.

D.8. SAMPLE PLANNING, MANAGEMENT, AND MEASUREMENT/DATA ACQUISITION

Many types of data are collected to measure and monitor effluents from DOE operations and to maintain surveillance on the effects of those operations on the environment and public health. Data types collected for EM are described in the following sections and consist of sample information, field measurements, and definitive data. Data are collected in accordance with requirements PAD-ENM-5003, *Quality Assured Data*.

D.9. DATA COLLECTION DESIGN

The EMP provides detailed information on sampling locations, the types of samples and sample parameters required at each location, and the frequency of collection for EM samples.

D.9.1 SAMPLE INFORMATION

Sample information is environmental data describing the sampling event and consists of the following: station (or location), date collected, time collected, and other sampling conditions collected for every sampling event. This information is recorded in logbooks and may be included on the COC or sample labels. This information is input directly into ES PEMS, as applicable.

D.9.2 FIELD MEASUREMENTS

Field measurements are measurements of a parameter that are collected real-time in the field. Field measurements for EM include water level measurements, pH, specific conductance (conductivity), flow rates, temperature, barometric pressure, residual chlorine, turbidity, reduction-oxidation potential (RedOx or Eh), dissolved oxygen, and depth to water.

Field measurements are taken and recorded on appropriate field forms or in logbooks and input into ES PEMS. If field forms are used, they are input and QC checked against the field logbook by appropriate data personnel. Criteria for field measurements are provided in Table D.9.1.

For the collection of depth to water and quarterly water level measurements, the tape measure must be checked against a source on an annual basis.

D.9.3 DEFINITIVE DATA

Definitive data is defined as the analytical and biological monitoring data generated by the fixed-base laboratory. Analyses are specified in Appendix C of the EMP Definitive data generated by the fixed-base laboratory is required to undergo a laboratory data review for consistency and completeness in accordance with the fixed-base laboratory QA plan. The primary data outputs include data packages (i.e., hard copies) and EDDs.

All data packages received from the fixed-base laboratory are tracked, reviewed, and maintained in a secure environment. The primary individual responsible for these tasks is the Sample/Data Coordinator. PAD-ENM-5007, *Data Management Coordination*, provides the process of evaluating the quality of laboratory EDDs.

Table D.9.1. Field Measurement Criteria

Sampling Activity	Field Screening Method*	Criteria for Sample Selection
Low-Flow/Minimal Drawdown Groundwater Sampling	Field measurements performed consist of pH, specific conductance, turbidity, dissolved oxygen, temperature, and oxidation reduction potential (Eh).	• pH must read within the ± 0.2 range; • Temperature must read within ± 0.2°C • Conductivity must read ± 1% of reading, ±1 count • Dissolved oxygen must read within ± ± 0.2 mg/L ≤ 20 mg/L, ± 0.6 mg/L > 20 mg/L • Turbidity must read within ± 5% of reading ± 1 nephelometric turbidity unit • Oxidation reduction potential must read within ± 25 mV
Surface Water Sampling	Field measurements for pH, specific conductance, temperature, dissolved oxygen, total residual chlorine, and flow rate.	• pH must read within the ±0.2 range; • Temperature must read within ± 1°C • Conductivity must read ± 20 µmhos/cm • Dissolved oxygen must read within ± 0.5 mg/L • Total residual chlorine is performed using amperometric titrator; no particular range is required • Flow rate is determined by using the ISCO open channel flow flume located at the outfalls or by the Stream Discharge Calculation on open streams

***** Field measurements are identified on a project basis. Appendix C of the PAD-ENM-0055, *Environmental Monitoring Plan*, lists the project-specific measurements.

D.10. SAMPLING METHODS REQUIREMENTS

The DQOs discussed in Section 5 are used to create Statements of Work (SOWs) for sampling and analyses to be performed. This information is input into ES PEMS for the purpose of sample planning, scheduling, and management. ES PEMS is used to plan sampling and manage data. ES PEMS performs the following functions:

- Generates COC records and sample labels;
- Tracks sample collection and shipment;
- Manages field-generated data;
- Imports laboratory-generated data;
- Updates field and laboratory data based on integrated data verification and validation;
- Reports data for project use; and
- Formats data for transfer to Paducah OREIS.

