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Bechtel Jacobs Company LLC

DOE Contract No. DE-AC05-98OR22700
Job No. 23900
December 4, 2002

RECORD COPY

Mr. W. Don Seaborg
Paducah Site Manager
Department of Energy
P.O. Box 1410
Paducah, KY 42002-1410

Subject: Environmental Monitoring Plan, Calendar Year 2003, Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Dear Mr. Seaborg:

Enclosed is the E*nvironmental Monitoring Plan, Calendar Year 2003, Paducah Gaseous Diffusion Plant, Paducah, Kentucky.* This plan contains the rationale and design criteria for the monitoring program, extent and frequency of monitoring and measurements, methods for laboratory analyses, quality assurance requirements, and program implementation procedures. This plan reflects the importance of monitoring as a critical element of an effective environmental protection program. A summary is included to provide a listing of changes made from the CY 2002 Environmental Monitoring Plan.

If you have any questions or require additional information, please contact Danny Guminski at (270) 441- 5051 or John Young at (270) 441-5077.

Sincerely,

Gordon L. Dover
Paducah Manager of Projects

GLD:sm
LTR-PAD/ESS-JB-02-0179

Enclosures: 1. *Environmental Monitoring Plan, Calendar Year 2003, Paducah Gaseous Diffusion Plant, Paducah Kentucky*

c/w enc: EIC
File-EMEF-DMC-PAD-RC

c/w/o encs: J. D. Young
File-CDM/ESS

Attachment 1

Summary of Changes to the 2003 Environmental Monitoring Plan

C-746-S, T, and U Landfill Groundwater

- No change in parameters
- Incorporated new wells

Future Action – Request KDWM to reduce parameters (some rad and PCBs) – Due Date: February 28, 2003

C-404 Groundwater

- Added turbidity and Eh as field measurements
- Incorporated new wells (MW90A and MW95A)

C-746-K Groundwater

- Added turbidity and Eh as field measurements
- Deleted strontium
- Deleted hexavalent chromium, total suspended solids, and silica
- Added calcium, chloride, sulfate, and nitrate
- Added ferrous iron and alkalinity as field measurements

Northeast Plume Groundwater

- Added turbidity and Eh as field measurements

Northwest Plume Groundwater

- Added turbidity and Eh as field measurements

Future Action – Determine approach for reduction of parameters. Due Date: February 28, 2003

Residential and Carbon Filter

- No change

Future Action – Determine if changes in the residential reporting should be implemented. Due Date: January 31, 2003

Surveillance Quarterly Groundwater – Changed to Semiannual Monitoring

- Added turbidity and Eh as field measurements
- Combined old quarterly and semiannual locations

Surveillance Semiannual Groundwater – Changed to Attenuation Semiannual Monitoring

- Added iron, sodium, potassium, magnesium, manganese, and calcium to metals listing
- Added turbidity and Eh as field measurements
- Added alkalinity and ferrous iron as field measurements
- Added chloride, sulfate, nitrate, and total organic carbon
- Utilized list of wells provided by BJC groundwater subject matter expert

Surveillance Radiological Groundwater

- Removed americium, cesium, plutonium, neptunium, cobalt
- Added thorium-234

Landfill and KPDES Surface Water

- No change

Watershed Monitoring

- No change

Future Action – Determine path forward for submitting a revised plan for approval to KDOW.
Due Date: February 28, 2003

Quarterly Surface Water Sampling

- Deleted 2-propanol and acetone
- Modified seep sampling requirements to be consistent with groundwater surveillance
- Deleted 7 locations from quarterly sampling
- Added 6 locations from semiannual sampling
- Added thorium-234
- Deleted BOD and CBOD
- Added field measurements

Semiannual Surface Water Sampling

- Eliminated – incorporated locations into quarterly program

Semiannual Sediment Sampling

- Removed locations LBCN1, K006, K010, K012
- Deleted aliphatic hydrocarbons, PAHs, pesticides/herbicides, and semivolatiles
- Added TOC

Annual Deer Sampling

- Removed strontium and cesium in bone.
- Removed cesium in liver and muscle

Landfill Leachate Sampling (C-746-S&T, C-746-U, C-404)

- Included annual leachate list from new landfill permits

TLD Monitoring Locations

- Added neutron monitoring locations

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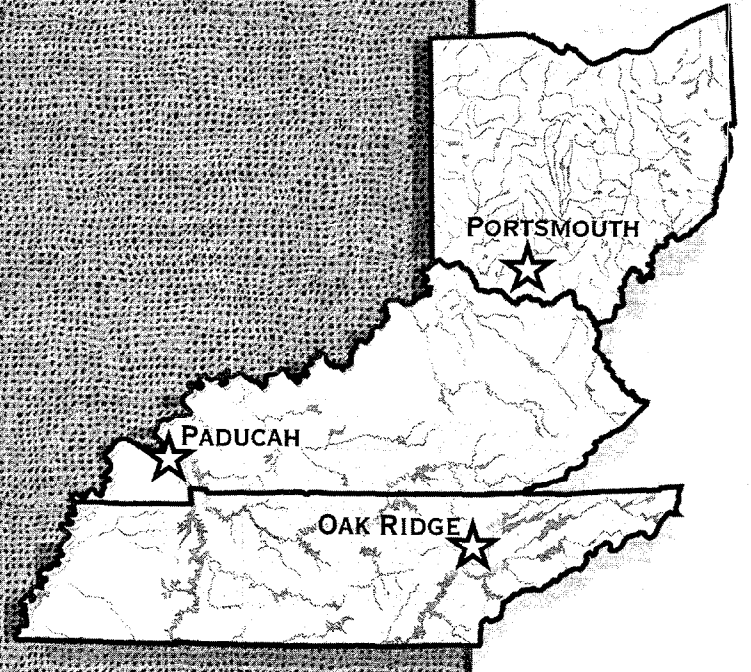
ENVIRONMENTAL MANAGEMENT

& ENRICHMENT FACILITIES

MANAGEMENT AND INTEGRATION CONTRACT

Environmental Monitoring Plan Calendar Year 2003 Paducah Gaseous Diffusion Plant, Paducah, Kentucky



MANAGED BY
BECHTEL JACOBS COMPANY LLC
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

BJC/PAD-285/R1

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA ·

This document has received the appropriate reviews for release to the public.

BJC/PAD-285/R1

Environmental Monitoring Plan
Calendar Year 2003
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

Date Issued—November 2002

Prepared by
CDM Federal Services Inc.,
under subcontract 23900-SC-RM056F

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

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Oak Ridge Y-12 Plant Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant Portsmouth Gaseous Diffusion Plant
Under Contract No. DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

CONTENTS

TABLES

FIGURES

ACRONYMS

AIP	Agreement in Principle
ASER	Annual Site Environmental Report
BJC	Bechtel Jacobs Company
CAP-88	Clean Air Act Assessment Package-88
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
CY	calendar year
DCG	Derived Concentration Guide
DOE	Department of Energy
DQO	Data Quality Objectives
DUF_6	Depleted Uranium Hexafluoride
EDE	Effective Dose Equivalent
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
ETTP	East Tennessee Technology Park
FFA	Federal Facilities Agreement
GWPP	Groundwater Protection Program
GWPMP	Groundwater Protection Management Plan
KAR	Kentucky Administrative Regulation
KDFW	Kentucky Department of Fish and Wildlife
KDOW	Kentucky Division of Water
KDWM	Kentucky Division of Waste Management
KOW	Kentucky Ordnance Works
KPDES	Kentucky Pollutant Discharge Elimination System
MW	Monitoring Wells
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
OECD	Office of Environmental Compliance and Documentation
OREIS	Oak Ridge Environmental Information System
PCB	Polychlorinated Biphenyl
PEMS	Paducah Project Environmental Management System
PGDP	Paducah Gaseous Diffusion Plant
QA	Quality Assurance
QC	Quality Control
QA/DM	Quality Assurance/Data Management
RADCON	Radiological Control Organization
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RFIs	Remedial Feasibility Investigations
SARA	Superfund Amendments Reauthorization Act
SMO	Sample Management Organization
SOW	Statement of Work
STR	Subcontract Technical Representative
SWMU	Solid Waste Management Unit
^{99}Tc	Technetium-99
TCE	Trichloroethene

TLD	Termoluminescent Dosimeter
TRE	Toxicity Reduction Evaluation
^{234}U	Uranium-234
^{235}U	Uranium-235
^{238}U	Uranium-238
UF_6	Uranium Hexafluoride
UCRS	Upper Continental Recharge System
USEC	United States Enrichment Corporation
Water Policy	The Action Memorandum for the Water Policy at PGDP
WKWMA	West Kentucky Wildlife Management Area
WMP	Watershed Monitoring Program
WQM	Water Quality Management

EXECUTIVE SUMMARY

Department of Energy (DOE) Order 5400.1 defines *environmental monitoring* as the collection and analysis of samples or direct measurements of environmental media. Environmental monitoring consists of two major activities: 1) effluent monitoring and 2) environmental surveillance. Data Quality Objectives are conducted whenever changes to the sampling program are required.

The Environmental Monitoring Program at the Paducah Site is intended to govern routine monitoring. The Paducah Environmental Monitoring Plan also supplements the Paducah Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigations. Currently there are five defined CERCLA operable units (i.e. surface water, groundwater, surface soils, burial grounds, and decommissioning and decontamination) that have been, or will be, investigated under the Paducah Federal Facilities Agreement. Upon completion of response action activities for these five operable units, a Comprehensive Site Wide Operable Unit will be implemented in accordance with the Paducah Federal Facilities Agreement. The routine Environmental Monitoring Program will be integrated with each operable unit investigation to provide collection of optimal data sets. For example, where appropriate, existing routine environmental monitoring data will be reviewed and utilized prior to an operable unit investigation. Furthermore, if additional routine data is determined to be needed as a result of an operable unit investigation, it will be addressed in future Environmental Monitoring Plans.

Appendix C is a planning document for all DOE environmental monitoring and surveillance activities at the Paducah Site. Appendix C also lists sites to be monitored, the governing program(s), wells, parameters, and the frequency of sample collection.

1. INTRODUCTION

1.1 PURPOSE

The Environmental Monitoring Plan (EMP) for the Paducah Site is a document providing a single point of reference for all the effluent monitoring and environmental surveillance programs at the site. The purpose of this EMP is to define and document the requirements for Environmental Monitoring Programs at the Paducah Site in conformity with the requirements of the Department of Energy (DOE) Order 5400.1, *General Environmental Protection Program* and DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (hereafter referred to as the *Regulatory Guide*). DOE is currently circulating for final comments *Draft Order 450.1, Environmental Protection Program.* Upon issuance of DOE Order 450.1, the EMP will be updated as needed and changes related to DOE Order 450.1 will be incorporated.

1.2 SCOPE

This EMP sets forth the requirements for the Environmental Monitoring Programs established to: 1) measure and monitor effluents from DOE operations and 2) through measurement, monitoring, and calculation, maintain surveillance on the effects of those operations on the environment and public health. Although the evaluation and assessment of unplanned releases are addressed in this plan, emergency monitoring and responsibilities for this activity are not included. As part of the ongoing environmental restoration activities, Solid Waste Management Units (SWMUs) and areas of concern, both on and off DOE property have been identified. Characterization and/or remediation of these sites will continue pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and Hazardous and Solid Waste Amendments corrective action conditions of the Resource Conservation and Recovery Act (RCRA) Permit. RCRA and CERCLA requirements are coordinated by DOE, Environmental Protection Agency (EPA), and Commonwealth of Kentucky through the Federal Facilities Agreement (FFA) which DOE, EPA, and the Commonwealth of Kentucky signed in 1998. The prior requirements of the Administrative Consent Order were superceded by the execution of the FFA. This EMP is updated annually and revised every three years. These revisions incorporate any newly released contaminants detected during a site investigation as part of environmental remediation or other studies. In addition, existing environmental monitoring data will be utilized, as appropriate, prior to implementing remedial investigation (RI) activities.

1.3 GENERAL CONSIDERATIONS

1.3.1 Facility Description

The Paducah Site, which contains the Paducah Gaseous Diffusion Plant (PGDP), is a government-owned facility within the DOE complex. As of July 1, 1993, responsibility for environmental monitoring was split between DOE and United States Enrichment Corporation (USEC). DOE is the site owner and operator of waste management and environmental remediation projects and management of the DOE uranium hexafluoride (UF_6) cylinder inventory at the Paducah Site. USEC, which operates the uranium enrichment facilities of the PGDP, was a government-owned corporation from July 1993 to July 1998, at which time it became a privately-owned corporation. This EMP addresses monitoring and surveillance of only DOE activities at the Paducah Site.

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The PGDP is a uranium enrichment facility consisting of a diffusion cascade and extensive support facilities. The cascade is housed in five buildings covering a total of about 75 acres. Construction at the plant began in 1951 and by 1952 operations were underway. PGDP serves as a first step in the uranium enrichment process. The PGDP enriches the uranium-235 (^{235}U) isotope via a physical separation process based on the faster rate at which ^{235}U diffuses through a barrier compared with the heavier uranium-238 (^{238}U) isotope. Radionuclides associated with this process are primarily uranium-234 (^{234}U), ^{235}U, ^{238}U, and technetium-99 (^{99}Tc). Hazardous, nonhazardous, and radioactive wastes resulting from PGDP operations are disposed of or stored.

1.3.2 Measuring Facility Impact

The *Regulatory Guide* requires comparisons of contaminants measured in the Environmental Monitoring Program to "background" concentrations. For the purposes of this report, a "background" location is called a reference location and is defined as an area unaffected by releases from or operation of DOE or USEC facilities. 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 DOE boundary.

1.4 PROGRAM OBJECTIVES

The Environmental Monitoring Program shall be implemented to help determine:

- compliance with all applicable environmental quality standards, public exposure limits, and compliance with applicable federal, state, and local effluent regulations and DOE Orders, including DOE Orders 5400.1, *General Environmental Protection Program,* and 5400.5, *Radiation Protection of the Public and the Environment*, the *Regulatory Guide*, and environmental commitments made in environmental impact statements, environmental assessments, or other official DOE documents;
- reference levels and site contributions of radioactive and chemical materials in the environment;
- effectiveness of effluent treatment and controls in reducing effluents and emissions;
- validity and effectiveness of models to predict the concentration of pollutants in the environment;
- long-term buildup from site-released radioactive and chemical material, and the direction of long-term trends;
- presence and quantification of unplanned releases; and
- need for permit revisions and/or reissuances.

It will also:

- provide information to the public on the releases from and potential impacts of DOE operations to the public and the environment;
- distinguish DOE operations pollutant contributions from other local sources where possible;
- provide ancillary data that may be required to assess the consequences of an accident;
- identify significant changes in sample analytical results;
- supplement other RI data;
- support data needs for operable units in some instances; and
- provide a mechanism for long term data collection needs under the FFA when applicable.

1.5 OVERVIEW

The preceding section describes the general objectives contained in DOE Orders 5400.1, 5400.5, and the *Regulatory Guide* for Environmental Monitoring Programs.

Bechtel Jacobs Company LLC (BJC) is responsible for Sect. 2, which presents the DOE programs for monitoring liquid (surface water and groundwater) and airborne effluents. Section 3 addresses the Meteorological Monitoring System, which is operated by USEC. Section 4 addresses, by individual media, environmental surveillance activities undertaken to monitor the effects of DOE operations on the on-site and off-site environment.

The remaining sections of the EMP describe the laboratory procedures, dose calculations, data management activities, reporting requirements, and the Quality Assurance Plan and Data Management (QA/DM) that support the Environmental Monitoring Program.

DOE Order 5400.1 requires that this EMP be reviewed annually and updated a minimum of every three years or as often as warranted by changes to the Environmental Monitoring Program.

2. EFFLUENT MONITORING

For the purposes of this document, monitoring is defined to include both sampling and the measurement of a parameter (e.g., pH, temperature) without the physical collection of a sample. Sampling refers to the actual collection of a representative portion of the medium for subsequent analysis for chemical/radiological species.

Environmental monitoring, as defined by DOE Order 5400.1, consists of 2 components: 1) effluent monitoring and 2) environmental surveillance (discussed in Sect. 4). Effluent groundwater, surface water, and air monitoring is the collection and analysis of samples, or direct measurements of liquid and gaseous effluents for the purpose of characterizing and quantifying contaminants, assessing radiation exposures of members of the public, providing a means to control effluents at or near the point of discharge, and demonstrating compliance with applicable standards and permit requirements. Effluent monitoring is initiated to demonstrate compliance with one or more federal or state regulations, permit conditions, or environmental commitments made in environmental impact statements, environmental assessments, DOE orders and guides, or other official documents. Included under this heading are: the Kentucky Pollutant Discharge Elimination System (KPDES) permitted discharges of surface waters; surface water, groundwater, and leachate monitoring at either interim-status or permitted-status RCRA units; solid waste landfills; and RCRA facilities in conjunction with CERCLA actions [e.g., RI/feasibility study (FS)]; monitoring at landfills in compliance with permit regulations; and monitoring of SWMUs and areas of concern in accordance with the CERCLA FFA and RCRA corrective actions. Table 2.1 lists the various routine effluent monitoring activities performed at the Paducah Site. A summary of permits and compliance agreements are listed in Appendix A.

Table 2.1 Routine effluent monitoring

Program	Number of Locations	Sampling Frequency	Parameters
Groundwater			
C-746S&T	19	Quarterly	See Appendix C
C-746-U	21	Quarterly	
C-404	14	Semiannual	
C-746-K	4	Quarterly	
NE Plume	13	Quarterly	
NW Plume	18	Quarterly	
Residential	18	Semiannual	
	3	Monthly	
Monitoring Well 66	1	Monthly	
Water Levels	85	Quarterly	
	91	Annually	
Surface Water			
C-746-S&T	3	Quarterly	See Appendix C
C-746-U	3	Quarterly	
KPDES			
Chemical	1	Weekly	See Appendix C
	4	Monthly	
Toxicity	4	Quarterly	

Table 2.1 Continued

Program	Number of Locations	Sampling Frequency	Parameters
Watershed Biological Monitoring			
Bioaccumulation	5	Annually	See Appendix C
Fish Community	9		
Benthic Macroinvertebrates	9		
Landfill Leachate			
C-746-S&T	2	As required	See Appendix C
C-746-U	1		
C-404	1		
* C-637 Cooling Tower	1	Monthly	n/a
** Ambient Air	n/a	n/a	n/a
*** Meterologic	n/a	n/a	n/a

* Sample Collected under Northeast Plume Operations
** Operated by Agreement in Principle (AIP) personnel
*** Operated by USEC

2.1 LIQUID

2.1.1 Groundwater

2.1.1.1 Site geology and hydrogeology

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 sediments unconformably overlying Paleozoic bedrock. Fig. 2.1 presents a schematic cross-section that illustrates regional stratigraphic relationships. The *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III* (Clausen 1992) discusses geology and hydrogeology of the Paducah Site in detail. More recent discoveries regarding the geology and hydrogeology at the Paducah site are covered in the *Groundwater Conceptual Model for the Paducah Gaseous Diffusion Plant* (Jacobs, 1997). Below is a summary of the Paducah Site geology and hydrogeology.

Geology. Paleozoic bedrock located below the Paducah Site consists of Mississippian age limestone. The Upper Cretaceous Tuscaloosa Formation has not been encountered during drilling activities conducted at the site. Rather, the site bedrock is overlain by the Upper Cretaceous McNairy Formation, which consists of interbedded and interlining sand, silt, and clay. Data indicate that sand may account for 40 to 50 percent of this formation near the site. The Porters Creek Clay is Paleocene in age and occurs in the southern portions of the site and consists of dark-gray-to-black clay with varying amounts of silt and fine-grained, micaceous, commonly glauconitic sand. The Eocene Sands consisting of interbedded and interlining sand, silt, and clay, overlie the Porters Creek Clay in the extreme southern portion of the Paducah Site.

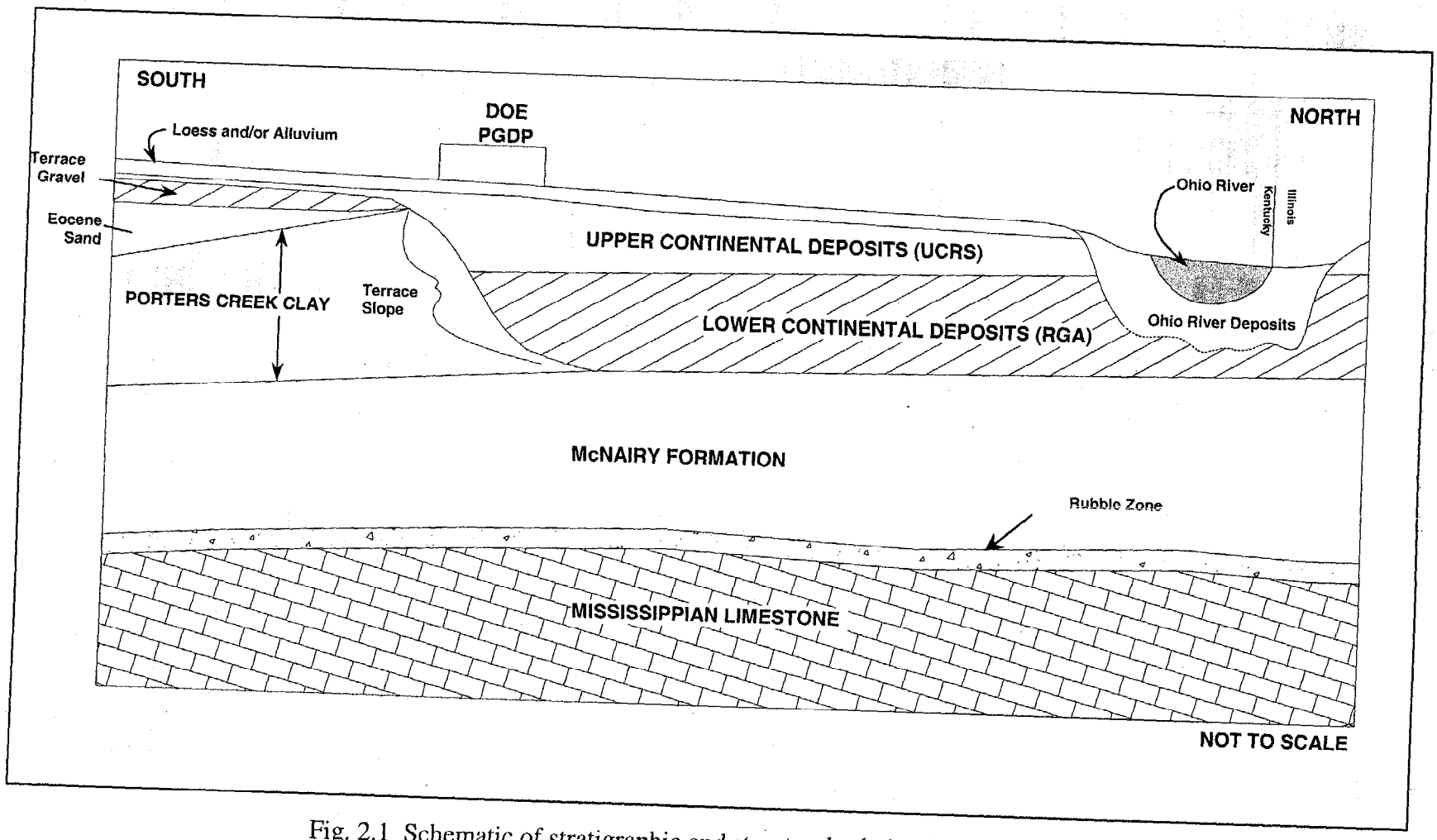

Fig. 2.1 Schematic of stratigraphic and structural relationships near PGDP.

Miocene, Pliocene, and Pleistocene continental deposits unconformably overlie Cretaceous through Eocene strata at the Paducah Site. The thicker sequence of Pleistocene continental deposits represents a valley fill which overall comprises a thick, fining upward sequence. The continental deposits extend from the southern end of the Paducah Site to the Ohio River, and overlay an unconformable surface at the base of the deposits that exhibits steps or terraces. The continental deposits have been divided into a basal gravel facies (lower continental deposits) and an upper, fine-grained clastic facies (upper continental deposits).

The lower continental deposits consist of chert gravel in a matrix of poorly sorted sand and silt. A Pliocene facies, ranging in thickness from 0 to 30 feet and averaging less than 10 feet, exists in the southern portions of the site occurring on the upper surfaces of a buried terrace at elevations greater than 350 feet above mean sea level (amsl). A second gravel facies, ranging in thickness from 15 to 20 feet, exists in southeastern and eastern portions of the site occurring on an erosional surface at approximately 320 to 345 feet amsl elevation. The third and most prominent of the three gravel facies beneath the site consists of Pleistocene deposits which occur north of a buried terrace face on an erosional surface with elevations varying from approximately 245 to 310 feet amsl. The upper surface of these gravel deposits occurs at an average elevation of 310 feet amsl with an average thickness of approximately 30 feet. Thicker deposits, up to 50 feet, exist in deeper scoured channels which trend east west across the site and pinch out against the terrace slope at the southern end of the site.

The upper continental deposits primarily consist of clayey silt, with thin zones of sand and occasional gravel, and vary in thickness from approximately 15 to 55 feet. These deposits have been differentiated into three general lithofacies based on grain-size distributions: (1) clay and silt sediments, (2) sand sediments, and (3) gravel sediments. Sand- and gravel-dominated lithofacies exist at different elevations throughout the upper continental deposits; however, most occur at consistent elevations. Sand and gravel lithofacies appear relatively discontinuous in cross-section, but may be more connected in three dimensions. Eolian origin loess, consisting of yellowish-brown silt and clayey silt, overlies the continental deposits at the site and varies in thickness from approximately 5 to 25 feet with an average of approximately 15 feet. Holocene alluvial deposits occur at lower elevations within the Ohio River floodplain north of the Paducah Site.

Hydrogeology. The local groundwater flow system at the Paducah Site occurs within four specific components: the terrace gravels, the upper continental recharge system (UCRS), the regional gravel aquifer (RGA), and the McNairy flow system. The components are defined as follows:

1. *Terrace Gravels* - This component consists of Pliocene-aged gravel deposits found at elevations higher than 350 feet amsl in the southern portion of the Paducah Site. These deposits usually lack sufficient thickness and saturation to constitute an aquifer. Hydrogeologic conditions along the Porters Creek terrace are uncertain. Alluvial channels intersecting the terrace may provide groundwater underflow to recharge the RGA.

2. *UCRS* - This component consists of the sand and gravel dominated lithofacies found at different elevations throughout the predominantly clayey silt of the upper continental deposits. The UCRS consists of three distinct hydrogeologic units: HU1, HU2, and HU3. The uppermost unit, HU1, is the overlying loess that blankets the entire site. HU2, the second unit, primarily comes to mind when discussing the UCRS. The unit consists of discontinuous sand and gravel lenses with groundwater flow ultimately downward to recharge the RGA. The lowermost unit, HU3, is nearly continuous throughout the site and consists of predominantly clay, silt, or clayey silt. Composition of HU3 may vary, but it appears to form a confining layer due to relatively low hydraulic conductivity. The sand and gravel lithofacies appear relatively discontinuous in cross-section but may be more connected in three dimensions. The most prevalent sand and gravel deposits occur at

an elevation of approximately 345 to 351 feet amsl with less prevalent deposits occurring at an elevation of 337 to 341 feet amsl. Groundwater flows downward into the RGA from the UCRS in the vicinity of Paducah Site, but lateral flow in the UCRS may occur near the Ohio River.

3. *RGA* - This component consists primarily of the lower continental deposits (HU5) of the Quaternary sand and gravel facies, but also includes the hydrologic unit HU4 and coarse-grained upper McNairy sediments in direct contact with the lower continental deposits, and Holocene alluvium found adjacent to the Ohio River, which are of sufficient thickness and saturation to constitute an aquifer. These deposits are commonly thicker than the Pliocene terrace gravel deposits with an average thickness of 30 feet and range up to 50 feet along an axis that trends east-west through the site. The RGA is the primary aquifer used locally.

4. *McNairy Flow System* - This component consists of the interbedded and interlensing sand, silt, and clay of the McNairy Formation. Sand facies account for 40 to 50 percent of the total formation thickness of approximately 225 feet.

Topographically controlled recharge and discharge areas to the south and north, respectively, bound the local groundwater flow system. Recharge within the Eocene sands has resulted in a groundwater divide located southwest of the Paducah Site. The main recharge area for the RGA is located nearer to the site and occurs as percolation through the UCRS. From the Paducah Site, groundwater flows northward toward the Ohio River, which is the local base level for the system. Flow originates south of the Paducah Site within the Eocene sands and subsequently moves into the Pliocene terrace gravel that separate the Eocene sands from the RGA. Groundwater within the Pliocene gravel either discharges to local streams or flows into the RGA which eventually discharges to the Ohio River.

Differences in permeability and aquifer thickness affect the hydraulic gradient. Toward the southern part of the site, the RGA is either truncated or thins and grades laterally into the Pliocene terrace gravel. The restriction results in a high gradient and probably causes groundwater discharge to adjoining streams. In the north central portion of the site, the lower gradients are a result of the thickened Pleistocene sequence containing high fractions of coarse sand and gravel. Northward, near the Ohio River, the hydraulic gradient increases as a result of either a thinner section of the RGA and Holocene alluvium, or the low permeability of bottom sediments in the Ohio River.

The major pathway of groundwater flow is within the RGA, which dominates the flow regime. Conceptually, a larger hydraulic conductivity in the aquifer than in the overlying sediments produces high vertical gradients in the aquitard and low horizontal gradients in the aquifer (Freeze and Witherspoon, 1967).

The RGA flow system is based on the results of a three-dimensional computer model of the Paducah Site. The RGA receives a recharge via underflow from the Pliocene terrace gravels to the south and percolation through the UCRS. The discontinuous nature of sands and gravels in the UCRS and the large vertical gradient require groundwater flow in the UCRS to be oriented downward. Indeed, measured hydraulic gradients and results from analytical and numerical analyses suggest that most of the water entering the shallow system flows vertically into the RGA. Some horizontal flow in the UCRS likely occurs, but, near the Paducah Site, it is probably insignificant because of the lateral discontinuity of shallow sand and gravel lenses. Groundwater flow in the RGA is to the north and discharges into the Ohio River. Hydraulic conductivities of the RGA range between 100 and 1000 ft/d. Existing regional maps show the RGA thin or absent beneath the Ohio River, suggesting that flow under the river is unlikely.