Requirements for addressing the day-to-day operations of ES PEMS include data entry, backups, security, and interface with the Sample and Data Management Organization (SMO). A QC check of the sample information and measurements data entry is made and involves comparing printouts of 100% of the data in ES PEMS to the original COC, field form, logbook, or instrument printout. Guidelines set forth in PAD-ENM-5007, *Data Management Coordination*, are followed. The QC check should be appropriately documented.

System backups are performed daily by the Network Administrator. Backups follow normal protocol maintained by the Network Administrator. Upon completion of the EM project, ES PEMS will be stored on a zip disk or other form of electronic media, and transferred to the t for archival. Security of the data within ES PEMS is essential for the success of EM. The security precautions and procedures implemented by the data management team are designed to minimize the vulnerability of the data to unauthorized access or corruption. ES PEMS users have network passwords and have installed password-protected screen savers.

D.11. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Samples are uniquely identified by a sample identification number. Sample identification numbers for EM are identified in ES PEMS and are assigned by the Sample/Data Management Manager according to the project, sample type, and location. Examples of sample numbering schemes are found in the Data Management Implementation Plan.

Sample Handling Procedures and Documentation. The samples are properly preserved, packaged, and delivered to the laboratory under proper COC. The following procedures are used for handling samples:

- PAD-ENM-5003, *Quality Assured Data*
- PAD-ENM-2700, *Logbooks and Data Forms*
- PAD-ENM-2708, *Chain of Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*
- PAD-ENM-5007, *Data Management Coordination*
- PAD-ENM-5004, *Sample Tracking, Laboratory Coordination, and Sample Handling Guidance*
- PAD-ENM-2704, *Trip, Equipment, and Field Blank Preparation*
- PAD-ENM-2702, *Decontamination of Sampling Equipment and Devices*

Documentation from the sample collection process is in the form of logbooks, COC forms, and other records. Prior to the shipment of samples to fixed-base laboratories, a copy of the COC is to be provided to the Sample/Data Coordinator. The SMO assists with the coordination of sample shipments to a fixed-base laboratory. Shipping COCs will be provided prior to sample shipments for off-site, fixed-base laboratory services.

D.12. ANALYTICAL METHOD REQUIREMENTS

When available and appropriate for the sample matrix, SW-846 methods or EPA methods are used. When not available, other nationally recognized methods such as those of DOE, EPA, and the American Society for Testing and Materials will be used. Analytical methods, analytical parameters, and reporting limits are identified in the analytical SOWs in ES PEMS. [Note: If no specific reporting limit is required by a

specific project, a reporting limit will not be provided in the SOW. In these cases, the laboratory will report its applicable and appropriate reporting limit for the method.]

D.13. QUALITY CONTROL REQUIREMENTS

D.13.1 FIELD QUALITY CONTROL SAMPLES

Table D.13.1 provides a summary of the field QC samples that are taken for the EM samples. Field QC samples include field blanks, equipment blanks, field duplicates, and trip blanks. QC samples for EM activities are collected 1 per every 20 samples, as defined by SW-846, *Test Methods for Evaluating Solid Waste*. These samples will be analyzed in the same manner as the field samples.

- Field Duplicates (or Replicates)

  Field duplicate samples are collected and analyzed to assess the overall precision of the field and laboratory effort. Field duplicate samples, of a similar matrix, will be collected at a rate of 5% or one per 20 samples or fewer.

- Trip Blanks

  Trip blanks are used to determine whether on-site atmospheric contaminants are seeping into the sample vials, or if any cross-contamination of samples is occurring during shipment or storage of sample containers. A trip blank consists of demonstrated analyte-free water sealed in 40-mL Teflon septum vials with no headspace (or bubbles) in the vials. Trip blanks are to be kept in close proximity to the samples being collected and will be maintained at $4^{o}C$ and handled in the same manner as the other volatile organic compounds (VOCs) aqueous samples. Trip blanks are collected when VOCs are collected at a frequency of one per 20 environmental samples or one per cooler per day, whichever is more frequent. Trip blanks will be analyzed for volatile organics only.