2.1.1.2 Definitions

DOE Order 5400.1 requires effluent monitoring to assess compliance with federal or state regulations, permit conditions, or environmental commitments made in environmental impact statements, environmental assessments, DOE Orders and guides, or other official documents. This includes groundwater monitoring at permitted-status RCRA units, monitoring in conjunction with CERCLA action, (e.g., RI/FS), monitoring around landfills in compliance with permit regulations, and monitoring of SWMUs and areas of concern in accordance with CERCLA FFA and RCRA corrective actions.

2.1.1.3 Rationale and design criteria

The Effluent Monitoring Program for groundwater, supplemented by the Surveillance Program (Sect. 4.1), consist of routine compliance monitoring constructed to:

- 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 land disposal practices and the management and protection of groundwater resources.

2.1.1.4 Extent and frequency of monitoring

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), wells, parameters, and the frequency. The following summarizes the Groundwater Effluent Monitoring Program.

C-746-S and C-746-T Landfills. DOE currently has Commonwealth of Kentucky permitted (KY-073-0014 & 073-00015) closed solid waste landfills (C-746-S and C-746-T). The groundwater is monitored utilizing wells near the two landfills for collection of samples to analyze organic, inorganic, and radiological parameters identified in Appendix C. The wells are monitored quarterly.

C-746-U Landfill. DOE has an operating landfill, C-746-U Solid Waste Landfill. This landfill is currently being operated as a permitted contained landfill and groundwater monitoring wells are monitored quarterly for organic, inorganic, and radiological parameters as listed in Appendix C.

C-404 Landfill. The C-404 Hazardous Waste Landfill is monitored under EPA Hazardous Waste Permit KY8-890-008-982. The C-404 Hazardous Waste Landfill is currently being monitored under detection monitoring (semiannual sampling) according to permit requirements. The permit requires 14 MWs to be monitored. There are six downgradient and four upgradient compliance point wells within the regional gravel aquifer. An additional four MWs, within the upper continental recharge system, are monitored but are not compliance point wells. Parameters specified to be analyzed are provided in Appendix C. Figure 2.2 shows the C-404 Landfill area.

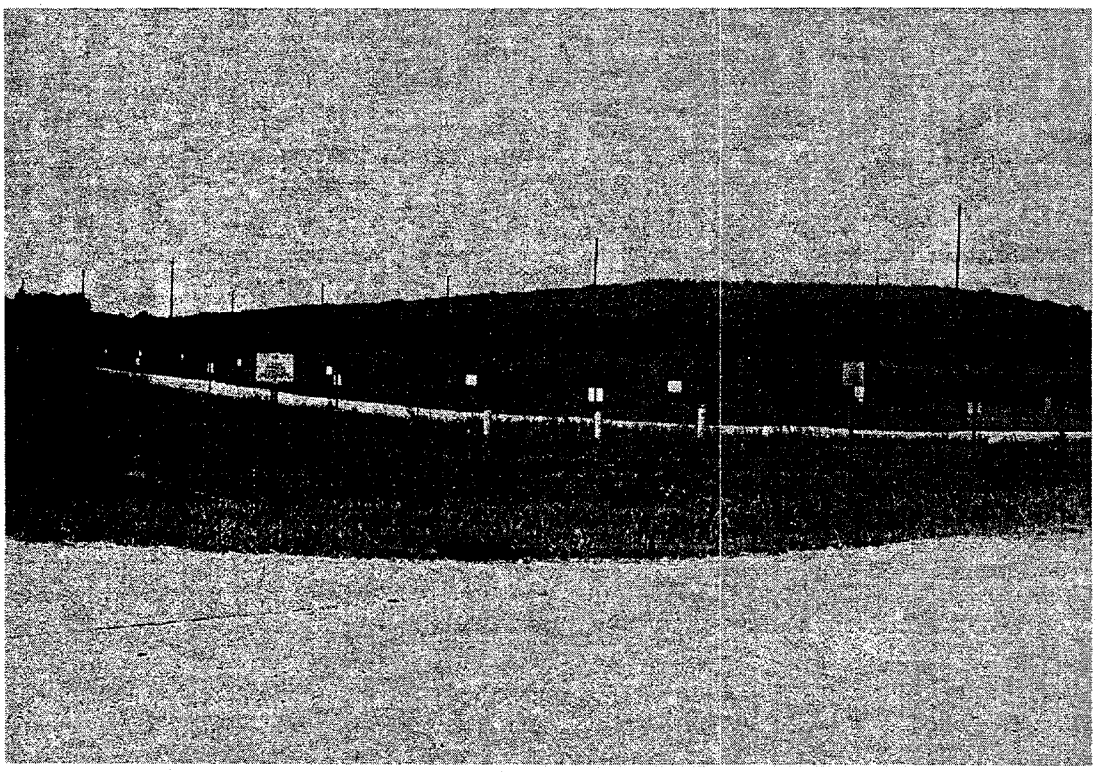

Fig 2.2 C-404 Hazardous Waste Landfill

CERCLA Actions. The FFA between DOE, EPA, and the Commonwealth of Kentucky states that monthly sampling of residential wells is required for those wells potentially affected by migration of the Northeast and Northwest Plumes. Additionally, MW66 is also required to be sampled on a monthly basis. Another requirement of the FFA is to determine the nature and extent of off-site contamination. This requirement is addressed through the remedial investigation process for operable units at the Paducah Site.

The Action Memorandum for the Water Policy at PGDP (Water Policy) (according to the FFA under Sects. 104 and 106 of CERCLA) also requires groundwater sampling of three residential wells affected by off-site contamination (Jacobs Engineering Group, 1994 and SAIC, 1993). Twenty-one residential wells are currently sampled for the parameters listed in Appendix C. However, the wells are utilized for sampling purposes only, as the residents have been supplied an alternate water source in accordance with the Water Policy. 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. This was considered a non-time critical removal action under CERCLA.

The practice of nonroutine sampling of wells, per the request of a residential homeowner near the Paducah Site, will be handled on a case-by-case basis by DOE. All special sample requests by individuals will be screened by DOE before sampling.

In addition to the routine and nonroutine sampling, a feasibility study for the Groundwater Operable Unit is currently being developed to identify additional remedial alternatives that may be effective in addressing groundwater contamination. The implementation of additional remedial actions will need to be considered in future revisions of the EMP.

The Paducah Environmental Monitoring Plan also supplements the Paducah CERCLA remedial investigations. Currently, there are five defined CERCLA operable units (i.e. surface water, groundwater, surface soils, burial grounds, and decommissioning and decontamination) that have been, or will be, investigated under the Paducah FFA. Upon completion of response action activities for these five operable units, a Comprehensive Site Wide Operable Unit will be implemented in accordance with the Paducah FFA. The routine Environmental Monitoring Program will be integrated with each operable unit investigation to provide collection of optimal data sets.

FFA Requirement and Operational and Maintenance Plan for the Northwest and Northeast Plume Program. In order to monitor the nature and extent of groundwater contamination and to evaluate any cyclic trends in water quality which may affect contaminant migration, MW66 is required to be sampled monthly per the FFA. Parameters analyzed for MW66 are listed in Appendix C. Eighteen additional wells are required to be sampled for the Northwest Plume and 13 for the Northeast Plume according to the Operational and Maintenance Plans.

C-746-K Landfill. Sampling of four MWs is conducted to evaluate the potential impact of waste disposal activities at the C-746-K Landfill on the groundwater quality parameters which are analyzed quarterly as identified in Appendix C. Sampling of these wells is not required by regulation, but is conducted in support of the FFA CERCLA Investigation and RCRA Facility Investigations, as well as DOE 5400.1, according to the Paducah FFA.

2.1.1.5 Procedures for sampling and laboratory analyses

Procedures are followed for sample collection, sample preservation and handling, chain-of-custody, sample analysis, QA/DM, and data quality evaluation. All procedures are traceable to standard reference manuals for field procedures and EPA-approved laboratory procedures. See Appendix D for QA/DM requirements.

2.1.1.6 Program implementation procedures

Organization. The Groundwater Protection Program (GWPP) Manager (or designee) and/or the Environmental Services Subcontract Technical Representative (STR) is responsible for implementing all relevant aspects of the EMP. In that role, the GWPP Manager/designee or Environmental Services STR reports through a line organization to the Paducah Manager of Projects and provides centralized coordination of the GWPP matrix organization. The organizational structure is defined in the most recent version of the *Groundwater Protection Management Program Plan* (CDM 2000b).

Plans. The *Groundwater Protection Management Program Plan* is reviewed annually and updated every three years. The plan describes implementation plans that provide the framework to implement the Groundwater Monitoring Program. Those plans include the Environmental Monitoring Plan. Other site-specific plans include Health and Safety Plans, Groundwater Monitoring Well Installation Plan, Well Plugging and Abandonment Plan, Well Inspection and Maintenance Plan, Statistical Analysis Plan, Hydrogeological Interpretation Plan, and Remedial/Corrective Action Plans.

2.1.1.7 Data analysis

For a discussion of the data review process, see the QA/DM requirements in Appendix D.

2.1.1.8 Reports and records

The data generated from the EMP will be presented in the *Paducah Site – Annual Site Environmental Report (ASER).* Data from the Paducah-Oak Ridge Environmental Information System (OREIS) data tables are summarized in the ASER. Other reports supporting compliance activities at the site that present the data generated are the monthly and quarterly discharge monitoring reports, the quarterly groundwater monitoring reports for the C-746-S & -T and the 746-U landfills, the C-404 Landfill semiannual groundwater monitoring report, the FFA Quarterly Progress Report, and letters to residents regarding their sampling data.

2.1.2 Surface Water

2.1.2.1 Introduction

Surface water leaving DOE-owned outfalls include rainfall runoff from cylinder yards and landfills, C-612 Northwest Plume Groundwater Treatment System, as well as effluent from the C-616 USEC Wastewater Treatment Facility. The intent of monitoring is to assess compliance with state and federal regulations, permits, and DOE orders and to assess the impact of DOE operations on the quality of the environment. In addition, DOE has responsibility for "legacy" contaminants such as polychlorinated biphenyls (PCBs) and trichloroethylene (TCE) in USEC-operated outfalls.

Definitions. Effluent surface water monitoring is water monitoring which is performed at the point where liquids are discharged to the waters of the Commonwealth of Kentucky.

Regulations. The primary statute governing the monitoring of effluents to surface water is the Clean Water Act (CWA), which requires the issuance of a National Pollutant Discharge Elimination System (NPDES) permit. The 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. In addition, DOE Order 5400.1, *General Environmental Protection Program*, DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* and

the *Regulatory Guide* provide general and detailed guidance regarding the establishment of effluent monitoring programs for both chemical and radiological parameters.

2.1.2.2 Rationale and design objectives

The objectives of the Effluent Monitoring Program include:

- verifying compliance with applicable federal, state, 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 mitigation measures;
- supporting permit revision and/or reissuance;
- detecting, characterizing, and reporting unplanned releases; and
- measuring trends in effluents.

In addition, the *Regulatory Guide* requires this plan to document:

- 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 and accuracy by analyte;
- quality assurance components; and
- effluent outfall alarm settings and bases.

Evaluation of Effluents. Effluents, whether or not they contain radiological contaminants from new or modified facilities, will be evaluated by environmental compliance organization to determine the appropriate response.

Physical/Chemical/KPDES. KPDES is the regulatory program administered by KDOW for discharge of wastewater to the waters of the Commonwealth of Kentucky. The DOE Paducah Site KPDES Permit (KY0004049 effective April 1, 1998) establishes monitoring requirements for the discharge of wastewater. 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. The permit does not have limits for radiological parameters.

Processes for DOE operations have been evaluated from the standpoints of both the chemical and radiological species and the physical parameters (e.g., temperature) likely to become part of the effluent stream as part of the KPDES permit. Effluents from state-permitted landfills are evaluated during the reporting and permit renewal processes. Figure 2.3 shows the locations of KPDES outfalls.

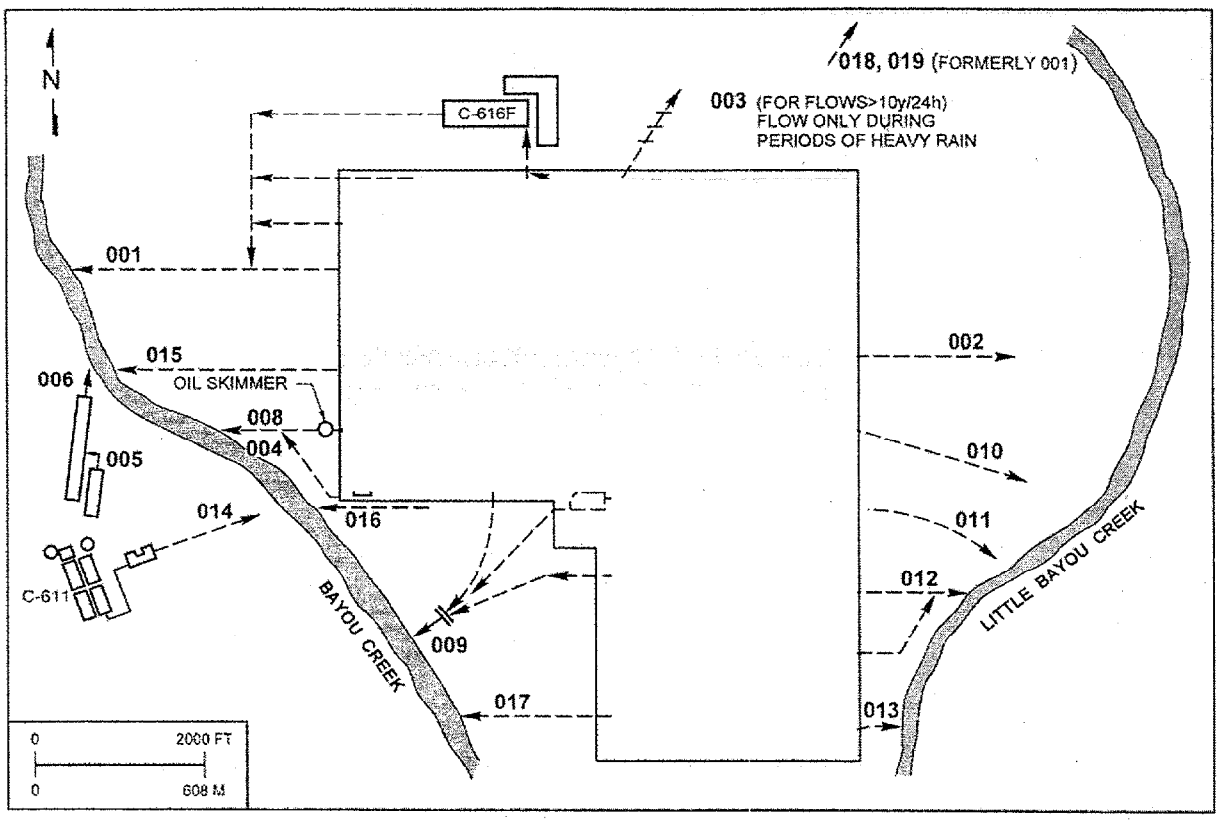

Figure 2.3 KPDES outfall locations.
(Outfalls 001, 015, 017, and 019 are the responsibility of DOE and others are the responsibility of USEC.)

Radiological. Based on the evaluation of emissions and the results of radiological monitoring reported in the ASER for 1999, neither continuous monitoring nor continuous sampling with frequent analyses are required by DOE Order 5400.5. 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.) and from several stream locations (Bayou Creek and Little Bayou Creek).

2.1.2.3 Extent and frequency of monitoring

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 to be sampled for parameters listed in Appendix C. All samples will be preserved according to 40 CFR 136.3 Table II.

KPDES Monitoring. Four DOE-owned effluent sampling points covered by the KPDES permit (K001, K015, K017, and K019) are illustrated in Appendix C.

C-746-S&T and C-746-U Leachate. Leachate from the solid waste landfills is sampled and analyzed for the parameters listed in Appendix C in accordance with permit requirements. All samples will be preserved according to 40 CFR 136.3 Table II.

C-404 Leachate. Leachate samples are collect from the C-404 Landfill Leachate Collection System and analyzed for the parameters listed in Appendix C in accordance with the landfill permit. The samples will be preserved according to SW-846.

Northeast Plume Cooling Tower. C-637-2A basin (L-234) will be sampled monthly for TCE. One sample plus a trip blank and a field blank will be collected for TCE only. All samples will be preserved according to 40 CFR 136.3 Table II.

2.1.2.4 Procedures for sampling and laboratory analyses

Field Procedures. Sampling procedures for each effluent monitoring program location will vary from use of a dipper for grab samples to collecting samples from an automated composite sampler when necessary.

Flow Measurement. Any device or process may be used to determine the instantaneous flow rate at KPDES locations if the following criteria are met:

- devices or processes are built or used in accordance with guidance in accepted documents;
- devices are capable of determining the flow to ± 10 percent of the actual flow; and
- if nonstandard methods are used, their ability to meet the ±10 percent flow requirement must be documented against an accepted method and be accepted in writing by regulatory agencies having oversight responsibilities for KPDES monitoring.

Laboratory Procedures. In addition to implementing the procedures for data recording and chain-of-custody, laboratory-specific procedures include those describing specific analytical methods, participation in outside control sample programs, statistical measures of accuracy, precision, and determining the type of quality control program necessary for various environmental measurements. When available and appropriate for the sample matrix, EPA methods will be used for KPDES. When not available, other nationally recognized methods (DOE, EPA, American Society for Testing Materials, etc.) will be used. See Appendix D for QA/DM requirements.

2.1.2.5 Program implementation procedures

BJC is responsible for implementing and monitoring the DOE portion of the KPDES Program. Analyses will be performed by Sample Management Organization (SMO)-approved laboratories through BJC SMO. Sample data are managed by CDM Federal Programs Corporation for evaluation and reporting.

2.1.2.6 Reports and records

Discharge Monitoring Reports. The KPDES Discharge Monitoring Reports are prepared from data managed according to Appendix D. These reports are transmitted to KDOW on a monthly and quarterly basis. The surface water and leachate data associated with the landfills are reported to KDWM on quarterly basis. The discharge monitoring information and the landfill surface water run-off information is summarized annually and included in the ASER.

2.1.3 Watershed Biologcal Monitoring

2.1.3.1 Introduction

Biological monitoring of receiving streams at the Paducah Site was initiated in 1987. This Biological Monitoring Program included quantitative surveys of benthic macroinvertebrate and periphyton (attached algae) communities, ambient toxicity testing, and qualitative surveys of fish communities in Bayou Creek and Little Bayou Creeks and an off-site reference stream (Massac Creek).

Bioaccumulation studies of aquatic insects and fish are used to detect toxicants that may be human health concerns. Sampling the aquatic communities will also provide a direct measure of the ecological health of streams and the condition of the biotic resources at risk. In 1998 with the insurance of a new KPDES permit, a Watershed Monitoring Program (WMP) was required. A plan for the program was developed and approved by the KDOW.

The WMP for the Paducah Site consists of three major tasks: (1) effluent toxicity monitoring; (2) bioaccumulation studies; and (3) ecological surveys of stream communities (i.e., benthic macroinvertebrates, fish). Aquatic sampling locations are identified in Appendix C.

2.1.3.2 Rationale and design objectives

The design of the Sampling Program for surface water, and aquatic biota is intended to comply with the goals of environmental surveillance monitoring outlined in DOE Order 5400.1 and the *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan* (BJC 2001b). These goals include:

1. Ambient water quality monitoring will be conducted through a network of fixed stations from which data will establish well-defined histories of the physical, biological, and chemical conditions of local bodies of water. The data obtained from this network should be coordinated with other monitoring activities.

2. Analysis of data collected from a fixed station-monitoring network will include:

   - characterizing and defining trends in the physical, chemical, and biological condition of surface waters;
   - establishing baselines of water quality;
   - continuing assessment of water pollution control programs; and
   - identifying new water quality problems.

3. Monitoring networks will be operated and maintained in a uniform manner, i.e., through established procedures that allow comparative evaluations of data from monitoring sites. Sites will be selected to measure the effects of current and past DOE operations on receiving waters at points immediately downstream from all possible contaminant sources.

4. Surface water sampling performed at fixed monitoring stations will characterize physical and chemical properties of the water column, and biological species in the water column and benthos. Types of sampling performed should depend upon local conditions and the variability of stream characteristics and water quality.

5. Relatively infrequent monitoring of a large number of analytes in water, sediment, and biota in a small number of samples and sites provides screening capable of detecting whether or not harmful levels of chemical contamination is occurring or has occurred. If such contamination is discovered, a Contaminant Tracking Program will be initiated in appropriate media to provide quantitative evaluation of the extent and degree of contamination over time. This will involve additional sites, larger numbers of samples, and greater sampling frequencies.

6. Ambient water quality monitoring serves to confirm compliance with the CWA. An understanding of the Water Quality Management (WQM) process implemented by EPA, the states, interstate agencies, and area-wide, local and regional planning organizations is essential to the design of a Water Quality Monitoring Program. The elements of the WQM processes are described in 40 CFR 130. Test procedures for pollutant analyses are listed in 40 CFR 136.

2.1.3.3 Extent and frequency of monitoring

One sampling site each on Bayou Creek and Little Bayou Creeks downstream from the Paducah Site inputs will be adequate for routine contaminant screening analyses. Sample locations, frequency, and analytical parameters are listed in Appendix C. Since comparison of results at these sites with reference levels typical of uncontaminated fish will be used to determine the need for contaminant tracking studies, an uncontaminated local stream will be used to collect fish for this purpose. Upstream sites on Bayou Creek and Little Bayou Creek are unlikely to contain adequate populations to support such an effort, and they can be compromised by migration of fish from downstream reaches (below Paducah Site).

Sample Type and Frequency. Criteria for selecting appropriate species to monitor include:

1. limited range;

2. year round abundance at the sampling site;

3. ability to accumulate contaminants to a maximum extent in comparison to other species; and

4. likelihood of ingestion by humans (i.e., food or game species).

No single species is likely to be optimal with respect to all criteria. Sunfish (small members of the family Centrarchidae) meet all except criteria 3 (see above) at most sites (other than small headwater sites). Catfish generally meet criteria 3 and 4 (see above), but are more migratory than sunfish and are present in abundance only in larger water bodies. Short-lived species with high annual turnover rates are generally preferred because contaminant burdens will most likely integrate exposure over the previous year and not include substantial historical carryover. However, selection of a short-lived species may compromise the ability to document maximum bioaccumulation levels.

A second species may need to be included in contaminant tracking studies at some sites to achieve the broader objectives of those investigations. Fish will be sampled once a year in routine monitoring studies.

Analytes. Since 1987, the bioaccumulation of chemicals (PCBs, metals, including mercury, organics, and radionuclides) in fish were conducted at many sites in Bayou Creek and Little Bayou Creek. After a sufficient baseline data set had been established, the sampling and analysis efforts were reduced to more efficiently meet the needs of the Paducah site. After evaluating the initial baseline data set, PCBs

were determined to be the only necessary analyte for bioaccumulation studies. The necessary sampling and analytical parameters were documented in the *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan* (BJC 2001b). PCBs will be analyzed at the five locations on Bayou Creek and Little Bayou Creek on an annual basis.

The benthic macroinvertebrate and fish communities will be sampled at three sites downstream of plant operations (one on Little Bayou Creek and two on Bayou Creek) and two reference sites. One reference site will be located on upper Bayou Creek above the Paducah Site. Because stream flow is intermittent in the upper reaches of Little Bayou Creek, the site is not suitable for fish community sampling. Therefore, the second reference site will be located off-site in a minimally impacted stream, Massac Creek near the Route 62 bridge. The sites selected to monitor the ecological health of receiving streams at the Paducah Site consist of locations shown in Appendix C.

Sample Type and Frequency. Based on historical data, monitoring of the macroinvertebrates and fish communities will be conducted annually at the same locations (see Appendix C). Quantitative benthic macroinvertebrate samples will be collected from designated riffle areas and quantitative fish population sampling will be conducted by backpack electroshocking a designated reach of stream.

2.1.4 Procedures for Sampling and Laboratory Analyses

2.1.4.1 Surface water and sediment

Standard operating procedures will be used in the Surface Water and Sediment Programs.

2.1.4.2 Watershed monitoring

The procedures for the Watershed Monitoring Program are described in *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan* (BJC 2001b).

2.1.5 Reports and Records

Results of the Surveillance Program are summarized in the ASER. Specific reporting requirements for surface water monitoring are required by the *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan* (BJC 2001b).

2.2 AIRBORNE

Industrial operations that emit airborne pollutants considered potentially harmful to the environment are regulated through operating permits. Currently, ambient air monitoring is performed by USEC and AIP personnel only. However, AIP ambient air monitoring data will be utilized to evaluate fugitive emissions as allowed under Sect. 5a of the May 1995 memorandum of understanding between EPA and DOE. The DOE operations at the Paducah Site currently have one air permit for depleted uranium cylinder refurbishment and minor fugitive sources (i.e., scrap yards, building roofs, vehicle traffic, etc.). Point source emissions from the Northwest Plume are monitored and reported by BJC. No permit is required since the amount of TCE is below regulatory permitting requirements at the Northwest Plume and ^{99}Tc is reported under the National Emission Standards for Hazardous Air Pollutants (NESHAP).

3. METEOROLOGICAL MONITORING

Since DOE operations may have airborne radionuclide emissions (i.e., Northwest Plume, fugitive sources, etc.), a meteorological monitoring system consisting of a 10-meter and 60-meter tower located at PGDP is leased to and operated by USEC. The meteorological monitoring system is utilized for emergency releases only and is unable to store sufficient data for modeling input. However, data are available from the National Weather Service located at the Barkley Airport approximately four miles southwest of the Paducah Site. Meteorological data utilized for the Clean Air Act Assessment Package-88 (CAP-88) radionuclide emission modeling and is compiled from historical data from the on-site tower.

4. ENVIRONMENTAL SURVEILLANCE

DOE Order 5400.1 requires the Paducah Site to perform environmental surveillance monitoring. Environmental surveillance is the collection and analysis of samples, or direct measurements, of air, water, soil, foodstuff, 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 Order 5400.5 has established a radiation protection standard of 100 mrem per year to members of the public. This standard 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 (Chap. II, 1). EPA regulations establish additional public dose limits for exposures to several selected sources or exposure modes: regulations implementing the Clean Air Act (40 CFR Part 61) incorporated by Kentucky by reference per 401 KAR 57:002 establish a dose limit of 10 mrem per year from airborne emissions and regulations implementing the Safe Drinking Water Act (40 CFR Part 141) establish a dose limit of 4 mrem per year from drinking water.

DOE Order 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 practices, or doses received from consumer products. The determination of the public dose as established by EPA regulation 40 CFR Part 61 differs in that the 10-mrem per year limit applies where the members of the public reside or abide.

The *Regulatory Guide* further requires that DOE facilities perform routine surveillance if an annual dose of site origin at the site boundary exceeds 5 mrem EDE to an individual or 100 person-rem collective EDE within a radius of 80 km 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 (individual) or 100 person-rem, therefore, no routine surveillance is required; however, to verify compliance, routine surveillance will be conducted at the Paducah Site. An overview of routine environmental surveillance is provided in Table 4.1. The table lists for each program the number of sampling locations, sampling frequency, sample type, and laboratory analyses.

Table 4.1 Routine environmental surveillances

Program	Number of Locations	Sampling Frequency	Sample Type	Parameters
Groundwater				
Surveillance Semiannual	78	Semiannually	Grab	See Appendix C
Surveillance Attenuation	15	Semiannually		
Radiological Surveillance	83	Annually		
Surface Water	31	Semiannual	Grab	See Appendix C
Sediment	16	Semiannual	Grab	See Appendix C
Terrestrial - Deer	n/a	Annual	Species	See Appendix C
Environmental TLDs	46 6	Quarterly	Continuous	External Gamma and Neutron Radiation

4.1 GROUNDWATER

4.1.1 Introduction

The site geology and hydrogeology have been summarized in Sect. 2.1. The definitions of groundwater effluents and surveillance are also provided in that section. This section addresses groundwater surveillance.

Environmental surveillance is defined as perimeter exit pathway monitoring and voluntary off-site water well monitoring. Perimeter exit pathway at the facility boundary monitors the effects of facility operations on the regional groundwater quality and quantity. In addition to verifying compliance with regulatory requirements at the reservation boundary, perimeter exit pathway monitoring provides a redundant system for detecting previously unidentified, on-site groundwater quality problems not detected by effluent monitoring. Off-site water well monitoring is initiated by DOE to address the public's concern about off-site groundwater contamination, especially of drinking water sources.

4.1.2 Rationale and Design Criteria

The Groundwater Surveillance Plan for the Paducah Gaseous Diffusion Plant (Forstrom et al 1993) describes in detail the rationale and criteria used to design the perimeter and off-site water well surveillance networks for the Paducah Site. That information is based on the more general *Strategy for Conducting Environmental Surveillance of Groundwater to Comply with DOE Orders* (Forstrom 1990) and is summarized in Sect. 4.1.3.

The groundwater monitoring requirements for each of these specific laws, regulations, and orders are addressed as follows:

DOE Orders. DOE Order 5400.1 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 (DOE 1990). DOE Order 5400.1 outlines requirements for groundwater monitoring at all DOE facilities and specific development of documents related to groundwater monitoring. To address these requirements, the *Groundwater Protection Management Program Plan* (BJC 2000b) and this *Environmental Monitoring Plan* were written to include effluent monitoring and environmental surveillance at the Paducah Site. Background wells are monitored annually for several parameters, including organics, inorganics, and radionuclides.

The Groundwater Protection Management Plan (GWPMP). The purpose of the GWPMP is to achieve the goals outlined in DOE's Groundwater Protection Policy and to comply with the federal, state, and other requirements described in the plan. DOE's Groundwater Policy is formulated under the applicable section in DOE Order 5400.1 and the draft 10 Code of Federal Regulations 834. The Paducah GWPMP incorporates guidance from both documents which are applicable to site specific conditions which exist at the Paducah site. The document is revised and reissued every three years.