- Field Blanks

  A field blank is a sample that serves as a check on environmental contamination at the sample site. Analyte-free water is transported to the site, opened in the field, transferred into each type of sample bottle, and returned to the laboratory for analysis of all parameters associated with that sampling event. It is also acceptable for field blanks to be filled in the lab, transported to the field, and then opened. Field blanks may be used as a reagent blank, as needed. One field blank will be collected per every 20 environmental samples.

- Equipment Blanks (or Rinseates)

  An equipment blank is a sample of analyte-free water passed through decontaminated sampling equipment. Equipment blanks are used as a measure of decontamination process effectiveness and are analyzed for the same parameters as the sample collected with the equipment. Equipment blanks may also be used as a reagent blank, as needed. Equipment blanks are required only when nondisposable, non-dedicated equipment is being used. Equipment blanks are collected at a frequency of one per 20 environmental samples.

Table D.13.1. Field QC Samples

QC Samples	Frequency
Field Duplicates	One per 20 samples
Trip Blanks	One per cooler per day
Field Blanks	One per 20 samples
Equipment Blanks	One per 20 samples

D.13.2 INTERNAL QC CHECKS AND FREQUENCY FOR LABORATORY ANALYSIS

The fixed-base laboratory has an established internal QC program that is managed by the laboratory supervisors. QC samples are run in accordance with the applicable regulatory procedure or method. Where regulatory methods do not apply, QC is defined in the technical procedure.

Independent Quality Control

The fixed-base laboratories are directed by DOE and EPA regulators to participate in independent QC programs, such as Proficiency Evaluation Testing and Proficiency Acceptance Testing, etc. The site fixed-base laboratory participates in additional voluntary independent programs to improve analytical QC. These programs generate data that are readily recognizable as objective measures, allowing the participating laboratory and government agencies a periodic review of their performance. Results that exceed acceptable limits are investigated and documented according to formal procedures. Although participation in a certain program is mandated, the degree of participation is voluntary so that each laboratory can select parameters of particular interest to that facility. These programs are conducted by EPA, DOE, and commercial laboratories.

EPA has an additional QA program known as the Discharge Monitoring Report– Quality Assurance (DMR-QA) study. This study applies to all major and selected minor permittees under the National Pollutant Discharge Elimination System (NPDES). The purpose is to evaluate the analytical and reporting ability of the laboratories routinely performing the inorganic chemical and whole-effluent toxicity self-monitoring analyses required in NPDES permits. The results are reported on an annual basis upon the request of the DMR-QA Coordinator.

D.14. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Any equipment (an inclusive term for tools, gauges, instruments, and other items that have specific preventive maintenance) is serviced as specified by manufacturers recommended schedule. Maintenance activities are documented in the appropriate logbook. Out-of-service equipment is clearly tagged. Changing or removing status indicators is the responsibility of the Surveillance and Maintenance Manager. Spare parts are maintained for equipment as needed.

The laboratories are also responsible for implementing preventive maintenance procedures, schedules, and record keeping similar to those described previously for field equipment on instruments and equipment. For additional information, refer to the fixed-base laboratory QA Plan.

D.15. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

D.15.1 FIELD EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

Calibration of equipment is performed according to manufacturer's specifications. Field instrument calibrations are documented in field logbooks.

D.15.2 LABORATORY EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

Laboratory equipment calibration procedures and frequencies associated with samples collected in support of EM and submitted to fixed based laboratories will be in accordance with the associated analytical method.

D.16. INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES (PROCUREMENT)

Inspection/acceptance requirements for supplies and consumables are managed in accordance with the LATA Kentucky Quality Program and QA procedures.