Commonwealth of Kentucky Regulation. The Kentucky Administrative Regulation (KAR) 401 KAR 5:037 requires preparation of a Groundwater Program Plan (GWPP) which addresses requirements to ensure protection for all current and future uses of groundwater and to prevent groundwater pollution. This requirement was addressed by writing and implementing a GWPP, according to 401 KAR 5:037, by the DOE prior to the deadline of August 24, 1995. This document was last revised in 2001 and is scheduled to be revised again by the fall of 2004.

AIP Sampling. The 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. 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 also 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.

AIP also funds research and special projects to assist in understanding groundwater contamination movement and its effects.

4.1.3 Extent and Frequency of Monitoring

The *Environmental Monitoring Plan* addresses the chemical and radiological sampling of individual monitoring and residential wells on a routine basis for both effluent and surveillance monitoring (see Appendix C). An effort has been made to reduce the amount of sampling conducted at certain wells. The criteria used to determine less frequent sampling of a well include:

1. New understanding of contaminant migration pathways and contaminants present.
2. Review of historical MW results.
3. Analyses to determine if the MW meets the current and future objective of the GWPP
4. Addition of new MWs which eliminate the need of older MWs or as frequent sampling.

Each of the programs for groundwater surveillance monitoring are described below. The description includes extent and frequency of the monitoring. Chemical parameters analyzed are provided in Appendix C. Field parameters (such as barometric pressure, dissolved oxygen, and depth to water, pH, temperature, and conductivity) are taken during each sampling event.

Environmental Surveillance (Semiannual Monitoring) Program. In order to monitor the nature and extent of groundwater contamination and to monitor groundwater quality, sixty-eight (68) non-background wells are sampled semiannually as shown in Appendix C. Sampling of these wells is not regulatory driven, but is conducted in support of the FFA CERCLA investigations and RCRA Facility Investigations (RFIs), as well as DOE Order 5400.1. All of these wells lie on the plant perimeter or site boundary and any detection of contaminants will allow for an increase in sample frequency of downgradient MWs.

Background Monitoring Program. Ten (10) background wells are sampled semiannually to monitor the background water chemistry of wells located upgradient to the plant so that this can be compared with MWs potentially impacted from plant activities.

Environmental Surveillance (Attenuation Monitoring) Program. In order to monitor the effects of natural attenuation on of groundwater contamination and to monitor groundwater quality, fifteen (15) MWs are sampled semiannually. Sampling of these wells is not regulatory driven but is conducted in support of the FFA CERCLA investigations and RFIs, as well as, DOE Order 5400.1.

Radiological Monitoring Annual Program. Eighty-three (83) monitoring wells are sampled annually to monitor the nature and extent of groundwater radiological contamination and to monitor groundwater quality. Wells included in the Annual Environmental Surveillance Radiological Monitoring as well as analytical parameters, are shown in Appendix C. Sampling of these wells is not regulatory driven but is conducted in support of the FFA CERCLA investigation and RFIs, as well as, DOE Order 5400.1.

4.1.4 Procedures for Sample Collection and Laboratory Analysis

Procedures exist for sample collection, sample preservation and handling, chain-of-custody, sample analysis, QA/DM, and data quality evaluation. All procedures are traceable to standard reference manuals for field procedures and EPA-approved laboratory procedures. See Appendix D for QA/DM requirements.

4.1.5 Program Implementation Procedures

The GWPP Manager (or designee) and/or Environmental Services STR (or designee) is responsible for implementing all aspects of the Groundwater Program. In that role, the GWPP Manager (or designee) or Environmental Services STR reports through the line organization.

4.1.6 Reports and Records

The results of plant perimeter groundwater surveillance at the Paducah Site will be maintained in the Paducah OREIS database and summarized in the ASER.

4.2 SURFACE WATER/SEDIMENT ENVIRONMENT

4.2.1 Introduction

The Environmental Surveillance Watershed Monitoring Program at the Paducah Site for surface water, sediment, and aquatic biota has evolved, over a number of years, in response to regulatory and community concerns. The program is described in the following sections. Frequencies of monitoring and chemical parameters are provided in Appendix C.

4.2.1.1 Surface Water Program

The Surface Water Monitoring Program for the Paducah Site currently consists of sampling at the locations shown in Appendix C. Grab samples will be collected in such a way as to be representative of the bulk of water flowing past the sampling site. Sample location, frequencies, and parameters are listed in Appendix C. The results of all surface water monitoring are summarized in the ASER.

4.2.1.2 Sediment Program

Sediment samples are collected semiannually from sixteen (16) locations. Reference sample locations are located upstream of the plant on Bayou Creek and Little Bayou Creek. In 1989, elevated levels (compared to reference) of PCBs, uranium, ^{99}Tc, plutonium, neptunium, and cesium were found in several on-site ditches. PCBs were also present above reference in Little Bayou Creek sediment. Sample location, frequencies, and parameters are listed in Appendix C.

4.2.2 Program Rationale and Design Criteria

The surface water, sediment, and biological sampling sites included in this Environmental Monitoring Plan are located on (1) selected receiving streams immediately downstream from all possible contaminant sources and (2) 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. More than one downstream site on a receiving stream was included in the program design if there was a substantial distance (>3 km) between major contaminant sources. In these cases, two sites will ensure that adverse impacts and ecological recovery can be detected before additional dilution occurs downstream, thus providing a suitable database for documenting the effectiveness of remedial actions. Reference streams were determined to be minimally impacted using site-specific data on the species composition of the benthic macroinvertebrate (benthos) and fish communities. These data were obtained from either qualitative sampling conducted as part of the reference site selection process or previous Biological Monitoring Programs.

4.2.2.1 Surface water

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

4.2.2.2 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. Sediments act to collect, concentrate, and store specific kinds of contaminants at specific locations. Concentrations of contaminants in sediments thus are integrated measures of aqueous contaminant concentrations over some preceding period of time.

4.2.3 Extent and Frequency of Monitoring

4.2.3.1 Surface water

Surface water will be sampled at various locations upstream and downstream from the Paducah Site operations. Grab samples will be collected quarterly and semiannually. Samples will also be taken from a site 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. The sampling sites are illustrated in Appendix C.

4.2.3.2 Sediment

Sediment will be sampled near the surface water and biological stations at locations downstream from plant operations and in reference streams. Station locations will coincide with those for surface water in Bayou Creek and Little Bayou Creek. Sediment samples will also be taken from a site in Little Bayou Creek upstream from plant inputs where the stream does not have permanent flow. Frequency, field measurement parameters, and analytical parameters are listed in Appendix C.

Sample Type and Frequency. Compositing sediment samples will reduce some of the variability associated with sediment heterogeneity. Perhaps more important, though, is the use of procedures to normalize sediment data to adjust for variation in the sediment matrix. Particle size fractionation, total organic carbon, aluminum, and iron content have been used with varying degrees of success to normalize sediment analyses. Particle size fractionation is the most straightforward technique and will be used on all sediment samples by wet sieving the sample to isolate fine particles.

Because sediments represent a time-integrated index of contaminant release, the sampling frequency can be less frequent than that for surface waters.

4.3 TERRESTRIAL ENVIRONMENT

4.3.1 Introduction

The terrestrial environment around the DOE reservation is predominantly rural with residences and farms surrounding the site. Immediately adjacent to the DOE reservation is the WKWMA, which is used by a considerable number of hunters, trappers, and fishermen each year. Hunting and trapping activities may include such wildlife as rabbits, deer, quail, raccoon, squirrels, beavers, and doves.

This section will discuss 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, milk, and eggs, 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 will be discussed in subsequent sections. Concentrations of both radionuclide and chemical contaminants will be evaluated in the terrestrial environment. The *Regulatory Guide* suggests that if wild game, such as deer or game birds, is available locally, these should be considered.

4.3.2 Rationale and Design Criteria

4.3.2.1 Milk

Because a predicted effective dose from the airborne pathway is insignificant from a risk perspective and ^{99}Tc and uranium do not bioaccumulate in milk, the surveillance of milk is not required or recommended by the *Regulatory Guide* and will not be performed by the Paducah Site. In addition, metals have been evaluated in deer and found to pose no health risk, therefore are not monitored in other terrestrial media.

4.3.2.2 Food crops

Food crops are not pathways since no significant (i.e. exceeding NESHAP regulatory levels) airborne sources of contaminants have been identified for DOE operations utilizing the EPA Data Quality Objectives (DQO).

4.3.2.3 Wildlife

Deer. Under an agreement between the Kentucky Department of Fish and Wildlife (KDFW) and DOE, the Paducah Site, in conjunction with WKWMA personnel, conducts an Annual Deer Sampling Program to obtain samples for analysis of potential contaminants. Sufficient deer will be collected by WKWMA personnel to ensure that samples representative of the deer population living near the site are obtained. When available, reference deer will be obtained for analysis. Appendix C provides a list of the parameters required for the various tissue samples.

Special studies may also be initiated for specific evaluations as needed. Additional game species may be harvested and sampled for target analytes or compounds per procedures approved by BJC and DOE.

4.3.3 Sampling Frequency and Procedures

Deer will be sampled annually (prior to hunting season) following approved procedures. Rabbit sample results were benign in CY 1999 and were discontinued in CY 2000. Opportunistic sampling will occur for other wildlife species as determined by DOE.

4.3.4 Procedures for Laboratory Analyses

Animal tissues will be analyzed using the specific laboratory methods appropriate for tissue analysis. Each of these methods specifies the accuracy of the measurements and the detection limits.

4.3.5 Reports and Records

Summary statistics for each type of animal will be presented in the ASER. Comparisons to reference locations and previous years data will also be presented, as applicable.

4.4 EXTERNAL GAMMA AND NEUTRON RADIATION

Due to past releases of radionuclides and current operations involving radioactive sources (e.g., depleted uranium hexafluoride [DUF_6] cylinder management), the Paducah Site conducts routine surveillance of external gamma and neutron 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. However, new cylinder yard additions near the plant boundary could increase exposure; therefore, routine surveillance of external gamma and neutron radiation with thermoluminescent dosimeters (TLD) monitors is being done although it is not required to comply with DOE Order 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. Paducah Site personnel monitoring is not within the scope of this program because it is covered by the Radiological Protection Department.

A second objective is to establish the potential dose a member of the public may receive 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

Both theoretical calculations and historical monitoring indicate that any plausible DOE contribution to ambient gamma radiation levels is negligible. However, new cylinder yard additions near the plant boundary could increase exposure. Higher radiation levels in the cylinder yards are due to protactinium (^{234}Pa), a decay product of ^{238}U. Past liquid releases to Little Bayou Creek have resulted in contamination of the sediments, which also contribute to the elevated gamma readings (Energy Systems 1988).

4.4.3 Design Criteria

The External Gamma and Neutron 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 environmental monitoring.

The primary source terms for radiation exposure to areas outside the PGDP security fence are the UF_6 cylinder storage yards. 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 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. For residual contamination, neutron-producing radionuclides have not been detected in sufficient quantity to create a significant source term for neutron radiation.

The Radiological Control Organization (RADCON) 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 security fence. The RADCON area dose rate-monitoring program is described in BJC/PAD-225, "Technical Basis for the Area Dosimeter Program at the Paducah Gaseous Diffusion Plant." Results from this program will be for inclusion in the ASER.

4.4.4 Extent and Frequency of Monitoring

The extent and frequency of monitoring for external gamma radiation are determined based on the assumptions 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 perimeter fence provides a physical boundary beyond which the public has no access; (2) public access to the reservation is administratively controlled and limited; (3) the locations of residences and communities outside the reservation are known; and (4) individual exposure scenarios may vary.

4.4.4.1 Location

Environmental gamma detection TLDs are located at approximately forty-six (46) locations including PGDP perimeter, outfalls, ditches, and background locations. TLDs have also been placed in areas that have historically received the highest radiation exposure. Six (6) neutron monitoring devices are placed around the plant perimeter.

The RADCON area monitoring TLDs are located at approximately thirty-five (35) locations within the PGDP security fence. These areas monitored by this program included routinely occupied break areas, cylinder yards, storage facilities, and areas with elevated dose rate. These locations are provided in BJC/PAD-225, "Technical Basis for the Area Dosimeter Program at the Paducah Gaseous Diffusion Plant."

Re-evaluation of the TLD placement locations will be conducted periodically to assess facility additions or modifications.

4.4.4.2 Parameters

External gamma and neutron radiation are determined. Although neutron exposure is a potential source of dose adjacent to the cylinder yards, it will not influence gamma readings from the environmental TLDs.

4.4.5 Data Analysis and Statistical Treatment

The results of the surveys will be presented in report form, including maps and measurement readings. To determine the public exposure, the average external gamma and neutron readings for a particular area (in mrem/h) is multiplied by the estimated public exposure duration for that location (hours per year).

4.4.6 Reports and Records

Monitoring results are presented in the ASER.

The quality records for this program are inventoried and managed according to the records retention requirements of DOE Order 1324.2A and the QA/DM requirements in Appendix D.

4.5 AMBIENT AIR

DOE complies with 40 CFR 61 subpart H controlling 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, Part 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 one percent of the standard prescribed in Sect. 61.92, then an application for approval under Sect. 61.07 or notification of startup under Sect. 61.09 does not need to be filed per Sect. 61.96. The EDE shall be calculated in accordance with 40 CFR, Part 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/Environmental Monitoring Section of the Radiation Health and Toxic Agents Branch of the Department for Public Health of the Kentucky Cabinet for Health Services, conducts ambient air monitoring for the Paducah Site. The air-monitoring network is comprised of eight ambient air monitoring stations including one background station. In addition, USEC personnel operate a six-station ambient air-monitoring network for alpha, beta, and uranium. State of Kentucky ambient air monitoring data will be reviewed and included in the NESHAP and ASER reports.

4.6 VEGETATION/SOIL

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

5. LABORATORY PROCEDURES

5.1. INTRODUCTION

Procedures for laboratory analysis are, by definition, an integral element of the Environmental Monitoring Program; that is, the definitions of both effluent monitoring and environmental surveillance in DOE Order 5400.1 begin with the phrase "the collection and analysis of samples." The objectives of the EMP concerning compliance with applicable regulations and commitments, identification of DOE operations contributions to ambient contaminant levels, and determination of the effectiveness of effluent treatment/controls would be impossible to achieve without a valid and reliable analytical system.

In compliance with the *Regulatory Guide*, laboratory procedures and practices used for the Paducah Site Monitoring and Surveillance Programs are documented in this chapter to show:

- sample identification systems,
- procedures preventing cross-contamination,
- analytical methods and/or modifications thereof,
- analytical capabilities,
- equipment calibration and reference source practices, and
- other quality control procedures.

5.2 ORGANIZATION

The BJC Environmental Services STR determines the types of analyses to be performed and specifies the methods to be used and detection limits required. Analytical services requested by the Environmental Services STR for the Environmental Monitoring Program are contracted through the SMO.

The BJC SMO coordinates the analytical services for the Environmental Monitoring Program. Responsibilities of this office include: 1) developing statements of work (SOW) for analytical services; 2) determining appropriate analytical protocols to be applied to meet the data quality objectives; 3) developing technical and quality standards for requested analytical services; 4) deciding on appropriate laboratory with which to place the work; 5) negotiating schedule for provision of services and oversight to assure schedule is met; 6) assessing laboratories to ensure they comply with quality and technical standards; and 7) ensuring transmittal of data to the program customer.

5.3 GENERAL QA

A laboratory quality assurance plan is available from each analytical laboratory performing analyses of environmental and waste samples. The purpose of this plan is to ensure that quality data are generated from the analysis of DOE samples. This plan will address the requirements of DOE Order 5400.1 with respect to laboratory quality assurance (QA) and data verification and will address the laboratory procedures requirements in the *Regulatory Guide*. In the context of laboratory qualification, the plan provides a basis for evaluating a laboratory's QA procedures. This evaluation includes a critical

review of the plan and verification of the laboratory's adherence to the plan through on-site audits. The laboratory QA plan may contain, but is not limited to, the following elements:

a. Title page with Provision for Signatures
b. Table of Contents
c. Organization and Personnel
d. Personnel Training
e. Sample Management Practices and Chain-of-Custody
f. Material Procurement and Control
g. Facilities and Equipment
h. Equipment Maintenance
i. Analytical Procedures
j. Calibration
k. Limits of Detection
l. Analysis of quality control (QC) Samples and Documentation
m. Out-of-Control Events and Corrective Action
n. Document Control
o. Data Evaluation
p. Holding Times and Preservatives
q. Internal Laboratory Audits
r. QA Reports to Management
s. Accuracy, Precision, and Completeness

5.4 ANALYTICAL METHODS

5.4.1 Effluent Monitoring

When available and appropriate for the sample matrix, SW-846, *Test Methods for Evaluating Solid Waste,* or other EPA methods are used. Analytical methods, sample preservation, sample type, and reporting detection limits are identified in an analytical SOW for each sampling event. Analytical SOWs are developed and contracted by BJC with input from the Environmental Services Subcontract Team, as necessary. Information on analytical methods is also documented in ES Paducah Project Environmental Management System (PEMS) and in Appendix C.

6. DOSE CALCULATIONS

Operations at the Paducah Site may emit waterborne radionuclides and chemicals. After release, these substances disperse throughout the environment by applicable transport mechanisms, where eventually some 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 80 km of the site. Exposures to chemicals are characterized in terms of percent allowable daily intake or reference dose.

6.1 CONFORMANCE WITH STANDARDS FOR PUBLIC DOSE CALCULATIONS

All models selected to assess environmental transport of and human exposures to substances released from DOE operations will be appropriate for the physical and environmental situation encountered and for the data available to characterize the situation. Information used in the assessments will be as accurate and realistic as possible. All input data, including default values, will be documented and evaluated for applicability to the situation being modeled.

A complete set of potential human exposure pathways will be 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 80 km of the site will be evaluated. The pathways that will be evaluated are discussed in Sects. 6.3 and 6.4.

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 will be conducted as necessary to conform to applicable requirements of the Commonwealth of Kentucky and of the regional EPA office.

6.2 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 will be estimated for all potentially important exposure pathways relevant to the above exposure modes. Table 6.1 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 census was performed in 1990. This census recorded and mapped the locations of all residences, dairy and meat animals, and vegetable gardens within a 5-km (3-mi) 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 census also verified the accumulated data with flyover photographs and by consulting the McCracken County Cooperative Extension Service. Information kept on file by Public Affairs 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 6.1 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 sediments 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 6.44-km (4-mi) radius of the site and to determine the number of surface water intakes on the Ohio River up to 24.2 km (15 mi) 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. A surface water sample is collected immediately downstream of all PGDP effluents. Cairo is within 50 miles of the Paducah Site and drinking water concentrations at that location are considered in the dose assessment (see Sect. 6.4.2). Figures 6.1 and 6.2 list potential environmental pathways to humans and associated human exposure modes for the release mechanisms given in Table 6.1. Sections 6.3 and 6.4 discuss the environmental transport, foodchain, and dosimetric models used to evaluate human exposures due to current or past DOE operations at the site. Input data to the models will be evaluated using site-specific (collected under the environmental monitoring and surveillance activities described earlier in this plan) and generic (default) values. If warranted and if possible, studies will be conducted to obtain site-specific values for any critical parameters currently characterized by default values.

Models and computer codes for evaluating public exposures to released radionuclides and chemicals will be 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. Unless required by regulatory or legal mandates, the simplest model needed to evaluate a situation will be used.

6.3 TRANSPORT MODELS

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

6.3.1 Atmospheric Transport

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

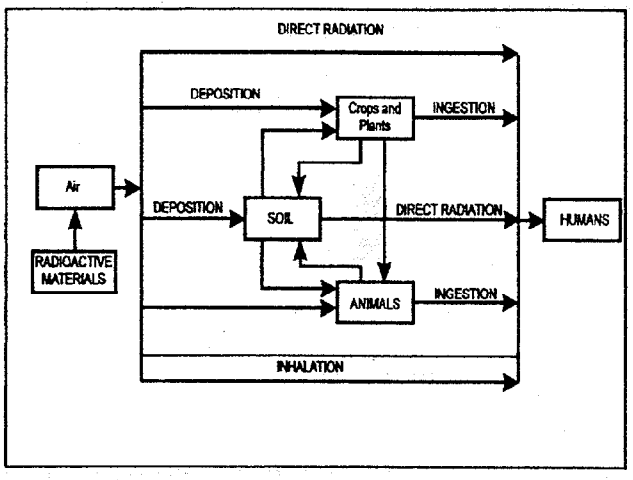

Fig. 6.1 Possible pathways between radioactive material released to the atmosphere and individuals.

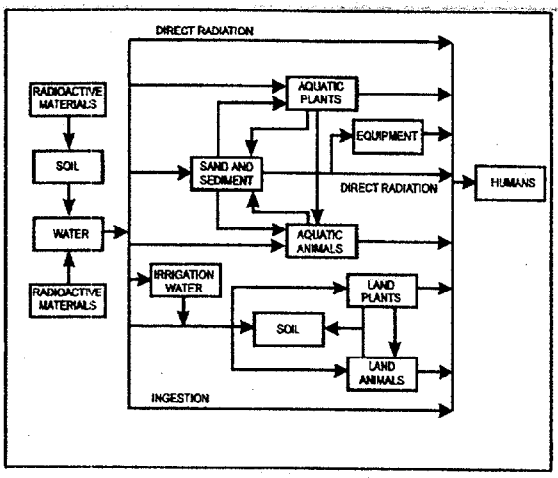

Fig. 6.2 Possible pathways between radioactive materials released to the ground or to surface waters and individuals.

Dose calculations on atmospheric releases are described in Sect. 6.4.1.

6.3.2 Surface Water Transport

Contaminants released to surface water may remain dissolved or suspended in water, may deposit in sediments, and may be deposited by irrigation on the ground surface and vegetation.

Quantities of radionuclides and chemicals released to surface waters are determined by sampling upstream and downstream of site outfalls in each of the local receiving streams including Little Bayou Creek, Bayou Creek, and the Ohio River. Concentrations of these substances in surface waters accessible to the public are quantified by sampling.

6.3.3 Groundwater Transport

Contaminants released into groundwater may remain dissolved or suspended in the water and may be deposited by irrigation on the ground surface and vegetation. Fifteen residences north of the plant between the site and the Ohio River have historically used groundwater. Contamination of private wells with both ^{99}Tc and TCE due to releases from past 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 detection limit of 1 ppb. For a long-term water supply, a community water line was extended to the residents with contaminated wells. Drinking water is also supplied to residents who have ^{99}Tc concentrations greater than or equal to 25 pCi/L in their wells. Irrigation of gardens and watering of livestock using contaminated well water has ceased. Presently, groundwater transport is not modeled; but such modeling will be initiated if off-site samples indicate a need.

6.4 ENVIRONMENTAL PATHWAY MODELS

This section describes the methodologies that will be used to characterize mechanisms for human uptake and exposure to the contaminant concentrations described in Sect. 6.3. As in Sect. 6.3, both modeling and sampling will be used to obtain contaminant concentrations in media and foods to which humans may be exposed. In addition, environmental gamma radiation exposure (direct) radiation is measured through a TLD program. *Regulatory Guide* 1.109 models (NRC 1977) will be used unless a better site-specific model is available.

6.4.1 Contaminants in Air

At the Paducah Site, the radioactive emissions to the air, which will be assessed by Bechtel Jacobs Company LLC in Calendar Year 2001, are monitored by USEC and AIP personnel to (see Sect. 2.2.1) determine the extent to which the public could be exposed and to demonstrate compliance with EPA and Kentucky regulations and DOE directives on radiation exposure to the public. Figure 6.3 illustrates current air monitoring locations in addition to new locations proposed by the Commonwealth of Kentucky and DOE. The DOE contribution to airborne radioactivity from operations at the Paducah Site is normally 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 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 Fig. 6.1, although the primary pathway of exposure is inhalation. The ambient air monitoring data collected from the USEC and AIP ambient air monitoring network will be used to assess the impact of all fugitive and source emissions. This monitoring network is designed to identify large emission releases from the site.

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

On August 28, 1995, DOE began operation of its only radionuclide point source at Paducah, the Northwest Plume Groundwater System designed to remove TCE and ^{99}Tc from groundwater. The Northwest Plume Pump and Treat Facility is the only routine air source for DOE with sufficient releases to be used in calculating a dose. The facility is located at the northwest corner of the Paducah Site security area. The facility includes an air stripper to remove volatile organics from water and an ion exchange unit for the removal of ^{99}Tc. The air stripper is located upstream of the ion exchange unit. Emissions of ^{99}Tc were estimated using the mass differential between the analysis of the influent groundwater and the water leaving the air stripper. The 9 percent concentration in the influent and effluent of the air stripper and the quantity of the water passing through the stripper was used to estimate the total quantity of ^{99}Tc emitted from the facility.

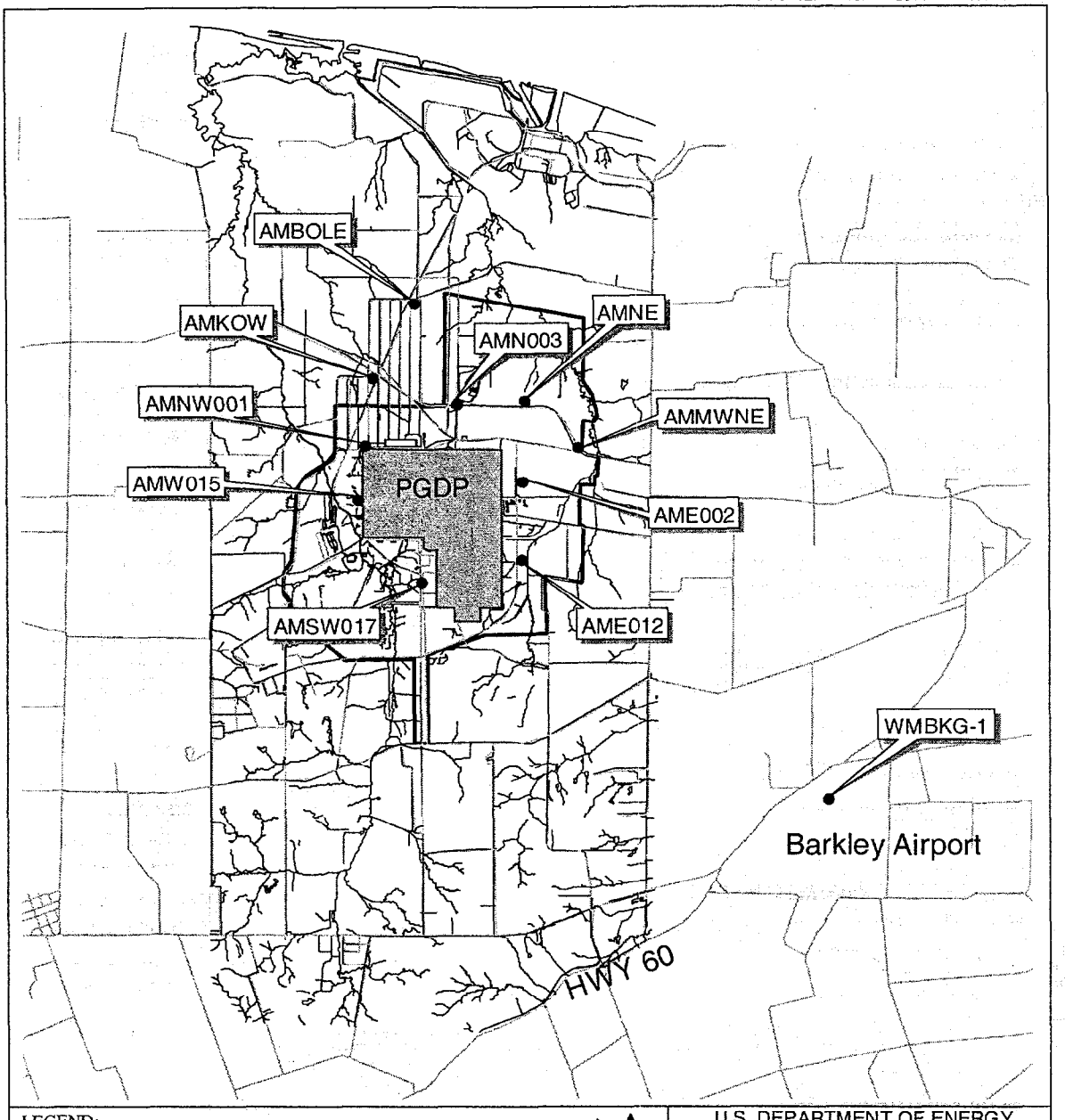

Fig. 6.3 Ambient air monitoring locations.

FIGURE No. c5ac90002sk124.apr
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6.4.2 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 (Sect. 6.3.2); deposition in sediments (Sect. 6.3.2); and uptake by fish (Sect 6.4.7) and ingestion by terrestrial animals (Sect. 6.4.7). While surface water is not used for drinking or irrigation near the plant, Cairo, IL, less than 50 miles downstream on the Ohio River, has the nearest drinking water intake to the plant. The dose to a Cairo, IL, resident from drinking water ingestion (730 L/year from the Ohio River) is estimated based on samples from Bayou Creek and Little Bayou Creek with the appropriate dilution factors.

6.4.3 Contaminants in Sediment

Discharges from DOE operations to surface waters may result in accumulations in sediment of radionuclides or chemicals of concern. Potential pathways of human exposure from sediments is direct irradiation and ingestion. An indirect pathway involves fish ingesting contaminated sediments and subsequent human ingestion of fish.

External irradiation from contaminated sediments in Little Bayou Creek is a pathway of potential importance. These sediments are known to contain uranium isotopes, ^{237}Np, and ^{239}Pu. 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 they remain on the contaminated surfaces.

Incidental ingestion of contaminated sediments may result from exposure during fishing, hunting, or other recreational activities. To determine a realistic exposure time for the Little Bayou Creek area, several assumptions are made. During 1990, the 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 is probably 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, August 1997.

6.4.4 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 (Sect. 6.4.5) and ingestion by terrestrial animals (Sect. 6.4.7).

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 L of water per year containing the measured concentrations of radionuclides. These calculations will continue to be performed as dictated by the findings of the Sampling Program. The primary use of the sampling data is to verify that significant quantities of radionuclides and chemicals from DOE operations are not seeping into off-site water supplies.