D.17. DATA ACQUISITION REQUIREMENTS (NONDIRECT MEASUREMENT)

All historical data used in support of EM is downloaded or directly accessed from Paducah OREIS, if available. If historical data required for EM are not available from Paducah OREIS, other databases, records, etc., may be used with the approval of the Sample/Data Management Manager.

D.18. DATA MANAGEMENT

LATA Kentucky utilizes ES PEMS for sample scheduling, collection, and tracking each sample and associated data from the point of collection through final data reporting. ES PEMS tracking includes field forms, COCs, hard copy data packages, and EDDs. Data are entered as the project progresses. All field measurement data, analytical data, sampling information, and other pertinent information are entered into ES PEMS.

Field measurement data and sampling information are entered into ES PEMS on a routine basis. Analytical EDDs are loaded to ES PEMS as they are provided by the laboratories. Project data sets are verified, validated (if applicable) and assessed. Once the assessment is complete, an ASCII file is prepared with the project data and associated QC samples for inclusion into Paducah OREIS and for official reporting.

D.19. ASSESSMENT/OVERSIGHT

D.19.1 ASSESSMENTS AND RESPONSE ACTIONS

Audits and surveillances are performed to review and evaluate adherence to requirements. Unscheduled and scheduled audits and surveillances may be performed to verify compliance with all aspects of the QA Program and determine the program's effectiveness. These audits and surveillances are conducted in accordance with written procedures and checklists and are performed by personnel who do not have direct responsibility for performing the activities being audited.

Independent assessment activities include reviewing documents and monitoring work activities to provide an effective real-time means of evaluating the adequacy and effectiveness of methods for achieving quality.

Management assessments are conducted in accordance with a schedule prepared by the Environmental Monitoring and Reporting Manager.

Corrective actions of internal audit/surveillance findings and nonconformances are managed in accordance with the LATA Kentucky quality program and applicable procedures.

D.19.2 REPORTS TO MANAGEMENT

Reports providing a status update on the activities affecting quality are provided to management upon request.

D.20. DATA VALIDATION AND USABILITY

D.20.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

The data review process determines whether a set of environmental data satisfies the data requirements defined during DQOs. This process involves the integration and evaluation of all information associated with a result. Data review consists of an evaluation of the following: data authenticity, data integrity, data usability, and outliers. The data review process is conducted using the checklists from PAD-ENM-5003, *Quality Assured Data*. This checklist provides a listing of the QC elements that may be applicable to each groundwater and EM program. Checklists are completed as required for reporting.

D.20.2 INITIAL DATA REVIEWS

Initial data reviews are conducted by a technical reviewer, prior to submitting documents, plans, data, etc., to the project manager for review and approval.

D.20.3 FINAL DATA REVIEW AND DATA USAGE

Final data reviews are performed prior to release of data to external agencies to ensure accuracy in reported results. The final data review steps are performed by the Environmental Monitoring and Reporting Manager, Sample/Data Management Manager, and other EM team members, as appropriate.

D.20.4 VALIDATION AND VERIFICATION METHODS

Data verification and validation is performed according to PAD-ENM-5003, *Quality Assured Data* and the following procedures:

- PAD-ENM-5105 *Volatile and Semivolatile Data Verification and Validation*
- PAD-ENM-5107, *Inorganic Data Verification and Validation*
- PAD-ENM-5103, *Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans Verification and Validation*
- PAD-ENM-5102, *Radiochemical Data Verification and Validation*
- PAD-ENM-0026, *Wet Chemistry and Miscellaneous Analyses Data Verification and Validation*
- PAD-ENM-0811, *Pesticide and PCB Data Verification and Validation*

D.20.5 RECONCILIATION WITH USER REQUIREMENTS

The equations used for precision, accuracy, and completeness will be used to quantitatively compare sample data results with the required DQOs. Any DQO deviations and/or data outliers will be discussed with the appropriate personnel to determine possible causes for such conditions. Discussions, evaluations, and conclusions as a result of the above assessments will be consolidated into the data assessment report. The assessment qualifiers and supporting comments will note any limitations on the use of the data.