Verification is based on comparison of measured concentrations with federal and state standards and with historical concentrations for each contaminant found.

6.4.5 Contaminants in Soil

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

6.4.6 Contaminants in or on Vegetation

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

6.4.7 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 drinking milk. Because bioconcentration factors associated with radionuclides of concern at the Paducah Site in eggs, fish, and milk are low, assessments of these pathways are not performed based on measured concentrations.

A dose assessment from the ingestion of deer meat is performed using measured concentrations of contaminants. For ingestion of deer, the average weight of deer was obtained from the WKWMA manager. The assessment assumes that an individual kills two average-weight deer and consumes the edible portions of these deer during the year.

6.4.8 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.

Based on historical and current external gamma monitoring results, the external gamma radiation dose from routine DOE operations at the Paducah Site boundary is well under 5 mrem (individual) and 100 person-rem. However, new cylinder yard additions near the plant boundary could increase exposure; therefore, routine surveillance of external gamma radiation with TLD monitors is being done although it is not required to comply with DOE Order 5400.5 or other regulations or requirements. Gamma radiation from the plant is monitored via TLDs placed at approximately 46 locations surrounding the plant. These measurements are used to estimate the dose to the maximum exposed individual. An additional receptor is utilized to estimate dose to a receptor who hypothetically travels frequently along Dyke Road about 1500 feet east of the plant security fence.

6.4.9 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 four-mile radius of the plant site and to determine the number of surface water intakes on the Ohio River within 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 or on 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 that would supply all residents in the vicinity of the plant site water regardless of the level of contamination. That effort was completed May 31, 1994. The groundwater pathway for exposure does not exist today.

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

6.5 INTERNAL DOSIMETRY MODELS

The results of all dose calculations will be 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. All dose conversion factors used in the calculations will be obtained from the following sources, and any revisions to them. Factors that will be used in the calculations are given in DOE/EH-0070, *External Dose-Rate Conversion Factors for Calculation of Dose to the Public;* DOE/EH-0071, *Internal Dose Conversion Factors for Calculation of Dose to the Public;* 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.* Although not used in specific dose calculations, the DCGs given in DOE Order 5400.5 may be used to infer the acceptability or magnitude of doses associated with measured concentrations of radionuclides in environmental media.

6.6 RADIATION DOSE TO NATIVE AQUATIC ORGANISMS

Compliance with the one rad/day absorbed dose rate limit to native aquatic organisms (invertebrates, fish, and muskrats) will be 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 (National Research Council of Canada 1983, *Radioactivity in the Canadian Aquatic Environment)* and summing the external and internal contributions.

6.7 QA/DM

BJC has responsibility for summarizing environmental monitoring data and stack characteristics and submitting these and background data (e.g., population density, land use, and geographical information) to Oak Ridge National Laboratory's Office of Environmental Compliance and Documentation (OECD). This office has primary responsibility for performing both radiation and chemical dose calculations. The OECD is responsible for retaining records on input parameters, assumptions, and results of model calculations. The doses are submitted to BJC organization for review

and inclusion in the ASER. The use of standard EPA or DOE DCGs or analytical models for calculations of doses to the public from exposures resulting from activities from DOE operations will ensure comparability and representativeness of the results. If an alternative model or approach is used, approval will be obtained from EPA and DOE prior to its use. To verify the concentrations of radionuclides or chemicals in water, measured concentrations will be compared to calculated concentrations derived by dividing the total emissions by the total flow.

6.8 REPORTS AND RECORDS

Doses to the maximally exposed individual and to the population will be published in the ASER. In addition, if the dose to the maximally exposed individual exceed 10 mrem in a year, the Paducah Site will notify DOE headquarters. All input data used in dose calculations are considered records requiring "permanent retention." Chemical doses and doses to aquatic biota will be published in the ASER. All doses will be compared to applicable standards.

7. REPORTS

7.1 INTRODUCTION

This section provides an overview of the reporting requirements that will be followed by the Paducah Site for the Environmental Monitoring Program. These requirements have been established in regulations, statutes, and orders issued by regulatory agencies of government 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.

7.2 REPORTING REQUIREMENTS

The preparation and disposition of reports relevant to environmental monitoring are shown in Table 7.1, "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. Special studies describing research activities that are related to the Environmental Program are also discussed.

The ASER includes the information from the Superfund Amendments Reauthorization Act (SARA) Title III, Sect. 313, *Toxic Chemical Release Inventory Report* on quantities of nonradiological chemical emissions to the environment from unplanned releases. The summary will include additional "large quantity" chemicals used or stored for DOE operations that are not required to be reported by SARA Title III but are known to be emitted from the facilities.

Table 7.1 Applicable reporting requirements

Reporting	Due Date	Source of Requirement	Requirement
Annual Site Environmental Report	9/1	DOE 5400.1 Chap. II	All DOE facilities that conduct significant environmental protection programs shall prepare an Annual Site Environmental Report for DOE/OR. The report must provide a comprehensive review of the Environmental Surveillance Programs, status of environmental compliance, and effluent data for nonradioactive pollutants.
Department Pollution	Semiannual	OMB Circular	Department pollution abatement projects shall be Abatement Projects (5/1, 12/15) A-106 reported to EH-1 by Field Organizations for 5-year plan as required by OMB Circular A-106, and by EPA and DOE guidance issued thereto. Confirmatory reports are required if no pollution abatement projects are planned or underway.
Unplanned Releases of Radioactive Materials in Effluents		DOE 5400.1, Chap. II	Unplanned off-site or on-site releases of radioactive materials in effluents shall be reported if they are of concern to the environment.
Annual Compliance Report	*6/30	NESHAP 40 CFR Part 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 will be included in the NESHAP and ASER reports for assessment of fugitive emission sources.
Discharge Monitoring Reports	Monthly & Quarterly	Clean Water Act	Discharge Monitoring Reports are required for compliance with the state KPDES permit.
Preoperational Environmental Survey Report	As Required	DOE 5400.1	An environmental study shall be conducted prior to startup of a new site, facility, or process which has the potential for significant adverse environmental impact. The study shall be consistent with National Environmental Policy Act compliance activities.
Occurrence Report	Determined by Categorization	DOE 5000.3A	An Occurrence Report shall be prepared for all events or conditions to be reported in accordance with the criteria defined in DOE 5000.3A.

* Covering previous calendar year

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Table 7. 1 ***Applicable reporting requirements*** **(continued)**

Reporting	Due Date	Source of Requirement	Requirement
Radionuclide Release Report		DOE 5400.4 (CERCLA Implementation)	Releases of radionuclides that exceed "reportable quantities" shall be reported to the EPA National Response Center and to DOE/OR. They must be reported to the Nuclear Regulatory Commision within two hours after determining that the reportable quantity has been exceeded.
SARA Sect. 312	March 1	SARA Title III	Facilities at which hazardous chemicals are present in excess of specified thresholds shall submit inventory information to the local emergency and planning commissions, State Emergency Responses Commission, and local fire department.
SARA Sect. 313 Report	*March 1	SARA Title III	Covered facilities (see above) shall report to EPA and the state all environmental releases of specified toxic chemicals that are manufactured, processed, or otherwise used in excess of specified thresholds.
Monitoring Notification for Statistically Significant Increase of Parameters Constituents	7 days	RCRA 40 CFR 264.98(g)	If there is a statistically significant increase for parameters of monitored constituents at any monitoring well at the point of compliance, this finding shall be reported to the EPA.
Compliance Monitoring Notification Requirements	7 days	RCRA 40 CFR 264.99	If sample analysis from any monitoring well at the compliance point determines the presence of constituents in the uppermost aquifer that are not identified in the permit as hazardous constituents, the concentrations of these additional constituents shall be reported to the EPA.
Compliance Monitoring Notification Requirements	2 days	RCRA 40 CFR 264.99	If the groundwater protection standard is being exceeded at at any monitoring well at the point of compliance, the EPA shall be notified of this finding.

* Covering previous calendar year

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Table 7.1 ***Applicable reporting requirements*** **(continued)**

Reporting	Due Date	Source of Requirement	Requirement
Groundwater Quality Notification Requirements	2 days	RCRA 40 CFR 265.93	If analysis confirms a significant increase (or decrease) for indicator parameters of groundwater contamination, the EPA shall be notified that the facility may be affecting groundwater quality.
Reporting of Suspected Releases from USTs	24 hr.	RCRA 40 CFR 280.50	The implementing agency shall be notified of: (a) discovery of releases of regulated substances, (b) unusual operating conditions, or (c) monitoring results indicating the possibility of release.
Investigations for Soil and Groundwater Cleanup	As soon as practicable	RCRA 40 CFR 280.65(b)	In order to determine soil and groundwater contamination, investigations of releases from USTs must be submitted to to the implementing agency.
RCRA Groundwater Monitoring Report	Semiannually	RCRA 40 CFR 265	Summarizes results of RCRA Groundwater Monitoring Program.
Biological Monitoring and Program Annual Report	4/30	KPDES Permit	Characterizes ecology of the watersheds impacted by DOE and USEC facilities.
Watershed Monitoring Program Report	*April 28	KPDES Permit	Provides biological monitoring information for the Paducah Site effluents and streams.
Environmental Monitoring Plan	Annually	DOE 5400.1 Chap. IV	All DOE facilities that conduct significant environmental protection programs shall prepare an EMP. The contents of the EMP are outlined in Chap. IV of DOE Order 5400.1. The EMP shall be reviewed annually and updated, as needed, or every three years.

* Covering previous calendar year

8. DATA MANAGEMENT, ANALYSIS, STATISTICAL, AND QUALITY ASSURANCE PROGRAM

8.1 DATA MANAGEMENT AND QUALITY ASSURANCE PROGRAMS

Since Data Management and Quality Assurance Programs are an integral part of not only the EMP but also many other programs at PGDP, the two programs have been incorporated into one dynamic document and are enclosed as Appendix D. This document replaces the two separate sections in the previous EMPs (Sects. 7 and 9).

9. REFERENCES

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APPENDIX A

PADUCAH PERMIT SUMMARY

PADUCAH SITE 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)	03/31/2003	KY0004049	Department of Energy (DOE)
Stormwater Point Sources	KDOW	09/30/2002	KYR100000	DOE
SOLID WASTE				
C-746-S Residential Landfill (Closure)	Kentucky Division of Waste Management (KDWM)	11/01/03	073-00014	DOE
C-746-T Inert Landfill (Closure)	KDWM	06/11/03	073-00015	DOE
C-746-U Solid Waste Landfill	KDWM	11/04/2006	073-00045	DOE
RCRA				
State Hazardous Waste Management Permit	KDWM	08/19/2001*	KY8-890-008-982	DOE/Bechtel Jacobs Company LLC (BJC)
EPA Hazardous and Solid Waste Management Permit	KDWM	08/19/2001*	KY8-890-008-982	DOE/BJC

* New permits have been applied for.

PADUCAH SITE COMPLIANCE AGREEMENTS SUMMARY
FOR THE
PADUCAH GASEOUS DIFFUSION PLANT

Agreement	Effective Date	Expiration Date	Entities
Toxicity Characteristic Leaching Procedure, Federal Facility Compliance Agreement		Ongoing	Environmental Protection Agency (EPA) and DOE
TSCA FFCA (Toxic Substances Control Act Federal Facility Compliance Agreement)	03/92	To be determined	EPA and DOE
FFC Act/Site Treatment Plan	10/95	2006	KDWM and DOE
Federal Facility Agreement	02/98	Ongoing	KDWM, EPA, and DOE

APPENDIX B

MONITORING WELL PROGRAM INVENTORY

Note: Acronyms are defined on Page B-13 and B-14.

Monitoring 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***	GWESSA	NS	NR
MW21	RGA	AB 94	NA	NA	NA
MW22	RGA	AB 94	NA	NA	NA
MW23	Porters Creek Clay Well	AB 94	NA	NA	NA
MW24	Porters Creek Clay Well	AB 94	NA	NA	NA
MW25	Porters Creek Clay Well	AB 94	NA	NA	NA
MW26	Porters Creek Clay Well	AB 94	NA	NA	NA
MW27	Porters Creek Clay Well	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	McNairy	AB 94	NA	NA	NA
MW41	RGA	AB 94	NA	NA	NA

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
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	GWESSA	WLQ	A
MW64	UCRS	Current	NS	WLA	A
MW65	RGA	Current	GWESSA	NS	A
MW66	RGA	Current	MW66M	WLQ	A
MW67	RGA	Current	NS	WLA	A
MW68	RGA	Current	NS	WLA	A
MW69	UCRS	Current	NS	WLA	A
MW70	RGA	AB 94	NA	NA	NA
MW71	RGA	Current	GWESSA	WLQ	A
MW72	RGA	Current	NS	WLA	A
MW73	RGA	Current	NS	WLA	A
PZ74	UCRS	Current	NS	WLA	A
MW75	UCRS	Current	NS	WLA	A
MW76	RGA	Current	NS	WLA	A
MW77	RGA	Current	NS	WLA	A
MW78	RGA	Current	NS	WLA	A
MW79	RGA	Current	NS	WLA	A
MW80	RGA	Current	NS	WLA	A
MW81	RGA	Current	NS	WLA	A
MW82	UCRS	Current	NS	WLA	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW83	UCRS	Current	NS	WLA	A
MW84	RGA	Current	404G	WLQ	Q
MW85	UCRS	Current	404G	NS	Q
MW86	RGA	Current	404G	NS	Q
MW87	RGA	Current	404G	NS	Q
MW88	UCRS	Current	404G	NS	Q
MW89	RGA	Current	404G	NS	Q
MW90	RGA	AB 2001	NA	NA	NA
MW90A	RGA	Current	404G	WLQ	Q
MW91	UCRS	Current	404G	NS	Q
MW92	RGA	Current	404G	NS	Q
MW93	RGA	Current	404G	WLQ	Q
MW94	UCRS	Current	404G	NS	Q
MW95	RGA	AB 2001	NA	NA	NA
MW95A	RGA	Current	404G	WLQ	Q
MW96	UCRS	Current	GWESSA	NS	A
MW97	RGA	AB 97	NA	NA	NA
MW98	RGA	Current	GWESSA	WLQ	A
MW99	RGA	Current	GWESSA	WLQ	A
MW100	RGA	Current	GWESSA	NS	A
PZ101	RGA	Current	NS	WLQ	A
MW102	McNairy	Current	GWESSA	WLQ	A
MW103	RGA	Current	GWESSA	WLQ	A
MW104	UCRS	AB 96	NA	NA	NA
MW105	RGA	AB	NA	NA	NA
MW106	RGA	Current	GWESSA	WLQ	A
PZ107	RGA	Current	NS	WLQ	A
W108	RGA	Current	NS	WLA	A
PZ109	RGA	Current	NS	WLA	A
PZ110	RGA	Current	NS	WLA	A
PZ111	UCRS	Current	NS	WLA	A
PZ112	RGA	Current	NS	WLA	A
PZ113	RGA	Current	NS	NS	A-TS
PZ114	McNairy	Current	NS	WLA	A
PZ115	McNairy	Current	NS	WLQ	A
PZ116	RGA	Current	NS	NS	A
PZ117	RGA	Current	NS	WLQ	A
PZ118	RGA	Current	NS	WLQ	A
MW119	RGA	AB	NA	NA	NA
MW120	McNairy	Current	GWESSA	WLQ	A
MW121	McNairy	Current	GWESSA	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW122	McNairy	Current	GWESSA	WLQ	A
MW123	RGA	Current	NS	WLQ	A
MW124	RGA	Current	GWNEQ	NS	A
MW125	RGA	Current	GWESSA	NS	A
MW126	RGA	Current	GWNEQ	WLQ	A
MW127	UCRS	AB-IP	NA	NA	NA
MW128	UCRS	AB-IP	NA	NA	NA
MW129	Terrace Gravels	AB-IP	NA	NA	NA
MW130	Terrace Gravels	AB-IP	NA	NA	NA
MW131	Terrace Gravels	AB-IP	NA	NA	NA
MW132	RGA	Current	NS	WLA	A
MW133	McNairy	Current	GWESSA	WLQ	A
MW134	RGA	Current	GWESSA	WLQ	A
MW135	RGA	Current	GWESSA	NS	A
MW136	UCRS	NA	NA	NA	NA
MW137	RGA	Current	NS	WLQ	A
MW138	UCRS	Current	NS	WLA	A
MW139	RGA	Current	GWESSA	WLQ	A
MW140	McNairy	Current	NS	WLA	A
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	WLA	A
MW145	RGA	Current	GWNEQ	NS	A
MW146	RGA	Current	GWESSA	WLQ	A
MW147	RGA	Current	NS	WLA	A
MW148	RGA	Current	NS	WLA	A
MW149	UCRS	Current	NS	WLA	A
MW150	RGA	Current	GWESSA	WLQ	A
MW151	Terrace Gravels	Current	NS	WLQ	A
MW152	RGA	Current	GWESSA	WLQ	A
MW153	UCRS	Current	NS	WLA	A
MW154	UCRS	Current	NS	WLA	A
MW155	RGA	Current	GWESSA	NS	A
MW156	RGA	Current	GWESSA	WLQ	A
MW157	UCRS	Current	NS	WLA	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	GWESSA	WLQ	A
MW162	UCRS	Current	NS	WLA	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW163	RGA	Current	GWESSA	WLQ	A
MW164	UCRS	Current	NS	WLA	A
MW165	RGA	Current	GWESSA	WLQ	A
MW166	UCRS	Current	GWESSA	NS	A
MW167	UCRS	Current	NS	WLA	A
MW168	RGA	Current	GWESSA	WLQ	A
MW169	RGA	Current	GWESSA	WLQ	A
MW170	UCRS	Current	NS	WLA	A
MW171	UCRS	Current	NS	WLA	A
MW172	UCRS	Current	NS	WLA	A
MW173	RGA	Current	GWESSA	WLQ	A
MW174	UCRS	Current	GWESSA	NS	A
MW175	RGA	Current	GWESSA	WLQ	A
MW176	UCRS	Current	NS	WLA	A
MW177	UCRS	Current	NS	WLA	A
MW178	RGA	Current	GWESSA	WLQ	A
MW179	RGA	Current	SG	Q	A
MW180	UCRS	Current	GWESSA	NS	A
MW181	RGA	AB 2000	NA	NA	NA
MW182	UCRS	Current	GWESSA	NS	A
183, Not Installed	NA	NA	NA	NA	NA
MW184	UCRS	AB 98	NA	NA	NA
MW185	RGA	Current	GWESSA	WLQ	A
MW186	UCRS	Current	GWESSA	NS	A
MW187	UCRS	Current	GWESSA	NS	A
MW188	RGA	Current	GWESSA	WLQ	A
MW189	UCRS	Current	NS	WLA	A
MW190	UCRS	Current	NS	WLA	A
MW191	RGA	Current	GWESSA	WLQ	A
MW192	UCRS	Current	GWESSA	NS	A
MW193	RGA	Current	GWESSA	WLQ	A
MW194	RGA	Current	GWESSA	WLQ	A
MW195	UCRS	AB 94	NA	NA	NA
MW196	Terrace Gravels	Current	GWESSA	WLQ	A
MW197	RGA	Current	GWESSA	WLQ	A
MW198	UCRS	Current	NS	WLA	A
MW199	RGA	Current	GWESSA	WLQ	A
MW200	RGA	Current	GWESSA	WLQ	A
MW201	RGA	Current	GWESSA	WLQ	A
MW202	RGA	Current	GWESSA	WLQ	A
MW203	RGA	Current	GWESSA	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW204	UCRS	Current	NS	WLA	A
MW205	RGA	Current	GWESSA	WLQ	A
MW206	RGA	Current	GWESSA	WLQ	A
MW207	UCRS	Current	NS	WLA	A
MW208	UCRS	Current	NS	WLA	A
MW209	UCRS	Current	NS	WLA	A
MW210	UCRS	Current	NS	WLA	A
MW211	UCRS	Current	NS	WLA	A
MW212	UCRS	Current	NS	WLA	A
MW213	UCRS	Current	NS	WLA	A
MW214	UCRS	Current	NS	WLA	A
MW215	UCRS	Current	NS	WLA	A
MW216	UCRS	Current	NS	WLA	A
MW217	UCRS	Current	NS	WLA	A
MW218	UCRS	Current	NS	WLA	A
MW219	UCRS	Current	NS	WLA	A
MW220	RGA	Current	SG	Q	A
MW221	RGA	Current	SG	Q	A
MW222	RGA	Current	SG	Q	A
MW223	RGA	Current	SG	Q	A
MW224	RGA	Current	SG	Q	A
MW225	RGA	Current	NS	NS	A
MW226	RGA	Current	404G	WLQ	Q
MW227	RGA	Current	404G	WLQ	Q
EW228	RGA	NA	NS	NS	NR
EW229	RGA	NA	NS	NS	NR
EW230	RGA	NA	NS	NS	NR
EW231	RGA	NA	NS	NS	NR
MW232	RGA	Current	NS	NS	A
MW233	RGA	Current	GWNWQ	WLQ	A
MW234	RGA	AB 2002	NA	NA	NA
MW235	RGA	AB 2002	NA	NA	NA
MW236	RGA	Current	GWNWQ	WLQ	A
MW237	UCRS	Current	GWNWQ	WLQ	A
MW238	RGA	Current	GWNWQ	WLQ	A
MW239	McNairy	Current	GWNWQ	WLQ	A
MW240	RGA	Current	GWNWQ	WLQ	A
MW241	UCRS	Current	GWNWQ	WLQ	A
MW242	RGA	Current	GWNWQ	WLQ	A
MW243	RGA	Current	GWNWQ	WLQ	A
MW244	RGA	Current	GWNWQ	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW245	RGA	Current	GWNWQ	WLQ	A
MW246	UCRS	Current	GWNWQ	WLQ	A
MW247	McNairy	Current	GWNWQ	WLQ	A
MW248	RGA	Current	GWNWQ	WLQ	A
MW249	RGA	Current	GWNWQ	WLQ	A
MW250	RGA	Current	GWNWQ	WLQ	A
PZ251	UCRS	Current	NS	WLA	A
MW252	RGA	Current	NS	WLA	A
MW253	RGA	Current	NS	WLA	A
254, Not Installed	NA	NA	NA	NA	NA
MW255	RGA	Current	GWNEQ	NS	A
MW256	RGA	Current	GWNEQ	NS	A
MW257	RGA	Current	NS	NS	A
MW258	RGA	Current	GWNEQ	NS	A
259, Not Installed	NA	NA	NA	NA	NA
MW260	RGA	Current	GWESSA	NS	A
MW261	RGA	Current	GWESSA	NS	A
MW262	RGA	Current	GWESSA	NS	A
MW263	RGA	Current	SG	Q	A
MW264	RGA	Current	SG	Q	A
MW265	RGA	AB 2000	NA	NA	NA
MW266	RGA	Current	SG	Q	A
MW267	RGA	Current	SG	Q	A
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	NA	NA	NA
PZ279	UCRS	AB	NA	NA	NA
PZ280	UCRS	AB	NA	NA	NA
PZ281	UCRS	AB	NA	NA	NA
PZ282	UCRS	AB	NA	NA	NA
MW283	RGA	Current	GWNEQ	NS	A
MW284	RGA	Current	GWNEQ	NS	A
285, Not Installed	NA	NA	NA	NA	NA

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
286, Not Installed	NA	NA	NA	NA	NA
PZ287	RGA	Current	NS	WL-NE	A
MW288	RGA	Current	GWNEQ	NS	A
PZ289	RGA	Current	NS	WL-NE	A
PZ290	RGA	Current	NS	WL-NE	A
MW291	RGA	Current	GWNEQ	NS	A
MW292	RGA	Current	GWNEQ	NS	A
MW293	RGA	Current	GWNEQ	NS	A
MW294	RGA	Current	GWNEQ	NS	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 Gravels	Current	KG	WLQ	A
MW301	Terrace Gravels	Current	KG	WLQ	A
MW302	Terrace Gravels	Current	KG	WLQ	A
MW303	Terrace Gravels	AB 94	NA	NA	NA
MW304	Terrace Gravels	Current	NS	WLA	A
MW305	Eocene	Current	GWESSA	WLQ	A
MW306	Eocene	Current	NS	WLA	A
MW307	Eocene	Current	NS	WLA	A
MW308	Eocene	Current	NS	WLA	A
MW309	Terrace Gravels	Current	NS	WLA	A
MW310	Terrace Gravels	Current	NS	WLA	A
MW311	Terrace Gravels	Current	NS	WLQ	A
MW312	UCRS	Current	NS	WLA	A
MW313	UCRS	Current	NS	WLA	A
MW314	UCRS	Current	NS	WLA	A
MW315	UCRS	Current	NS	WLA	A
MW316	UCRS	Current	NS	WLA	A
MW317	Terrace Gravels	Current	NS	WLA	A
MW318	Terrace Gravels	Current	NS	WLA	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	WLQ	A
MW326	RGA	Current	NS	WLA	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW327	RGA	Current	NS	WLQ	A
MW328	RGA	Current	GWESSA	NS	A
MW329	RGA	Current	GWESSA	NS	A
MW330	RGA	Current	NS	WLA	A
EW331	RGA	NA	NS	NS	NR
EW332	RGA	NA	NS	NS	NR
MW333	RGA	Current	GWESSA	NS	A
PZ334	UCRS	Current	NS	WLA	A
PZ335	UCRS	Current	NS	WLA	A
PZ336	UCRS	Current	NS	WLA	A
MW337	RGA	Current	GWESSA	NS	A
MW338	RGA	Current	GWESSA	NS	A
MW339	RGA	Current	GWESSA	NS	A
MW340	RGA	Current	GWESSA	NS	A
MW341	RGA	Current	GWESSA	WLQ	A
MW342	RGA	Current	GWESSA	WLQ	A
MW343	RGA	Current	GWESSA	WLQ	A
MW344	Terrace Gravels	Current	KG	WLQ	A
MW345	Rubble Zone	Current	GWESSA	NS	A
MW346	Rubble Zone	Current	GWESSA	NS	A
MW347	Rubble Zone	Current	GWESSA	NS	A
PZ348	UCRS	Current	NS	NS	A
PZ349	RGA	Current	NS	NS	A
PZ350	UCRS	Current	NS	NS	A
PZ351	RGA	Current	NS	NS	A
MW352	RGA	Current	GWESSA	NS	A
MW353	RGA	Current	SG	Q	A
MW354	RGA	Current	GWESSA	NS	A
MW355	RGA	Current	GWESSA	NS	A
MW356	McNairy	Current	GWESSA	NS	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

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
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	Q	A
MW373	LRGA	Current	UG/SG	Q	A
MW374	UCRS	Current	UG/SG	Q	A
MW375	URGA	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	GWNWQ	WLQ	A
MW381	RGA	Current	GWNWQ	WLQ	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	GWESSA	NS	A
MW402	RGA	Current	GWESSA	NS	A
MW403	RGA	Current	GWESSA	NS	A
MW404	RGA	Current	GWESSA	NS	A
PZ5G	Unknown	Current	NS	WLA	A
PZ5S	Unknown	Current	NS	WLA	A
Z-12	Unknown	Current	NS	WLQ	A
Z-16	Unknown	Current	NS	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
CM01	PTZ Project	Current	NS	WLA	A
CM02	PTZ Project	Current	NS	WLA	A
CM03	PTZ Project	Current	NS	WLA	A
CM04	PTZ Project	Current	NS	WLA	A
CM05	PTZ Project	Current	NS	WLA	A
CM06	PTZ Project	Current	NS	WLA	A
CM07	PTZ Project	Current	NS	WLA	A
CM08	PTZ Project	Current	NS	WLA	A
CM09	PTZ Project	Current	NS	WLA	A
CM10	PTZ Project	Current	NS	WLA	A
CM11	PTZ Project	Current	NS	WLA	A
R2	Unknown	Current	GWRESM	NS	NR
R9	Unknown	Current	GWRESS	NS	NR
R12	Unknown	Current	GWRESS	NS	NR
R13	Unknown	Current	GWRESS	NS	NR
R14	Unknown	Current	GWRESS	NS	NR
R19	Unknown	Current	GWRESS	NS	NR
R20	RGA	Current	GWRESS	NS	NR
R21	Unknown	Current	GWRESS	NS	NR
R23	Unknown	Current	GWRESS	NS	NR
R72	Unknown	Current	GWRESS	NS	NR
R82	Unknown	Current	GWRESS	NS	NR
R83	Unknown	Current	GWRESS	NS	NR
R90	Unknown	Current	GWRESS	NS	NR
R114	Unknown	Current	GWRESS	NS	NR
R294	RGA	Current	GWRESM	NS	NR
R302	RGA	Current	GWRESM	NS	NR
R381	RGA	Current	GWRESS	NS	NR
R383	RGA	Current	GWRESS	NS	NR
R384	RGA	Current	GWRESS	NS	NR
R387	RGA	Current	GWRESS	NS	NR
R392	RGA	Current	GWRESS	NS	NR
R424	RGA	Current	CARB	NS	NR

***: MW20 and R4 are the same wells
404G: C-404 Landfill groundwater well
A: Annual inspection
AB: Abandoned
AB-IP Abandoned in place
A-TS: Inspect only, transducer in well
EW: Extraction well
GWESSA: Groundwater surveillance semiannual well
GWNEQ: Groundwater Northeast Plume quarterly well

GWNWQ:	Groundwater Northwest Plume quarterly well
GWRESM:	Groundwater residential monthly well
GWRESS:	Groundwater residential semiannual well
KG:	C-746-K Landfill groundwater well
MW:	Monitoring well
MW66M:	Monitoring well 66 monthly monitoring
NA:	Not applicable; Monitoring well or piezometer abandoned; EW-Not Sampled Under EMP Program
NR:	Not required
NS:	Not sampled
PTZ:	PTZ Project multi-port well
PZ:	Piezometer
Q:	Quarterly inspection
RGA	regional groundwater aquifer
SG:	C-746-S & -T Landfill groundwater well
UCRS	upper continental recharge system
UG:	C-746-U Landfill groundwater well
Unknown:	Information is unknown, cannot be confirmed, or is unavailable
WLA:	Water level collected annually
WL-NE:	Water level collected under Northeast Pump and Treat Operations
WLQ:	Water level collected quarterly