ATTACHMENT 1

ENVIRONMENTAL MONITORING ORGANIZATIONAL CHART

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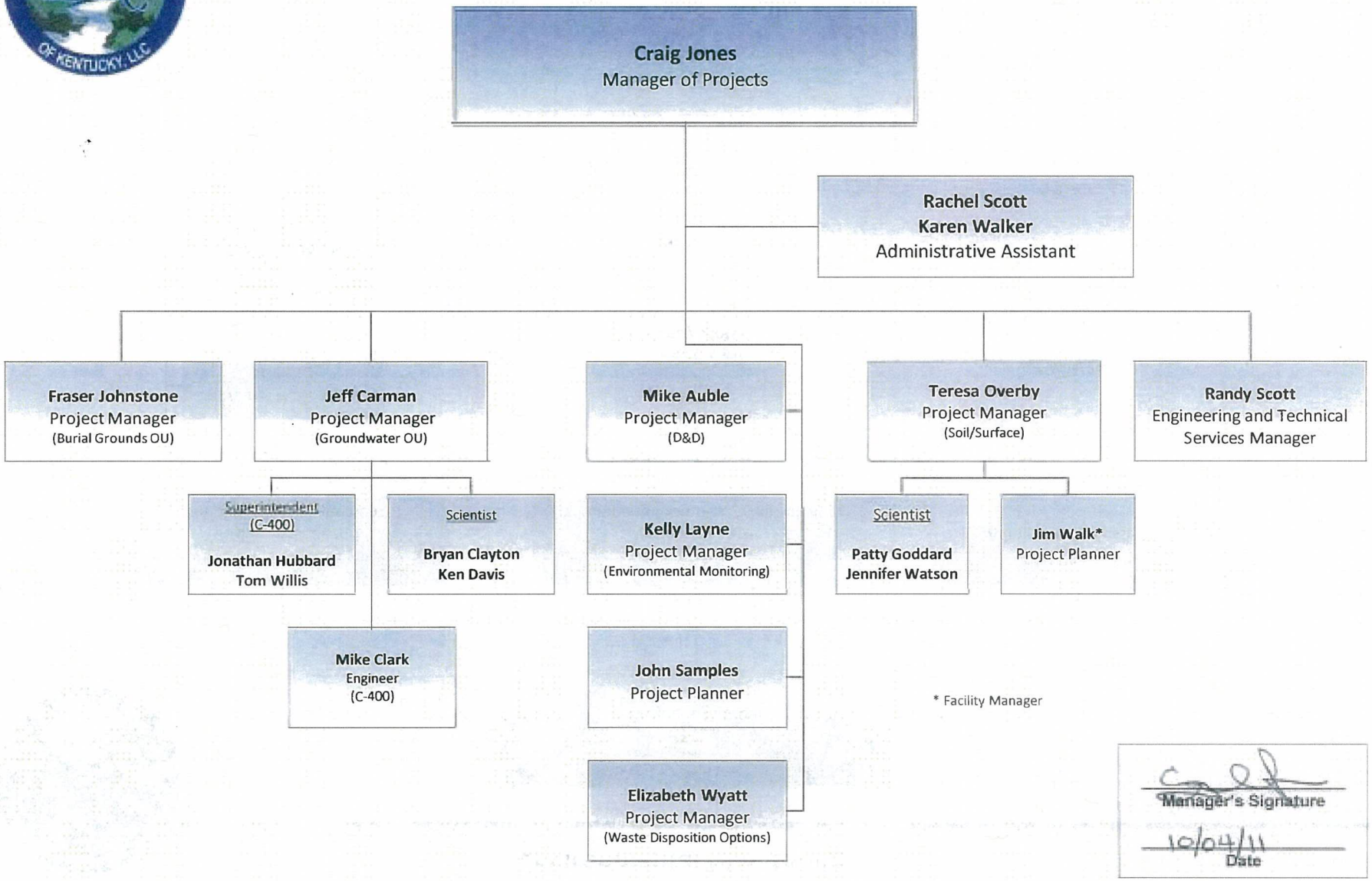
Projects



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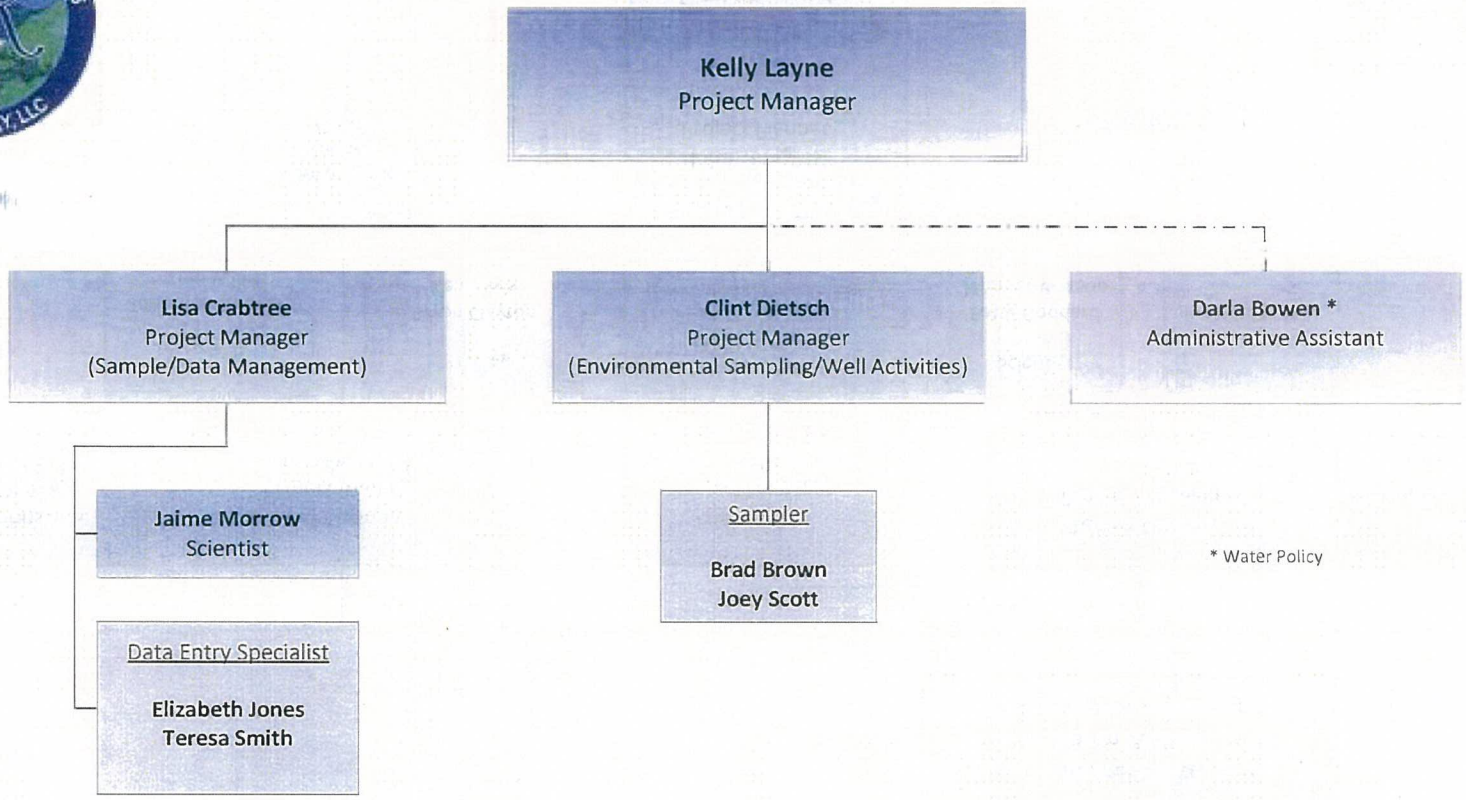
Environmental Monitoring



Manager's Signature

10/3/2011
Date

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